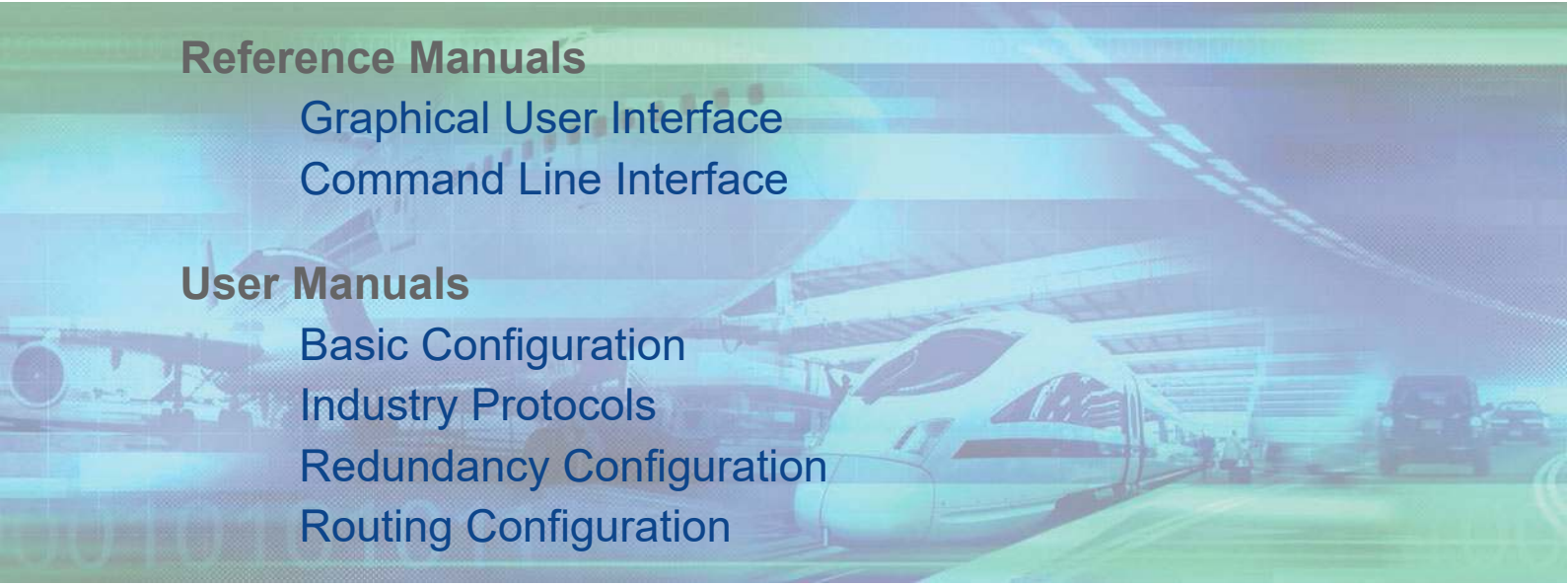
HIRSCHMANN
A BELDEN BRAND

Hirschmann Automation and Control GmbH

Classic L3E Rel. 09000



Reference Manuals

- Graphical User Interface
- Command Line Interface

User Manuals

- Basic Configuration
- Industry Protocols
- Redundancy Configuration
- Routing Configuration

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Reference Manual

GUI Graphical User Interface
Industrial ETHERNET (Gigabit-)Switch
PowerMICE, MACH 4000

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You can get the latest version of this manual on the Internet at the Hirschmann product site (www.hirschmann.com).

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Contents

Safety Information

⚠ WARNING

UNCONTROLLED MACHINE ACTIONS
To avoid uncontrolled machine actions caused by data loss, configure all the data transmission devices individually.
Before you start any machine which is controlled via data transmission, be sure to complete the configuration of all data transmission devices.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

About this Manual

The “GUI” reference manual contains detailed information on using the graphical interface to operate the individual functions of the device.
In the following, the GUI (Graphical User Interface) will be referred as Web-based Interface.

The “Command Line Interface” reference manual contains detailed information on using the Command Line Interface to operate the individual functions of the device.

The “Installation” user manual contains a device description, safety instructions, a description of the display, and the other information that you need to install the device.

The “Basic Configuration” user manual contains the information you need to start operating the device. It takes you step by step from the first startup operation through to the basic settings for operation in your environment.

The “Redundancy Configuration” user manual document contains the information you require to select the suitable redundancy procedure and configure it.

The “Industry Protocols” user manual describes how the device is connected by means of a communication protocol commonly used in the industry, such as EtherNet/IP or PROFINET IO.

The “Routing Configuration User Manual” document contains the information you need to start operating the routing function. The manual enables you to configure your router by following the examples.

The Industrial HiVision network management software provides you with additional options for smooth configuration and monitoring:

- ActiveX control for SCADA integration
- Auto-topology discovery
- Browser interface
- Client/server structure
- Event handling
- Event log
- Simultaneous configuration of multiple devices
- Graphical user interface with network layout
- SNMP/OPC gateway

Maintenance

Hirschmann are continually working on improving and developing their software. Check regularly whether there is an updated version of the software that provides you with additional benefits. You find information and software downloads on the Hirschmann product pages on the Internet (www.hirschmann.com).

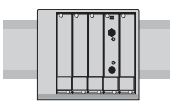
Key

The designations used in this manual have the following meanings:

▶	List
☐	Work step
■	Subheading
Link	Cross-reference with link
Note:	A note emphasizes an important fact or draws your attention to a dependency.
`Courier`	ASCII representation in the graphical user interface

Symbols used:

	WLAN access point
	Router with firewall
	Switch with firewall
	Router
	Switch
	Bridge

	Hub
	A random computer
	Configuration Computer
	Server
	PLC - Programmable logic controller
	I/O - Robot

Graphical User Interface

System requirements

Use HiView to open the graphical user interface. This application offers you the possibility to use the graphical user interface without other applications such as a Web browser or an installed Java Runtime Environment (JRE).

Alternatively you have the option to open the graphical user interface in a Web browser, e.g. in Mozilla Firefox version 3.5 or higher or Microsoft Internet Explorer version 6 or higher. You need to install the Java Runtime Environment (JRE-7) in the most recently released version. You can find installation packages for your operating system at http://java.com.

Starting the graphical user interface

The prerequisite for starting the graphical user interface, first configure the IP parameters of the device correctly. The “Basic Configuration” user manual contains detailed information that you need to specify the IP parameters.

Starting the graphical user interface in HiView:

☐ Start HiView.

☐ In the URL field of the start window, enter the IP address of your device.

☐ Click "Open".

HiView sets up the connection to the device and displays the login window.

Start the graphical user interface in the Web browser:

– This requires that Java is enabled in the security settings of your Web browser.

☐ Start your Web browser.

☐ Write the IP address of the device in the address field of the Web browser. Use the following form: `https://xxx.xxx.xxx.xxx`

The Web browser sets up the connection to the device and displays the login window.

Figure 1: Login window

- ☐ Select the user name and enter the password.
- ☐ Select the language in which you want to use the graphical user interface.
- ☐ Click "Ok".

The Web browser displays the graphical user interface.

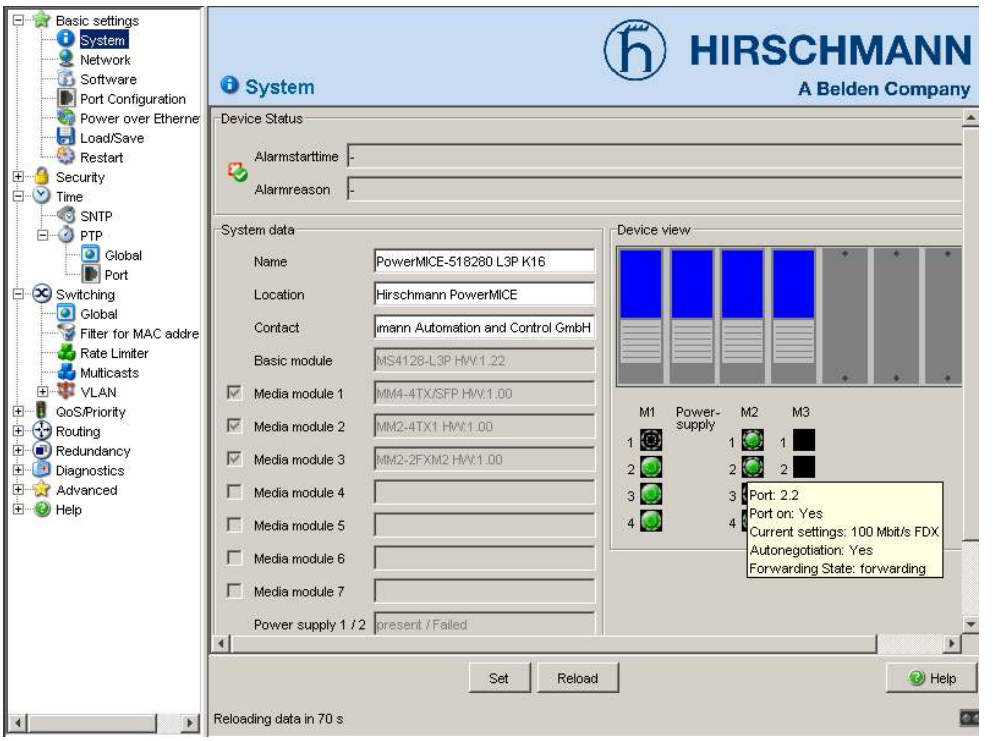
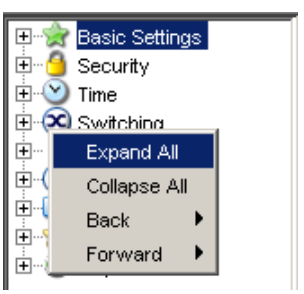


Figure 2: Web-based user interface of the device with tooltip.

Operating Instructions

The menu displays the menu items. When you click a menu item, the user interface displays the corresponding dialog in the dialog area.



You right-click the menu section to open the context menu.

Designation	Meaning
Expand All	Expands the nodes in the menu tree. The menu section displays the menu items for all levels.
Collapse All	Collapses the nodes in the menu tree. The menu section displays the menu items for the top level.
Expand Node	Expands the selected node and collapses the other nodes in the menu tree. This function allows you to expand a main node without scrolling and without collapsing other nodes manually.
Back	Allows you to quickly jump back to a previously selected menu item.
Forward	Allows you to quickly jump forward to a previously selected menu item when you have previously used the "Back" function.

Table 1: Menu section: Functions in the context menu

Notes on Saving the Configuration Profile

- ☐ To copy changed settings to the volatile memory, click the "Set" button.
- ☐ To update the display in the dialogs, click the "Load" button.
- ☐ To keep the changed settings even after restarting the device, open the `Basic Settings:Load/Save` dialog and click the "Set" button in the "Save" frame.

Note: Unintentional changes to the settings may cause the connection between your PC and the device to be terminated. Before you change the settings, enable the "Undo Modifications of Configuration" function in the `Basic Settings:Load/Save` dialog. With this function, the device restores the previous configuration if the connection is interrupted after the settings have been changed. The device remains reachable.

1 Basic Settings

The Basic Settings menu contains the dialogs, displays and tables for the basic configuration:

- System
- Modules
- Network
- Software
- Port configuration
- Power over Ethernet Plus
- Load/Save
- Restart

Note: The graphical user interface uses Java 7.

Install the Software from www.java.com.

1.1 System

The “System“ submenu in the basic settings menu is structured as follows:

- Device Status
- System data
- Device view
- Reloading data

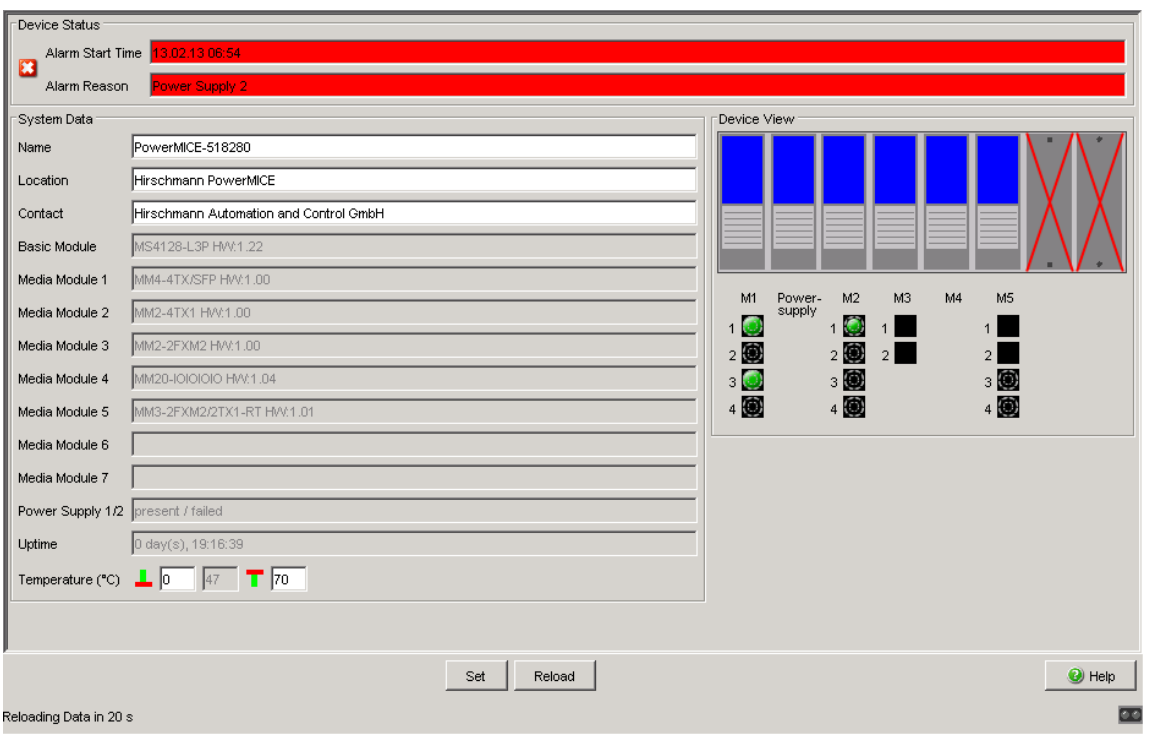


Figure 3: "System" Submenu

Device Status

This section of the graphical user interface provides information on the device status and the alarm states the device has detected.

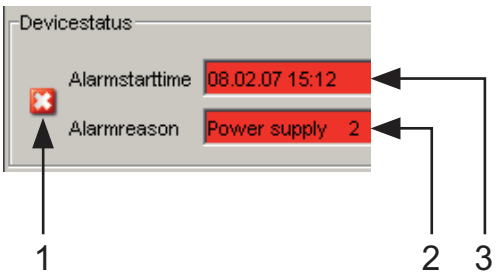


Figure 4: Device status and alarm display
1 - The symbol displays the device state
2 - Cause of the oldest existing alarm
3 - Start of the oldest existing alarm

System Data

The fields in this frame show operating data and information on the location of the device.

– the system name,
– the location description,
– the name of the contact person for this device,
– the temperature threshold values.

Name	Meaning
Name	System name of this device If you use the PROFINET function of the device, the system name can only contain alphanumeric characters, hyphens, and periods.
Location	Location of this device
Contact	The contact for this device
Basic module	Hardware version of the device
Media module 1	Hardware version of media module 1
Media module 2	Hardware version of media module 2
Media module 3	Hardware version of media module 3
Media module 4	Hardware version of media module 4
Media module 5	Hardware version of media module 5
Media module 6	Hardware version of media module 6
Media module 7	Hardware version of media module 7
Power supply (P1/P2)	Status of power units (P1/P2)
Power supply 3-1/3-2	Status of power units 3-1/3-2
Power supply 4-1/4-2	Status of power units 4-1/4-2

Table 2: System Data

Name	Meaning
Fan	Status of fans
Uptime	Shows the time that has elapsed since this device was last restarted.
Temperature (°C)	Temperature of the device. Lower/upper temperature threshold values. If the temperature goes outside this range, the device generates an alarm.

Table 2: System Data

Device View

The device view shows the device with the current configuration. The status of the individual ports is indicated by one of the symbols listed below. You will get a full description of the port's status by positioning the mouse pointer over the port's symbol.

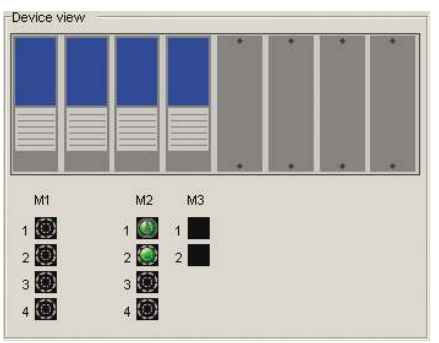


Figure 5: Device View

Meaning of the symbols:

The port (10, 100 Mbit/s, 1, 10 Gbit/s) is enabled and the connection is OK.

The port is disabled by the management and it has a connection.

The port is disabled by the management and it has no connection.


The port is in autonegotiation mode.


The port is in HDX mode.


The port (100 MBit/s) is in the discarding mode of a redundancy protocol such as Spanning Tree or HIPER-Ring.


The port is in routing mode (100 Mbit/s).

Reloading

The graphical user interface automatically updates the display of the dialog every 100 seconds. In the process, it updates the fields and symbols with the values that are saved in the volatile memory (RAM) of the device. At the bottom left of the dialog, you will find the time of the next update.

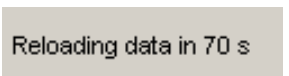


Figure 6: Time to next Reload

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 3: Buttons

1.2 Modules (MS, PowerMICE, MACH102 and MACH4000)

When you plug a module in an empty slot of a modular device, the device configures the module with the port default settings. With the port default settings loaded on the module, access to the network is possible. Deny network access to modules by disabling the module slot. The device recognizes the module and port configuration is possible but, the ports remains in the disabled state.

Use the following work steps when deinstalling a module helps deny network access using an empty slot.

- ☐ Remove module and update the graphical user interface by clicking "Reload".
- ☐ The "Module Status" column for the removed module contains the value `configurable`. The device also grays out the removed module in the "Device View" frame of the `Basic Settings:System` dialog.
- ☐ Highlight the entry and click "Remove Module". The value in the "Module Status" column changes to `remove` and the slot is empty in the "Device View" frame in the `Basic Settings:System` dialog. Additionally, the "Type" column for this entry contains the value `none` and the device deletes the other module parameters.
- ☐ The selected "Enable" control box indicates that the slot is active. Disable the entry to deny further network access through the unused slot. Deactivating the control box disables the entry. After disabling an entry in this table, the device places a red „X“ over the slot in the "Device View" frame of the `Basic Settings:System` dialog.

Use the following work steps when installing a module in the slot.

- ☐ Place the module in the slot and update the graphical user interface by clicking "Reload". The device automatically configures the module with the default settings, detects the module parameters, and enters the values in the table.
- ☐ The "Status" value of the module changes to `physical`.
- ☐ You allow access to the network through the module by selecting the "Enable" control box.

Note: The following modular devices support this function: MS (soho), PowerMICE (ms4128), MACH102 (soho) and MACH4000 (ex and dx) family.

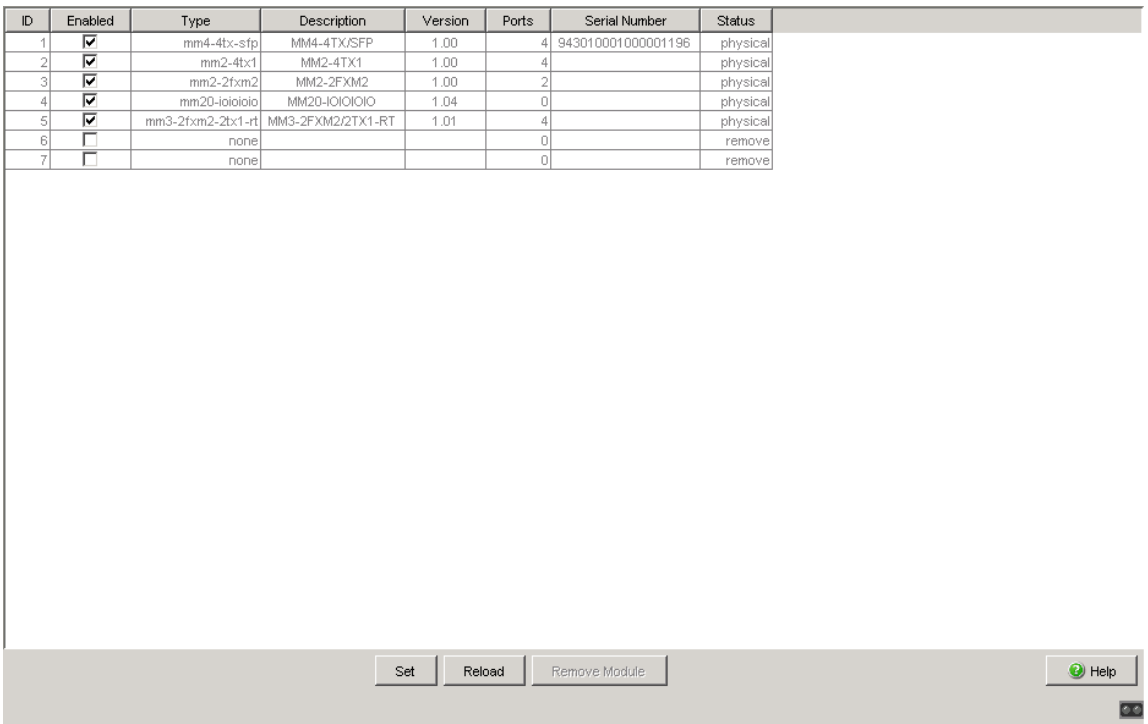


Figure 7: "Modules" Dialog

This configuration table allows you to enable or disable the slots and also displays the module parameters.

- The "ID" column identifies the slot to which the entry refers.
- The "Enabled" column activates network access to modules installed in this slot. When disabled, the device places a red „X“ over the slot in the "Device View" frame of the `Basic Settings:System` dialog. When disabled, the device recognizes the module installed in this slot and the module is configurable.
- The "Type" column lists the type of module installed in the slot. A value of `none` indicates that the slot is empty.
- The "Description" column gives a short description of the installed module.
- The "Version" column lists the module version.
- The "Ports" column lists how many ports are available on the module.

- The "Serial Number" column list the serial number of the module.
- The "Status" column contains the status of the slot.
  - `physical` - indicates that a module is present in the slot.
  - `configurable` - indicates that the slot is empty and available for configuration.
  - `remove` - indicates that the slot is empty.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Remove Module	Removes the module configuration from the device when the slot is empty.
Help	Opens the online help.

Table 4: Buttons

1.3 Network

With the `Basic settings:Network` dialog you define the source from which the device gets its IP parameters after starting, and you assign the IP parameters and VLAN ID and configure the HiDiscovery access.

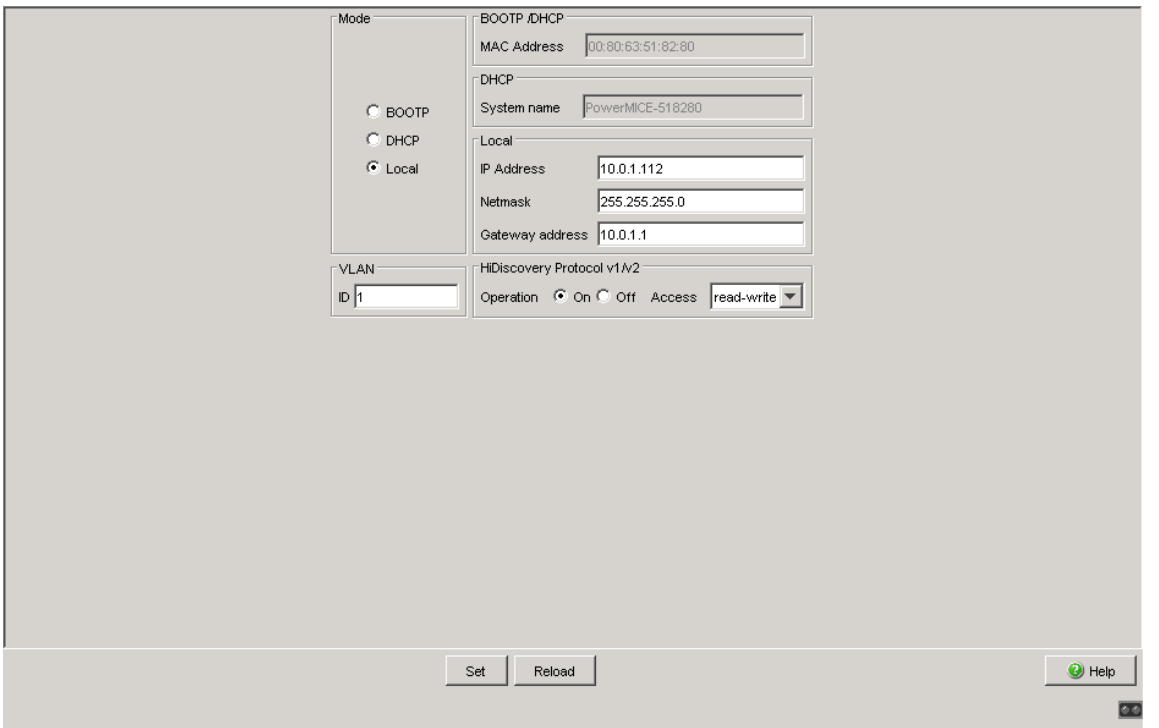


Figure 8: Network parameters dialog

☐ Under “Mode”, you enter where the device gets its IP parameters:
- ▶ In the BOOTP mode, the configuration is via a BOOTP or DHCP server on the basis of the MAC address of the device (see on page 51 “Load/Save”).
- ▶ In the DHCP mode, the configuration is via a DHCP server on the basis of the MAC address or the name of the device (see on page 51 “Load/Save”).
- ▶ In the local mode the net parameters in the device memory are used.

☐ Enter the parameters on the right according to the selected mode.

☐ You enter the name applicable to the DHCP protocol in the “Name” line in the `Basic Settings:System` dialog of the graphical user interface.

☐ The “VLAN” frame enables you to assign a VLAN to the management CPU of the device. If you enter 0 here as the VLAN ID (not included in the VLAN standard version), the management CPU will then be accessible from all VLANs.

☐ The HiDiscovery protocol allows you to allocate an IP address to the device. Activate the HiDiscovery protocol if you want to allocate an IP address to the device from your PC with the enclosed HiDiscovery software (default setting: operation “on”, access “read-write”).

Note: When you change the network mode from ”Local“ to ”BOOTP“ or ”DHCP“, the server will assign a new IP address to the device. If the server does not respond, the IP address will be set to 0.0.0.0, and the BOOTP/DHCP process will try to obtain an IP address again.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 5: Buttons

1.4 Software

This dialog provides you with the following functions:

- which display the software versions in the device.
- carry out a software update of the device via http (via a file selection window), tftp or ACA.
- restore the backup version of the software saved in Flash.

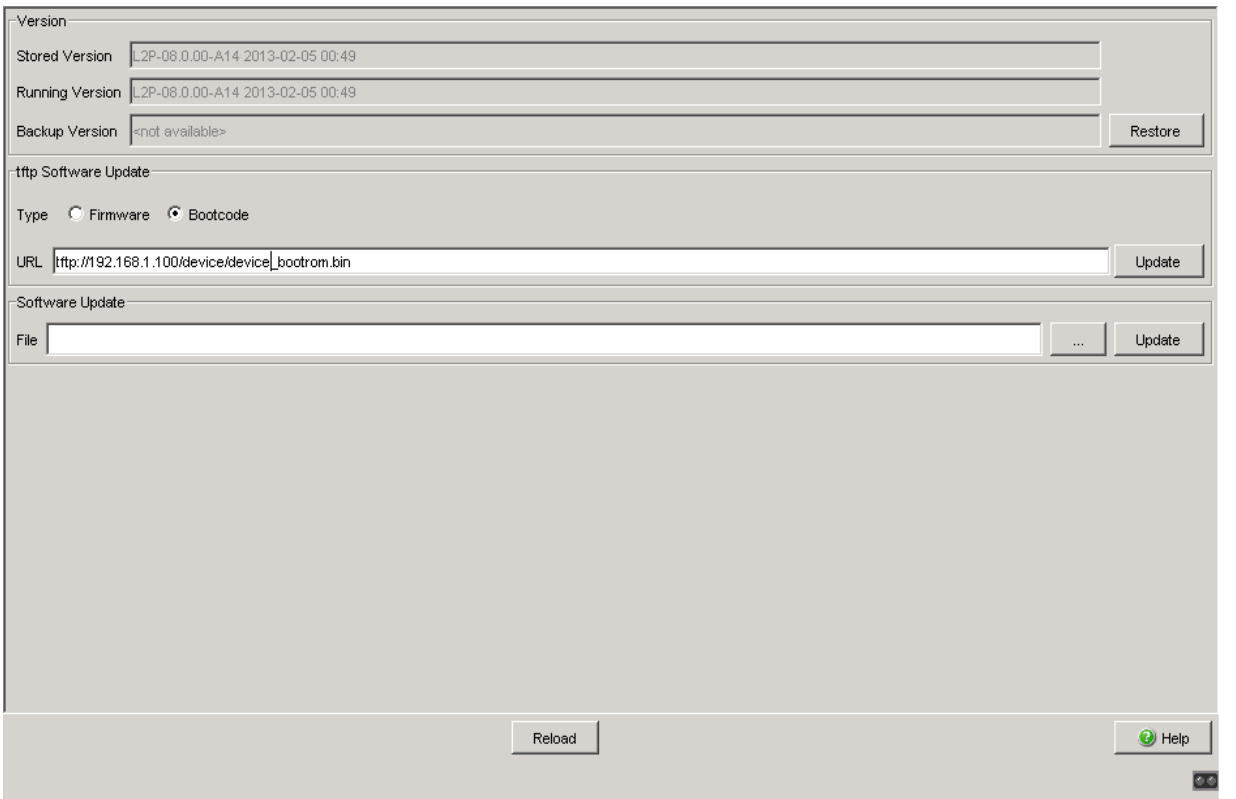


Figure 9: Software Dialog

1.4.1 View the software versions present on the device

The dialog shows the existing software versions:

- Stored Version:
  The version of the software stored in the flash memory.
- Running Version:
  The version of the software currently running.
- Backup Version:
  The version of the previous software stored in the flash memory.

1.4.2 Restoring the Backup Version

“Restore” replaces the software version stored with the backup version of the software. The relevant configuration files are replaced at the same time. A cold start is required to make the software versions effective. A warm start has no effect whatsoever.

☐ Click on the “Restore” button to replace the stored version of the software with the backup version.
☐ Once successfully replaced, activate the restored software:
Select the `Basic settings: Restart` dialog and perform a cold start. In a cold start, the device reloads the software from the non-volatile memory, restarts, and performs a self-test.
☐ Reload the graphical user interface in your browser to re-access the device after restarting.

1.4.3 TFTP Software Update

For a tftp update you need a tftp server on which the software to be loaded is stored.

The URL identifies the path to the software stored on the tftp server. The URL is in the format
tftp://IP address of the tftp server/path name/file name
(e.g. `tftp://192.168.1.1/device/device.bin`).

☐ Select the “Firmware“ radio button.
☐ Enter the URL for the software location.
☐ To load the software from the tftp server to the device, click "Update".
☐ To start the new software after loading, cold start the device.
See “Restart” on page 66.

1.4.4 TFTP Bootcode Update

For a tftp update you need a tftp server to store the required bootcode.
The URL identifies the path to the bootcode stored on the tftp server. The URL is in the format
tftp://IP address of the tftp server/path name/file name
(for example: `tftp://192.168.1.1/device/device_bootrom.bin`).

Note: If an interrupt occurs during a Bootcode update, the device is unrecoverable. Perform this update under the supervision of the Hirschmann support desk.

☐ Select the “Bootcode“ radio button.
☐ Enter the URL for the bootcode location.
☐ To load the bootcode from the tftp server to the device, click "Update".
☐ To start the new bootcode after loading, cold start the device.
See “Restart” on page 66.

1.4.5 HTTP Software Update

For a software update via a file selection window, the device software must be on a data carrier that you can access from your PC.

☐ Click on "..." in the "Software Update" frame.

☐ In the "Open" dialog select the device software image file with the suffix `*.bin`.

☐ Click on "Open".

☐ Click on "Update" to transfer the software to the device.
When the file is completely transferred, the device starts updating the device software. If the update was successful, the device displays the message "Successfully firmware update …".

1.4.6 Automatic software update by ACA

The device also allows you to perform an automatic software update using the external memory. You will find the relevant details in the document “Basic Configuration User”, chapter “Automatic Software Update by external memory“.

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 6: Buttons

1.5 Port Configuration

This configuration table allows you to configure each port of the device and also display each port‘s current mode of operation (link state, bit rate (speed) and duplex mode).

- The column “Port” shows the number of the device port to which the table entry relates.
- In the “Port Name” column, you can enter a name for every port.
- In the “Port on” column, you can switch on the port by selecting it here.
- In the “Propagate connection error” column, you can specify that a link alarm will be forwarded to the device status and/or the the signal contact is to be opened.
- In the “Automatic Configuration” column, you can activate the automatic selection of the the operating mode (Autonegotiation) and the automatic assigning of the connections (Auto cable crossing) of a TP port by selecting the appropriate field. After the autonegotiation has been switched on, it takes a few seconds for the operating mode to be set.
- In the “Manual Configuration” column, you can set the operating mode for this port. The choice of operating modes depends on the media module. The possible operating modes are:
  - 10 Mbit/s half duplex (HDX)
  - 10 Mbit/s full duplex (FDX)
  - 100 Mbit/s half duplex (HDX)
  - 100 Mbit/s full duplex (FDX)
  - 1000 Mbit/s half duplex (HDX)
  - 1000 Mbit/s full duplex (FDX)
  - 10 Gbit/s full duplex (FDX)
- The “Link/Current Settings” column displays the current operating mode and thereby also an existing connection.

- In the “Manual Cable Crossing (Auto. Conf. off)” column, you assign the connections of a TP port, if “Automatic Configuration” is deactivated for this port. The possible settings are:
  - enable: the device does not swap the send and receive line pairs of the TP cable for this port (MDI).
  - disable: the device swaps the send and receive line pairs of the TP cable for this port (MDIX).
  - unsupported: the port does not support this function (optical port, TP SFP port).
- In the “Flow Control” column, you checkmark this port to specify that flow control is active here. You also activate the global “Flow Control” switch (see on page 156 “Switching Global”).

Note: The device supports gigabit interfaces on copper ports with auto negotiation enabled.

Note: The active automatic configuration has priority over the manual configuration.

Note: If you are using link aggregation, pay attention to its configuration (see on page 242 “Link Aggregation”).

Note: When you are using a redundancy function, you deactivate the flow control on the participating device ports. If the flow control and the redundancy function are active at the same time, there is a risk that the redundancy function will not operate as intended.

Note: The following settings are required for the ring ports in a HIPER-Ring:

Port type	Bit rate	Autonegotiation (automatic configuration)	Port setting	Duplex
TX	100 Mbit/s	off	on	full
TX	1 Gbit/s	on	on	-
Optical	100 Mbit/s	off	on	full
Optical	1 Gbit/s	on	on	-
Optical	10 Gbit/s	off	on	full

Table 7: Port settings for ring ports

When you switch the DIP switch for the ring ports, the device sets the required settings for the ring ports in the configuration table. The port, which has been switched from a ring port to a normal port, is given the settings Autonegotiation (automatic configuration) on and Port on. The settings remain changeable for all ports.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 8: Buttons

1.6 Power over ETHERNET

Note: The following devices are equipped with Power over Ethernet (PoE) ports:

- RS20/30
- MS20/30
- PowerMICE
- OCTOPUS
- MACH 4002
- MACH 1020/1030/1040

You will learn in this section how these devices operate.

Note: However the following devices are equipped with Power over Ethernet **Plus** (**PoE+**) ports

- MACH104-16TX-PoEP and
- MACH 102 with media module M1-8TP-RJ45 PoEP

You will learn in the “Power over Ethernet Plus” section how these devices operate.

If the device is equipped with PoE media modules, it will then allow you to supply current to devices such as IP phones via the twisted-pair cable. PoE media modules support Power over ETHERNET according to IEEE 802.3af. On delivery, the Power over ETHERNET function is activated globally and on all PoE-capable ports.

Nominal power for MS20/30, MACH 1000 and PowerMICE:
The device provides the nominal power for the sum of all PoE ports plus a surplus. Because the PoE media module gets its PoE voltage externally, the device does not know the possible nominal power.
The device therefore assumes a “nominal power” of 60 Watt per PoE media module for now.

Nominal power for MACH 4000:
The device provides the nominal power for the sum of all PoE ports plus a surplus. Should the connected devices require more PoE power than is provided, the device then switches PoE off at the ports. Initially, the device switches PoE off at the ports with the lowest PoE priority. If multiple ports have the same priority, the device first switches PoE off at the ports with the higher port number.

Frame "Operation":
☐ With “On/Off” you turn the PoE on or off.

Frame "Configuration":
☐ With “Send Trap” you can get the device to send a trap in the following cases:
  – If a value exceeds/falls below the performance threshold.
  – If the PoE supply voltage is switched on/off on at least one port.
☐ Enter the power threshold in “Threshold”. When the device exceeds or is below this value, the device will send a trap, provided that you enable the “Send Trap” function. For the power threshold you enter the power yielded as a percentage of the nominal power.
☐ “Budget [W]” displays the power that the device nominally provides to the PoE ports.
☐ “Reserved [W]” displays the maximum power that the device provides to the connected PoE devices on the basis of their classification.
☐ “Delivered [W]” shows how large the current power requirement is on the PoE ports.

The difference between the "nominal" and "reserved" power indicates how much power is still available to the free PoE+ ports.

Port Table:
The table only shows ports that support PoE.

☐ In the “POE enable” column, you can enable/disable PoE on this port.
☐ The “Status” column indicates the PoE status of the port.
☐ In the “Priority” column (MACH 4000), set the PoE priority of the port to “low”, “high” or “critical”.

☐ The "Class" column indicates the class of the connected device:
Class: Maximum delivered power
0: 15.4 W = As-delivered state
1: 4.0 W
2: 7.0 W
3: 15.4 W
4: reserved, treated as Class 0

☐ The column „Consumption [W]“ displays the current power delivered at the respective port.

☐ The “Name” column indicates the name of the port, see `Basic settings:Port configuration`.

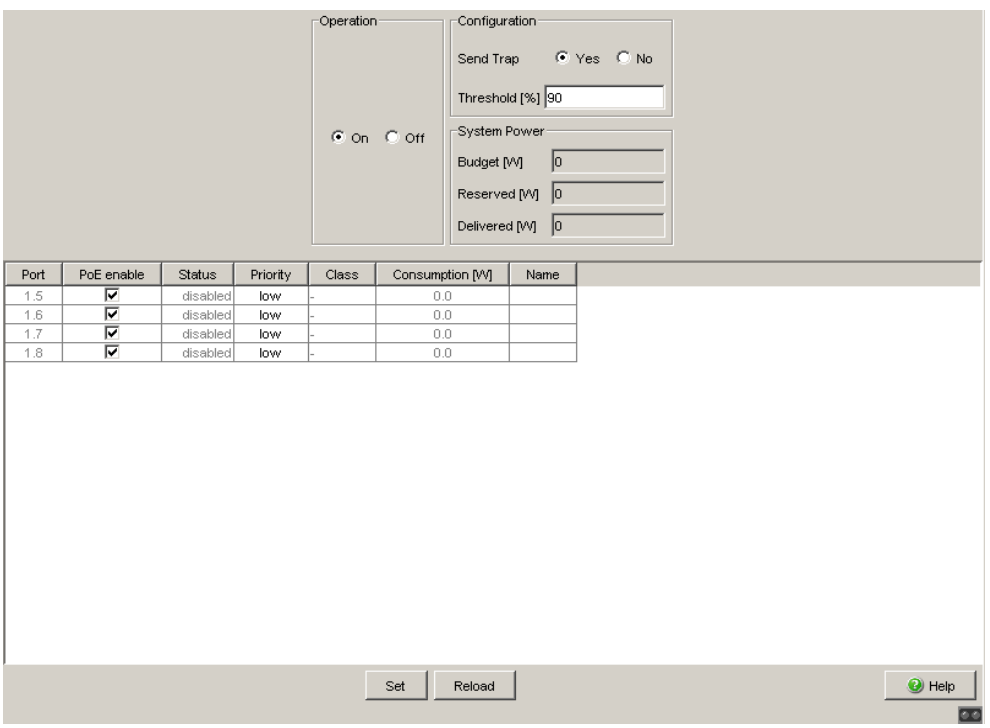


Figure 10: Power over Ethernet dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 9: Buttons

1.7 Power over Ethernet Plus

Note: The following devices are equipped with Power over Ethernet **Plus** (**PoE+**) ports

- MACH104-16TX-PoEP and
- MACH 102 with media module M1-8TP-RJ45 PoEP

You will learn in this section how both of these devices operate.

However the following devices are equipped with Power over Ethernet (PoE) ports:

- RS20/30
- MS20/30
- PowerMICE
- OCTOPUS
- MACH 4002
- MACH 1020/1030/1040

In the “Power over ETHERNET” section you will learn how these devices operate.

Devices with Power over Ethernet Plus (PoE+) ports enable you to supply current to terminal devices such as IP phones via the twisted-pair cable. PoE+ ports support Power over Ethernet Plus in accordance with IEEE 802.3at.
The Power over Ethernet Plus function is activated both globally and on the PoE-capable ports on delivery.

Connecting too many PoE+ Powered Devices (PD) can overload your external PoE+ power supply. It may fail as a result. The Power over Ethernet Plus dialog assists you in managing the power supply and helps you to protect your external PoE+ power supply devices from overloading.

For the devices

- MACH104-16TX-PoEP and
- MACH 102 with media module M1-8TP-RJ45 PoEP:

- Maximum power for MACH104-16TX-PoEP:
  The device provides maximum power of 248 W for the aggregate of all PoE ports.
- Maximum power for MACH 102 with media module M1-8TP-RJ45 PoE:
  The device provides maximum power for the aggregate of all PoE ports. Because the PoE+ media module gets its PoE voltage externally, the device cannot know the maximum power possible,
  so here the device uses the value of 124 watts per M1-8TP-RJ45 PoE media module as "maximum power".

Should the PDs connected require more PoE power than is provided, then the device deactivates PoE at designated ports. Initially, the device switches PoE off at the ports with the lowest PoE priority. If multiple ports have the same priority, the device first switches PoE off at the ports with the higher port number.

1.7.1 Power over Ethernet Plus - Global

Frame "Operation":

Parameter	Meaning	Value Range	Default Setting
Operation	Switching Power over Ethernet Plus operation on/off.	`On, Off`	On

Table 10: PoE+ Global - Operation

Frame "Configuration":

Parameter	Meaning	Value Range	Default Setting
Send Trap	Causes the device to send a trap in the following cases: ▶ If a value exceeds/falls below the performance threshold. ▶ If the PoE+ supply voltage is switched on/off at at least one port.	`Yes, No`	Yes
Threshold [%] (performance threshold)	Performance threshold in percent of the nominal performance: When this value is exceeded/not achieved, the device will send a trap, provided that “Send Trap” is enabled.	`0 - 99%`	90%

Table 11: PoE+ Global - Configuration

Frame "System Power":

Parameter	Meaning	Value Range	Default Setting
Budget [W]	Displays the power that the device nominally provides for the PoE+ ports.	`0 - 248 W`	`248 W`
Reserved [W]	Displays how much power the device provides at most to the connected PoE devices on the basis of their classification.	`0 - 248 W`	`0 W`
Delivered [W]	Displays how large the current power requirement is on the PoE+ ports.	`0 - 248 W`	-

Table 12: PoE+ Global - System Power

The difference between the "configured power" and "reserved power" indicates how much power is still available to the free PoE+ ports.

"Global" table:

Parameter	Meaning	Value Range	Default Setting
Module	▶ For MACH102 media modlues M1-8TP-RJ45 PoE: Module = slot number of the PoE+ module ▶ For MACH104-16TX-PoEP devices: Module = 1	`1 - 2`	-
Configured power budget [W]	Configure whichever power budget the device nominally provides for the module's PoE+ ports.	`0 - 248 W`	`248 W`
Maximum power budget [W]	Displays the power that the device nominally provides for the module's PoE+ ports.	`0 - 248 W`	`248 W`
Reserved power [W]	Displays how much power the device provides at most to the PoE devices connected to the module on the basis of their classification.	`0 - 248 W`	`0 W`
Delivered power [W]	Displays how large the current power requirement is on every PoE+ port of the module.	`0 - 248 W`	-
Threshold [%]	Specify the performance threshold in percent of the nominal performance; when the module exceeds or is below this value, the device will send a trap, provided that “Send Trap” is enabled.	`0 - 99%`	`90%`I
Trap notification	Causes the device to send a trap in the following cases: ▶ If a value exceeds/falls below the performance threshold. ▶ If the PoE+ supply voltage is switched on/off on at least one port.	`On, Off`	`On`

Table 13: Power over Ethernet Plus - Global

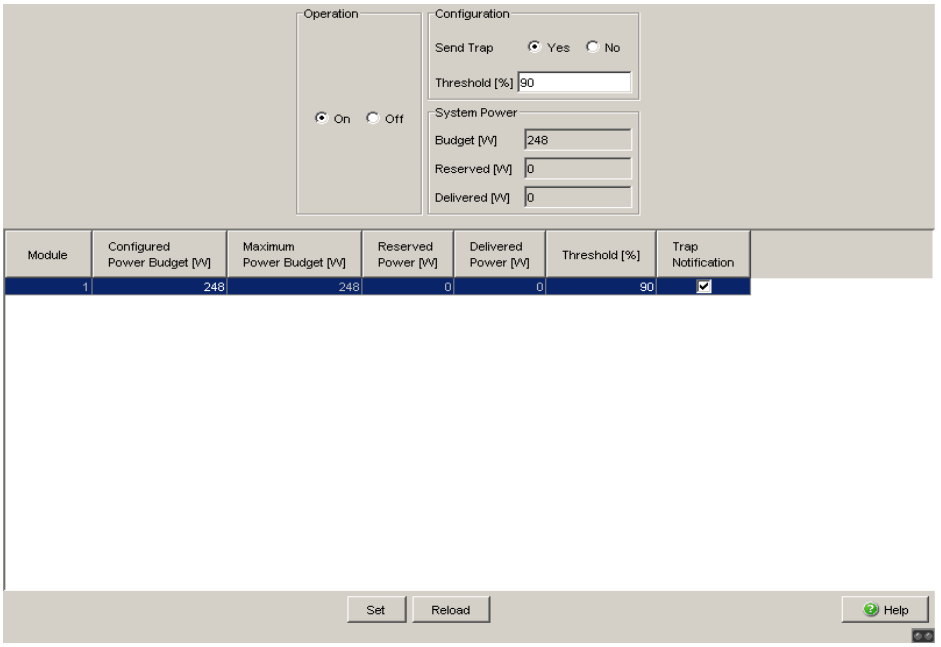


Figure 11: Power over Ethernet Plus Dialog:Global

Note: For MACH 102 devices with media module M1-8TP-RJ45 PoE: We recommend distributing PoE+ power equally between the two port groups (ports 5 to 12 and ports 13 to 20).

1.7.2 Power over Ethernet Plus - Port

The table only shows ports that support PoE+.

Parameter	Meaning	Value range	Default setting
Port	Module and port numbers of the PoE+ port to which this entry applies. On the MACH104-16TX-PoEP device, the ports 1.5 to 1.20 support PoE+.	`1,5 - 1,20 dB`	-
PoE enable	Switching Power over Ethernet Plus operation on/off for this port.	`An, Aus`	`An`

Table 14: Power over Ethernet Plus - Port

Parameter	Meaning	Value range	Default setting
Status	Displays the PoE+ status of the port.	`suche, …`	`suche, …`
Priority	Specify the PoE+ priority of the port.	`niedrig, hoch, kritisch`	`niedrig`
Class	Displays the class of the connected device:Class: Maximum output power ▶ 0: 15.4 W ▶ 1: 4.0 W ▶ 2: 7.0 W ▶ 3: 15.4 W ▶ 4: 30.0 W	`0 - 4`	-
Consumption [W]	Displays the current power output on the particular port.	`0,0 - 248,0 W`	-
Power limit [mW]	Defines the maximum power in watts that the port outputs. This function allows you to distribute the power budget available among the PoE ports as required. For example, for a connected device without the “Power Class” function, the port reserves a fixed amount of 15.4 W (class 0) even if the device requires less power. The surplus power is not available to any other port. By defining the power limit, you reduce the reserved power to the actual requirement of the connected device. The unused power is available to other ports. If the exact power consumption of the connected device is unknown, see the value in the "Maximum Observed [W]" field. The power limit must be greater than the value in the "Maximum Observed [W]" field. If the maximum observed power is greater than the set power limit, the device sees the power limit as invalid. In this case, the device uses the PoE class for the calculation.	`0 - 30,0`	`0`

Table 14: Power over Ethernet Plus - Port

Parameter	Meaning	Value range	Default setting
Maximum Observed [mW]	Displays the maximum power in watts that the device has consumed so far. You reset the value when you disable PoE on the port or terminate the connection to the connected device.	`0 - 30,0`	–
Name	Displays the name of the port, see `Grundeinstellungen:Portkonfiguration`	-	-

Table 14: Power over Ethernet Plus - Port

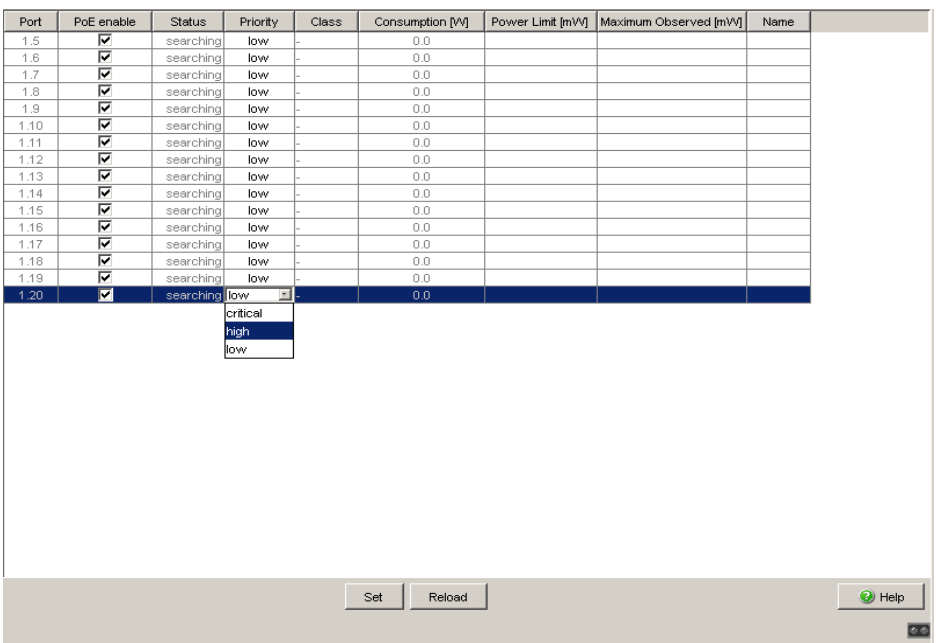


Figure 12: Power over Ethernet Plus Dialog:Port

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 15: Buttons

1.8 Load/Save

With this dialog you can:

- load a configuration,
- save a configuration,
- enter a URL,
- restore the delivery configuration,
- use the ACA for configuring,
- cancel a configuration change.

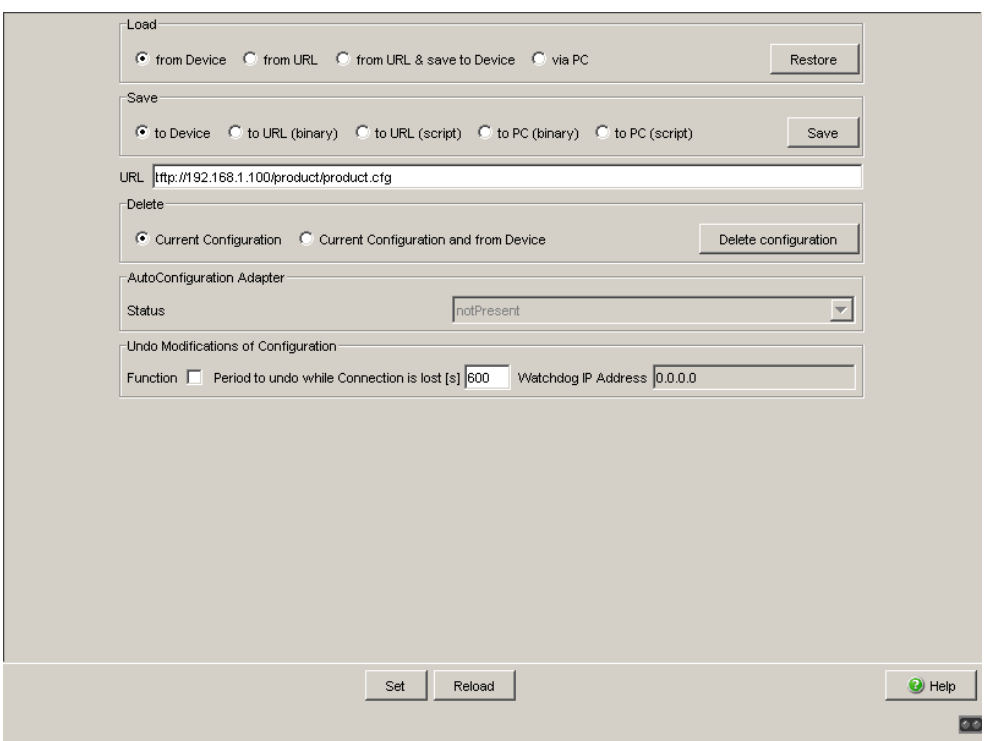


Figure 13: Load/Save dialog

1.8.1 Loading a Configuration

In the “Load” frame, you have the option to

- load a configuration saved on the device,
- load a configuration stored under the specified URL,
- load a configuration stored on the specified URL and save it on the device,
- load a configuration stored on the PC as an editable and readable script or in binary form,
- load a configuration saved on the PC for the offline configurator in XML format.

If you change the current configuration (for example, by switching a port off), the graphical user interface changes the “load/save” symbol in the navigation tree from a disk symbol to a yellow triangle. After saving the configuration, the graphical user interface displays the “load/save” symbol as a disk again.

Loading configuration of the offline configurator

Installing and starting the offline configurator
To create a configuration file in the offline configurator, proceed as follows:

☐ If you have not installed the offline configurator on your PC yet: Install the offline configurator by running the "Setup.exe" installation file from the "ocf_setup" folder included on the CD-ROM.

☐ Start the offline configurator by double-clicking the “Offline Management” desktop symbol.

Creating an XML configuration file with the offline configurator

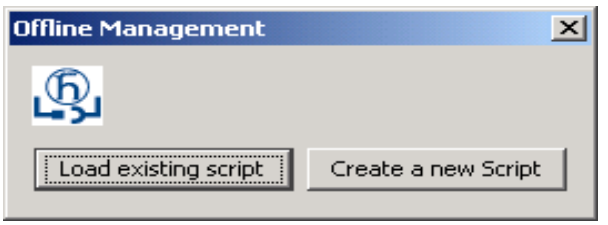


Figure 14: Offline Management selection

▶ Revising an existing script

☐ Click on "Load existing script" to load a previously created script for revision in the offline configurator.

▶ Creating a new script

☐ Click on “Create a new script" to create a new script with the aid of the offline configurator.

☐ Then in the "Product Selection" list select the product that you want to create the script for.

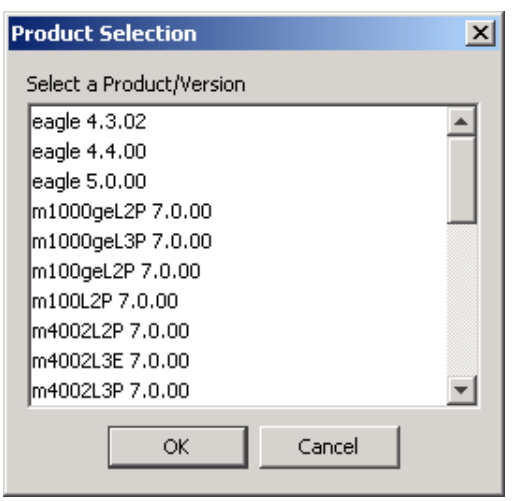


Figure 15: Creating New Script Dialog - Product Selection

☐ In the offline configurator interface, set the desired parameters appropriate to your requirements.

Note: The offline configurator interface contains only dialogs, tables and input fields for parameters writable to the device. You cannot read parameters from the device in the offline mode. The range of the offline configurator interface is reduced vis-à-vis that of the graphical user interface.

You can find a description of the settings you can make in the offline configurator interface in the respectively appropriate section of this manual.

▶ Example: Basic Settings Dialog - System

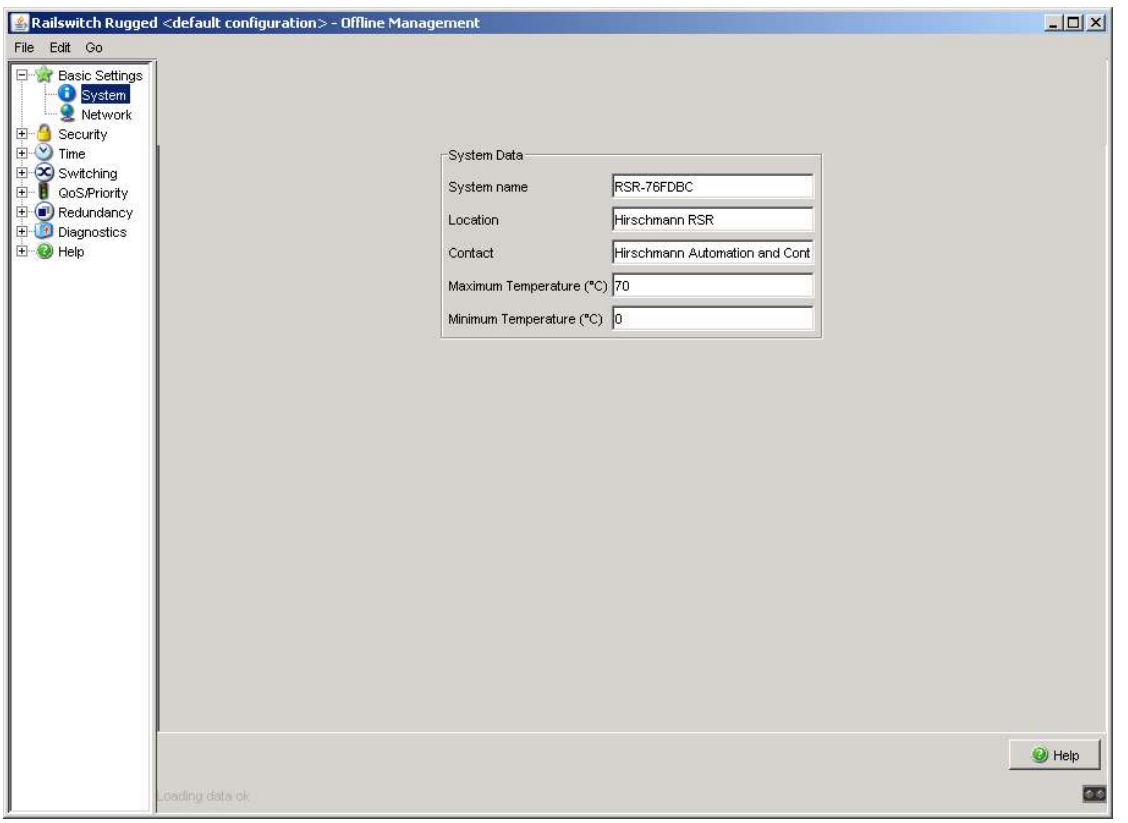


Figure 16: Basic Settings Dialog:System in the Offline Configurator

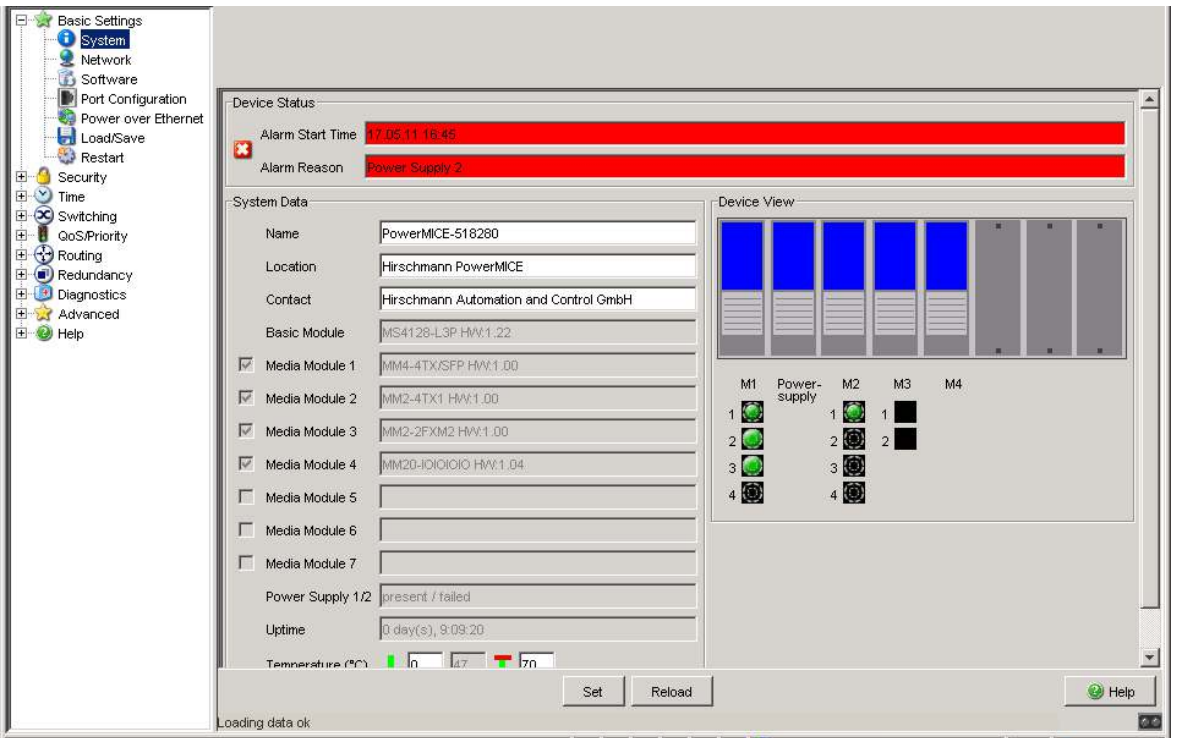


Figure 17: Basic Settings Dialog:System in the Graphical User Interface

The following applies to the above example: You can find a description of the parameters that can be set in the offline configurator `Basic Settings:System` dialog.
See “System” on page 22.

☐ Once you have set the desired parameters appropriate to your requirements in the offline configurator interface, save the configuration:
- `File - Save as` or
- `File - Save`

☐ Quit the offline configurator with File - Quit.

Loading an XML configuration file onto the device

☐ In the graphical user interface, select the `Basic Settings:Load/Save` menu item.

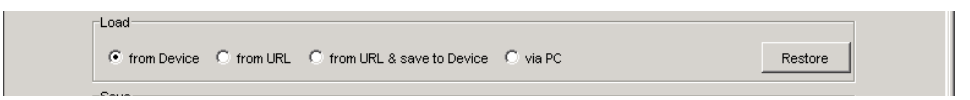


Figure 18: Loading the Configuration Dialog - Via PC

☐ To load a configuration saved on the PC with the offline configurator in XML format, check the "via PC" field in the "Load" frame with a click of the mouse and click on "Restore".
☐ Select the desired path in the "Open" window, from which the device is to load your configuration file. Specify in the "File Name" field the name of the desired file, including the .ocf (offline configurator) extension.

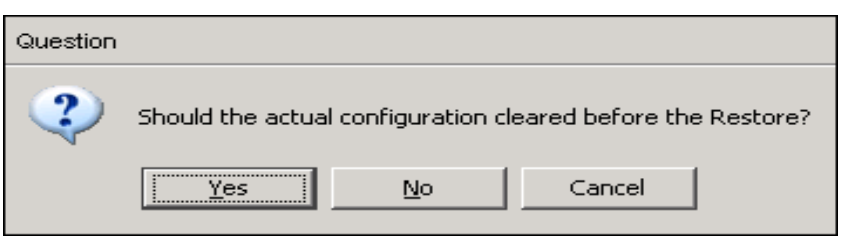


Figure 19: Query - Resetting Configuration

☐ To reset the current configuration on your device before loading the offline configuration file, click on "Yes".
☐ To retain the current configuration on your device before loading the offline configuration file and then to overwrite it with the contents of the offline configuration file, click on "No".

Once the offline configuration file has loaded successfully, the device returns in the subsequent "Configuration" window an overview of the configuration parameters that have loaded. By clicking in this window you can choose between the following two views:

- Tables View
- Text View

Tables View

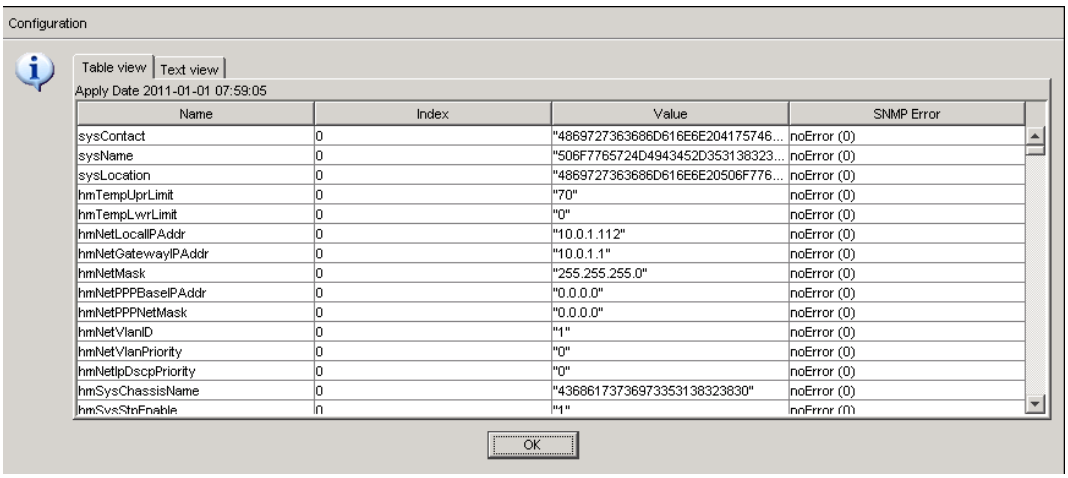


Figure 20: Information - Configuration - Tables View

In the Tables View you get an overview in tabular format of the configuration parameters that have loaded:

Parameters	Meaning	Possible values
Application date	Point in time (date and time of day) when you loaded the offline configuration file onto the device. Notation: `yyyy-mm-dd hh-mm-ss`	`yyyy` = valid year `mm` = 1 to 12 `dd` = 1 to 31 `hh` = 0 to 23 `mm` = 0 to 59 `ss` = 0 to 59
Name	Name of the configuration parameter (MIB variable)	see MIB
Index	Index of the configuration parameter (MIB variable)	see MIB

Table 16: Information - Configuration - Tables View

Parameters	Meaning	Possible values
Value	Value of the configuration parameter (MIB variable), which was set by loading the offline configuration file.	see MIB
SNMP error	The device's success at loading the respective configuration parameter	▶ (0) = Success ▶ (1) = Response PDU Too Big ▶ (2) = Variable does not exist ▶ (3) = Cannot modify variable: Bad Value ▶ (4) = Cannot modify object, Read Only ▶ (5) = Cannot perform operation, General Error

Table 16: Information - Configuration - Tables View

Text View

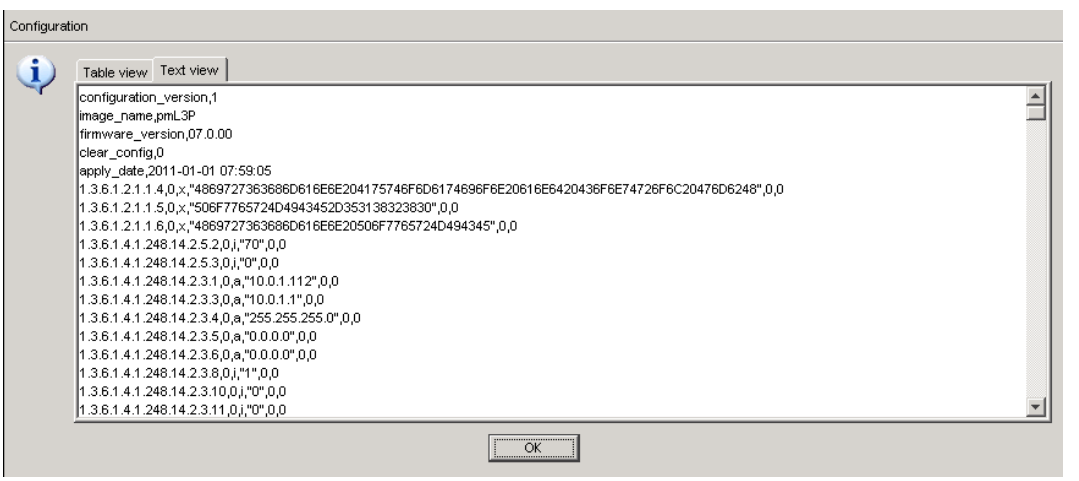


Figure 21: Information - Configuration - Text View

In the Text View you get an overview in textual format of the configuration parameters (MIB variables) that have loaded:
The device lists the individual configuration parameters in the following form. The data are separated by commas:

- Position in the MIB, e.g. 1.3.6.1.2.1.1.4
- Index
- Value
- SNMP error (see table 16, "SNMP Error" parameter)
- The last parameter has the value of 0. It is included for future expansions.

1.8.2 Saving the Configuration

In the “Save” frame, you have the option to

- save the current configuration on the device,
- save the current configuration in binary form in a file under the specified URL, or as an editable and readable script,
- save the current configuration in binary form or as an editable and readable script on the PC.
- save the current configuration for the offline configurator on the PC in XML format.

Note: For script configuration files, note the following characteristics:

- If you save the configuration in a binary file, the device saves all configuration settings in a binary file.
  In contrast to this, the device only saves those configuration settings that deviate from the default setting when saving to a script file.
- When you load a configuration from a script file, delete the configuration on the device first so that the script that is being loaded overwrites the configuration default settings correctly.
  If a configuration already exists on the device, the result is the loading of a script file in a configuration involving the union of the settings which differ from the default setting in the existing configuration or in the script file. If you use this feature, remember that loading a script sets configuration settings only to values that differ from the default setting.
- To delete the configuration on a device, select “Current configuration” in the “Delete” frame and click on “Delete configuration”. The device immediately deletes its current configuration from the volatile memory (see on page 62 “Deleting a configuration”). The configuration in the non-volatile memory is kept, along with the IP address. Thus the device remains reachable.

Note: The loading process started by DHCP/BOOTP (see on page 29 “Network”) shows the selection of “from URL & save local” in the “Load” frame. If you get an error message when saving a configuration, this could be due to an active loading process. DHCP/BOOTP only finishes a loading process when a valid configuration has been loaded. If DHCP/BOOTP does not find a valid configuration, finish the loading process by loading the local configuration from the device in the “Load” frame.

If you change the current configuration (for example, by switching a port off), the graphical user interface changes the “load/save” symbol in the navigation tree from a disk symbol to a yellow triangle. After saving the configuration, the graphical user interface displays the “load/save” symbol as a disk again.

After you have successfully saved the configuration on the device, the device sends a trap `hmConfigurationSavedTrap` together with the information about the AutoConfiguration Adapter (ACA), if one is connected. When you change the configuration for the first time after saving it, the device sends a trap `hmConfigurationChangedTrap`.

Saving configuration for the offline configurator

☐ In the graphical user interface, select the `Basic Settings:Load/Save` menu item.

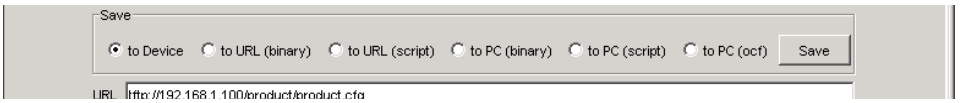


Figure 22: Saving Configuration Dialog - On the PC (ocf)

☐ To save the current configuration for the offline configurator as an XML configuration file on the PC, check with a click of the mouse the "on the PC (ocf)" field in the "Save" frame and click on the "Save" button.

☐ Select the desired path in the "Save" window, on which the device is to save your configuration file. Specify the desired name in the "File name" field. The device saves your configuration in a file with the .ocf (offline configurator) extension.

Configuration Signature

A configuration signature as seen in the "Configuration Signature" frame of the `Basic Settings:Load/Save` dialog, uniquely identifies a particular configuration. Every time you save a configuration to the device, the device generates a random sequence of numbers and/or letters as a signature for the configuration. The signature changes every time you save the configuration to the device. The device stores the randomly generated signature with the configuration to assure the device loads appropriate configuration after a reboot.

1.8.3 URL

The URL identifies the path to the tftp server on which the configuration file is to be stored. The URL is in the format: tftp://IP address of the tftp server/path name/file name (e.g. `tftp://192.168.1.100/device/config.dat`).

Note: The configuration file includes all configuration data, including the passwords for accessing the device. Therefore, pay attention to the access rights on the tftp server.

1.8.4 Deleting a configuration

In the "Delete" frame, you have the option to

- Reset the current configuration to the default settings. The configuration saved on the device is retained.
- Reset the device to the default settings. In this case, the device deletes its configuration in the volatile memory as well as in the non-volatile memory. This includes the IP address. The device will be reachable again over the network after it has obtained a new IP address, for example, via DHCP or the V.24 interface.

Note: With the exception of the watchdog configuration, the device stores user defined configurations in Non-volatile Memory. The device stores the watchdog configuration separately. Therefore, when you reset the configurations to the default settings, using the "Current Configuration" or "Current Configuration from the Device" delete functions, the watchdog configuration remains in the device.

1.8.5 Using the AutoConfiguration Adapter (ACA)

The ACAs are devices for saving the configuration data of a device. An ACA enables the configuration data to be transferred easily by means of a substitute device of the same type.

Note: When replacing a device with DIP switches, check the DIP switch settings to ensure that they are the same.

Storing the current configuration data in the ACA:

You have the option of transferring the current device configuration, including the SNMP password, to the ACA and the flash memory by using the “to device” option in the “Save” frame .

Note: The device saves the configuration, with the exception of its SSH key (see on page 78 “Telnet/Web/SSH Access”). You will find instructions on how to transfer the SSH key of the old device to the new one in the document “Basic Configuration User Manual”, chapter “Replacing defective devices”.

Loading the Configuration file from the ACA:

When you restart the device with ACA connected, the device adopts the configuration data from ACA and saves it permanently in the flash memory. If the connected ACA contains invalid data, for example, if the ACA contains an unchanged default configuration, the device loads the data from the flash memory.

Note: Before loading the configuration data from the ACA, the device compares the password in the device with the password in the ACA configuration data.

The device loads the configuration data if

- the admin password matches or
- there is no password saved locally or
- the local password is the original default password or
- no configuration is saved locally.

Status	Meaning
notPresent	No ACA present
ok	The configuration data from the ACA and the device match.
removed	The ACA was removed after booting.

Table 17: ACAstatus

Status	Meaning
notInSync	- The configuration data of the ACA and the device do not match, or only one file exists[a], or - no configuration file is present on the ACA or on the device[b].
outOfMemory	The local configuration data is too extensive to be stored on the ACA.
wrongMachine	The configuration data in external memory originates from a different device type and cannot be read or converted.
checksumErr	The configuration data is damaged.

Table 17: ACAstatus

a. In these cases, the ACA status is identical to the status “not in sync”, which sends “Not OK” to the signal contacts and the device status.,
b. In this case, the ACA status (“notInSync”) deviates from the status “ACA not in sync”, which sends “OK” to the signal contacts and forwards the device status.

1.8.6 Cancelling a configuration change

Operation

If the function is activated and the connection to the device is interrupted for longer than the time specified in the field “Period to undo while connection is lost [s]”, the device then loads the last configuration saved.

☐ Activate the function before you configure the device so that you will then be reconnected if an incorrect configuration interrupts your connection to the device.

☐ Enter the “Period to undo while the connection is lost [s]” in seconds.
Possible values: 10-600 seconds.
Default setting: 600 seconds.

Note: Deactivate the function after you have successfully saved the configuration. In this way you help prevent the device from reloading the configuration after you close the web interface.

Note: When accessing the device via SSH, also note the TCP connection timeouts for the cancellation of the configuration.

Watchdog IP address

“Watchdog IP address” shows you the IP address of the PC from which you have activated the (watchdog) function. The device monitors the link to the PC with this IP address, checking for interruptions.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 18: Buttons

1.9 Restart

This dialog provides you with the following functions:

- initiate a cold start or delayed cold start of the device. After the time set has elapsed, the device reloads the software from the non-volatile memory, restarts, and performs a self-test.
  - ☐ Reload the graphical user interface in your browser to reaccess the device after restarting.
- initiate a warm start or delayed warm start of the device. After the time set has elapsed, the device checks the software in the volatile memory and restarts. If a warm start is not possible, a cold start is automatically performed.
- abort a delayed restart.
- reset the entries with the status “learned” in the filter table (MAC address table).
- reset the ARP table.
  The device maintains an ARP table internally.
  If, for example, you assign a new IP address to a computer and subsequently cannot set up a connection to the device, you then reset the ARP table.
- reset the port counters.
- delete the log file.

Note: During the restart, the device temporarily does not transfer any data, and it cannot be accessed via the graphical user interface or other management systems such as Industrial HiVision.

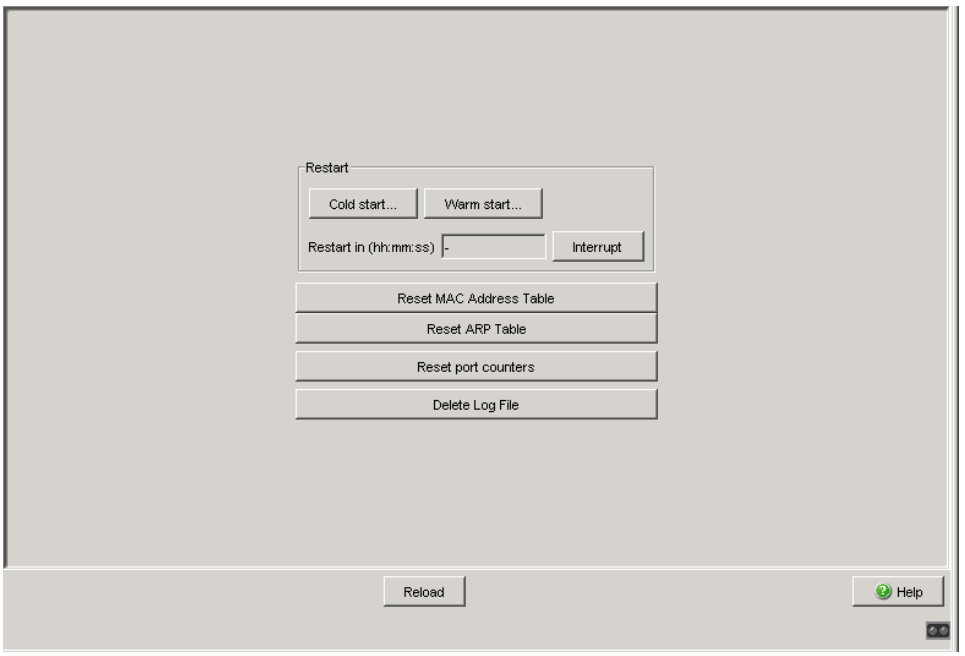


Figure 23: Restart Dialog

Note: Once you select "Cold Start" or "Warm Start", the "Restart" window appears. Here you enter the delay time after which the device performs its restart. The maximum value is 24 d, 20 h, 31 min, 23 s.
In order to interrupt the restart procedure, click "Interrupt".

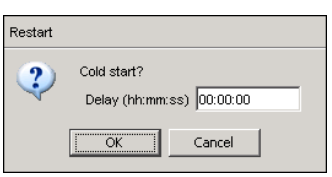


Figure 24: Delayed Restart Dialog

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 19: Buttons

2 Security

The “Security” menu contains the dialogs, displays and tables for configuring the security settings:

- Password/SNMPv3 access
- SNMPv1/v2 access
- Telnet/Web/SSH access
- Restricted management access
- Port security
- 802.1X port authentication
- RADIUS
- Login Banner
- Access Control Lists (ACLs, operation via CLI only)

2.1 Password / SNMPv3 access

This dialog gives you the option of changing the read and read/write passwords for access to the device via the graphical user interface, via the CLI, and via SNMPv3 (SNMP version 3).
Set different passwords for the read password and the read/write password so that a user that only has read access (user name “user”) does not know, or cannot guess, the password for read/write access (user name “admin”).
If you set identical passwords, when you attempt to write this data the device reports a general error.

The graphical user interface and the command line interface (CLI) use the same passwords as SNMPv3 for the users “admin” and “user”.

Note: Passwords are case-sensitive.

☐ Select “Modify read-only password (user)” to enter the read password.
☐ Enter the new read password in the “New password” line and repeat your entry in the “Please retype” line.

☐ Select “Modify read-write password (admin)” to enter the read/write password.
☐ Enter the read/write password and repeat your entry.

☐ The “Accept only encrypted requests” function controls the encryption of the management data for the transfer between your PC and the device via SNMPv3.
  – When the data encryption is deactivated, the transfer of the configuration data is unencrypted, and is protected from corruption.
  – The graphical user interface always transfers the passwords securely.
  – The graphical user interface always transfers the user name in plain text.

  - The device allows you to set the “Accept only encrypted requests” function differently for the access with the read password and with the read/write password.
  - When logging in, the graphical user interface queries the current setting of the device and sends encrypted queries if the device requests this.

☐ When you activate the "Synchronize password to v1/v2 community" function, when the password is changed the device synchronizes the corresponding community name.
  - When you change the password for the read/write access, the device updates the readWrite community for the SNMPv1/v2 access to the same value.
  - When you change the password for the read access, the device updates the readOnly community for the SNMPv1/v2 access to the same value.

Note: As the graphical user interface displays the communities readably in the dialog for SNMPv1/v2, this dialog can only be accessed by a user who has logged in with the user name “admin” and the correct read/write password.

Note: When you change the SNMPv3 password for the user name with which you have logged in to the graphical user interface, log in again so that you can access the graphical user interface of the device again. Otherwise you will get a general error message when you attempt to access it.

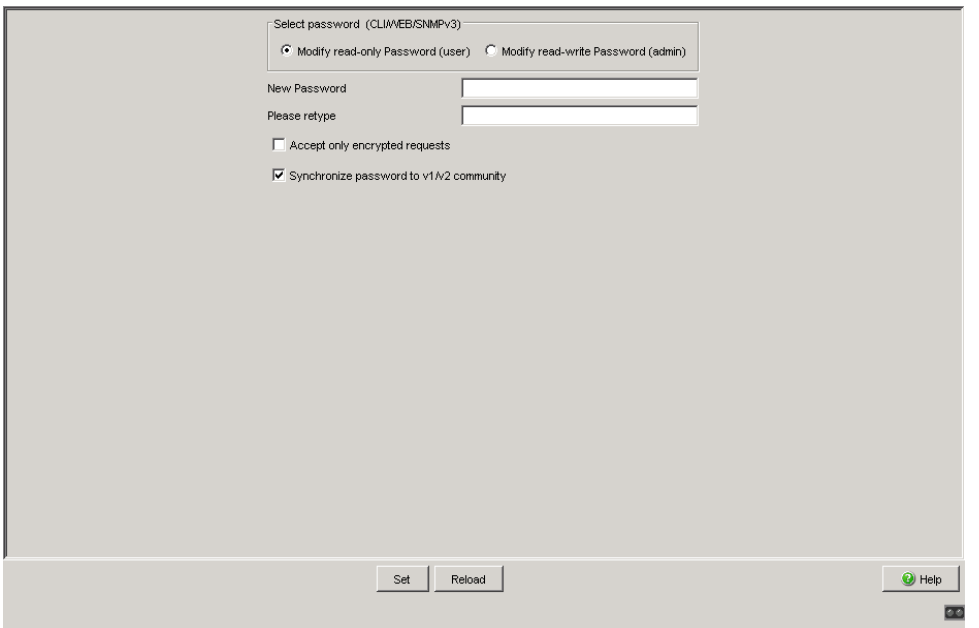


Figure 25: Dialog Password/SNMP Access

Note: If you do not know a password with “read/write” access, you will not have write access to the device.

Note: For security reasons, the device does not display the passwords. Make a note of every change. You cannot access the device without a valid password.

Note: For security reasons, SNMPv3 encrypts the password. With the “SNMPv1” or “SNMPv2” setting in the dialog `Security:SNMPv1/v2 access`, the device transfers the password unencrypted, so that this can also be read.

Note: Use between 5 and 32 characters for the password in SNMPv3, since many applications do not accept shorter passwords.

You can block access via a Web browser, SSH or Telnet client in a separate dialog.
See “Telnet/Web/SSH Access” on page 78.

Access at IP address level is restricted in a separate dialog.
See “SNMPv1/v2 Access Settings” on page 74.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 20: Buttons

2.2 SNMPv1/v2 Access Settings

With this dialog you can select access via SNMPv1 or SNMPv2. In the default setting, both protocols are activated.
You can thus manage the device with Industrial HiVision and communicate with earlier versions of SNMP.

Note: To be able to read and/or change the data in this dialog, log in to the graphical user interface with the user name `admin` and the relevant password.

- In the "Index" column, the device shows the sequential number.
- In the "Community Name" column, you enter the password with which a management station may access the device via SNMPv1/v2 from the specified address range.

  Note: Passwords are case-sensitive.

If you activate the "Synchronize community to v3 password" function in the "Configuration" frame, the device synchronizes the corresponding SNMPv3 password when you change the community name.

– When you change the readWrite community, the device updates the SNMPv3 password for the read/write access to the same value.
– When you change the readOnly community, the device updates the SNMPv3 password for the read access to the same value.

- In the “IP Address” column, you enter the IP address which may access the device. No entry in this field, or the entry “0.0.0.0”, allows access to this device from computers with any IP address. In this case, the only access protection is the password.
- In the “IP Mask” column, much the same as with netmasks, you have the option of selecting a group of IP addresses.
  Example:
  255.255.255.255: a single IP address
  255.255.255.240 with IP address = 172.168.23.20:
  the IP addresses 172.168.23.16 to 172.168.23.31.

Binary notation of the mask 255.255.255.240:
1111 1111 1111 1111 1111 1111 1111 0000
mask bits
Binary notation of the IP address 172.168.23.20:
1010 1100 1010 1000 0001 0111 0001 0100

The binary representation of the mask with the IP address yields an address range of:
1010 1100 1010 1000 0001 0111 0001 0000 bis
1010 1100 1010 1000 0001 0111 0001 1111
i.e.: 172.168.23.16 to 172.168.23.31

- In the "Access Mode" column, you specify whether this computer can access the device with the read password (access mode `readOnly`) or with the read/write password (access mode `readWrite`).
See “Password / SNMPv3 access” on page 70.

  Note: The password for the `readOnly` access mode is the same as the SNMPv3 password for read access.
  The password for the `readWrite` access mode is the same as the SNMPv3 password for read/write access.
  If you are changing one of the passwords, manually set the corresponding password for SNMPv3 to the same value. Alternatively mark the "Synchronize community to v3 password" checkbox in the "Configuration" frame. This way you ensure that you can also access with the same password via SNMPv3.

- You can activate/deactivate this table entry in the "Active" column.

  Note: If you have not activated any row, the device does not apply any access restriction with regard to the IP addresses.

- With "Create" you create a new row in the table.
- With "Remove" you delete selected rows in the table.

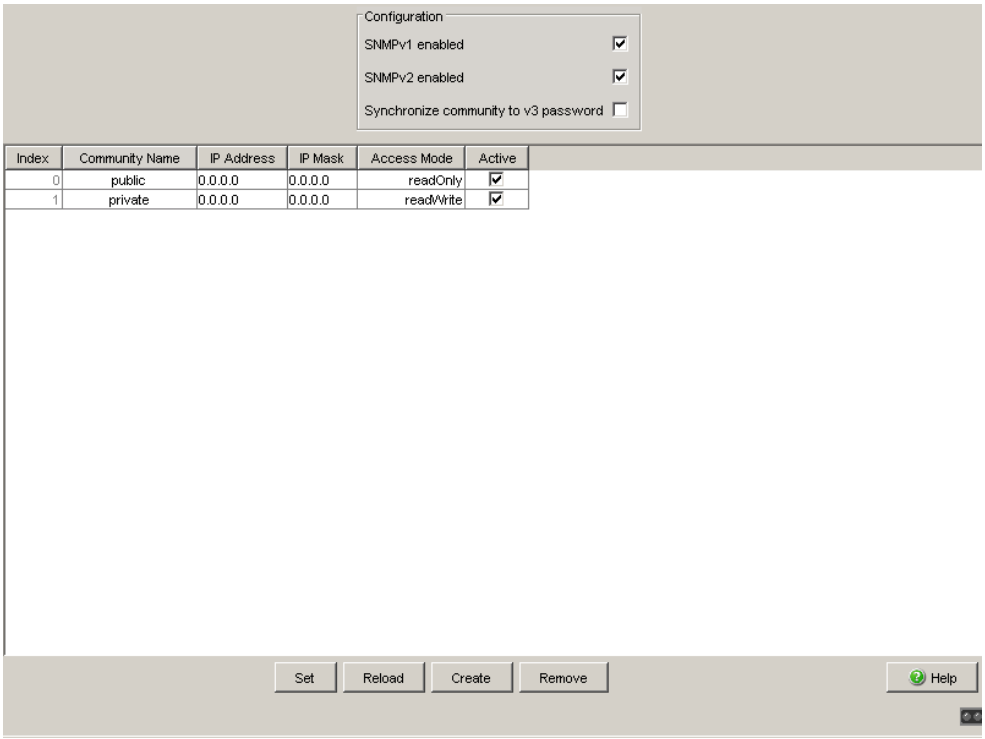


Figure 26: SNMPv1/v2 Access Dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 21: Buttons

2.3 Telnet/Web/SSH Access

This dialog allows you to switch on/off the Telnet server and the SSH server, and to switch off the Web server on the device.

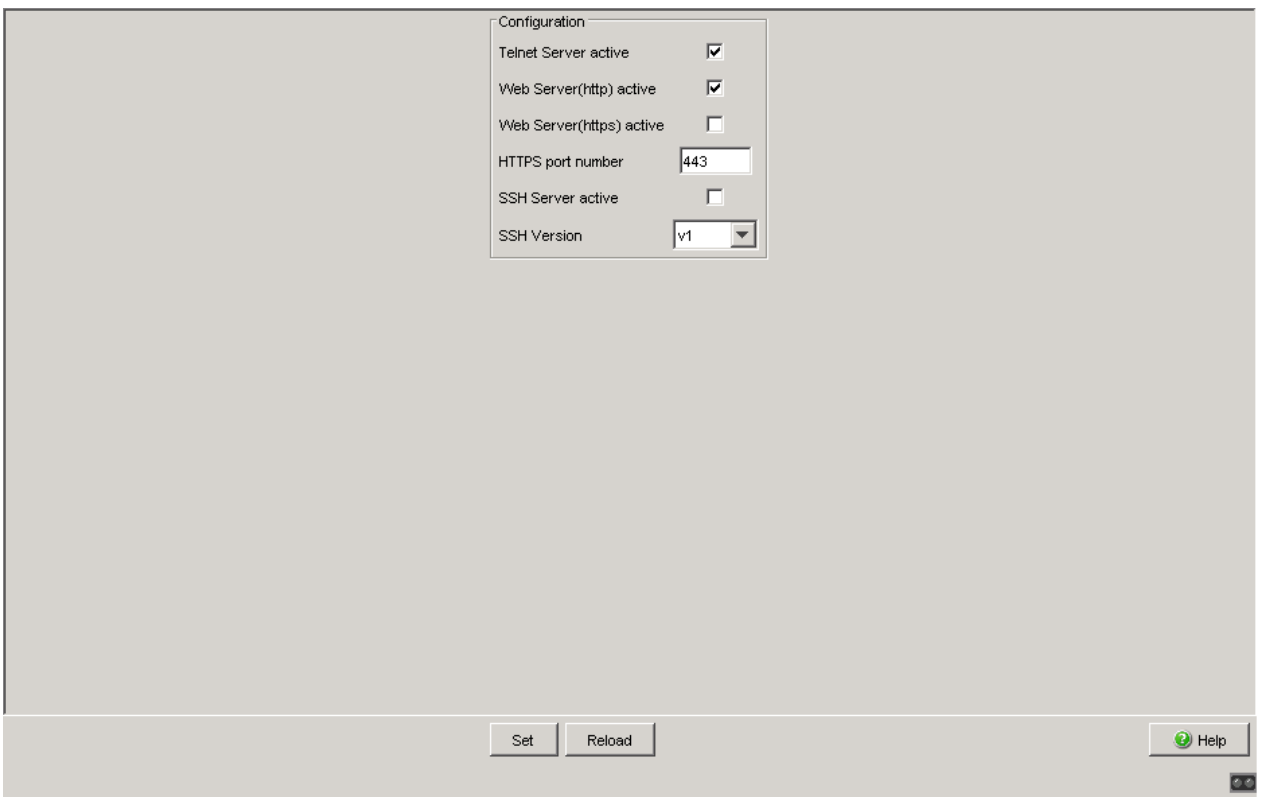


Figure 27: Telnet/Web/SSH Access dialog

Parameters	Meaning	Possible values	Default setting
Telnet server active	Activates or deactivates the Telnet service (Telnet access) for this device.	`On` `Off`	`On`
Web server (HTTP) active	Activates or deactivates the http service (Web server) for this device.	`On` `Off`	`On`
Web server (HTTPS) active	Activates or deactivates the https service (Web server) for this device.	`On` `Off`	`Off`

Table 22: Telnet/Web/SSH Access

Parameters	Meaning	Possible values	Default setting
HTTPS port number	Enter the port number of the https Web server for the https access to the device.	`1..65535`	`443`
SSH server active	Activates or deactivates the SSH service (SSH access) for the device.	`On` `Off`	`Off`

SSH version	Defines the SSH protocol version for the device.	`v1`
		`v2`
		`v1 & v2`
			`v1 & v2`

Table 22: Telnet/Web/SSH Access

2.3.1 Description of Telnet Access

The Telnet server of the device allows you to configure the device using the Command Line Interface (in-band). You can deactivate the Telnet server to inactivate Telnet access to the device.
The server is activated in its default setting.
After the Telnet server has been deactivated, you will no longer be able to access the device via a new Telnet connection. If a Telnet connection already exists, it is retained.

Note: The Command Line Interface (out-of-band) and the `Security:Telnet/Web/SSH Access` dialog in the graphical user interface allows you to reactivate the Telnet server.

2.3.2 Description of Web Access (http)

The device's Web server allows you to configure the device by using the graphical user interface. You can deactivate the Web server to prevent Web access to the device.
The server is activated in its default setting.

After you switch the http Web server off, it is no longer possible to log in via a http Web browser. The http session in the open browser window remains active.

Note: The Command Line Interface allows you to reactivate the Web server.

2.3.3 Description of Web Access (https)

The Web server of the device allows you to configure the device by using the graphical user interface via https (Hypertext Transfer Protocol Secure). In order to use the RADIUS server for authentication, activate the HTTPS function.
If you activate HTTPS and HTTP, the device redirects you to a HTTPS connection. Furthermore, if you change the HTTPS Port during an active HTTPS session, in order for the device to use the new port, deactivate and reactivate HTTPS.
You can open up to 16 http/https connections at the same time.

☐ To enable the https access to the device,
  ☐ set the checkmark in the field `Web server (https) active`.
  ☐ In the field HTTPS Port Number, enter the port number of the https Web server.
☐ To prevent https access to the device, remove the checkmark in the field `Web server (https) active`.

The HTTPS access to the Web server of the device is deactive in the default setting, and the port number of the https Web server is 443.

By deactivating the Web server you prevent a new login via a Web browser with https. The login in the open browser window remains active.

Note: The Command Line Interface allows you to reactivate the access to the Web server via https.

2.3.4 Description of SSH Access

The device's SSH server allows you to configure the device using the Command Line Interface (in-band). You can deactivate the SSH server to prevent SSH access to the device.
The server is deactivated in its default setting.
After the SSH server has been deactivated, you will no longer be able to access the device via a new SSH connection. If an SSH connection already exists, it is retained.

Note: The Command Line Interface (out-of-band) and the `Security:Telnet/Web/SSH Access` dialog in the graphical user interface allows you to reactivate the SSH server.

Note: To be able to access the device via SSH, you require a key. If no key is present, the device generates a random key (see the "Basic Configuration User Manual”).

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 23: Buttons

2.4 Restricted Management Access

This dialog allows you to differentiate (restrict) the management access to the device based on IP address ranges and individual management services.

When you activate this function, you can only use the specified IP address ranges to access the management services activated for these address ranges. The device rejects all other requests. You can make up to 16 entries in the list, permit or forbid specific management access for each address range, and activate or deactivate the individual entries separately.

The following management services support restricted management access:
- http
- https
- snmp
- telnet
- ssh

Note: The CLI access via the V.24 interface is excluded from the function and cannot be restricted.

Note: You require the http or https service to start the graphical user interface in a browser.
Afterwards, you require the snmp service to access the device with the graphical user interface. When you start the graphical user interface outside the browser, you only require snmp.

In the default setting, the restricted management access is deactivated. In this case, anyone with the correct administrator logon data has access to all management services.

If you have activated the function, and if there is at least one active entry whose IP address range matches the request and for which the requested management service is allowed, the device processes the request. Otherwise the device rejects it.

In the default setting, the device provides you with a default entry with the IP address 0.0.0.0, the netmask 0.0.0.0 and all the management services. This allows access to services from any IP address. This allows you access to the device, even if a restriction is activated, for example to initially configure the function. You have the option to change or delete this entry.
When you create a new entry, this entry also has these preset properties.

Note: If you activate the function and no entry in the table permits your current access, then you can no longer access the management of the device once you write these settings to the device.
If no entry allows access, nobody has access to the device management. In this case, use the CLI access via V.24 to access the management of the device.

Parameters	Meaning	Possible values	Default setting
Operation	Switches the function on and off for the device.	`On` `Off`	`Off`
Index	Sequential number of the entry. When you delete an entry, this leaves a gap in the numbering. When you create a new entry with the Web-based interface, the device fills the first gap.	1 - 16	1 (the preset entry).
IP Address	Together with the netmask, defines the network area for which this entry applies.	Valid IPv4 address or 0.0.0.0	0.0.0.0 (for all newly created entries)
Netmask	Together with the IP address, defines the network area for which this entry applies.	Valid IPv4 netmask or 0.0.0.0	0.0.0.0 (for all newly created entries)
HTTP	Activates or deactivates the http service (Web server) for this entry.	`On` `Off`	`On` (for all newly created entries)
HTTPS	Activates or deactivates the https service (Web server) for this entry.	`On` `Off`	`On` (for all newly created entries)

Table 24: Restricted management access

Parameters	Meaning	Possible values	Default setting
SNMP	Activates or deactivates the SNMP service (SNMP access) for this entry.	`On` `Off`	`On` (for all newly created entries)
Telnet	Activates or deactivates the Telnet service (Telnet access) for this entry.	`On` `Off`	`On` (for all newly created entries)
SSH	Activates or deactivates the SSH service (SSH access) for this entry.	`On` `Off`	`On` (for all newly created entries)
Active	Activates or deactivates the entire entry.	`On` `Off`	`On` (for all newly created entries)

Table 24: Restricted management access

Note: An entry with an IP address of 0.0.0.0 together with a netmask of 0.0.0.0 applies for all IP addresses.

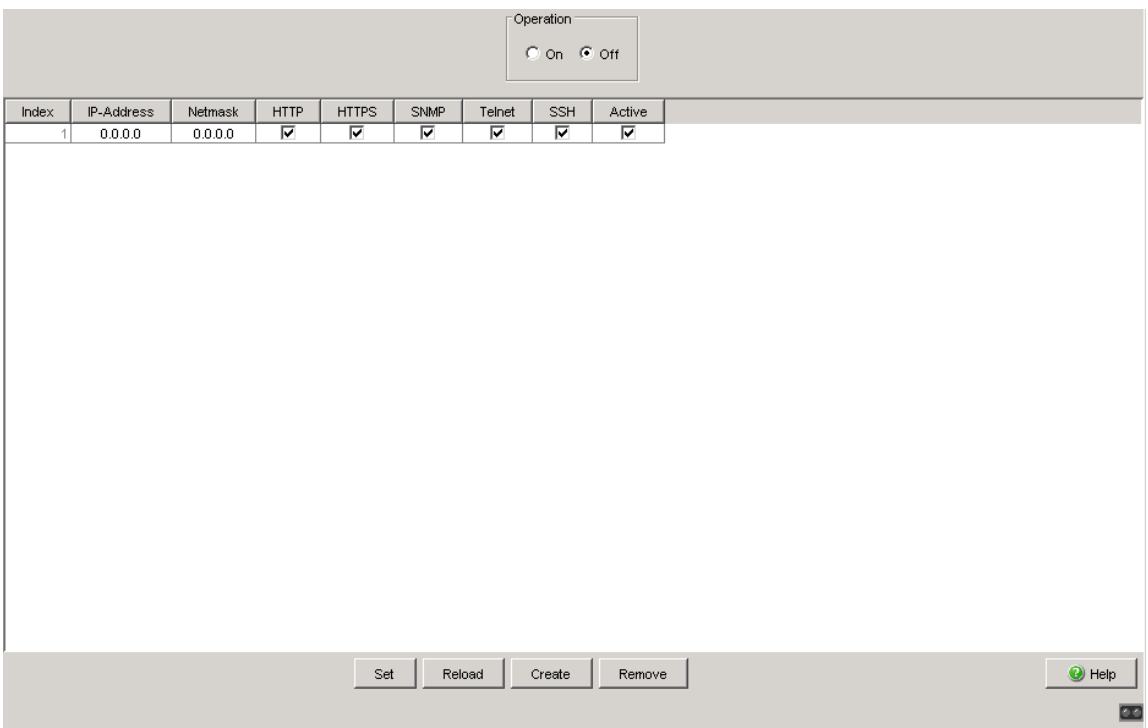


Figure 28: Restricted Management Access dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 25: Buttons

2.5 Port Security

The device allows you to configure each port to help prevent unauthorized access. Depending on your selection, the device checks the MAC address or the IP address of the connected device.

If the device receives data packets at a port from an undesired sender, it performs the action defined for the port, e.g. send trap, disable port or auto-disable.

In the “Configuration” frame, you set whether the port security works with MAC or with IP addresses.

Name	Meaning
MAC-Based Port Security	Check source MAC address of the received data packet.
IP-Based Port Security	IP-Based Port Security internally relies on MAC-Based Port Security. Principle of operation: When you configure the function, the device translates the entered source IP address into the respective MAC address. In operation, it checks the source MAC address of the received data packet against the internally stored MAC address.

Table 26: Configuration of port security globally for all ports

Set the individual parameters for each port in the port table.

With MAC-based port security, the device allows you either to define the permitted MAC addresses specifically or record the MAC addresses automatically.

With automatic recording, the device “learns” the MAC addresses of the sender by evaluating the received data packets. When the user-defined upper limit has been reached, the device performs the specified action.

Compared with the specific definition of MAC addresses, the automatic recording gives you the advantage of being able to replace the connected terminal devices at any time without having to modify the MAC address list in the device.

Name	Meaning
Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two.
Port Status	`enabled`: Port is switched on and transmitting. `disabled`: Port is switched off and not transmitting. The port is switched on if - an authorized address accesses the port or - an unauthorized address attempts to access the port and `trapOnly` or `none` is selected under “Action”. The port is switched off if - an unauthorized address attempts to access the port and `portDisable` is selected under “Action”.
Allowed MAC Addresses	MAC addresses of the devices with which you allow data exchange on this port. The graphical user interface allows you to enter up to 50 MAC addresses, each separated by a space. After each MAC address you can enter a slash followed by a number identifying an address area. This number, between 2 and 47, indicates the number of relevant bits. Example: 00:80:63:01:02:00/40 stands for 00:80:63:01:02:00 to 00:80:63:01:02:FF or 00:80:63:00:00:00/24 stands for 00:80:63:00:00:00 to 00:80:63:FF:FF:FF If there is no entry, any number of devices can communicate via this port.
Current MAC Address	Shows the MAC address of the device from which the port last received data. The graphical user interface allows you to copy an entry from the “Current MAC Address” column into the “Allowed MAC Addresses” column by dragging and dropping with the mouse button.
Allowed IP Addresses	IP addresses of the devices with which you allow data exchange on this port. The graphical user interface allows you to enter up to 10 IP addresses, each separated by a space. If there is no entry, any number of devices can communicate via this port.
Dynamic Limit	Specifies the upper limit for the number of automatically recorded senders. When the upper limit is reached, the device performs the action defined in the "Action" column. Possible values: ▶ `0` or – (default setting: –) Deactivates the automatic recording of the senders on this port. ▶ `1..50` Upper limit for the automatic recording of senders. Adjust the value to the number of expected senders. In this way you make MAC flooding attacks more difficult.

Table 27: Configuration of port security for a single port

Name	Meaning
Dynamic Count	Shows how many senders the device has automatically recorded.
Action	Action performed by the device after an unauthorized access. Possible values: ▶ `none` (default setting) No action. ▶ `trapOnly` Send alarm. ▶ `portDisable` Disables the port. Then the port LED on the device blinks green 3 times per period. The device re-enables the port when you have defined the following settings in the `Diagnostics:Ports:Auto Disable` dialog: – In the "Configuration" frame, the checkbox for the "Port Security" triggering event is marked. – The reset timer is defined >0 for the port. ▶ `autoDisable` Disables the port depending on the settings in the `Diagnostics:Ports:Auto Disable` dialog, "Configuration" frame. – The device disables the port when the checkbox for the "Port Security" triggering event is marked. Then the port LED on the device blinks green 3 times per period. The device re-enables the port when the reset timer is defined >0 for the port in the `Diagnostics:Ports:Auto Disable` dialog for the port. – The port remains enabled when the checkbox for the "Port Security" triggering event is unmarked. **Note:** Prerequisites for the device to be able to send an alarm (trap): – You have entered at least one recipient – You have selected at least one recipient in the "Active" column – In the "Selection" frame, you have selected "Port Security"

Table 27: Configuration of port security for a single port

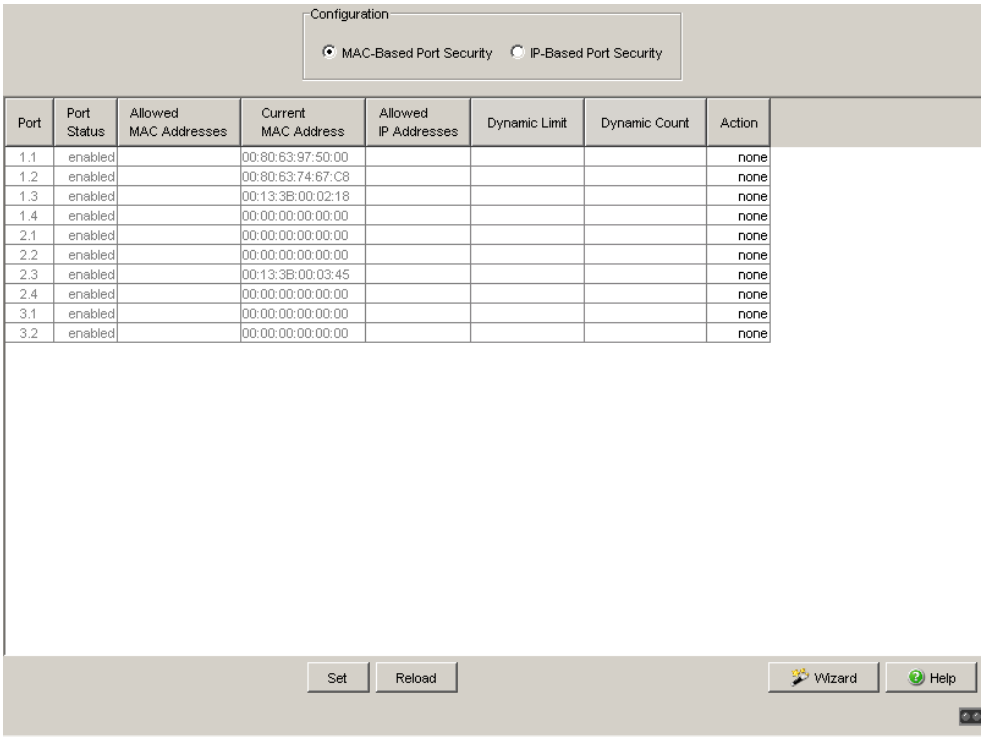


Figure 29: Port Security dialog

Note: The IP port security operates internally on layer 2. The device internally translates an allowed IP address into an allowed MAC address when you enter the IP address. An ARP request is used for this.

Prerequisites for the IP-based port security:
– The device with the allowed IP address supports ARP,
– The device is accessible during the configuration of IP port security,
– The MAC address to which the IP address is assigned is unique and remains unchanged after the IP address is entered.

If you have entered a router interface as the allowed IP address, all the packets sent from this interface are considered allowed, since they contain the same MAC source address.

If a connected device sends packets with the allowed IP address but a different MAC address, the Switch denies this data traffic. If you replace the device with the allowed IP address with a different one having the same IP address, enter the IP address in the Switch again so that the Switch can learn the new MAC address.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Wizard	Opens the "Wizard". With the "Wizard" you assign the permitted MAC addresses to a port.
Help	Opens the online help.

Table 28: Buttons

Wizard – Select Port

The "Wizard" helps you to connect the device ports with one or more desired senders.

Parameters	Meaning
Select Port	Defines the device port that you assign to the sender in the next step.

Table 29: Wizard in the Security:Port Security dialog, "Select Port" page

Wizard – Addresses

The "Wizard" helps you to connect the device ports with one or more desired senders. When you have defined the settings, click "Finish". To save the changes afterwards, click `Set` in the "Security:Port Security" dialog.

Parameters	Meaning
Allowed MAC Addresses	Lists the MAC Addresses allowed access to the port. Possible values: ▶ `Valid Unicast MAC addresses` Click "Add" to transfer the MAC address to the "Allowed MAC Addresses" field.
MAC Address	Defines the MAC address allowed access to the port. Possible values: ▶ Valid Unicast MAC address Enter the value in one of the following formats: – without a separator, e.g. `001122334455` – separated by spaces, e.g. `00 11 22 33 44 55` – separated by colons, e.g. `00:11:22:33:44:55` – separated by hyphens, e.g. `00-11-22-33-44-55` – separated by points, e.g. `00.11.22.33.44.55` – separated by points after every 4th character, e.g. `0011.2233.4455` Click "Add" to transfer the MAC address to the "Allowed MAC Addresses" field.
Mask	Defines number of significant digits in the MAC address range. Possible values: ▶ 1..48 Used this field to indicate the significant digits as with CIDR notation. For example, 00:11:22:33:44:00/40 indicates that the port allows devices with a MAC Address matching the first 5 groups of hexadecimal digits to access the network.
Add	Transfers the values specified in the "MAC Address" fields to the "Allowed MAC Addresses" field.
Remove	Removes the entries selected in the "Allowed MAC Addresses" field.

Table 30: Wizard in the `Security:Port Security` dialog, "Addresses" page

Wizard – Action

This dialog defines the actions that the device performs in the event of unauthorized access to the port.

Name	Meaning
Action	Action performed by the device after an unauthorized access. Possible values: ▶ `none` (default setting) No action. ▶ `trapOnly` Send alarm. ▶ `portDisable` Disables the port. Then the port LED on the device blinks green 3 times per period. The device re-enables the port when you have defined the following settings in the `Diagnostics:Ports:Auto Disable` dialog: – In the "Configuration" frame, the checkbox for the "Port Security" triggering event is marked. – The reset timer is defined >0 for the port. ▶ `autoDisable` Disables the port depending on the settings in the `Diagnostics:Ports:Auto Disable` dialog, "Configuration" frame. – The device disables the port when the checkbox for the "Port Security" triggering event is marked. Then the port LED on the device blinks green 3 times per period. The device re-enables the port when the reset timer is defined >0 for the port in the `Diagnostics:Ports:Auto Disable` dialog for the port. – The port remains enabled when the checkbox for the "Port Security" triggering event is unmarked. **Note:** Prerequisites for the device to be able to send an alarm (trap): – You have entered at least one recipient, – You have selected at least one recipient in the "Active" column – In the "Selection" frame, you have selected "Port Security".

Table 31: Wizard in the `Security:Port Security` dialog, "Action" page

After closing the Wizard, click "Set" to save your settings.

Buttons

Button	Meaning
Back	Displays the previous page again. Changes are lost.
Next	Saves the changes and opens the next page.
Finish	Saves the changes and completes the configuration.
Cancel	Closes the Wizard. Changes are lost.

Table 32: Buttons

2.6 802.1X Port Authentication

The 802.1X Port Authentication provides you with the following dialogs:
- “802.1X Global Configuration”
- “802.1X Port Configuration”
- “802.1X Port Clients”
- “802.1X Port Statistics”

The port-based network access control is a method described in norm IEEE 802.1X to protect IEEE 802 networks from unauthorized access. The protocol controls the access on a port by authenticating and authorizing a terminal device that is connected to this port of the device.
The 802.1X Port Authentication function requires that you configure a RADIUS Server for authentication and authorization. The authentication and authorization are carried out by the authenticator, in this case the device. The device authenticates the supplicant (the querying device, e.g. a PC), which means that it permits the access to the services it provides (e.g. access to the network to which the device is connected), or else refuses it. In the process, the device accesses an external authentication server (RADIUS server), which checks the authentication data of the supplicant. The device exchanges the authentication data with the supplicant via the Extensible Authentication Protocol over LANs (EAPOL), and with the RADIUS server via the RADIUS protocol.

2.6.1 802.1X Global Configuration

The Global dialog allows you to:
- activate or deactivate the port authentication,
- control the VLAN assignment via RADIUS.

Parameters	Meaning	Possible values	Default setting
Operation	Switches the function on or off	`On`, `Off`	`Off`
Activating the VLAN assignment	Activates or deactivates the assigning of a VLAN ID via the RADIUS server to a port. If a device places a query to a port via 802.1X, the RADIUS server will optionally send along a VLAN ID when a positive response is returned. If you have activated the function, the Switch then incorporates the port as an untagged member in the VLAN specified and sets the port VLAN ID to this value. Note the following information about VLAN assignment.	`On`, `Off`	`Off`

Table 33: 802.1X Port Security Dialog, Part 1

Note: The Switch can assign untagged frames to a VLAN per port.
If you:
- use the multi-client setting for a port and
- the Switch has already set up a port VLAN for the existing client,

then the Switch will only accept an additional client after that:
- if the RADIUS server assigns the same VLAN ID to it.

If the VLAN ID is different for the new client, the Switch decides on the basis of the client's authentication priority which client it gives access to:
A client that authenticates itself via 802.1X has a higher priority than a client with access to the guest or unauthenticated VLAN.
- If a client authenticates with a lower priority, the Switch denies access to the client with the lower priority and continues to give access to the client with the higher priority.
- If a client authenticates with a higher priority, the Switch blocks the hitherto existing access to the client with the lower priority and instead gives access to the client with the higher priority.

Parameters	Meaning	Possible values	Default setting
Activate Dynamic VLAN Creation	Assigns the Switch to create the VLAN designated by the RADIUS server, provided it does not yet exist.	`On` `Off`	`Off`
Activate Safe VLAN mode	**For the device families other than MACH 104 and MACH 1040:** Sets whether the Switch only gives access to a safe VLAN to a client that sends untagged frames or whether it may assign to the client a different one than the VLAN specified by the RADIUS server. ▶ `On`: The Switch only gives the client access to the VLAN whose ID the RADIUS server specifies. If the Switch finds a conflict between the existing port VLAN ID and the one specified by the RADIUS server, then the Switch sets the port VLAN ID that the client with the higher authentication priority requires (see above). The Switch denies access to the client with the lower priority. ▶ `Off`: If the Switch finds a conflict between the existing port VLAN ID and the one specified by the RADIUS server, the Switch ignores the VLAN ID specified by the RADIUS server and gives the client access to the VLAN of the port VLAN ID (native VLAN ID).	`On` `Off`	`Off`

Table 34: 802.1X Port Security Dialog, Part 2

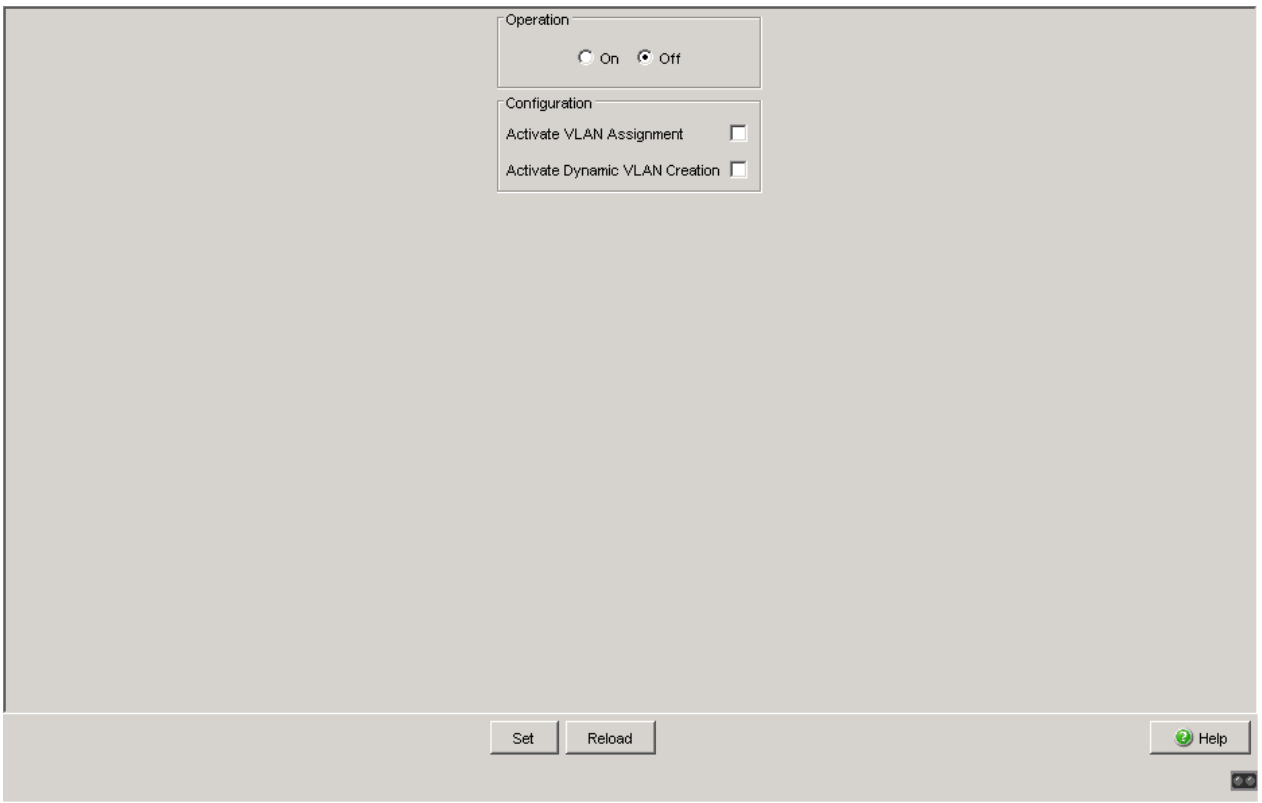


Figure 30: 802.1X Global Dialog for the MACH 104 and MACH 1040 device families

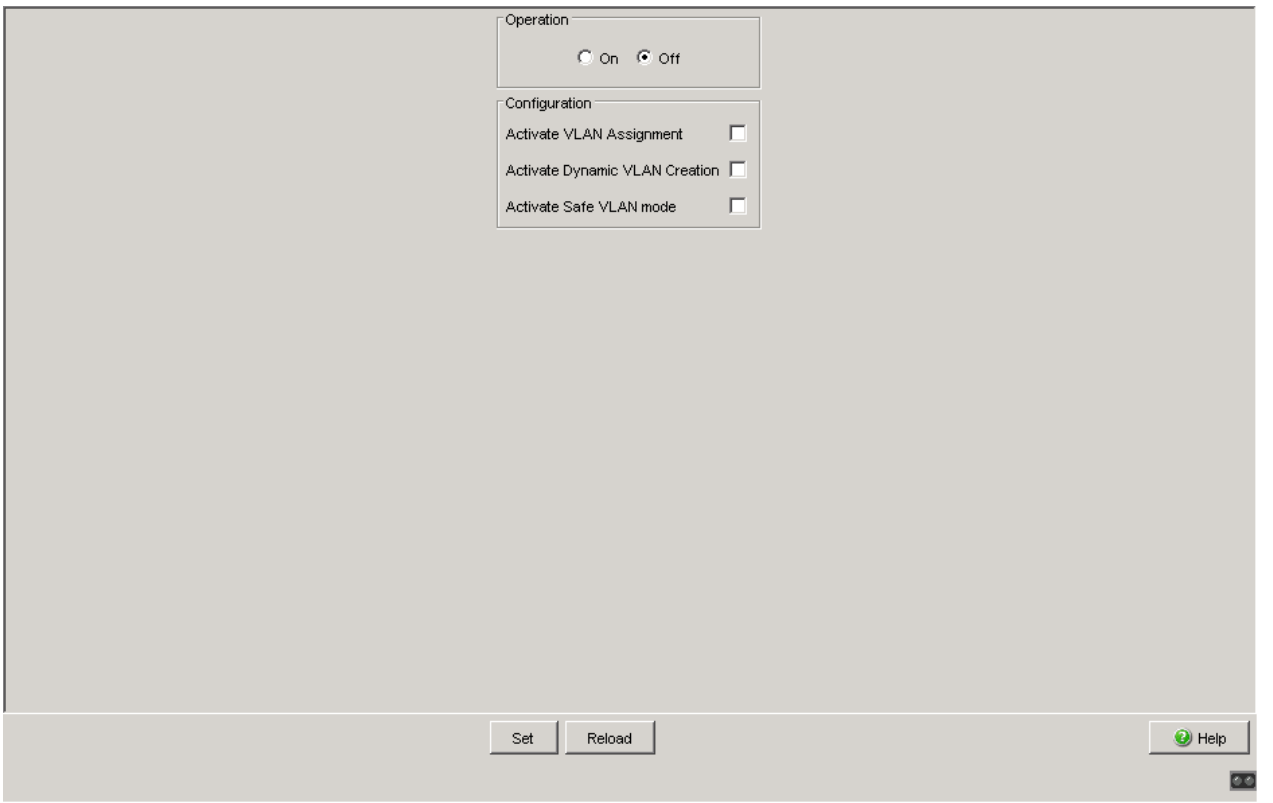


Figure 31: 802.1X Global Dialog

Preparing the device for the 802.1X port authentication:

☐ Configure the device's IP parameters.
☐ Activate the 802.1X port authentication function globally.
☐ Set the 802.1X "Port Control" to `auto`. The default setting is `forceAuthorized`.
☐ Configure a RADIUS server for authorization and authentication.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 35: Buttons

2.6.2 802.1X Port Configuration

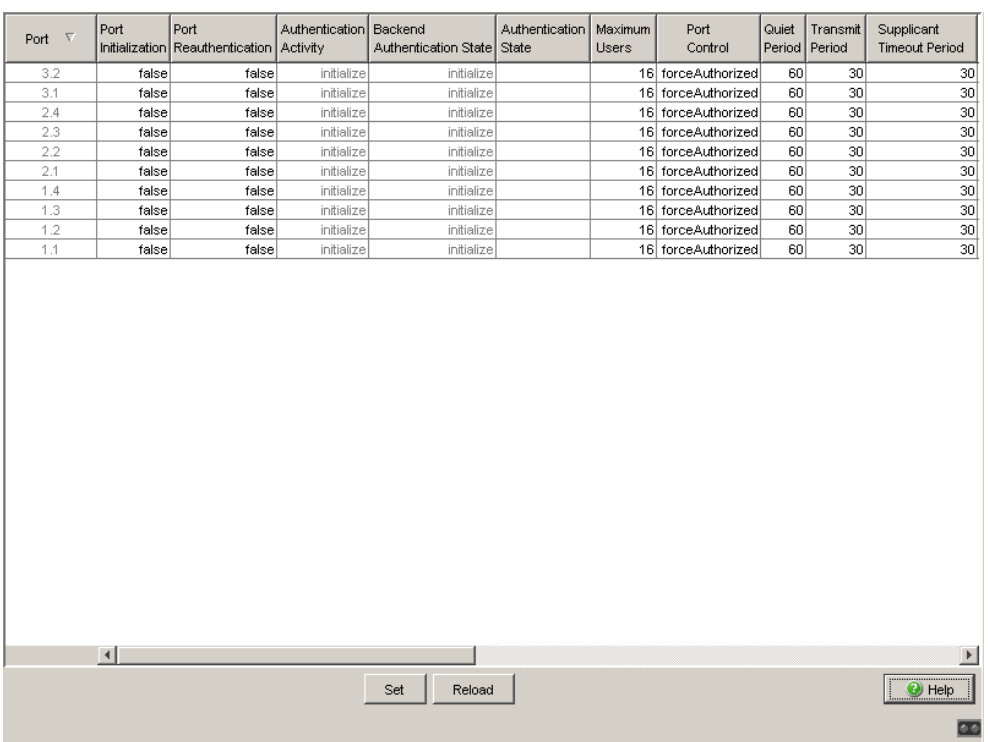


Figure 32: 802.1X Port Configuration Table

Parameters	Meaning	Possible values	Default setting
Port Initialization	Reset the initialization function. Setting this attribute to “true” causes the device to reset the function for this port. When the resetting process is concluded, the value is reset to “false”.	`true, false`	`false`
Port Reauthentication	Activating and deactivating the reauthentication of the port. Setting this attribute “true” causes the device to ask the supplicant to reauthenticate itself on this port. The device resets the value to “false” following a reauthentication.	`true, false`	`false`
Authentication Activity	Displays the current status of the authentication activity.	1 = initialized 2 = disconnected 3 = connecting 4 = authenticating 5 = authenticated 6 = aborting authenticating 7 = temporarily not authenticated (held) 8 = access without authentication (force authorized) 9 = no access (force unauthorized)	
Backend Authentication State	Displays the current status of the authentication server.	1 = request 2 = response 3 = success 4 = fail 5 = timeout 6 = idle 7 = initialize	
Authentication State	Displays the current value of the authentication status for the port.	`authorized` = the connected subscriber is authenticated `unauthorized` = the connected subscriber is not authenticated	
Maximum Users	Maximum number of clients that the device authenticates on a port at the same time. This parameter is effective if you have set the port control (see below) to `macBased`.	`1 - 16`	`16`

Table 36: 802.1X Setting Options per Port, entries in the configuration table

Parameters	Meaning	Possible values	Default setting
Port Control	Setting for the port access control. **Note:** ▶ In the `ForceAuthorized`, `ForceUnauthorized` and `auto` modes the Switch opens or blocks the port for all clients. Use these modes if you are connecting a single client to the Switch. ▶ In the `macBased` mode the Switch authenticates the clients based on the individual MAC addresses and allows or blocks their data traffic separately. Use this mode if you want to use multi-client authentication or the “MAC Authentication Bypass” function.	▶ ForceAuthorized: Access is also available for all clients without authentication. ▶ `ForceUnauthorized`: Access is blocked for all clients, even for clients with authentication. ▶ `auto`: Access to the port depends on the result of the authentication. ▶ `macBased`: Behavior like for auto. Access is also available for clients with a MAC address which the client uses in the course of authentication.	`ForceAuthorized`
Quiet Period	Period in seconds in which the authentication process does not expect authentication from the supplicants.	0-65535	60
Transmit Period	Wait period before the device resends an EAP packet.	1-65535	30
Supplicant Timeout Period	Excess time in seconds for the communication between the device and the supplicant.	1-65535	30
Server Timeout	Excess time in seconds for the communication between the device and the server.	1-65535	30
Max. Request Constant	Maximum number of request attempts to the supplicants before the authentication process terminates.	1-10	2

Table 36: 802.1X Setting Options per Port, entries in the configuration table

Parameters	Meaning	Possible values	Default setting
Assigned VLAN ID	VLAN that the Switch assigned to the port. The port is an untagged member in this VLAN and the port VLAN ID has the same value. Prerequisite: The port control is set to `auto`. **Note:** If you are using the multi-client setting by setting “Port Control” to `macBased`, take into account: ▶ the device-dependent resolution of possible VLAN assignment conflicts for untagged received frames; (see on page 94 “802.1X Global Configuration”) ▶ the VLANs assigned, you can find the current values in the “Port Clients” table . (see on page 106 “802.1X Port Clients”)	`0 - 4094`	0

Assignment Reason	Reason for assigning the VLANs to the port.
	
	Prerequisite: The port control is set to `auto`.
	
	Note: If you are using the multi-client setting by setting “Port Control” to `macBased`, take into account:
	▶ the device-dependent resolution of possible VLAN assignment conflicts for untagged received frames; (see on page 94 “802.1X Global Configuration”)
	▶ the VLANs assigned, you can find the current values in the “Port Clients” table . (see on page 106 “802.1X Port Clients”)
		`notAssigned`
		`radius`
		`unauthenticatedVLAN`
			`notAssigned`

Table 36: 802.1X Setting Options per Port, entries in the configuration table

Parameters	Meaning	Possible values	Default setting
Reauthentication Period	Time in seconds after which the device requests another authentication from the supplicant.	1-65535	3600
Reauthentication Enabled	Enabling or disabling reauthentication	Selected (on), Not selected (off)	Not selected (off)
Guest VLAN ID	ID of a VLAN that the Switch assigns to the port, if: ▶ the 802.1X protocol is active on the port and the port control is set to `auto` or `macBased`, ▶ a client wants to receive data traffic ▶ and EAPOL frames from the client fail to appear, i.e. the client does not support the 802.1X protocol. The Switch: ▶ switches the port to the authenticated state, ▶ allows data traffic, ▶ but only to the guest VLAN. Specify a guest VLAN ID if you want to allow devices without 802.1X support access to a guest VLAN. **Note:** ▶ Use only as a guest VLAN a VLAN that you have set up statically in the Switch. ▶ However, if a client connects via 802.1X and his authentication fails, then the Switch only gives him access to the unauthenticated VLAN. ▶ When you activate the MAC Authorized Bypass (MAB) function, the device automatically sets the guest VLAN ID to 0.	0 - 4094 With a VLAN ID of 0, the Switch blocks the data traffic because it denies a VLAN setup with this ID.	0
Guest VLAN Period	Time that the Switch waits for EAPOL frames after connecting a device on this port in order to determine whether it supports the 802.1X protocol. If this time elapses, the Switch only provides access to the guest VLAN for the device connected.	1 - 300 s	90 s

Table 36: 802.1X Setting Options per Port, entries in the configuration table

Parameters	Meaning	Possible values	Default setting
Unauthenticated VLAN ID	ID of a VLAN that the Switch assigns to the port, if: ▶ the 802.1X protocol is active on the port, ▶ the Switch receives EAPOL frames from the client, i.e. the client supports the 802.1X protocol, ▶ and the client's authentication fails. The Switch: ▶ switches the port to the authenticated state, ▶ allows data traffic, ▶ but only to the unauthenticated VLAN. Specify a VLAN ID for unauthenticated devices, if: ▶ you want to allow devices access to a particular VLAN, ▶ these devices do indeed support 802.1X, ▶ but their identity and authenticity are unknown to your network. **Note:** ▶ Use only as an unauthenticated VLAN a VLAN that you have set up statically in the Switch.	0 - 4094 With a VLAN ID of 0, the Switch blocks the data traffic because it denies a VLAN setup with this ID.	0

Table 36: 802.1X Setting Options per Port, entries in the configuration table

Parameters	Meaning	Possible values	Default setting
MAC Authorized Bypass Enable	The Switch makes authenticated access available via MAB, if: ▶ You have set the “Port Control” to `macBased`, ▶ a device wants to receive data traffic employing a particular known MAC address, ▶ this device does not authenticate itself via 802.1X and ▶ the RADIUS server recognizes the MAC addresses authorized to access. The Switch: ▶ waits for the guest VLAN interval to elapse in order to do this, ▶ then sends a query to the RADIUS server and in doing so uses the MAC address as the user name and the password. Activate this function, if: ▶ you want to allow particular devices normal access, ▶ however these devices do not support 802.1X. **Note:** ▶ If the RADIUS server denies the MAB authentication, the Switch blocks the access for the device. ▶ When you activate the function, the device automatically deactivates guest VLAN access.	`On` `Off`	`Off`

Table 36: 802.1X Setting Options per Port, entries in the configuration table

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 37: Buttons

2.6.3 802.1X Port Clients

The device enables you to operate several devices on one port (e. g. via a hub) and to authenticate these devices separately (multi-client authentication).
This means that the Switch allows data traffic for an authenticated device, but at the same time denies data traffic for still unauthenticated devices attempting both to send and to receive.
This applies equally to devices whose authentication has expired and whose renewal is outstanding.
A device can also log out of the authenticated state and is then blocked by the Switch for its data traffic without this affecting other authenticated devices' data traffic. In doing so the Switch differentiates the devices based on their MAC sender address.
You can authenticate up to 16 devices separately on one port.

The dialog shows you the authenticated devices' data per port.

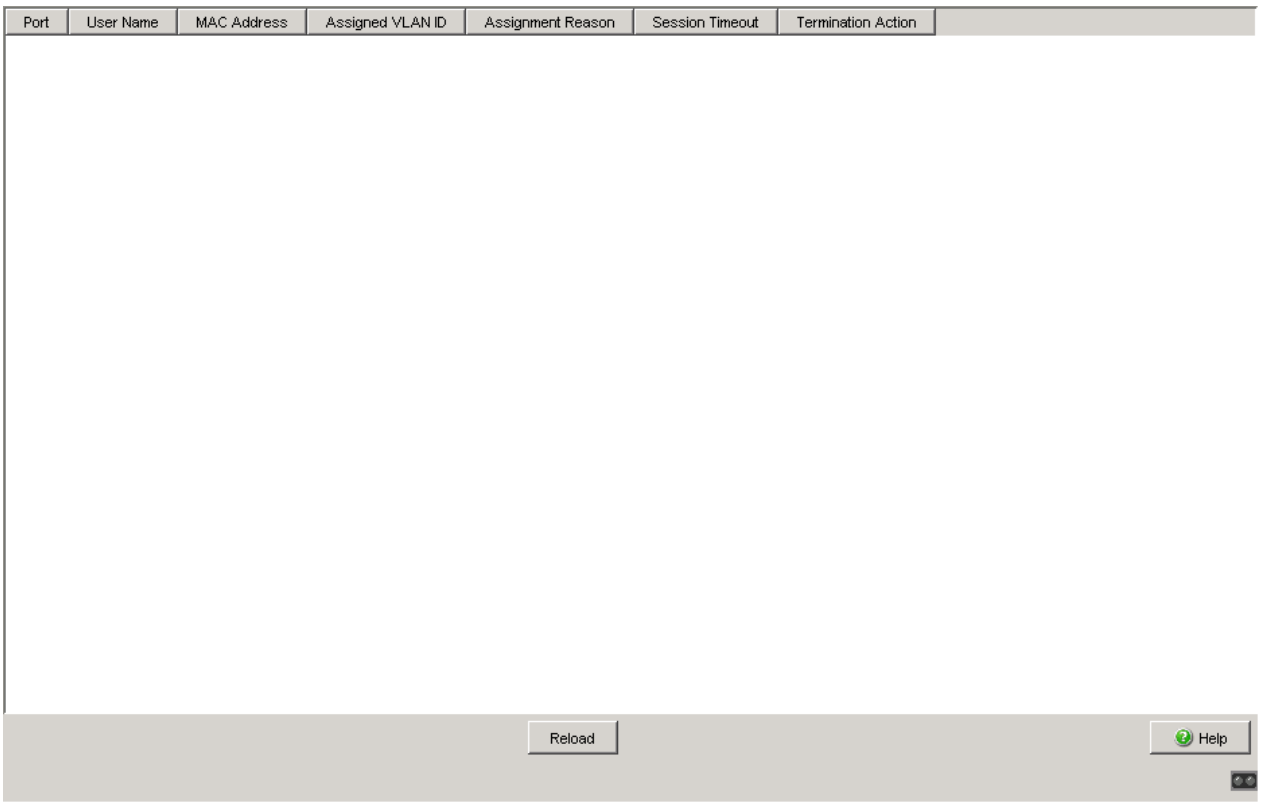


Figure 33: 802.1X Port Client Table

Parameters	Meaning	Possible values	Default setting
Port	Module and port numbers to which this entry applies	-	-
User Name	The name by which the client (in the role of the IEEE 802.1X supplicant) is identified vis-à-vis the Switch	The user name of the IEEE 802.1X supplicant	-
MAC Address	The client's MAC address	Unicast MAC Address	-

Table 38: 802.1X Setting Options per Port, entries in the port client table

Parameters	Meaning	Possible values	Default setting
Assigned VLAN ID	The VLAN ID that the 802.1X protocol assigned the port after the 1st client's successful authentication **Note:** If you are using the multi-client setting by setting “Port Control” to `macBased`, take into account: ▶ the device-dependent resolution of possible VLAN assignment conflicts for untagged received frames; (see on page 94 “802.1X Global Configuration”) ▶ the VLANs assigned, you can find the current values in the “Port Clients” table . (see on page 106 “802.1X Port Clients”)	`0 - 4094`	-
Assignment Reason	Reason for assigning the VLANs to the client.	`default`, `radius`, `unauthenticatedVlan`, `invalid`	-
Session Timeout	Duration of the client's authenticated session after authentication or reauthentication in seconds	0 - 65535 s (0: no timeout)	-
Termination Action	Action that the Switch performs when the client's session elapses	`default`, `reauthenticate`	?

Table 38: 802.1X Setting Options per Port, entries in the port client table

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 39: Buttons

2.6.4 802.1X Port Statistics

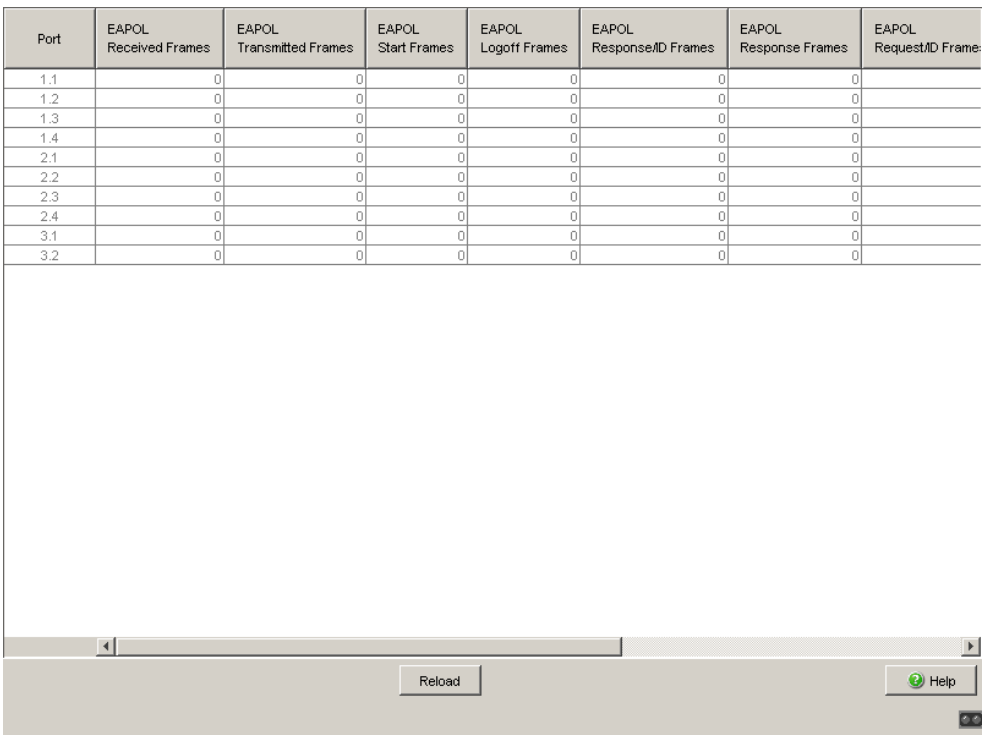


Figure 34: 802.1X Statistics Table

Parameters	Meaning
EAPOL Received Frames	Number of EAPOL frames (both valid and invalid) of any type that have been received at this port.
EAPOL Transmitted Frames	Number of EAPOL frames of any type that have been received at this port.
EAPOL Start Frames	Number of EAPOL start frames that have been received at this port.
EAPOL Logoff Frames	Number of EAPOL logoff frames that have been received at this port.
EAPOL Response/ID Frames	Number of EAPOL resp/ID frames that have been received at this port.
EAPOL Response Frames	Number of valid EAP response frames (other than resp/ID frames) that have been received at this port.
EAPOL Request/ID Frames	Number of EAPOL req/ID frames that have been transmitted at this port.
EAPOL Request Frames	Number of EAPOL Request frames (other than Request/ID frames) that have been transmitted at this port.

Table 40: 802.1X Statistics Table

Parameters	Meaning
EAPOL Invalid Frames	Number of EAPOL frames with a frame type that is not recognized that have been transmitted at this port.
EAPOL Error Frames	Number of EAPOL frames with an invalid packet body length field that have been transmitted at this port.
EAPOL Frame Version	The protocol version number carried in the last EAPOL frame received at this port.
EAPOL Frame Source	The MAC source address of the last received EAPOL frames 00:00:00:00:00:00 means: no frames received yet.

Table 40: 802.1X Statistics Table

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 41: Buttons

2.7 RADIUS

With its factory settings, the device authenticates users based on the local user management. However, as the size of a network increases, it becomes more difficult to keep the login data of the users consistent across the devices.

RADIUS (Remote Authentication Dial-In User Service) allows you to manage the users at a central location in the network. A RADIUS server performs the following tasks here:

- Authentication
  The authentication server authenticates the users when the RADIUS client at the access point forwards the users' login data to the server.
- Authorization
  The authentication server authorizes logged in users for selected services by assigning various parameters for the relevant end device to the RADIUS client at the access point.

The device forwards the users' login data to the primary authentication server. The authentication server decides whether the login data is valid and transfers the user's authorizations to the device.

The menu contains the following dialogs:

- Global
- RADIUS Server

2.7.1 Global

In this dialog you configure the device to send user requests to the RADIUS Server for service. If you configure multiple servers and requests sent to the primary server remain unanswered, then the device sends the requests to the next active RADIUS server.

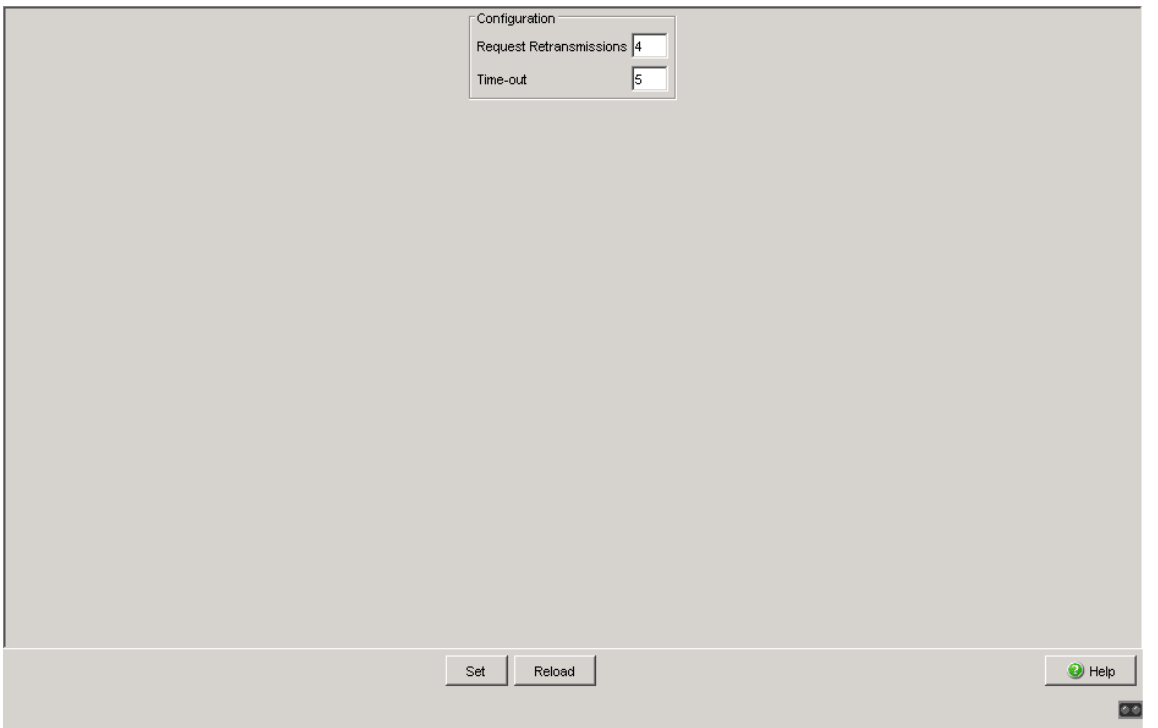


Figure 35: `Security:RADIUS:Global` dialog

Configuration

Parameters	Meaning	Possible values	Default setting
Request Retransmissions	Specify how often the Switch resubmits an unanswered request to the RADIUS server before it sends the request to another RADIUS server.	1 - 15	4
Time-out	Sets how long (in seconds) the Switch waits for a response from the RADIUS server before it resends the request.	1 - 30 s	5 s

Table 42: Security:RADIUS:RADIUS Global dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 43: Buttons

2.7.2 RADIUS Server

This dialog allows you to define up to 3 RADIUS servers. A RADIUS server authenticates and authorizes the users when the device forwards the login data to the server.

The device sends the login data to the specified primary server. If the server does not respond, the device contacts the next server in the table.

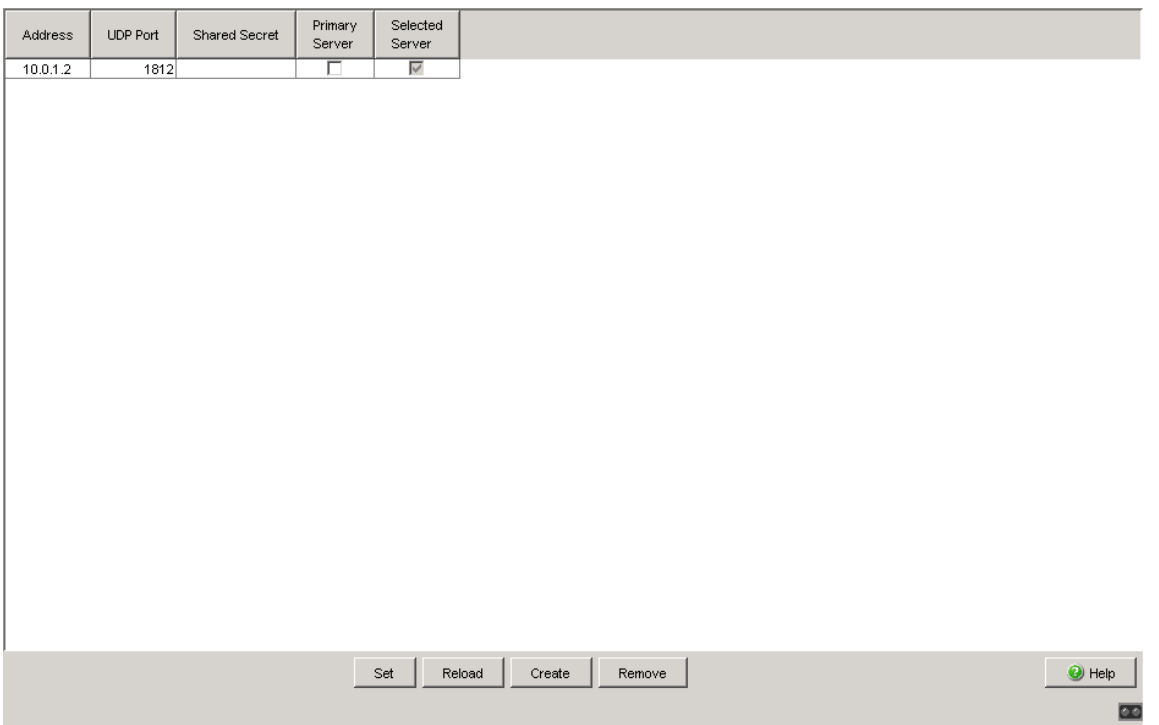


Figure 36: `Security:RADIUS:RADIUS Server` *dialog for the Power MICE*

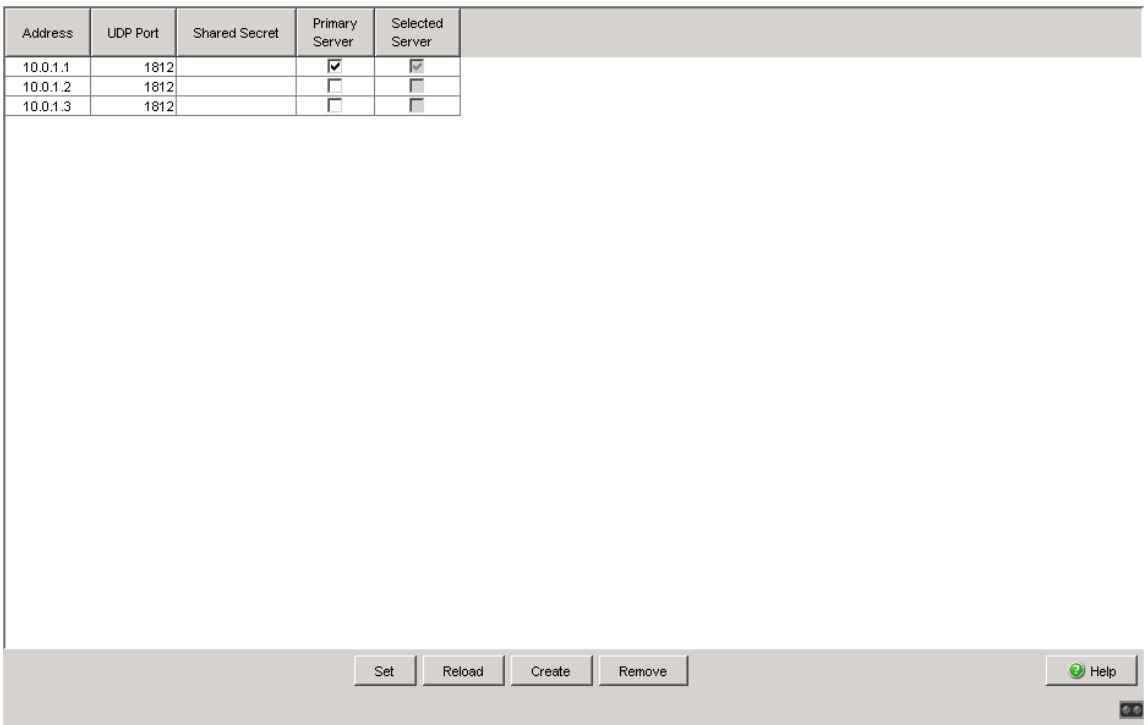


Figure 37: `Security:RADIUS:RADIUS Server` dialog for the MACH 1040 family

Table

Parameters	Meaning
Address	Specifies the IP address of the server. Possible values: ▶ Valid IPv4 address
UDP Port	Specifies the number of the UDP port on which the server receives requests. Possible values: ▶ `0..65535` (default setting: `1812`) Exception: Port `2222` is reserved for internal functions.
Shared Secret	Defines the password with which the device logs in to the server. To change the password for a server, double click in the relevant password field. After storing the password, the device displays ****** (asterisks). Possible values: ▶ 1..20 alphanumeric characters You get the password from the RADIUS server administrator.

Table 44: Table in the `Security:RADIUS:RADIUS Server` dialog

Parameters	Meaning
Primary Server	Specifies the authentication server as primary or secondary. Possible values: ▶ `Selected` The server is specified as the primary authentication server. The device sends the login data for authenticating the users to this authentication server. If you select multiple servers, the device specifies the last server selected as the primary authentication server. ▶ `Not selected` (default setting) The server is specified as the secondary authentication server. The device sends the login data to the secondary authentication server if it does not receive a response from the primary authentication server.
Selected Server	Shows the connection to an active server. Possible values: ▶ `Selected` The connection is active. The device sends the login data for authenticating the users to this server if the preconditions named above are fulfilled. ▶ `Not selected` The connection is inactive. The device does not send any login data to this server.

Table 44: Table in the `Security:RADIUS:RADIUS Server` dialog (cont.)

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 45: Buttons

RADIUS Server Settings

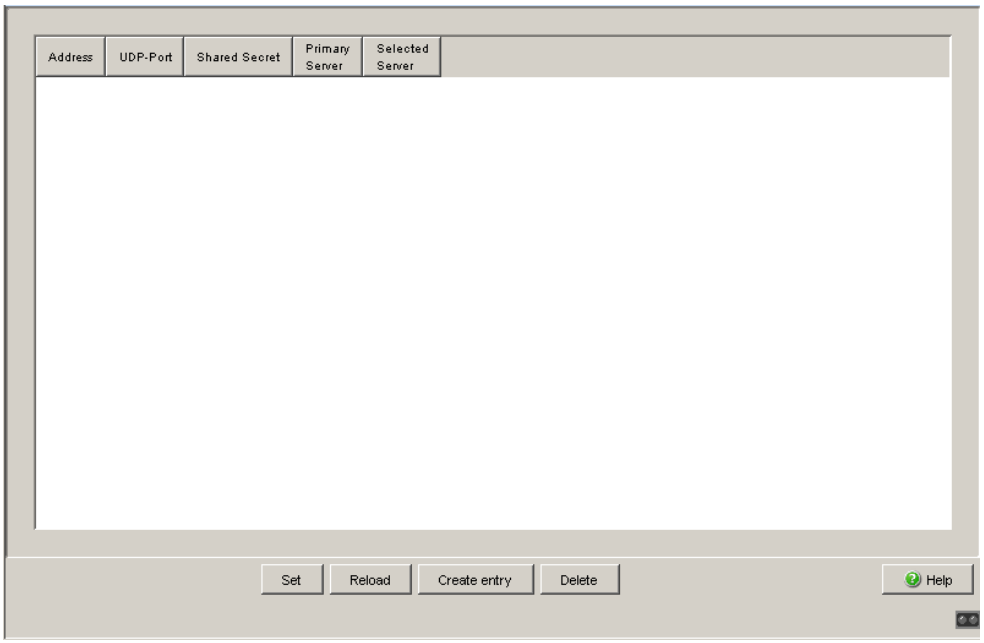


Figure 38: RADIUS Server Dialog

This dialog allows you to enter the data for up to three RADIUS servers.

☐ Click “Create” to display the dialog window for entering the IP address of a RADIUS server, and to enter this.

☐ Confirm the entered IP address with “OK”. This creates a new row in the table for this RADIUS server.

☐ In the “UDP Port” column you enter the UDP port for the RADIUS server (the default setting is 1812).

☐ In the “Shared secret” column you enter the character string which you get as a key from the administrator of your RADIUS server.

☐ With “Primary server” you name this server as the first server which the device should contact for port authentication queries. If this server is not available, the device contacts the next server in the table.

☐ “Selected server” shows the server to which the device actually sends its queries.

☐ With “Delete” you delete the selected row in the table.

Note: The Switch protects the password during the transfer to the RADIUS server by sending an MD5 checksum instead of the password.

2.8 Login/CLI Banner

This dialog allows you to display a greeting or information text to users before they login to the device.

The dialog contains the following tabs:

- Login Banner
- CLI Banner

2.8.1 Login Banner

This tab allows you to show the users a greeting or information text in the login dialog of the graphical user interface and in the command line interface before the users login.

Users logging in in the command line interface with SSH see the text - regardless of the client used - before or during the login.

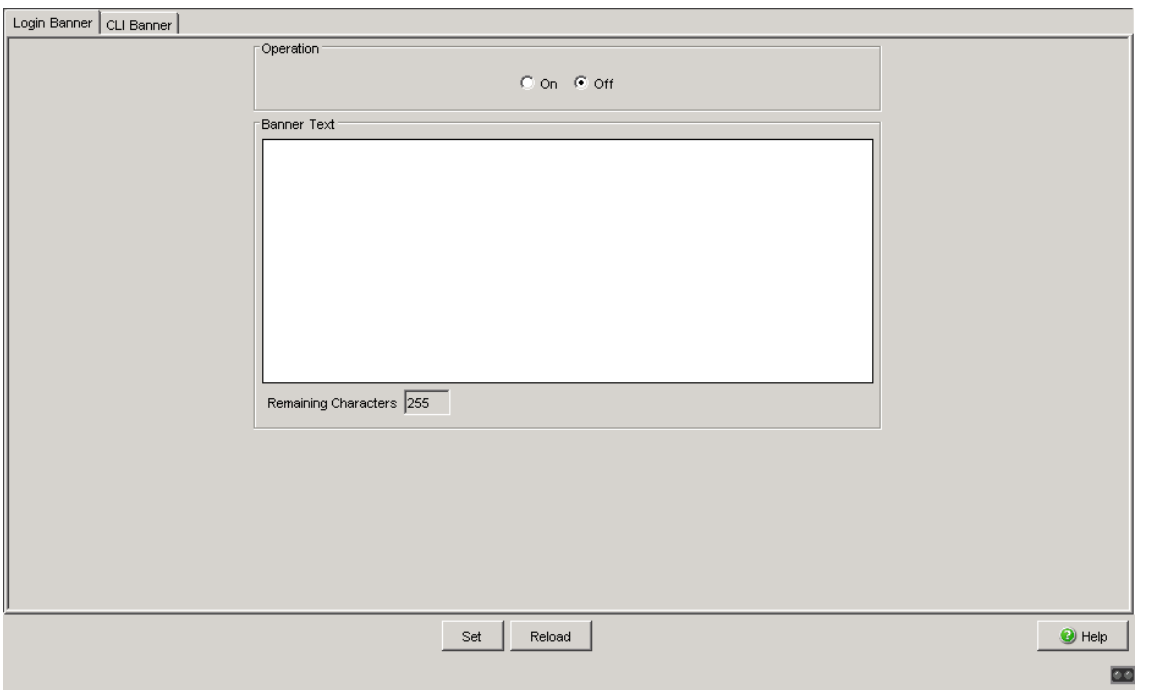


Figure 39: "Login/CLI Banner" dialog, "Login Banner" tab

Function

Parameter	Meaning
Operation	When this function is switched on, the device shows the text defined in the "Banner Text" field to the users that login in the login dialog of the graphical user interface or in the command line interface. Possible values: ▶ Off (default setting) ▶ On

Banner Text

Parameter	Meaning
Banner Text	Specifies the text that the device displays in the login dialog of the graphical user interface and in the command line interface. Possible values: ▶ Alphanumeric ASCII character string with 0..255 characters (`0x20..0x7E`) including spaces ▶ Tab `\t` ▶ Line break `\n`
Remaining Characters	Shows how many characters are still available in the "Banner Text" field. Possible values: ▶ `255..0`

2.8.2 CLI Banner

This tab page allows you to display an individual text only in the command line interface.

In the default setting, the CLI start screen shows information about the device, such as the software version and the device settings. With the function on this tab page, you deactivate this information and replace it with an individually definable text.

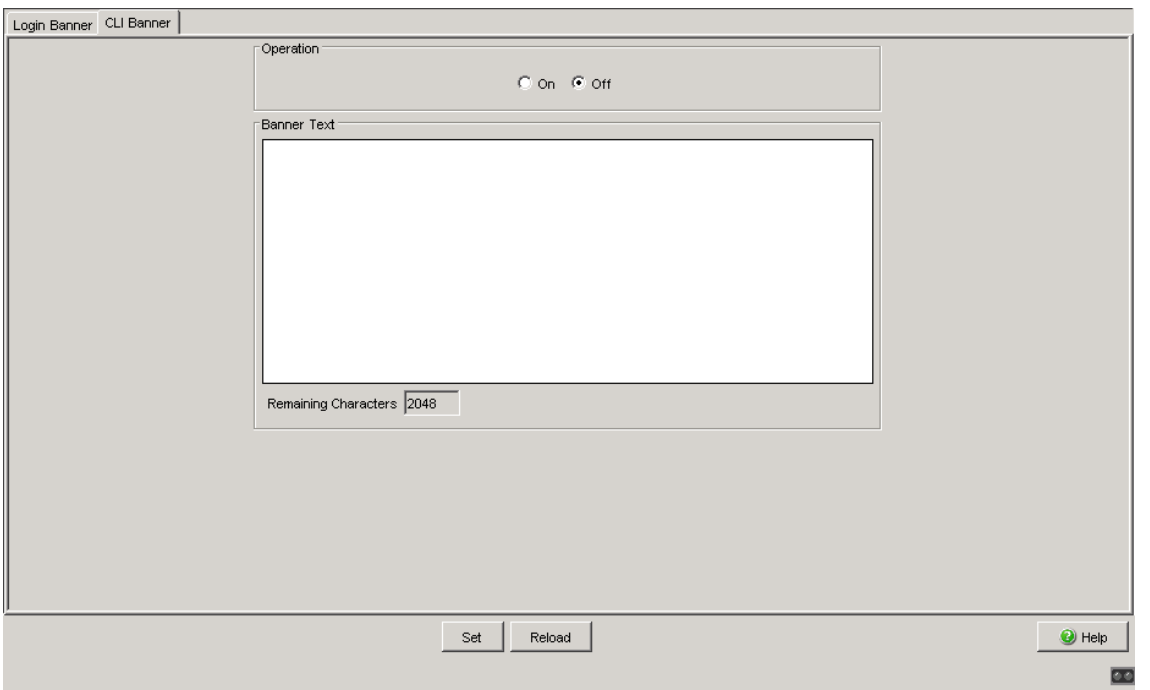


Figure 40: "Login/CLI Banner" dialog, "CLI Banner" tab

Function

Parameter	Meaning
Operation	When this function is switched on, the device shows the text information defined in the "Banner Text" field to the users that login to the device via the command line interface. When the function is switched off, the CLI start screen shows information about the device. The text information in the "Banner Text" field is retained. Possible values: ▶ Off (default setting) ▶ On

Banner Text

Parameter	Meaning
Banner Text	Defines the text information that the device displays to the users instead of the default information. Possible values: ▶ Alphanumeric ASCII character string with 0..2048 characters (`0x20..0x7E`) including spaces ▶ Tab `\t` ▶ Line break `\n`
Remaining Characters	Shows how many characters are still remaining in the "Banner Text" field for the text information. Possible values: ▶ `2048..0`

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 46: Buttons

2.9 Access Control Lists (ACLs)

Access Control Lists offer the possibility to select incoming data packets based on L2 and L3 criteria and to treat them accordingly, e.g., to drop or to prioritize them.
By means of ACLs, you can realize security- as well as Quality-of-Service-(QoS-) functions in a simple manner.
You can define the conditions that the device uses to select a particular packet type in a fine-grained manner with an ACL. This also applies to the actions that the device executes if the condition matches.

You configure Access Control Lists via the Command Line Interface.
You will find details on this in the document “Reference Manual Command Line Interface“.

3 Time

3.1 Basic Settings

With this dialog you can enter time-related settings independently of the time synchronization protocol selected.

- The “System Time (UTC)” displays the time with reference to Universal Time Coordinated.
  The time displayed is the same worldwide. Local time differences are not taken into account.

- The "System Time" uses "System Time (UTC)", allowing for the local time difference from "System Time (UTC)".
  "System Time" = "System Time (UTC)" + "Local Offset".

- "Time Source" displays the source of the following time data. The device automatically selects the source with the greatest accuracy.
  Possible sources are: `local`, `ptp` and `sntp`. The source is initially `local`.
  If PTP is activated and the device receives a valid PTP frame, it sets its time source to `ptp`. If SNTP is activated and if the device receives a valid SNTP packet, the device sets its time source to `sntp`. The device gives the PTP time source priority over SNTP.

☐ With "Set Time from PC", the device takes the PC time as the system time and calculates the "System Time (UTC)" using the local time difference.
"System Time (UTC)" = "System Time" - "Local Offset"

- The "Local Offset" is for displaying/entering the time difference between the local time and the "System Time (UTC)".

☐ With "Set Offset from PC", the device determines the time zone on your PC and uses it to calculate the local time difference.

The device is equipped with a buffered hardware clock. This keeps the current time
- if the power supply fails or
- if you disconnect the device from the power supply.

Thus the current time is available to you again, e.g. for log entries, when the device is started.
The hardware clock bridges a power supply downtime of 1 hour. The prerequisite is that the power supply of the device has been connected continually for at least 5 minutes beforehand.

Note: When setting the time in zones with summer and winter times, make an adjustment for the local offset, if applicable. The device can also get the SNTP server IP address and the local offset from a DHCP server.

Interaction of PTP and SNTP
According to PTP (IEEE 1588) and SNTP, both protocols can exist in parallel in the same network. However, since both protocols affect the system time of the device, situations may occur in which the two protocols compete with each other.
The PTP reference clock gets its time either via SNTP or from its own clock. All other clocks favor the PTP time as the source.

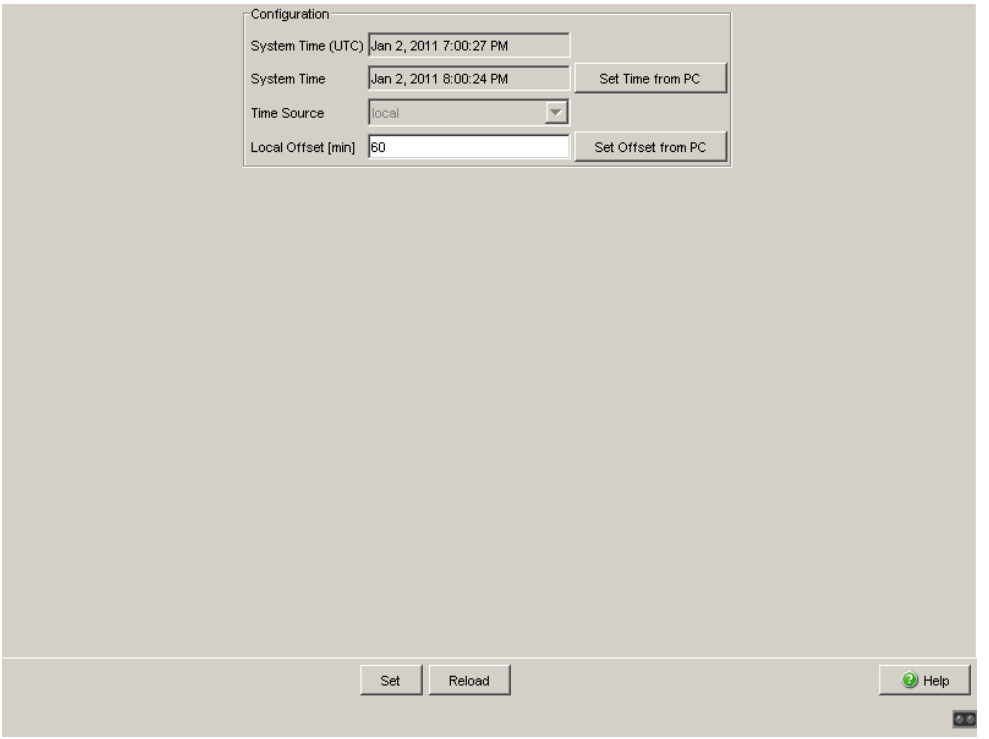


Figure 41: Time Dialog:Basic Settings

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 47: Buttons

3.2 SNTP configuration

The Simple Network Time Protocol (SNTP) enables you to synchronize the system time in your network.
The device supports the SNTP client and the SNTP server function.

The SNTP server makes the UTC (Universal Time Coordinated) available. UTC is the time relating to the coordinated world time measurement. The time displayed is the same worldwide. Local time differences are not taken into account.

SNTP uses the same packet format as NTP. In this way, an SNTP client can receive the time from an SNTP server as well as from an NTP server.

Note: For accurate system time distribution with cascaded SNTP servers and clients, use only network components (routers, switches, hubs) in the signal path between the SNTP server and the SNTP client which forward SNTP packets with a minimized delay.

Parameters	Meaning	Possible values	Default setting
Operation	Switches the SNTP function on and off globally.	`On, Off`	`Off`

Table 48: Switches SNTP on and off globally

Parameters	Meaning	Possible values	Default setting
SNTP Status	Displays conditions such as “Server cannot be reached”.	-	-

Table 49: SNTP Status

Parameters	Meaning	Possible values	Default setting
Client Status	Switches the SNTP client on and off.	`On, Off`	`On`
External Server Address	IP address of the SNTP server from which the device periodically requests the system time.	Valid IPv4 address	0.0.0.0
Redundant Server Address	IP address of the SNTP server from which the device periodically requests the system time if it does not receive a response to a request from the “External server address” within 0.5 seconds.	Valid IPv4 address	0.0.0.0
Server Request Interval	Time interval at which the device requests SNTP packets.	1 s - 3600 s	30 s
Accept SNTP Broadcasts	Specifies whether the device accepts the system time from SNTP Broadcast/Multicast packets that it receives.	`On, Off`	`On`
Threshold for obtaining the UTC [ms]	The device changes the time as soon as the deviation from the server time is above this threshold in milliseconds. This reduces the frequency of time changes.	0 - 2147483647 (2^{31}-1)	0
Disable Client after successful Synchronization	Enable/disable further time synchronizations once the client, after its activation, has synchronized its time with the server.	`On, Off`	`Off`

Table 50: Configuration SNTP Client

Note: If you have enabled PTP at the same time, the SNTP client first collects 60 time stamps before it deactivates itself. The device thus determines the drift compensation for its PTP clock. With the preset server request interval, this takes about half an hour.

Note: If you are receiving the system time from an external/redundant server address, switch off the reception of SNTP Broadcasts (see “Accept SNTP Broadcasts”). You thus ensure that the device only takes the time from a defined SNTP server.

Parameters	Meaning	Possible values	Default setting
Server Status	Switches the SNTP server on and off.	`On, Off`	`On`
Anycast Destination Address	IP address, to which the SNTP server of the device sends the SNTP packets (see table 52).	Valid IPv4 address	0.0.0.0
VLAN ID	VLANs to which the device periodically sends SNTP packets.	1-4042	1
Anycast Send Interval	Time interval at which the device sends SNTP packets.	1 - 3600	120
Disable Server at local Time Source	Enables/disables the SNTP server function if the status of the time source is `local` (see Time dialog).	`On, Off`	`Off`

Table 51: Configuration SNTP-Server

IP destination address	Send SNTP packet to
0.0.0.0	Nobody
Unicast address (0.0.0.1 - 223.255.255.254)	Unicast address
Multicast address (224.0.0.0 - 239.255.255.254), especially 224.0.1.1 (NTP address)	Multicast address
255.255.255.255	Broadcast address

Table 52: Destination address classes for SNTP and NTP packets

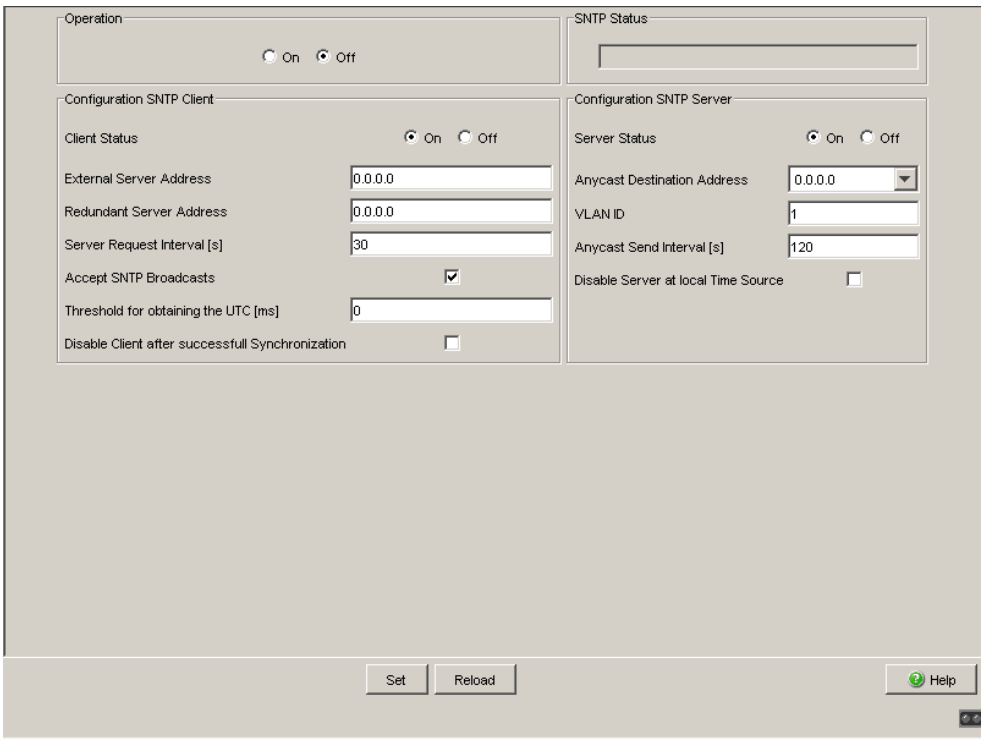


Figure 42: SNTP Dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 53: Buttons

3.3 PTP (IEEE 1588)

Precise time management is required for running time-critical applications via a LAN.
The IEEE 1588 standard with the Precision Time Protocol (PTP) describes a procedure that determines the best master clock in a LAN and thus enables precise synchronization of the clocks in this LAN.

Devices without PTP hardware support

Devices without PTP hardware support, which only have ports absent a time stamp unit, support the PTP simple mode. This mode gives a less accurate division of time.

With these devices

- enable/disable the PTP function in the `PTP` Dialog,
- select PTP mode in the `PTP` Dialog.
  - Select `v1-simple-mode` if the reference clock uses PTP Version 1.
  - Select `v2-simple-mode`, if the reference clock uses PTP Version 2.

Note: In the simple mode a device synchronizes itself with PTP messages received. This mode provides a precision comparable to SNTP absent other functions, such as PTP management or runtime measuring. If you want to transport PTP time accurately through your network, only use devices with PTP hardware support on the transport paths.

Devices with PTP hardware support

Devices with PTP hardware support, which have ports with a time stamp unit, support other modes subject to the version of the time stamp unit.

- MS20, MS30 and PowerMICE devices with the modules
  - MM3-4TX1-RT
  - MM3-2FXM2/2TX1-RT
  - MM3-2FXS2/2TX1-RT
  - MM3-2FLM4/2TX1-RT

  support the modes
  - `v1-boundary-clock`
  - `v1-simple-mode`
  - `v2-boundary-clock-twostep`, only with the network protocol `UDP/IPv4` and the runtime measurement `E2E`

- MS20, MS30 and PowerMICE devices with the modules
  - MM23
  - MM33

  support the modes:
  - v1-boundary-clock
  - v1-simple-mode
  - v2-boundary-clock-onestep
  - v2-boundary-clock-twostep
  - v2-transparent-clock
  - v2-simple-mode

- MACH 104 and MACH 1040 devices support the modes
  - v1-boundary-clock
  - v1-simple-mode
  - v2-boundary-clock-twostep
  - v2-transparent-clock
  - v2-simple-mode

The following sections relate exclusively to devices **with** PTP hardware support.

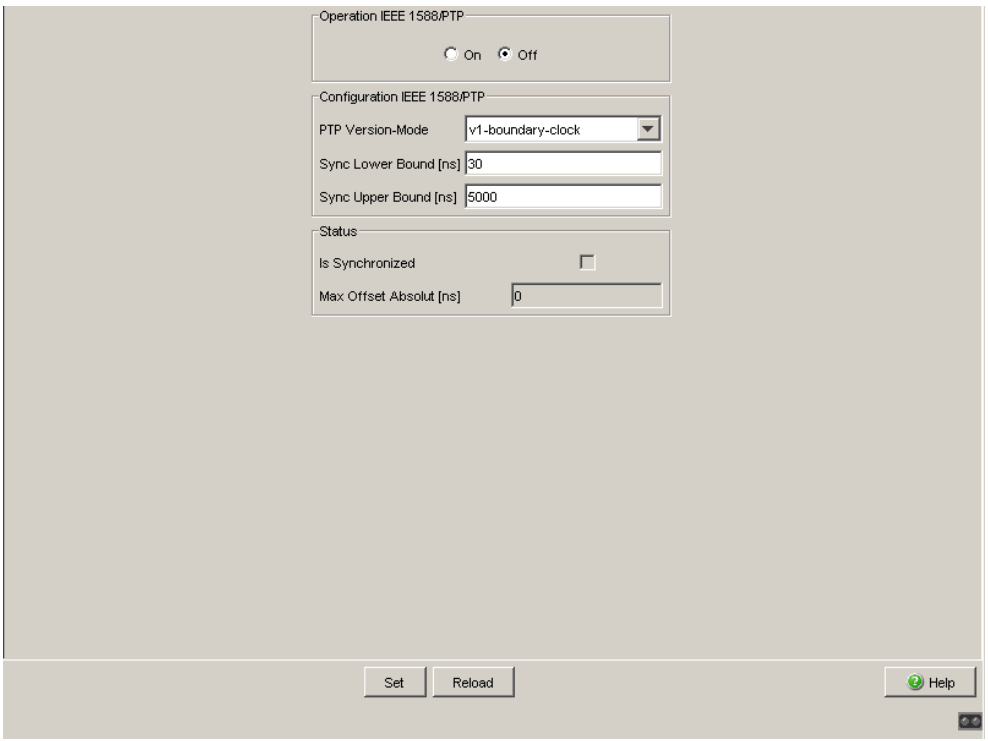


Figure 43: PTP Global Dialog

Note: The MACH 104 device supports PTP only on ports for data rates of 10 Mbit/s, 100 Mbit/s and 1 Gbit/s.

Note: The MACH 104 and MACH 1040 devices support a maximum sync receive rate of 8 frames/s.

Note: The MACH 1140 and MACH 1142 devices support PTP only on front ports 1 - 16.

3.3.1 PTP Global (MS20/MS30, PowerMICE, MACH 104, MACH 1040)

The table below helps you to select the PTP version and the PTP mode.

Version	Mode	Reference clock used	Device with timestamp	PTP messages
Version 1	`v1-simple-mode`	Version 1	No	—
	`v1-boundary-clock`	Version 1	Yes	Process
Version 2	`v2-simple-mode`	Version 2	No	—
	`v2-boundary-clock-onestep`	Version 2	Yes	Process
	Note: For the MS20, MS30 and PowerMICE devices with MM23 or MM33 modules, see sections “Devices without PTP hardware support” on page 133 and “Devices with PTP hardware support” on page 134.			
	`v2-boundary-clock-twostep`	Version 2	Yes	Process
	`v2-transparent-clock`	Version 2	Yes	Forward

Table 54: Selecting the PTP version and the PTP mode

The PTP modes
- `v1-boundary-clock`
- `v2-boundary-clock-onestep`[1]
- `v2-boundary-clock-twostep`
- `v2-transparent-clock`

enable you to optimize time division accuracy.

You use these dialogs for this purpose
- Version 1
- Version 2 (Boundary Clock, BC)
- Version 2 (Transparent Clock, TC)

The PTP modes
- v1-simple-mode
- `v2-simple-mode`

allow you to use the plug-and-play start-up.

Parameters	Meaning	Possible values	Default setting
Operation on/off	Enable/disable the PTP function	`On, Off`	`Off`

Table 55: Function IEEE 1588/PTP

Parameters	Meaning	Possible values	Default setting

PTP Version-Mode	Version and mode of the local clock.	`v1-boundary-clock`
		`v1-simple-mode`
		`v2-boundary-clock-onestep`
		`v2-boundary-clock-twostep`
		`v2-transparent-clock`
		`v2-simple-mode`
			`v1-boundary-clock`

Table 56: Configuration IEEE 1588/PTP, PTP version and mode, overview

1. For the MS20, MS30 and PowerMICE devices with MM23 or MM33 modules, see sections “Devices without PTP hardware support” on page 133 and “Devices with PTP hardware support” on page 134.

Value for PTP version and PTP mode	Meaning
`v1-boundary-clock`	Boundary Clock function based on IEEE1588-2002 (PTPv1). For the MS20, MS30 and PowerMICE devices with realtime modules and for MACH 104 and MACH 1040, see sections “Devices without PTP hardware support” on page 133 and “Devices with PTP hardware support” on page 134.
`v1-simple-mode`	Support for PTPv1 without special hardware. The device synchronizes itself with PTPv1 messages received. This mode does not provide any other functions, such as PTP management or runtime measuring. Select this mode if the device only has ports absent a timestamp unit.
`v2-boundary-clock-onestep`	Boundary Clock function based on IEEE 1588-2008 (PTPv2). The one-step mode determines the precise PTP time with 1 message. For the MS20, MS30 and PowerMICE devices with MM23 or MM33 modules, see sections “Devices without PTP hardware support” on page 133 and “Devices with PTP hardware support” on page 134.
`v2-boundary-clock-twostep`	Boundary Clock function based on IEEE 1588-2008 (PTPv2). The two-step mode determines the precise PTP time with 2 messages.
`v2-transparent-clock`	Transparent Clock function based on IEEE 1588-2008 (PTPv2). Here, the MS20, MS30 and PowerMICE devices with MM23 or MM33 modules use only the one-step mode. Here, the MACH 104 and MACH 1040 devices use only the two-step mode. They support a receive rate of 8 frames/s max.
`v2-simple-mode`	Support for PTPv2 without special hardware. The device synchronizes itself with PTPv2 messages received. This mode does not provide any other functions, such as PTP management or runtime measuring. Select this mode if the device only has ports absent a timestamp unit.

Table 57: Configuration IEEE 1588/PTP, PTP version and mode, details

Parameters	Meaning	Possible values	Default setting
Sync Lower Bound [ns]	Bottom PTP synchronization threshold value, specified in nanoseconds. If the result of (reference time - local time) is lower than the value of the bottom PTP synchronization threshold, then the local clock is deemed as synchronous with the reference clock.	0-999999999	30
Sync Upper Bound [ns]	Top PTP synchronization threshold value, specified in nanoseconds. If the result of (reference time - local time) is greater than the value of the top PTP synchronization threshold, then the local clock is deemed as not being synchronous with the reference clock.	31-1000000000	5000

Table 58: Configuration IEEE 1588/PTP, synchronization thresholds

Parameters	Meaning	Possible values	Default setting
Is Synchronized	Local clock synchronized with reference clock; compare `Bottom synchronization threshold` and `Top synchronization threshold`.	`true, false`	-
Max Offset Absolute [ns]	Total deviation of the local clock from the reference clock in nanoseconds since the local clock was last reset. The local clock is reset with “Reinitialize” in this dialog or by resetting the device.		-

Table 59: IEEE 1588/PTP status

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 60: Buttons

3.3.2 PTP Version 1 (MS20/MS30, PowerMICE, MACH 104, MACH 1040)

You select the PTP version you will use in the `Time:PTP:Global` dialog.

PTP Version 1, Global Settings

Parameters	Meaning	Possible values	Default setting
Sync Interval	Period for sending synchronization messages. Entered in seconds. In order for changes to take effect, click "Reinitialize".	- sec-1 - sec-2 - sec-8 - sec-16 - sec-64	sec-2
Subdomain Name	Name of the PTP subdomain to which the local clock belongs. In order for changes to take effect, click "Reinitialize".	1 to 16 ASCII characters, hex value 0x21 (!) through 0x7e (~)	_DFLT
Preferred Master	Defines the local clock as the preferred master. If PTP does not find another preferred master, then the local clock is used as the grandmaster clock. If PTP finds other preferred masters, then PTP determines which of the preferred masters is used as the grandmaster clock.	true false	false

Table 61: Function IEEE 1588/PTPv1

Parameters	Meaning	Possible values	Default setting
Offset to Master [ns]	Deviation of the local clock from the reference clock in nanoseconds.		
Delay to Master [ns]	Single signal runtime between the local device and reference clock in nanoseconds.		
Grandmaster UUID	MAC address of the grandmaster clock (Unique Universal Identifier).		
Parent UUID	MAC address of the master clock with which the local time is directly synchronized.		
Clock Stratum	Qualification of the local clock.		
Clock Identifier	Clock properties (e.g. accuracy, epoch, etc.).		

Table 62: Status IEEE 1588/PTPv1

Note: PTPv1 uses as the device UUID 48 bits which are identical to the MAC address of the particular device.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Reinitialize	Restarts synchronization after changing the interval time and sets the Subdomain Name.
Help	Opens the online help.

Table 63: Buttons

PTP Version 1, Port Settings

Parameters	Meaning	Possible values	Default setting
Port	Port to which this entry applies. The table remains empty if the device does not support the PTP mode selected		
PTP enable	Port sends/receives PTP synchronization messages	`on`	`on`
	Port blocks PTP synchronization messages.	`off`	
PTP Burst enable	`on`: 2 to 8 synchronization runs take place during the synchronization interval. This enables faster synchronization with a correspondingly higher network load. `off`: One synchronization run is performed in a synchronization interval.	`on` `off`	`off`

Table 64: Port dialog version 1

Parameters	Meaning	Possible values	Default setting
PTP Status	Port is in the initialization phase.	`initializing`	
	Port is in the faulty mode. Error in the PTP protocol.	`faulty`	
	PTP function is switched off at this port.	`disabled`	
	Port has not received any information and is waiting for synchronization messages.	`listening`	
	Port is in PTP pre-master mode.	`pre-master`	
	Port is in PTP master mode.	`master`	
	Port is in PTP passive mode.	`passive`	
	Port is in PTP uncalibrated mode.	`uncalibrated`	
	Port is in PTP slave mode.	`slave`	

Table 64: Port dialog version 1

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 65: Buttons

3.3.3 PTP Version 2 (BC) (MS20/MS30, PowerMICE, MACH 104, MACH 1040)

PTP version 2 provides considerably more settings. These support
- faster reconfiguration of the PTP network than in PTP version 1
- greater precision in some environments.

You select the PTP version you will use in the `Time:PTP:Global` dialog.

Global

Parameters	Meaning	Possible values	Default setting
Priority 1	The clock with the lowest priority 1 becomes the reference clock (grandmaster).	0-255	128
Priority 2	If all the relevant values for selecting the reference clock are the same for multiple devices, the clock with the lowest priority 2 is selected as the reference clock (grandmaster).	0-255	128
Domain Number	Assignment of the clock to a PTPv2 domain. Only clocks with the same domain are synchronized.	0-255	0

Table 66: Function IEEE 1588/PTPv2 BC

Parameters	Meaning	Possible values	Default setting
Two-Step	Displays the device's clock mode	`Off` (select `v2-boundary-clock-onestep` in `PTP Global` dialog) `On` (select `v2-boundary-clock-twostep` in `PTP Global` dialog)	
Steps Removed	Number of boundary clocks between this device and the PTP reference clock.		
Offset to Master [ns]	Deviation of the local clock from the reference clock in nanoseconds.		
Delay to Master [ns]	Single signal runtime (end-to-end) between the local device and reference clock in nanoseconds. Prerequisite: The slave port's runtime mechanism is set to `E2E`.		

Table 67: IEEE 1588/PTPv2 BC Status

Parameters	Meaning	Possible values	Default setting
Clock identifty	Own device UUID (unique identification number)		

Table 68: PTP Clock Identities

Parameters	Meaning	Possible values	Default setting
Parent Port identity	Port UUID of the direct master		
Grandmaster identity	Device UUID of the reference clock		

Table 68: PTP Clock Identities

Note: PTPv2 uses as the device UUID 64 bits, consisting of the device's MAC address, between whose No. 3 and No. 4 bytes the values ff and fe are added.
A port UUID consists of the device UUID followed by a 16-bit port ID.
The device displays UUIDs as a byte sequence in hexadecimal notation.

Parameters	Meaning	Possible values	Default setting
Priority 1	Display priority 1 of the current reference clock.		
Priority 2	Display priority 2 of the current reference clock.		
Class	Class of the reference clock		
Precision	Estimated accuracy with regard to the UTC, indicated by the reference clock (the Grandmaster).		
Variance	Variance as described in the IEEE 1588-2008 standard		

Table 69: Grandmaster (reference clock)

Parameters	Meaning	Possible values	Default setting

Time source	Source selected for own clock.	`atomicClock`
		`gps`
		`terrestrialRadio`
		`ptp`
		`ntp`
		`handset`
		`other`
		`internalOscillator`
			`internalOscillator`

UTC Offset [s]	Current difference between the PTP time scale (see below) and the UTC.	`-32768 to 32767`	`35` (since 2012-07-01)
UTC Offset valid	Specifies whether value of UTC offset is valid or not.	`Yes` `No`	`No`
Time Traceable	The device gets the time from a primary UTC reference, e.g. from an NTP server.	`Yes` `No`	

Table 70: Properties of the local time

Parameters	Meaning	Possible values	Default setting
Frequency Traceable	The device gets the frequency from a primary UTC reference, e.g. NTP server, GPS.	`Yes` `No`	
PTP Time Scale	The device uses the PTP time scale. According to IEEE 1588, the PTP time scale is the TAI atomic time started on 01.01.1970. In contrast to UTC, TAI does not use leap seconds. On 01.01.2009, the difference between UTC and TAI was +34 seconds.	`Yes` `No`	

Table 70: Properties of the local time

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 71: Buttons

Port

Parameters	Meaning	Possible values	Default setting
Port	Port to which this entry applies. If the device does not support the PTP mode selected, the table is empty.		
PTP enable	Port sends/receives PTP synchronization messages	`on`	`on`
	Port blocks PTP synchronization messages.	`off`	

Table 72: Port Dialog Version 2(BC)

Parameters	Meaning	Possible values	Default setting
PTP Status	Port is in the initialization phase.	`initializing`	
	Port is in the faulty mode. Error in the PTP protocol.	`faulty`	
	PTP function is switched off at this port.	`disabled`	
	Port has not received any information and is waiting for synchronization messages.	`listening`	
	Port is in PTP pre-master mode.	`pre-master`	
	Port is in PTP master mode.	`master`	
	Port is in PTP uncalibrated mode.	`uncalibrated`	
	Port is in PTP passive mode.	`passive`	
	Port is in PTP slave mode.	`slave`	
Sync Interval [s]	Interval in seconds for the synchronization messages	`0,5; 1; 2`	`1`
Runtime Measuring Mechanism	Mechanism for measuring the message runtime. Enter the same mechanism for the PTP device connected to this port.		
	A PTP slave port measures the runtime of the entire transmission path to the master. The device displays the measured value in the `PTP:Version 2(BC):Global` dialog (see on page 143 “Global”).	`E2E` (end-to-end):	
	The device measures the runtime to all the PTP devices connected. If a reconfiguration is performed, this mechanism eliminates the need to determine the runtime again, provided all these devices support P2P. The MS20, MS30 and PowerMICE devices with MM23 or MM33 modules, as well as the MACH 104 and MACH 1040 devices support these mechanisms.	`P2P` (peer-to-peer)	
	No runtime determination.	`Disabled`	`Disabled`
P2P Runtime	Measured P2P (peer-to-peer) runtime. Prerequisite: You have selected the P2P runtime measuring mechanism.		

Table 72: Port Dialog Version 2(BC)

Parameters	Meaning	Possible values	Default setting
P2P Runtime Measuring Interval	Interval for peer-to-peer runtime measurements at this port. Prerequisite: You have selected the P2P runtime measuring mechanism on the device itself and on the PTP device connected.		
Network Protocol	Transport protocol for PTP messages.	`802.3 Ethernet`, `UDP/IPv4`	`UDP/IPv4`
Announce Interval	Message interval for PTP topology discovery (selection of the reference clock). Select the same value for all devices within a PTP domain.	`1, 2, 4, 8, 16`	`2`
Announce Timeout	Announce interval timeout for PTP topology discovery in number of announce intervals. The standard settings of announce interval = 2 (2 per second) and announce timeout = 3 result in a timeout of 3 x 2 seconds = 6 seconds. Select the same value for all devices within a PTP domain.	2-10	3
E2E Runtime Measuring Interval	Displays in seconds the interval for E2E (end-to-end) runtime measurements at this port. This is a device variable and is assigned to ports with PTP slave status by the master connected. If the port itself is the master, then the device assigns the port the value 8 (state on delivery).		8
V1 Hardware Compatibility	Some devices from other manufacturers require PTP messages of specific length. If the `UDP/IPv4` network protocol is selected and the function is active, the device extends the PTP messages.	`auto, on, off`	`auto`
Asymmetry	Correction of the runtime asymmetry in ns. A runtime measurement value of x ns corrupted by asymmetrical transmission values corresponds to an asymmetry of x·2 ns		

Table 72: Port Dialog Version 2(BC)

Parameters	Meaning	Possible values	Default setting
VLAN	The VLAN ID with which the device sends PTP frames to this port. **Note:** ▶ Also take the port's VLAN setting (see on page 185 “VLAN Static”) into account here, in particular whether the VLAN exists and if the port is a tagged or untagged member in the VLAN. ▶ `none`: The device always sends PTP frames absent a VLAN tag, even if the port is a tagged member of the VLAN. ▶ You can select VLANs that you have already set up using of the table row drop-down list.	`none`, `0 - 4042`	`none`
VLAN Priority	The VLAN priority (Layer 2, IEEE 802.1p) with which the device sends PTP frames to this port. If you have set the VLAN ID to `none`, the device ignores the VLAN priority.	`0 - 7`	`4`

Table 72: Port Dialog Version 2(BC)

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 73: Buttons

3.3.4 PTP Version 2 (TC) (MS20/MS30, PowerMICE, MACH 104, MACH 1040)

In strongly cascaded networks in particular, the transparent clock (TC) introduced in PTP Version 2 provides a noticeable increase in precision. The combination with the P2P runtime mechanism (simultaneous runtime measurement at all ports) enables “seamless” reconfiguration.

For the MS20, MS30 and PowerMICE devices with MM23 or MM33 modules:
The following settings enable you to also use the TC for Unicast PTP messages:
– Selecting the E2E mechanism
– Syntonize disabled
– PTP Management disabled.

You select the PTP version you will use in the `Time:PTP:Global` dialog.

PTP Version 2 (TC), Global Settings

Parameters	Meaning	Possible values	Default setting

Profile	Defines relevant PTP parameters to a specific profile.	`E2E-Defaults`
		`P2P-Defaults`
		`Power-Defaults`	

Table 74: PTP Version 2(TC) Profile Presets

Parameters	Meaning	Possible values	Default setting
Runtime Measuring Mechanism	Mechanism for measuring the message runtime. Enter the same mechanism for the PTP device connected to this port.		
	A PTP slave port measures the runtime of the entire transmission path to the master. The device displays the measured value in the `PTP:Version 2(BC):Global` dialog (see on page 143 “Global”).	`E2E` (end-to-end):	
	The device itself measures the runtime to all the PTP devices connected. If a reconfiguration is performed, this eliminates the need to determine the runtime again.	`P2P` (peer-to-peer)	
	For the MACH 104 and MACH 1040 devices: Such as E2E with the following characteristics: ▶ The device only transmits the PTP slaves' delay queries to the master, even though these queries are multicast frames. In this way, the device relieves the other clients from unnecessary multicast queries. ▶ With changes in the PTP master-slave topology, the device relearns the port for the PTP master as soon as it has received a frame from another PTP master. ▶ If the device does not recognize a PTP master, it also floods delay queries received in the `E2E Optimized` mode.	`E2E Optimized` (end-to-end, optimized)	
	For the MACH 104 and MACH 1040 devices: The device does not allow runtime measurement, i.e., it discards frames received, which are used for measuring runtime.	`Disabled`	
Primary Domain	Assignment of the clock to a PTPv2 domain.	0-225	0
Network Protocol	Network protocol for P2P and management messages.	`UDP/IPv4`, `IEEE 802.3`	`UDP/IPv4`

Table 75: Function IEEE 1588 / PTPv2 TC

Parameters	Meaning	Possible values	Default setting
Syntonize	Synchronize frequency.	`On` `Off`	For the MS20, MS30 and PowerMICE devices: `Off` For devices MACH 104 and MACH 1040: `On`
Synchronizing local time	The device synchronizes its local time with the time received via the PTP. Prerequisite: the Syntonize setting is activated.	`On` `Off`	`Off`
PTP Management	Activate/deactivate PTP management. To reduce the load on the device, deactivate PTP Management and Syntonize - at high synchronization rates and - in Unicast mode.	`On` `Off`	`Off`
Multi Domain Mode	`On`: TC corrects messages from all domains. `Off`: TC only corrects messages from the primary domain.	`On` `Off`	`Off`
Power TLV Check	Activate/deactivate the Power TLV check. `On`: The device ignores announce messages without the Power Profile TLV.	`On` `Off`	`Off`

Table 75: Function IEEE 1588 / PTPv2 TC

Parameters	Meaning	Possible values	Default setting
VLAN	The VLAN ID with which the device sends its own frames (like PTP Management frames or P2P frames) to this port. **Note:** ▶ Also take the port's VLAN setting (see on page 185 “VLAN Static”) into account here, in particular whether the VLAN exists and if the the port is a tagged or untagged member in the VLAN. ▶ `none`: The device always sends PTP frames absent a VLAN tag, even if the port is a tagged member of the VLAN. ▶ You can select VLANs that you have already set up using of the table row drop-down list.	`none`, `0 - 4042`	`none`
VLAN Priority	The VLAN priority (Layer 2, IEEE 802.1p) with which the device sends tagged PTP frames. If you have set the VLAN ID to `none`, the device ignores the VLAN priority.	`0 - 7`	`4`

Table 75: Function IEEE 1588 / PTPv2 TC

Parameters	Meaning	Possible values	Default setting
Clock identifier	Device UUID of the TC (transparent clock)		
Current master	When the Syntonize function is enabled, the master's port UUID, with which the device synchronizes its frequency, is displayed. A value consisting of zeros means that: ▶ the Syntonize function is deactivated or ▶ the device has not found a master		

Table 76: Status IEEE 1588 / PTPv2 TC

Note: PTPv2 uses as the device UUID 64 bits, consisting of the device's MAC address, between whose No. 3 and No. 4 bytes the values ff and fe are added.
A port UUID consists of the device UUID followed by a 16-bit port ID.
The device displays UUIDs as a byte sequence in hexadecimal notation.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 77: Buttons

PTP Version 2 (TC), Port Settings

Parameters	Meaning	Possible values	Default setting
Module	Module number for modular devices, otherwise 1.		
Port	Port to which this entry applies. If the device does not support the PTP mode selected, the table is empty.		
PTP enable	Port sends/receives PTP synchronization messages	`on`	`on`
	Port blocks PTP synchronization messages. The device does not process any PTP messages it receives at this port.	`off`	
P2P Runtime Measuring Interval	Interval for peer-to-peer runtime measurements at this port. Prerequisite: You have selected the P2P runtime measuring mechanism on the device itself and on the PTP device connected.		

Table 78: Port Dialog Version 2(TC)

Parameters	Meaning	Possible values	Default setting
P2P Runtime	Measured P2P (peer-to-peer) runtime. Prerequisite: You have selected the P2P runtime measuring mechanism.		
Asymmetry	Correction of the runtime asymmetry in ns. A runtime measurement value of x ns corrupted by asymmetrical transmission values corresponds to an asymmetry of x·2 ns		

Table 78: Port Dialog Version 2(TC)

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 79: Buttons

4 Switching

The switching menu contains the dialogs, displays and tables for configuring the switching settings:

- Switching Global
- Filters for MAC Addresses
- Rate Limiter
- Multicasts
- VLAN

4.1 Switching Global

Parameters	Meaning	Possible values	Default setting
MAC address (read only)	Display the MAC address of the device		
Aging Time (s)	Enter the Aging Time in seconds for dynamic MAC address entries. In connection with the router redundancy, select a time ≥ 30 s.	10-630	30
Activate Flow Control	Activate/deactivate the flow control	`On`, `Off`	`Off`

Table 80: Switching:Global dialog

Note: When you are using a redundancy function, you deactivate the flow control on the participating device ports. If the flow control and the redundancy function are active at the same time, there is a risk that the redundancy function will not operate as intended.

Parameters	Meaning	Possible values	Default setting
Address learning	Activate/deactivate the learning of MAC source addresses. **Note:** If routing is active, the device prevents the address learning from being switched off. When you activate routing, the device automatically activates the address learning.	`On`, `Off`	`On`
Frame size	Set the maximum packet size (frame size) in bytes.	1522, 1552	1522

Table 81: Switching:Global dialog

Parameters	Meaning	Possible values	Default setting
Activate Address Relearn Detection	Enable/disable whether the device detects whether it has repeatedly learned the same MAC source addresses at different ports. This process very probably indicates a loop situation in the network. If the device detects this process, it creates an entry in the log file and sends an alarm (trap).	`On`, `Off`	`Off`
Address Relearn Threshold	Number of learned MAC addresses on different ports within a checking interval. If the number of learned addresses reach this threshold, the device sees this as a relevant event. The interval for this check is a few seconds.	1 - 1024	1
Activate Duplex Mismatch Detection	Enable/disable whether the device reports a duplex problem at a port for specific error events. This means that the duplex mode of the port might not match that of the remote port. If the device detects a potential non-match, it creates an entry in the trap log and sends an alarm (trap). To detect potential non-matches, the device evaluates the error counters of the port after the connection is set up, in the context of the port settings (see table 82).	`On`, `Off`	`On`

Table 81: Switching:Global dialog

The following table lists the duplex operating modes for TX ports, with the possible fault events. The meanings of terms used in the table are as follows:

- Collisions: In half-duplex mode, collisions mean normal operation.
- Duplex problem: Mismatching duplex modes.
- EMI: Electromagnetic interference.
- Network extension: The network extension is too great, or too many cascading hubs.

- Collisions, late collisions: In full-duplex mode, no incrementation of the port counters for collisions or late collisions.
- CRC error: The device evaluates these errors as non-matching duplex modes in the manual full duplex mode.

No.	Automatic configuration	Current duplex mode	Detected error events (≥ 10 after link up)	Duplex modes	Possible causes
1	On	Half duplex	None	OK	
2	On	Half duplex	Collisions	OK	
3	On	Half duplex	Late collisions	Duplex problem detected	Duplex problem, EMI, network extension
4	On	Half duplex	CRC error	OK	EMI
5	On	Full duplex	None	OK	
6	On	Full duplex	Collisions	OK	EMI
7	On	Full duplex	Late collisions	OK	EMI
8	On	Full duplex	CRC error	OK	EMI
9	Off	Half duplex	None	OK	
10	Off	Half duplex	Collisions	OK	
11	Off	Half duplex	Late collisions	Duplex problem detected	Duplex problem, EMI, network extension
12	Off	Half duplex	CRC error	OK	EMI
13	Off	Full duplex	None	OK	
14	Off	Full duplex	Collisions	OK	EMI
15	Off	Full duplex	Late collisions	OK	EMI
16	Off	Full duplex	CRC error	Duplex problem detected	Duplex problem, EMI

Table 82: Evaluation of non-matching of the duplex mode

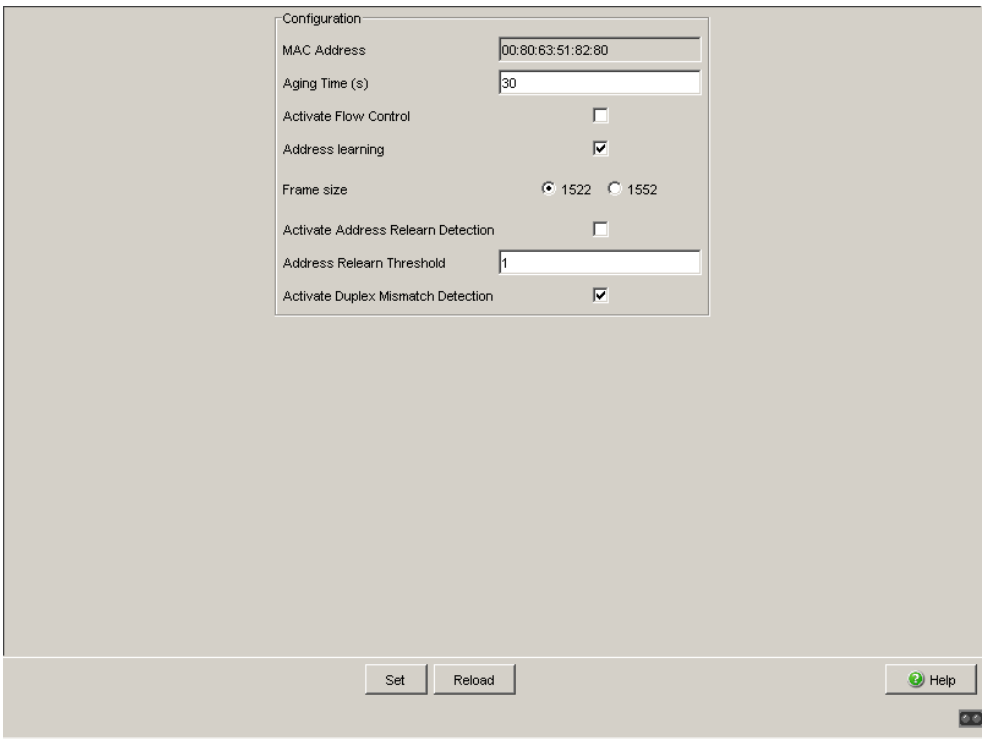


Figure 44: Dialog Switching Global

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 83: Buttons

4.2 Filter for MAC addresses

The filter table for MAC addresses is used to display and edit filters. Each row represents one filter. Filters specify the way in which data packets are sent. They are set automatically by the device (learned status) or manually. Data packets whose destination address is entered in the table are sent from the receiving port to the ports marked in the table. Data packets whose destination address is not in the table are sent from the receiving port to all other ports. The following conditions are possible:

- `learned`: The filter was created automatically by the device.
- `invalid`: With this status you delete a manually created filter.
- `permanent`: The filter is stored permanently in the device or on the URL (see on page 51 “Load/Save”).
- `gmrp`: The filter was created by GMRP.
- `gmrp/permanent`: GMRP added further port markings to the filter after it was created by the administrator. The port markings added by the GMRP are deleted by a restart.
- `igmp`: The filter was created by IGMP Snooping.

In the “Create” dialog (see buttons below), you can create new filters.

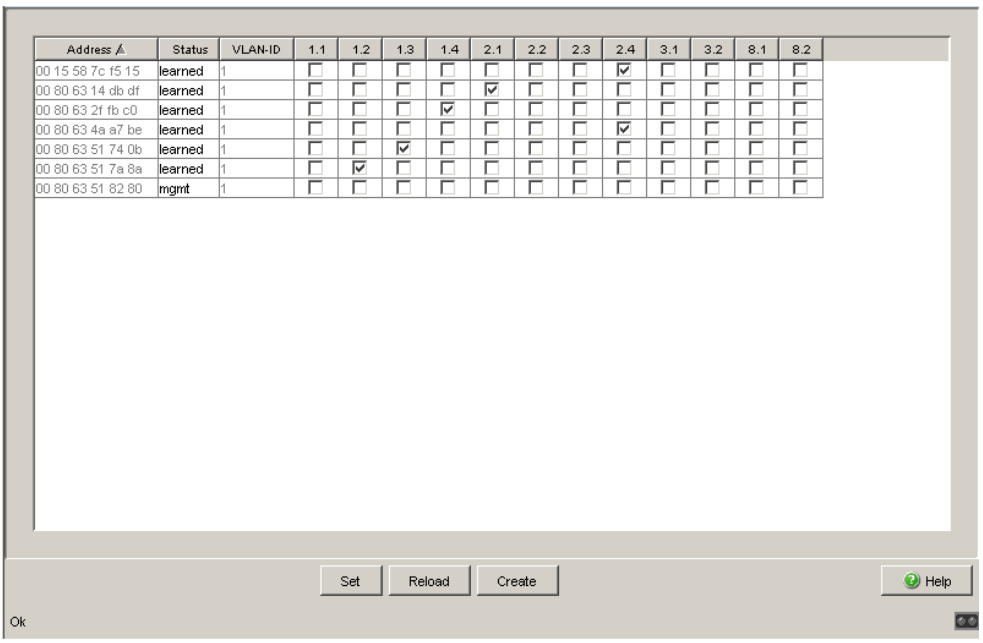


Figure 45: Filter Table dialog

Note: For Unicast addresses, the device allows you to include multiple ports in a filter entry. Do not include any ports if you want to create a discard filter entry.

Note: For Unicast addresses, the PowerMICE, MACH 1040 and MACH 4000 devices allow you to include multiple ports in a filter entry. Do not include any port if you want to create a Discard Filter entry.

Note: The filter table allows you to create up to 100 filter entries for Multicast addresses.

Create

To set up a filter manually, click the "Create" button.

Parameters	Meaning
VLAN ID	Defines the ID of the VLAN to which the table entry applies. Possible values: ▶ All VLAN IDs that are set up
Address	Defines the destination MAC address to which the table entry applies. Possible values: ▶ Valid MAC address Enter the value in one of the following formats: – without a separator, e.g. `001122334455` – separated by spaces, e.g. `00 11 22 33 44 55` – separated by colons, e.g. `00:11:22:33:44:55` – separated by hyphens, e.g. `00-11-22-33-44-55` – separated by points, e.g. `00.11.22.33.44.55` – separated by points after every 4th character, e.g. `0011.2233.4455`
Possible Ports	Defines the device ports to which the device transmits data packets with the destination MAC address: ☐ Select one port if the destination MAC address is a Unicast address. ☐ Select one or more ports if the destination MAC address is a Multicast address. ☐ Select no port to set up a discard filter. The device discards data packets with the destination MAC address specified in the table entry.

Table 84: "Create" window

Edit Entry

To manually adapt the settings for a table entry, click the "Edit Entry" button.

Parameters	Meaning
Possible Ports	This column contains the ports available in the device.
Dedicated Ports	This column contains the device ports that are assigned to the table entry. ☐ Select one port if the destination MAC address is a Unicast address. ☐ Select one or more ports if the destination MAC address is a Multicast address. ☐ Select no port to set up a discard filter. The device discards data packets with the destination MAC address specified in the table entry.

Table 85: "Edit Entry" window in the `Switching:Filters for MAC Addresses` dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Edit Entry	Opens the "Edit Entry" window.
Help	Opens the online help.
>	Moves the selected entry to the right column.
>>	Moves all entries to the right column.
<	Moves the selected entry to the left column.
<<	Moves all entries to the left column.

Table 86: Buttons

4.3 Rate Limiter

To ensure reliable operation at a high level of traffic, the device allows you to limit the rate of traffic at the ports.

Entering a limit rate for each port determines the amount of traffic the device is permitted to transmit and receive.

If the traffic at this port exceeds the maximum rate entered, then the device suppresses the overload at this port.

A global setting enables/disables the rate limiter function at all ports.

Note: The limiter functions only work on Layer 2 and are used to limit the effect of storms by frame types that the Switch floods (typically broadcasts). In doing so, the limiter function disregards the protocol information of higher layers, such as IP or TCP. This can affect on TCP traffic, for example.

To minimize these effects, use the following options:

- limiting the limiter function to particular frame types (e.g. to broadcasts, multicasts and unicasts with unlearned destination addresses) and receiving unicasts with destination addresses established by the limitation,
- using the output limiter function instead of the input limiter function because the former works slightly better together with the TCP flow control due to switch-internal buffering.
- increasing the aging time for learned unicast addresses.

Note: Ports that are included in a Link Aggregation (see on page 242 “Link Aggregation”) are excluded from the rate limitation, regardless of the entries in the “Rate Limiter” dialog.

4.3.1 Rate limiter settings (PowerMICE and MACH 4000)

- "Ingress Limiter (kbit/s)" allows you to enable or disable the ingress limiter function for all ports and to select the ingress limitation on all ports (either broadcast packets only or broadcast packets and Multicast packets).
- "Egress Limiter (Pkt/s)" allows you to enable or disable the egress limiter function for broadcasts on all ports.

Setting options per port:

- Ingress Limiter Rate for the packet type selected in the Ingress Limiter frame:
  - = 0, no ingress limit at this port.
  - > 0, maximum ingress traffic rate in kbit/s that can be sent at this port.
- Egress Limiter Rate for broadcast packets:
  - = 0, no rate limit for egress broadcast packets at this port.
  - > 0, maximum number of egress broadcasts per second sent at this port.

Note: If applicable, the device rounds the values entered up to the next value that the hardware can process. After entering the values, to see which values the device actually uses, click "Set" and then "Reload".

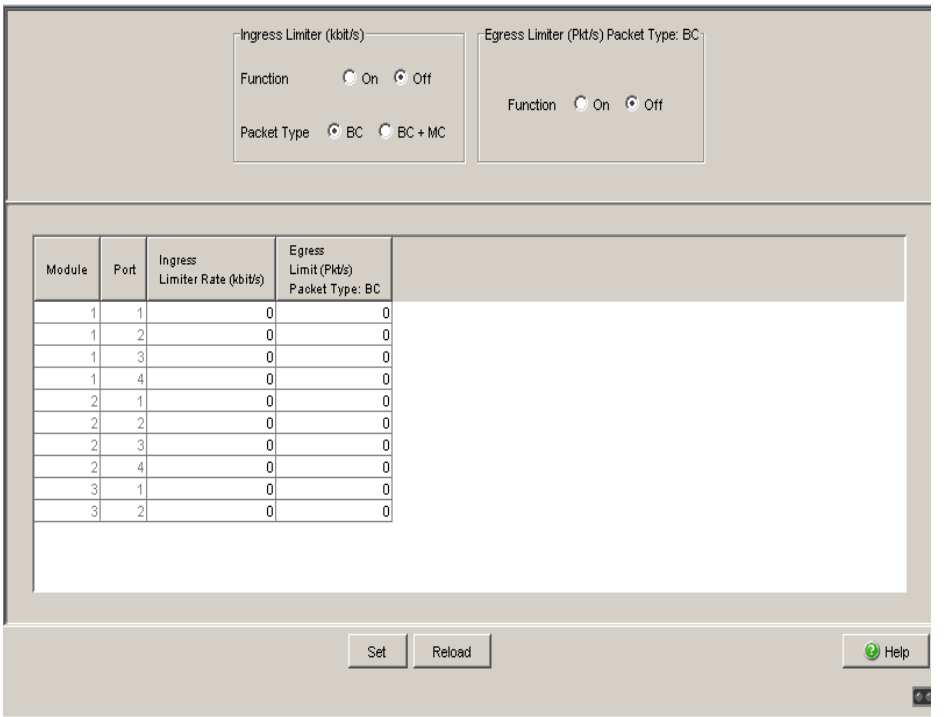


Figure 46: Rate Limiter Dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 87: Buttons

4.4 Multicasts

4.4.1 IGMP (Internet Group Management Protocol)

With this dialog you can
- activate/deactivate the IGMP function globally,
- configure the IGMP protocol globally and per port.

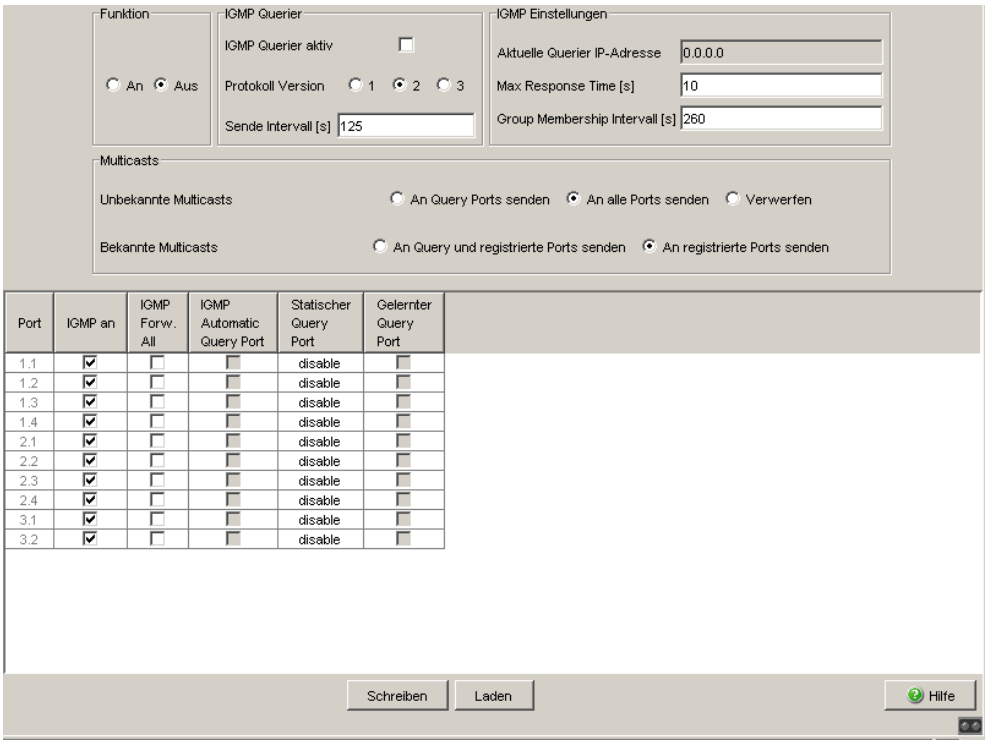


Figure 47: IGMP Snooping dialog

Operation

In this frame you can:

- activate/deactivate the IGMP Snooping protocol.

Parameters	Meaning	Possible values	Default setting
Operation	Activate/deactivate IGMP Snooping globally for the device. If IGMP Snooping is switched off: ▶ the device does not evaluate Query and Report packets received, and ▶ it sends (floods) received data packets with a Multicast address as the destination address to all ports.	`On` `Off`	`Off`

Table 88: IGMP Snooping, global function

IGMP Querier and IGMP settings

With these frames you can enter global settings for the IGMP settings and the IGMP Querier function.

Prerequisite: The IGMP Snooping function is activated globally.

Parameters	Meaning	Possible values	Default setting
IGMP Querier			
IGMP Querier active	Switch query function on/off	on off	off
Protocol Version	Select IGMP version 1, 2 or 3.	1, 2, 3	2
Transmit Interval [s]	Enter the interval at which the switch sends query packets. All IGMP-capable terminal devices respond to a query with a report message.	2-3599 s[a]	125 s
IGMP settings			
Current querier IP address	Display the IP address of the router/switch that has the query function.		

Table 89: IGMP Querier and IGMP settings

Parameters	Meaning	Possible values	Default setting
Max. Response Time	Enter the time within which the multicast group members are to respond to a query. The multicast group members select a random value within the response time for their response to prevent all multicast group members from responding to the query at the same time.	Protocol Version - 1, 2: 1-25 s - 3: 1-3598 s[a]	10 s
Group Membership Interval	Enter the period for which a dynamic Multicast group remains entered in the device if it does not receive any report messages.	3-3600 s[a]	260 s

Table 89: IGMP Querier and IGMP settings

a. Note the connection between the parameters Max. Response Time, Transmit interval and Group Membership Interval (see table 90.)

The parameters
– Max. Response Time,
– Transmit Interval and
– Group Membership Interval
have a relationship to one another:

Max. Response Time < Transmit Interval < Group Membership Interval.

If you enter values that contradict this relationship, the device then replaces these values with a default value or with the last valid values.

Parameters	Protocol Version	Possible values	Default setting
Max. Response Time	1, 2 3	1-25 seconds 1-3,598 seconds	10 seconds
Transmit Interval	1, 2, 3	2-3,599 seconds	125 seconds
Group Membership Interval	1, 2, 3	3-3,600 seconds	260 seconds

Table 90: Value range for Max. Response Time, Transmit Interval and Group Membership Interval

For “Transmit interval” and “Max. Response Time”,
– select a large value if you want to reduce the load on your network and can accept the resulting longer switching times,
– select a small value if you require short switching times and can accept the resulting network load.

Multicasts

In this frame you specify how the device transmits packets with

- unknown MAC/IP multicast addresses not learned with IGMP Snooping
- known MAC/IP multicast addresses learned with IGMP Snooping.

Prerequisite: The IGMP Snooping function is activated globally.

Parameters	Meaning	Possible values	Default setting
Unknown Multicasts	▶ Send to Query Ports: The device sends the packets with an unknown MAC/IP Multicast address to all query ports. ▶ Send to All Ports: The device sends the packets with an unknown MAC/IP Multicast address to all ports. ▶ Discard: The device discards all packets with an unknown MAC/IP Multicast address.	Send to Query Ports Send to All Ports Discard	Send to All Ports
Known Multicasts	▶ Send to query and registered ports: The device sends the packets with a known MAC/IP Multicast address to all query ports and to registered ports. The advantage of this setting is that it works in many applications without any additional configuration. Application: “Flood and Prune” routing in PIM-DM. ▶ Send to registered ports: The device sends the packets with a known MAC/IP Multicast address to registered ports. The advantage of this setting is that it uses the available bandwidth optimally through direct distribution. It requires additional port settings. Application: Routing protocol PIM-SM.	Send to query and registered ports: Send to registered ports	Send to registered ports

Table 91: Known and unknown Multicasts

Note: The way in which unlearned Multicast addresses are handled also applies to the reserved addresses from the “Local Network Control Block” (224.0.0.0 - 224.0.0.255). This can have an effect on higher-level routing protocols.

Settings per Port (Table)

With this configuration table you can enter port-related IGMP settings.

Parameters	Meaning	Possible values	Default setting
Port	Module and port numbers to which this entry applies.	-	-
IGMP enabled	Switch IGMP on/off for each port. Switching IGMP off at a port prevents registration for this port. Prerequisite: The IGMP Snooping function is activated globally.	`On` `Off`	`On`
IGMP Forward All	Switch the IGMP Snooping function `Forward All` on/off. With the `IGMP Forward All` setting, the device sends to this port all data packets with a Multicast address in the destination address field. Prerequisite: The IGMP Snooping function is activated globally. **Note:** If a number of routers are connected to a subnetwork, you must use IGMP version 1 so that all the routers receive all the IGMP reports. **Note:** If you use IGMP version 1 in a subnetwork, then you must also use IGMP version 1 in the entire network.	`On` `Off`	`Off`
IGMP Automatic Query Port	Displays which ports the device has learned as query ports if `automatic` is selected in “Static Query Port”. Prerequisite: The IGMP snooping function is activated globally.	`yes`, `no`	-

Table 92: Settings per port

Parameters	Meaning	Possible values	Default setting
Static Query Port	The device sends IGMP report messages to the ports at which it receives IGMP queries (default setting). This column allows you to also send IGMP report messages to: other selected ports (enable) or connected Hirschmann devices (automatic). Prerequisite: The IGMP snooping function is activated globally.	`enable`, `disable`, `automatic`	`disable`
Learned Query Port	Shows at which ports the device has received IGMP queries if “disable” is selected in “Static Query Port”. Prerequisite: The IGMP Snooping function is activated globally.	`Yes` `No`	-

Table 92: Settings per port

Note: If the device is incorporated into a HIPER-Ring, you can use the following settings to quickly reconfigure the network for data packets with registered Multicast destination addresses after the ring is switched:

- Switch on the IGMP Snooping on the ring ports and globally, and
- activate “IGMP Forward All” per port on the ring ports.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 93: Buttons

4.4.2 GMRP (GARP Multicast Registration Protocol)

With this dialog you can:

- activate/deactivate the GMRP function globally,
- configure the GMRP for each Port.

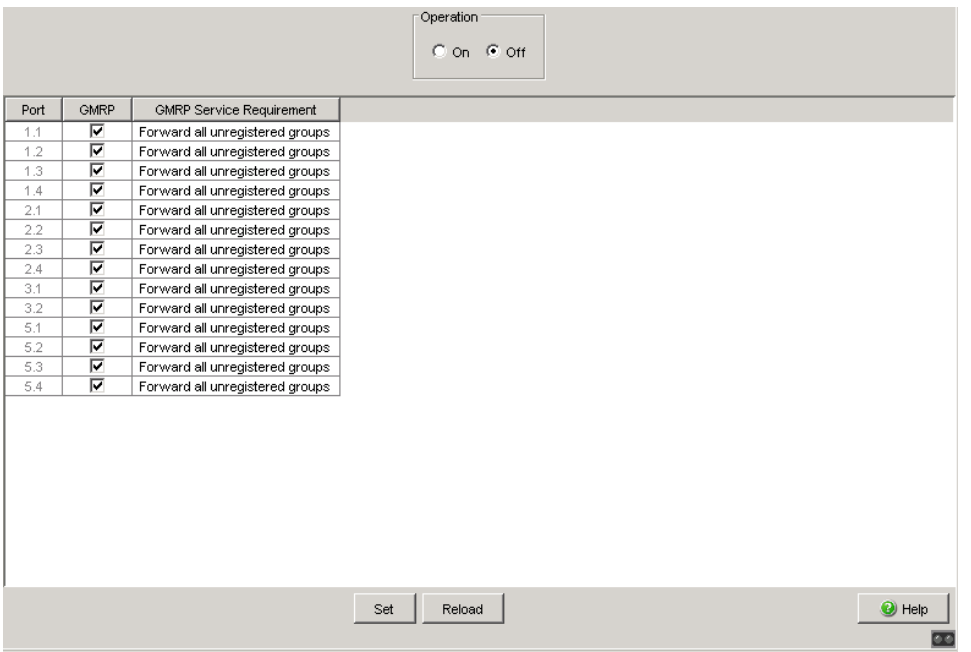


Figure 48: Multicasts dialog

Operation

In this frame you can:

- activate/deactivate the GMRP function globally.

Parameters	Meaning	Possible values	Default setting
GMRP	Activate GMRP globally for the entire device. If GMRP is switched off: ▶ the device does not generate any GMRP packets, ▶ does not evaluate any GMRP packets received, and ▶ sends (floods) received data packets to all ports. The device is transparent for received GMRP packets, regardless of the GMRP setting.	`On, Off`	`Off`

Table 94: Global setting

Multicasts

Note: This feature is available for the following device families: RS20/RS30/RS40, MS20/MS30, RSR20/RSR30, MACH100, MACH1000, OCTOPUS.

In this frame you specify how the device transmits packets with

- unknown MAC multicast addresses not learned with GMRP.

Prerequisite: The GMRP function is activated globally.

Parameters	Meaning	Possible values	Default setting
Unknown Multicasts	▶ Send to All Ports: The device sends the packets with an unknown MAC Multicast address to all ports. ▶ Discard: The device discards the packets with an unknown MAC Multicast address.	Send to All Ports Discard	Send to All Ports

Table 95: Unknown Multicasts

Settings per Port (Table)

With this configuration table you can enter port-related settings for:

Parameters	Meaning	Possible values	Default setting
Port	Module and port numbers to which this entry applies.	-	-
GMRP	Switch GMRP on/off for each port. When you disable GMRP at a port, no registrations can be made for this port, and GMRP packets cannot be forwarded at this port. Prerequisite: In the `Switching:Multicasts:GMRP` dialog, GMRP is enabled.	`On`, `Off`	`On`
GMRP Service Requirement	Devices that do not support GMRP can be integrated into the Multicast addressing by means of – a static filter address entry on the connecting port. – selecting “Forward all groups”. The device enters ports with the selection “Forward all groups” in all Multicast filter entries learned via GMRP. Prerequisite: In the `Switching:Multicasts:GMRP` dialog, GMRP is enabled.	`Forward all groups`, `Forward all unregistered groups`	`Forward all unregistered groups`

Table 96: GMRP settings per port

Note: If the device is incorporated into a HIPER-Ring, you can use the following settings to quickly reconfigure the network for data packets with registered Multicast destination addresses after the ring is switched:

- Activate GMRP on the ring ports and globally, and
- activate “Forward all groups” on the ring ports.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 97: Buttons

4.5 VLAN

At VLAN you can find all the dialogs and views to:

- configure and monitor the VLAN functions in accordance with the IEEE 802.1Q standard.,
- for voice devices (e.g. VoIP telephones) per port:
  - define a voice VLAN network policy that the switch transmits via LLDP-MED to the devices connected,
  - bypass an active 802.1X authentication for voice devices

4.5.1 VLAN Global

With this dialog you can:

- display VLAN parameters
- activate/deactivate the VLAN 0 transparent mode
- activate/deactivate GVRP
- configure and display the learning mode
- reset the device's VLAN settings to the original defaults.

Parameter	Meaning
Max. VLAN ID	Displays the biggest possible VLAN ID (see on page 185 “VLAN Static”)
Max. supported VLANs	Displays the maximum number of VLANs (see on page 185 “VLAN Static”).
Number of VLANs	Displays the number of VLANs configured (see on page 185 “VLAN Static”).

Table 98: VLAN Displays

Note: The device provides the VLAN with the ID 1. The VLAN with ID 1 is always present.

Parameters	Meaning	Possible values	Default setting
VLAN 0 Transparent Mode	When the VLAN 0 Transparent Mode is activated, the device accepts a VLAN ID of 0 in the packet when it receives it, regardless of the setting for the port VLAN ID in the dialog (see on page 188 “Port”). Activate “VLAN 0 Transparent Mode” to transmit packets with a priority TAG without VLAN membership, i.e. with a VLAN ID of 0.	`On`, `Off`	`Off`
GVRP active	Activate “GVRP” to ensure the distribution of VLAN information to the neighboring devices via GVRP data packets.	`On`, `Off`	`Off`
Double VLAN Tag Ethertype	Defines the value of the outer VLAN tag which a core port uses when sending a frame. The selectable values have the following meaning: – 0x8100 (802.1Q): VLAN tag – 0x88A8 (vman): Provider Bridging **Note:** This setting is only effective for a core port. Access ports and normal ports ignore this setting and always use 8100_H	0 - 65535	33024 (8100_H)

Table 99: VLAN settings

Note: If you are using the GOOSE protocol in accordance with IEC61850-8-1, then you activate the “VLAN 0 transparent mode”. In this way, the prioritizing information remains in the data packet in accordance with IEEE802.1D/p when the device forwards the data packet.
This also applies to other protocols that use this prioritizing in accordance with IEEE 802.1D/p, but do not require any VLANs according to IEEE 802.1Q.

Note: When using the “Transparent Mode” in this way, note the following:

- For PowerMICE, MACH 104, MACH 1040 and MACH 4000:
  In “Transparent mode”, the devices ignore the VLAN tags and the priority tag on reception. Set the ports’ VLAN membership for all VLANs to "U“ (Untagged).
- For MACH 4002-24/48G:
  In “Transparent mode”, the devices ignore the VLAN tags but evaluate the priority tag. Set the ports’ VLAN membership for all VLANs to "U“ (Untagged).

Parameters	Meaning	Possible values	Default setting
Mode	Selecting the VLAN Mode. **“Independent VLAN”** subdivides the forwarding database (see on page 160 “Filter for MAC addresses”) virtually into one independent forwarding database per VLAN. The device cannot assign data packets with a destination address in another VLAN and it floods them to all the ports of the VLAN. **Application area:** Setting up identical networks that use the same MAC addresses. **“Shared VLAN”** uses the same forwarding database for all VLANs (see on page 160 “Filter for MAC addresses”). The device cannot assign data packets with a destination address in another VLAN, and so only forwards them to the destination port if the receiving port is also a member of the VLAN group of the destination port. **Application area:** In the case of overlapping groups, the device can distribute directly across VLANs, as long as the ports involved belong to a VLAN that can be reached. Changes to the mode are only applied after a warm start (see on page 66 “Restart”) is performed on the device, and the changes are then displayed in the line below under “Status”.	Independent VLAN, Shared VLAN	Independent VLAN
Status	Displays the current status. After a warm start (see on page 66 “Restart”) on the device, the device take the setting for the “Mode” into the status line.	Independent VLAN, Shared VLAN	

Table 100: Settings and displays in the “Learning” frame

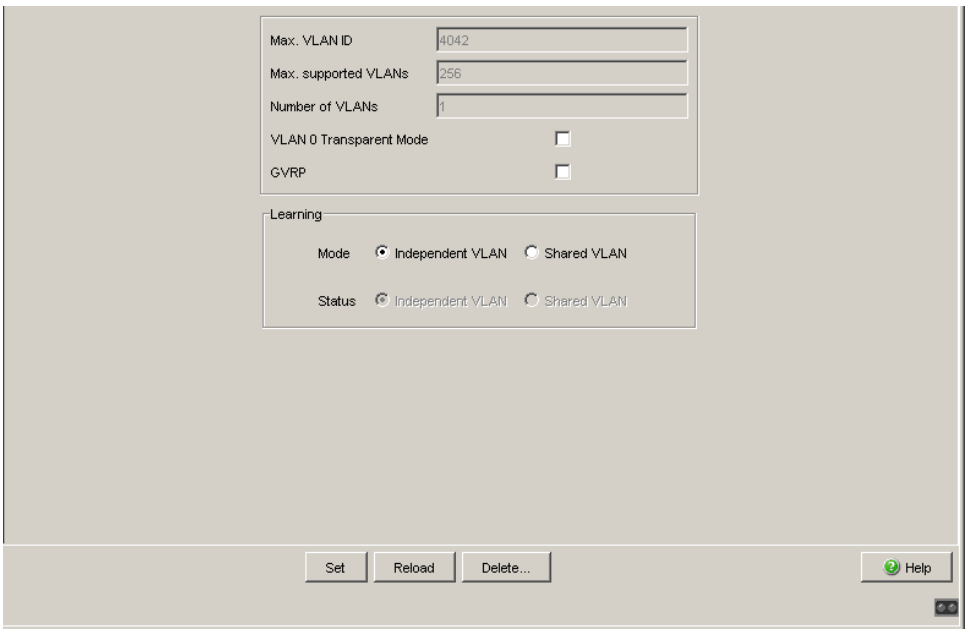


Figure 49: VLAN Global dialog

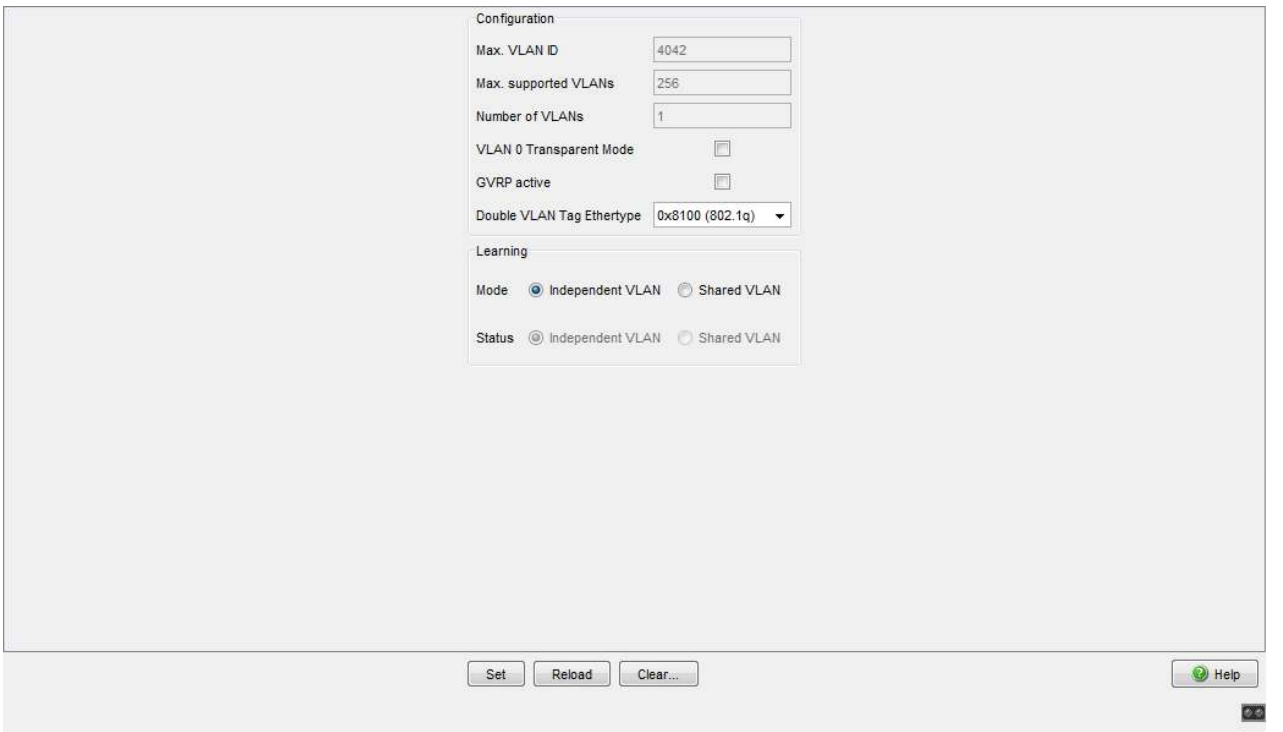


Figure 50: `Switching:VLAN:Global` dialog (MACH4000 and MACH 1040)

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Clear…	Resets the VLAN settings of the device to the state on delivery. Caution: You block your access to the device if you have changed the VLAN ID for the management functions of the device in the `Basic Settings:Network` dialog.
Help	Opens the online help.

Table 101: Buttons

4.5.2 Current VLAN

This dialog gives you the option of displaying the current VLAN parameters

The Current VLAN table shows all
- manually configured VLANs
- VLANs configured via redundancy mechanisms
- VLANs configured via GVRP

The Current VLAN Table is only used for display purposes. You can make changes to the entries in the `VLAN:Static` dialog (see on page 185 “VLAN Static”).

Note: Ports not displayed are participants in a link aggregation. You can assign these ports to a VLAN using the port assigned to the link aggregation in module 8 (display 8.X).

Parameters	Meaning	Possible values
VLAN ID	Displays the ID of the VLAN.	
Status	Displays the VLAN status.	`other`: This entry solely appears for VLAN 1. The system provides VLAN 1. VLAN 1 is always present. `permanent`: A static entry made by you. This entry is kept when the device is restarted. dynamic: This VLAN was created dynamically via GVRP.
Creation time	Operating time (see “System Data”) at which the VLAN was created.	
Ports x.x	VLAN membership of the relevant port and handling of the VLAN tag.	- Currently not a member `T` Member of VLAN; send data packets with tag. `U` Member of the VLAN; send data packets without tag (untagged). `F` Membership forbidden, so no entry possible via GVRP either.

Table 102: Current VLAN

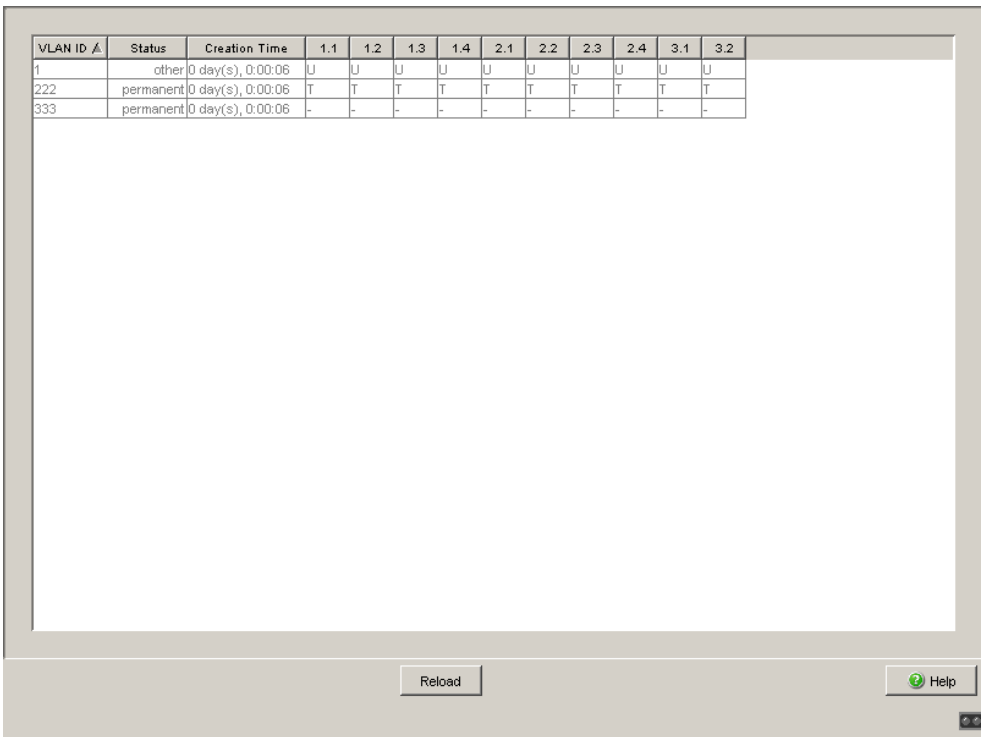


Figure 51: Current VLAN dialog

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 103: Buttons

4.5.3 VLAN Static

With this dialog you can:

- Create VLANs
- Assign names to VLANs
- Assign ports to VLANs and configure them
- Delete VLANs

Parameters	Meaning	Possible values	Default setting
VLAN ID	Displays the ID of up to 255 VLANs that are simultaneously possible. (Up to 256 VLANs possible simultaneously for Power MICE, MACH 104, MACH 1040, MACH 4000.)	1-4042	
Name	Enter the name of your choice for this VLAN.	Maximum 32 characters	VLAN 1: default
Ports x.x	Select the membership of the ports to the VLANs.	–: currently not a member (GVRP allowed). T: Member of the VLAN; send data packets with tag (tagged). U: Member of the VLAN; send data packets without tag (untagged). F: Membership forbidden, so no entry possible via GVRP either.	VLAN 1: U, new VLANs: –

Table 104: VLAN Static dialog

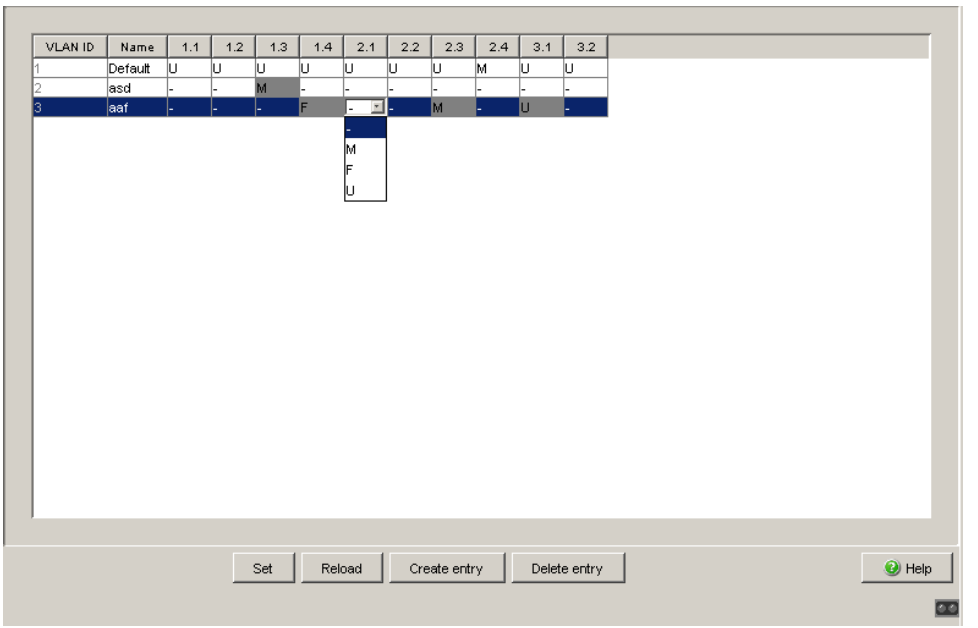


Figure 52: VLAN Static Dialog

Note: When configuring the VLAN, ensure that the management station still has access to the device after the VLAN configuration is saved.
Connect the management station to a port that is a member of the VLAN that is selected as the management VLAN. In the state on delivery, the device transmits the management data in VLAN 1.

Note: The device automatically creates VLANs for MRP rings. The MRP ring function prevents the deletion of these VLANs.

Note: Note the tagging settings for ports that are part of a redundant Ring or of the Ring/network coupling.

Redundancy	VLAN membership
HIPER-Ring	VLAN 1 U
MRP-Ring	any
Ring/Network coupling	VLAN 1 U

Table 105: Required VLAN settings for ports that are part of redundant Rings or Ring/Network coupling.

Note: In a redundant ring with VLANs, you should only operate devices whose software version supports VLANs:

- RS2 xx/xx (from rel. 7.00)
- RS2-16M
- RS20, RS30, RS40 (with software variants L2E, L2P)
- MICE (from rel. 3.0)
- PowerMICE
- MS20, MS30
- RSR20, RSR30
- MACH 100
- MACH 1000
- MACH 4000
- MACH 3000 (from Rel. 3.3),
- OCTOPUS

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 106: Buttons

4.5.4 Port

With this dialog you can:

- assign ports to VLANs
- define the Acceptable Frame Type
- activate/deactivate Ingress Filtering
- activate/deactivate GVRP

Parameters	Meaning	Possible values	Default setting
Port	Port to which this entry applies.		
Port VLAN ID	Specifies which VLAN the port assigns a received, untagged data packet to.	All allowed VLAN IDs	1

Acceptable Frame Types	Specifies whether the port can also receive untagged data packets.
	`admitAll`: The device accepts frames received on this port and assigns untagged or Priority-tagged frames to the port PVID.
	`admitOnlyVlanTagged`: The device discards untagged frames received on this port.
	`admitOnlyUntagged`: The device discards frames with a VLAN tag. This value is available on MS, RS, Octopus, MACH102, MACH1020/30, and RSR devices.
		`admitAll`
		`admitOnlyVlanTagged`
		`admitOnlyUntagged`
			`admitAll`

Ingress Filtering	Specifies whether the port evaluates the received tags.	`on`, `off`	`off`

Table 107: `Switching:VLAN:Port` dialog

Parameters	Meaning	Possible values	Default setting
GVRP	- on: The device sends and receives GVRP data packets. The device exchanges VLAN configuration data with other devices. - off: The device does not send or receive GVRP data packets. The device does not exchange VLAN configuration data with other devices.	`On` (selected), `Off` (not selected)	`Off`
DVLAN Tag Mode	- `normal`: The port is not involved in DVLAN tagging. - `core`: The port sends a double-tagged frame with the Ether type selected under “Double VLAN Ether type”. For this, you include the port as a tagged member in all tunnel VLANs. - `access`: The port assigns its port VLAN ID to a received frame, even for an already tagged frame. The port sends the originally received frame back out (tagged or untagged). You assign the port the tunnel VLAN ID as port VLAN ID and include it as an untagged member in this VLAN.	`normal`, `core`, `access`	`normal`

Table 107: `Switching:VLAN:Port` dialog

Note: If you selected `admitOnlyVlanTagged` under "Acceptable Frame Types" and GVRP is active, you assign the value 0 to the VLAN ID in `Basic Settings:Network`.

Note: Note the following:

- HIPER-Ring
  Select the port VLAN ID 1 for the ring ports and deactivate “`Ingress Filtering`”.
- MRP-Ring
  - If the MRP-Ring configuration (see on page 252 “Configuring the MRP-Ring”) is not assigned to a VLAN, select the port VLAN ID 1.
  - If the MRP-Ring configuration (see on page 252 “Configuring the MRP-Ring”) is assigned to a VLAN, the device automatically performs the VLAN configuration for this port.
- Network/Ring coupling
  Select the VLAN ID 1 for the coupling and partner coupling ports and deactivate “`Ingress Filtering`”.

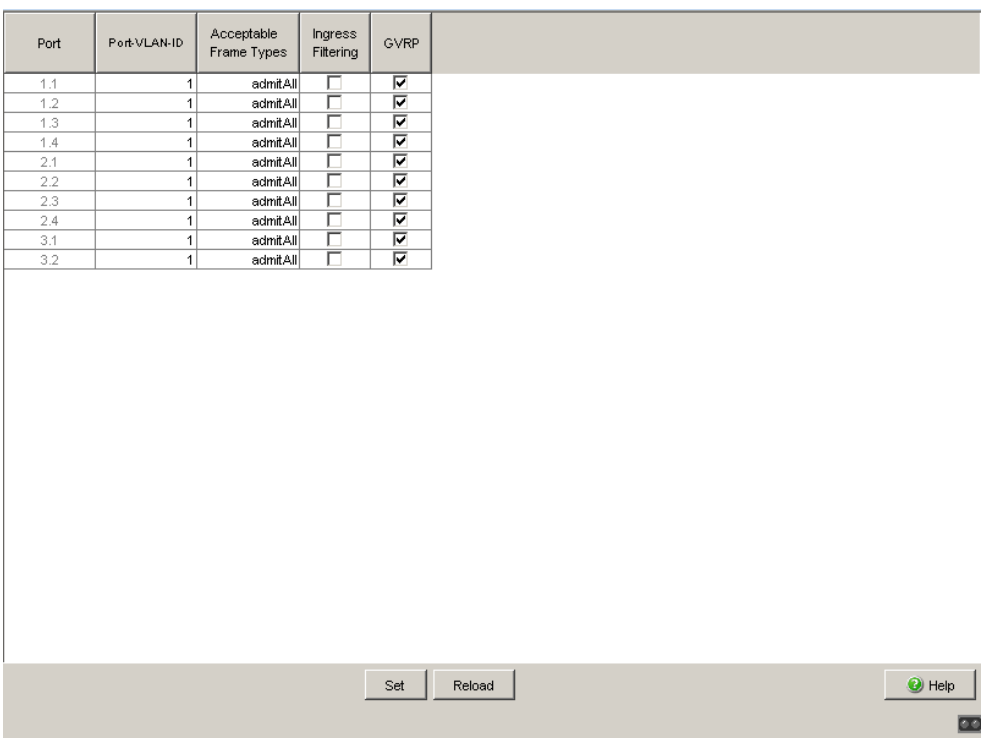


Figure 53: `Switching:VLAN:Port` dialog

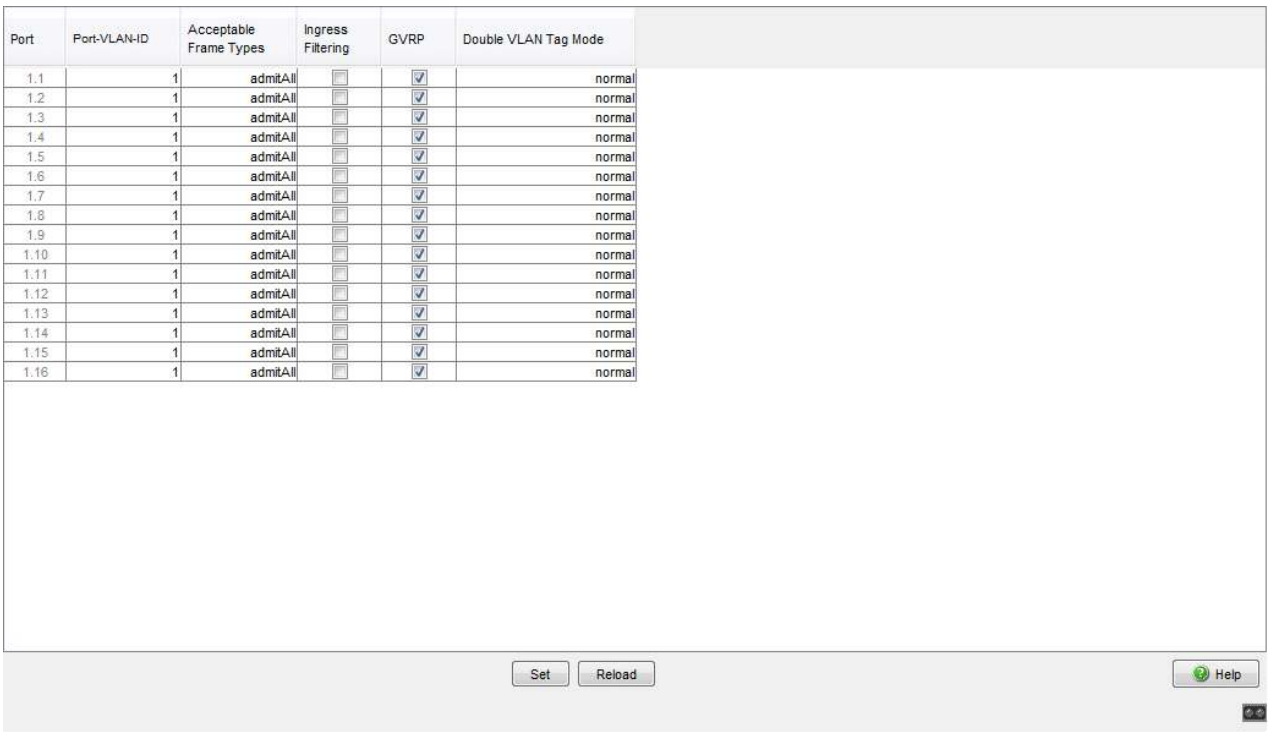


Figure 54: `Switching:VLAN:Port` dialog (MACH4000 and MACH1040)

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 108: Buttons

4.5.5 Voice VLAN

The voice VLAN function enables you to operate voice devices, e.g. VoIP telephone via plug-and-play.

For this purpose, you can use one or several VLANs configured in the Switch as voice VLANS and define voice VLAN network policy per port. The policy consists of the voice VLAN mode, the voice VLAN ID and the voice VLAN priority. The Switch sends it via LLDP-MED to the terminal devices connected.

An LLDP-MED-capable terminal device can then determine the proper settings automatically in order to receive its data traffic.

What is required for this is that you activate at the Switch both the LLDP (see on page 347 “LLDP Information from Neighbor Devices”) and the LLDP-MED (see on page 349 “LLDP-MED (Media Endpoint Discovery)”).

This dialog allows you to do the following:

- globally activate or deactivate the transmission of a Switch voice VLAN network policy via LLDP-MED.
- assign a voice VLAN network policy to a Switch port.
  The Switch informs devices that are connected to this port about its voice VLAN network policy via LLDP-MED.
- assign a voice VLAN ID for the voice VLAN network policy to a Switch port.
  The Switch informs devices on this port via LLDP-MED about its voice VLAN network policy's voice VLAN ID.
- assign a VLAN priority for the voice VLAN network policy to a Switch port.

The Switch informs devices on this port via LLDP-MED about its voice VLAN network policy's voice VLAN priority.

- explicitly deactivate an already active 802.1X authentication for an LLDP-MED-capable device (e.g. a VoIP telephone) at a Switch port.
  - For active voice authentication, the device connected must first authenticate itself via 802.1X at the Switch. Only then will the Switch allow the device's data traffic on its port.
  - For inactive voice authentication, however, the Switch will ultimately allow the data traffic for a connected device despite an active 802.1X authentication, if - the device has identified itself via LLDP-MED as a voice device, and - the device sends tagged frames with the voice VLAN ID.

Parameters	Meaning	Possible values	Default setting
Frame Operation	Globally activates or deactivates the transmission of a port-specific voice VLAN network policy via LLDP-MED. **Note:** To transmit the voice VLAN network policy you must have activated both the LLDP (see on page 347 “LLDP Information from Neighbor Devices”) and the LLDP-MED (see on page 349 “LLDP-MED (Media Endpoint Discovery)”).	`On`, `Off`	`Off`

Table 109: Global Settings for the Voice VLAN Dialog

Parameters	Meaning	Possible values	Default setting
Port	Module and port numbers to which this entry applies	-	-
Voice VLAN Mode	Mode of the voice VLAN network policy which the Switch communicates via LLDP-MED to the devices connected. ▶ `disabled`: The Switch does not sent a voice VLAN network policy. ▶ `none`: The Switch sends the voice VLAN network policy of "none", i.e. that the device connected is to use its own configuration. ▶ `untagged`: The device connected is to send untagged frames. ▶ `vlan`: The device connected is to send VLAN-tagged frames. ▶ `dot1p-priority`: The device connected is to send priority-tagged frames (with VLAN ID 0). ▶ `vlan & dot1p-priority`: The device connected is to send VLAN- and priority-tagged frames.	`disabled`, `none`, `untagged`, `vlan`, `dot1p-priority`, `vlan & dot1p-priority`	`disabled`
VLAN ID	VLAN ID of the voice VLAN network policy which the Switch communicates via LLDP-MED to the devices connected. **Note:** Use a VLAN ID that is already configured in the Switch. This is how you enable the plug-and-play start-up of a voice device.	`0 - 4094`	`0`

Table 110: Settings for the Voice VLAN Dialog

Parameters	Meaning	Possible values	Default setting
Priority	Layer 2 (802.1p) priority of the voice VLAN network policy which the Switch communicates via LLDP-MED to the devices connected.	`none`, `0 - 7`	`none`
Bypass authentification	▶ `On`: For active 802.1X authentication, the device connected must first authenticate itself at the Switch. Only then will the Switch allow the device's data traffic on its port. ▶ `Off`: However, the Switch will ultimately allow the data traffic for a connected device despite an active 802.1X authentication, if - the device has identified itself via LLDP-MED as a voice device, and - the device sends tagged frames with the voice VLAN ID. **Note:** ▶ If you are using the authentication for a port, activate the 802.1X-based port security at this port (see on page 99 “802.1X Port Configuration”). ▶ If you are using the 802.1X-based port security, connecting more than one device to a port[a] and are also using voice authentication, then activate the MAC-based authentication. ▶ If you have set MAC- or IP-based port security for this port, it remains active in any case. ▶ Only use IP-based port security if the voice device has a secure IP address.	`On` `Off`	`On`

Table 110: Settings for the Voice VLAN Dialog

[a] For example, a VoIP telephone with integrated switch, to which you have connected a PC.

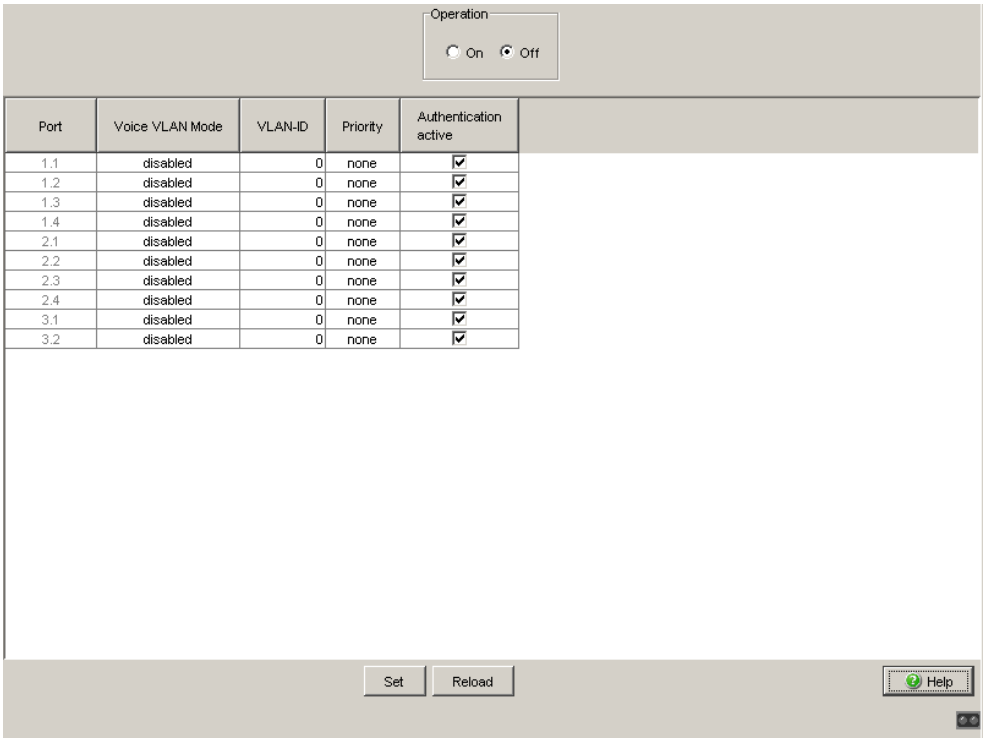


Figure 55: Voice VLAN Dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 111: Buttons

5 QoS/Priority

The device enables you to set

- how it evaluates the QoS/prioritizing information of incoming data packets:
  - VLAN priority based on IEEE 802.1Q/ 802.1D (Layer 2)
  - Type of Service (ToS) or DiffServ (DSCP) for IP packets (Layer 3)
- which QoS/prioritizing information it writes to outgoing data packets (e.g. priority for management packets, port priority).

The QoS/Priority menu contains the dialogs, displays and tables for configuring the QoS/priority settings:

- Global
- Port configuration
- IEEE 802.1D/p mapping
- IP DSCP mapping
- Queue Management

5.1 Global

With this dialog you can:

- enter the VLAN priority for management packets in the range 0 to 7 (default setting 0).
  In order for you to have full access to the management of the device, even when there is a high network load, the device enables you to prioritize management packets.
  In prioritizing management packets (SNMP, Telnet, etc.), the device sends the management packets with priority information.
  Note the assignment of the VLAN priority to the traffic class (see table 116).
- enter the IP-DSCP value for management packets in the range 0 to 63 (default setting: 0 (be/cs0)).
  In order for you to have full access to the management of the device, even when there is a high network load, the device enables you to prioritize management packets.
  In prioritizing management packets (SNMP, Telnet, etc.), the device sends the management packets with priority information.
  Note the assignment of the IP-DSCP value to the traffic class (see table 114).

  Note: Certain DSCP values have DSCP names, such as be/cs0 to cs7 (class selector) or af11 to af43 (assured forwarding) and ef (expedited forwarding).

- display the maximum number of queues possible per port.
  The device supports 4 (8 for MACH 4000, MACH 104, MACH 1040 and PowerMICE) priority queues (traffic classes in compliance with IEEE 802.1D).

Note: Changing the global setting for „Trust Mode“ and clicking “Set“ will set all ports‘ settings at once. You can then modifiy each port's settings individually.
Changing the global setting again will overwrite the individual port settings.

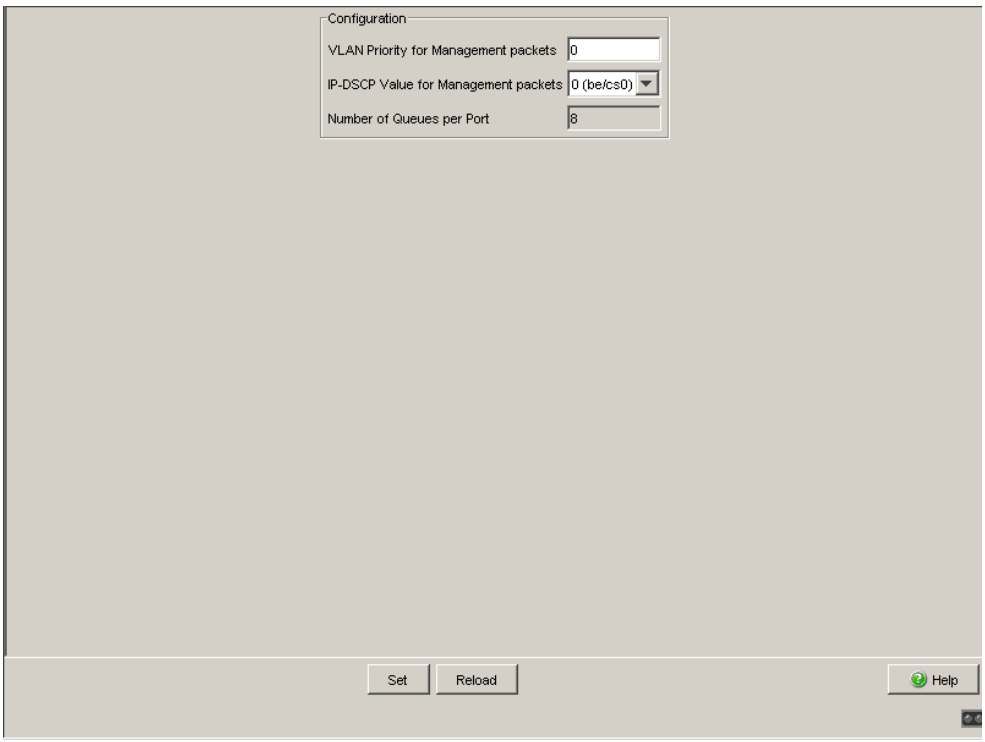


Figure 56: Global dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 112: Buttons

5.2 Port Configuration

This dialog allows you to configure the ports. You can:
- assign a port priority to a port.
- select the trust mode for a port,
- display the untrusted traffic class,
- assign a shaping rate to a port,

Parameter	Meaning
Module.Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two.
Port priority	Enter the port priority.
Trust mode	Select the trust mode.
Untrusted traffic class	Display the traffic class used in the “untrusted” trust mode.
Shaping rate	Select the maximum bandwidth available in %. Range permitted: 0% (off) to 95% in steps of 5%.

Table 113: Port configuration table

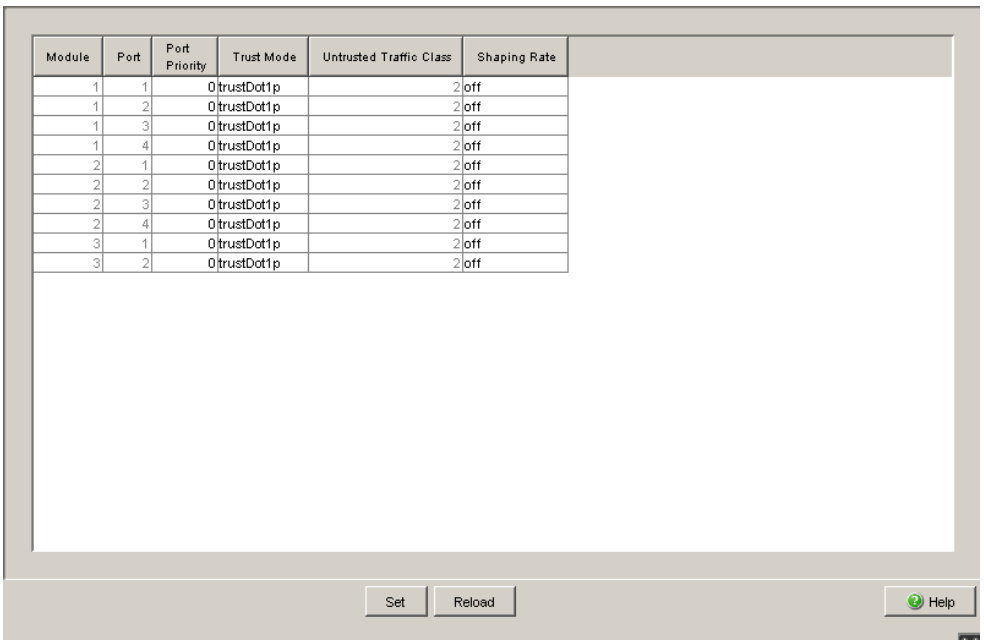


Figure 57: Port configuration dialog

5.2.1 Entering the port priority

☐ Double-click a cell in the “Port priority” column and enter the priority (0-7). According to the priority entered, the device assigns the data packets that it receives at this port to a traffic class (see table 114).
Prerequisite:
setting in the `Trust Mode column: untrusted` or
setting in the `Trust Mode column: trustDot1p` and the data packets do not contain a VLAN tag or
setting in `Trust Mode column: trustIpDscp` and the data packets are not IP packets.

Port priority	Traffic class (default setting)	IEEE 802.1D traffic type
0	2	Best effort (default)
1	0	Background
2	1	Standard
3	3	Excellent effort (business critical)
4	4	Controlled load (streaming multimedia)
5	5	Video, < 100 ms of latency and jitter
6	6	Voice, < 10 ms of latency and jitter
7	7	Network control reserved traffic

Table 114: Assigning the port priority to the traffic classes

5.2.2 Selecting the Trust Mode

The device provides 3 options for selecting how it handles received data packets that contain priority information. Click once on a cell in the “Trust mode” column to select one of the 3 options:

- “untrusted”
  The device ignores the priority information in the packet and always assigns the packets the port priority of the receiving port.
- “trustDot1p”:
  The device prioritizes received packets that contain VLAN tag information according to this information (assigning them to a traffic class - see “802.1D/p mapping”).
  The device prioritizes received packets that do not contain any tag information (assigning them to a traffic class - see “Entering the port priority”) according to the port priority of the receiving port .
- “trustIpDscp”:
  The device prioritizes received IP packets (assigning them to a traffic class - see “IP DSCP mapping”) according to their DSCP value.
  The device prioritizes received packets that are not IP packets (assigning them to a traffic class - see “Entering the port priority”) according to the port priority of the receiving port .
  - For received IP packets:
    The device also performs VLAN priority remarking.
    In VLAN priority remarking, the device modifies the VLAN priority of the IP packets if the packets are to be sent with a VLAN tag (see on page 185 “VLAN Static”).
  - For received IP packets:
    Based on the traffic class to which the IP packet was assigned (see above), the device assigns the new VLAN priority to the IP packet in accordance with table 118.
    Example: A received IP packet with a DSCP value of 16 (cs2) is assigned traffic class 1 (default setting). The packet is now assigned VLAN priority 2 in accordance with table 118.

5.2.3 Displaying the untrusted traffic class

“Untrusted traffic class” shows you the traffic class that is used in the “untrusted” trust mode. When you change the port priority (see on page 202 “Entering the port priority”), the untrusted traffic class also changes (see table 118).

5.2.4 Shaping rate

The device allows you to limit the maximum bandwidth of a port (traffic shaping).

Click once on a cell in the “Shaping rate” column to select one of the possible values for the bandwidth limit in the range from 5% to 95%, in steps of 5%.

- ☐ The value “off” means: no bandwidth limit (0%).
- ☐ The value “95” means that 95% of the bandwidth is available.

If the bandwidth set is temporarily exceeded, the device saves the data and sends it when the bandwidth load has decreased again. Traffic Shaping thus smooths out any overload situations.

If Traffic Shaping is active on an interface, the device ignores the bandwidths reserved for Weighted Fair Queuing.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 115: Buttons

5.3 802.1D/p mapping

The 802.1D/p mapping dialog allows you to assign a traffic class to every VLAN priority.

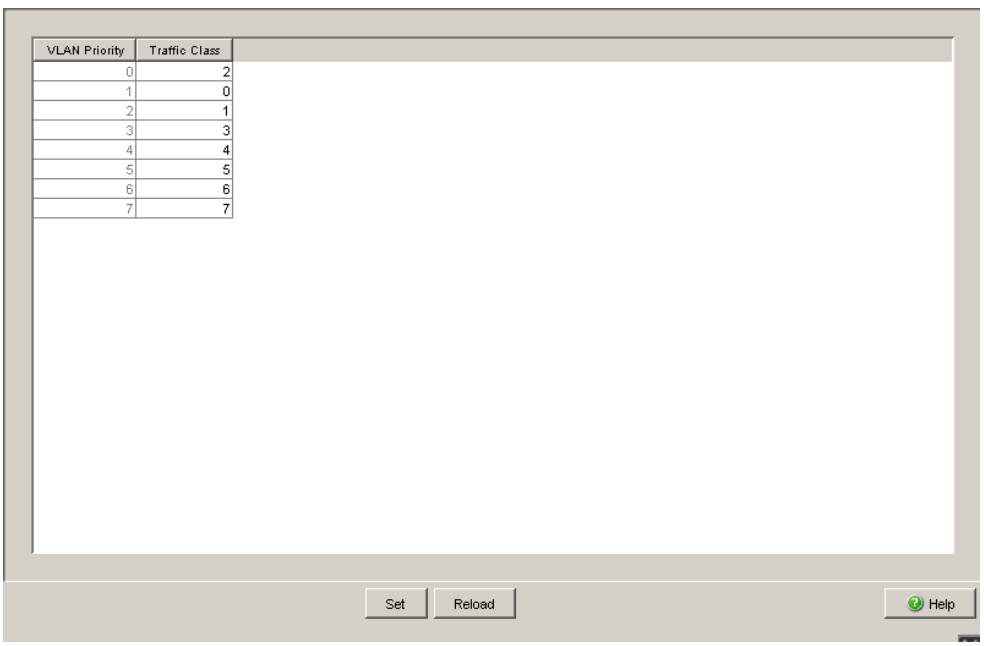


Figure 58: 802.1D/p Mapping dialog

☐ Enter the desired value from 0 to 7 in the Traffic Class field for every VLAN priority.

VLAN priority	Traffic class (default setting)	IEEE 802.1D traffic type
0	2	Best effort (default)
1	0	Background

Table 116: Assigning the VLAN priority to the 8 traffic classes

VLAN priority	Traffic class (default setting)	IEEE 802.1D traffic type
2	1	Standard
3	3	Excellent effort (business critical)
4	4	Controlled load (streaming multimedia)
5	5	Video, < 100 ms of latency and jitter
6	6	Voice, < 10 ms of latency and jitter
7	7	Network control reserved traffic

Table 116: Assigning the VLAN priority to the 8 traffic classes

Note: Network protocols and redundancy mechanisms use the highest traffic class 7. Therefore, select other traffic classes for application data.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 117: Buttons

5.4 IP DSCP mapping

The IP DSCP mapping table allows you to assign a traffic class to every DSCP value.

☐ Enter the desired value from 0 to 7 in the Traffic Class field for every DSCP value (0-63).

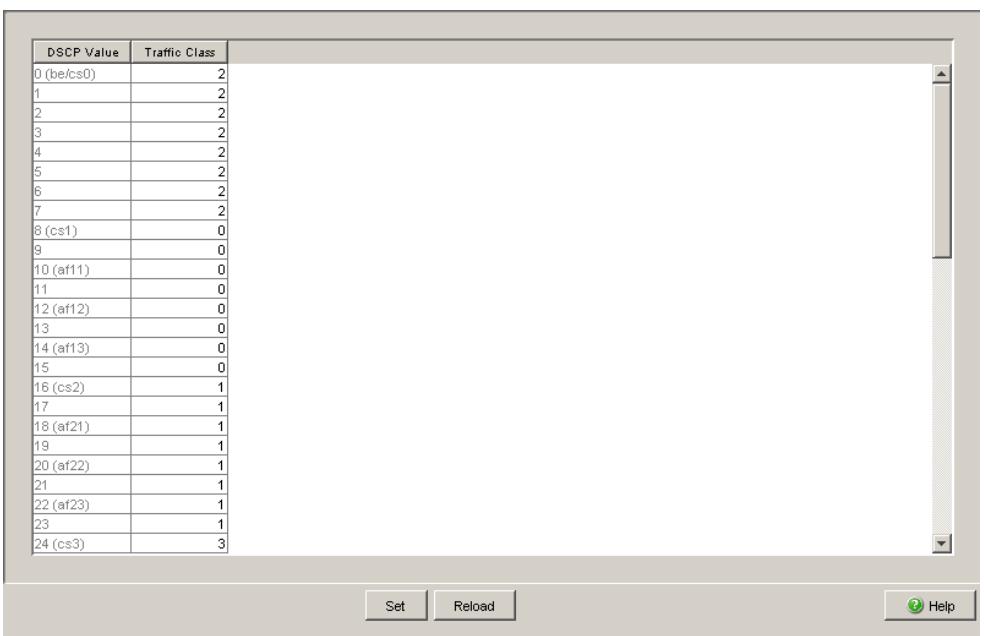


Figure 59: IP DSCP mapping table

The different DSCP values get the device to employ a different forwarding behavior, namely Per-Hop Behavior (PHB).
PHB classes:

- Class Selector (CS0-CS7): For reasons of compatibility to TOS/IP Precedence
- Expedited Forwarding (EF): Premium service.
  Reduced delay, jitter + packet loss (RFC 2598)

- Assured Forwarding (AF): Provides a differentiated schema for handling different data traffic (RFC 2597).
- Default Forwarding/Best Effort: No particular prioritizing.

DSCP value	DSCP name	Traffic class (default setting)
0	Best Effort /CS0	2
1-7		2
8	CS1	0
9,11,13,15		0
10,12,14	AF11,AF12,AF13	0
16	CS2	1
17,19,21,23		1
18,20,22	AF21,AF22,AF23	1
24	CS3	3
25,27,29,31		3
26,28,30	AF31,AF32,AF33	3
32	CS4	4
33,35,37,39		4
34,36,38	AF41,AF42,AF43	4
40	CS5	5
41,42,43,44,45,47		5
46	EF	5
48	CS6	6
49-55		6
56	CS7	7
57-63		7

Table 118: Mapping the DSCP values onto the traffic classes

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".

Table 119: Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 119: Buttons (cont.)

5.5 Queue Management

For every traffic class, the Queue Management table allows you to:

- enable Strict Priority (= disable Weighted Fair Queuing),
- disable Strict Priority (= enable Weighted Fair Queuing),
- enter a value for activated Weighted Fair Queuing for minimum bandwidth,
- enter a value for the maximum bandwidth,

Note: Disabling Strict Priority for a traffic class also disables Strict Priority for all traffic classes with a lower priority level. Enabling Strict Priority for a traffic class enables Strict Priority for all traffic classes with a higher priority level.

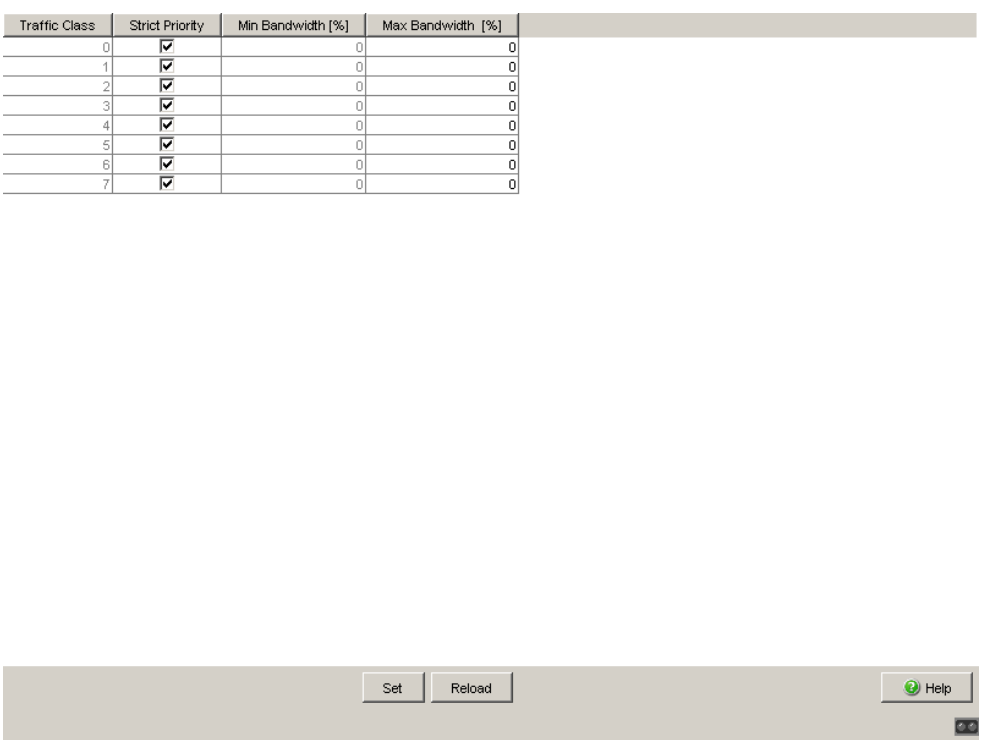


Figure 60: Queue Management table

5.5.1 Strict Priority

With the Strict Priority setting, the device first transmits data packets that have a higher traffic class (higher priority) before transmitting a data packet with the next highest traffic class. The device transmits a data packet with the lowest traffic class (lowest priority) when there are no other data packets remaining in the queue. In unfortunate cases, the device never sends packets with a low priority if there is a high volume of high-priority traffic waiting to be sent on this port.
In applications that are time- or latency-critical, such as VoIP or video, Strict Priority enables high-priority data to be sent immediately(see on page 212 “Maximum Bandwidth”).

☐ In the “Strict Priority” column you enable the function for the desired traffic class.

5.5.2 Weighted Fair Queuing

With Waited Fair Queuing, also called WeightedRoundRobin (WRR), the user assigns a minimum or reserved bandwidth to each traffic class. This ensures that data packets with a lower priority are also sent when the network is very busy.

If you assign Weighted Fair Queuing to every traffic class, the entire bandwidth for the corresponding port is available to you.

The weighting values range from 0% to 100% of the available bandwidth, in steps of 5%.

▶ A weighting of 0 is equivalent to a "no bandwidth" setting.

▶ The sum of the individual bandwidths may add up to 100%.

☐ In the “Strict Priority” column you enable the function for the desired traffic class. To do so, you disable “Strict Priority”.

☐ In the “Minimum Bandwidth” column you enter a value for the desired traffic class.

5.5.3 Maximum Bandwidth

By entering a maximum bandwidth you can limit the bandwidth for each traffic class to a maximum value, regardless of whether you selected "Weighted Fair Queuing" or "Strict Priority".

- Weighted Fair Queuing (see on page 211 “Weighted Fair Queuing”) requires that the maximum bandwidth is at least as big as the minimum bandwidth.
- With "Strict Priority", individual high-priority packets with low latency are processed (see on page 211 “Strict Priority”). If the maximum bandwidth is configured to a value less than 100%, even data packets will lower traffic classes can be sent in periods of high-priority overloading.
  The weighting values range from 0% to 100% of the available bandwidth, in steps of 5%.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 120: Buttons

6 Routing

A router is a node for exchanging data on the layer 3 of the ISO/OSI layer model (network layer).

The Routing section contains the dialogs for configuring the routing function.

6.1 Routing Global

With this dialog you can:

- switch on the routing function globally.
  Default setting: Routing is switched off.
- display the default TTL (Time To Live).
  TTL is a value in an IP data packet. Every router that passes on a data packet reduces this value by 1. The router that receives a data packet with the TTL value 1 rejects the data packet and reports it to the sender, whose IP source address is contained in the IP packet.
  If the Switch sends its own data packet, then it sets the TTL value to the default value displayed. Default value: 64.

Note: When you activate routing, the device automatically activates the learning of MAC source addresses . If routing is active, the device prevents the address learning from being switched off.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 121: Buttons

6.2 Configuring Router Interfaces

With these dialogs you can:

- Configure port-based and VLAN-based router interfaces.
- Assign a number of IP addresses for each router interface (multinetting).

6.2.1 Configuration

This dialog allows you to configure the router interfaces. You can:

- assign an IP address/netmask to a router interface. Enter additional addresses for a router interface in the “Secondary addresses” dialog (multinetting).
- set up a VLAN-based router interface.
- switch the routing function for each routing interface on/off.
- switch the proxy ARP function for each routing interface on/off.
- switch the net-directed broadcasts function for each routing interface on/off.
- **For the MACH 104 and MACH 1040 devices:**
  enter an IP MTU value for a particular routing interface.

Parameters	Meaning
Module	Module of the Switch on which the port is located. The Switch uses the virtual module 9 for a VLAN-based router interface.
Port	Port to which this entry applies.
Type	Type of the router interface: – Ethernet: physical port – VLAN: VLAN-based router interface

Table 122: Router interface table

Parameters	Meaning
VLAN ID	VLAN ID of the VLAN-based router interface.
IP Address	IP address for this router interface.
Netmask	Netmask for this router interface
Routing	Switches the routing function on and off for this router interface.
Proxy ARP	Switches the proxy ARP function on and off for this router interface.
Netdirected Broadcasts	Switches the Netdirected Broadcasts function on and off for this router interface.

Table 122: Router interface table

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Remove	Removes the selected table entry.
Wizard	Opens the "Wizard". With the "Wizard" you assign the permitted MAC addresses to a port.
Help	Opens the online help.

Table 123: Buttons

Configuring the port-based router interface

- ☐ Double-click on a cell in the “IP Address” column and enter the IP address for this router interface.
- ☐ Double-click on a cell in the “Netmask” column and enter the netmask for this router interface.
- ☐ Click once on a cell in the “Routing” column to switch on the routing function for this router interface.
- ☐ Click once on a cell in the “Proxy ARP” column to switch on the proxy ARP function for this router interface.
- ☐ Click once on a cell in the “Netdirected Broadcasts” column to switch on the Netdirected Broadcasts function for this router interface.

Setting up a VLAN-based router interface

- ☐ Click “Wizard” on the bottom right.
- ☐ In the Wizard window,
  – select a row in the table to configure an existing VLAN, or
  – enter a VLAN ID for a new VLAN to be configured.
- ☐ Click “Next”.
- ☐ In the next Wizard window, enter the name of your choice under “VLAN Name”.
- ☐ In the “Member” column select the ports you wish to assign to the VLAN.
- ☐ “Untagged”: In this column you select the ports that you want to be members of the VLAN and that will send data packets without a tag.
- ☐ “Port VLAN ID”: Double-click on a cell in this column in order to change the port VLAN ID. A tag with this port VLAN ID is added to data packets which this port receives without a tag.
- ☐ Click “Next”.
- ☐ In the “Primary IP Address” frame you enter the IP address of this router interface and the related netmask.
  The “Secondary Addresses/Multinetting” frame enables you to assign additional IP addresses to this router interface. Enter the IP address and the netmask.
  Click “Add” to transfer the entry to the table.
  Select a row in the table to delete it from the table using “Remove”.
- ☐ Click “Finish” to transfer the configured VLAN-based router interface to the router interface table.

You then have the option of configuring additional parameters in the table for the VLAN-based router interface, like with the configuration of port-

based router interfaces.

☐ Click once on a cell in the “Routing” column to switch the routing function for this router interface on or off.

☐ Click once on a cell in the “Proxy ARP” column to switch on the proxy ARP function for this router interface.

☐ Click once on a cell in the “Netdirected Broadcasts” column to switch on the Netdirected Broadcasts function for this router interface.

Deleting a router interface

☐ Select a row and click "Delete". By doing this,
– you delete the row if it is a VLAN-based entry, or
– you reset the values in the row if it is a port-based entry.

Note: The prerequisite for resetting the values is the prior deletion of other entries (if present) in the "Secondary Addresses" dialog.

6.2.2 Configuring secondary addresses

When you want to use the multinetting function, this dialog enables you to assign secondary IP addresses to a router interface.

☐ Use the left mouse-button to select a row that contains the port ID in the first column. Right-click on the selected row and select “Add IP address” to add a secondary IP address/netmask to the router interface.

Note: You have the option to configure up to 31 secondary IP addresses per router interface and a total of up to 1,024 secondary IP addresses per router.

☐ To delete or edit an existing secondary address, select the appropriate row, right-click on this row, and select “Edit” or “Delete”.

Note: The prerequisite for deletion is that routing has been switched on for this router interface in the “Router Interfaces” dialog.

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Add IP Address	Opens the "Create" dialog. This dialog gives you the option of adding a further IP address to a router interface. Enter the desired value in the "IP Address" and "Netmask" fields. Confirm the entry by clicking on "OK".
Delete IP Address	This dialog gives you the option of deleting an IP address for a router interface. Select an IP address in the list and then click "Delete IP Address".
Help	Opens the online help.

Table 124: Buttons

6.3 ARP

The Address Resolution Protocol (ARP) determines the MAC address that belongs to an IP address.

With this dialog you can:
- set parameters for the ARP,
- view statistical values and
- view the table of the ARP entries, delete the dynamic entries in the ARP table, and configure static entries.

6.3.1 Setting ARP parameters

Parameter	Meaning	Possible Values	Default Setting
Aging Time	With “Aging Time” you specify the time for which an entry remains before being deleted from the table. If there is a data transfer with the device within this time period, then the time measuring begins from the start again.	15-21600 s	1200
Response Time	With “Response Time” you specify how long ARP waits for a response before the query is seen to have failed.	1-10	1
Retries	With “Retries” you specify how often ARP repeats a failed query before stopping the query to this address.	0-10	4

Table 125: ARP parameters

Parameter	Meaning	Possible Values	Default Setting
Cache Size	“Cache Size” enables you to limit the maximum number of entries in the table. When the maximum number is reached, ARP deletes the oldest entry.	PowerMICE: 192-2112 MACH 4000: 212-2132 MACH 4000 24/48G: 212-3584	Maximum
Dynamic Renew	When the “Dynamic Renew” is switched on, ARP starts a new query to a device for which the entry has exceeded the aging time. If this query is not answered, the Switch removes the entry from the table.	on/off	on
Selective Learning	In the default setting, the router learns ARP entries passively. This means that the router receives all ARP requests and automatically learns the IP/MAC address assignment of the sending device. The automatic learning of all connected devices means that time-consuming ARP queries are excluded if the router has to send a data packet to an unknown device. In this case, the ARP tables may also be filled with unnecessary ARP entries (e.g. from devices that only wish to communicate locally). If “Selective Learning” is activated, then the router only learns the source IP/MAC address assignment if the ARP request was directed to the router itself (i.e. if the router address was explicitly queried).	on/off	off

Table 125: ARP parameters

6.3.2 ARP Statistics Display

Parameter	Meaning
Total Entry Current Count	Current number of ARP entries in the ARP table
Total Entry Peak Count	Highest number of ARP entries in the ARP table
Static Entry Current Count	Current number of static ARP entries in the ARP table
Static Entry Max. Count	Maximum possible number of static ARP entries in the ARP table

Table 126: ARP Statistics

6.3.3 ARP Table Display

Parameter	Meaning
Module	Router module
Port	Port to which this entry applies.
IP Address	IP address of a device that responded to an ARP query on this port.
MAC Address	MAC address of a device that responded to an ARP query on this port.
Type	Type of entry: – static: static ARP entry that is retained even after the ARP table is deleted. – dynamic: dynamic entry that is deleted from the table after the "Aging Time" if no data is received by this device during this time. – local: IP and MAC address of the device's own port

Table 127: ARP Table

6.3.4 Editing the ARP table

Deleting dynamic entries

By clicking on "Reset" you delete the dynamic entries from the ARP table.

Editing static entries

Using an assistant, you can add, edit and delete static entries.
The prerequisites for adding static entries are:

- At least one router interface is configured, is in the network of the static entry and the routing function is switched on (see on page 215 “Configuration”).
- The router interface has at least at one port an active connection.
- The routing function is switched on globally (see on page 214 “Routing Global”).

☐ Click on "Wizard" to open the Wizard window.
☐ To create a new entry, enter the IP address in the format 0.0.0.0 and the MAC address in the format 00:00:00:00:00:00 for a new entry and click on "Add".
☐ Select an entry and click "Remove" to delete this entry.
☐ Click "Finish" to finish the editing and transfer the changes into the ARP table.
☐ Click "Cancel" to finish the editing and reject the changes.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Remove	Removes the selected table entry.
Reset	Deletes the dynamic entries from the routing APR table.

Table 128: Buttons

Button	Meaning
Wizard	Opens the "Wizard". With the "Wizard" you assign the permitted MAC addresses to a port.
Help	Opens the online help.

Table 128: Buttons (cont.)

6.4 Router Discovery Configuration

ICMP Router Discovery is a procedure for locating possible routers in the network for data transmission. The Switch supports this procedure by transferring presence messages when the function is active.

Parameter	Meaning	Value range	Default setting
Module	Router module	Device dependent	–
Port	Port of the module	Device dependent	–
VLAN ID	VLAN membership of the port	Device dependent	
Advertise Mode	Activate/deactivate the router discovery function at this port	on/off	off
Advertise Address	Destination for sending the presence messages.	Multicast/ Broadcast	Multicast

Table 129: Router discovery configuration

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 130: Buttons

6.5 RIP

The Routing Information Protocol (RIP) is a routing protocol based on the distance vector algorithm. It is used for the dynamic creation of the routing table for routers.

6.5.1 Configuration

With this dialog you can enter both general settings and settings for each port for the routing information protocol.

General settings

- Operation: Switch the RIP function on and off. Default value: off
- Auto Summary Mode: Switch the auto summary mode on and off. When this is switched on, RIP combines a number of subnetworks together, where possible, in order to reduce the range of routing information in the routing table. Default value: selected
- Host Routes Accept Mode: Switch the host routes accept mode on and off. When this is switched on, RIP allows you to enter routes with a 32-bit network mask. Default value: selected

- Advertise default route: Switch the propagation of the default route on and off. Default value: not selected
- Update interval: the time interval at which the router transfers the entire content of the routing table to the RIP neighbors. You can set values in the range from 1 to 1,000 seconds. Values below 10 seconds cause an increased network load in larger networks. Default value: 30 s
  The router sets the other RIP timers accordingly:
  – Timeout: 6 x update interval
  – Garbage collection: 10 x update interval

Update interval	Maximum number of routes
1 s	250
5 s	600
10 s	1,000

Table 131: Recommendation for setting the update interval.

- Split horizon: select the split horizon mode. The split horizon mode is used to avoid the count-to-infinity problem. Default value: simple
  – none: Switch off the split horizon (state on delivery).
  – simple: simple split horizon omits the entries known by a neighbor when sending the routing table to this neighbor.
  – poisonReverse: The PoisonReverse split horizon sends the routing table to a neighbor with the entries known by this neighbor, but denotes these entries with the infinity metric.
- Default metric: default metric for a route that RIP takes over from another protocol. This metric is used when no metric was configured for the corresponding protocol in the (see on page 229 “Route Distribution”) dialog on . Default value: 0
  The value 0 means there is no specification for the default metric. In this case, RIP uses the metric 1.

Settings per port

Parameters	Meaning
Port	Port of the module of the Switch
VLAN ID	VLAN membership of the port. Default value: -
Admin Status	Switch the RIP function at this port on and off. Default value: not selected
Send Version	RIP version that the router uses at this port to send RIP information. Default value: ripVersion2 – doNotSend: RIP does not send any routing information. – ripVersion1: RIP sends information with version 1 as a broadcast. – rip1Compatible: RIP sends information with version 2 as a broadcast. – ripVersion2: RIP sends information with version 2 as a multicast.
Receive Version	RIP version that the Switch accepts on the receiver side. Default value: rip1OrRip2 – rip1: RIP accepts RIP V1 packets. – rip2: RIP accepts RIP V2 packets. – rip1OrRip2: RIP accepts RIP V1 and V2 packets. – doNotReceive: RIP does not allow RIP information to be received.
Authentication	Type of authentication used: – “noAuthentication”: RIP information is exchanged without authentication. – “simplePassword”: RIP information is exchanged with plain text password authentication. – “md5”: RIP information is exchanged with password authentication, whereby the password is transferred with md5 encryption. Default value: noAuthentication
Key	Password for authentication. For communication purposes, the port at the other end must have the same authentication settings.
Key Identifier	Password identification number for authentication. For communication purposes, the port at the other end must have the same key ID.

Table 132: RIP configuration table

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 133: Buttons

6.5.2 Route Distribution

Route distribution describes how RIP propagates routes that RIP transferred from other protocols to other RIP routers.

Parameters	Meaning	Value range	Default setting
Source	Source from which RIP takes over routing information: – connected: The route points to a subnetwork that is connected directly to the interface. – static: The route is in the static routing table. – ospf: The route is from OSPF.	`connected`, `static`, `ospf`	
Mode	You use the mode to select whether RIP should take over routes from these sources.		
Metric	In this column you enter the metric that RIP assigned to the routes from the source. If the value 0 is entered, then RIP uses the value entered under “Default Metric” (see on page 226 “General settings”).		
Match internal	Enable: Internal OSPF routes (OSPF Intra, OSPF Inter) are adopted in RIP.	`Active`, `Inactive`	`Active`
Match external 1	Enable: External OSPF routes of metric type 1 (OSPF Ext T1) are adopted in RIP.	`Active`, `Inactive`	`Inactive`
Match external 2	Enable: External OSPF routes of metric type 2 (OSPF Ext T2) are adopted in RIP.	`Active`, `Inactive`	`Inactive`
Match NSSA external 1	Enable: External OSPF routes of metric type 1 from an NSSA (Not so Stubby Area) are adopted in RIP.	`Active`, `Inactive`	`Inactive`
Match NSSA external 2	Enable: External OSPF routes of metric type 2 from an NSSA (Not so Stubby Area) are adopted in RIP.	`Active`, `Inactive`	`Inactive`

Table 134: Route distribution table

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 135: Buttons

6.5.3 Statistics

The RIP statistics window displays the numbers on counters that count events relevant to routing.

Parameters	Meaning
Global route changes	Number of route changes caused by RIP in the routing table
Global Queries	Number of responses sent to queries from other systems
Module	Router module
Port	Port to which this entry applies
Receive Bad Packets	Number of received routing data packets that the Switch rejected for various reasons, such as different protocol version, unknown command type.
Receive Bad Routes	Number of routing information messages received, which the router ignored because the input format was invalid.
Sent Updates	Number of routing tables sent with changed routing entries.

Table 136: RIP statistics table

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 137: Buttons

6.6 Routing table

The routing table contains all the routes known by the device.

If there are a number of routes to a destination, then the device chooses the route with the lowest value in the Metric column.

Under Routing Table, you will find the following dialogs:

- Current
- Static
- Preferences

6.6.1 Current

The current routing table contains all the routes to which there is currently a valid connection.

Parameter	Meaning
Module	Module of the router
Port	Router interface
Network Address	IP address of the destination network
Netmask	Network mask for the IP address of the destination network
Next Hop IP Address	IP address of the next router on the path to the destination network.
Type	Displays the type of the entry: – local: The destination can be reached directly via this router interface. – remote: The next hop is a router.

Table 138: Current routing table

Parameter	Meaning
Protocol	Shows how the entry came about: – local: own router interface – netmg: static route – ospf – rip
Metric	Metric of this route. The Switch chooses the route with the smallest value for the metric for the transmission. If a number of routing entries with an identical network address/network mask, but with different next hop IP addresses, have the same metric, then the Switch enters all these entries in the routing table (ECMP - equal cost multiple path). The Switch supports up to four ECMP routes.

Table 138: Current routing table

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 139: Buttons

6.6.2 Static

The static routing table allows you to enter static routes.
On delivery, the preferences are set so that the Switch gives preference to statically entered routes over dynamically entered routes (see on page 235 “Preferences”).

☐ Click on “Create Entry” to open a window for entering a new row in the table.
After entering
– the IP address of the destination network
– the network mask for the IP address of the destination network, and
– IP address of the next router on the path to the destination network,
you click on “OK” to transfer the entry into the table.
You can change the entry for the preference directly in the table.

☐ To delete a row, select the row and click on “Delete entry”.

Parameter	Meaning
Destination	IP address of the destination network
Destination Mask	Network mask for the IP address of the destination network
Next Hop	IP address of the next router on the path to the destination network.
Preference	The importance of this entry, on the basis of which this route is considered in selecting the best route. As a default, the dialog takes the value from the table in the preference dialog (see on page 235 “Preferences”). A preference with the value 255 means “cannot be reached”, i.e. the route is not used.
Track ID	Identification number of the tracking object whereby if this object changes its status to `down`, the device deletes this route from the current routing table (see on page 232 “Current”).

Table 140: Table for static routes

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 141: Buttons

6.6.3 Preferences

This dialog enables you to find a default setting for the importance (administrative distance) of an entry in the routing table. The smaller the value, the more important the entry. The router automatically assigns the importance that is entered in the preference list to a new entry in the routing table.

Note: You always assign "connected" to the smallest value for the administrative distance.

Source	Meaning	Default Setting
connected	Entry for routes/interfaces connected directly to the Switch.	0
static	Entry for routes from the static routing table.	1
ospf-intra	Entry for routes from OSPF within an area	8
ospf-inter	Entry for routes from OSPF between areas	10

Table 142: Preference Lists

Source	Meaning	Default Setting
ospf-ext-t1	These routes were imported from an Autonomous System Boundary Router (ASBR) into the OSPF area. These routes use the costs relating to the connection between the ASBR and this Switch as part of the route costs.	13
ospf-ext-t2	These routes were imported from an Autonomous System Boundary Router (ASBR) into the OSPF area. These routes do not use the costs relating to the connection between the ASBR and this Switch as part of the route costs.	150
rip	Entry for routes from the Routing Information Protocol.	15

Table 142: Preference Lists

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 143: Buttons

6.7 Tracking

The tracking function gives you the option of monitoring certain objects, such as the availability of an interface.
A special feature of this function is that it forwards an object status change to an application, e.g. VRRP, which previously registered as an interested party for this information.

6.7.1 Configuration

This dialog allows you to create a new tracking object, or change or delete an existing tracking object.

The device provides tracking objects of the type:
- Interface
- Ping
- Logical

The device supports up to 128 tracking objects (track ID: 1 to 128).

Parameter	Meaning
Track ID	Identification number of this tracking object.
Active	Activate/deactivate this tracking object.
Module.Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two.
Link up delay [s]	An interface object is given the `up` status if the physical link holds for longer than the delay time.
Link down delay [s]	An interface object is given the `down` status if the physical link interruption remains for longer than the delay time.
Send change trap	Activate/deactivate the sending of an alarm when the status of this tracking object changes.

Table 144: Parameters of a tracking object of the type Interface

Parameter	Meaning
Status	Displays the status of this tracking object.
Number of changes	Displays the number of status changes.
Time since last change	Displays the time that elapsed since the last status change.

Table 144: Parameters of a tracking object of the type Interface

Parameter	Meaning
Track ID	Identification number of this tracking object.
Active	Activate/deactivate this tracking object.
IP Address	IP address of the device being monitored with ping.
Module.Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two. If you select "auto“, the device will automatically use the interface with the best route.
Ping interval [s]	Interval between the ping requests in seconds.
Ping Replies to lose	Number of lost ping responses that will result in the status `down`.
Ping Replies to receive	Number of received consecutive ping responses that will result in the status `up`.
Ping timeout [ms]	The time for which the device waits for a ping response before it evaluates this as “No ping response”.
Ping TTL	The TTL value (Time To Live) in the IP packet header that the device uses to send the ping request.
Send change trap	Activate/deactivate the sending of an alarm when the status of this tracking object changes.
Status	Displays the status of this tracking object.
Number of changes	Displays the number of status changes.
Time since last change	Displays the time that elapsed since the last status change.

Table 145: Parameters of a tracking object of the type Ping

Parameter	Meaning
Track ID	Identification number of this tracking object.
Active	Activate/deactivate this tracking object.
Operator	Operator for linking up to 8 operands (tracking objects). If the result of the link is true, then the status of this tracking object is `up`.
Operand 1 to n	Operand for the link with the operator. You select the operands from existing tracking objects.
Send change trap	Activate/deactivate the sending of an alarm when the status of this tracking object changes.

Table 146: Parameters of a tracking object of the type Logical

Parameter	Meaning
Status	Displays the status of this tracking object.
Number of changes	Displays the number of status changes.
Time since last change	Displays the time that elapsed since the last status change.

Table 146: Parameters of a tracking object of the type Logical

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Remove	Removes the selected table entry.
Wizard	Opens the "Wizard". The "Wizard" assists you in creating a new entry in the table.
Back	Displays the previous page again. Changes are lost.
Next	Saves the changes and opens the next page.
Finish	Saves the changes and completes the configuration.
Cancel	Closes the Wizard. Changes are lost.
Help	Opens the online help.

Table 147: Buttons

6.7.2 Applications

This table displays the tracking objects for which applications are registered.

- You register VRRP for a tracking object in the `Redundancy:VRRP:Configuration` dialog (see on page 301 “VRRP instance settings”).
- You register static routes for a tracking object in the `Routing:Routing Table:Static` dialog (see on page 234 “Static”).
- The devices automatically registers logical links of tracking objects for a tracking object.

Parameter	Value
Track ID	Identification number of the tracking object.
Application	Application registered for this tracking object.
Number of changes	Number of status changes for this tracking object.
Time since last change	Time that has elapsed since the last status change for this tracking object.

Table 148: Applications registered for tracking objects

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 149: Buttons

7 Redundancy

Under Redundancy you will find the dialogs and views for configuring and monitoring the redundancy functions:

- Link Aggregation
- Ring Redundancy
- Ring/Network coupling
- Spanning Tree
- VRRP/HiVRRP

Note: The “Redundancy Configuration User Manual” document contains detailed information that you require to select the suitable redundancy procedure and configure it.

7.1 Link Aggregation

With this dialog you can:
- display an overview of all the existing link aggregations,
- create link aggregations,
- configure link aggregations,
- allow static link aggregations, and
- Delete link aggregations.

The LACP (Link Aggregation Control Protocol based on IEEE 802.3ad) is a network protocol for dynamically bundling physical network connections. The added bandwidth of all connection lines is available for data transmission. In the case of a connection breaking down, the remaining connections take over the entire data transmission (redundancy). The load distribution between the connection lines is performed automatically.
You configure a link aggregation by combining at least 2 existing parallel redundant connection lines (known as a trunk) between two devices into one logical connection. You can use link aggregation to combine up to 8 (optimally up to 4) connection lines between devices into a trunk.
Any combination of twisted pair and F/O cables can be used as the connection lines of a trunk. Configure the connections so that the data rates and the duplex settings of the related ports are matching.
A maximum of 7 trunks can exit a device.

Note: Exclude the combination of a link aggregation with the following redundancy procedures:
- Network/Ring coupling
- MRP-Ring
- Sub-Ring

Note: A link aggregation connects exactly 2 devices.
You configure the link aggregation on each of the 2 devices involved. During the configuration phase, you connect only one single connection line between the devices. This is to avoid loops.

Parameter	Meaning
Allow static link aggregation	When you connect devices using multiple lines, the Link Aggregation Control Protocol (LACP) automatically prevents loops from forming. Select `Allow static link aggregation` if the partner device does not support LACP (e.g. MACH 3000). Default value: not selected
Trunk-Port	This column shows you the index under which the device uses a link aggregation as a virtual port (8.x).
Device-Ports	List of physical ports that are members of the link aggregation.
Name	Here you can assign a name to the link aggregation.
Active	This column allows you to enable/disable a link aggregation that has been set up.
Link Trap	When you select “Link Trap”, the device generates an alarm if all the connections of the link aggregation are interrupted.
STP-Mode	In the “STP Mode” column, select `on` if you have integrated the link aggregation into a Spanning Tree, or `off` if you have not.
Type	`- manual` The partner device does not support LACP, and you have selected “Allow static link aggregation”. `- dynamic` Both devices support LACP and you have not selected “Allow static link aggregation”. **Note:** If there are multiple connections between devices that all support LACP, the device displays `dynamic` even if “Allow static link aggregation” was selected. In this case, the devices automatically switch to dynamic.

Table 150: Link Aggregation

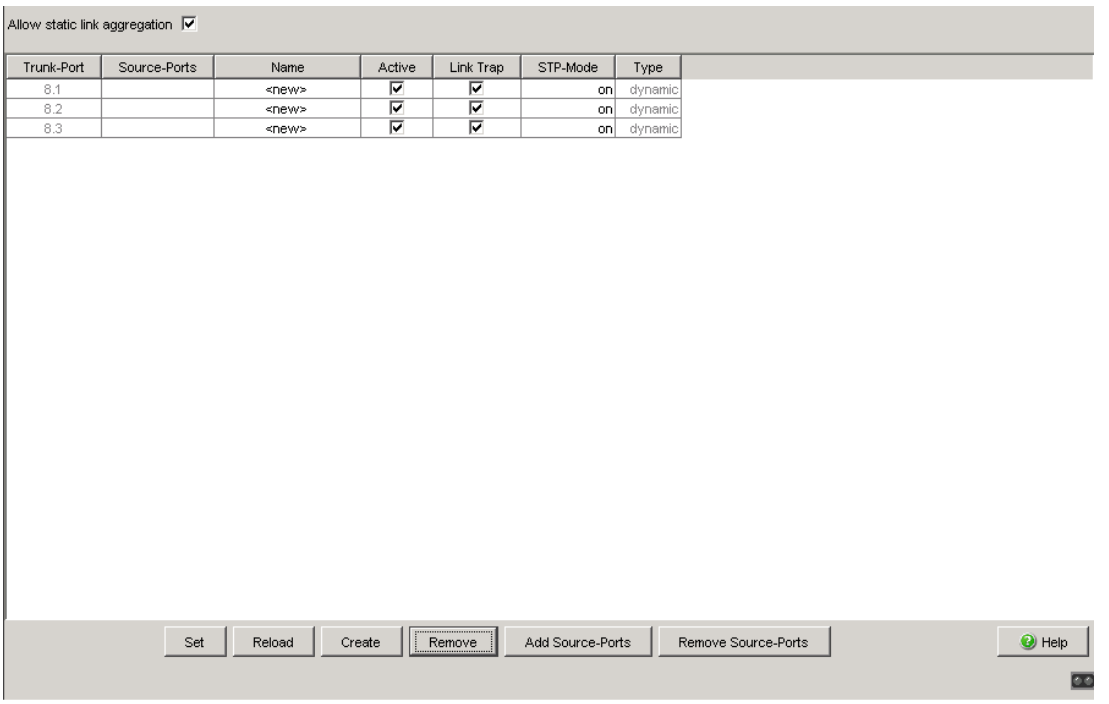


Figure 61: Setting the link aggregation

Note: For PowerMICE and MACH 4000
To increase the availability of particularly important connections, you can combine HIPER-Ring (see on page 246 “Ring Redundancy”) and link aggregation.
If you want to use a link aggregation in a HIPER-Ring, you first configure the link aggregation, then the HIPER-Ring. In the HIPER-Ring dialog, you enter the index of the desired link aggregation as the value for the module and the port (8.x). Ascertain that the respective ring port belongs to the selected link aggregation.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Add Device Ports	Opens "Select Ports to add" window which displays available ports.To add a port from the trunk, select it, then click "OK".
Remove Device-Ports	Opens a list of ports present on the trunk. To remove a port from the trunk, select it, then click "OK".
OK	Carries out the selected action.
Cancel	Stops the selected action.
Help	Opens the online help.

Table 151:Buttons

7.2 Ring Redundancy

The concept of the Ring Redundancy enables the construction of high-availability, ring-shaped network structures.

If a section is down, the ring structure of a

- HIPER-(**HI**GH **PE**RFORMANCE **R**EDUNDANCY) Ring with up to 50 devices typically transforms back to a line structure within 80 ms (possible settings: standard/accelerated).
- MRP (**M**edia **R**edundancy **P**rotocol) Ring (IEC 62439) of up to 50 devices typically transforms back to a line structure within 80 ms (adjustable to max. 200 ms/500 ms).

With the aid of a device's **R**ing **M**anager (RM) function you can close both ends of a backbone in a line-type configuration to form a redundant ring.

- Within a HIPER-Ring, you can use any combination of the following devices:
  - RS2-./.
  - RS2-16M
  - RS2-4R
  - RS20, RS30, RS40
  - RSR20, RSR30
  - OCTOPUS
  - MICE
  - MS20, MS30
  - PowerMICE
  - MACH 100
  - MACH 1000
  - MACH 3000
  - MACH 4000
- Within an MRP-Ring, you can use devices that support the MRP protocol based on IEC62439.

Depending on the device model, the Ring Redundancy dialog allows you to:

- Select one of the available Ring Redundancy versions, or change it.
- Display an overview of the current Ring Redundancy configuration.
- Create new Ring Redundancies.
- Configure existing Ring Redundancies.
- Enable/disable the Ring Manager function.

- Receive Ring information.
- Delete the Ring Redundancy.

Note: Only one Ring Redundancy method can be enabled on one device at any one time. When changing to another Ring Redundancy method, deactivate the function for the time being.

Note: If you have configured a device as the MRP Ring Manager, the device enables you to carry out the MRP Ring Configuration automatically (see on page 255 “Advanced Ring Configuration/Diagnostics (ARC)”).

Parameter	Meaning

Version	Select the Ring Redundancy version you want to use:
	`HIPER-Ring`
	`MRP`

Ring port No.	In a ring, every device has 2 neighbors. Define 2 ports as ring ports to which the neighboring devices are connected.
Module	Module identifier of the ports used as ring ports
Port	Port identifier of the ports used as ring ports
Operation	Value depends on the Ring Redundancy version used. Described in the following sections for the corresponding Ring Redundancy version.

Table 152: Ring Redundancy basic configuration

7.2.1 Configuring the HIPER-Ring

Note: For the ring ports, select the following basic settings in the `Basic Settings:Port Configuration` dialog:

Port type	Bit rate	Autonegotiation (automatic configuration)	Port setting	Duplex
TX	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
TX	1 Gbit/s	on	on	-
Optical	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
Optical	1 Gbit/s	on	on	-
Optical	10 Gbit/s	-	on	10 Gbit/s full duplex (FDX)

Table 153: Port settings for ring ports

Note: Configure all the devices of the HIPER-Ring individually. Before you connect the redundant line, you must complete the configuration of all the devices of the HIPER-Ring. You thus avoid loops during the configuration phase.

Note: As an alternative to using software to configure the HIPER-Ring, with the RS20/30/40, MS20/30 and PowerMICE Switches, you can also use DIP switches to enter a number of settings on the devices. You can also use a DIP switch to enter a setting for whether the configuration via DIP switch or the configuration via software has priority. The state on delivery is “Software Configuration”. You will find details on the DIP switches in the “Installation” user manual.

Parameter	Meaning
Ring port X.X operation	Display in “Operation” field: `active`: This port is switched on and has a link. `inactive`: This port is switched off or it has no link.
Ring Manager Status	Status information, no input possible: `Active (redundant line)`: The redundant line was closed because a data line or a network component within the ring failed. `Inactive`: The redundant ring is open, and all data lines and network components are working.
Ring Manager Mode	If there is exactly one device, you switch the Ring Manager function on at the ends of the line.
Ring Recovery	The settings in the ”Ring Recovery“ frame are only effective for devices that are ring managers. In the ring manager, select the desired value for the test packet timeout for which the ring manager waits after sending a test packet before it evaluates the test packet as lost. ▶ `Standard`: test packet timeout 480 ms ▶ `Accelerated`: test packet timeout 280 ms **Note:** The settings are especially meaningful if at least one line in the ring consists of a 1,000 MBit/s twisted pair line. The reconfiguration time after connection interruption existing due to the reaction characteristic of 1,000 MBit/s twisted pair ports can thus be accelerated considerably.
Information	If the device is a ring manager: The displays in this frame mean: “Redundancy working”: When a component of the ring is down, the redundant line takes over its function. “Configuration failure”: You have configured the function incorrectly, or there is no ring port connection.

Table 154: HIPER-Ring configuration

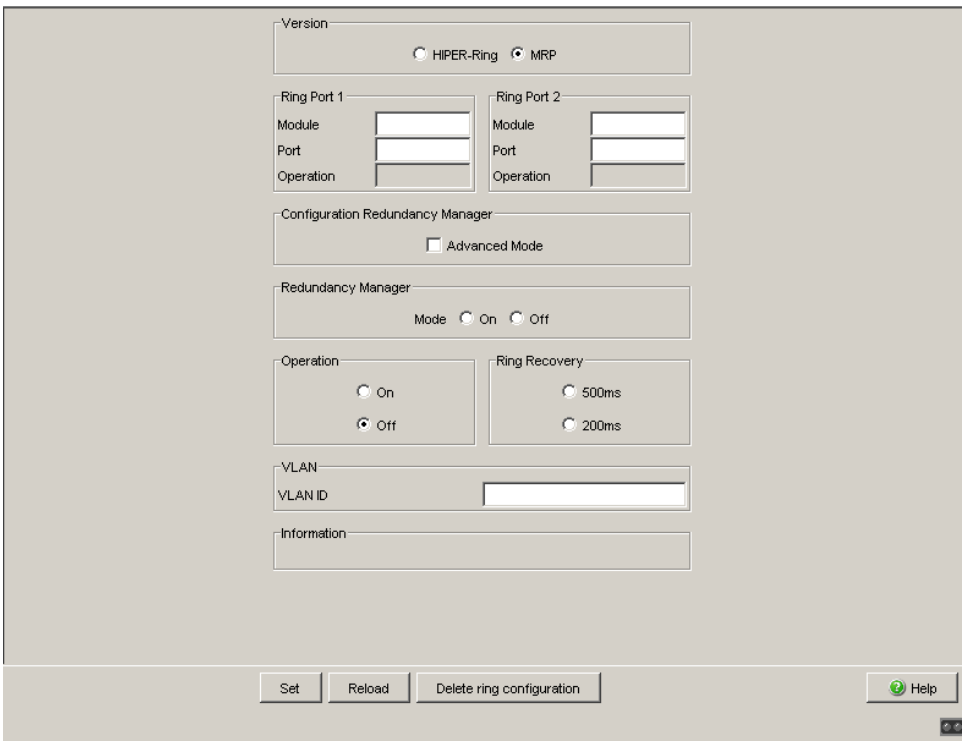


Figure 62: Selecting ring redundancy, entering ring ports, enabling/disabling ring manager and selecting ring recovery.

Note: Deactivate the Spanning Tree protocol (STP) for the ports connected to the redundant ring, because the Spanning Tree and the Ring Redundancy work with different reaction times (`Redundancy:Spanning Tree:Port`). If you used the DIP switch to activate the HIPER-Ring function, STP is automatically switched off.

Note: If you have configured VLANS, note the VLAN configuration of the ring ports.
In the configuration of the HIPER-Ring, you select for the ring ports
– VLAN ID 1 and "`Ingress Filtering`" disabled in the port table and
– VLAN membership `U` or `T` in the static VLAN table.

Note: If you are also using redundant ring/network coupling, make sure that the device is transmitting VLAN 1 packets tagged on the two ring ports.

Note: If you want to use link aggregation connections in the HIPER-Ring (PowerMICE and MACH 4000), you enter the index of the desired link aggregation entry for the module and the port.

Note: When activating the HIPER-Ring function via software or DIP switches, the device sets the corresponding settings for the pre-defined ring ports in the configuration table (transmission rate and mode). If you switch off the HIPER-Ring function, the ports, which are changed back into normal ports, keep the ring port settings. Independently of the DIP switch setting, you can still change the port settings via the software.

7.2.2 Configuring the MRP-Ring

Note: To configure an MRP-Ring, you set up the network to meet your demands. For the ring ports, select the following basic settings in the `Basic Settings:Port Configuration` dialog:

Port type	Bit rate	Autonegotiation (automatic configuration)	Port setting	Duplex
TX	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
TX	1 Gbit/s	on	on	-
Optical	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
Optical	1 Gbit/s	on	on	-
Optical	10 Gbit/s	-	on	10 Gbit/s full duplex (FDX)

Table 155: Port settings for ring ports

Note: Configure all the devices of the MRP-Ring individually. Before you connect the redundant line, you must have completed the configuration of all the devices of the MRP-Ring. You thus avoid loops during the configuration phase.

Note: If you have configured VLANs and you want to assign the MRP-Ring configuration to a VLAN.

- ☐ Select a VLAN-ID > 0 in the `VLAN` field in the `Redundancy:Ring Redundancy` dialog. Select this VLAN ID in the MRP-Ring configuration for all devices in this MRP-Ring.
- ☐ Check the VLAN configuration of the ring ports: For all ring ports in this MRP-Ring, select this corresponding VLAN ID and the VLAN membership `T` in the static VLAN table.
- ☐ Avoid the VLAN ID = 0.

Note: If you are also using redundant ring/network coupling, make sure that the device is transmitting VLAN 1 packets tagged on the two ring ports.

Parameter	Meaning
Ring port X.X operation	Display in “Operation” field: `forwarding`: This port is switched on and has a link. `blocked`: This port is blocked and has a link. `disabled`: This port is switched off. `not connected`: This port has no link.
Ring Manager Configuration	Deactivate the advanced mode if a device in the ring does not support the advanced mode for fast switching times. Otherwise you activate the advanced mode. **Note:** All Hirschmann devices that support the MRP-Ring also support the advanced mode.
Ring Manager Mode	If there is exactly one device, you switch the Ring Manager function on at the ends of the line.
Operation	When you have configured all the parameters for the MRP-Ring, you switch the operation on with this setting. When you have configured all the devices in the MRP-Ring, you close the redundant line.
Ring Recovery	For the device for which you have activated the ring manager, select the value 200 ms if the stability of the ring meets the requirements for your network. Otherwise select 500 ms. `Note`: Settings in the “Ring Recovery” frame are only effective for devices that are ring managers.
VLAN ID	If you have configured VLANs, then here you select: ▶ `VLAN ID 0` if you do not want to assign the MRP-Ring configuration to any VLAN. Note the VLAN configuration of the ring ports: Select VLAN ID 1 and VLAN membership `U` in the static VLAN table for the ring ports. ▶ `VLAN ID > 0` if you want to assign the MRP-Ring configuration to this VLAN. Select this VLAN ID in the MRP-Ring configuration for all devices in this MRP-Ring.Note the VLAN configuration of the ring ports: For all ring ports in this MRP-Ring, select this corresponding VLAN ID and the VLAN membership `T` in the static VLAN table.
Information	If the device is a ring manager: The displays in this frame mean: “Redundancy working”: When a component of the ring is down, the redundant line takes over its function. “Configuration failure”: You have configured the function incorrectly, or there is no ring port connection.

Table 156: MRP-Ring configuration

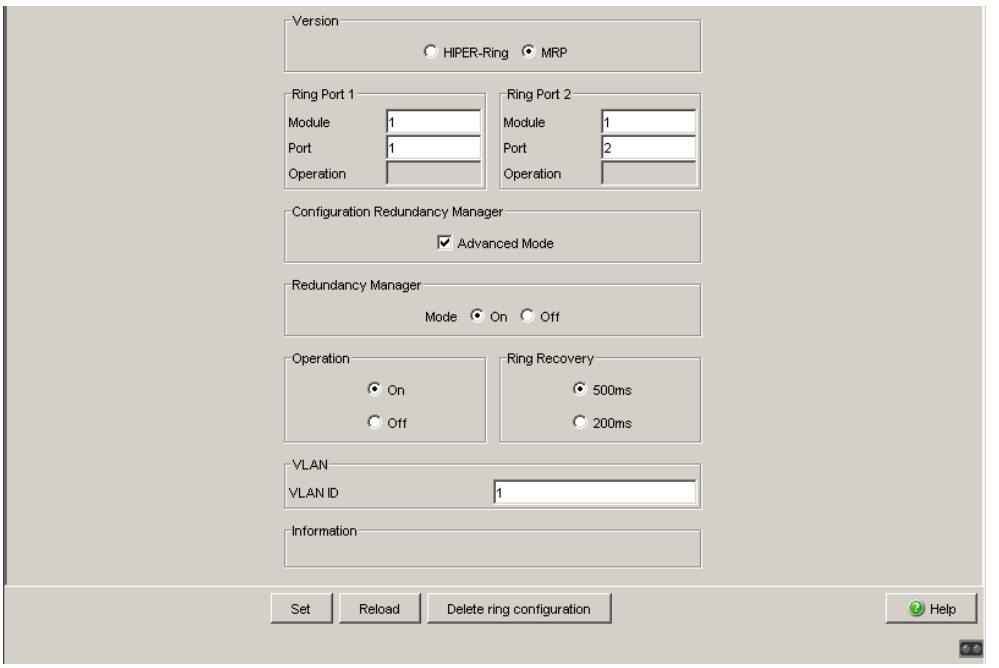


Figure 63: Selecting MRP-Ring version, entering ring ports and enabling/disabling ring manager

Note: For all devices in an MRP-Ring, activate the MRP compatibility in the `Redundancy:Spanning Tree:Global` dialog if you want to use RSTP in the MRP-Ring. If this is not possible, perhaps because individual devices do not support the MRP compatibility, you deactivate the Spanning Tree protocol on the ports connected to the MRP-Ring. Spanning Tree and Ring Redundancy affect each other.

Note: If you combine RSTP with an MRP-Ring, you must give the devices in the MRP-Ring a better (i.e. numerically lower) RSTP bridge priority than the devices in the connected RSTP network. You thus help avoid a connection interruption for devices outside the Ring.

Advanced Ring Configuration/Diagnostics (ARC)

A special feature of the Hirschmann device is completing the configuration of all the devices in an MRP Ring using the ARC protocol (Advanced Ring Configuration).

To configure an MRP Ring using ARC, all you have to do is to connect Hirschmann devices in their default state to a ring and to run the Advanced Ring Configuration/Diagnostics on a device. Only the device on which you are operating the ARC using the Web-based interface requires an IP address.

The ARC manager first sends diagnostic packets to the ring and analyzes the responses from the ring subscribers. In doing so, it determines the ring ports and the ring subscribers' current settings.
If the ARC manager determines that the requirements for the Advanced Ring Configuration/Diagnostics are met, it carries through the configuration for you automatically.
At the same time, the ARC manager sends the configuration packets to the ring. In the course of this, all the devices in the ring automatically configure their ring redundancy settings for an MRP Ring according to the ARC manager's specifications.
After this, all the devices in the ring save their new configuration non-volatilely.

The prerequisites for checking and carrying out the Advanced Ring Configuration/Diagnostics automatically are:

- Preventing loops:
  - RSTP is active on all the devices and ring ports in the ring (default: globally and active on all ports).
- All the devices in the ring support Advanced Ring Configuration/Diagnostics:
  - They operate with software variant L2P, L3E or L3P,
  - They operate with software version 07.0.00 or higher.
- All the devices that you have designated as MRP **Ring Subscribers**:
  - The ring manager's configured mode is `Off` (default: `Off`).
  - Advanced Ring Configuration/Diagnostics is `Read/Write` (default: `Read/Write`).

Note: To read the settings in the Advanced Ring Configuration/Diagnostics frame, set in the Web-based interface
- the Ring Redundancy version to `MRP` and
- the function to `On`.

– The Ring Redundancy's configured version default is `MRP`. If you have selected another version, the devices automatically set your setting to `MRP` while the Advanced Ring Configuration/Diagnostics is being carried out.
– The function's default is `Off`. The devices automatically set your setting to `On` while the Advanced Ring Configuration/Diagnostics is being carried out.

▶ The device that you have designated as MRP **Ring Manager**:
  – Only 1 device in the ring is the MRP Ring Manager,
  – The Ring Redundancy's configured version is `MRP` (default: MRP),
  – The configured ring ports correlate with the ring cabling (default for both ports: 1.1),
  – The ring manager's configured mode is `On` (default: Off),
  – The configured function is `On` (default: Off),
  – Advanced Ring Configuration/Diagnostics is `On` (default: `Off`),
  – Only this device carries out the Advanced Ring Configuration/Diagnostics.

▶ Physical Topology:
  – You connected the devices to a physical ring.

Note: Note the following special features of the Advanced Ring Configuration/Diagnostics:

▶ Advanced Ring Configuration/Diagnostics configures an MRP Primary Ring only. Manually configure rings with another redundancy protocol, as well as Sub-Rings.
▶ When carrying out the Advanced Ring Configuration/Diagnostics configuration, deactivate all the devices in the ring at their ring ports. Exception: If the "MRP Compatibility" setting is active on a device (see on page 274 “Global”), then the device leaves RSTP activated on the ring port.
  If you need RSTP, activate RSTP on the ring ports manually (see on page 288 “Port”).

If you have designated a device as a Ring **Subscriber**, it displays the “Advanced Ring Configuration/Diagnostics” frame, including 3 selection options, in the Ring Redundancy dialog.
If necessary, select the “Read/Write” option and save the setting to the device.

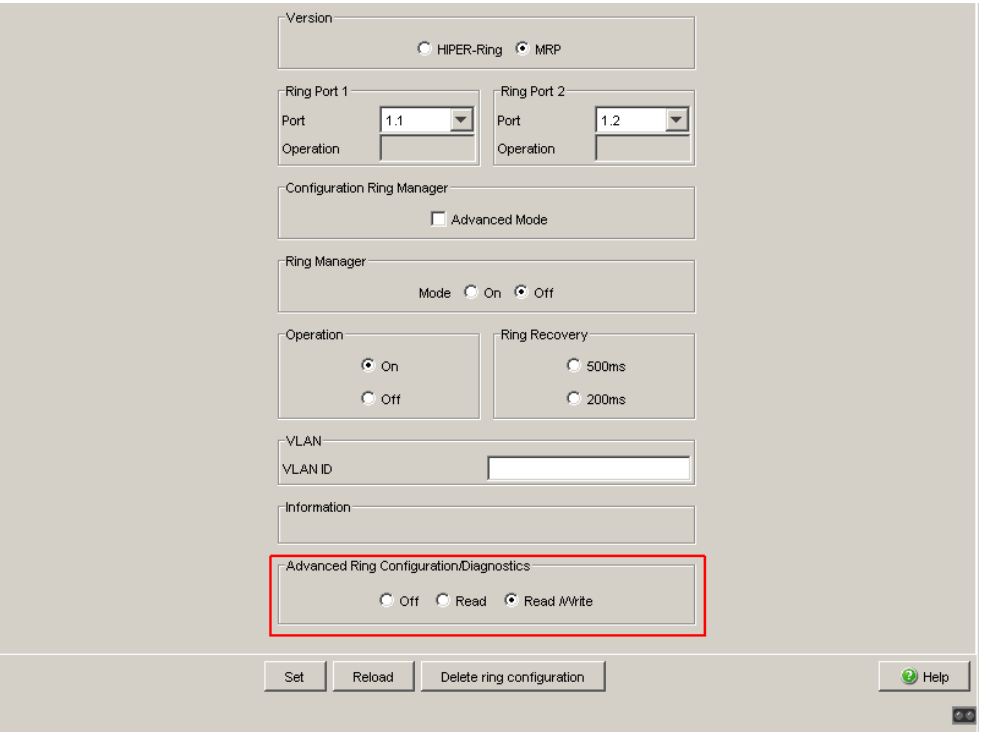


Figure 64: Ring Redundancy Dialog, Advanced Ring Configuration/Diagnostics of an MRP client

If you have designated a device as a Ring **Manager**, it displays the “Advanced Ring Configuration/Diagnosics Protocol” frame in the Ring Redundancy dialog. It includes 2 selection options and the “Configuration” and “Diagnostics” buttons.
If necessary, select the “On” option and save the setting to the device.

To check whether the ARC can configure the ring automatically, click on “Diagnostics”. To configure the ring automatically using the ARC, click on “Configuration”. The device guides you through the diagnostic and configuration steps with the aid of a wizard and displays the results for you.

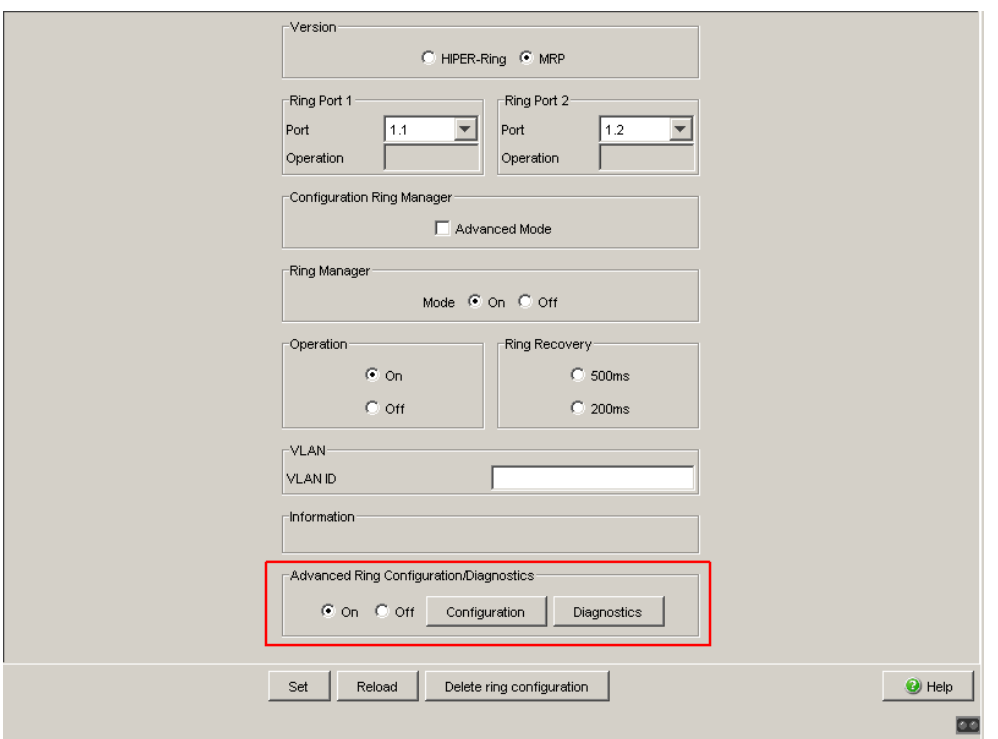


Figure 65: Ring Redundancy Dialog, Advanced Ring Configuration/Diagnostics of an MRP manager.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Delete ring configuration	Switches off the redundancy function and resets all the settings in the dialog to the state on delivery.
Help	Opens the online help.

Table 157: Buttons

7.3 Sub-Ring

With this dialog you can:
- display an overview of all the connected Sub-Rings,
- create Sub-Rings,
- configure Sub-Rings, and
- Delete Sub-Rings.

Note: The following devices support the Sub-Ring Manager function:
– RSR20/RSR30
– PowerMICE
– MACH 1000
– MACH 4000

In a Sub-Ring, you can integrate as participants the devices that support MRP - the Sub-Ring Manager function is not required.

Note: Configure all the devices in the Sub-Ring before you close the redundant line. In this way, you prevent loops during the configuration phase.

Note: Sub-Rings use MRP. You can couple Sub-Rings to existing primary rings with the HIPER-Ring protocol, the Fast HIPER-Ring protocol and MRP. If you couple a Sub-Ring to a primary ring under MRP, configure both rings in different VLANs. You configure
- either the Sub-Ring Managers' Sub-Ring ports and the devices of the Sub-Ring in a separate VLAN. Here multiple Sub-Rings can use the same VLAN.
- or the devices of the primary ring including the Sub-Ring Managers' primary ring ports in a separate VLAN. This reduces the configuration effort when coupling multiple Sub-Rings to a primary ring.

Note: In the Sub-Ring, you configure the devices with the Sub-Ring Manager functions switched off as participants of an MRP-Ring (see on page 252 “Configuring the MRP-Ring”).
This means:

- Define a different VLAN membership for the Primary Ring and the Sub-Ring even if the basis ring is using the MRP protocol, e.g. VLAN ID 1 for the Primary Ring and VLAN ID 2 for the Sub-Ring.
- Switch the MRP-Ring function on for all devices.
- Switch the Ring Manager function off for all devices.
- Do not configure link aggregation.
- Switch RSTP off for the MRP Ring ports used in the Sub-Ring.
- Assign the same MRP domain ID to all devices. If you are only using Hirschmann Automation and Control GmbH devices, you do not have to change the default value for the MRP domain ID.

Note: Use the Command Line Interface (CLI) to assign devices without the Sub-Ring Manager function a different MRP domain name. For further information, see the Command Line Interface reference manual.

7.3.1 Sub-Ring configuration

Parameters	Meaning	Possible values	Default setting
Max. Table Entries	Number of Sub-Rings that can be managed by a Sub-Ring Manager at the same time.	4 MACH1040: (16)	-
Sub Ring ID	Unique name for this Sub-Ring.	0 - 2147483647 (2^{31}-1)	-
Function on/off	Only switch on the Sub-Ring when the configuration is complete. Then close the Sub-Ring.	`On` `Off`	`On`
Configuration State	A symbol displays the current state of the Sub-Ring.		

Table 158: Sub-Ring basic configuration

Parameters	Meaning	Possible values	Default setting
Redundancy existing	A symbol displays whether the redundancy exists.		
Port	ID of the port that connects the device to the Sub-Ring.	All available ports that do not already belong to the ring redundancy of the basis ring, in the form X.X. (module.port)	
Name	Optional name for the Sub-Ring		
SRM Mode	Target state: Define whether this SRM is to manage the redundant connection (`Redundant Manager` mode) or not. If you have set the same value for the SRM Mode for both SRMs, the SRM with the higher MAC address assumes the function of redundant manager. `SingleManager` describes the special state when you connect a Sub-Ring via 2 ports of a single device. In this case, the port with the higher port number manages the redundant connection.	Manager RedundantManager SingleManager	Manager
SRM State	Actual state: Shows whether this SRM manages the redundant connection (`Redundant Manager` mode) or not. If you have set the same value for the SRM Mode for both SRMs, the SRM with the higher MAC address assumes the function of redundant manager. `SingleManager` describes the special state when you connect a Sub-Ring via 2 ports of a single device. In this case, the port with the higher port number manages the redundant connection.	Manager RedundantManager SingleManager	Manager
Port Status	Connection status of the Sub-Ring port	forwarding disabled blocked not connected	
VLAN	VLAN to which this Sub-Ring is assigned. If no VLAN exists under the VLAN ID entered, the device automatically creates it. If you do not want to use a separate VLAN for this Sub-Ring, you leave the entry as “0”.	Corresponds to the entries in the VLAN dialog	-

Table 158: Sub-Ring basic configuration

Parameters	Meaning	Possible values	Default setting
Partner MAC	Shows the MAC address of the Sub-Ring Manager at the other end of the Sub-Ring.	Valid MAC address	00 00 00 00 00 00
MRP Domain	Assign the same MRP domain name to all the members of a Sub-Ring. If you are only using Hirschmann devices, you can use the default value for the MRP domain; otherwise adjust it if necessary. With multiple Sub-Rings, all the Sub-Rings can use the same MRP domain name.	All permitted MRP domain names	255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255
Protocol		`standardMRP`	`standardMRP`

Table 158: Sub-Ring basic configuration

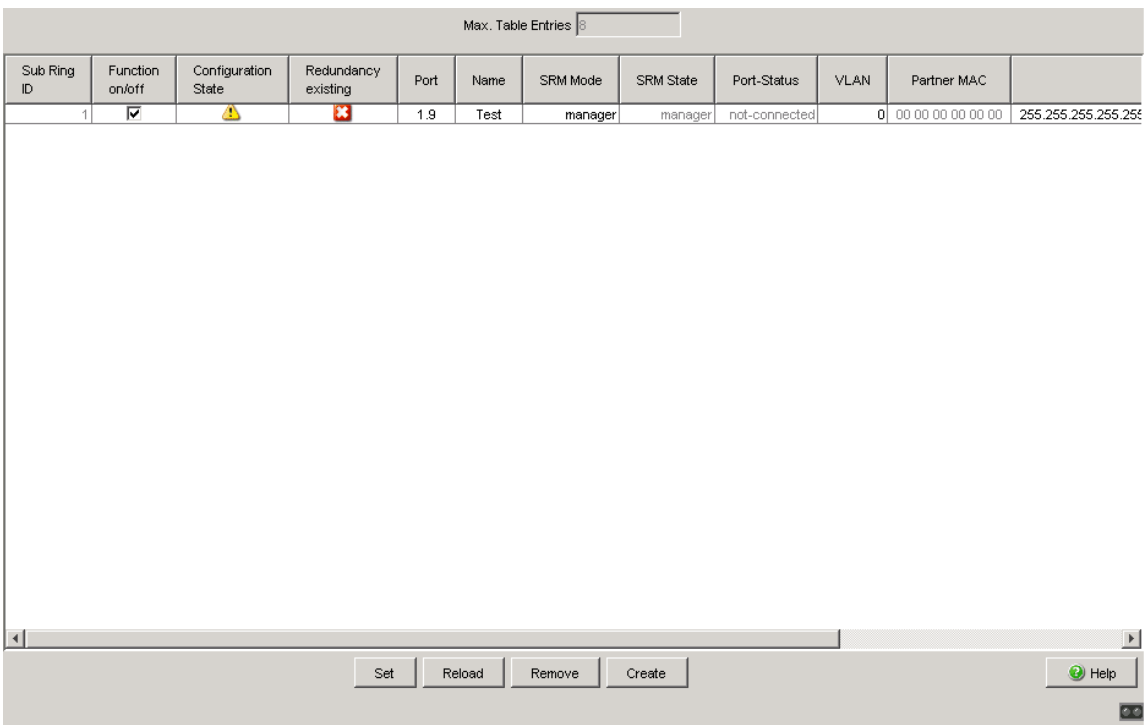


Figure 66: Sub-Ring basic configuration

7.3.2 Sub-Ring – New Entry

Parameters	Meaning	Possible values	Default setting
Sub Ring ID	Unique name for this Sub-Ring.	0 - 2147483647 (2^{31}-1)	-
Port	ID of the port that connects the device to the Sub-Ring.	All available ports that do not already belong to the ring redundancy of the basis ring, in the form X.X. (module.port)	
Name	Optional name for the Sub-Ring		
SRM Mode	Target state: Define whether this SRM is to manage the redundant connection (`Redundant Manager` mode) or not. If you have set the same value for the SRM Mode for both SRMs, the SRM with the higher MAC address assumes the function of redundant manager. `SingleManager` describes the special state when you connect a Sub-Ring via 2 ports of a single device. In this case, the port with the higher port number manages the redundant connection.	Manager RedundantManager SingleManager	Manager
VLAN	VLAN to which this Sub-Ring is assigned. If no VLAN exists under the VLAN ID entered, the device automatically creates it. If you do not want to use a separate VLAN for this Sub-Ring, you leave the entry as “0”.	Corresponds to the entries in the VLAN dialog	-
MRP Domain	Assign the same MRP domain name to all the members of a Sub-Ring. If you are only using Hirschmann devices, you can use the default value for the MRP domain; otherwise adjust it if necessary. With multiple Sub-Rings, all the Sub-Rings can use the same MRP domain name.	All permitted MRP domain names	255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255

Table 159: Sub-Ring - New Entry

Note: For one Sub-Ring in the `singleManager` mode, create 2 entries with different Sub-Ring IDs.

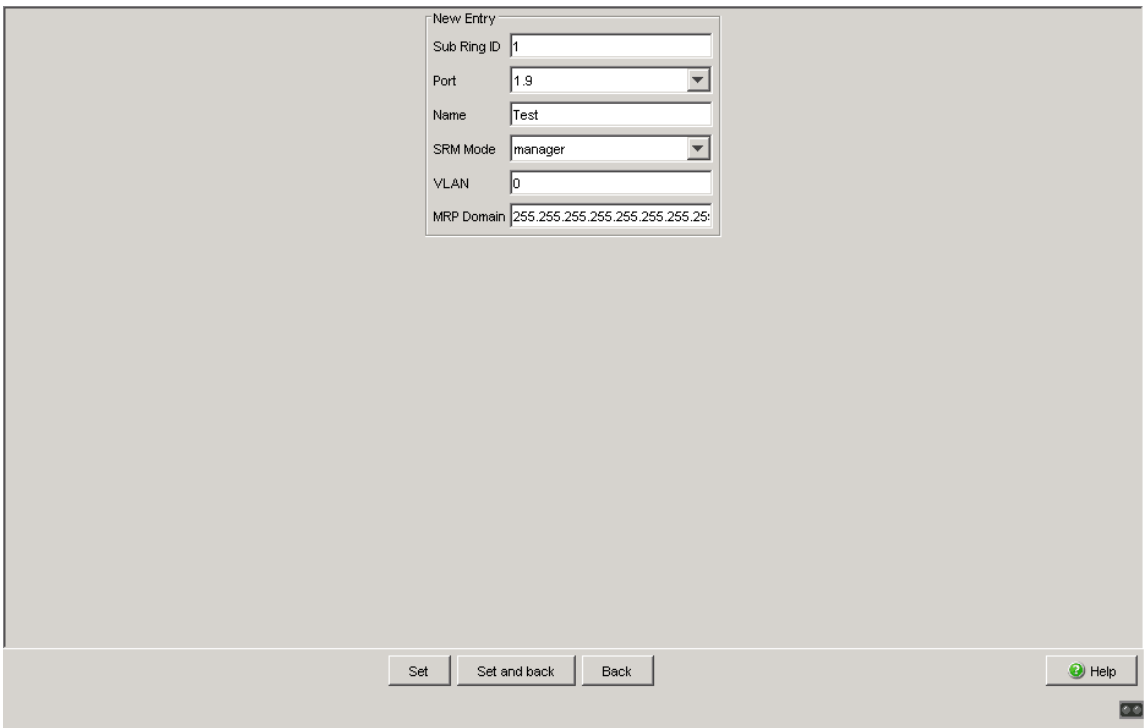


Figure 67: Sub-Ring – New Entry dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Remove	Removes the selected table entry.
Create	Adds a new table entry.
Set and back	Transfers the changes to the volatile memory (RAM) of the device and goes back to the previous dialog.
Back	Displays the previous page again. Changes are lost.
Help	Opens the online help.

Table 160: Buttons

7.4 Ring/Network Coupling

Use the ring/network coupling to redundantly couple an existing ring (HIPER-Ring, MRP, Fast HIPER-Ring) to another network or another ring. Make sure the coupling partners are Hirschmann devices.

Note: Two-Switch coupling
Make sure you have configured a ring (HIPER-Ring, MRP, Fast HIPER-Ring) before setting up the ring/network coupling.

With this dialog you can:
- display an overview of the existing Ring/Network coupling,
- configure a Ring/Network coupling,
- switch a Ring/Network coupling on/off,
- create a new Ring/Network coupling, and
- Delete Ring/Network couplings

7.4.1 Preparing a Ring/Network Coupling

STAND-BY switch

All devices have a STAND-BY switch, with which you can define the role of the device within a Ring/Network coupling.
Depending on the device type, this switch is a DIP switch on the devices, or else it is exclusively a software setting (`Redundancy:Ring/Network Coupling` dialog). By setting this switch, you define whether the device has the main coupling or the redundant coupling role within a Ring/Network coupling. You will find details on the DIP switches in the “Installation” user manual.

Note: Depending on the model, the devices have a DIP switch, with which you can choose between the software configuration and the DIP switch configuration. When you set the DIP switches so that the software configuration is selected, the DIP switches are effectively deactivated.

Device type	STAND-BY switch type
RS2-./.	DIP switch
RS2-16M	DIP switch
MICE/Power MICE	Selectable: DIP switch and software setting
MACH 3000/MACH 4000	Software switch

Table 161: Overview of the STAND-BY switch types

Depending on the device and model, set the STAND-BY switch in accordance with the following table:

Device with	Choice of main coupling or redundant coupling
DIP switch	On “STAND-BY” DIP switch
DIP switch/software switch option	According to the option selected - on “STAND-BY” DIP switch or in the - `Redundancy:Ring/Network Coupling` dialog, by making selection in “Select configuration”. **Note:** These devices have a DIP switch, with which you can choose between the software configuration and the DIP switch configuration. You can find details on the DIP switches in the User Manual Installation.
Software switch	In the `Redundancy:Ring/Network Coupling` dialog

Table 162: Setting the STAND-BY switch

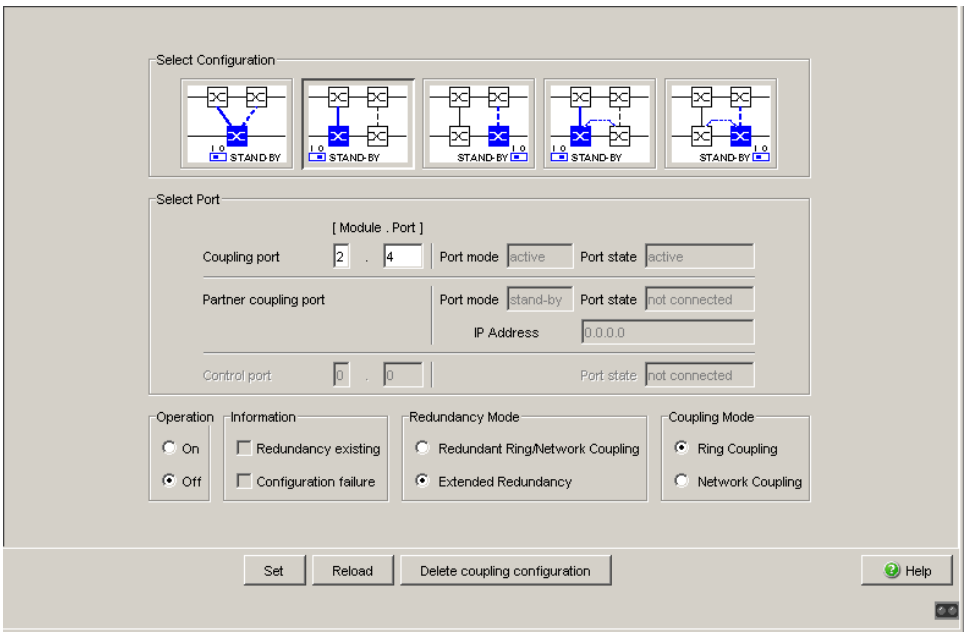


Figure 68: Software configuration of the STAND-BY switch

Depending on the STAND-BY DIP switch position, the dialog displays those configurations that are not possible as grayed-out. If you want to select one of these grayed-out configurations, change the STAND-BY DIP switch on the device to the other position.

One-Switch coupling
On the device set the 'STAND BY' dip switch to the ON position or use the software configuration to assign the redundancy function to it.

Two-Switch coupling
Assign the device in the redundant line the DIP switch setting “STAND-BY”, or use the software configuration to assign the redundancy function to it.

Note: For reasons of redundancy reliability, do not use Rapid Spanning Tree and Ring/Network Coupling in combination.

Ring/Network Coupling dialog

Parameter	Meaning
Selecting the configuration	Depending on your local conditions, select “One-Switch coupling”, “Two-Switch coupling, Slave”, “Two-Switch coupling, Master”, “Two-Switch coupling with control line, Slave” or “Two-Switch coupling with control line, Master”. These options are presented as buttons from left to right. Depending on the device type (see table 161), you make this setting: – only using DIP switches – only using software – using DIP switch and software You will find details on the DIP switches on the devices in the “Installation” user manual. – For devices configured only using DIP switches, you use these switches to make the settings. In this case, the buttons in the dialog are only for display purposes. – For devices without DIP switches, you only use the software to make settings. You can select the configuration using the buttons. – For devices that can be configured using DIP switches and software, you can activate or deactivate the DIP switches. If you have activated the DIP switches, you cannot overwrite the DIP switch settings using the software - settings that cannot be selected using the software are grayed-out in the dialog. To configure using the software, select the relevant Ring/Network coupling constellation by pressing the corresponding button.
Coupling port	This is the port to which you have connected a redundant connection. **Note:** Configure the coupling port and the ring ports, if there are any ring ports, on different ports. **Note:** To avoid continuous loops, the device sets the port status of the coupling port to “off” if you switch off the function or change the configuration while the connections are operating at these ports.
Port mode	- `active`: You have switched the port on. - `stand-by`: The port is in stand-by mode.
Port State	- `active`: You have switched the port on. - `stand-by`: The port is in stand-by mode. - `not connected`: You have not connected the port.
Partner coupling port	This is the port at which the partner has made its connection. It is only possible and necessary to enter a port if “One-Switch coupling” is being set up. **Note:** Configure the partner coupling port and the ring ports, if there are any ring ports, on different ports.
IP address	If you have selected “Two-Switch coupling”, the device displays the IP address of the partner here, once you have already started operating the partner in the network.
Control port	This is the port to which you connect the control line.

Table 163: Ring/Network Coupling dialog

Parameter	Meaning
Operation	Here you switch the Ring/Network coupling for this device on or off
Information	If the device is a ring manager: The displays in this frame mean: “Redundancy working”: When a component of the ring is down, the redundant line takes over its function. “Configuration failure”: You have configured the function incorrectly, or there is no ring port connection.
Redundancy Mode	With the “Redundant Ring/Network Coupling” setting, either the main line or the redundant line is active. Both lines are never active simultaneously. With the “Extended Redundancy” setting, the main line and the redundant line are simultaneously active if a problem is detected in the connection line between the devices in the connected (i.e., the remote) network. During the reconfiguration period, package duplications may possibly occur. Therefore, only select this setting if your application detects package duplications.
Coupling Mode	Here you define whether the constellation you are configuring is a coupling of redundancy rings (HIPER-Ring, MRP-Ring), or network segments.

Table 163: Ring/Network Coupling dialog

Note: For the coupling ports, select the following settings in the `Basic Settings:Port Configuration` dialog:

Port type	Bit rate	Autonegotiation (automatic configuration)	Port setting	Duplex
TX	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
TX	1 Gbit/s	on	on	-
Optical	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
Optical	1 Gbit/s	on	on	-
Optical	10 Gbit/s	-	on	10 Gbit/s full duplex (FDX)

Table 164: Port settings for ring ports

Note: If you have configured VLANS, note the VLAN configuration of the coupling and partner coupling ports.
In the Ring/Network Coupling configuration, select for the coupling and partner coupling ports
– VLAN ID 1 and “`Ingress Filtering`” disabled in the port table and
– VLAN membership `T` in the static VLAN table.

Note: Independently of the VLAN settings, the device sends the ring coupling frames with VLAN ID 1 and priority 7. Make sure that the device sends VLAN 1 packets tagged in the local ring and in the connected network. This maintains the priority of the ring coupling frames.

Note: If you are operating the Ring Manager and two-Switch coupling functions at the same time, there is the possibility of creating a loop.

Note: The Ring/Network coupling operates with test packets (Layer 2 frames). The devices subscribed always send their test packets VLAN-tagged, including the VLAN ID 1 and the highest VLAN priority 7. This also applies if the send port is an untagged member in VLAN 1.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Delete Coupling configuration	Removes the coupling configuration.
Help	Opens the online help.

Table 165: Buttons

7.5 Spanning Tree

Under Spanning Tree you will find the dialogs and views for configuring and monitoring of the Spanning Tree function according to the IEEE 802.1Q-2005 standard, Rapid Spanning Tree (RSTP) and Multiple Spanning Tree (MSTP).

Note: The Spanning Tree Protocol is a protocol for MAC bridges. For this reason, the following description uses the term bridge for Switch.

Introduction

Local networks are getting bigger and bigger. This applies to both the geographical expansion and the number of network participants. Therefore, it is advantageous to use multiple bridges, for example:

- to reduce the network load in sub-areas,
- to set up redundant connections and
- to overcome distance limitations.

However, using multiple bridges with multiple redundant connections between the subnetworks can lead to loops and thus loss of communication across of the network. In order to help avoid this, you can use Spanning Tree. Spanning Tree enables loop-free switching through the systematic deactivation of redundant connections. Redundancy enables the systematic reactivation of individual connections as needed.

Rapid Spanning Tree Protocol (RSTP)

RSTP is a further development of the Spanning Tree Protocol (STP) and is compatible with it. If a connection or a bridge becomes inoperable, the STP required a maximum of 30 seconds to reconfigure. This is no longer acceptable in time-sensitive applications. RSTP achieves average reconfiguration times of less than a second. When you use RSTP in a ring topology with 10 to 20 devices, you can even achieve reconfiguration times in the order of milliseconds.

Note: RSTP reduces a layer 2 network topology with redundant paths into a tree structure (Spanning Tree) that does not contain any more redundant paths. One of the Switches takes over the role of the root bridge here. The maximum number of devices permitted in an active branch (from the root bridge to the tip of the branch) is specified by the variable `Max Age` for the current root bridge. The preset value for `Max Age` is 20, which can be increased up to 40.
If the device working as the root is inoperable and another device takes over its function, the `Max Age` setting of the new root bridge determines the maximum number of devices allowed in a branch.

Note: You have the option of coupling RSTP network segments to an MRP-Ring. For this, you activate the MRP compatibility. This enables you to operate RSTP via an MRP-Ring.
If the root bridge is within the MRP-Ring, the devices in the MRP-Ring count as a single device when calculating the length of the branch. A device that is connected to a random Ring bridge receives such RSTP information as if it were directly connected to the root bridge.

Note: The RSTP standard dictates that all the devices within a network work with the (Rapid) Spanning Tree Algorithm. If STP and RSTP are used at the same time, the advantages of faster reconfiguration with RSTP are lost in the network segments that are operated in combination.
A device that only supports RSTP works together with MSTP devices by not assigning an MST region to itself, but rather the CST (Common Spanning Tree).

Note: By changing the IEEE 802.1D-2004 standard for RSTP, the Standards Commission reduced the maximum value for the “Hello Time” from 10 s to 2 s. When you update the Switch software from a release before 5.0 to release 5.0 or higher, the new software release automatically reduces the locally entered “Hello Time” values that are greater than 2 s to 2 s.
If the device is not the RSTP root, “Hello Time” values greater than 2 s can remain valid, depending on the software release of the root device.

Multiple Spanning Tree Protocol (MSTP)
MSTP is a extension of the Rapid Spanning Tree Protocol used to increase the benefits of VLANs. MSTP allows you to define multiple groups of VLANs, and to configure a separate Spanning Tree Instance for each group. This Spanning Tree Instance prevents loops within the related VLAN group and provides redundancy in the case of a failure.
Additionally, MSTP enables existing connections to be used more efficiently in normal operation, i.e. when all connections are being operated. For example, MSTP can set a connection between 2 bridges to the “discarding” state for a certain VLAN group, while simultaneously operating the same connection for another VLAN group in the “forwarding” state. In normal operation, MSTP thus enables you to use your resources more efficiently via load sharing.

Note: The following text uses the term Spanning Tree (STP) to describe settings or behavior that applies to STP, RSTP or MSTP.

7.5.1 Global

With this dialog you can:
- switch the Spanning Tree Protocol on/off and select the RSTP or MSTP protocol version
- display bridge-related information on the Spanning Tree Protocol,
- configure bridge-related parameters of the Spanning Tree Protocol,
- set bridge-related additional functions,
- display the parameters of the root bridge and
- display bridge-related topology information.

Note: Rapid Spanning Tree is activated on the device by default, and it automatically begins to resolve the existing topology into a tree structure. If you have deactivated RSTP on individual devices, you avoid loops during the configuration phase.

The following tables show the selection options and default settings, and information on the global Spanning Tress settings for the bridge.

Parameters	Meaning	Possible values	Default setting
Frame „Function“	Switches the Spanning Tree function for this device “On” or “Off”. If you switch off the Spanning Tree for a device globally, the device floods the Spanning Tree packets received like normal Multicast packets to the ports. Thus the device behaves transparently with regard to Spanning Tree packets.	`On`, `Off`	`On`
Frame „Protocol Version“	Select the protocol version: - `RSTP` (IEEE 802.1Q-2005), to use the Spanning Tree jointly for all configured VLANs, - `MSTP` (IEEE 802.1Q-2005), to use the Spanning Tree separately for various VLAN groups.	`RSTP`, `MSTP`	RSTP

Table 166: Global Spanning Tree settings, basic function

In the “Protocol Configuration / Information” frame you can configure the following values and read information.

In the context of MSTP, these are the settings for the Common Spanning Tree (CST).

Parameters	Meaning	Possible values	Default setting
Column „Bridge“	**Information and configuration parameters of the local device**		
Bridge ID (read only)	The local Bridge ID, made up of the local priority and its own MAC address. The format is ppppp / mm mm mm mm mm mm, with: ppppp: priority (decimal) and mm: the respective byte of the MAC address (hexadecimal).		

Table 167: Global Spanning Tree settings, local bridge parameters

Parameters	Meaning	Possible values	Default setting
Priority	Sets the local bridge priority. The bridge priority and its own MAC address make up this separate `Bridge ID`. The device with the best (numerically lowest) priority assumes the role of the root bridge. Define the root device by assigning the device the best priority in the `Bridge ID` among all the devices in the network. Enter the value as a multiple of 4096.	0 ≤ n*4096 ≤ 61440	32768
Hello Time	Sets the Hello Time. The local `Hello Time` is the time in seconds between the sending of two configuration messages (Hello packets). If the local device has the root function, the other devices in the entire network take over this value. Otherwise the local device uses the value of the root bridge in the “Root” column on the right.	1 - 2	2
Forward Delay	Sets the Forward Delay parameter. In the previous STP protocol, the Forward Delay parameter was used to delay the status change between the statuses `disabled`, `discarding`, `learning`, `forwarding`. Since the introduction of RSTP, this parameter has a subordinate role, because the RSTP bridges negotiate the status change without any specified delay. If the local device is the root, the other devices in the entire network take over this value. Otherwise the local device uses the value of the root bridge in the “Root” column on the right.	4 - 30 s See the note following this table.	15 s
Max Age	Sets the Max Age parameter. In the previous STP protocol, the Max Age parameter was used to specify the validity of STP BPDUs in seconds. For RSTP, Max Age signifies the maximum permissible branch length (number of devices to the root bridge). If the local device is the root, the other devices in the entire network take over this value. Otherwise the local device uses the value of the root bridge in the “Root” column on the right.	6 - 40 s See the note following this table.	20 s

Table 167: Global Spanning Tree settings, local bridge parameters

Parameters	Meaning	Possible values	Default setting
Tx Hold Count	Sets the Hx Hold Count parameter. If the device sends a BPDU, it increments a counter at this port. When the counter reaches the value of the Tx Hold Count, the port stops sending any more BPDUs. The counter is decremented by 1 every second. The device sends a maximum of 1 new BPDU in the following second.	1 - 40 (based on RSTP standard: 1 - 10)	10
MRP compatibility	Switches the MRP compatibility on/off. MRP compatibility enables RSTP to be used within an MRP-Ring and when coupling RSTP segments to an MRP-Ring. The prerequisite is that all devices in the MRP-Ring must support MRP compatibility.	`On`, `Off`	`Off`
BPDU Guard	Switches the `BPDU Guard` function on/off. If `BPDU Guard` is switched on, the device automatically activates the function for edge ports (with the setting “Admin Edge Port” `true`). When such a port receives any STP-BPDU, the device sets the port status “BPDU Guard Effect” to `true` and the transmission status of the port to `discarding`(see table 178). Thus the device helps you protect your network at terminal device ports from incorrect configurations or attacks with STP-BPDUs that try to change the topology.	`On`, `Off`	`Off`

Table 167: Global Spanning Tree settings, local bridge parameters

Note: If you combine RSTP with an MRP-Ring, you must give the devices in the MRP-Ring a better (i.e. numerically lower) RSTP bridge priority than the devices in the connected RSTP network. You thus help avoid a connection interruption for devices outside the Ring.

Note: The parameters `Forward Delay` and `Max Age` have the following relationship:

`Forward Delay` ≥ (`Max Age`/2) + 1

If you enter values that contradict this relationship, the device then replaces these values with the last valid values or the default value.

Parameters	Meaning	Possible values	Default setting
Column „Root“	**Information on the device that is currently the root bridge**		
Bridge ID	The `Bridge ID` of the current root bridge. The format is pppp / mm mm mm mm mm mm, with: pppp: priority (decimal) and mm: the respective byte of the MAC address (hexadecimal).		
Priority	The `Priority` of the current root bridge.	0 ≤ n*4096 ≤ 61440	32768
Hello Time	The `Hello Time` of the current root bridge.	1 - 2	2
Forward Delay	The `Forward Delay` of the current root bridge.	4 - 30 s	15 s
Max Age	The `Max Age` of the current root bridge.	6 - 40 s	20 s

Table 168: Global Spanning Tree settings, root bridge information

Parameters	Meaning	Possible values
Column „Topology“	**Spanning Tree topology information**	
Bridge is root	If the local device is currently the root bridge, the device displays this box as selected, and otherwise as empty.	Selected, not selected.
Root Port	The port of the device from which the current path leads to the root bridge. 0: the local bridge is the root.	Valid port ID or 0.
Root path costs	Path costs from the root port of the device to the current root bridge of the entire layer 2 network. 0: the local bridge is the root.	0-200000000

Table 169: Global Spanning Tree settings, topology information

Parameters	Meaning	Possible values
Topology change count	Counts how often the device has put a port into the `Forwarding` status via Spanning Tree since it was started.	
Time since last change	Time since the last topology change.	

Table 169: Global Spanning Tree settings, topology information

If you have activated the “MRP Compatibility” function, the device displays the “Information” frame with additional information on MRP compatibility:

Parameters	Meaning	Possible values	Default setting
Information	If you have activated the MRP compatibility (RSTP over MRP) and one of the participating devices has detected a configuration problem, the device displays “Conflict with bridge pppp / mm mm mm mm mm”. During normal operation, this field is empty.	Message with bridge ID or empty.	-

Table 170: Global Spanning Tree settings, Information frame

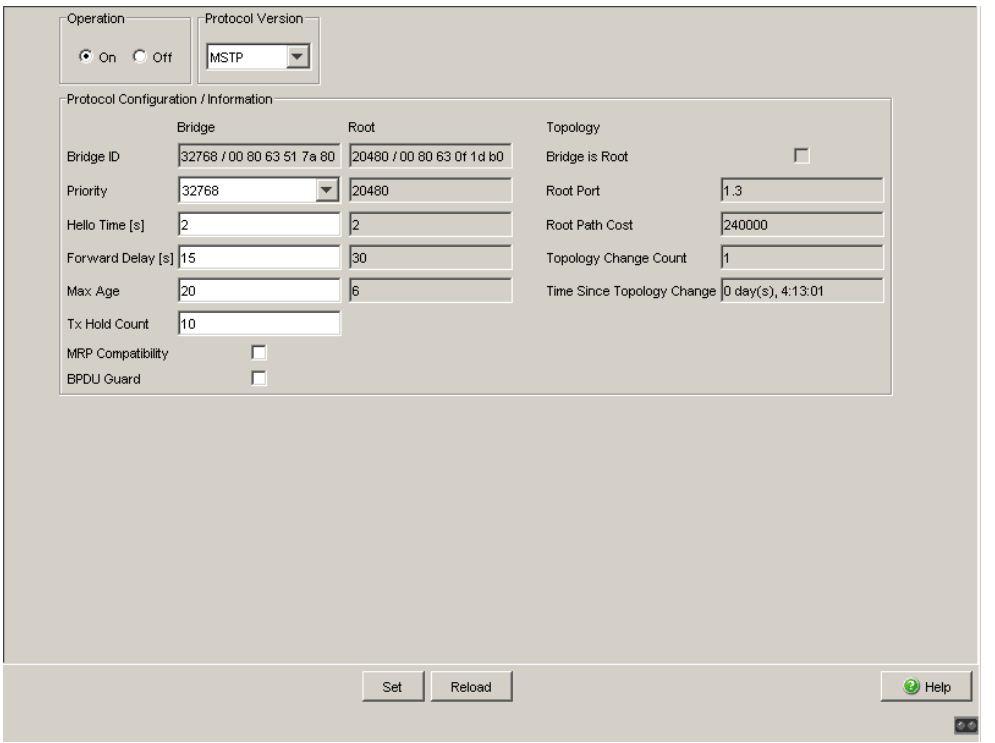


Figure 69: Dialog Spanning Tree, Global

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 171: Buttons

7.5.2 MSTP (Multiple Spanning Tree)

With this dialog you can:

- manage the global Multiple Spanning Tree Instance
- create or delete a Multiple Spanning Tree Instance
- assign VLANs to a Multiple Spanning Tree Instance and manage the MSTI.

The tab for the global Multiple Spanning Tree Instance is named “MST Global (CIST)”. This instance is always available and cannot be deleted. It contains all the configured VLANs that are not explicitly assigned to an MSTI. The settings include the MST region identifier, the maximum number of Hops for the Internal Spanning Tree (IST), and information on IST and CST (known in combination as CIST).

The tabs for the MSTIs are named MSTI, followed by the number of the instance, e.g. “MSTI 2”. Here you can manage the individual Multiple Spanning Tree Instances (MSTIs). The device allows you to create up to 16 Multiple Spanning Tree Instances (MSTIs). The prerequisite for using MSTP is that all the bridges in the network that make up an MSTP region must also support MSTP.

Note: To use MSTP, disable the other redundancy protocols on this device.

Note: When combining MSTP with the management VLAN 0, note the following restriction: the DHCP client of the device only sends its DHCP Broadcasts in VLAN 1.

Dialog Tab MSTP Global (CIST)

This tab in the dialog allows you to configure the MST region and the global Multiple Spanning Tree Instance (IST) within the MST region, and to display information on IST and CST.

Parameters	Meaning	Possible values	Default setting
"MST Region Identifier" Frame	Information about the MST region		
Name	Name of the MSTP region to which the device belongs.	Max. 32 characters, value 0x21 (!) up to and incl. 0x7e (~)	The MAC address of the device.
Revision level	Version number of the MSTP region to which the device belongs.	0 -65535	0
Digest	The MD5 checksum of the MSTP configuration.	16 bytes in hexadecimal.	

Table 172: Dialog Multiple Spanning Tree settings, MST Global, MST region identifier

Note: Configure all the bridges of an MST region with identical values for:
– the name of the MST region,
– the Revision Level, and
– the assignment of the VLANs to the MSTP instances.

Note: Include the ports that connect the bridges of an MST region as tagged members in all the VLANs that are set up on the bridges. You thus avoid potential connection breaks when the topology is changed within the MST region.
Also include the ports that connect an MST region with other MST regions or with the CST region (known as boundary ports) as tagged members in all the VLANs that are set up on both regions. You thus avoid potential connection breaks when topology changes affecting the boundary ports are made.

Parameters	Meaning	Possible values	Default setting
Frame „Global CIST Parameters“	Detailed information on the global MST instance (IST) for the region and CST.		
Maximum Hops	Maximum number of bridges within the MST region in a branch to the root bridge.	6-40	20
Attached VLANs	List of all VLANs that are assigned only to the global MST instance and to no other MSTI.	List of all static VLANs.	1;
Bridge ID (read only)	The local Bridge ID, made up of the local priority and its own MAC address. The format is ppppp / mm mm mm mm mm mm, with: ppppp: priority (decimal) and mm: the respective byte of the MAC address (hexadecimal).		
Root ID	The `Bridge ID` of the current root bridge of the entire layer 2 network.[a] The format is ppppp / mm mm mm mm mm mm, with: ppppp: priority (decimal) and mm: the respective byte of the MAC address (hexadecimal).		
Regional Root ID	The `Bridge ID` of the current root bridge that belongs to the global instance (IST) of the MST region to which this device belongs.[b] The format is ppppp / mm mm mm mm mm mm, with: ppppp: priority (decimal) and mm: the respective byte of the MAC address (hexadecimal).		
Root Port	The port of the device from which the current path leads to the root bridge of the entire layer 2 network (CIST root). 0: local bridge is CIST root.	Valid port ID or 0	-

Table 173: Dialog Multiple Spanning Tree settings, MST Global (CIST), Global MST parameters

Parameters	Meaning	Possible values	Default setting
Root path costs	External path costs from the regional root bridge of the MST region of the device to the current root bridge of the entire layer 2 network (CIST root).[c] These are the same for all devices within an MST region. 0: Regional root bridge is simultaneously CIST root bridge	0-200000000	
Internal root path costs	Internal path costs from the root port of the device to the current regional root bridge of the MST region of the device. 0: local bridge is root.	0-200000000	-

Table 173: Dialog Multiple Spanning Tree settings, MST Global (CIST), Global MST parameters

– [a] This bridge is also known as the CIST root bridge (CIST: Common and Internal Spanning Tree). It has the best bridge ID of all bridges - both those that do not belong to any MSTP region (CST, Common Spanning Tree) and those that belong to the global instance of an MSTP region (Internal Spanning Tree, IST). All the bridges in the entire layer 2 network use the time parameters of the CIST root bridge, e.g. the Hello Time.
– [b] The IST regional root ID can be identical to the above CIST root ID for the MST region of the device if the IST regional root bridge has the best bridge ID in the entire layer 2 network.
– [c] These are identical to the root path costs from Spanning Tree or Rapid Spanning Tree if you are not using MSTP (in these cases every device sees itself as a separate region).

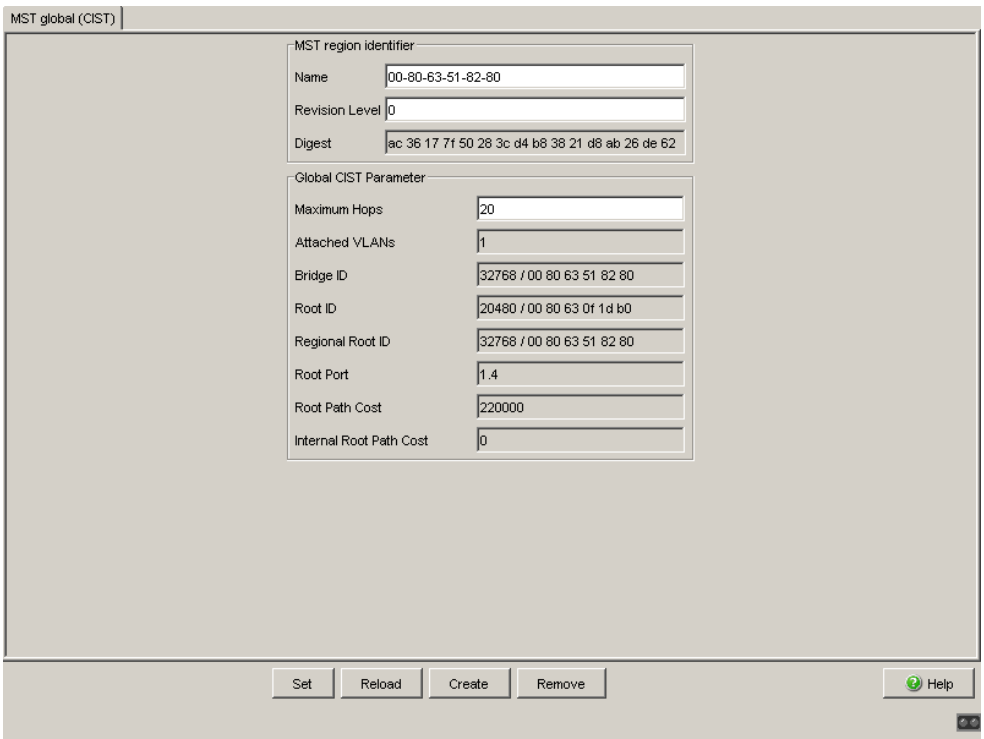


Figure 70: Multiple Spanning Tree dialog, MST Global (CIST)

MSTI (Multiple Spanning Tree Instance) dialog tab

The MSTI tabs in the dialog allow you to manage the individual Multiple Spanning Tree Instances. The tab is named MSTI, followed by the number of the instance, e.g. “MSTI 2”.

Parameters	Meaning	Possible values	Default setting
Frame „VLANs“	Manage the VLANs assigned to this Multiple Spanning Tree Instance.		
Assigned VLANs	List of all VLANs currently assigned to this MSTI.	Subset of all statically set up VLANs.	No VLANs.

Table 174: Multiple Spanning Tree settings, MST Instance, VLANs

Parameters	Meaning	Possible values	Default setting
“Add VLAN” button	Opens a dialog for selecting a VLAN ID from the statically set up VLANs of the device. Select the desired VLAN ID and click on “OK”.	One of the static VLANs.	
“Remove VLAN” button	Opens a dialog for selecting a VLAN ID. Select the desired VLAN ID and click on “OK”.	A VLAN currently assigned to the MSTI	

Table 174: Multiple Spanning Tree settings, MST Instance, VLANs

Parameters	Meaning	Possible values	Default setting
Frame „Instance Parameters“	Detailed information on the selected Multiple Spanning Tree Instance.		
Priority	The local bridge `Priority` for the selected MST Instance. The bridge priority and its own MAC address make up this separate `Bridge ID`. The device with the best (i.e. numerically lowest) priority becomes the root device of the selected MST region. Define the root device by assigning to this device the best priority in the `Bridge ID` among all the devices in the selected MST region. Enter the value as a multiple of 4096.	0 ≤ n*4096 ≤ 61440	32768
Bridge ID	The local `Bridge ID`, made up of the local `priority` + MSTI, following by its own MAC address. The format is ppppp / mm mm mm mm mm mm, with: ppppp: priority+MSTI (decimal) and mm: the respective byte of the MAC address (hexadecimal).	0 - 65534; sum of priority (0 - 61440 in steps of 4096) and MSTI (1 - 4094)	32768 + MSTI
Time since last change	Time since the last topology change for this MST Instance.		
Topology changes	Counts how often the device has put a port into the `Forwarding` status via Spanning Tree since the selected MST Instance was started.		
Root ID	The `Bridge ID` of the current root bridge of the selected MST region. The format is ppppp / mm mm mm mm mm mm, with: ppppp: priority (decimal) and mm: the respective byte of the MAC address (hexadecimal).	0 - 65534; sum of priority (0 - 61440 in steps of 4096) and MSTI (1 - 4094)	

Table 175: Multiple Spanning Tree settings, MST Instance, parameters

Parameters	Meaning	Possible values	Default setting
Root path costs	Path costs from the root port to the current root bridge of the selected MST region. 0: bridge is root for this MST region.	0-200000000	
Root Port	The port of the device from which the current path leads to the root bridge of the selected MST region. 0: bridge is root for this MST region.	Valid port ID or 0	

Table 175: Multiple Spanning Tree settings, MST Instance, parameters

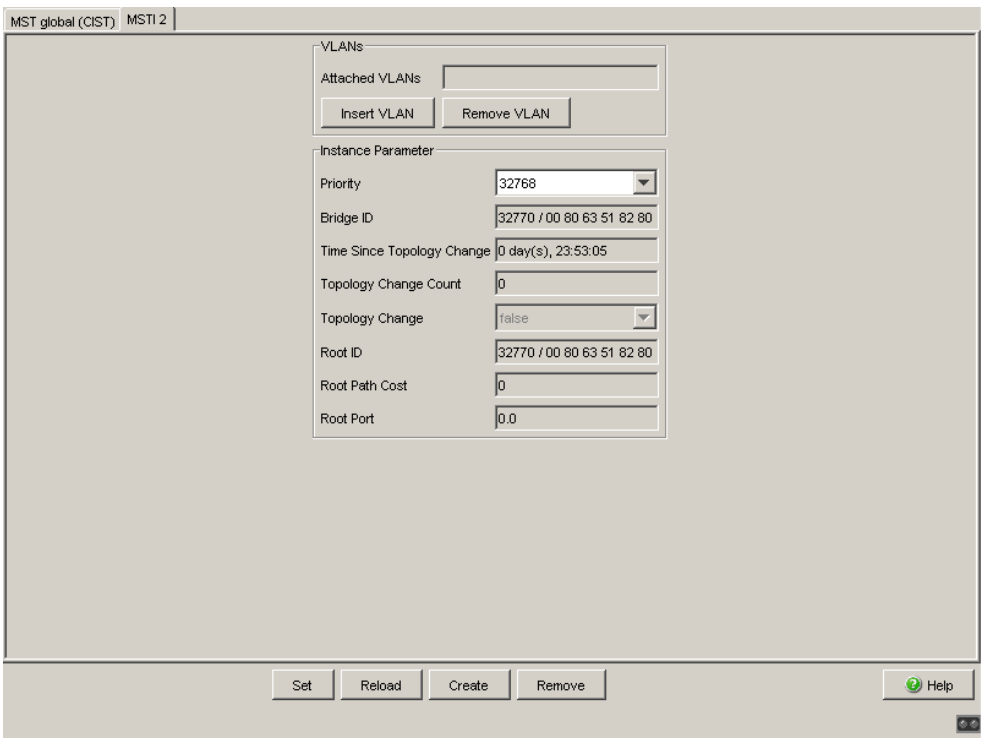


Figure 71: Multiple Spanning Tree dialog, MSTI <ID>

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a MSTP instance.
Remove	Removes a MSTP instance.
Help	Opens the online help.

Table 176: Buttons

7.5.3 Port

Note: Deactivate the Spanning Tree protocol for the ports connected to a HIPER-Ring, Fast HIPER-Ring, or Ring/Network coupling, because Spanning Tree and Ring Redundancy or Ring/Network coupling affect each other.
Activate the MRP compatibility in an MRP-Ring if you want to use RSTP and MRP in combination.
If you combine RSTP with an MRP-Ring, you must give the devices in the MRP-Ring a better (i.e. numerically lower) RSTP bridge priority than the devices in the connected RSTP network. You thus help avoid a connection interruption for devices outside the Ring.

The MSTI tabs in the dialog allow you to manage the individual Multiple Spanning Tree Instances. The tab is named MSTI, followed by the number of the instance, e.g. “MSTI 2”.

- switch Spanning Tree on or off at the individual ports, configure the ports for the global MST Instance (CIST), and display information on the port status,
- set various protection functions at the ports,
- configure the ports for an existing MST Instance (port path costs and port priority), read information on the port status, and display information for the selected MSTI.

Parameters	Meaning	Possible values	Default setting
Tab „CIST“	Port configuration and information on the global MSTI (IST) and the CST.		
Module.Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two.		
STP active	Here you can switch Spanning Tree on or off for this port. If Spanning Tree is activated globally and switched off at one port, this port does not send STP-BPDUs and drops any STP-BPDUs received. **Note:** If you want to use other layer 2 redundancy protocols such as HIPER-Ring or Ring/Network coupling in parallel with Spanning Tree, make sure you switch off the ports participating in these protocols in this dialog for Spanning Tree. Otherwise the redundancy may not operate as intended or loops can result.	`On`, `Off`	`On`
Port status (read only)	Displays the STP port status with regard to the global MSTI (IST).	`discarding`, `learning`, `forwarding`, `disabled`, `manualForwarding`, `notParticipate`	-

Table 177: Port-related STP settings and displays, CIST

Parameters	Meaning	Possible values	Default setting

Port Role (read only)	Displays the STP port role with regard to the global MSTI (IST).	`root`
		`alternate`
		`designated`
		`backup`
		`master`
		`disabled`
			-

Port path costs	Enter the path costs with regard to the global MSTI (IST) to indicate preference for redundant paths. If the value is 0, the Switch automatically calculates the path costs for the global MSTI (IST) depending on the transmission rate.	0 - 200000000	0 (automatically)
Port priority	Here you enter the port priority (the four highest bits of the port ID) with regard to the global MSTI (IST) as a decimal number of the highest byte of the port ID.	16 ≤ n·16 ≤ 240	128
Received bridge ID (read only)	Displays the remote bridge ID from which this port last received an STP-BPDU.[a]	Bridge identification (format ppppp / mm mm mm mm mm mm)	-
Received port ID (read only)	Displays the port ID at the remote bridge from which this port last received an STP-BPDU.[a]	Port ID, format pn nn, with p: port priority / 16, nnn: port No., (both hexadecimal)	-
Received path costs (read only)	Displays the path costs of the remote bridge from its root port to the CIST root bridge.[a]	0-200000000	-

Table 177: Port-related STP settings and displays, CIST

Parameters	Meaning	Possible values	Default setting
Admin Edge Port	Only activate this setting when a terminal device is connected to the port (administrative: default setting). Then the port immediately has the forwarding status after a link is set up, without first going through the STP statuses. If the port still receives an STP-BPDU, the device blocks the port and clarifies its STP port role. In the process, the port can switch to a different status, e.g. `forwarding`, `discarding`, `learning`. Deactivate the setting when the port is connected to a bridge. After a link is set up, the port then goes through the STP statuses first before taking on the `forwarding` status, if applicable. This setting applies to all MSTIs.	`active` (box selected), `inactive` (box empty)	`inactive`
Auto Edge Port	The device only considers the Auto Edge Port setting when the Admin Edge Port parameter is deactivated. If Auto Edge Port is active, after a link is set up the device sets the port to the forwarding status after 1.5 · `Hello Time` (in the default setting 3 s). If Auto Edge Port is deactivated, the device waits for the `Max Age` instead (in the default setting 20 s). This setting applies to all MSTIs.	`active` (box selected), `inactive` (box empty)	`active`

Table 177: Port-related STP settings and displays, CIST

Parameters	Meaning	Possible values	Default setting
Oper Edge Port	The device sets the “Oper Edge Port” condition to `true` if it has not received any STP-BPDUs, i.e. a terminal device is connected. It sets the condition to `false` if it has received STP-BPDUs, i.e. a bridge is connected. This condition applies to all MSTIs.	`true`, `false`	-
Oper PointToPoint	The device sets the “Oper point-to-point” condition to `true` if this port has a full duplex condition to an STP device. Otherwise it sets the condition to `false` (e.g. if a hub is connected). The point-to-point connection makes a direct connection between 2 RSTP devices. The direct, decentralized communication between the two bridges results in a short reconfiguration time. This condition applies to all MSTIs.	`true`, `false` The device determines this condition from the duplex mode: FDX: `true` HDX: `false`	

Table 177: Port-related STP settings and displays, CIST

– [a] These columns show you more detailed information than that available up to now:
For designated ports, the device displays the information for the STP-BPDU last received by the port. This helps with the diagnosis of possible STP problems in the network.
For the port roles alternative, back-up, master and root, in the stationary

condition (static topology), this information is identically to the designated information.
If a port has no link, or if it has not received any STP-BDPUs for the current MSTI, the device displays the values that the port would send as a designated port.

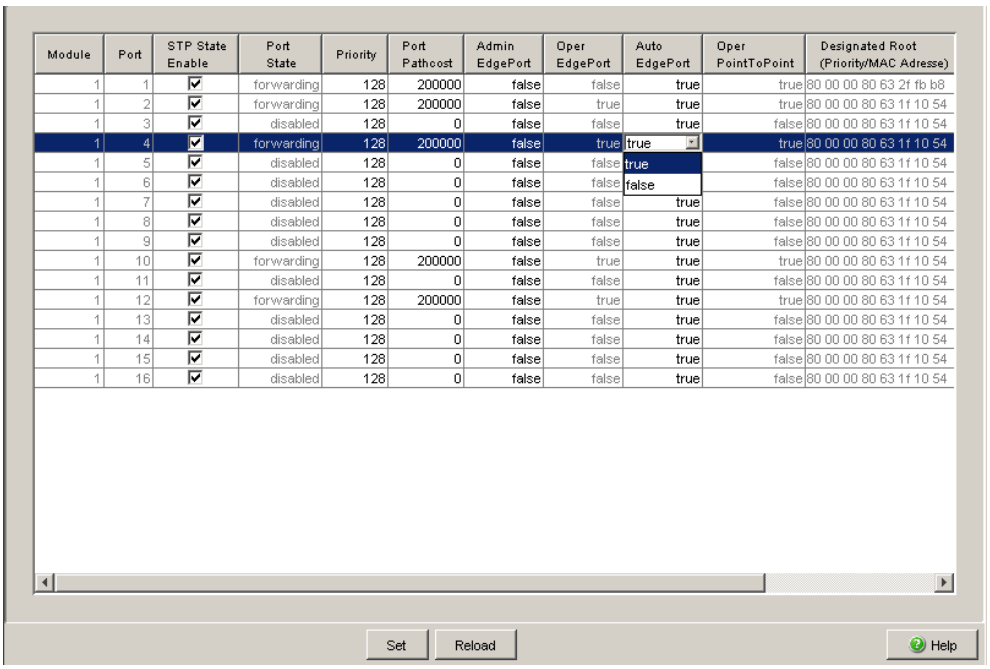


Figure 72: Multiple Spanning Tree dialog, Port, CIST tab

Parameters	Meaning	Possible values	Default setting
Tab „Guards“	Protective settings for the ports.		
Module.Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two.		

Table 178: Port-related STP settings and displays, guards

Parameters	Meaning	Possible values	Default setting
Root Guard	The “Root Guard” setting is only relevant for ports with the STP role `designated`. If such a port receives an STP-BPDU with better path information on the root that what the device knows, the device discards the BPDU and sets the port status to `discarding`, instead of assigning the port the STP port role `root`. Thus the device helps protect your network from attacks with STP-BPDUs that try to change the topology, and from incorrect configurations. If there are no STP-BPDUs with better path information on the root, the device resets the transmission status of the port according to the port role. **Note:** The “Root Guard” and “Loop Guard” settings are mutually exclusive. If you activate one setting when the other is already active, the device switches off the other one.	`active` (box selected), `inactive` (box empty)	`inactive`
TCN Guard	If the “TCN Guard” setting is active (TCN: Topology Change Notification) the port ignores the topology change flag in the STP-BPDUs received, which is reporting a topology change. Thus the device protects your network from attacks with STP-BPDUs that try to change the topology. If the “TCN Guard” setting is inactive, the device follows the protocol in reacting to the STP-BPDUs received: it deletes its address table and forwards the TCN information. **Note:** If the received BPDU contains other information apart from the topology change flag that causes a topology change, the device processes the BPDU even if the TCN guard is activated. Example: the device receives better path information for the root than that already known.	`active` (box selected), `inactive` (box empty)	`inactive`

Table 178: Port-related STP settings and displays, guards

Parameters	Meaning	Possible values	Default setting
Loop Guard	The “Loop Guard” setting is only meaningful for ports with the STP role `alternate`, `backup` or `root`. If the “Loop Guard” setting is active and the port has not received any STP-BPDUs for a while, the device sets the port to the `discarding` condition (port sends no more data). The device also sets the port to what is known as the “loop inconsistent status” and displays this in the “Loop Status” column. The device prevents a potential loop if no more STP-BPDUs are received if, for example, you switch STP off on the remote device, or the link only fails in the receiving direction. When the port receives BPDUs again, the device resets the loop status of the port to `false`, and the transmission status of the port according to the port role. If the “Loop Guard” setting is inactive, however, the device sets the port to the `forwarding` status when STP-BPDUs have not been received. **Note:** The “Root Guard” and “Loop Guard” settings are mutually exclusive. If you activate one setting when the other is already active, the device switches off the other one.	`active` (box selected), `inactive` (box empty)	`inactive`
Loop State (read only)	Display the status of the Loop Status. The device sets the loop status of the port to `true` if the “Loop Guard” setting is active at the port and the port is not receiving any more STP-BPDUs. Here the device leaves the port in the `discarding` transmission status, thus helping to prevent a potential loop. When the port receives STP-BPDUs again, the device resets the loop status to `false`.	`true`, `false`	-
Transitions to Loop Status (read only)	Counts how often the device has set the port to the loop status (“Loop Status” column `true`).	0 - 4294967295 (2^{32}-1)	0

Table 178: Port-related STP settings and displays, guards

Parameters	Meaning	Possible values	Default setting
Transitions from Loop Status	Counts how often the device has set the port out of the loop status (“Loop Status” column `true`).	0 - 4294967295 (2^{32}-1)	0
BPDU Guard Effect (read only)	The “BPDU Guard Effect” status is only relevant for edge ports (ports with the “Admin Edge Port” status `true`), and only if the “BPDU Guard” global function is active (see table 167). When such a port receives any random STP-BPDU, the device sets the port's “BPDU Guard Effect” status to `true` and its transmission status to `discarding`. Thus the device helps you protect your network at terminal device ports from incorrect configurations or attacks with STP-BPDUs that try to change the topology. To return the port to a normal transmitting status from the locked status, break and reconnect the link, or switch the “Admin Edge Port” port setting off and on again.	`true`, `false`	-

Table 178: Port-related STP settings and displays, guards

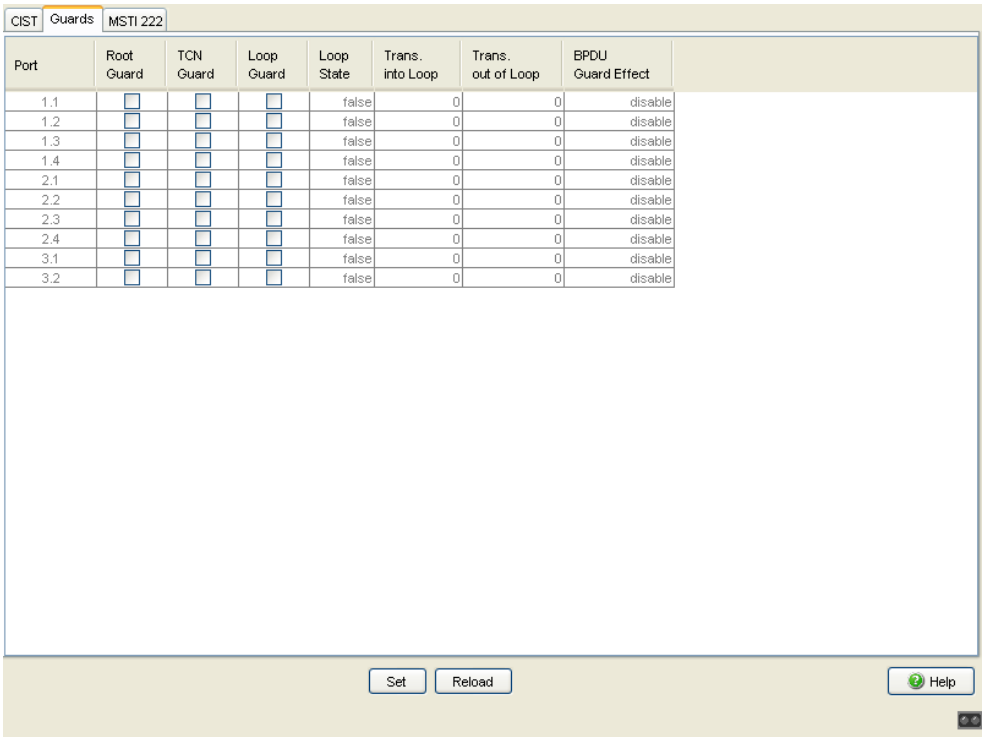


Figure 73: Multiple Spanning Tree dialog, Port, Guards tab

Parameters	Meaning	Possible values	Default setting
"MSTI <ID>" tab	Port configuration and information on the selected MSTI. **Note:** Note: the device only displays the MSTI ... tab if you have configured at least 1 MST instance.		
Port status (read only)	Displays the STP port status with regard to the current MSTI.	`discarding`, `learning`, `forwarding`, `disabled`, `manualForwarding`, `notParticipate`	-
Port role (read only)	Displays the STP port role with regard to the current MSTI.	`root`, `alternate`, `designated`, `backup`, `master`, `disabled`	-

Table 179: Port-related STP settings and displays, per MSTI

Parameters	Meaning	Possible values	Default setting
Port path costs	Enter the path costs with regard to the current MSTI to indicate preference for redundant paths. If the value is 0, the Switch automatically calculates the path costs depending on the transmission rate.	0 - 200000000	0 (automatically)
Port priority	Here you enter the port priority (the four highest bits of the port ID) with regard to the current MSTI as a decimal number of the highest byte of the port ID.	16 ≤ n*16 ≤ 240	128
Received bridge ID (read only)	Displays the remote bridge ID of the current MSTI from which this port last received a BPDU.[a].	Bridge identification (format ppppp / mm mm mm mm mm mm)	-
Received port ID (read only)	Displays the port ID of the remote bridge of the current MSTI from which this port last received a BPDU.[a]	Port ID, format pn nn, with p: port priority / 16, nnn: port No., (both hexadecimal)	-
Received path costs (read only)	Displays the path costs of the remote bridge from its root port to the root bridge of the current MSTI.[a].	0-200000000	-

Table 179: Port-related STP settings and displays, per MSTI

– [a] These columns show you more detailed information than that available up to now:
For designated ports, the device displays the information for the STP-BPDU last received by the port. This helps with the diagnosis of possible STP problems in the network.
For the port roles alternative, back-up, master and root, in the stationary

condition (static topology), this information is identically to the designated information.
If a port has no link, or if it has not received any STP-BDPUs for the current MSTI, the device displays the values that the port would send as a designated port.

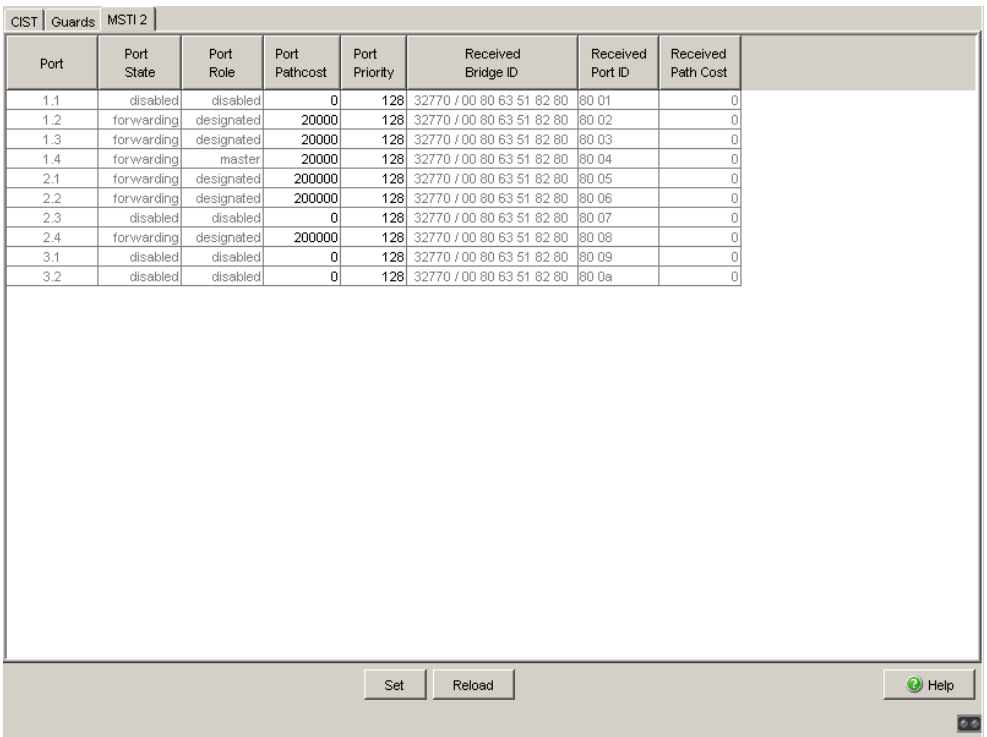


Figure 74: Multiple Spanning Tree dialog, Port, MSTI <ID> tab

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 180: Buttons

7.6 VRRP/HiVRRP

The Virtual Router Redundancy Protocol (VRRP) is a procedure that enables the system to react to the failure of a router.
VRRP is used in networks with terminal devices that only support one entry for the default gateway. If the default gateway fails, VRRP ensures that the terminal devices find a redundant gateway.
The Hirschmann company has further developed the VRRP into the Hirschmann Virtual Router Redundancy Protocol (HiVRRP). With the appropriate configuration, HiVRRP provides switching times of less than 400 ms.

Note: You will find detailed information on VRRP and HiVRRP in the "Routing Configuration“ user manual.

7.6.1 VRRP/HiVRRP Configuration

With this dialog you can enter general settings and settings for each port for the VRRP.
You can configure
– up to 8 virtual routers per port and
– up to 16 entries with HiVRRP per router.

General settings

Parameter	Meaning
Operation	Switch the VRRP function on and off
Version	Display the VRRP version

Table 181: VRRP general settings

Parameter	Meaning
Send VRRP Master Trap	As soon as the router takes over the VRRP master function, it sends a master trap
Send VRRP Authentication Failure Trap	As soon as the router receives a VRRP message with an incorrect authentication, it sends a VRRP authentication error trap.

Table 181: VRRP general settings

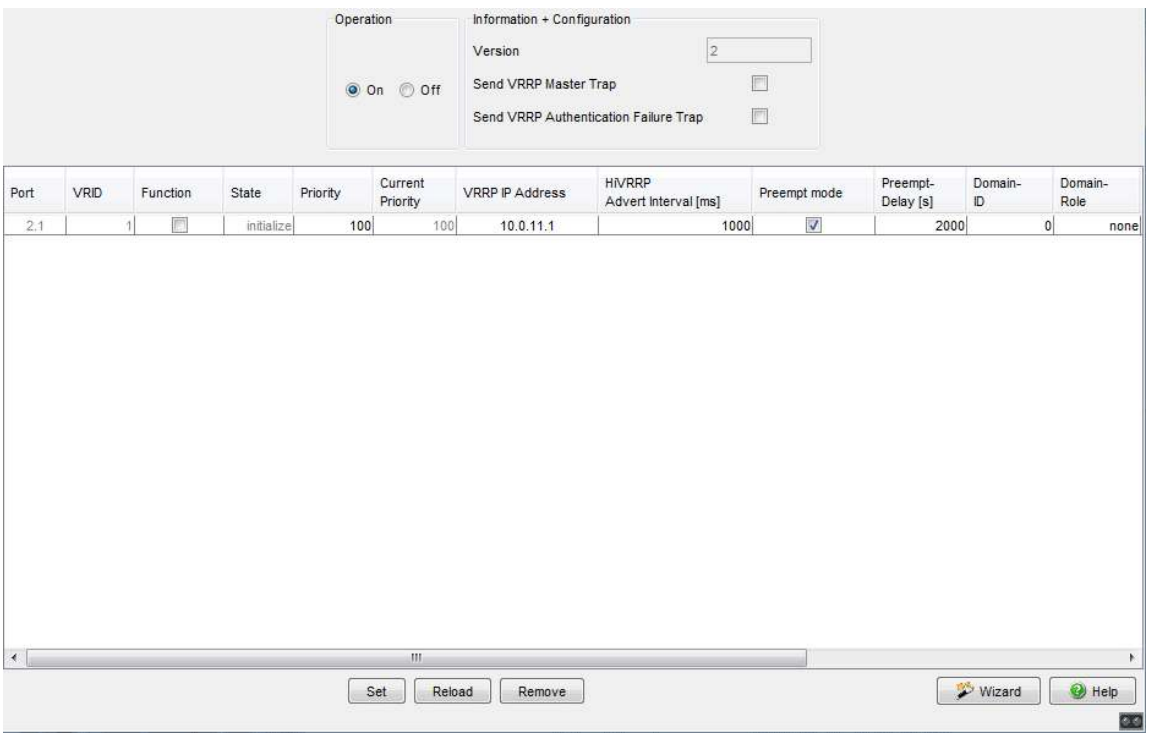


Figure 75: VRRP/HiVRRP Configuration dialog

VRRP instance settings

Parameter	Meaning
Port	Port to which this entry applies
VRID	Virtual router ID (value 1-255)
Function	Switch the VRRP instances on and off
State	VRRP state – `initialize`: VRRP is in the initialization phase. No master has been named yet. – `backup`: The router sees the possibility of becoming master. – `master`: The router is master.

Table 182: VRRP configuration table

Parameter	Meaning
Priority	VRRP priority set (value: 1-255; default: 100). The router with the highest value takes over the master function. If the virtual router IP address is the same as the IP address of the router interface, then this router is the “owner”. If an owner exists, then VRRP assigns the owner the VRRP priority 255 and thus declares it the master.
Current Priority	VRRP priority actually used (value: 1-255). This value is usually the same as the VRRP priority set, but it can be smaller if monitored tracking objects have the “down” status.
VRRP IP address	Primary virtual router IP address.
HiVRRP Advert Interval[ms]	Interval for sending out messages (advertisements) as the master (value for VRRP: `1-255 s`, value for HiVRRP: `100-255,000 ms`, default setting: `1 s`).
Preempt mode	This setting specifies whether this router, as a backup router, will take over the master role from a master router with a lower VRRP priority. If the preempt mode is switched off, this router only takes on the master role if the IP Multicast message from the existing master does not appear.
Preempt Delay[s]	The preempt mode, in collaboration with VRRP tracking, can enable a switch to a better router. However, dynamic routing procedures take a certain amount of time to react to changed routes and refill their routing table. To avoid the loss of packets during this time, delayed switching (preempt delay) from the master router to the backup router enables the dynamic routing procedure to fill the routing tables (value: 0-65535 s, default setting 0 s).
Domain ID	The domain ID is a number identifying the domain (see on page 305 “HiVRRP Domains”). Value: 0-8, default setting 0 = no domain.
Domain Role	`none`: not a member of a domain `member`: copies the behavior of the supervisor `supervisor`: determines the behavior of the domains
Authentication Type	Type of authentication used: – `noAuthentication`: VRRP information is exchanged without authentication. – `simpleTextPassword`: VRRP information is exchanged with plain text password authentication.
Authentication Key	Password for authentication. In order to communicate, the routers with the same virtual router IP address must have the same authentication setting.
Master IP Address	Actual router interface IP address of the master.

Table 182: VRRP configuration table

Setting up the VRRP router instance

☐ In the `Redundancy:VRRP/HiVRRP:Configuration` dialog, click “Wizard” at the bottom right.

☐ In the table in the Wizard dialog, select a port row and enter the virtual router ID in the VRID row. You can configure up to 8 virtual routers per interface.

☐ Click “Next”.

☐ Under “Edit entry” in the “Basic configuration” frame, enter:
- the IP address of the virtual router
- the VRRP priority
- the type of authentication
- the key for the authentication
- the preempt delay
- the advertisement interval.

If necessary, select the preempt mode
Switch on the operation of VRRP.
If you want
- switching times of less than 3 s,
- the routers to use Unicasts to communicate with each other,
- to set up domains or
- to send link-down notifications,

you activate the “HiVRRP” field.
In the “HiVRRP” frame, enter:
- the “Advertisement Interval”
- the “Destination Address”. The HiVRRP destination address is the IP address of the partner HiVRRP router.
- the IP address of the second router to which the link-down notifications are sent. This function can be used when the virtual router consists of two VRRP routers.
- the domain ID
- the domain role

☐ Click “Finish” to transfer the VRRP router interface to the VRRP router interface table
or

☐ Click “Next” to assign tracking objects to the virtual router under “Tracking”. If a tracking object’s status changes to “down”, the VRRP priority is decremented.
Select an existing tracking entry and click “Add”. You can add up to 8 tracking objects. Ascertain that the sum of the decrements of all the assigned tracking entries is less than the VRRP priority of this VRRP interface.

Note: As the IP address owner has the fixed VRRP priority 255 by definition, the VRRP tracking function requires the IP addresses of the VRRP router interfaces to differ from the virtual router IP address.

Note: Activate the preempt mode so that, the backup router can take over the master role after the decrementation of the master's VRRP priority via the tracking function.

- ☐ Click "Finish" to transfer the VRRP router interface to the VRRP router interface table
  or
- ☐ Click "Next" if you want to enter additional IP addresses under "Associated IP Addresses" (Multinetting).
- ☐ Click "Finish" to transfer the VRRP router interface to the VRRP router interface table.

Configuring the VRRP router instance

- ☐ In the `Redundancy:VRRP/HiVRRP:Configuration` dialog, double-click a cell of the table and edit the entry or right-click a cell and select a value.
- ☐ As an alternative to editing directly in the table, you can mark a row in the table and use the Wizard to edit it.

Deleting a VRRP router instance

- ☐ In the `Redundancy:VRRP/HiVRRP:Configuration` dialog, select a row and click "Remove". You thus delete the row.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.

Table 183: Buttons

Button	Meaning
Remove	Removes the selected table entry.
Wizard	Opens the "Wizard". With the "Wizard" you assign the permitted MAC addresses to a port.
Back	Displays the previous page again. Changes are lost.
Next	Saves the changes and opens the next page.
Finish	Saves the changes and completes the configuration.
Cancel	Closes the Wizard. Changes are lost.
Help	Opens the online help.

Table 183: Buttons (cont.)

7.6.2 HiVRRP Domains

A HiVRRP instance is a router instance configured as HiVRRP with functions that HiVRRP contains. In a HiVRRP domain you combine multiple HiVRRP instances of a router into one administrative unit. You nominate one HiVRRP instance as the supervisor of the HiVRRP domain. This supervisor regulates the behavior of all HiVRRP instances in its domain.
The router supports up to 8 domains.

Displaying HiVRRP domains

Parameters	Meaning
Domain ID	identification of the domains
Status	status of the supervisor of the domains `noError`: supervisor is active `SupervisorDown`: supervisor is not active `noSupervisor`: no supervisor defined
Supervisor Port	HiVRRP instance (module and port, written as <Slot>.<Port>) that was defined as the supervisor
Supervisor VRID	VRID of the supervisor

Table 184: Displaying HiVRRP domains

Parameters	Meaning
Supervisor Status	status of the supervisor – `initialize`: VRRP is in the initialization phase. No master has been named yet – `backup`: The router sees the possibility of becoming master – `master`: The router is master – `unknown`: no supervisor
Current Priority	current VRRP priority
Redundancy Check per Member	Activates the function for the selected domain.

Table 184: Displaying HiVRRP domains

HiVRRP domain instances at different ports

If domain instances (members) are divided among different physical ports, the router monitors by default only the supervisor's connection for line interruptions (“Redundancy Check per Member” deactivated).
You have the option of activating the monitoring of the other connections for line interruptions within the domain. Monitoring means that the router sends HiVRRP messages when it detects a line interruption. If there is a

low probability of a line interruption, you select a long HiVRRP message interval (see on page 301 “VRRP instance settings”) in order to minimize the network load.

☐ In the “Redundancy check per member” column, you can activate the function for a chosen domain as required.

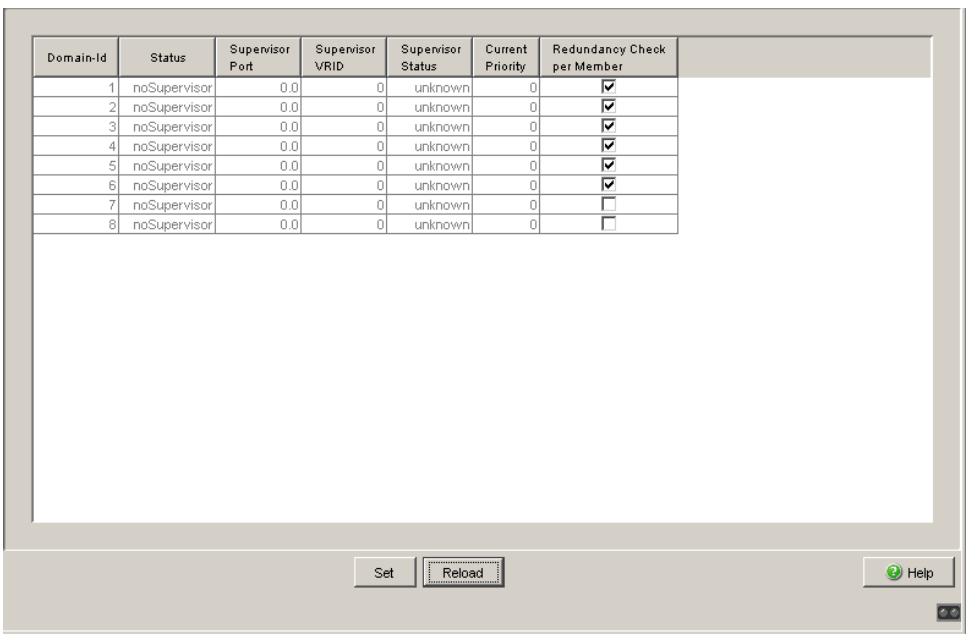


Figure 76: HiVRRP domain dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 185: Buttons

7.6.3 Statistics

The VRRP statistics window displays the numbers on counters that count events relevant to VRRP.

Parameter	Meaning
Checksum Error	Number of VRRP messages received with the wrong checksum.
Version Errors	Number of VRRP messages received with an unknown or unsupported version number.
VRID Errors	Number of VRRP messages received with an invalid VRID for this virtual router.

Table 186: VRRP Statistics for All Ports

Parameter	Meaning
Port	Port of the module of the device.
VRID	Virtual router ID.
Become Master	Number of times the Switch has become the master.
Advertise received	Number of VRRP advertisements received.
Advertise interval errors	Number of VRRP advertisements received by the router outside the advertisement interval.
Authentication failures	Number of VRRP advertisements received with authentication errors.
IP TTL errors	Number of VRRP advertisements received with an IP-TTL not equal to 255.
Priority Zero packets received	Number of VRRP advertisements via a VRRP participant with priority 0.
Priority Zero packets sent	Number of VRRP advertisements that the Switch sent with priority 0.
Invalid Type packets received	Number of VRRP advertisements received with an invalid type.
Address list errors	Number of VRRP advertisements received for which the address list does not match the address list configured locally for the virtual router.
Invalid authentication type	Number of VRRP advertisements received with an invalid authentication type.
Authentication type mismatch	Number of VRRP advertisements received with an incorrect authentication type.
Packet length errors	Number of VRRP advertisements received with an incorrect packet length.

Table 187: VRRP port statistics table

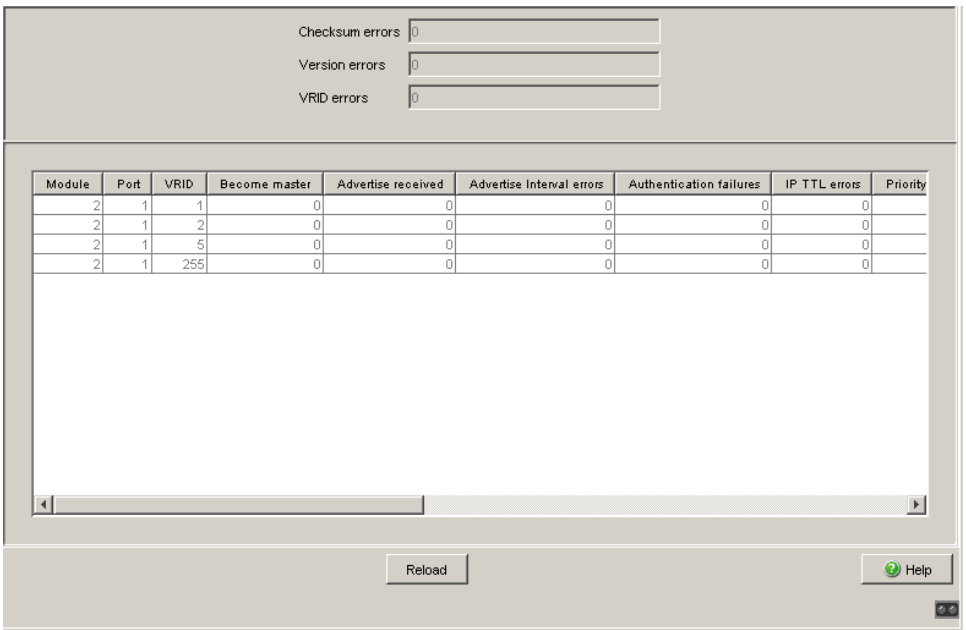


Figure 77: VRRP statistics dialog

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 188: Buttons

7.6.4 Tracking

The VRRP Tracking window displays the status of all the tracking objects assigned to VRRP objects.

Parameter	Bedeutung
Port	Port to which this entry applies, in the form <Slot>.<Port>
VRID	Virtual router ID of the virtual route assigned.
Track ID	Identification number of the tracking object for which you are registering this entry (see on page 239 “Applications”).
Decrement	Value by which the local router reduces the current VRRP priority of the VRRP router assigned when the tracking object receives the status of “down”.
Status	Current status of the tracking object: “up” or “down”.
Active	Entry is displayed as “active” if the tracking object is completely set up and is activated. More information about active entries: (see figure 78). If the entry is not active, its status is always “up”.

Table 189: VRRP Tracking Table

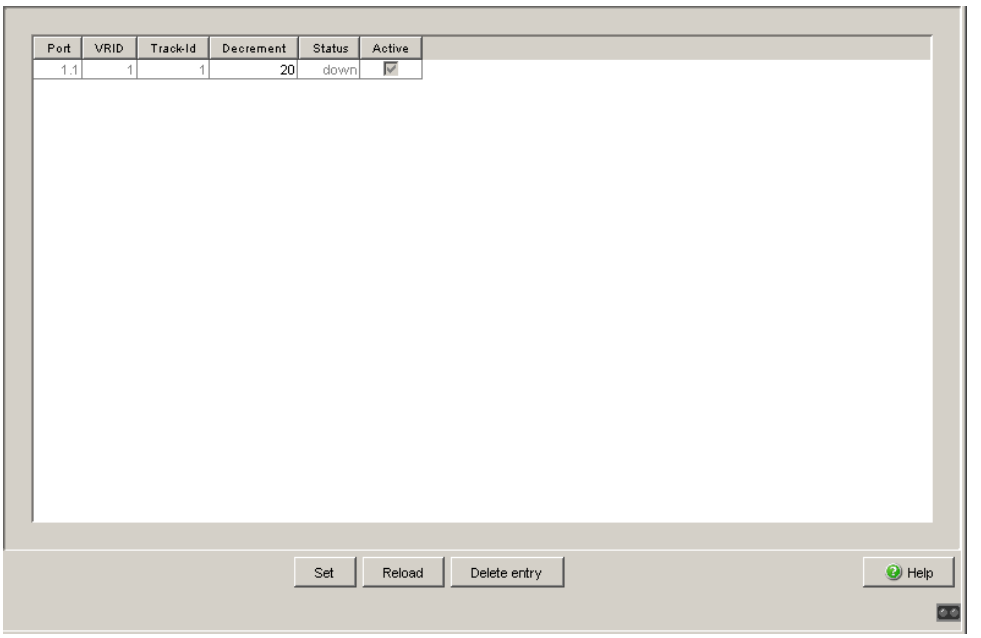


Figure 78: Tracking dialog

Deleting a tracking object

☐ In the `Redundancy:VRRP:Tracking` dialog, select a row and click “Remove”. You thus delete the row.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 190: Buttons

8 Diagnostics

The diagnostics menu contains the following tables and dialogs:

- Syslog
- Trap Log
- Ports (statistics, network load, SFP modules, TP cable diagnosis, port monitor)
- Auto Disable
- Configuration Check
- Topology Discovery
- Port Mirroring
- Device Status
- Signal Contact
- Alarms (Traps)
- Report (log file, system information)
- IP Address Conflict Detection
- Self-test

In service situations, they provide the technician with the necessary information for diagnosis.

8.1 Syslog

The “Syslog” dialog enables you to additionally send to one or more syslog servers, the events that the device writes to its trap log or event log. You can switch the function on or off, and you can manage a list of up to 8 syslog server entries. You also have the option to specify that the device informs various syslog servers, depending on the minimum “severity” (level to report) of the event.

Additionally, you can also send the SNMP requests to the device as events to one or more syslog servers. Here you have the option of treating GET and SET requests separately, and of assigning a “severity” to the requests to be logged.

Note: You will find the actual events that the device has logged in the “Trap Log” dialog (see on page 318 “Trap log”) and in the log file (see on page 370 “Event Log”). The device evaluates SNMP requests as events if you have activated “Log SNMP Set/Get Request” (see table 192).

Parameters	Meaning	Possible values	Default setting
“Operation” Frame	Switches the syslog function for this device “On” or “Off”	`On` `Off`	`Off`
“SNMP Logging” Frame	Settings for sending SNMP requests to the device as events to the list of syslog servers.		
Log SNMP Get Request	Creates events for the syslog for SNMP Get requests with the specified “severity”.	`Active` `inactive`	`inactive`

Severity (for logs of SNMP Get Requests)	Specifies the level for which the device creates the event “SNMP Get Request received” for the list of the syslog servers.	`debug`
		`informational`
		`notice`
		`warning`
		`error`
		`critical`
		`alert`
		`emergency`
			`notice`

Table 191: Syslog and SNMP Logging settings

Parameters	Meaning	Possible values	Default setting
Log SNMP Set Request	Creates events for the syslog for SNMP Set requests with the specified “severity”.	`Active` `inactive`	`inactive`

Severity (for logs of SNMP Set Requests)	Specifies the level for which the device creates the event “SNMP Set Request received” for the list of the syslog servers.	`debug`
		`informational`
		`notice`
		`warning`
		`error`
		`critical`
		`alert`
		`emergency`
			`notice`

Table 191: Syslog and SNMP Logging settings

Parameters	Meaning	Possible values	Default setting
Syslog server entries			
Index	Sequential number of the syslog server entry in the table. When you delete an entry, this leaves a gap in the numbering. When you create a new entry, the device fills the first gap.	1 - 8	-
IP-Address	Address of a syslog server to which the device sends its log entries.	Valid IPv4 address	0.0.0.0
Port	UDP port at which your syslog server receives entries.	1 - 65535	514

Minimum Severity	Minimum severity for an event for the device to sent a log entry for it to this syslog server.	`debug`
		`informational`
		`notice`
		`warning`
		`error`
		`critical`
		`alert`
		`emercency`
			critical

Active	Activate or deactivate the current syslog server entry in the table.	`active` (box selected) `inactive` (box empty)	inactive

Table 192: Syslog server entries

Note: When you activate the logging of SNMP requests, the device sends these as events with the preset severity `notice` to the list of syslog servers. The preset minimum severity for a syslog server entry is `critical`.

To send SNMP requests to a syslog server, you have a number of options to change the default settings. Select the ones that meet your requirements best.

- Set the severity for which the device creates SNMP requests as events to `warning` or `error` and change the minimum severity for a syslog entry for one or more syslog servers to the same value.
  You also have the option of creating a separate syslog server entry for this.
- When you set the severity for SNMP requests to `critical` or higher. The device then sends SNMP requests as events with the severity `critical` or higher to the syslog servers.
- When you set the minimum severity for one or more syslog server entries to `notice` or lower. Then it is possible that the device sends many events to the syslog servers.

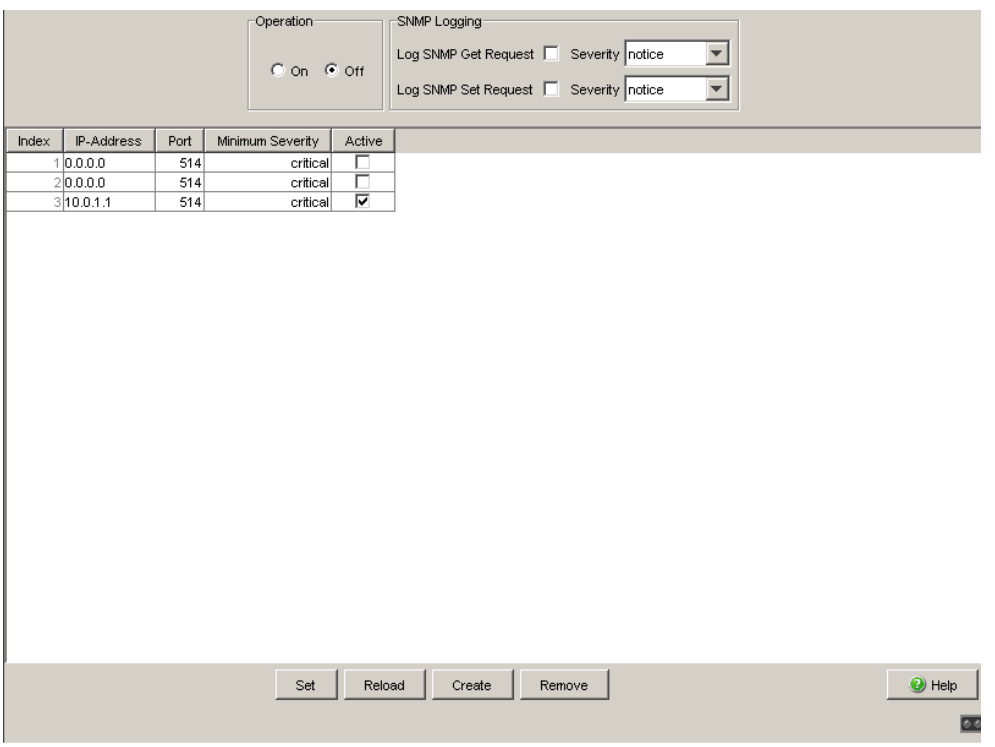


Figure 79: Syslog dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 193: Buttons

8.2 Trap log

The table lists the logged events with a time stamp. You update the content of the trap log via the “Reload” button. You delete the content of the trap log via the “Clear” button.

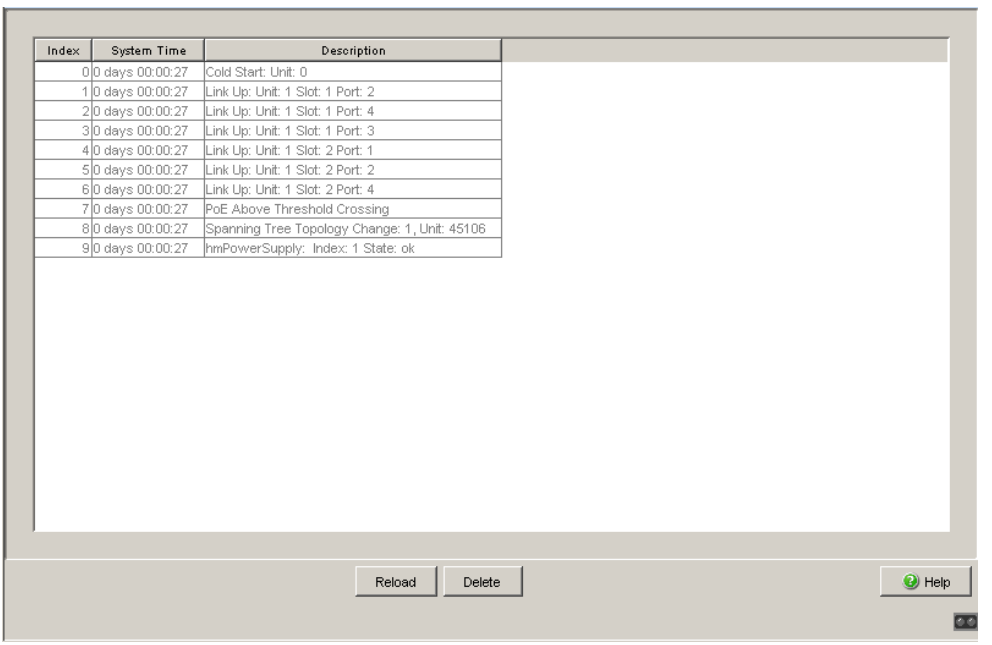


Figure 80: Trap log table

Parameters	Meaning	Possible values	Default setting
Index	Shows a sequential number to which the table entry relates. The device automatically defines this number.	0, 1, 2, ...	
System Time	Displays the time elapsed since the logged event.	d days hh:mm:ss	
Description	Displays a short description of the logged event.	-	

Table 194: Trap log table

You have the option to also send the logged events to one or more syslog servers (see on page 314 “Syslog”).

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Clear	Deletes the table entries.
Help	Opens the online help.

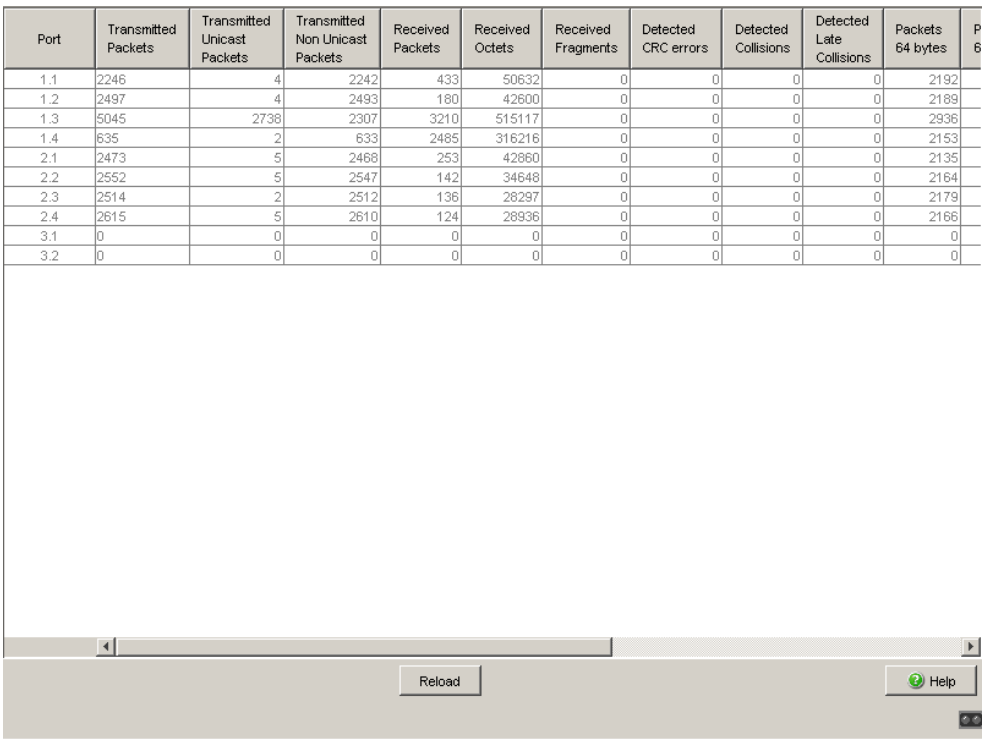
Table 195: Buttons

8.3 Ports

The port menu contains displays and tables for the individual ports:
- Statistics table
- Utilization
- SFP Modules
- TP cable diagnosis
- Port Monitor

8.3.1 Statistics table

This table shows you the contents of various event counters. In the Restart menu item, you can reset the event counters to zero using "Warm start", "Cold start" or "Reset port counter".
The packet counters add up the events sent and the events received.



Port	Transmitted Packets	Transmitted Unicast Packets	Transmitted Non Unicast Packets	Received Packets	Received Octets	Received Fragments	Detected CRC errors	Detected Collisions	Detected Late Collisions	Packets 64 bytes
1.1	2246	4	2242	433	50632	0	0	0	0	2192
1.2	2497	4	2493	180	42600	0	0	0	0	2189
1.3	5045	2738	2307	3210	515117	0	0	0	0	2936
1.4	635	2	633	2485	316216	0	0	0	0	2153
2.1	2473	5	2468	253	42860	0	0	0	0	2135
2.2	2552	5	2547	142	34648	0	0	0	0	2164
2.3	2514	2	2512	136	28297	0	0	0	0	2179
2.4	2615	5	2610	124	28936	0	0	0	0	2166
3.1	0	0	0	0	0	0	0	0	0	0
3.2	0	0	0	0	0	0	0	0	0	0

Figure 81: Port statistics, table

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Reset port counters	Resets the counter for the port statistics to `0`.
Help	Opens the online help.

Table 196: Buttons

8.3.2 Network load (Utilization)

This table displays the network load of the individual ports. The network load is the data quantity that the port received in the previous 30 s, compared to the maximum possible data quantity at its currently configured data rate.

The upper and lower thresholds work together controlling utilization alarms for a port. The device sends an alarm when utilization exceeds the upper threshold. Then, when the utilization is below the lower threshold the alarm is reset. A wide range between the upper and lower thresholds keeps the device from sending multiple alarms.

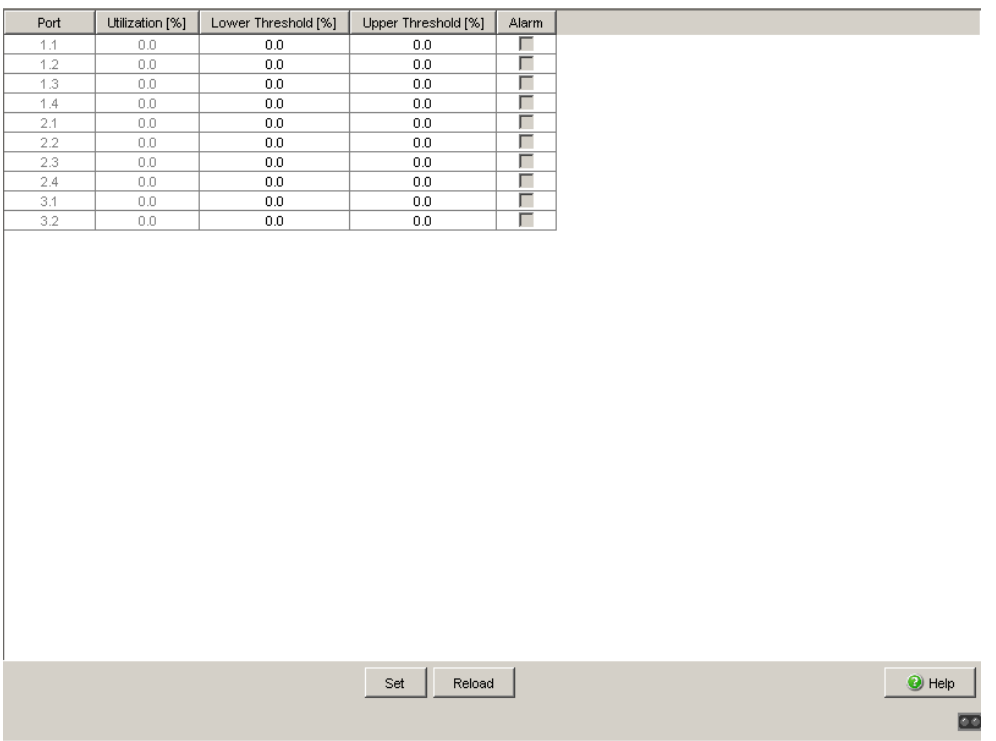


Figure 82: Network load dialog

Parameters	Meaning	Possible values	Default setting
`Port`	Number of the device port to which the table entry relates.	`1.1`, `1.2`, `1.3` etc.	
`Utilization` [%]	Shows the current utilization in percent which the device port has received within the last 30 s. The utilization is the relationship of the received data quantity to the maximum possible data quantity at the currently configured data rate.	`0.00..100.00`	0.00
`Lower Threshold [%]`	Defines the lower threshold for utilization. When the utilization of the device port falls below this value, the alarm is reset. The value 0 deactivates the lower threshold.	`0.00..100.00`	0.00
`Upper Threshold [%]`	Defines an upper threshold for the utilization. If the utilization of the device port exceeds this value, the `Alarm` field shows an alarm. The value 0 deactivates the upper threshold.	`0.00..100.00`	0.00
`Alarm`	Indicates the alarm status for the utilization. – `Selected` The utilization of the device port is below the value defined in the Lower Threshold [%] field or above the value defined in the Upper Threshold [%] field. The device sends an SNMP message (trap). – Not selected The utilization of the device port is above the value defined in the Lower Threshold [%] field or below the value defined in the Upper Threshold [%] field.	`Selected` `Not selected`	`Not selected`

Table 197: Network load (Utilization) table

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 198: Buttons

8.3.3 SFP Transceiver

The SFP status display enables you to look at the current SFP module connections and their properties. The properties include:

Parameters	Meaning
Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two.
Module type	Type of SFP module, e.g. M-SFP-SX/LC.
Supported	Shows whether the media module supports the SFP module.
Temperature in °C	Shows the SFP's operating temperature.
Tx Power in mW	Shows the transmission power in mW.
Rx Power in mW	Shows the receive power in mW.
Tx power in dBm	Shows the transmission power in dBm.
Rx power in dBm	Shows the receive power in dBm.

Table 199: SFP Modules dialog

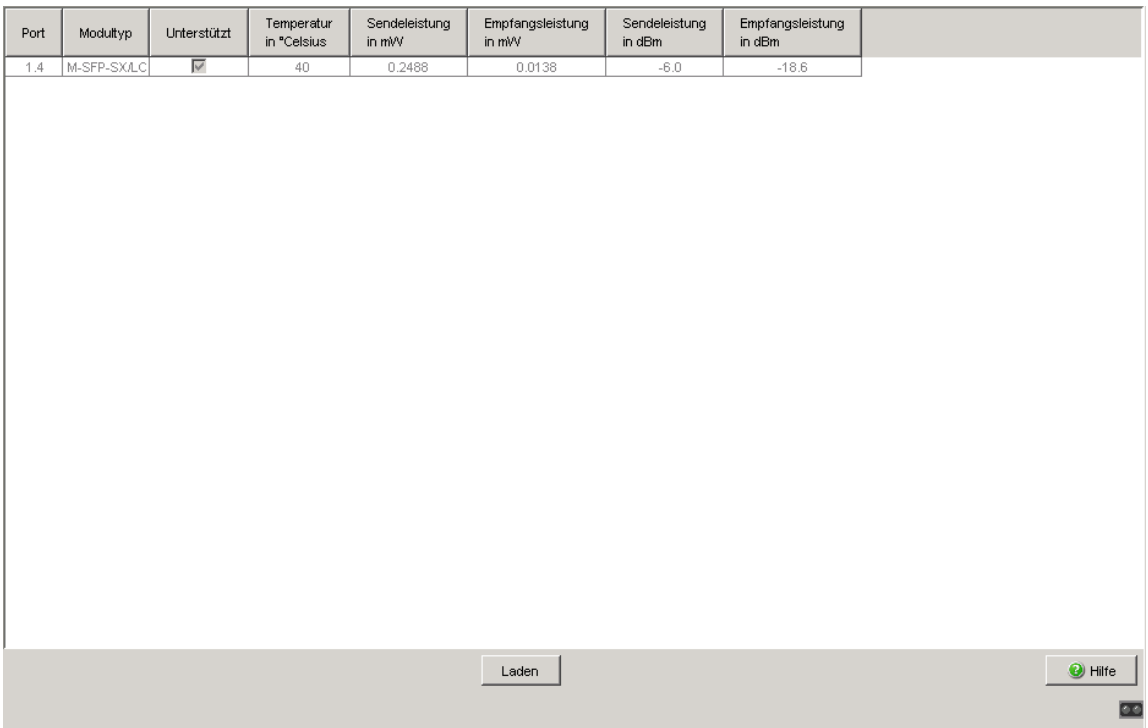


Figure 83: SFP Modules dialog

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 200: Buttons

8.3.4 TP Cable Diagnosis

The TP cable diagnosis allows you to check the connected cables for short-circuits or interruptions.

Note: While the check is running, the data traffic at this port is suspended.

☐ Select the TP port on which you want to perform the check.

☐ Click "Set" to start the check.

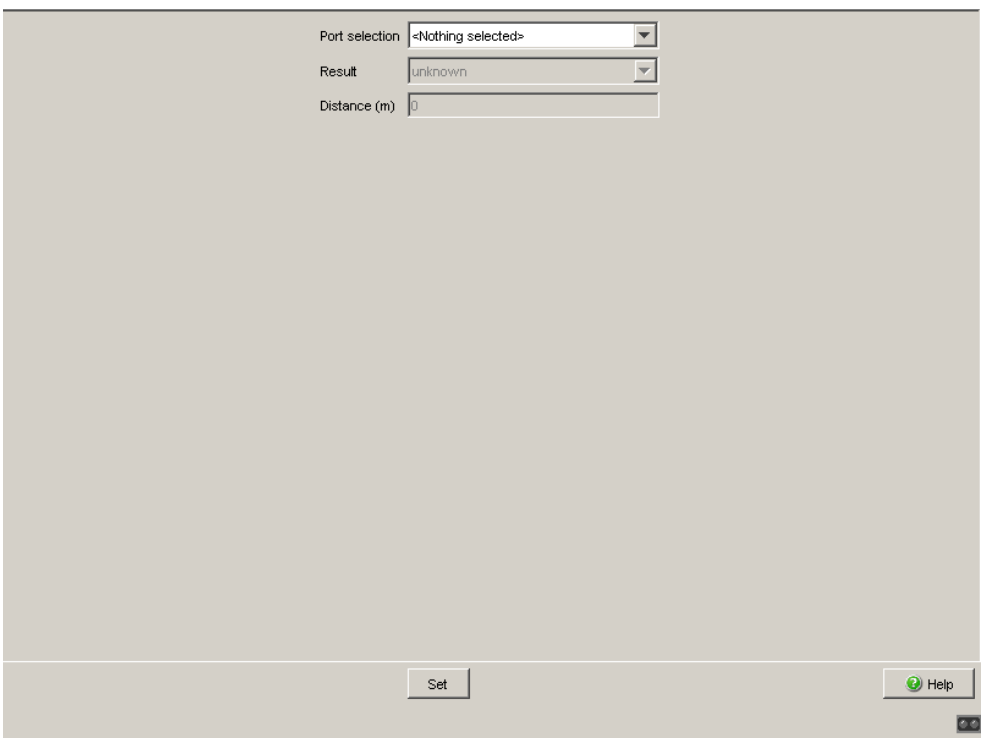


Figure 84: TP cable diagnosis dialog

The check takes a few seconds. After the check, the "Result" row contains the result of the cable diagnosis. If the result of the check shows a cable problem, then the "Distance" row contains the cable problem location's distance from the port.

Result	Meaning
normal	The cable is okay.
open	The cable is interrupted.
short circuit	There is a short-circuit in the cable.
unknown	No cable check was performed yet, or it is currently running

Table 201: Meaning of the possible results

Prerequisites for correct TP cable diagnosis:
- 1000BASE-T port, connected to a 1000BASE-T port via 8-core cable or
- 10BASE-T/100BASE-TX port, connected to a 10BASE-T/100BASE-TX port.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Help	Opens the online help.

Table 202: Buttons

8.3.5 Port Monitor

The Port Monitor monitors the ports of the device. When an event occurs, the device performs an action for the port, e.g. if there are too many connection breaks due to a loose contact.

Global

On the "Global" tab you define the triggering events and an action for the ports to be monitored:

- ☐ Switch on the function globally in the "Operation" frame.
- ☐ For every port to be monitored, mark the checkbox in the "Port Monitor on" column.
- ☐ Define the triggering event for every port to be monitored. To do this, mark the checkboxes in the "Link Flap on" to "Link Speed and Duplex Mode on" columns.
- ☐ Define the parameters for the triggering event on the related tab.
- ☐ For every port to be monitored, select the action that the device is to perform in the “Action” column.
- ☐ Save the settings.

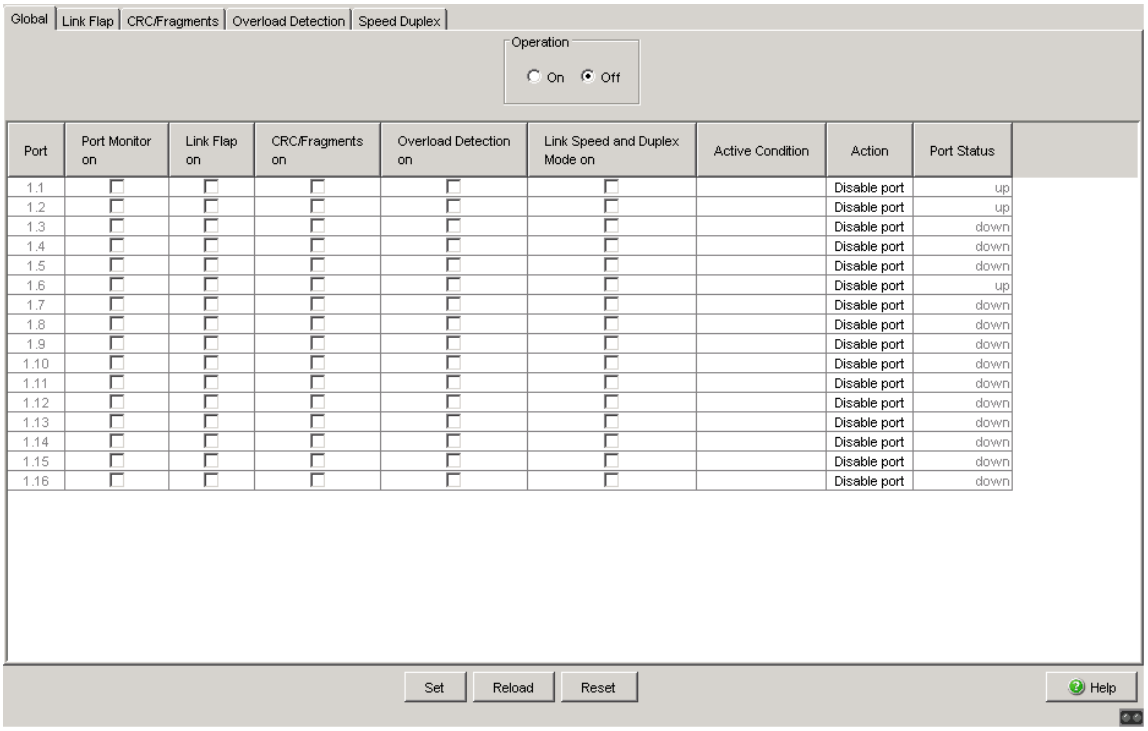


Figure 85: Global Port Monitor Dialog

Parameter	Meaning
“Operation” Frame	Switches the “Port monitor” function for the device on or off.
Port table	
Port	List of the available ports on the device.
Port Monitor on	You select the ports to be monitored here.
Link Changes on	You select here whether link changes trigger an action. Changes from the “Link down” state to “Link up” are treated as link changes.
CRC/Fragment Error on	You select here whether CRC or fragment errors that occur trigger an action.
Overload Detection on	You select here whether overload detection triggers an action.
Link Speed and Duplex Mode on	You select here whether an incorrect combination of duplex mode and transmission speed triggers an action.
Active Condition	Shows the condition on the basis of which the device performed an action on this port.

Table 203: Port Monitor Global table

Parameter	Meaning
Action	You select the action here that the device performs when the triggering event occurs. The following actions are possible: ▶ `Disable port` Disables the port. Then the port LED on the device blinks green 3 times per period. The device re-enables the port when you have defined the following settings in the `Diagnostics:Ports:Auto Disable` dialog. – In the "Configuration" frame, the checkbox is marked for the triggering event that disabled the port. – The reset timer is defined >0 for the port. ▶ `Send trap` Sends an SNMP trap. The port remains enabled. ▶ `Auto Disable` Disables the port depending on the settings on the `Diagnostics:Ports:Auto Disable` dialog, "Configuration" frame. – The device disables the port when the checkbox for the triggering event is marked. Then the port LED on the device blinks green 3 times per period. The device re-enables the port when the reset timer for the port is defined >0 in the `Diagnostics:Ports:Auto Disable` dialog for the port. If the device has disabled the port due to an overload, further prerequisites apply for the re-enabling of the port (see on page 334 “Overload Detection”). – The port remains enabled when the checkbox for the triggering event is unmarked.
Port Status	Displays the current port status. – `up`: data transmission via the port is possible. – `down`: data transmission via the port is interrupted. – `notPresent`: no physical port is present.

Table 203: Port Monitor Global table

Link Flap

On the "Link Flap" tab, define the parameters on the basis of which the device triggers an action for the relevant port if there are too many link changes:

☐ Open the "Link Flap" tab.

☐ On the "Parameter" tab, define the number of link changes and the related interval.
These parameters apply to all ports for which the checkbox is marked on the "Global" tab, "Link Flap on" column.

☐ Save the settings.

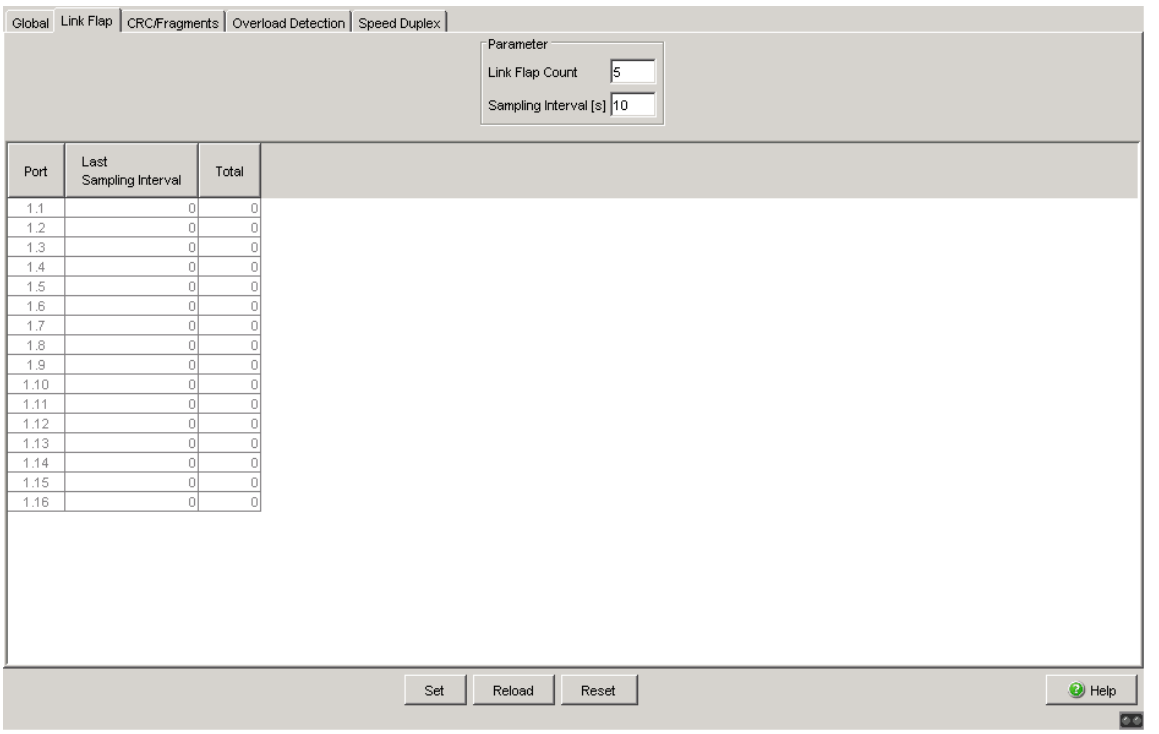


Figure 86: Link Flap Port Monitor Dialog

Note: For ports at which you have set the number of link changes to the value of 1, note the following particularity:
If you have selected the "Disable Port" action, the device deactivates the port as early as after the 1st link change. The "Link Up" change also relates to this in the following instances:

- on restarting the device, if a communication partner is already connected to the port,
- on the 1st connection of communication partner and
- on loading a configuration (see on page 52 “Loading a Configuration”).

If the device deactivated all the ports, you can only access the Switch via the V.24 access.

Parameters	Meaning
Link Flap Count	Number of link changes in the completed sampling interval that leads to an action by the device.
Sampling Interval [s]	Length of the sampling interval in which the device determines the number of link changes.
Port table	
Port	List of the device's available ports.
Last Sampling Interval	Number of link changes during the last sampling interval. Link changes are also still counted after the port is deactivated.
Total	Sum of all link changes having occurred up to now. Link changes are also still counted after the port is deactivated.

Table 204: Link Changes Port Monitor Table

CRC/Fragments

On the "CRC-/Fragments" tab, define the parameters on the basis of which the device triggers an action for the relevant port if too many faulty Ethernet packets are received:

☐ Open the "CRC-/Fragments" tab.

☐ In the "Parameter" frame, define the rate of the faulty packets (in parts per million) and the related interval.
These parameters apply to all ports for which the checkbox is marked on the "Global" tab, "CRC-/Fragments on" column.

☐ Save the settings.

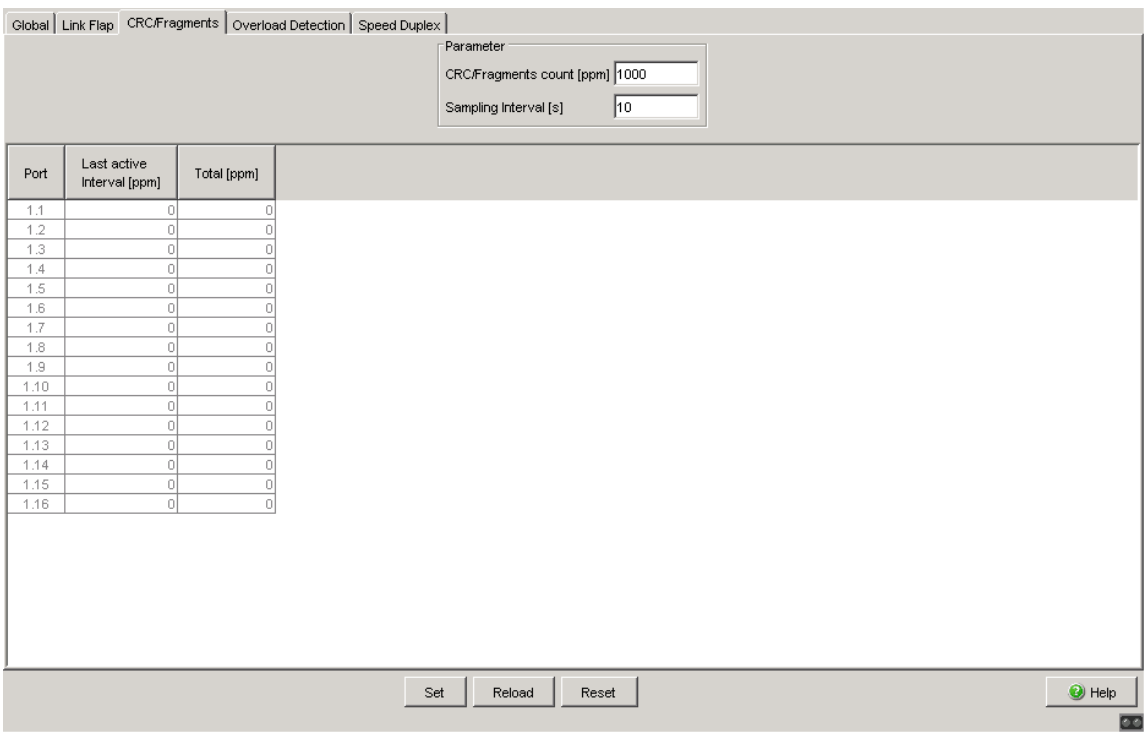


Figure 87: CRC/Fragment Error Port Monitor Dialog

Parameters	Meaning
CRC/Fragments count [ppm]	Fragment error rate in the completed sampling interval that leads to an action by the device.
Sampling Interval [s]	Length of the sampling interval in which the device determines the CRC/fragment error rate.
Port table	
Port	List of the device's available ports.

Table 205: CRC/Fragments Port Monitor Table

Parameters	Meaning
Last active Interval [ppm]	Detected error rate during the last active sampling interval that triggered the action.
Total [ppm]	Total error rate that has occurred so far in ppm (parts per million).

Table 205: CRC/Fragments Port Monitor Table

Overload Detection

On the "Overload Detection" tab, define the parameters on the basis of which the device triggers an action for the relevant port if there is an overload.

☐ Open the "Overload Detection" tab.

☐ Define the interval in the "Parameter" frame.
This parameter applies to all ports for which the checkbox is marked on the "Global" tab, "Overload Detection on" column.

☐ In the "Traffic Type" column, define which packets the device considers for the load detection.

☐ In the "Upper Threshold" column, define the desired value in `pps` (packets per second).
If the data rate on the port exceeds this value, the device performs the action defined on the "Global" tab for the port.

☐ In the "Lower Threshold" column, define the desired value in `pps` (packets per second) if you are using the `Send trap` or `Auto Disable` action on the port.
The auto-disable function re-enables a disabled port when the following prerequisites are fulfilled:
– In the auto-disable settings, the "Reset Timer" value for the port is defined >0.
– The time defined in "Reset Timer" has elapsed.
– The load on the port is lower than the value defined in the "Lower Threshold" column.

☐ Save the settings.

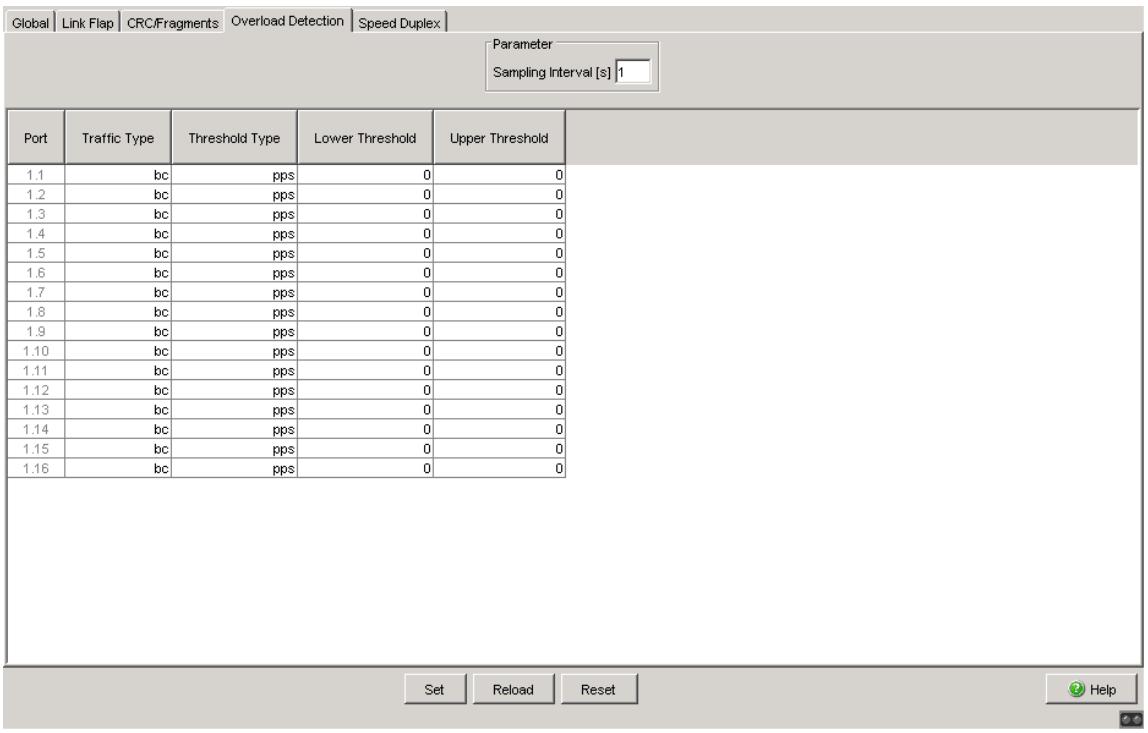


Figure 88: Overload Detection Port Monitor Dialog

Parameters	Meaning
Sampling Interval [s]	Length of the sampling interval in which the device determines the amount of values below and above the permitted thresholds.
Port table	
Port	List of the device's available ports.

Table 206: CRC/Fragments Port Monitor Table

Parameters	Meaning
Traffic Type	Defines the overload detection traffic type. The following types are possible: – all: The overload function uses unicast, broadcast and multicast traffic for threshold detection. – bc: The overload function uses broadcast traffic for threshold detection. – bc-mc: The overload function uses broadcast and multicast traffic for threshold detection.
Threshold Type	Defines the overload detection threshold type. The following types are possible: – pps - packets per second Available on the MACH1040 and MACH104: – kbps - kilobits per second – link-capacity - percent of the link capacity
Lower Threshold	Defines the value at which the device auto-enables the port.
Upper Threshold	Defines the value at which the device auto-disables the port.

Table 206: CRC/Fragments Port Monitor Table

Speed Duplex

On the "Speed Duplex" tab, you define the permitted combinations of speed and duplex mode. If the device detects an unpermitted combination of speed and duplex mode, it triggers an action for the relevant port:

☐ Open the "Speed Duplex" tab.

☐ You define for each port individually which duplex mode is permitted for which speed.

☐ Save the settings.

Note: The port monitor monitors the speed and the duplex mode exclusively on enabled physical ports.

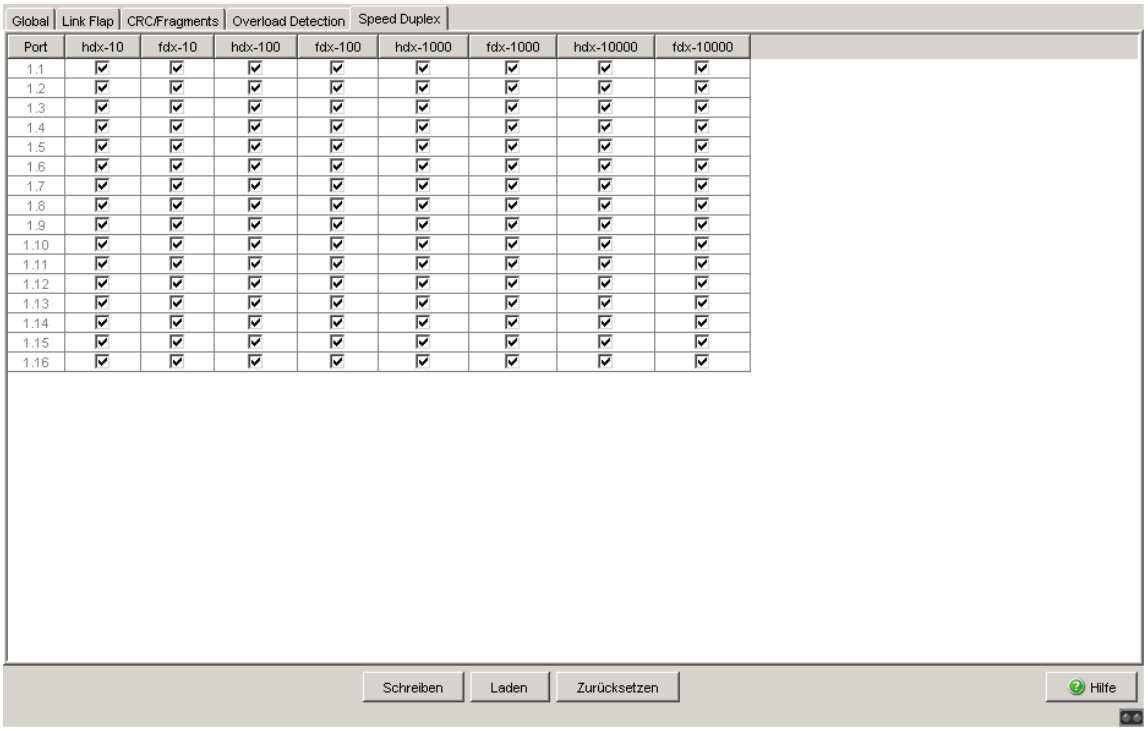


Figure 89: Port-Monitor Speed Duplex dialog

Parameters	Meaning
Port	List of the device's available ports.
hdx-10	Activates/deactivates the port monitor to accept a half-duplex and 10 Mbit/s data rate combination on the port. Possible values: ▶ `marked` (default setting) The port monitor allows the speed and duplex combination. ▶ `unmarked` If the port monitor detects the speed and duplex combination on the port, then the device executes the action specified in the "Global" tab.
fdx-10	Activates/deactivates the port monitor to accept a full-duplex and 10 Mbit/s data rate combination on the port. Possible values: ▶ `marked` (default setting) The port monitor allows the speed and duplex combination. ▶ `unmarked` If the port monitor detects the speed and duplex combination on the port, then the device executes the action specified in the "Global" tab.

Table 207: Port-Monitor Speed Duplex table

Parameters	Meaning
hdx-100	Activates/deactivates the port monitor to accept a half-duplex and 100 Mbit/s data rate combination on the port. Possible values: ▶ `marked` (default setting) The port monitor allows the speed and duplex combination. ▶ `unmarked` If the port monitor detects the speed and duplex combination on the port, then the device executes the action specified in the "Global" tab.
fdx-100	Activates/deactivates the port monitor to accept a full-duplex and 100 Mbit/s data rate combination on the port. Possible values: ▶ `marked` (default setting) The port monitor allows the speed and duplex combination. ▶ `unmarked` If the port monitor detects the speed and duplex combination on the port, then the device executes the action specified in the "Global" tab.
hdx-1000	Activates/deactivates the port monitor to accept a half-duplex and 1 Gbit/s data rate combination on the port. Possible values: ▶ `marked` (default setting) The port monitor allows the speed and duplex combination. ▶ `unmarked` If the port monitor detects the speed and duplex combination on the port, then the device executes the action specified in the "Global" tab.

Table 207: Port-Monitor Speed Duplex table

Parameters	Meaning
fdx-1000	Activates/deactivates the port monitor to accept a full-duplex and 1 Gbit/s data rate combination on the port. Possible values: ▶ `marked` (default setting) The port monitor allows the speed and duplex combination. ▶ `unmarked` If the port monitor detects the speed and duplex combination on the port, then the device executes the action specified in the "Global" tab.
fdx-10000	Available on the MACH4002 24G/48G and MACH104: Activates/deactivates the port monitor to accept a full-duplex and 10 Gbit/s data rate combination on the port. Possible values: ▶ `marked` (default setting) The port monitor allows the speed and duplex combination. ▶ `unmarked` If the port monitor detects the speed and duplex combination on the port, then the device executes the action specified in the "Global" tab.

Table 207: Port-Monitor Speed Duplex table

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Reset	Resets the port monitor function for the selected interface and enables the port when disabled by the Port Monitor function.
Help	Opens the online help.

Table 208: Buttons

8.3.6 Auto Disable

The auto-disable function allows you to automatically re-enable ports that the port monitor has disabled after a user-defined period of time. In the process, the device allows multiple triggering events to be considered.

You define the triggering events on the basis of which the device disables the ports in the settings for the port security (see on page 87 “Port Security”) and the port monitor (see on page 328 “Port Monitor”).

When the port monitor performs the `Auto Disable` action for a port, the settings in the "Auto-Disable" dialog, "Configuration" frame, decide what happens to the port:

- The device disables the port when the checkbox for the triggering condition is marked. Then the port LED on the device blinks green 3 times per period.
  The device re-enables the port if the Reset Timer value for the port is defined >0.
- The port remains enabled when the checkbox for the triggering event is unmarked.

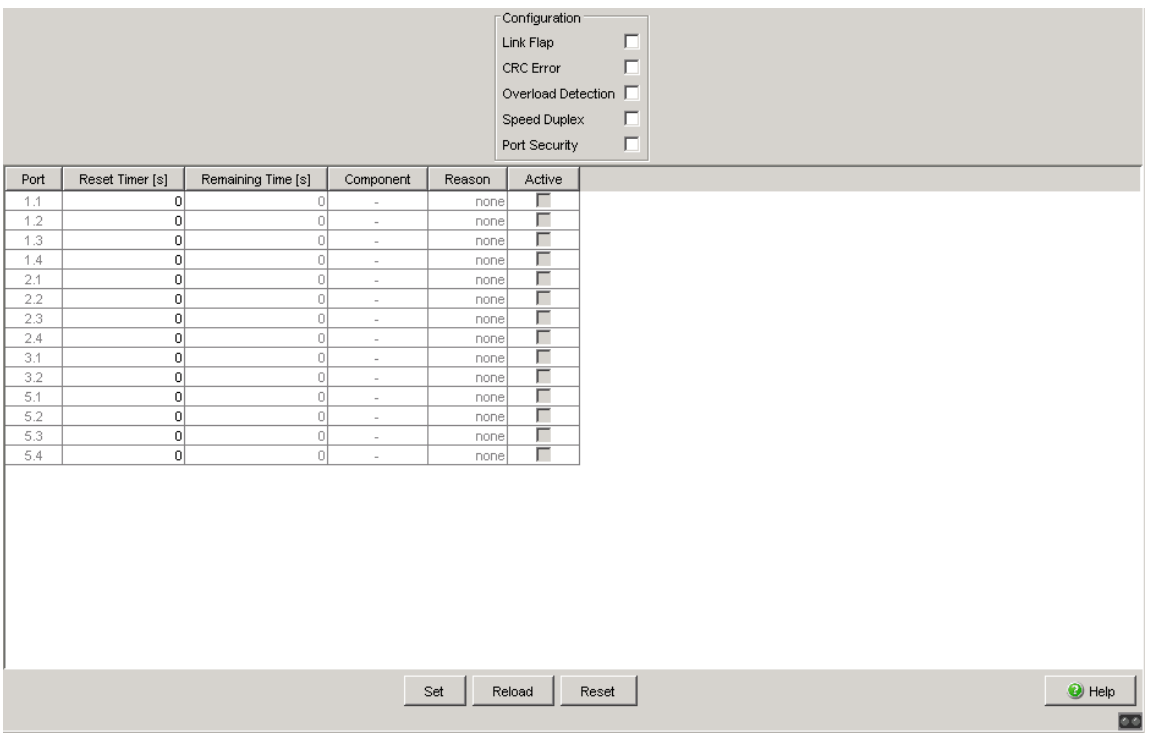


Figure 90: "Auto Disable" dialog

Configuration

Parameters	Meaning
Link Flap	Enables/disables the monitoring of link changes on the ports. Possible values: ▶ `marked` The auto-disable function monitors link changes on the ports. When the port monitor disables a port due to too many link changes, the device re-enables the port after the time defined in the “Reset Timer” field has elapsed. The prerequisite for this is that the “Reset Timer” value for the port is >0. ▶ `unmarked` (default setting) The auto-disable function ignores link changes on the ports.
CRC/Fragments	Enables/disables the monitoring of CRC/fragment errors on the ports. Possible values: ▶ `marked` The auto-disable function monitors CRC/fragment errors on the ports. When the port monitor disables a port due to too many CRC/fragments, the device re-enables the port after the time defined in the “Reset Timer” field has elapsed. The prerequisite for this is that the “Reset Timer” value for the port is >0. ▶ `unmarked` (default setting) The auto-disable function ignores CRC/fragment errors on the ports.
Overload Detection	Enables/disables the monitoring of the load on the ports. Possible values: ▶ `marked` The auto-disable function monitors the load on the ports. When the port monitor disables a port due to an overload, the device re-enables the port after the time defined in the “Reset Timer” field has elapsed. The prerequisite for this is that the “Reset Timer” value for the port is >0. For more prerequisites, see “Overload Detection” on page 334. ▶ `unmarked` (default setting) The auto-disable function ignores the load on the ports.

Table 209: "Configuration" frame in the `Diagnostics:Ports:Auto Disable` dialog

Parameters	Meaning
Speed Duplex	Enables/disables the monitoring of the speed and duplex combination on the ports. Possible values: ▶ `marked` The auto-disable function monitors the speed and duplex combination on the ports. When the port monitor disables a port due to an unpermitted combination of speed and duplex mode, the device re-enables the port after the time defined in the “Reset Timer” field has elapsed. The prerequisite for this is that the “Reset Timer” value for the port is >0. ▶ `unmarked` (default setting) The auto-disable function ignores the speed and duplex combination on the ports.
Port Security	Enables/disables the monitoring of unauthorized accesses to the ports in combination with the "Port Security" function (see on page 87 “Port Security”). Possible values: ▶ `marked` The auto-disable function monitors unauthorized accesses to the ports. When the port monitor disables a port due to too many CRC/fragment errors, the device re-enables the port after the time defined in the “Reset Timer” field has elapsed. The prerequisite for this is that the “Reset Timer” value for the port is >0. ▶ `unmarked` (default setting) The auto-disable function ignores unauthorized accesses to the ports.

Table 209: "Configuration" frame in the `Diagnostics:Ports:Auto Disable` dialog

Table

Parameter	Meaning
Port	Shows the number of the device port to which the table entry relates.
Reset Timer [s]	Defines the time in seconds after which the device automatically re-enables the port disabled by the port monitor. Possible values: ▶ `0` (default setting) Timer is deactivated. The port remains disabled. ▶ `30...2147483` If the port monitor has disabled the port due to an overload, further prerequisites apply for the re-enabling of the port (see on page 334 “Overload Detection”).
Remaining Time [s]	Remaining time in seconds until the automatic re-enabling of the port.

Table 210: Table in the `Diagnostics:Ports:Auto Disable` dialog

Parameter	Meaning
Component	Shows the name of the function that disabled the port.
Reason	Shows the triggering event due to which the port monitor disabled the port.
Active	Shows whether the auto-disable function is active on the relevant port. Possible values: ▶ `marked` The auto-disable function is active on the port. The port is currently disabled. After the time defined in the "Reset Timer" field has elapsed, the auto-disable function re-enables the port. ▶ `unmarked` (default setting) The auto-disable function is inactive on the port.

Table 210: Table in the `Diagnostics:Ports:Auto Disable` dialog (cont.)

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Reset	Enables the port when disabled by the Port Monitor or Port Security function.
Help	Opens the online help.

Table 211: Buttons

8.4 Configuration Check

The device enables you to compare its configuration with those of its neighboring devices.
For this purpose, it uses the data that it received from its neighboring devices via topology recognition (LLDP).
The dialog lists the deviations detected, which affect the performance of the communication between the device and the recognized neighboring devices.

☐ You update the table's content via the "Reload" button. If the table remains empty, the configuration check was successful and the device's configuration is compatible for the recognized neighboring devices.

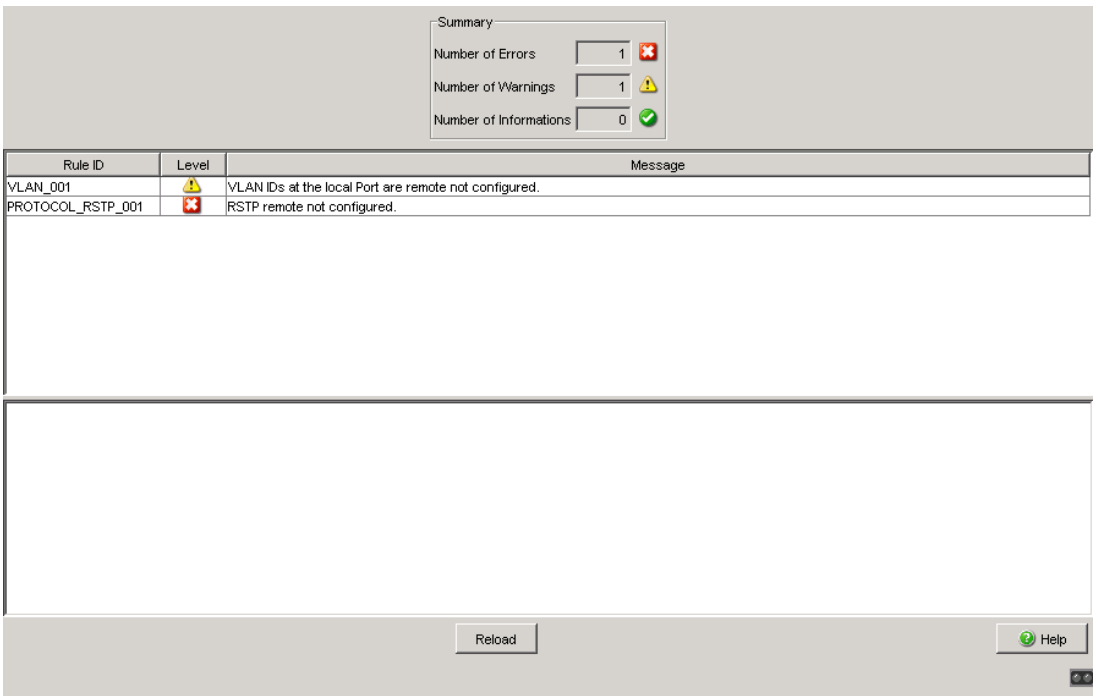


Figure 91: Configuration Check Dialog

Parameters	Meaning
Number of Errors	Displays the number of errors that the device detected during the configuration check.
Number of Warnings	Displays the number of warnings that the device detected during the configuration check.
Amount of Information	Displays the amount of information that the device detected during the configuration check.

Table 212: Configuration Check Summary

Parameters	Meaning
Rule ID	Rule ID of the deviations having occurred. The dialog combines several deviations with the same rule ID under one rule ID.
Level	Level of deviation between this device's configuration and the recognized neighboring devices. The rule level can have 3 statuses:  Information: The performance of the communication between the two devices is not impaired.  Warning: The performance of the communication between the two devices may be impaired.  Error: Communication between the two devices is impaired.
Message	The dialog specifies more precisely the information, warnings and errors having occurred.

Table 213: Configuration Check table

☐ If you select a line in the Configuration Check table, the device displays additional information in the window beneath it.

Note: A neighboring device without LLDP support, which forwards LLDP packets, may be the cause of equivocal messages in the dialog. This occurs if the neighboring device is a hub or a switch without management, which ignores the IEEE 802.1D-2004 standard.
In this case, the dialog displays the devices recognized and connected to the neighboring device as connected to the device itself, even though they are connected to the neighboring device.

Note: If you have more than 39 VLANs configured on the device, the dialog always displays a warning. The reason is the limited number of possible VLAN data sets in LLDP frames with a maximum length. The device compares the first 39 VLANs automatically.
If you have 40 or more VLANs configured on a device, check the congruence of the further VLANs manually, if necessary.

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 214: Buttons

8.5 Topology Discovery

This dialog enables you to activate/deactivate the function for Topology Recognition (LLDP) and to display the LLDP information received in the form of 2 tables grouped according to general LLDP information and LLDP-MED information.

8.5.1 LLDP Information from Neighbor Devices

The table on the “LLDP” tab page shows you the collected LLDP information for neighboring devices. This information enables the network management station to map the structure of your network.

Activating “Display FDB entries” below the table allows you to add entries for devices without active LLDP support to the table. In this case, the device also includes information from its FDB (forwarding database).

The table shows you which LLDP-MED information the device received on its ports from other devices.

Parameters	Meaning
Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two.
Neighbor Identifier	Chassis ID of the neighboring device. This can be the basis MAC address of the neighboring device, for example.
Neighbor IP Address	Management address of the neighboring device. This can be an IPv4 address, for example.
Neighbor Port Description	Port description of the neighboring device. The port description is an alphanumeric string.

Table 215: Topology discovery (LLDP information)

Parameters	Meaning
Neighbor System Name	System name of the neighboring device. The system name is an alphanumeric string.
Neighbor System Description	System description of the neighbor device, according to IEEE 802.1AB.

Table 215: Topology discovery (LLDP information)

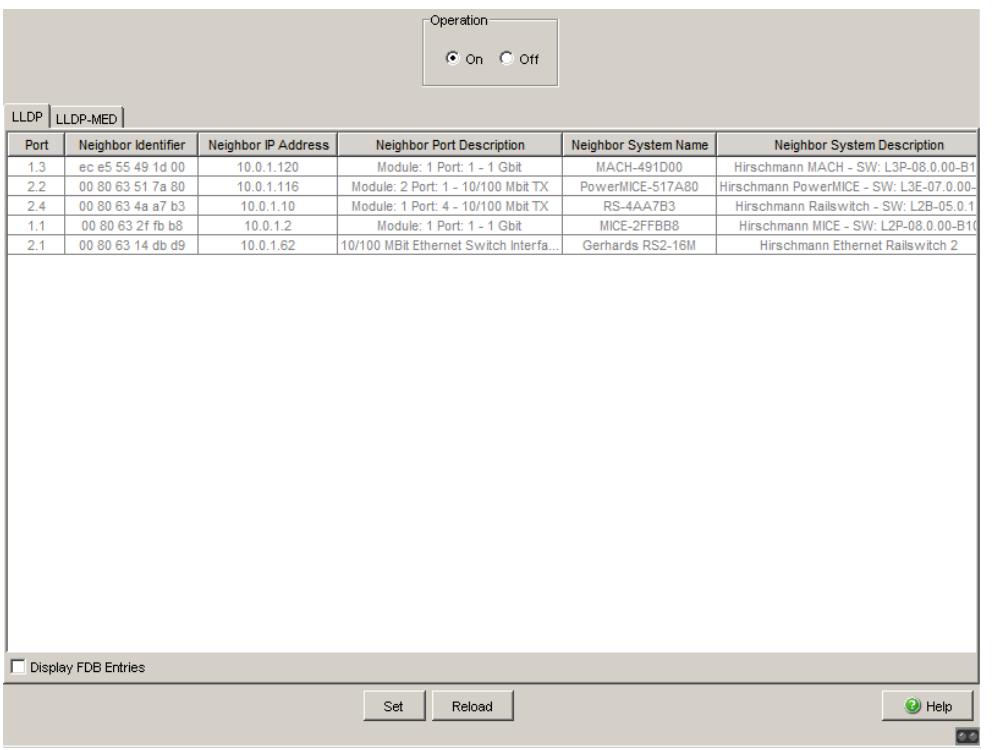


Figure 92: Topology Discovery

If several devices are connected to one port, for example via a hub, the table will contain one line for each connected device.

When devices both with and without an active topology discovery function are connected to a port, the topology table hides the devices without active topology discovery.

When only devices without active topology recognition are connected to a port, the table will contain one line for this port to represent all devices. This line contains the number of connected devices.
You can find the MAC addresses of devices, which the topology table hides for clarity's sake, in the address table (FDB), (see on page 160 “Filter for MAC addresses”).

8.5.2 LLDP-MED (Media Endpoint Discovery)

The card index “LLDP-MED” tabs table shows you the LLDP-MED information about neighboring devices collected. This requires that both the LLDP-MED function and the LLDP function (see on page 347 “LLDP Information from Neighbor Devices”) are activated.

The device supports the following sub-types in the network connectivity messages:

- LLDP-MED Capabilities TLV (Subtype 1)
- LLDP-MED Network Policy TLV (Subtype 2)

The table shows you which LLDP-MED information the device received on its ports from other devices.

Parameters	Meaning
Port	Port identification using module and port numbers of the device, e.g. 2.1 for port one of module two.
Device Class	LLDP-MED device class of the remote device: – 0: undefined (properties not included in any defined class) – 1: Terminal Device Class I – 2: Terminal Device Class II – 3: Terminal Device Class III – 4: Network Device
VLAN ID	VLAN ID of the network policy for the remote device's port (0 - 4094), 0: Priority-Tagged Frames
Priority	Layer 2 (IEEE 802.1p) priority of the network policy for the remote device's port (0 - 7)
DSCP	Value of Differentiated Services Code Point (according to RFC 2474 and 2475) of the network policy for the remote device's port (0 - 63)
Unknown Bit Status	– `true`: The network policy for the remote device's application type is currently unknown. The values for VLAN ID, Priority and DSCP are meaningless in this instance. – false: The network policy for the remote device's application type is known.
Tagged Bit Status	– `true`: The remote device's application uses VLAN-tagged frames – `false`: The remote device's application uses untagged frames or does not support port VLAN-based operation. The values for VLAN ID and Priority are meaningless in this instance.
Hardware Revision	Manufacturer-specific string including the terminal device's hardware version (max. 32 characters)
Firmware Revision	Manufacturer-specific string including the terminal device's firmware version (max. 32 characters)
Software Revision	Manufacturer-specific string including the terminal device's software version (max. 32 characters)
Serial Number	Manufacturer-specific string including the terminal device's serial number (max. 32 characters)
Manufacturer's Name	Manufacturer-specific string including the name of terminal device's manufacturer (max. 32 characters)
Model Name	Manufacturer-specific string including the name of terminal device's model (max. 32 characters)
Asset ID	Manufacturer-specific string including the ID for the terminal device's inventory (max. 32 characters)

Table 216: Topology discovery (LLDP-MED information)

Note: When you activate the LLDP-MED function, the Switch sends out information about its properties in the form of LLDP-MED frames. Information about the voice VLANs configured in the Switch also pertain to it (see on page 192 “Voice VLAN”). As a consequence, activate the LLDP-MED function if you want to operate the Switch devices, e.g. a VoIP telephone via plug-and-play, because both devices require information about their respective neighboring devices on that account.

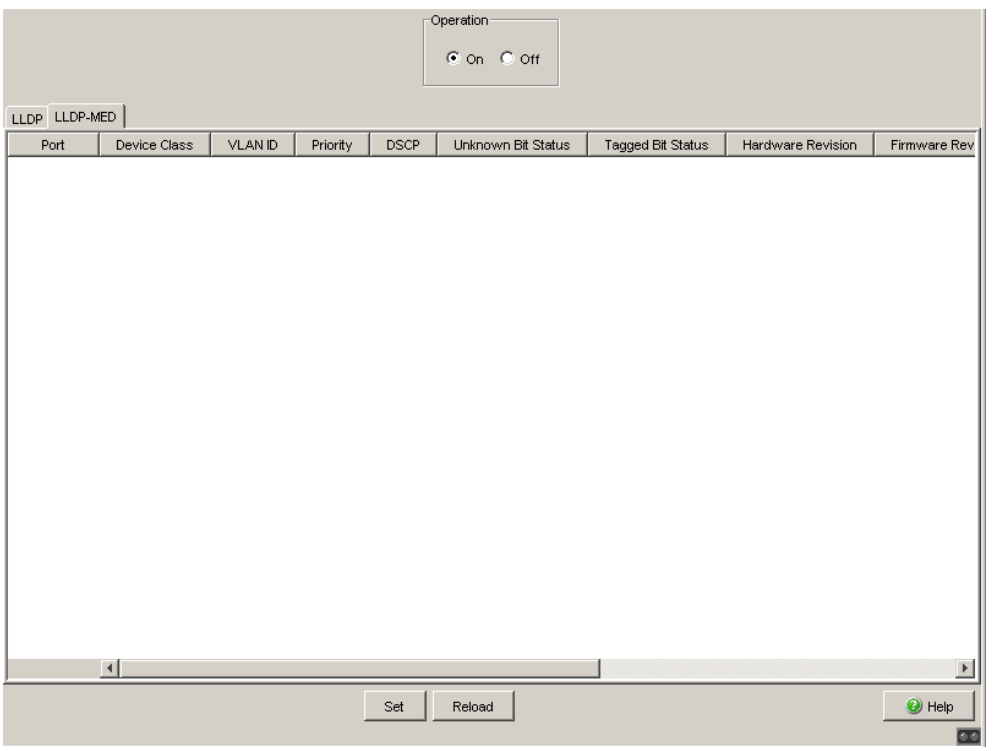


Figure 93: LLDP-MED Information

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".

Table 217: Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 217: Buttons (cont.)

8.6 Port Mirroring

The port mirroring function enables you to review the data traffic from a group of ports on the device for diagnostic purposes. The device forwards (mirrors) the data for the source ports to the destination. A management tool connected at the destination port, e.g. an RMON probe, can thus monitor the data traffic of the source ports in the sending and receiving directions. The device does not affect the data traffic on the source ports during port mirroring.

Note: The destination port needs sufficient bandwidth to receive the data stream. When the copied data stream exceeds the bandwidth of the destination port, the device discards surplus data packets on the destination port.

You use physical ports as source or destination ports.
The MACH4002 24/48 + 4G and the Power MICE support up to 8 source ports.

☐ Select the source ports whose data traffic you want to review from the physical ports list. Mark the relevant checkboxes.
The device displays the port currently used as the "Destination Port" as grayed out in the table. Default setting: (no source ports)

☐ In the "Destination Port" frame, select the destination port to which you have connected your management tool.
The drop-down list displays available ports exclusively. For example, the list excludes the ports currently in use as source ports. Default setting: (no destination port)

☐ Specifiy the monitoring traffic direction.
  – When selecting "RX", only frames received on the source port will be mirrored to the destination port (monitoring ingress).
  – When selecting "TX", only frames transmitted on the source port will be mirrored to the destination port (monitoring egress).

☐ To enable the function, select `On` in the "Operation" frame and click "Set". Default setting: `Off`.

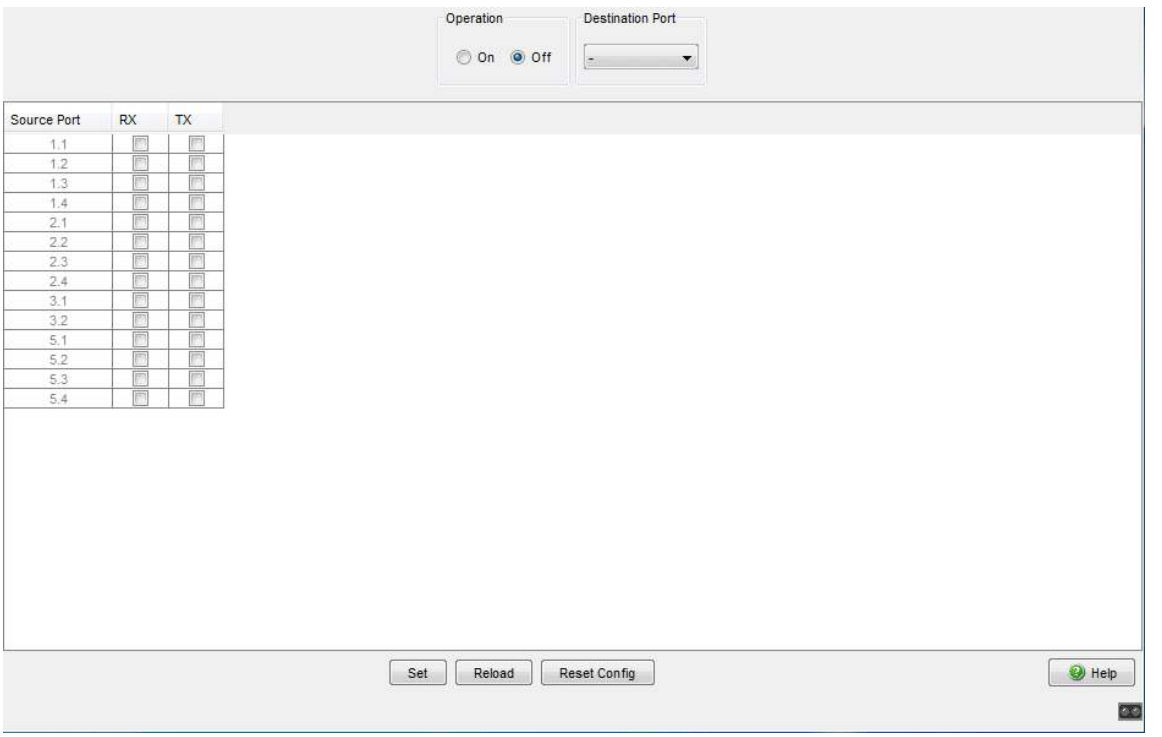


Figure 94: `Diagnostics:Port Mirroring N:1` dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.

Table 218: Buttons

Button	Meaning
Reset Config	Resets the settings in the dialog to the default settings.
Help	Opens the online help.

Table 218: Buttons (cont.)

8.7 Device Status

The device status provides an overview of the overall condition of the device. Many process visualization systems record the device status for a device in order to present its condition in graphic form.

The device displays its current status as "Error" or "OK" in the "Device Status" frame. The device determines this status from the individual monitoring results.

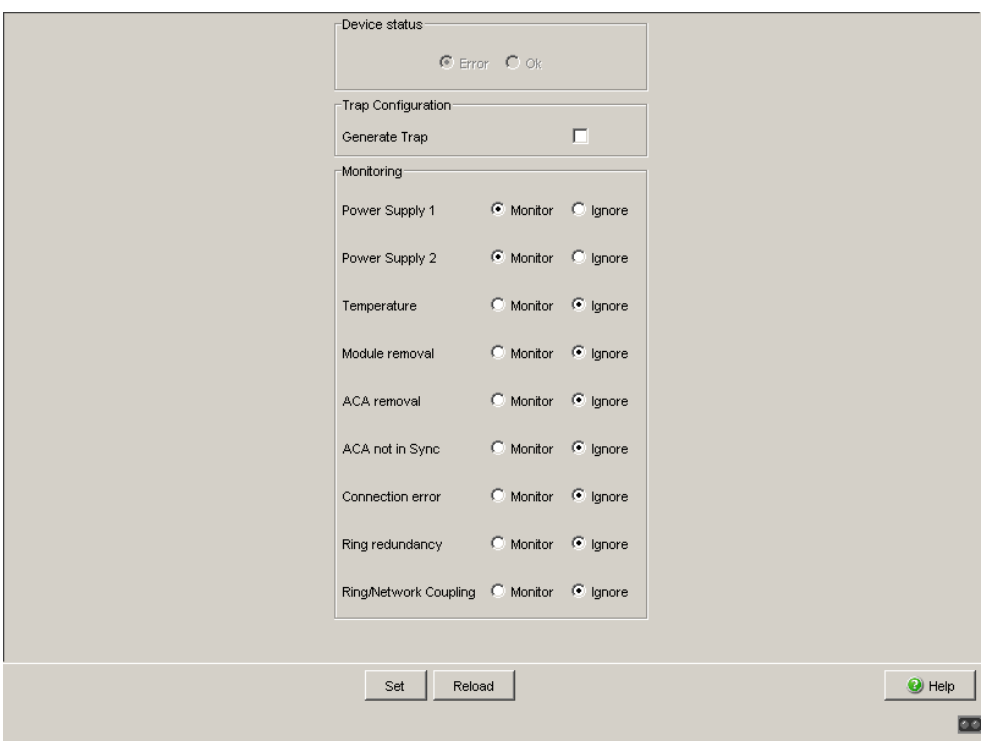


Figure 95: Device State dialog (for PowerMICE)

☐ In the “Monitoring” field, you select the events you want to monitor.
☐ To monitor the temperature, you also set the temperature thresholds in the `Basic settings:System` dialog at the end of the system data.

The events which can be selected are:

Name	Meaning
“Device Status” Frame	The device determines this status from the individual monitoring results. It can have the values “Error” or “OK”.
“Trap Configuration” Frame	-
Generate Trap	Activate this setting so the device sends a trap if it changes its device status.
“Monitoring” Frame	-
Power supply ...	Monitor/ignore supply voltage(s).
Temperature (°C)	Monitor/ignore temperature thresholds set (see on page 22 “System”) for temperatures that are too high/too low
Module removal	Monitor/ignore the removal of a module (for modular devices).
ACA removal	Monitor/ignore the removal of the ACA.
ACA not in sync	Monitor/ignore non-matching of the configuration on the device and on the ACA[a] .
Connection error	Monitor/ignore the link status (Ok or inoperable) of at least one port. The reporting of the link status can be masked for each port by the management (see on page 36 “Port Configuration”). Link status is not monitored in the state on delivery.
Ring Redundancy	Monitor/ignore ring redundancy (for HIPER-Ring only in Ring Manager mode). On delivery, ring redundancy is not monitored. If the device is a normal ring subscriber and not the ring manager, it reports the following: ▶ nothing (for the HIPER-Ring) ▶ detected errors in the local configuration (for Fast HIPER-Ring and for MRP)
Ring/Network coupling	Monitor/ignore the redundant coupling operation. On delivery, no monitoring of the redundant coupling is set. For two-Switch coupling with control line, the slave additionally reports the following conditions: – Incorrect link status of the control line – Partner device is also a slave (in standby mode). **Note:** In two-Switch coupling, both Switches must have found their respective partners.
Fan	Monitor/ignore fan function (for devices with fan).

Table 219: Device Status

a. The configurations are non-matching if only one file exists or the two files do not have the same content.

Note: With a non-redundant voltage supply, the device reports the absence of a supply voltage. If you do not want this message to be displayed, feed the supply voltage over both inputs or switch off the monitoring (see on page 359 “Signal contact”).

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 220: Buttons

8.8 Signal contact

The signal contacts are used for

- controlling external devices by manually setting the signal contacts,
- monitoring the functions of the device,
- reporting the device state of the device.

8.8.1 Manual Setting

☐ Select the "Signal Contact 1" or "Signal Contact 2" card index (for devices with two signal contacts).
☐ Select the “Manual Setting” mode in the “Signal Contact Mode” field. This mode enables you to control this signal contact remotely.
☐ Select “Open” in the “Manual Setting” field to open the contact.
☐ Select “Closed” in the “Manual Setting” field to close the contact.

Application options:

- Simulation of an error during PLC error monitoring.
- Remote control of a device via SNMP, such as switching on a camera.

8.8.2 Function monitoring

☐ Select the tab “Signal contact 1” or “Signal contact 2” (for devices with two signal contacts).
☐ In the “Mode Signal contact” box, you select the “Monitoring correct operation” mode. In this mode, the signal contacts monitor the functions of the device, thus enabling remote diagnosis.
A break in contact is reported via the potential-free signal contact (relay contact, closed circuit).

- Loss of the supply voltage 1/2 (either of the external voltage supply or of the internal voltage).[1] Select “Monitor” for the respective power supply if the signal contact shall report the loss of the power supply voltage, or of the internal voltage that is generated from the external power supply.
- One of the temperature thresholds has been exceeded (see on page 23 “System Data”). Select “Monitor” for the temperature if the signal contact should report an impermissible temperature.
- Removing a module. Select “Monitor” for removing modules if the signal contact is to report the removal of a module (for modular devices).
- Fan inoperable (for devices with a fan).
- The removal of the ACA. Select “Monitor” for ACA removal if the signal contact is to report the removal of an ACA (for devices which support the ACA).
- Non-matching of the configuration in the device and on the ACA[2]. Select “Monitor” ACA not in sync if the signal contact is to report the non-matching of the configuration (for devices which support ACA).
- The connection error (non-functioning link status) of at least one port. The reporting of the link status can be masked via the management for each port in the device. On delivery, the link monitoring is inactive. You select “Monitor” for link errors if device is to use the signal contact to report a defective link status for at least one port.

1. You can install additional power supplies in a MACH4000 device, which the device reports as P3-1, P3-2, P4-1 and P4-2 in its user interfaces. You will find details on the power supplies in the document Installation Guide.
2. The configurations are non-matching if only one file exists or the two files do not have the same content.

- If the device is part of a redundant ring: the elimination of the reserve redundancy (i.e. the redundancy function did actually switch on), (see on page 246 “Ring Redundancy”).
  - ☐ Select “Monitor” for the ring redundancy if the signal contact is to report the elimination of the reserve redundancy in the redundant ring.
  - ☐ Select “Monitor” for the sub-ring redundancy if the signal contact is to report the elimination of the reserve redundancy in the redundant sub-ring.

  Default setting: no monitoring.

  Note: If the device is a normal ring member and not a ring manager, it doesn't report anything for the HIPER-Ring; for the Fast HIPER-Ring and for MRP it only reports detected errors in the local configuration.

- The elimination of the reserve redundancy for the ring/network coupling (i.e. the redundancy function did actually switch on). Select “Monitor” for the ring/network coupling if the signal contact is to report the elimination of the reserve redundancy for the ring/network coupling (see on page 246 “Ring Redundancy”).
  Default setting: no monitoring.

  Note: In two-Switch coupling, both Switches must have found their respective partners.

8.8.3 Device status

- ☐ Select the tab page “Alarm 1” or “Alarm 2” (for devices with two signal contacts).
- ☐ In the “Mode Signal Contact” field, you select the “Device status” mode. In this mode, the signal contact monitors the device status (see on page 22 “Device Status”) and thereby offers remote diagnosis.
  The device status “Error detected” (see on page 22 “Device Status”) is reported by means of a break in the contact via the potential-free signal contact (relay contact, closed circuit).

8.8.4 Configuring Traps

☐ Select `generate Trap`, if the device is to create a trap as soon as the position of a signal contact changes when function monitoring is active.

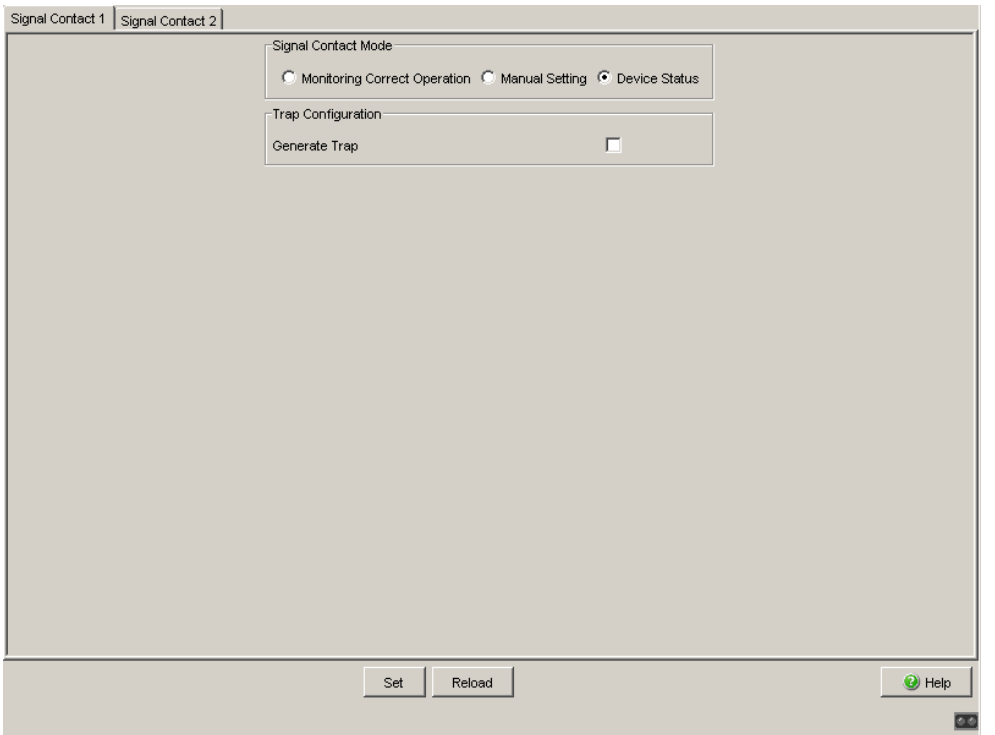


Figure 96: Signal Contact Dialog

The Signal Contact dialog contains 1 tab (“Signal contact 1”) if the device has 1 signal contact.

The Signal Contact dialog contains 2 tabs (“Signal contact 1” and “Signal contact 2”) if the device has 2 signal contacts.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".

Table 221: Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 221: Buttons (cont.)

8.9 Alarms (Traps)

This dialog allows you to determine which events trigger an alarm (trap) and where these alarms should be sent.

The following device types support 6 trap destinations:
- PowerMICE
- MACH 4000

☐ In the “Configuration” frame, select the trap categories from which you want to send traps. Default setting: all trap categories are active.

☐ Click "Create".
☐ In the "IP Address“ column, enter the IP address of the management station to which the traps should be sent.
☐ In the column "Password", enter the community name that the device uses to identify itself as the trap's source.
☐ In the "Enabled“ column, you mark the entries that the device should take into account when it sends traps. Default setting: inactive.

The events which can be selected are:

Name	Meaning
Authentication	The device has rejected an unauthorized access attempt (see on page 74 “SNMPv1/v2 Access Settings”).
Link Up/Down	At one port of the device, the link to another device has been established/interrupted.
Spanning Tree	The topology of the Rapid Spanning Tree has changed.

Table 222: Trap categories

Name	Meaning
Chassis	Summarizes the following events: ▶ The status of a supply voltage has changed (see the `System` dialog). ▶ The status of the signal contact has changed. To take this event into account, you activate “Create trap when status changes” in the `Diagnostics:Signal Contact 1/2` dialog. ▶ The AutoConfiguration Adapter (ACA) has been added or removed. ▶ – The configuration on the AutoConfiguration Adapter (ACA) differs from that in the device. ▶ The temperature thresholds have been exceeded/not reached. ▶ The receiver power status of a port with an SFP module has changed (see dialog `Diagnosis:Ports:SFP Modules`). ▶ The configuration has been successfully saved in the device and in the AutoConfiguration Adapter(ACA), if present. ▶ The configuration has been changed for the first time after being saved in the device.
Redundancy	The redundancy status of the ring redundancy (redundant line active/inactive) or (for devices that support redundant ring/network coupling) the redundant ring/network coupling (redundancy exists) has changed.
Port security	On one port a data packet has been received from an unauthorized terminal device (see the `Port Security` dialog).

Table 222: Trap categories

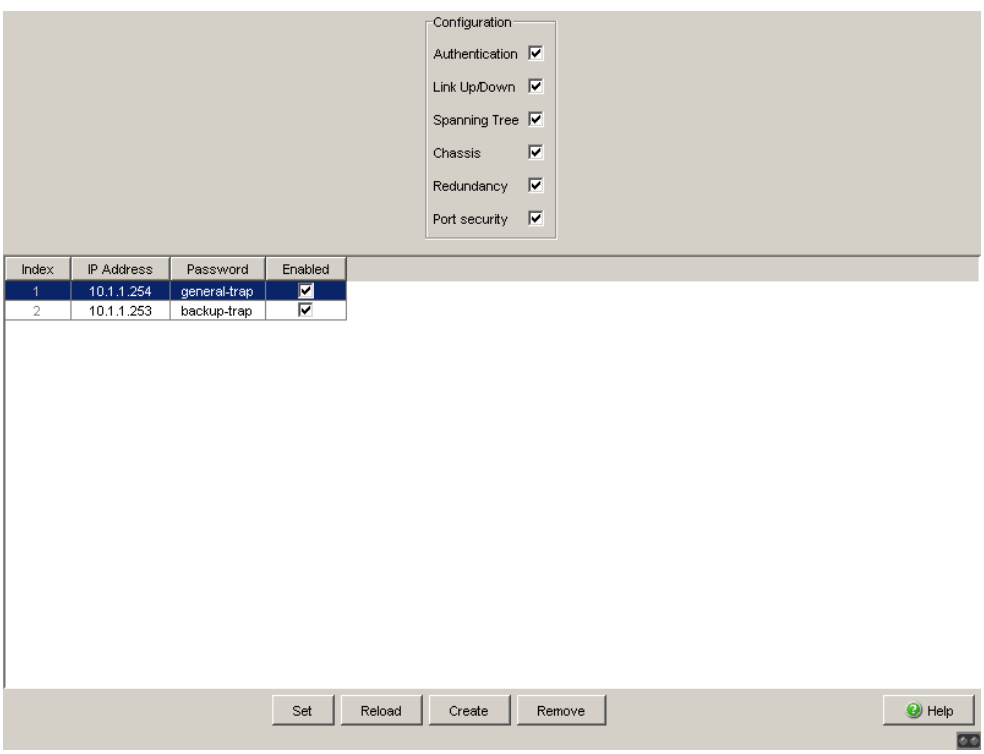


Figure 97: Alarms Dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 223: Buttons

8.10 Report

The following reports are available for the diagnostics:

- System Information (see on page 369 “System Information”).
  The System Information is an HTML file with system-relevant data. The device displays the system information in its own dialog.
- Event Log (see on page 370 “Event Log”).
  The Event Log is an HTML file in which the device writes important device-internal events. The device displays the event log in its own dialog.

Note: You have the option to also send the logged events to one or more syslog servers (see on page 314 “Syslog”).

The following buttons are available:

- Download Switch Dump.
  This button allows you to download system information as files in a ZIP archive (see table 224).
  - ☐ Select the directory in which you want to save the switch dump.
  - ☐ Click “Save”.

The device creates the file name of the switch dumps automatically in the format <IP address>_<system name>.zip, e.g. for a device of the type PowerMICE: “10.0.1.112_PowerMICE-517A80.zip”.

- Download JAR-File.
  This button allows you to download the applet of the Web-based interface as a JAR file. Afterwards you have the option to start the applet outside a browser.
  This enables you to administer the device even when you have deactivated its Web server for security reasons.
  - ☐ Select the directory in which you want to save the applet.
  - ☐ Click “Save”.

The device creates the file name of the applet automatically in the format <device type><software variant><software version)>_<software revision of applet>.jar, e.g. for a device of type PowerMICE with software variant L3P: “pmL3P06000_00.jar”.

File	Name	Format	Comments
Log file	event_log.html	HTML	
System information	systemInfo.html	HTML	
Trap log	traplog.txt	Text	
Device configuration (binary)	switch.cfg, powermice.cfg or .mach.cfg	Binary	File name depends on device type.
Device configuration (as script)	switch.cli, powermice.cli or mach.cli	Script	File name depends on device type.
Internal memory extract for the manufacturer to improve the product	dump.hmd	Binary	
Exception log	exception_log.html	HTML	
Output of CLI commands[a]: – show running-config[b] – show port all – show sysinfo – show mac-address-table – show mac-filter-table igmpsnooping	clicommands.txt	Text	

Table 224: Files in switch dump archive

a: Prerequisite: a Telnet connection is available.

b: Prerequisite: you are logged in as a user with write access.

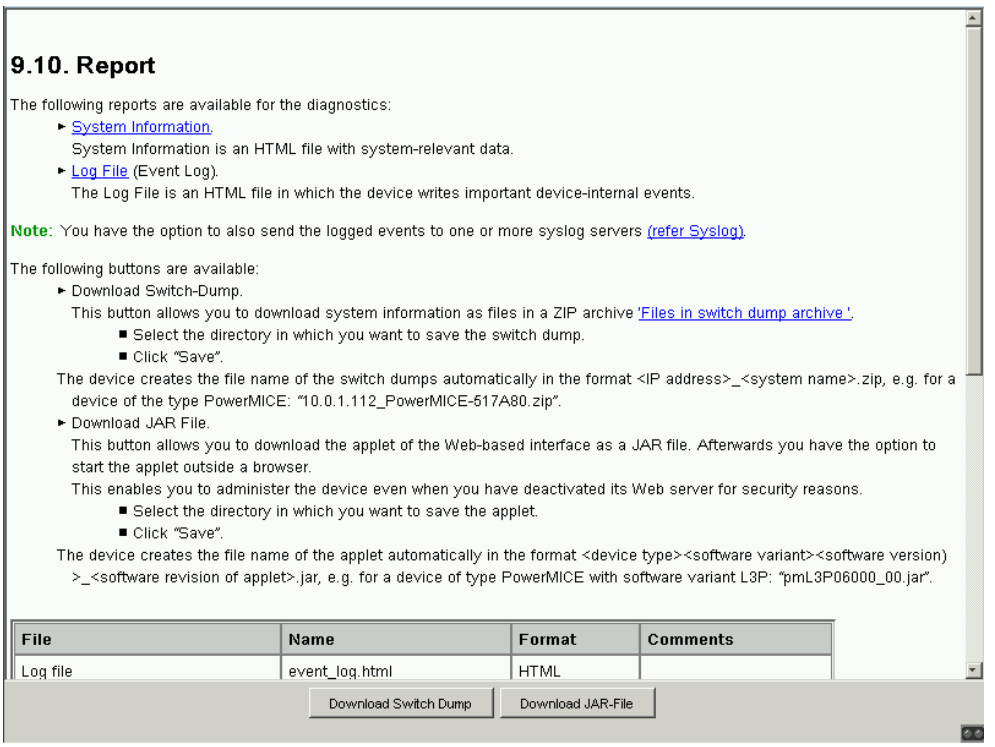


Figure 98: Report dialog

8.10.1 System Information

The System Information is an HTML file with system-relevant data.

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Search	Opens the "Search" dialog. The dialog allows you to search the log file for search terms or regular expressions.

Table 225: Buttons

Button	Meaning
Save	Opens the "Save" dialog. The dialog allows you to save the log file in HTML format on your PC.
Help	Opens the online help.

Table 225: Buttons (cont.)

8.10.2 Event Log

The Event Log is an HTML file in which the device writes important device-internal events.

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Search	Opens the "Search" dialog. The dialog allows you to search the log file for search terms or regular expressions.
Save	Opens the "Save" dialog. The dialog allows you to save the log file in HTML format on your PC.
Delete Log File	Removes the logged events from the log file.
Help	Opens the online help.

Table 226: Buttons

8.11 IP address conflict detection

This dialog allows you to detect address conflicts the device is having with its own IP address and rectify them (Address Conflict Detection, ACD).

☐ In “Status”, select the operating mode for the IP address conflict detection (see table 227). The default setting is `disable`.

☐ In the “Fault State” field, the device displays the current result of the IP address conflict detection.
Possible values:
- `false`: the detection is disabled, or the device has not detected any problem; or
- `true`: the device has detected a problem.

Mode	Meaning
Field „Status“	Defines the status for the IP address conflict detection. The value of the status field can be „enable“, „disable“, „activeDetectionOnly“ or „passiveDetectionOnly“.
`enable`	Enables active and passive detection.
`disable`	Disables the function
`activeDetectionOnly`	Enables active detection only. After connecting to a network or after the IP configuration has been changed, the device immediately checks whether its own IP address already exists within the network. If the IP address already exists, the switch will return to the previous configuration, if possible, and make another attempt after 15 seconds. The device thus avoids participating in the network traffic with a duplicate IP address.
`passiveDetectionOnly`	Enables passive detection only. The device listens passively to the network to determine whether its IP address already exists. If it detects a duplicate IP address, it will initially defend its address by employing the ACD mechanism and sending out gratuitous ARPs. If the remote connection does not disconnect from the network, the management interface of the local device will then disconnect from the network. Every 15 seconds, it will poll the network to determine if there is still an address conflict. If there is no conflict, it will connect back to the network.
Field „Fault State“	Displays, if the device has detected an IP address conflict. In this case the value of the field is „false“.

Table 227: Possible address conflict operating modes

- In the table, the device logs IP address conflicts with its IP address. The device logs the following data for each conflict:
  - the time („Timestamp“ column)
  - the conflicting IP address („IP Address“ column)
  - the MAC address of the device with which the IP address conflicted („MAC Address“ column).

  For each IP address, the device logs a line with the last conflict that occurred.

☐ During a restart, the device deletes the table.

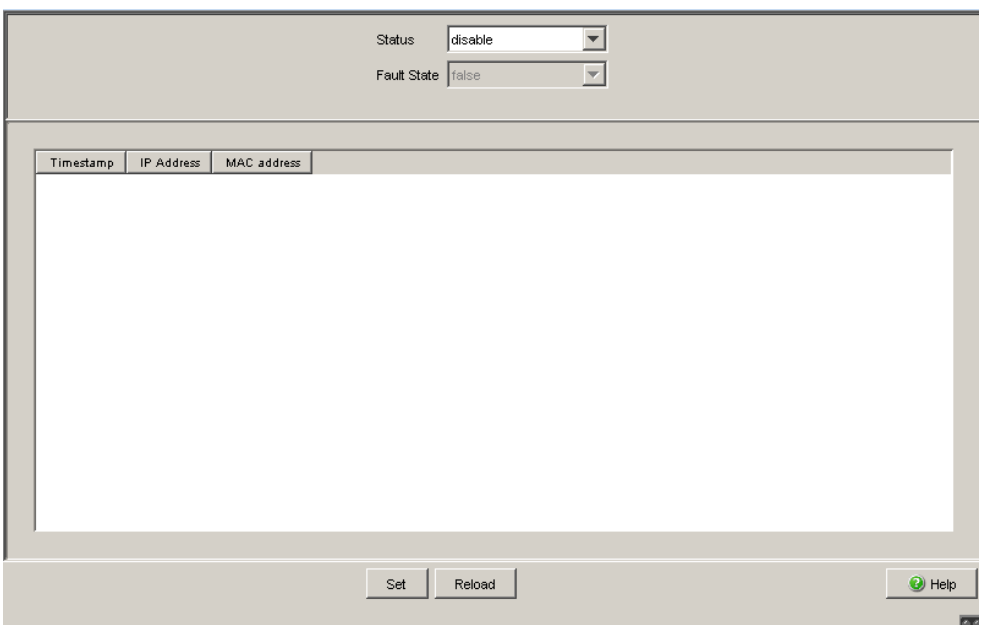


Figure 99: IP Address Conflict Detection dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes afterwards, you open the Basic Settings:Load/Save dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 228: Buttons

8.12 MAC Notification

The device allows you to track changes in the network using the MAC address of the end devices. When on a port the MAC address of a connected devices changes, the device sends an SNMP trap periodically.

This function is intended solely for ports on which you connect end devices and thus the MAC address changes infrequently.

8.12.1 Operation

Parameters	Meaning
Operation	Activates/deactivates the MAC Notification function globally on the device. Possible values: ▶ `On` The device sends traps for the active rows to the active management stations in `Diagnostics:Status Configuration:Alarms (Traps)`. ▶ `Off` (default setting)

Table 229: "Operation" frame in the `Diagnostics:Status Configuration:MAC Notification` dialog

8.12.2 Configuration

Parameters	Meaning
Intervals [s]	Defines the interval, in seconds, between notifications. The device buffer contains up to 20 addresses. If the buffer is full before the interval expires, then the device sends a trap to the management station. Possible values: ▶ `0..2147483647`

Table 230: "Configuration" frame in the `Diagnostics:Status Configuration:MAC Notification` dialog

8.12.3 Table

Parameters	Meaning
Port	Shows the number of the device port to which the table entry relates.
Enable	Activates/deactivates the MAC Notification function on this port. Possible values: ▶ `Selected` When globally activated, the device sends traps for this row to the active management stations in `Diagnostics:Status Configuration:Alarms (Traps)`. ▶ `Not selected` (default setting)

Table 231: Table in the `Diagnostics:Status Configuration:MAC Notification` dialog

Parameters	Meaning
Mode	Defines when the device sends a trap for MAC address events on a specific interface. Possible values: ▶ `add` The device sends notifications for entries added to the FDB. ▶ `remove` The device sends notifications for entries removed from the FDB. ▶ `add + remove` (default setting) The device sends notifications for entries added to or removed from the FDB.
Last MAC Address	Shows the last MAC address added or removed from the address table for this interface.
Last MAC Status	Displays the status of the last MAC address on this interface. Possible values: ▶ `other` ▶ `added` ▶ `removed`

Table 231: Table in the `Diagnostics:Status Configuration:MAC Notification` dialog (cont.)

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 232: Buttons

8.13 Self Test

With this dialog you can:

- activate/deactivate the RAM test for a cold start of the device.
  Deactivating the RAM test shortens the booting time for a cold start of the device.
  Default setting: activated.
- allow or prevent a restart due to an undefined software or hardware state.
  Default setting: activated.
- to allow/prohibit a change to the system monitor during the system start.
  Default setting: enabled, so that changing to the system monitor during the system start via a V.24 connection is possible.
  This function works exclusively in combination with a boot code in version 09.0.00 or higher. To update the boot code, contact your sales partner.

  Note: If changing to the system monitor is prohibited and you forget the password, you are permanently unable to access the device. To have the device unlocked again, contact your sales partner.

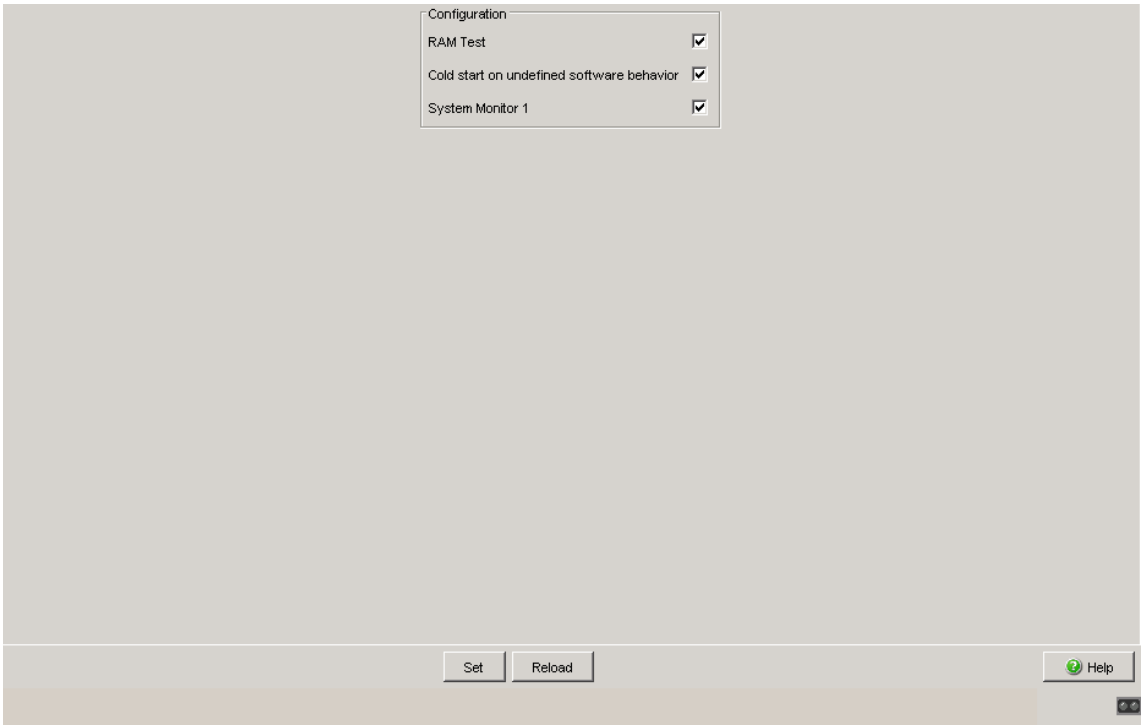


Figure 100:Self-test dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 233:Buttons

9 Advanced

The menu contains the dialogs, displays and tables for:

- DHCP Relay Agent
- DHCP Server
- Industry Protocols
- Command Line

9.1 DHCP Relay Agent

This menu allows you to configure the DHCP relay agent.

The DHCP relay agent forwards the DHCP requests of connected terminal devices to a DHCP server. The forwarding to a specific DHCP server is performed independently of the port or interface at which the device receives the DHCP request. You define the required settings for this in the `Advanced:DHCP Relay Agent:Server` dialog. There you can define up to 16 DNCP servers.

9.1.1 Global

This dialog allows you to configure the DHCP relay agent.

- The “Circuit ID” column in the table shows you the value that you enter when configuring your DHCP server. In addition to the port number, the “Circuit ID” also includes the ID of the VLAN that the DHCP relay received the DHCP query from.

  Note: The VLAN ID is in the circuit ID's 4th and 5th octet. The circuit ID displayed applies to untagged frames. If the DHCP relay receives a VLAN-tagged frame, then it is possible that the device sends a circuit ID that is different from the one displayed to the DHCP server.

The “Network” Chapter contains further information about VLAN 0.

Example of a configuration of your DHCP server:
Type: `mac`
Remote ID entry for DHCP server: `00 06 00 80 63 00 06 1E`
Circuit ID: `B3 06 00 00 01 00 01 01`

This results in the entry for the “Hardware address” in the DHCP server:
`B3060000010001010006008063000 61E`

- ☐ The "DHCP-Relay on" activates the relay on the port. Clients connected to an activated port communicate directly with a DHCP Server.
- ☐ The "DHCP-Relay Operation" shows the operating state of the relay on the port.
- ☐ In the “Option 82 on” column in the table, you switch this function on/off for each port.
- ☐ In the "Hirschmann Device" column, you check the ports connected to a Hirschmann device.

Note: The DHCP relay function requires a minimum of 2 ports. Connect a port to the DHCP client and a port to the DHCP server. Enable the DHCP relay function globally and on the relay ports. The DHCP server function has priority over the DHCP relay function. Therefore, disable the DHCP server function on both the client and the server ports.

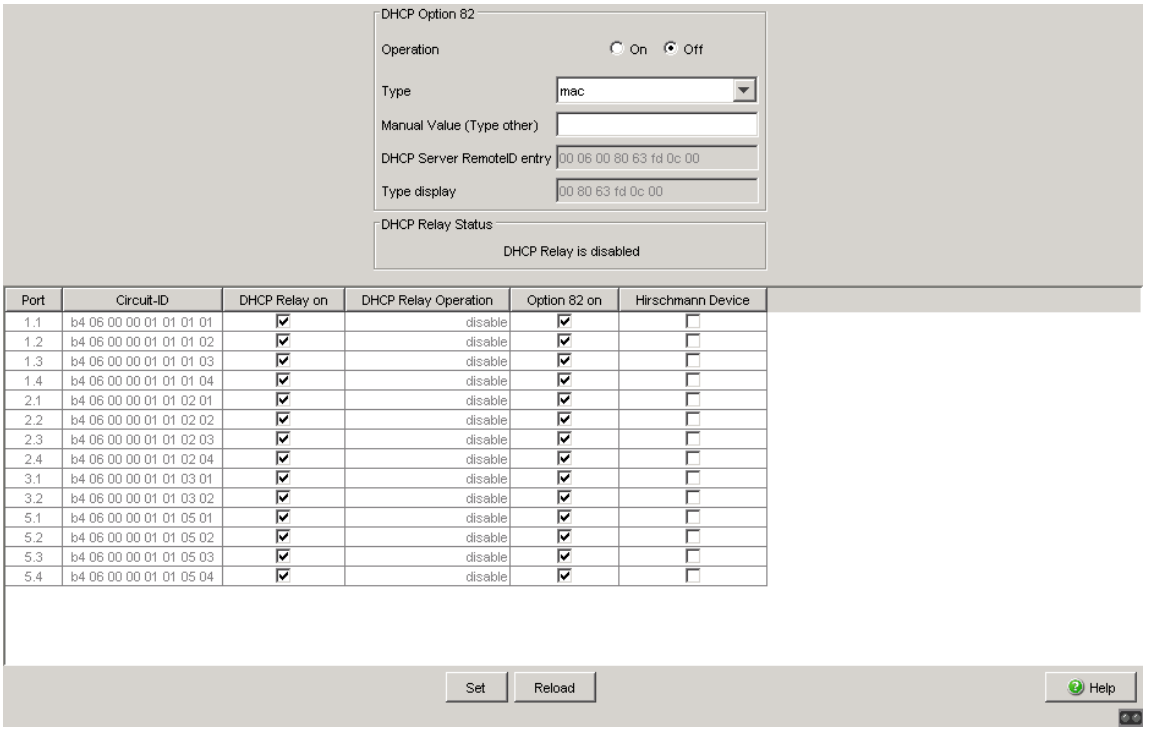


Figure 101:DHCP Relay Agent dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 234:Buttons

9.1.2 Server

With this dialog you can define up to 16 DHCP servers to which the DHCP relay agent sends the DHCP requests. The device forwards either every DHCP request to a server or only requests that it receives at a specific port or interface.

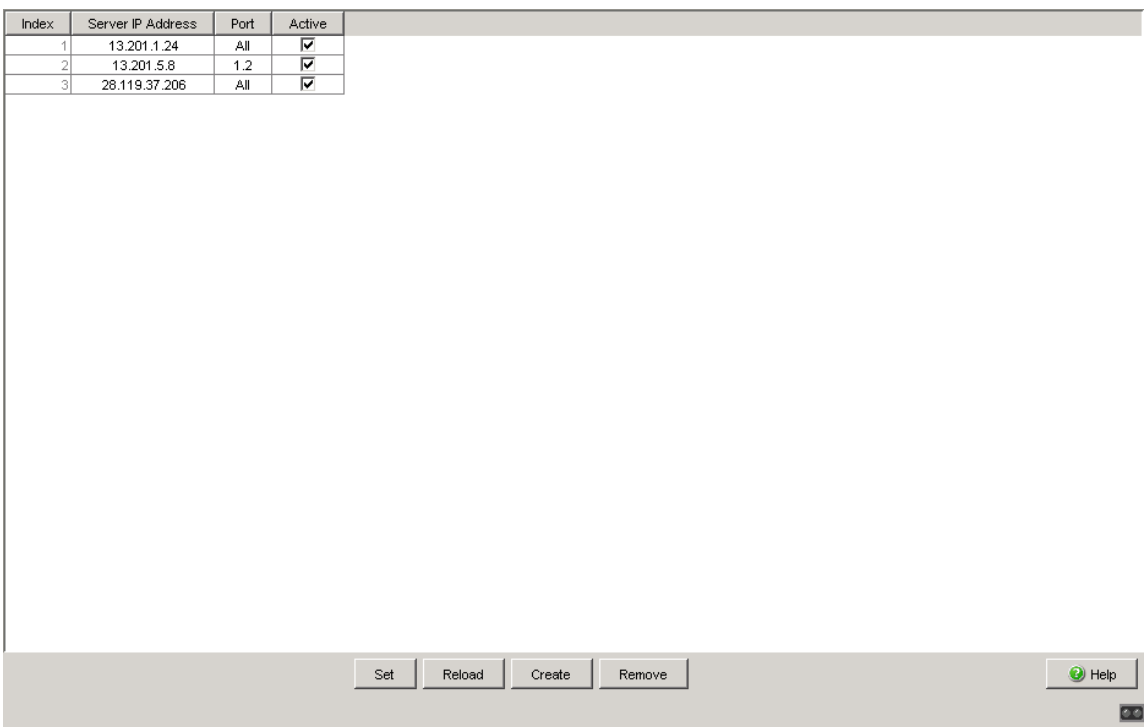


Figure 102:`Advanced:DHCP Relay Agent:Port` dialog

Parameter	Meaning	Value range	Default setting
Index	Shows a sequential number to which the table entry relates. The device automatically defines this number.	`1..16`	–
Server IP Address	Defines the IP address of the DHCP server.	Valid IPv4 address	`0.0.0.0`

Table 235: "DHCP-Server Mode" frame in the `Advanced:DHCP Server:Global` dialog

Parameter	Meaning	Value range	Default setting
Port	Defines whether the device forwards every DHCP request to the server or only requests that it receives at a port or interface.	`All` <Port number>	`All`
Active	Activates/deactivates the forwarding of DHCP requests to this DHCP server.	`activated` `deactivated`	`deactivated`

Table 235: "DHCP-Server Mode" frame in the `Advanced:DHCP Server:Global` dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 236: Buttons

9.2 DHCP Server

The DHCP Server dialogs allow you to very easily include new devices (clients) in your network or exchange them in your network: When you select DHCP as the configuration mode for the client, the client gets the configuration data from the DHCP server.

The DHCP server assigns to the client:

– a fixed IP address (static) or an address from an address range (dynamic),
– the netmask,
– the gateway address,
– the DNS server address,
– the WINS server address and
– the lease time.

You can also specify globally or for each port a URL for transferring additional configuration parameters to the client.

9.2.1 Global

This dialog allows you to switch the DHCP server of the device on and off globally and for each port.

Parameter	Meaning	Value range	Default setting
DHCP server mode	Switching the DHCP server on and off globally on the device.	`On`, `Off`	`Off`

Table 237: "DHCP-Server Mode" frame in the `Advanced:DHCP Server:Global` dialog

Parameter	Meaning	Value range	Default setting
IP Probe	Activates/deactivates the probing for unique IP addresses. When allocating a new address, servers verify that the offered network address is unique in the network. For example, the server probes the offered address with an ICMP Echo Request.	`On`, `Off`	`On`

Table 238: "Configuration" frame in the `Advanced:DHCP Server:Global` dialog

Parameter	Meaning	Value range	Default setting
Port	Module and port numbers to which this entry applies.	-	-
DHCP Server active	Switch the DHCP server on and off at this port. To activate the DHCP server at a port, also switch the DHCP server mode on globally.	`On`, `Off`	`On`

Table 239: Table in the `Advanced:DHCP Server:Global` dialog

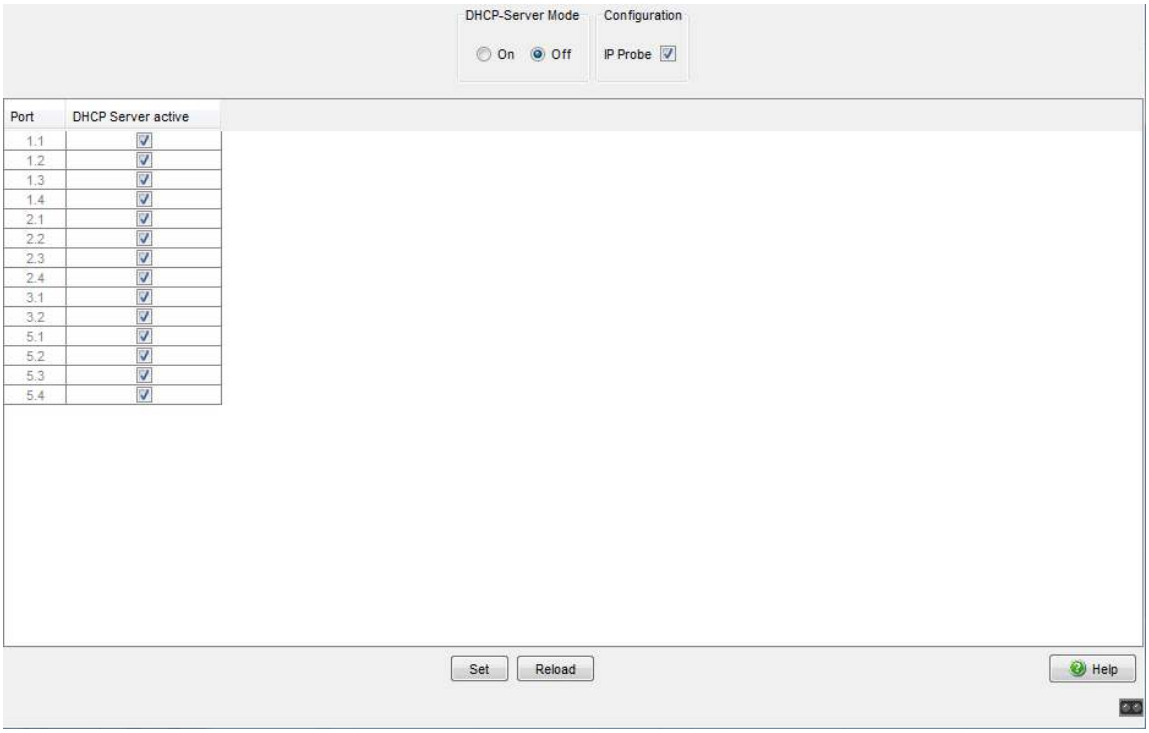


Figure 103:DHCP Server global dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 240:Buttons

9.2.2 Pool

This dialog allows you to closely control the allocation of IP addresses. You can activate or deactivate the DHCP server for each port or for each VLAN. For this purpose, the DHCP server provides what is known as an IP address pool (in short “pool”) from which it allocates IP addresses to clients. The pool consists of a list of entries. An entry can define a specific IP address or a connected IP address range.
You can choose between dynamic and static allocation.

- An entry for dynamic allocation applies to all the ports of the device for which you activate the DHCP server. If a client makes contact at a port, the DHCP server allocates a free IP address from a pool entry for this port. For dynamic allocation, create a pool entry for all ports and enter the first and last IP addresses for the IP address range. Leave the MAC Address, Client ID, Remote ID and Circuit ID fields empty.
  You have the option to create multiple pool entries. You can thus create IP address ranges that contain gaps.
- With static allocation, the DHCP server always allocates the same IP address to a client. The DHCP server identifies the client using a unique hardware ID.
  A static address entry can only contain 1 IP address, and it can apply for all ports or for a specific port of the device.
  For static allocation, create a pool entry for all ports or one specific port, enter the IP address, and leave the “Last IP Address” field empty. Enter a hardware ID with which the DHCP server uniquely identifies the client. This ID can be a MAC address, a client ID, a remote ID or a circuit ID. If a client makes contact with a known hardware ID, the DHCP server allocates the static IP address.

The table shows you the configured entries of the DHCP server pool. You have the option to create a new entry, edit an existing entry or delete entries. You have the option to create up to 128 pool entries.

Click “Create” to create a new entry. Fill in the fields you require, then click “Set”.

Parameter	Meaning	Value range	Default setting
Index	Shows a sequential number to which the table entry relates. The device automatically defines this number.	0, 1, 2, ...	
Active	Activates or deactivates the pool entry.	`On`, `Off`	`Off`
IP Address	▶ For a dynamic address entry: the 1st address of the IP address pool that the DHCP server allocates to a client. ▶ For a static address entry: the IP address that the server each time allocates to the same client.	Valid IPv4 address	-
Last IP Address	For a dynamic address entry: the last address of the IP address pool that the DHCP server allocates to a client.	Valid IPv4 address	-
Port	Module and port numbers to which this entry applies. ▶ For a dynamic address entry select `all`. ▶ For a static address entry select all or one valid module and port number.	Valid module and port number or `all`.	`all`
VLAN	VLAN number to which this entry applies. **Note:** This column is available on the MS, Octopus, RS, RSR, MACH102, and MACH1020/10130 devices.	Valid VLAN No.	-
MAC Address	For a static address entry: MAC address with which the client identifies itself.	MAC address of the client that contains the static IP address	-
DHCP Relay	IP address of the DHCP relay via which the client makes its request. If the DHCP server receives a request via another DHCP relay, it ignores this. If there is no DHCP relay between the client and the DHCP server, leave these fields empty.	IPv4 address of the DHCP relay.	-
Client ID	For a static address entry: Client ID with which the client identifies itself.	Client ID of the client that contains the static IP address[a]	-

Table 241: DHCP server pool settings, IP address basic settings

Parameter	Meaning	Value range	Default setting
Remote ID	For a static address entry: Remote ID with which the client identifies itself.	Remote ID of the client that contains the static IP address[a]	-
Circuit ID	For a static address entry: Circuit ID with which the client identifies itself.	Circuit ID of the client that contains the static IP address[a]	-
Hirschmann Device	Activate this setting if the device from this entry only serves devices from Hirschmann.	`On` `Off`	`Off`
Configuration URL	TFTP URL, from which the client can obtain additional configuration information. Enter the URL in the form tftp://server name or ip address/directory/file.	Valid TFTP URL	-
Lease time [s]	Time in s for which the DHCP server allocates the address to the client. Within the lease time, the client can apply for an extension. If the client does not apply for an extension, after it has elapsed the DHCP server takes the IP address back into the pool and allocates it to any client that requires it.	1 s - 4294967295 s (2^{32}-1 s)	86400 s (1 day)
Default gateway	Default gateway entry for the client.	Valid IPv4 address	-
Netmask	Netmask entry for the client.	Valid IPv4 netmask	-
WINS Server	WINS (Windows Internet Name Service) entry for the client.	Valid IPv4 address	-
DNS Server	DNS server entry for the client.	Valid IPv4 address	-

Table 241:DHCP server pool settings, IP address basic settings

Parameter	Meaning	Value range	Default setting
Host name	Host name for the client. If this name is entered, it overwrites the system name of the client (see on page 23 “System Data”).	Max. 64 ASCII characters in the range 0x21 (!) - 0x7e (~).	- (no host name)
Vendor specific	Defines vendor-specific information entered as a hex string in a TLV (Type Length Value) format. **Note:** For example: Vendor Specific Information,"f1 08 0a 7e 7e 02 0a 7f 7f 02". Represents a specific type of vendor f1, with a field length of 08. The next 8 octets contain the actual vendor data. If present, the device treats the next 2 octets as type and length fields. Therefore, enter a valid hex string containing the correct length values.	Valid hex string.	-

Table 241: DHCP server pool settings, IP address basic settings

[a] A client, remote or circuit ID consists of 1 - 255 bytes in hexadecimal form (00 - ff), separated by spaces.

Figure 104:DHCP Server Pool per Port dialog

Figure 105:DHCP Server Pool per VLAN dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (RAM) of the device. To permanently save the changes, open the Basic Settings:Load/Save dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Create	Adds a new table entry.
Remove	Removes the selected table entry.
Help	Opens the online help.

Table 242: Buttons

9.2.3 Lease Table

The lease table shows you the IP addresses that the DHCP server has currently allocated.
The device displays the related details for every IP address allocated.

Parameters	Meaning	Possible values
Port	Module and port numbers to which this entry applies.	-
IP Address	IP address that the DHCP server has allocated to the device with the specified MAC address.	An IPv4 address from the pool.
Status	Status of the DHCP address allocation according to the Dynamic Host Configuration Protocol.	bootp, offering, requesting, bound, renewing, rebinding, declined, released
Remaining Lifetime	Time remaining in seconds until the validity of the IP address elapses, unless the client applies for an extension.	-
Leased MAC Address	MAC address of the client that is currently leasing the IP address.	Format xx:xx:xx:xx:xx

Table 243: DHCP lease table

Parameters	Meaning	Possible values
DHCP Relay	IP address of the DHCP relay via which the client has made the request.	IPv4 address or empty
Client ID	The client ID that the client submitted for the DHCP request.	[a]
Remote ID	The remote ID that the client submitted for the DHCP request.	[a]
Circuit ID	The circuit ID that the client submitted for the DHCP request.	[a]

Table 243:DHCP lease table

– [a] A client, remote or circuit ID consists of 1 - 255 bytes in hexadecimal form (00 - ff), separated by spaces.

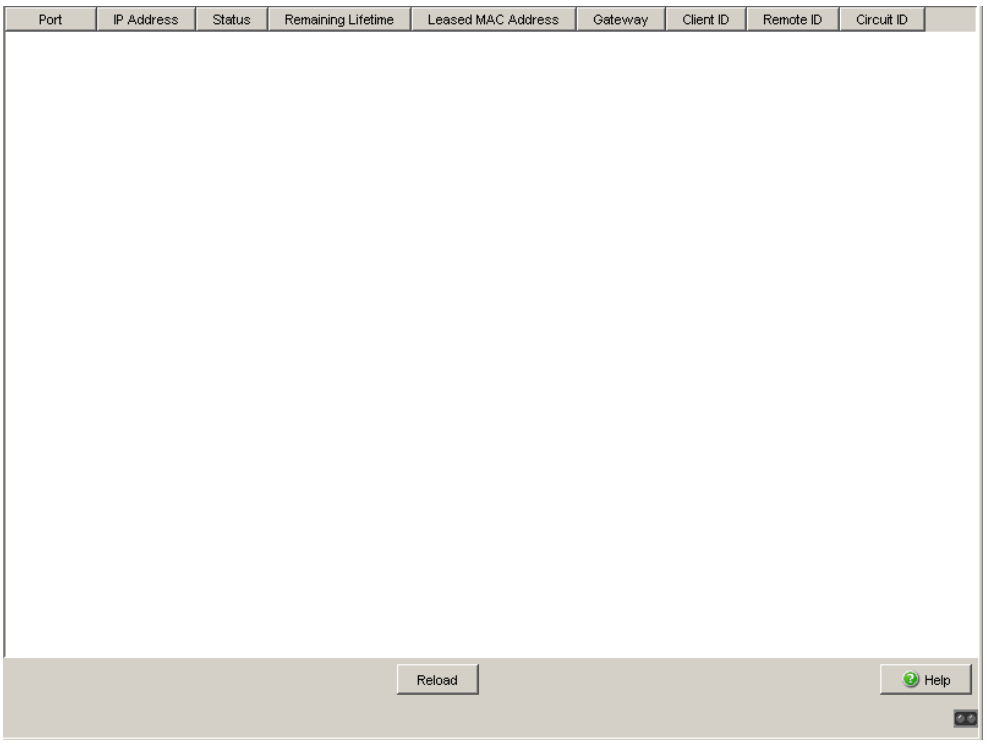


Figure 106:DHCP Server Lease Table dialog

Buttons

Button	Meaning
Reload	Updates the fields with the values that are saved in the volatile memory (RAM) of the device.
Help	Opens the online help.

Table 244: Buttons

9.3 Industrial Protocols

The “Industry Protocols” menu allows you to configure the following protocols
- the PROFINET protocol
- the EtherNet/IP protocol
- the IEC61850 MMS protocol

Detailed information on industrial protocols and PLC configuration is contained in the User Manual "Industrial Protocols“.

9.3.1 PROFINET

This dialog allows you to configure the PROFINET protocol. To integrate this in a control system, perform the following steps.

General settings:
- ☐ In the `Basic Settings:System` dialog, check if a valid system name for the device is specified in the "Name" field.
  The system name can only contain alphanumeric characters, hyphens, and periods.
- ☐ In the `Basic Settings:Network` dialog, check whether `Local` is selected in the “Mode” frame (see on page 29 “Network”).
- ☐ In the `Switching:VLAN:Global` dialog, check whether “VLAN 0 Transparent Mode” is selected (see on page 178 “VLAN Global”).

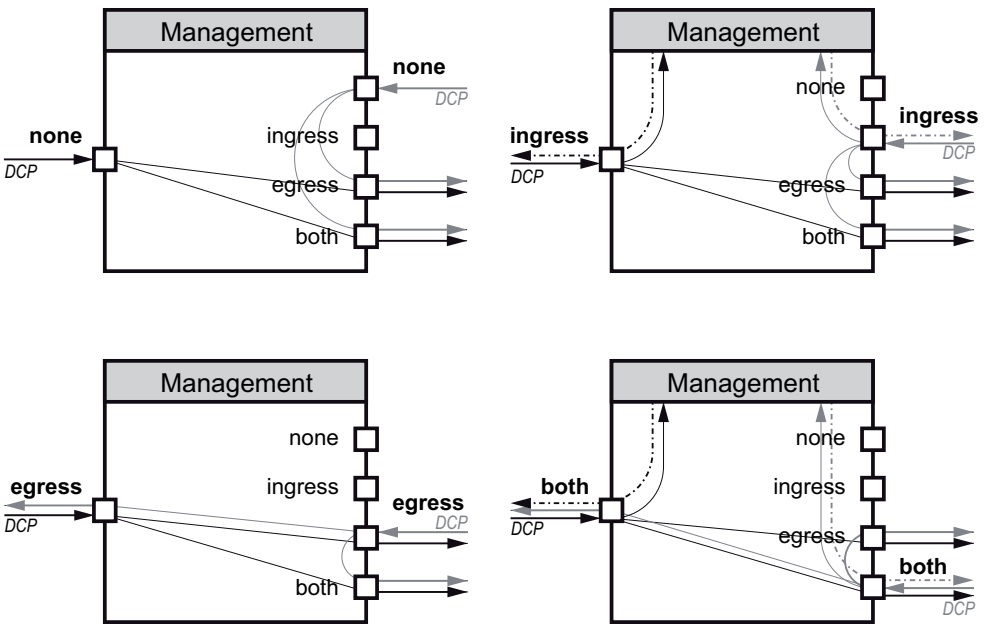
  Note: Preclude a combination of the VLAN 0 Transparent mode and the use of MSTP (Multiple Spanning Tree) or routing.

- ☐ Configure the alarm settings and the threshold values for the alarms you want to monitor (see on page 356 “Device Status”).

Global PROFINET settings:
- ☐ Activate PROFINET in the “Operation” frame.
- ☐ Click on “Download GSDML File” to load the GSDML file onto your PC.

PROFINET Port settings:

☐ Specify the desired settings for every port in the `DCP Mode` column. DCP frames are multicast, the responses from the management are unicast. Regardless of the settings, the device forwards the received DCP frames to other device ports whose setting is either `egress` or `both`.



- `none`:
  The management does not respond to DCP frames received on this port.
  The port does not forward DCP frames received on other ports.
- `ingress`:
  The management responds to DCP frames received on this port.
  The port does not forward DCP frames received on other ports.
- `egress`:
  The management does not respond to DCP frames received on this port.
  The port forwards DCP frames received on other ports.
- `both`:
  The management responds to DCP frames received on this port.
  The port forwards DCP frames received on other ports.

The default setting is `both`.

Note: If you connect 2 switches which are located in separate DCP domains, change the DCP mode of the corresponding ports to `none` or to `ingress` on **both** switches. This way neither of the switches receives or forwards DCP frames.

☐ Select the port for which you want to set its PHY module to the fast start mode, and select from the following in the column `Fast Start Up`:
- `disable` to set the normal start mode,
- `enable` to set the fast start mode.

Note: The setting `enable` only becomes effective if the automatic configuration of the port (Autoneg) is switched off (see on page 36 “Port Configuration”).

The default setting is `disable`. If a port does not support the fast start mode, the device will show `unsupported` in this column.

Settings for the PLC:

☐ Configure the PLC as described in the “Industry Protocols” user manual.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 245: Buttons

9.3.2 EtherNet/IP

This dialog allows you to activate the EtherNet/IP protocol. To integrate this in a control system, perform the following steps.

General settings:

☐ In the `Switching:Multicast:IGMP` dialog, check whether IGMP is activated (see on page 167 “IGMP (Internet Group Management Protocol)”).

EtherNet/IP settings:

☐ Activate EtherNet/IP in the “Operation” frame (default setting: Off).

☐ Click on “Download EDS File” to load the EDS file onto your PC.

Settings for the PLC:

☐ Configure the PLC as described in the “Industry Protocols” user manual.

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 246: Buttons

9.3.3 IEC61850 MMS Protocol (RSR, MACH 1000)

The IEC61850 is a standardized industrial communication protocol from the International Electrotechnical Commission (IEC). For example, automatic switching equipment uses this protocol when communicating with power station equipment.

The packet orientated protocol defines a uniform communication language based on the transport protocol, TCP/IP. The protocol uses a Manufacturing Message Specification (MMS) server for client server communications. The protocol includes functions for SCADA, Intelligent Electronic Device (IED) and the network control systems.

This dialog allows you to configure the following MMS Server functions:
- Activate/deactivate the MMS server
- Activate/deactivate write access to the MMS server

Parameter	Meaning	Value range	Default setting
Operation	Activate/deactivate the MMS server.	On, Off	Off

Table 247: "Operation" frame in the `Advanced:Industrial Protocols:IEC61850` dialog

Parameter	Meaning	Value range	Default setting
Write Access	Activate/deactivate the MMS server.	select, not selected	not selected
Technical Key	Specifies the IED Name. Thus, the IED Name is eligible independently of the System Name.	a..z A..Z _ 0..9	KEY

Table 248: "Configuration" frame in the `Advanced:Industrial Protocols:IEC61850` dialog

Parameter	Meaning	Value range	Default setting
Download ICD File	This button copys the ICD file to your PC.	-	-

Table 249: "Download" frame in the `Advanced:Industrial Protocols:IEC61850` dialog

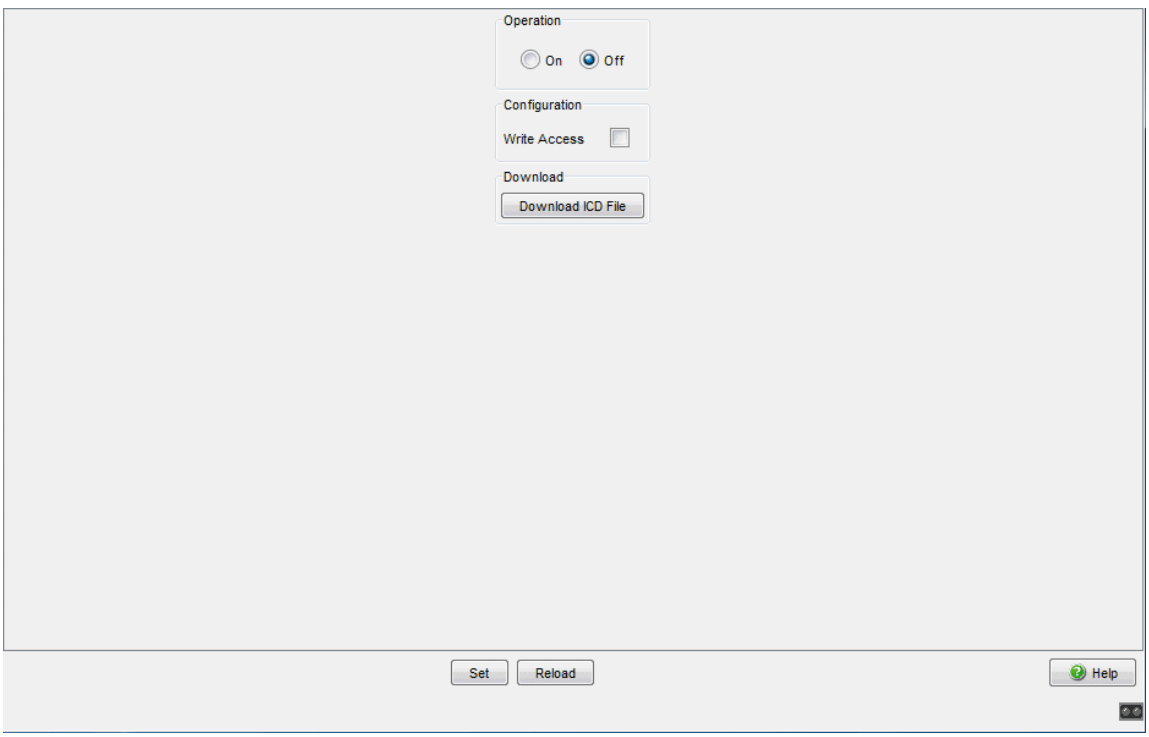


Figure 107: `Advanced:Industrial Protocols:IEC61850` dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes, open the `Basic Settings:Load/Save` dialog, select the location to save the configuration, and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 250: Buttons

9.3.4 Digital IO Module

The Digital I/O MICE Media module MM24-IOIOIOIO enables you to easily transfer status messages from one place in your network to another place. You install this module on (Power)MICE basic devices at the place designated in your network.

The Digital I/O MICE Media module's 4 digital inputs enable you to capture and to forward digital sensors signals.
The Digital I/O MICE Media module's 4 digital outputs enable you to apply actors.

The Digital I/O MICE Media module's 24 VDC output voltage enables you to operate actors or indicator lights, for example.

The software supports the logical function 1 for n. You can query a digital input of a Digital I/O MICE Media module and set practically any number (n) of outputs as a result. The outputs can be located in the following places:
- on the same Digital I/O MICE Media module on the same (Power)MICE basic device,
- on another Digital I/O MICE Media module on the same (Power)MICE basic device,
- on a Digital I/O MICE Media module on another (Power)MICE basic device.

In the "Description and Operation Instructions for Industrial ETHERNET Digital I/O MICE Media module MM24-IOIOIOIO" you will find:
- safety instructions
- a description of the device
- information about assigning the Digital I/O MICE Media module connection terminals
- a description of the display elements
- and other information that you need for installing the device prior to your configuring it

The "Digital IO Modules" menu contains the dialogs, displays and tables for configuring Digital I/O MICE Media modules:

- IO Input
  - Function (Activate/Deactivate)
  - Configuration (Configuring the update interval)
  - Displaying the input ID and value
  - Configuring the Log Event and SNMP Trap
- IO Output
  - Function (Activate/Deactivate)
  - Configuration (Configuring the update interval and number of retries)
  - Displaying the output ID and value
  - Configuring the Source IP Address, Input ID, Log Event and SNMP Trap

IO Input

This menu enables you to configure the 4 digital inputs of a Digital I/O MICE Media module MM24-IOIOIOIO.

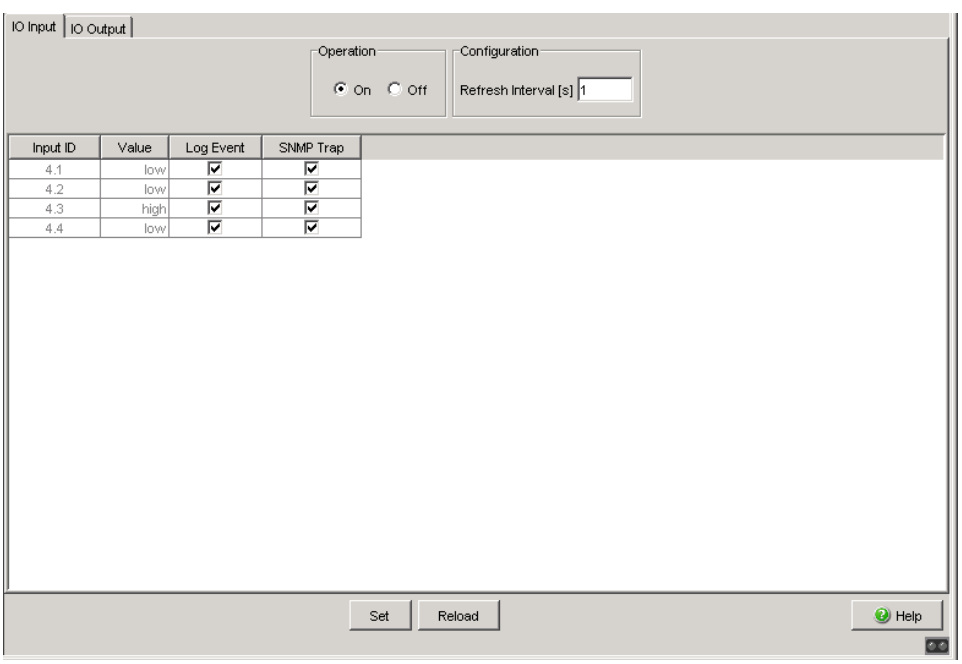


Figure 108:IO Input Dialog

Function

Parameter	Meaning	Value Range	Default Setting
Function	Activates or deactivates the cyclical queries from the digital inputs (IO Input).	`On`, Off	`Off`

Table 251: IO Input - Function

Configuration

Parameter	Meaning	Value Range	Default Setting
Update Interval [s]	Configure the interval for updating the IO input status. With this specification you define the intervals at which the device queries the values of the Digital I/O MICE Media module's digital inputs.	1 - 10 seconds	1 second

Table 252: IO Input - Configuration

IO Input

The "IO Input" table enables you to:

- display the input ID and value.
- configure the Log Event and SNMP Trap for this entry.

Once you have configured the Digital I/O MICE Media module's digital inputs, the dialog lists the values of the digital inputs configured.

Parameter	Meaning	Value Range	Default Setting
Input ID	Slot number of the Digital I/O MICE Media module and number of the digital input (i) that this entry applies to. Notation: x.i	x = 1 - 7 i = 1 - 4	-
Value	Digital input level – `low`: "0" state, input voltage at the digital input 0 V – `high`: "1" state, input voltage at the digital input +24 VDC – `not-available`: "undefined" state. Input voltage at the digital input corresponds to neither the high nor the low level. Possible cause: The digital inputs' cyclical query is deactivated.	low, high, not-available	not-available

Table 253: IO Input Table

Parameter	Meaning	Value Range	Default Setting
Log Event	Activates/deactivates the logging function for input status changes. – `On`: The device checks the status of the Digital I/O MICE Media module's digital inputs at regular intervals according to your setting in the "Update Interval [s]" input field. If the device detects a change in one of these IO input values, it writes an entry in its event log. The `Diagnostics:Report:EventLog` dialog displays these entries. – `Off`: The device does not write an entry in its event log in the course of an input status change.	`On`, `Off`	`Off`
SNMP Trap	Activates or deactivates the transmission of SNMP traps in the course of an input status changes. – On: The device checks the status of the Digital I/O MICE Media module's digital inputs at regular intervals according to your setting in the "Update Interval [s]" input field. If the device detects a change in one of these IO input values, it sends an SNMP trap. The Diagnostics:Trap Log dialog displays these traps. – Off: The device does not send an SNMP trap in the course of an input status change.	`On`, `Off`	`Off`

Table 253: IO Input Table

IO Output

This menu enables you to set the 4 digital outputs of a Digital I/O MICE Media module MM24-IOIOIOIO to the value of "High" (+24 VDC) or "Low" (0 VDC) (see table 256).

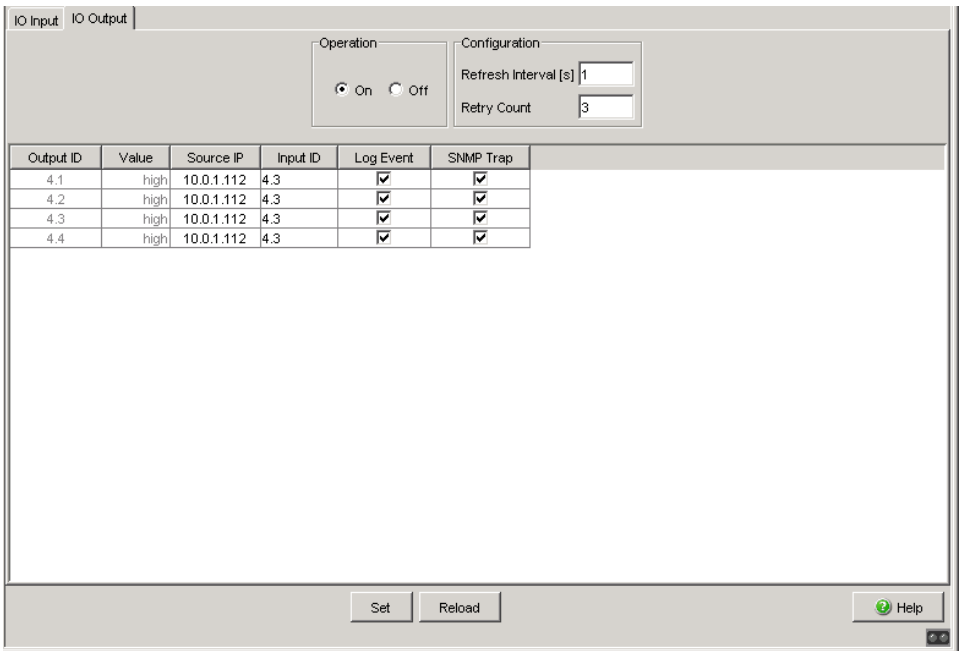


Figure 109:IO Output Dialog

Function

Parameters	Meaning	Possible values	Default setting
Operation	Activates or deactivates the cyclical setting of the digital outputs (IO Output).	`On` `Off`	`Off`

Table 254:IO Output - Function

Configuration

Note: If after the number of retries configured the device does not receive a response to its queries, it sets the digital output to the default value (low). This applies to all digital outputs that you have configured input monitoring for.

Parameter	Meaning	Value Range	Default Setting
Update Interval [s]	Configure the interval for updating the IO output status. With this specification you define the intervals at which the device sets the values of the Digital I/O MICE Media module's digital outputs.	1 - 10 seconds	1 second
Number of Retries	Specify the number of retry attempts the device will undertake to set the Digital I/O MICE Media module's digital outputs.	1 - 10	3

Table 255: IO Output - Configuration

IO Output

The "IO Output" table enables you to:

- display the output ID and value.
- configure the Source IP Address, Input ID, Log Event and SNMP Trap for this entry.

☐ In the "Source IP" field, enter the IP address of the (Power)MICE device that you installed the Digital I/O MICE Media module on, whose digital inputs you want to use for setting digital outputs.

☐ In the "Input ID" field, select the Digital I/O MICE Media module's slot number and the number of the digital input, whose status you want to use for setting the digital outputs.

☐ By clicking on the "Log Event" field, set a checkmark in order to activate the event log function for this digital output on the device.

☐ By clicking on the "SNMP Trap" field, set a checkmark in order to activate the transmission of SNMP traps for this digital output on the device.

☐ Click on "Set" to save your settings.

☐ Click on "Reload" in order to display in the table the current values at the device's digital outputs.

Parameters	Meaning	Value range	Default setting
Output ID	Slot number of the Digital I/O MICE Media module (x) and number of the digital output (o) that this entry applies to. Notation: x.o	x = 1 - 7 o = 1 - 4	-
Value	Digital output level. – `low`: State “0”, relay on digital output is in position 2 (center contact is connected to de-energized contact). – `high`: State “1”, relay on digital output is in position 1 (center contact is connected to operating contact). – `not-available`: “undefined” state. Voltage at the digital output corresponds to neither the high nor the low level. Possible cause: The digital outputs' cyclical setting is deactivated.	`low`, `high`, `not-available`	`not-available`
Source IP	IP address of the (Power)MICE device with a Digital I/O MICE Media module from which you want to analyze a digital input for setting the digital output.	Valid IPv4 address	0.0.0.0
Input ID	Slot number of the Digital I/O MICE Media module (x) and number of the digital input (i) that you use for setting the digital output. Notation: x.i	x = 1 - 7 i = 1 - 4	1.1

Table 256: IO Output Table

Parameters	Meaning	Value range	Default setting
Log Event	Activates/deactivates the logging function for output status changes. – `On`: The device checks the status of the Digital I/O MICE Media module's digital inputs at regular intervals according to the setting in the “Update Interval [s]” input field. If the device detects a change in one of these IO output values, it writes an entry in its event log. The `Diagnostics:Report:EventLog` dialog displays these entries. – `Off`: The device does not write an entry in its event log in the course of an output status change.	`On`, `Off`	`Off`
SNMP Trap	Activates or deactivates the transmission of SNMP traps in the course of an output status changes. – On: The device checks the status of the Digital I/O MICE Media module's digital inputs at regular intervals according to the setting in the “Update Interval [s]” input field. If the device detects a change in one of these IO output values, it sends an SNMP trap. – Off: The device does not send an SNMP trap in the course of an output status change.	`On`, `Off`	`Off`

Table 256: IO Output Table

Note: If the device cannot read the Digital I/O MICE Media module's digital input, it writes an entry in its event log. Possible cause: The device is unreachable or the configuration is incorrect.

9.4 Software DIP Switch overwrite (PowerMICE)

This dialog allows you to display the settings of the DIP switches on the device. If required, you can deactivate the settings of the DIP switches or overwrite them using the setting from the software.

Parameter	Meaning	Value range	Default setting
Function	Activates/deactivates the DIP switches on the device. `An`: The device uses the settings specified with the DIP switches. The prerequisite is that "DIP Switch On" is active. `Off`: The device ignores the settings of the DIP switches.	`On`, `Off`	`On`

Table 257: "Operation" frame in the `Advanced:DIP-Switch` dialog

Parameter	Meaning	Value range	Default setting
Conflict with hardware settings	Displays the conflicts between the settings of the DIP switches on the device and the software settings. `Active`Conflict between the settings of the DIP switches on the device and the software settings. `Inactive`: No conflict.	Active, inactive	-

Table 258: "DIP-Switch Status" frame in the `Advanced:DIP-Switch` dialog

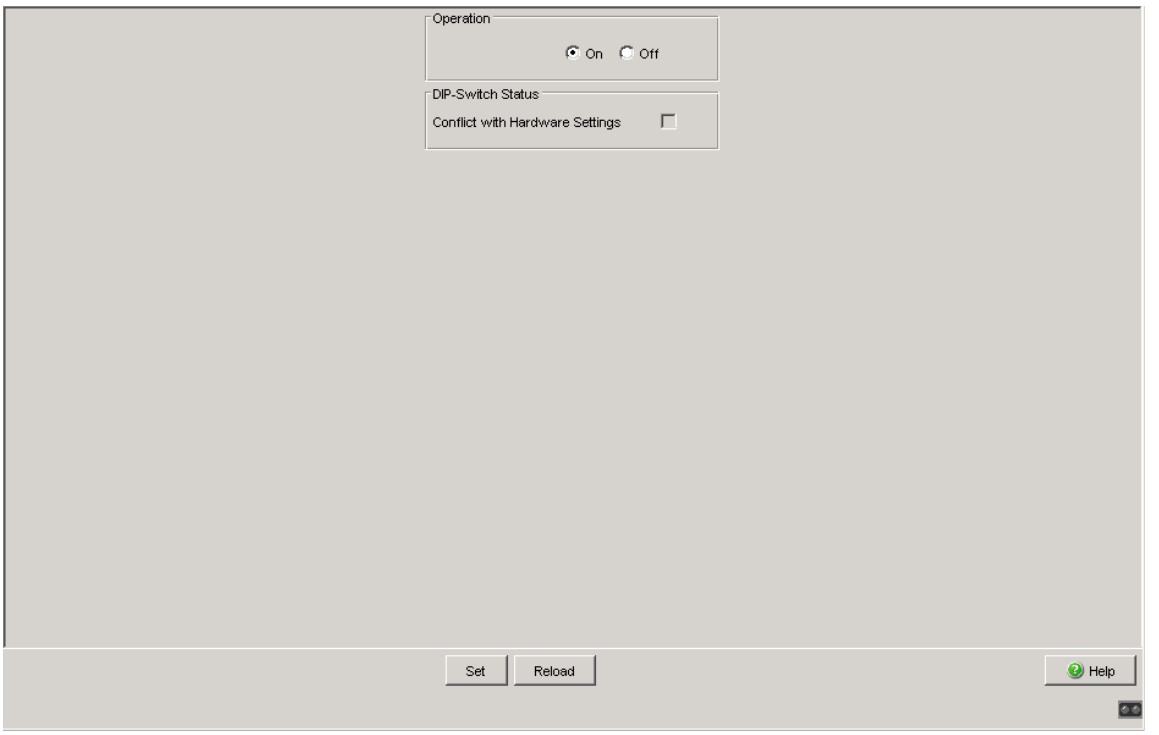


Figure 110:`Advanced:DIP-Switch` dialog

Buttons

Button	Meaning
Set	Transfers the changes to the volatile memory (`RAM`) of the device. To permanently save the changes afterwards, you open the `Basic Settings:Load/Save` dialog and click "Save".
Reload	Updates the fields with the values that are saved in the volatile memory (`RAM`) of the device.
Help	Opens the online help.

Table 259:Buttons

9.5 Command Line

This window enables you to access the Command Line Interface (CLI) using the Web interface.

You will find detailed information on CLI in the “Command Line Interface” reference manual.

Buttons

Button	Meaning
Help	Opens the online help.

Table 260: Buttons

A Appendix

A.1 Technical Data

Switching	
Size of MAC address table (incl. static filters)	8,000 (16,000 for PowerMICE and MACH 4000)
Max. number of statically configured MAC address filters	100
Max. number of MAC address filters learnable via GMRP/IGMP Snooping	1,000
Max. length of over-long packets	1,552 bytes
Latency, depending on the port data rate 10,000 Mbit/s 1,000 Mbit/s 100 Mbit/s 10 Mbit/s	 Layer 2: typically 3.0 µs; Layer 3: typically 3.0 µs Layer 2: typically 3.5 µs; Layer 3: typically 4.5 µs Layer 2: typically 4.5 µs; Layer 3: typically 5.5 µs Layer 2: typically 19 µs; Layer 3: typically 20 µs
Max. number of static address entries	100 (in RM mode: 0 Unicast entries)

VLAN	
VLAN ID	1 to 4,042
Number of VLANs	max. 256 simultaneously per device max. 256 simultaneously per port
Number of VLANs in GMRP in VLAN 1	max. 256 simultaneously per device max. 256 simultaneously per port

Access Control Lists (ACLs)	
Number of ACL entries	100
Number of possible rules	1,000
Number of rules per ACL entry	10
Number of rules per interface	20
Number of Switch queues	8
Port priorities that can be set	0-7

Router	
ARP entries	up to 2,000
Routing entries	up to 2,000 (1,500 for MACH 4002 24G/48G)
Number of VLAN interfaces	up to 32
Static routes	256
Static ARP entries	64
Number of tracking objects	128

A.2 List of RFCs

RFC 768	UDP
RFC 783	TFTP
RFC 791	IP
RFC 792	ICMP
RFC 793	TCP
RFC 826	ARP
RFC 951	BOOTP
RFC 1157	SNMPv1
RFC 1155	SMIv1
RFC 1212	Concise MIB Definitions
RFC 1213	MIB2
RFC 1493	Dot1d
RFC 1643	Ethernet-like -MIB
RFC 1757	RMON
RFC 1769	SNTP
RFC 1867	Form-Based File Upload in HTML
RFC 1901	Community based SNMP v2
RFC 1905	Protocol Operations for SNMP v2
RFC 1906	Transport Mappings for SNMP v2
RFC 1907	Management Information Base for SNMP v2
RFC 1908	Coexistence between SNMP v1 and SNMP v2
RFC 1945	HTTP/1.0
RFC 2068	HTTP/1.1 protocol as updated by draft-ietf-http-v11-spec-rev-03
RFC 2233	The Interfaces Group MIB using SMI v2
RFC 2246	The TLS Protocol, Version 1.0
RFC 2271	SNMP Framework MIB
RFC 2346	AES Ciphersuites for Transport Layer Security
RFC 2365	Administratively Scoped Boundaries
RFC 2474	Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers
RFC 2475	An Architecture for Differentiated Service
RFC 2570	Introduction to SNMP v3
RFC 2571	Architecture for Describing SNMP Management Frameworks
RFC 2572	Message Processing and Dispatching for SNMP
RFC 2573	SNMP v3 Applications
RFC 2574	User Based Security Model for SNMP v3
RFC 2575	View Based Access Control Model for SNMP
RFC 2576	Coexistence between SNMP v1, v2 & v3
RFC 2578	SMIv2

RFC 2579	Textual Conventions for SMI v2
RFC 2580	Conformance statements for SMI v2
RFC 2618	RADIUS Authentication Client MIB
RFC 2620	RADIUS Accounting MIB
RFC 2674	Dot1p/Q
RFC 2818	HTTP over TLS
RFC 2851	Internet Addresses MIB
RFC 2865	RADIUS Client
RFC 3164	The BSD Syslog Protocol
RFC 3580	(802.1X RADIUS Usage Guidelines)
RFC 4188	(Definitions of Managed Objects for Bridges)

A.3 Underlying IEEE Standards

IEEE 802.1AB	Topology Discovery (LLDP)
IEEE 802.1af	Power over Ethernet
IEEE 802.1D-1998, IEEE 802.1D-2004	Media access control (MAC) bridges (includes IEEE 802.1p Priority and Dynamic Multicast Filtering, GARP, GMRP)
IEEE 802.1Q-1998	Virtual Bridged Local Area Networks (VLAN Tagging, Port-Based VLANs, GVRP)
IEEE 802.1Q-2005	Spanning Tree (STP), Rapid Spanning Tree (RSTP), Multiple Spanning Tree (MSTP)
IEEE 802.3-2002	Ethernet
IEEE 802.3ac	VLAN Tagging
IEEE 802.3ad	Link Aggregation with Static LAG and LACP Support
IEEE 802.3af-2003	Power over Ethernet (PoE)
IEEE 802.3x	Flow Control

A.4 Underlying IEC Norms

IEC 62439	High availability automation networks; especially: Chap. 5, MRP – Media Redundancy Protocol based on a ring topology

A.5 Underlying ANSI Norms

ANSI/TIA-1057	Link Layer Discovery Protocol for Media Endpoint Devices, April 2006

A.6 Literature references

- “TCP/IP Illustrated”, Vol. 1
  W.R. Stevens
  Addison Wesley 1994
  ISBN 0-201-63346-9
- Hirschmann “Installation” user manual
- Hirschmann “Basic Configuration” user manual
- Hirschmann “Redundancy Configuration” user manual
- Hirschmann “Routing Configuration” user manual
- Hirschmann “GUI Graphical User Interface” reference manual
- Hirschmann “Command Line Interface” reference manual

A.7 Copyright of Integrated Software

A.7.1 Bouncy Castle Crypto APIs (Java)

A.7.2 Broadcom Corporation

B Readers' Comments

What is your opinion of this manual? We are always striving to provide as comprehensive a description of our product as possible, as well as important information that will ensure trouble-free operation. Your comments and suggestions help us to further improve the quality of our documentation.

Your assessment of this manual:

	Very good	Good	Satisfactory	Mediocre	Poor
Precise description	O	O	O	O	O
Readability	O	O	O	O	O
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Examples	O	O	O	O	O
Structure	O	O	O	O	O
Completeness	O	O	O	O	O
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D Further Support

Technical Questions

For technical questions, please contact any Hirschmann dealer in your area or Hirschmann directly.

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Reference Manual

CLI Command Line Interface
Industrial ETHERNET (Gigabit) Switch
PowerMICE, MACH 4000

L3E Rel. 9.0

Technical Support
HAC-Support@belden.com

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Rel. 9.0 - 02/2015 – 2/19/15

Content

About this Manual

The “GUI” reference manual contains detailed information on using the graphical user interface (web-based interface) to operate the individual functions of the device.

The "Command Line Interface" reference manual contains detailed information on using the Command Line Interface to operate the individual functions of the device.

The "Installation" user manual contains a device description, safety instructions, a description of the display, and the other information that you need to install the device.

The "Basic Configuration" user manual contains the information you need to start operating the device. It takes you step by step from the first startup operation through to the basic settings for operation in your environment.

The "Redundancy Configuration" user manual contains the information you need to select a suitable redundancy procedure and configure that procedure.

The "Industry Protocols" user manual describes how the device is connected by means of a communication protocol commonly used in the industry, such as EtherNet/IP or PROFINET IO.

The "Routing Configuration User Manual" document contains the information you need to start operating the routing function. It takes you step-by-step from a small router application through to the router configuration of a complex network. ƒn The manual enables you to configure your router by following the examples.

The HiVision Network Management Software provides you with additional options for smooth configuration and monitoring:

- Simultaneous configuration of multiple devices
- Graphic interface with network layout
- Auto-topology recognition
- Event log
- Event handling
- Client/server structure
- Browser interface

- ActiveX control for SCADA integration
- SNMP/OPC gateway.

Maintenance

Hirschmann are continually working on improving and developing their software. You should regularly check whether there is a new version of the software that provides you with additional benefits. You will find software information and downloads on the product pages of the Hirschmann website

Service Shell

A service technician uses the Service Shell function for maintenance of your functioning device. If you need service support, this function allows the service technician to access internal functions of your device from an external location.

Note: The Service Shell function is for service purposes exclusively. This function allows the access on internal functions of the device. In no case, execute internal functions without service technician instructions. Executing internal functions such as deleting the content of the NVM (non-volatile memory) possibly leads to inoperability of your device.

Permanently disabling the Service Shell

If you do not need the Service Shell, the device allows you to disable the function. In this case you still have the option to configure the device. Though, the service technician has no possibilities to access internal functions of your device to call up additional required information.

Note: Disabling the Service Shell function produces a permanent effect. This process is irreversible.

To reactivate the Service Shell function, send the device back to the manufacturer.

- ☐ To display the Service Shell function, enter `serviceshell` and a space, and then a question mark `?`
- ☐ To permanently deactivate the Shell Service function, enter `serviceshell deactivate` and a space, and press the enter key.

1 Command Structure

The Command Line Interface (CLI) syntax, conventions and terminology are described in this section. Each CLI command is illustrated using the structure outlined below.

1.1 Format

Some commands, such as **`clear vlan,`** do not require parameters. Other commands, such as **`network parms`**, have parameters for which you must supply a value. Parameters are positional — you must type the values in the correct order. Optional parameters will follow required parameters. For example:

Example 1

```
network parms <ipaddr> <netmask> [gateway]
```

- `network parms`
  is the command name.
- `<ipaddr> <netmask>`
  are the required values for the command.
- `[gateway]`
  is the optional value for the command.

Example 2

```
snmp-server location <loc>
```

- `snmp-server location`
  is the command name.
- `<loc>`
  is the required parameter for the command.

Example 3

```
clear vlan
```

- `clear vlan`
  is the command name.

1.1.1 Command

The following conventions apply to the command name:

- The command name is displayed in this document in courier font and is to be typed exactly as shown.
- Once you have entered enough letters of a command name to uniquely identify the command, pressing the ***<Space bar>*** or ***<Tab key>*** will cause the system to complete the word.
- Entering Ctrl-Z will return you to the root level command prompt.

1.1.2 Parameters

Parameters are order dependent.

Parameters are displayed in this document in *italic font*, which are to be replaced with a name or number.

To use spaces as part of parameter name, enclose it in double quotes. For example, the expression "System Name with Spaces" forces the system to accept the spaces.

Parameters may be mandatory values, optional values, choices, or a combination.

- <parameter>. The <> angle brackets indicate that a mandatory parameter is to be entered in place of the brackets and text inside them.
- [parameter]. The [] square brackets indicate that an optional parameter may be entered in place of the brackets and text inside them.
- choice1 | choice2. Vertical bars '|' separate alternative, mutually exclusive, elements.
- The {} curly braces indicate that a parameter must be chosen from the list of choices.
- Braces within square brackets [{}] indicate a required choice within an optional element.

1.1.3 Values

ipaddr

This parameter is a valid IP address. Presently the IP address can be entered in following formats:

a (32 bits)
a.b (8.24 bits)
a.b.c (8.8.16 bits)
a.b.c.d (8.8.8.8 bits)

In addition to these formats, decimal, hexadecimal and octal formats are supported through the following input formats (where n is any valid hexadecimal, octal or decimal number):

0xn (CLI assumes hexadecimal format)
0n (CLI assumes octal format with leading zeros)
n (CLI assumes decimal format)

macaddr

The MAC address format is six hexadecimal numbers separated by colons, for example 00:06:29:32:81:40.

areaid

Area IDs may be entered in dotted-decimal notation (for example, 0.0.0.1). An area ID of 0.0.0.0 is reserved for the backbone. Area IDs have the same form as IP addresses, but are distinct from IP addresses. The IP network address of the sub-netted network may be used for the area ID.

routerid

The value of <router id> must be entered in 4-digit dotted-decimal notation (for example, 0.0.0.1). A router ID of 0.0.0.0 is invalid.

Interface

Valid slot and port number separated by forward slashes. For example, 0/1 represents slot number 0 and port number 1. See “Slot-Port Naming Convention” on

page 43.

Logical Interface Logical slot and port number. This is applicable in the case of a port-channel (LAG) and vlan router interfaces (9/x). The operator can use the logical slot/port to configure the port-channel. See “Slot-Port Naming Convention” on page 43.

Character strings Use double quotation marks to identify character strings, for example, “System Name with Spaces”. An empty string (“”) is not valid.

1.1.4 Conventions

Network addresses are used to define a link to a remote host, workstation or network. Network addresses are shown using the following syntax:

Address Type	Format	Range
ipaddr	192.168.11.110	0.0.0.0 to 255.255.255.255 (decimal)
macaddr	A7:C9:89:DD:A9:B3	hexadecimal digit pairs

Table 1: Network Address Syntax

Double quotation marks such as "System Name with Spaces" set off user defined strings. If the operator wishes to use spaces as part of a name parameter then it must be enclosed in double quotation marks.

Empty strings (““) are not valid user defined strings.

Command completion finishes spelling the command when enough letters of a command are typed to uniquely identify the command word. The command may be executed by typing <enter> (command abbreviation) or the command word may be completed by typing the <tab> or <space bar> (command completion).

The value 'Err' designates that the requested value was not internally accessible.

The value of '-----' designates that the value is unknown.

1.1.5 Annotations

The CLI allows the user to type single-line annotations at the command prompt for use when writing test or configuration scripts and for better readability. The exclamation point (‘!’) character flags the beginning of a comment. The comment flag character can begin a word anywhere on the command line and all input following this character is ignored. Any command line that begins with the character ‘!’ is recognized as a comment line and ignored by the parser.

Some examples are provided below:

```
! Script file for setting the CLI prompt
set prompt example-switch
! End of the script file
```

1.1.6 Special keys

Certain special key combinations speed up use of the CLI. They are listed in this section. Also, help is available for the CLI by typing **HELP:**

BS	delete previous character
Ctrl-A Ctrl-E	go to beginning of line go to end of line
Ctrl-F Ctrl-B	go forward one character go backward one character
Ctrl-D	delete current character
Ctrl-H	display command history or retrieve a command
Ctrl-U, X Ctrl-K	delete to beginning of line delete to end of line
Ctrl-W	delete previous word
Ctrl-T	transpose previous character
Ctrl-P	go to previous line in history buffer
Ctrl-N	go to next line in history buffer
Ctrl-Z	return to root command prompt
Tab, <SPACE>	command-line completion
Exit	go to next lower command prompt
?	list choices

1.1.7 Special characters in scripts

Some of the configuration parameters are strings that can contain special characters. When the switch creates a script from the running configuration (by use of the command #show running-config <scriptname.cli>), these special characters are written to the script with a so-called escape character preceding them. This ensures that when applying the script, these characters are regarded as a normal part of the configuration parameter, not having the special meaning they usually have.

Character (plain)	Meaning, when entered in the CLI
!	Begin of a comment, ! and the rest of the line will be ignored
"	Begin or end of a string that may contain space characters
'	Begin or end of a string that may contain space characters
?	Shows possible command keywords or parameters
\	The backslash is used as an escape character to mask characters that normally have a special meaning

Tab. 2: Special characters

Character (escaped)	Meaning, when entered in the CLI
\!	! becomes part of the string
\"	" becomes part of the string
\'	' becomes part of the string
\?	? becomes part of the string
\\	\ becomes part of the string

Tab. 3: Special characters escaped

The commands with strings that may contain these special characters are listed below.

Note: Not every string is allowed to contain special characters. The string that is output with the escape characters (if necessary) is shown as "...".

Command	Note
!System Description "..."	"At the beginning of the script
!System Version "..."	"At the beginning of the script

Tab. 4: Commands in Privileged Exec mode

Command	Note
snmp-server location "..."	
snmp-server contact "..."	
snmp-server community "..."	
snmp-server community ipaddr <ip> "..."	
snmp-server community ipmask <ip> "..."	
snmp-server community ro "..."	
snmp-server community rw "..."	
no snmp-server community mode "..."	
no snmp-server community "..."	
link-aggregation "..."	
spanning-tree configuration name "..."	
ptp subdomain-name "..."	

Tab. 5: Commands in Global Config mode

Command	Note
name "..."	

Tab. 6: Commands in Interface Config mode

Command	Note
vlan name <n> "..."	

Tab. 7: Commands in VLAN Database mode

When a device creates a script, a human-readable header is included that lists the special characters and the escape characters:

```
!Parameter string escape handling \, 1
!Characters to be preceded with escape char (\): \, !, ", ', ?
```

1.1.8 Secrets in scripts

A configuration may include secrets (e. g., passwords). When creating a script, these secrets are written to it in a scrambled form, not in clear text. These secrets may be up to 31 characters long. The format for a scrambled secret is: ":v1:<scrambled secret>:" (without the quotes (), they were added for readability). v1 denotes the scrambling method (v1 in this case), the value of the scrambled secret is a 64-digit hex string.

The following commands produce scrambled secrets (if necessary):

Command	Note
ip rip authentication encrypt <secret> <id>	Software L3E and L3P
ip rip authentication simple <secret>	Software L3E and L3P
ip vrrp <id> authentication simple <secret>	Software L3E and L3P
radius server key acct <ip> <password>	
radius server key auth <ip> <password>	
users passwd <username> <password>	
users snmpv3 encryption <username> des <password>	

Tab. 8: Commands in Global Config mode

Applying or validating a script requires the following conditions for a scrambled secret, else it will be considered invalid (usually only relevant if a script is edited manually):

- string must not be longer than 64 hex digits
- string must only contain the digits 0-9 and the characters A-F (or a-f)
- string length must be even

1.1.9 Slot-Port Naming Convention

Switch software references physical entities such as cards and ports using a Slot/Port naming convention. This convention is also used to identify certain logical entities such as Link Aggregation (LAG) interfaces.
The slot number has two uses. In the case of physical ports it identifies the card containing the ports. In the case of logical ports it also identifies the type of interface or port.

Physical slot numbers

Physical slot numbers begin with one, and are allocated up to the maximum number of physical slots

Logical slot numbers

Logical slots immediately follow physical slots and identify LAG or router interfaces. For LAG the slot number 8 is used. For VLAN-based interfaces the slot number 9 is used.

The port identifies the specific physical port or logical interface being managed on a given slot.

Physical Ports

The physical ports for each slot are numbered sequentially starting from one.

Logical Interfaces

There are two types of logical interfaces: LAG and VLAN-based routing interfaces.

- LAG interfaces are only used for bridging functions. Each LAG interface consists of a set of up to eight physical ports and is identified by its own slot/port designation.
- VLAN routing interfaces are only used for routing functions.

2 Quick Start up

The CLI Quick Start up details procedures to quickly become acquainted with the software.

2.1 Quick Starting the Switch

- Read the device Installation Guide for the connectivity procedure. In-band connectivity allows access to the software locally or from a remote workstation. The device must be configured with IP information (IP address, subnet mask, and default gateway).
- Turn the Power on.
- Allow the device to load the software until the login prompt appears. The device‘s initial state is called the default mode.
- When the prompt asks for operator login, execute the following steps:
  - Type the word `admin` in the login area. Since a number of the Quick Setup commands require administrator account rights, we recommend logging into an administrator account. Press the enter key.
  - Enter the state on delivery password `private`.
  - Press the enter key.
  - The CLI User EXEC prompt will be displayed.
    User EXEC prompt:
    `(Hirschmann Product) >`
  - Use “enable” to switch to the Privileged EXEC mode from User EXEC.
    Privileged EXEC prompt:
    `(Hirschmann Product) #`
  - Use “configure” to switch to the Global Config mode from Privileged EXEC.
    Global Config prompt:
    `(Hirschmann Product) (Config)#`
  - Use “exit” to return to the previous mode.

2.2 System Info and System Setup

This chapter informs you about:

- Quick Start up Software Version Information
- Quick Start up Physical Port Data
- Quick Start up User Account Management
- Quick Start up IP Address
- Quick Start up Uploading from Switch to Out-of-Band PC Only XMODEM)
- Quick Start up Downloading from Out-of-Band PC to Switch (Only XMODEM)
- Quick Start up Downloading from TFTP Server
- Quick Start up Factory Defaults

Quick Start up Physical Port Data

Command	Details
`show port all` (in Privileged EXEC)	Displays the Ports
	slot/port
	Type - Indicates if the port is a special type of port
	Admin Mode - Selects the Port Control Administration State
	Physical Mode - Selects the desired port speed and duplex mode
	Physical Status - Indicates the port speed and duplex mode
	Link Status - Indicates whether the link is up or down
	Link Trap - Determines whether or not to send a trap when link status changes
	LACP Mode - Displays whether LACP is enabled or disabled on this port.

Table 9: Quick Start up Physical Port Data

Quick Start up User Account Management

Command	Details
`show users` (in Privileged EXEC)	Displays all of the users that are allowed to access the switch
	Access Mode - Shows whether the user is able to change parameters on the switch(Read/Write) or is only able to view them (Read Only). As a factory default, the ‘admin’ user has Read/Write access and the ‘user’ user has Read Only access. There can only be one Read/Write user and up to five Read Only users.
`show loginsession` (in User EXEC)	Displays all of the login session information

Table 10: Quick Start up User Account Management

Command	Details
`users passwd <user-name>` (in Global Config)	Allows the user to set passwords or change passwords needed to login A prompt will appear after the command is entered requesting the users old password. In the absence of an old password leave the area blank. The operator must press enter to execute the command. The system then prompts the user for a new password then a prompt to confirm the new password. If the new password and the confirmed password match a message will be displayed. User password should not be more than eight characters in length. Make sure, that the passwords of the users differ from each other. If two or more users try to choose the same password, the CLI will display an error message.
`copy system:running-config nvram:startup-config` (in Privileged EXEC)	This will save passwords and all other changes to the device. If you do not save the configuration by doing this command, all configurations will be lost when a power cycle is performed on the switch or when the switch is reset.
`logout` (in User EXEC and Privileged EXEC)	Logs the user out of the switch

Table 10: Quick Start up User Account Management

Quick Start up IP Address

To view the network parametes the operator can access the device by the following methods.

- Simple Network Management Protocol - SNMP
- Web Browser

Note: After configuring the network parameters it is advisable to execute the command '`copy system:running-config nvram:startup-config`' to ensure that the configurations are not lost.

Command	Details
`show network` (in User EXEC)	Displays the Network Configurations
	IP Address - IP Address of the switch Default IP is 0.0.0.0
	Subnet Mask - IP Subnet Mask for the switch Default is 0.0.0.0
	Default Gateway - The default Gateway for this switch Default value is 0.0.0.0
	Burned in MAC Address - The Burned in MAC Address used for in-band connectivity
	Network Configurations Protocol (BOOTP/DHCP) - Indicates which network protocol is being used Default is DHCP
	Network Configurations Protocol HiDiscovery - Indicates the status of the HiDiscovery protocol. Default is read-write
	Management VLAN Id - Specifies VLAN id
	Web Mode - Indicates whether HTTP/Web is enabled.
	JavaScript Mode - Indicates whether java mode is enabled. When the user accesses the switch's graphical user interface (web interface) and JavaScript Mode is enabled, the switch's web server will deliver a HTML page that contains JavaScript. Some browsers do not support JavaScript. In this case, a HTML page without JavaScript is necessary. In this case, set JavaScript Mode to disabled. Default: enabled.
`network parms <ipaddr> <net-mask> [gateway]` (in Privileged EXEC)	Sets the IP Address, subnet mask and gateway of the router. The IP Address and the gateway must be on the same subnet.
	IP Address range from 0.0.0.0 to 255.255.255.255
	Subnet Mask range from 0.0.0.0 to 255.255.255.255

Table 11: Quick Start up IP Address

Command	Details
	Gateway Address range from 0.0.0.0 to 255.255.255.255

Table 11: Quick Start up IP Address

Quick Start up Downloading from TFTP Server

Before starting a TFTP server download, the operator must complete the Quick Start up for the IP Address.

Command	Details
`copy <url> {nvram:startup-config | system:image}`	Sets the destination (download) datatype to be an image (system:image) or a configuration file (nvram:startup-config). The URL must be specified as: tftp://ipAddr/filepath/fileName. The nvram:startup-config option downloads the configuration file using tftp and system:image option downloads the code file.

Table 12: Quick Start up Downloading from TFTP Server

Quick Start up Factory Defaults

Command	Details
`clear config` (in Privileged EXEC Mode)	Enter yes when the prompt pops up to clear all the configurations made to the switch.
`copy system:running-config nvram:startup-config`	Enter yes when the prompt pops up that asks if you want to save the configurations made to the switch.
`reboot` (or cold boot the switch) (in Privileged EXEC Mode)	Enter yes when the prompt pops up that asks if you want to reset the system. This is the users choice either reset the switch or cold boot the switch, both work effectively.

Table 13: Quick Start up Factory Defaults

3 Mode-based CLI

The CLI groups all the commands in appropriate modes according to the nature of the command. A sample of the CLI command modes are described below. Each of the command modes support specific software commands.

- User Exec Mode
- Privileged Exec Mode
- Global Config Mode
- Vlan Mode
- Interface Config Mode
- Line Config Mode
- Router RIP Config Mode
- MAC Access-list Config Mode

The Command Mode table captures the command modes, the prompts visible in that mode and the exit method from that mode.

Command Mode	Access Method	Prompt	Exit or Access Next Mode
`User Exec Mode`	This is the first level of access. Perform basic tasks and list system information	`(Hirschmann Product)>`	Enter Logout command
`Privileged Exec Mode`	From the User Exec Mode, enter the `enable` command	`(Hirschmann Product)#`	To exit to the User Exec mode, enter exit or press Ctrl-Z.
`VLAN Mode`	From the Privileged User Exec mode, enter the `vlan database` command	`(Hirschmann Product) (Vlan) #`	To exit to the Privileged Exec mode, enter the exit command, or press Ctrl-Z to switch to User Exec mode.
`Global Config Mode`	From the Privileged Exec mode, enter the `configure` command	`(Hirschmann Product) (Config)#`	To exit to the Privileged Exec mode, enter the exit command, or press Ctrl-Z to switch to user exec mode.
`Interface Config Mode`	From the Global Configuration mode, enter the `interface <slot/port>` command	`(Hirschmann Product) (Interface-"if number")#`	To exit to the Global Config mode enter exit. To return to user EXEC mode enter ctrl-Z.

Table 14: Command Mode

Command Mode	Access Method	Prompt	Exit or Access Next Mode
`Line Config Mode`	From the Global Configuration mode, enter the `lineconfig` command	`(Hirschmann Product) (line) #`	To exit to the Global Config mode enter exit. To return to User Exec mode enter ctrl-Z.
`Router RIP Config Mode`	From the Global Config mode, enter the `router rip` command	`(Hirschmann Product) (Config-router)#`	To exit to the Global Config mode enter exit. To return to User Exec mode enter ctrl-Z.
`MAC Access-list Config Mode`	From the Global Config mode enter the `mac access-list extended <name>` command.	`(Hirschmann Product) (Config mac-access-list)#`	To exit to the Global Config mode, enter the exit command. To return to the User EXEC mode, enter Ctrl-Z.

Table 14: Command Mode

3.1 Mode-based Topology

The CLI tree is built on a mode concept where the commands are available according to the interface. Some of the modes are depicted in the following figure.

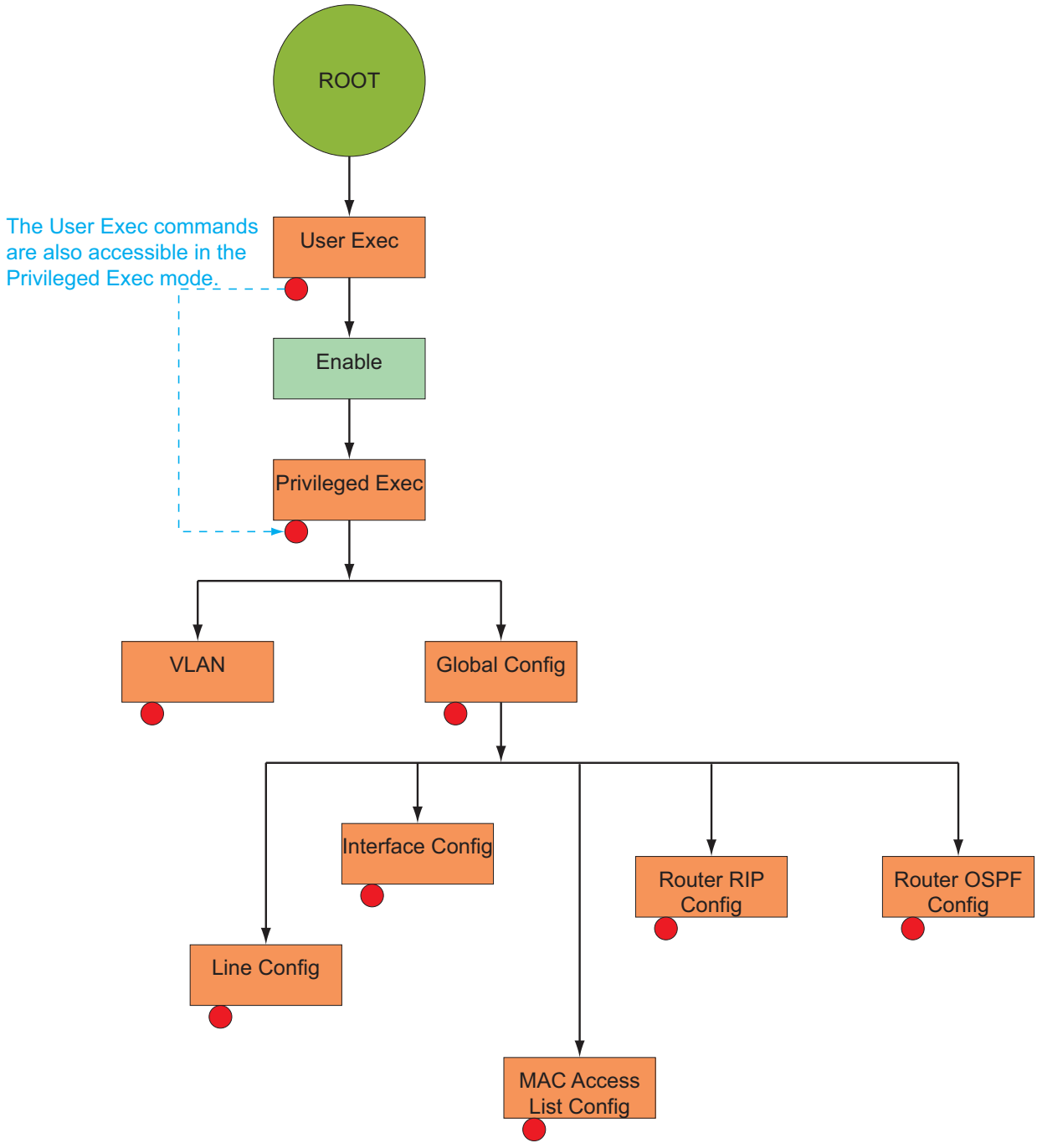

Fig. 1: Mode-based CLI

3.2 Mode-based Command Hierarchy

The CLI is divided into various modes. The Commands in one mode are not available until the operator switches to that particular mode, with the exception of the User Exec mode commands. The User Exec mode commands may also be executed in the Privileged Exec mode.
The commands available to the operator at any point in time depend upon the mode. Entering a question mark (?) at the CLI prompt, displays a list of the available commands and descriptions of the commands.

The CLI provides the following modes:

User Exec Mode

When the operator logs into the CLI, the User Exec mode is the initial mode. The User Exec mode contains a limited set of commands. The command prompt shown at this level is:

```
Command Prompt: (Hirschmann Product)>
```

Privileged Exec Mode

To have access to the full suite of commands, the operator must enter the Privileged Exec mode. Privileged users authenticated by login are able to enter the Privileged EXEC mode. From Privileged Exec mode, the operator can issue any Exec command, enter the VLAN mode orenter the Global Configuration mode . The command prompt shown at this level is:

```
Command Prompt: (Hirschmann Product)#
```

VLAN Mode

This mode groups all the commands pertaining to VLANs. The command prompt shown at this level is:

```
Command Prompt: (Hirschmann Product)(VLAN)#
```

Global Config Mode

This mode permits the operator to make modifications to the running configuration. General setup commands are grouped in this mode. From the Global Configuration mode, the operator can enter the System Configuration mode, the Physical Port Configuration mode, the

Interface Configuration mode, or the Protocol Specific modes specified below. The command prompt at this level is:

```
Command Prompt: (Hirschmann Product)(Config)#
```

From the Global Config mode, the operator may enter the following configuration modes:

Interface Config Mode

Many features are enabled for a particular interface. The Interface commands enable or modify the operation of an interface.

In this mode, a physical port is set up for a specific logical connection operation. The Interface Config mode provides access to the router interface configuration commands. The command prompt at this level is:

```
Command Prompt: (Hirschmann Product)(Interface
<slot/port>)#
```

The resulting prompt for the interface configuration command entered in the Global Configuration mode is shown below:

```
(Hirschmann Product)(Config)# interface 2/1
(Hirschmann Product)(Interface 2/1)#
```

Line Config Mode

This mode allows the operator to configure the console interface. The operator may configure the interface from the directly connected console or the virtual terminal used with Telnet. The command prompt at this level is:

```
Command Prompt: (Hirschmann Product)(Line)#
```

Router RIP Config Mode:

In this mode, the operator is allowed to access the router RIP configuration commands. The command prompt at this level is:

```
(Hirschmann Product)(Config)# router rip
Command Prompt: (Hirschmann Prodct)(Config router)#
```

MAC Access-List Config Mode

Use the MAC Access-List Config mode to create a MAC Access-List and to enter the mode containing Mac Access-List configuration commands.

```
(Hirschmann Product)(Config)# mac-access-list
extended <name>
```

```
Command Prompt: (Hirschmann Product)(Config mac-
access-list)#
```

3.3 Flow of Operation

This section captures the flow of operation for the CLI:

- The operator logs into the CLI session and enters the User Exec mode. In the User Exec mode the `(Hirschmann Product)`(exec)> prompt is displayed on the screen.

The parsing process is initiated whenever the operator types a command and presses <ENTER>. The command tree is searched for the command of interest. If the command is not found, the output message indicates where the offending entry begins. For instance, command node A has the command `"show spanning-tree"` but the operator attempts to execute the command `"show arpp brief"` then the output message would be `(Hirschmann Product)(exec)> show sspanning-tree^.` `(Hirschmann Product)%Invalid input detected at '^' marker`. If the operator has given an invalid input parameter in the command, then the message conveys to the operator an invalid input was detected. The layout of the output is depicted below:

```
(Hirschmann Product)(exec) #show sspanning-tree
                                              ^
(Hirschmann Product)Invalid input detected at '^' marker.
```

Fig. 2: Syntax Error Message

After all the mandatory parameters are entered, any additional parameters entered are treated as optional parameters. If any of the parameters are not recognized a syntax error message will be displayed.

- After the command is successfully parsed and validated, the control of execution goes to the corresponding CLI callback function.

- For mandatory parameters, the command tree extends till the mandatory parameters make the leaf of the branch. The callback function is only invoked when all the mandatory parameters are provided. For optional parameters, the command tree extends till the mandatory parameters and the optional parameters make the leaf of the branch. However, the call back function is associated with the node where the mandatory parameters are fetched. The call back function then takes care of the optional parameters.
- Once the control has reached the callback function, the callback function has complete information about the parameters entered by the operator.

3.4 “No” Form of a Command

“No” is a specific form of an existing command and does not represent a new or distinct command. Only the configuration commands are available in the “no” form. The behavior and the support details of the “no” form is captured as part of the mapping sheets.

3.4.1 Support for “No” Form

Almost every configuration command has a “no” form. In general, use the no form to reverse the action of a command or reset a value back to the default. For example, the `no shutdown interface` configuration command reverses the shutdown of an interface. Use the command without the keyword ”no“ to re-enable a disabled feature or to enable a feature that is disabled by default.

3.4.2 Behavior of Command Help ("?")

The “no” form is treated as a specific form of an existing command and does not represent a new or distinct command. However, the behavior of the “?” and help text differ for the “no” form (the help message shows only options that apply to the “no” form).

- The help message is the same for all forms of the command. The help string may be augmented with details about the “no” form behavior.
- For the (`no interface`?) and (`no inte`?) cases of the “?”, the options displayed are identical to the case when the “no” token is not specified as in (`interface`) and (`inte`?).

4 CLI Commands: Base

This chapter provides detailed explanation of the Switching commands. The commands are divided into five functional groups:

- Show commands display switch settings, statistics, and other information.
- Configuration commands configure features and options of the switch. For every configuration command, there is a show command that displays the configuration setting.
- Copy commands transfer or save configuration and informational files to and from the switch.
- Clear commands clear
  - some
    (e.g. the ”clear arp-table-switch” command which clears the agent´s ARP table) or
  - all
    (e.g. the ”clear config” command which resets the whole configuration to the factory defaults

This chapter includes the following configuration types:

- System information and statistics commands
- Management commands
- Device configuration commands
- User account management commands
- Security commands
- System utilities
- Link Layer Discovery Protocol Commands
- Simple Network Time Protocol Commands
- Precision Time Protocol Commands
- Power over Ethernet Commands

4.1 System Information and Statistics

4.1.1 show

This command displays the interface's configuration.

Format

```
show [all]
```

Mode

```
Interface Config
```

all

Show all the running configuration parameters on this interface. The configuration parameters will be displayed even if their value is the default value.

4.1.2 show address-conflict

This command displays address-conflict settings.

Format

```
show address-conflict
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.3 show arp switch

This command displays the Address Resolution Protocol cache of the switch.

Format

```
show arp switch
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.4 show bridge address-learning

This command displays the address-learning setting.
The setting can be enable or disable.

Format

```
show bridge address-learning
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.5 show bridge address-relearn-detect

This command displays the Bridge Address Relearn Detection setting and the Bridge Address Relearn Threshold.

Format

```
show bridge address-relearn-detect
```

Mode

```
Privileged EXEC and User EXEC
```

Bridge Address Relearn Detection

Setting can be enable or disable.

Bridge Address Relearn Threshold

The threshold can be 1 to 1024.

4.1.6 show bridge aging-time

This command displays the timeout for address aging.

Format

```
show bridge aging-time
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.7 show bridge duplex-mismatch-detect

This command displays the Bridge Duplex Mismatch Detection setting (Enabled or Disabled).

Format

```
show bridge duplex-mismatch-detect
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.8 show bridge fast-link-detection

This command displays the Bridge Fast Link Detection setting.

Format

```
show bridge fast-link-detection
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.9 show bridge framesize

This command displays the maximum size of frame (packet size) setting.

Format

```
show bridge framesize
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.10 show bridge vlan-learning

This command displays the bridge vlan-learning mode.

Format

`show bridge vlan-learning`

Mode

`Privileged EXEC and User EXEC`

4.1.11 bridge framesize

Activation of long frames. Configure 1522 or 1632[1)] as maximum size of frame (packet size).

Default

`1522`

Format

`bridge framesize { 1522 | 1632`[1)] `| 9022`[2)] `}`

Mode

`Global Config`

bridge framesize 1522

Configure 1522 as maximum size of frame (packet size).

bridge framesize 1632 [1)]

Configure 1632 [1)] as maximum size of frame (packet size).

[1)] On MACH4000, MACH100, MACH1000 and PowerMICE: `1552`

4.1.12 show config-watchdog

Activating the watchdog enables you to return automatically to the last configuration after a set time period has elapsed. This gives you back your access to the Switch.

Format

```
show config-watchdog
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.13 show device-status

The signal device status is for displaying

- the monitoring functions of the switch,
- the device status trap setting.

Format

```
show device-status
[monitor|state|trap]
```

Mode

```
Privileged EXEC and User EXEC
```

Device status monitor

Displays the possible monitored events and which of them are monitored:
– the detected failure of at least one of the supply voltages.
– the removal of the ACA

– the removal of a media module
– the temperature limits
– the defective link status of at least one port. With the switch, the indication of link status can be masked by the management for each port. Link status is not monitored in the delivery condition.
– the loss of Redundancy guarantee.
Ring/network coupling:
– The following conditions are reported in Stand-by mode:
– interrupted control line
– partner device running in Stand-by mode.
HIPER-Ring:
– The following condition is reported in RM mode additionally:
– Ring redundancy guaranteed. Ring redundancy is not monitored in the delivery condition.

Device status state

`Error` The current device status is error.

`No Error` The current device status is no error.

Device status trap

`enabled` A trap is sent if the device status changes.

`disabled` No trap is sent if the device status changes.

4.1.14 show authentication

This command displays users assigned to authentication login lists.

Format

```
show authentication [users <listname>]
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.15 show eventlog

This command displays the event log, which contains error messages from the system. The event log is not cleared on a system reset.

Format

```
show eventlog
```

Mode

```
Privileged EXEC and User EXEC
```

File

The file in which the event originated.

Line

The line number of the event

Task Id

The task ID of the event.

Code

The event code.

Time

The time this event occurred.

Note: Event log information is retained across a switch reset.

4.1.16 show interface

This command displays a summary of statistics for a specific port or a count of all CPU traffic based upon the argument.

Format

```
show interface {<slot/port> |
                ethernet{<slot/port>|switchport} |
                switchport}
```

Mode

```
Privileged EXEC and User EXEC
```

The display parameters, when the argument is ' <slot/port>', is as follows :

Packets Received Without Error

The total number of packets (including broadcast packets and multicast packets) received by the processor.

Packets Received With Error

The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.

Broadcast Packets Received

The total number of packets received that were directed to the broadcast address. Note that this does not include multicast packets.

Packets Transmitted Without Error

The total number of packets transmitted out of the interface.

Transmit Packets Errors

The number of outbound packets that could not be transmitted because of errors.

Collisions Frames

The best estimate of the total number of collisions on this Ethernet segment.

Time Since Counters Last Cleared

The elapsed time, in days, hours, minutes, and seconds since the statistics for this port were last cleared.

The display parameters, when the argument is 'switchport', is as follows :

Packets Received Without Error

The total number of packets (including broadcast packets and multicast packets) received by the processor.

Broadcast Packets Received

The total number of packets received that were directed to the broadcast address. Note that this does not include multicast packets.

Packets Received With Error

The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.

Packets Transmitted Without Error

The total number of packets transmitted out of the interface.

Broadcast Packets Transmitted

The total number of packets that higher-level protocols requested to be transmitted to the Broadcast address, including those that were discarded or not sent.

Transmit Packet Errors

The number of outbound packets that could not be transmitted because of errors.

Address Entries Currently In Use

The total number of Forwarding Database Address Table entries now active on the switch, including learned and static entries.

VLAN Entries Currently In Use

The number of VLAN entries presently occupying the VLAN table.

Time Since Counters Last Cleared

The elapsed time, in days, hours, minutes, and seconds since the statistics for this switch were last cleared.

4.1.17 show interface ethernet

This command displays detailed statistics for a specific port or for all CPU traffic based upon the argument.

Format

```
show interface ethernet {<slot/port> | switchport}
```

Mode

```
Privileged EXEC and User EXEC
```

The display parameters, when the argument is '<slot/port>', are as follows :

Packets Received

Octets Received - The total number of octets of data (including those in bad packets) received on the network (excluding framing bits but including Frame Check Sequence (FCS) octets). This object can be used as a reasonable estimate of ethernet utilization. If greater precision is desired, the etherStatsPkts and etherStatsOctets objects should be sampled before and after a common interval. ----- The result of this equation is the value Utilization which is the percent utilization of the ethernet segment on a scale of 0 to 100 percent.

Packets Received < 64 Octets - The total number of packets (including bad packets) received that were < 64 octets in length (excluding framing bits but including FCS octets).

Packets Received 64 Octets - The total number of packets (including bad packets) received that were 64 octets in length (excluding framing bits but including FCS octets).

Packets Received 65-127 Octets - The total number of packets (including bad packets) received that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Received 128-255 Octets - The total number of packets (including bad packets) received that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Received 256-511 Octets - The total number of packets (including bad packets) received that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Received 512-1023 Octets - The total number of packets (including bad packets) received that were between 512 and 1023

octets in length inclusive (excluding framing bits but including FCS octets).

Packets Received 1024-1518 Octets - The total number of packets (including bad packets) received that were between 1024 and 1518 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Received 1519-1522 Octets - The total number of packets (including bad packets) received that were between 1519 and 1522 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Received > 1522 Octets - The total number of packets received that were longer than 1522 octets (excluding framing bits, but including FCS octets) and were otherwise well formed.

Packets Received Successfully

Total - The total number of packets received that were without errors.

Unicast Packets Received - The number of subnetwork-unicast packets delivered to a higher-layer protocol.

Multicast Packets Received - The total number of good packets received that were directed to a multicast address. Note that this number does not include packets directed to the broadcast address.

Broadcast Packets Received - The total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.

Packets Received with MAC Errors

Total - The total number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.

Jabbers Received - The total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error). Note that this definition of jabber is different than the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition where any packet exceeds 20 ms. The allowed range to detect jabber is between 20 ms and 150 ms.

Fragments/Undersize Received - The total number of packets received that were less than 64 octets in length (excluding framing bits but including FCS octets).

Alignment Errors - The total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had a bad Frame Check Sequence (FCS) with a non-integral number of octets.

Rx FCS Errors - The total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had a bad Frame Check Sequence (FCS) with an integral number of octets

Overruns - The total number of frames discarded as this port was overloaded with incoming packets, and could not keep up with the inflow.

Received Packets not forwarded

Total - A count of valid frames received which were discarded (i.e. filtered) by the forwarding process.

Local Traffic Frames - The total number of frames dropped in the forwarding process because the destination address was located off of this port.

802.3x Pause Frames Received - A count of MAC Control frames received on this interface with an opcode indicating the PAUSE operation. This counter does not increment when the interface is operating in half-duplex mode.

Unacceptable Frame Type - The number of frames discarded from this port due to being an unacceptable frame type.

VLAN Membership Mismatch - The number of frames discarded on this port due to ingress filtering.

VLAN Viable Discards - The number of frames discarded on this port when a lookup on a particular VLAN occurs while that entry in the VLAN table is being modified, or if the VLAN has not been configured.

Multicast Tree Viable Discards - The number of frames discarded when a lookup in the multicast tree for a VLAN occurs while that tree is being modified.

Reserved Address Discards - The number of frames discarded that are destined to an IEEE 802.1 reserved address and are not supported by the system.

Broadcast Storm Recovery - The number of frames discarded that are destined for FF:FF:FF:FF:FF:FF when Broadcast Storm Recovery is enabled.

CFI Discards - The number of frames discarded that have CFI bit set and the addresses in RIF are in non-canonical format.

Upstream Threshold - The number of frames discarded due to lack of cell descriptors available for that packet's priority level.

Packets Transmitted Octets

Total Bytes - The total number of octets of data (including those in bad packets) transmitted into the network (excluding framing bits but including FCS octets). This object can be used as a reasonable estimate of ethernet utilization. If greater precision is desired, the etherStatsPkts and etherStatsOctets objects should be sampled before and after a common interval. -----

Packets Transmitted 64 Octets - The total number of packets (including bad packets) transmitted that were 64 octets in length (excluding framing bits but including FCS octets).

Packets Transmitted 65-127 Octets - The total number of packets (including bad packets) transmitted that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Transmitted 128-255 Octets - The total number of packets (including bad packets) transmitted that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Transmitted 256-511 Octets - The total number of packets (including bad packets) transmitted that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Transmitted 512-1023 Octets - The total number of packets (including bad packets) transmitted that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Transmitted 1024-1518 Octets - The total number of packets (including bad packets) transmitted that were between 1024 and 1518 octets in length inclusive (excluding framing bits but including FCS octets).

Packets Transmitted 1519-1522 Octets - The total number of packets (including bad packets) transmitted that were between 1519 and 1522 octets in length inclusive (excluding framing bits but including FCS octets).

Max Info - The maximum size of the Info (non-MAC) field that this port will receive or transmit.

Packets Transmitted Successfully

Total - The number of frames that have been transmitted by this port to its segment.

Unicast Packets Transmitted - The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.

Multicast Packets Transmitted - The total number of packets that higher-level protocols requested be transmitted to a Multicast address, including those that were discarded or not sent.

Broadcast Packets Transmitted - The total number of packets that higher-level protocols requested be transmitted to the Broadcast address, including those that were discarded or not sent.

Transmit Errors

Total Errors - The sum of Single, Multiple, and Excessive Collisions.

Tx FCS Errors - The total number of packets transmitted that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had a bad Frame Check Sequence (FCS) with an integral number of octets

Oversized - The total number of frames that exceeded the max permitted frame size. This counter has a max increment rate of 815 counts per sec. at 10 Mb/s.

Underrun Errors - The total number of frames discarded because the transmit FIFO buffer became empty during frame transmission.

Transmit Discards

Total Discards - The sum of single collision frames discarded, multiple collision frames discarded, and excessive frames discarded.

Single Collision Frames - A count of the number of successfully transmitted frames on a particular interface for which transmission is inhibited by exactly one collision.

Multiple Collision Frames - A count of the number of successfully transmitted frames on a particular interface for which transmission is inhibited by more than one collision.

Excessive Collisions - A count of frames for which transmission on a particular interface is discontinued due to excessive collisions.

Port Membership - The number of frames discarded on egress for this port due to egress filtering being enabled.

VLAN Viable Discards - The number of frames discarded on this port when a lookup on a particular VLAN occurs while that entry in the VLAN table is being modified, or if the VLAN has not been configured.

Protocol Statistics

BPDUs received - The count of BPDUs (Bridge Protocol Data Units) received in the spanning tree layer.

BPDUs Transmitted - The count of BPDUs (Bridge Protocol Data Units) transmitted from the spanning tree layer.

802.3x Pause Frames Received - A count of MAC Control frames received on this interface with an opcode indicating the PAUSE operation. This counter does not increment when the interface is operating in half-duplex mode.

GVRP PDU's Received - The count of GVRP PDU's received in the GARP layer.

GMRP PDU's received - The count of GMRP PDU's received in the GARP layer.

GMRP PDU's Transmitted - The count of GMRP PDU's transmitted from the GARP layer.

GMRP Failed Registrations - The number of times attempted GMRP registrations could not be completed.

STP BPDUs Transmitted - Spanning Tree Protocol Bridge Protocol Data Units sent

STP BPDUs Received - Spanning Tree Protocol Bridge Protocol Data Units received

RST BPDUs Transmitted - Rapid Spanning Tree Protocol Bridge Protocol Data Units sent

RSTP BPDUs Received - Rapid Spanning Tree Protocol Bridge Protocol Data Units received

MSTP BPDUs Transmitted - Multiple Spanning Tree Protocol Bridge Protocol Data Units sent

MSTP BPDUs Received - Multiple Spanning Tree Protocol Bridge Protocol Data Units received

Dot1x Statistics

EAPOL Frames Received- The number of valid EAPOL frames of any type that have been received by this authenticator.

EAPOL Frames Transmitted - The number of EAPOL frames of any type that have been transmitted by this authenticator.

Time Since Counters Last Cleared

The elapsed time, in days, hours, minutes, and seconds since the statistics for this port were last cleared.

The display parameters, when the argument is ‘switchport, are as follows :

Octets Received - The total number of octets of data received by the processor (excluding framing bits but including FCS octets).

Total Packets Received Without Error- The total number of packets (including broadcast packets and multicast packets) received by the processor.

Unicast Packets Received - The number of subnetwork-unicast packets delivered to a higher-layer protocol.

Multicast Packets Received - The total number of packets received that were directed to a multicast address. Note that this number does not include packets directed to the broadcast address.

Broadcast Packets Received - The total number of packets received that were directed to the broadcast address. Note that this does not include multicast packets.

Receive Packets Discarded - The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. A possible reason for discarding a packet could be to free up buffer space.

Octets Transmitted - The total number of octets transmitted out of the interface, including framing characters.

Packets Transmitted without Errors - The total number of packets transmitted out of the interface.

Unicast Packets Transmitted - The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.

Multicast Packets Transmitted - The total number of packets that higher-level protocols requested be transmitted to a Multicast address, including those that were discarded or not sent.

Broadcast Packets Transmitted - The total number of packets that higher-level protocols requested be transmitted to the Broadcast address, including those that were discarded or not sent.

Transmit Packets Discarded - The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. A possible reason for discarding a packet could be to free up buffer space.

Most Address Entries Ever Used - The highest number of Forwarding Database Address Table entries that have been learned by this switch since the most recent reboot.

Address Entries in Use - The number of Learned and static entries in the Forwarding Database Address Table for this switch.

Maximum VLAN Entries - The maximum number of Virtual LANs (VLANs) allowed on this switch.

Most VLAN Entries Ever Used - The largest number of VLANs that have been active on this switch since the last reboot.

Static VLAN Entries - The number of presently active VLAN entries on this switch that have been created statically.

Dynamic VLAN Entries - The number of presently active VLAN entries on this switch that have been created by GVRP registration.

VLAN Deletes - The number of VLANs on this switch that have been created and then deleted since the last reboot.

Time Since Counters Last Cleared

The elapsed time, in days, hours, minutes, and seconds, since the statistics for this switch were last cleared.

4.1.18 show interface switchport

This command displays data concerning the internal port to the management agent.

Format

```
show interface switchport
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.19 show interface utilization

This command displays the utilization statistics for the entire device.

Format

`show interface utilization`

Mode

`Global Config`

Interface

Display port number in `<slot/port>` notation.

Utilization

Display the utilization on this port.
Possible values: `0..100.00%`

Lower threshold

Display the lower threshold setting for the utilization statistics on this port.
Possible values: `0..100.00%`

Upper threshold

Display the upper threshold setting for the utilization statistics on this port.
Possible values: `0..100.00%`

Alarm condition

Display the alarm condition setting for the utilization statistics on this port.
Possible values: `true`, `false`

4.1.20 show logging

This command displays the trap log maintained by the switch. The trap log contains a maximum of 256 entries that wrap.

Format

```
show logging [buffered | hosts | traplogs |
snmp-requests]
```

Mode

```
Privileged EXEC and User EXEC
```

buffered

Display buffered (in-memory) log entries.

hosts

Display logging hosts.

traplogs

Display trap records.

snmp-requests

Display logging SNMP requests and severity level.

4.1.21 show mac-address-conflict

This command displays the mac-address-conflict configuration.

Format

`show mac-address-conflict`

Mode

`Privileged EXEC and User EXEC`

MAC Address Conflict Detection

The status of the mac-address-conflict configuration.

MAC Address Conflict Detection Operation

Possible values: `enabled`, `disabled`
Default value: `enabled`
The meanings of the values are:
enabled MAC Address Conflict Detection enabled.
The device sends a trap if it detects a packet with its own MAC address in the network.
disabled MAC Address Conflict Detection disabled.
The device disclaims sending a trap if it detects a packet with its own MAC address in the network.

4.1.22 show mac-addr-table

This command displays the forwarding database entries. If the command is entered with no parameter, the entire table is displayed. This is the same as entering the optional *all* parameter. Alternatively, the administrator can enter a MAC Address to display the table entry for the requested MAC address and all entries following the requested MAC address.

Note: This command displays only learned unicast addresses. For other addresses use the command show mac-filter-table.
See “show mac-filter-table gmrp” on page 246.

Format

```
show mac-addr-table [<macaddr> <1-4042> | all]
```

Mode

```
Privileged EXEC and User EXEC
```

Mac Address

A unicast MAC address for which the switch has forwarding and or filtering information. The format is 6 or 8 two-digit hexadecimal numbers that are separated by colons, for example 01:23:45:67:89:AB.

Slot/Port

The port which this address was learned.

if Index

This object indicates the ifIndex of the interface table entry associated with this port.

Status

The status of this entry. The meanings of the values are:

Learned The value of the corresponding instance was learned by observing the source MAC addresses of incoming traffic, and is currently in use.

Management The value of the corresponding instance (system MAC address) is also the value of an existing instance of dot1dStaticAddress.

4.1.23 show signal-contact

The signal contact is for displaying

- the manual setting and the current state of the signal contact,
- the monitoring functions of the switch,
- the signal-contacts trap setting.

Format

```
show signal-contact
  [1|2|all [mode|monitor|state|trap]]
```

Mode

`Privileged EXEC and User EXEC`

Signal contact mode

`Auto` The signal contact monitors the functions of the switch which makes it possible to perform remote diagnostics.
A break in contact is reported via the zero-potential signal contact (relay contact, closed circuit).

`Device Status` The signal contact monitors the device-status.

`Manual` This command gives you the option of remote switching the signal contact.

Signal contact monitor

Displays the possible monitored events and which of them are monitored:
– the detected failure of at least one of the supply voltages.
– the removal of the ACA
– the removal of a media module
– the temperature limits
– the defective link status of at least one port. With the switch, the indication of link status can be masked by the management for each port. Link status is not monitored in the delivery condition.
– the loss of Redundancy guarantee.
Ring/network coupling:
– The following conditions are reported in Stand-by mode:
– interrupted control line
– partner device running in Stand-by mode.
HIPER-Ring:
– The following condition is reported in RM mode additionally:
– Ring redundancy guaranteed. Ring redundancy is not monitored in the delivery condition.

Signal contact manual setting

`closed` The signal contact´s manual setting is closed.

`open` The signal contact´s manual setting is open.

Signal contact operating state

`closed` The signal contact is currently closed.

`open` The signal contact is currently open.

Signal contact trap

`enabled` A trap is sent if the signal contact state changes.

`disabled` No trap is sent if the signal contact state changes.

Note: To show the signal contact´s port related settings, use the command show port {<slot/port> | all} (see “show port” on page 254).

4.1.24 show slot

This command is used to display information about slot(s).
For `[slot]` enter the slot ID.

Format

`show slot [slot]`

Mode

`Privileged EXEC`, `Global Config`

Slot

Display the number of the media module slot.

Status

`Full` The media module slot is equipped with a module.
`Empty` The media module slot is not equipped.

Admin State

Note: This feature is available for MS20/MS30, PowerMICE, MACH102 and MACH4000 devices.
`Enable` The media module slot is logically enabled.
`Disable` The media module slot is logically disabled.

Configured Card Model ID

Display the type of the media module.

Card Description

Display the type of the media module.

Product Code

Display the type of the media module.

Pluggable

`Yes` The module is pluggable.
`No` The module is not pluggable.

4.1.25 show running-config

This command is used to display the current setting of different protocol packages supported on the switch. This command displays only those parameters, the values of which differ from default value. The output is displayed in the script format, which can be used to configure another switch with the same configuration.

Format

```
show running-config [all | <scriptname>]
```

Mode

```
Privileged EXEC
```

all

Show all the running configuration on the switch. All configuration parameters will be output even if their value is the default value.

<scriptname>

Script file name for writing active configuration.
Note: Make sure that the file extension is cli, that the file name does not exceed 16 characters, does not start with a dot (.) and does not contain a directory.

4.1.26 show sysinfo

Use this command to display system information for the device, including system-up time.

Format

```
show sysinfo
```

Mode

```
Privileged EXEC and User EXEC
```

Device Status

Displays the latest status for this device.

Alarms

Displays the latest present Alarm for a signal contact.

System Description

Text used to identify this switch.

System Name

Name used to identify the switch.

System Location

Text used to identify the location of the switch. May be up to 31 alpha-numeric characters. The factory default is blank.

System Contact

Text used to identify a contact person for this switch. May be up to 31 alpha-numeric characters. The factory default is blank.

System UpTime

The time in days, hours and minutes since the last switch reboot.

System Date and Time

The system clock´s date and time in local time zone.

System IP Address

The system´s IP address.

Boot Software Release

The boot code´s version number.

Boot Software Build Date

The boot code´s build date.

Operating system Software Release

The operating system´s software version number.

Operating system Software Build Date
The operating system´s software build date.

Running Software Release
The operating system´s software version number.

Running Software Build Date
The operating system´s software build date.

Stored Software Release
The stored operating system´s software version number.

Stored Software Build Date
The stored operating system´s software build date.

Backup Software Release
The backup operating system´s software version number.

Backup Software Build Date
The backup operating system´s software build date.

Backplane Hardware Revision
The hardware´s revision number.

Backplane Hardware Description
The hardware´s device description.

Serial Number (Backplane)
The hardware´s serial number.

Base MAC Address (Backplane)
The hardware´s base MAC address.

Number of MAC Addresses (Backplane)
The number of hardware MAC addresses.

Configuration state
The state of the actual configuration.

Configuration signature
The signature (watermark) of the stored configuration. The signature changes each time the configuration is saved.

Auto Config Adapter, State
The Auto Configuration Adapter's state.

Auto Config Adapter, Serial Number

The Auto Configuration Adapter's serial number (if present and operative).

Factory Hardware Description

The product code (factory hardware description) of the device, e.g. MAR1020-99TTTTMMMMTTTTTTTTTTTTTTTTUC9HPHH

Fan Status

The status of the MACH4000 fan.

Power Supply Information

The status of the power supplies.

Media Module Information

The description of each media module
– Description: media module type,
– Serial Number of the media modul (if available),
SFP Information:
– SFP Part ID: SFP type (if available),
– SFP Serial No. of the SFP module (if available),
– SFP Supported: yes/no,
– SFP Temperature (°C, F),
– SFP Tx Pwr, SFP transmit power (dBm / mW),
– SFP Rx Pwr, SFP receive power (dBm / mW)

CPU Utilization

The utilization of the central processing unit.

Average CPU Utilization

The average utilization of the central processing unit.

Flashdisk

Free memory on flashdisk (in Kbytes).

4.1.27 show temperature

Note: The command is available for RS20/RS30/RS40, MS20/MS30, RSR20/RSR30, MACH100, MACH1000, PowerMICE, MACH4000 and OCTOPUS devices.

This command displays the lower and upper temperature limit for sending a trap.

Format

```
show temperature
```

Mode

```
Privileged EXEC and User EXEC
```

4.1.28 utilization alarm-threshold

Use this command to add the alarm threshold value for monitoring bandwidth utilization of the interface.

Format

```
utilization alarm-threshold
     {lower <0..10000> | upper <0..10000>}
```

Mode

```
Interface Config
```

lower

Enter lower utilization alarm threshold in the range of `0..10000` where `10000` represents 100%.

upper

Enter upper utilization alarm threshold in the range of `0..10000` where `10000` represents 100%.

4.2 Debug Commands

4.2.1 debug tcpdump help

Run diagnostics commands. With the TCP dump you run a packet analyzer for capturing network traffic.
This command displays the supported options and expressions for the tcpdump command.

Format

```
debug tcpdump help
```

Mode

```
Privileged EXEC
```

4.2.2 debug tcpdump start cpu

Run diagnostics commands. With the TCP dump you run a packet analyzer for capturing network traffic.
This command starts a capture on the CPU interface with the options and expressions in the <command> parameter.
Without the <command> parameter this command starts a capture on the CPU interface using default options and no explicit filtering.

Format

```
debug tcpdump start cpu <command>
```

Mode

```
Privileged EXEC
```

4.2.3 debug tcpdump start cpu filter

Run diagnostics commands. With the TCP dump you run a packet analyzer for capturing network traffic.
This command starts a capture on the CPU interface with the options and expressions in the filter file.

Format

```
debug tcpdump start cpu filter <capturefilter>
```

Mode

```
Privileged EXEC
```

4.2.4 debug tcpdump stop

Run diagnostics commands. With the TCP dump you run a packet analyzer for capturing network traffic.
This command stops a running capture on the CPU interface.

Format

```
debug tcpdump stop
```

Mode

```
Privileged EXEC
```

4.2.5 debug tcpdump filter show

Run diagnostics commands. With the TCP dump you run a packet analyzer for capturing network traffic.
This command shows a saved filter file stored in flash memory.

Format

```
debug tcpdump filter show <capturefilter>
```

Mode

```
Privileged EXEC
```

4.2.6 debug tcpdump filter list

Run diagnostics commands. With the TCP dump you run a packet analyzer for capturing network traffic.
This command lists all saved filter files stored in flash memory.

Format

```
debug tcpdump filter list
```

Mode

```
Privileged EXEC
```

4.2.7 debug tcpdump filter delete

Run diagnostics commands. With the TCP dump you run a packet analyzer for capturing network traffic.
This command removes a saved filter file from the flash memory.

Format

```
debug tcpdump filter delete <capturefilter>
```

Mode

```
Privileged EXEC
```

4.3 Management VLAN Commands

4.3.1 network mgmt_vlan

This command configures the Management VLAN ID. If you enter the VLAN ID “0” , the agent can be accessed by all VLANs.

Default

1

Format

```
network mgmt_vlan <0-4042>
```

Mode

```
Privileged EXEC
```

4.4 Class of Service (CoS) Commands

This chapter provides a detailed explanation of the QoS CoS commands. The following commands are available.

The commands are divided into these different groups:

- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Show commands are used to display device settings, statistics and other information.

Note: The 'Interface Config' mode only affects a single interface, whereas the 'Global Config' mode is applied to all interfaces.

4.4.1 classofservice dot1p-mapping

This command maps an 802.1p priority to an internal traffic class for a device when in ‘Global Config’ mode. The number of available traffic classes may vary with the platform. Userpriority and trafficclass can both be the range from 0-7. The command is only available on platforms that support priority to traffic class mapping on a ‘per-port’ basis, and the number of available traffic classes may vary with the platform.

Format

```
classofservice dot1p-mapping
       <userpriority> <trafficclass>
```

Mode

```
Global Config or Interface Config
```

userpriority

Enter the 802.1p priority (0-7).

trafficclass

Enter the traffic class to map the 802.1p priority (0-3).

no classofservice dot1p-mapping

This command restores the default mapping of the 802.1p priority to an internal traffic class.

Format

```
no classofservice dot1p-mapping
```

Modes

```
Global Config or Interface Config
```

4.4.2 classofservice ip-dscp-mapping

This command maps an IP DSCP value to an internal traffic class. The <ipdscp> value is specified as either an integer from 0 to 63, or symbolically through one of the following keywords: af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, be, cs0, cs1, cs2, cs3, cs4, cs5, cs6, cs7, ef.

Format

```
classofservice ip-dscp-mapping
                              <ipdscp> <trafficclass>
```

Mode

```
Global Config
```

ipdscp

Enter the IP DSCP value in the range of 0 to 63 or an IP DSCP keyword (af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, be, cs0, cs1, cs2, cs3, cs4, cs5, cs6, cs7, ef).

trafficclass

Enter the traffic class to map the 802.1p priority (0-3).

no classofservice ip-dscp-mapping

This command restores the default mapping of the IP DSCP value to an internal traffic class.

Format

```
no classofservice dot1p-mapping
```

Modes

```
Global Config
```

4.4.3 classofservice trust

This command sets the class of service trust mode of an interface. The mode can be set to trust one of the Dot1p (802.1p) or IP DSCP packet markings.

Note: In `trust ip-dscp` mode the switch modifies the vlan priority for outgoing frames according to
– the DSCP mapping and VLAN mapping table
(PowerMICE, MACH104, MACH1040, MACH4000)
– the fix mapping table
(see Reference Manual „GUI Graphical User Interface“ (Web-based Interface) for further details).

Format

```
classofservice trust dot1p | ip-dscp
```

Mode

`Global Config` or
`Interface Config`
(PowerMICE, MACH104, MACH1040, MACH4000)

no classofservice trust

This command sets the interface mode to untrusted, i.e. the packet priority marking is ignored and the default port priority is used instead.

Format

```
no classofservice trust
```

Modes

`Global Config` or
`Interface Config`
(PowerMICE, MACH104, MACH1040, MACH4000)

4.4.4 show classofservice dot1p-mapping

This command displays the current 802.1p priority mapping to internal traffic classes for a specific interface. The slot/port parameter is required on platforms that support priority to traffic class mapping on a ‘per-port’ basis.

Platforms that support priority to traffic class mapping on a per-port basis:

Format

```
show classofservice dot1p-mapping
```

Platforms that do not support priority to traffic class mapping on a per-port basis:

Format

```
Show classofservice dot1p-mapping
```

Mode

```
Privileged EXEC and User EXEC
```

4.4.5 show classofservice ip-dscp-mapping

This command displays the current IP DSCP mapping to internal traffic classes for the global configuration settings.

Format

```
show classofservice ip-dscp-mapping [<slot/port>]
```

Mode

```
Privileged EXEC
```

The following information is repeated for each user priority.

IP DSCP

The IP DSCP value.

Traffic Class

The traffic class internal queue identifier to which the IP DSCP value is mapped.

slot/port

Valid slot and port number separated by forward slashes.

4.4.6 show classofservice trust

This command displays the current trust mode for the specified interface. The slot/port parameter is optional. If specified, the trust mode of the interface is displayed. If omitted, the most recent global configuration settings are displayed.

Format

```
show classofservice trust [slot/port]
```

Mode

```
Privileged EXEC
```

Class of Service Trust Mode

The current trust mode: Dot1p, IP DSCP, or Untrusted.

Untrusted Traffic Class

The traffic class used for all untrusted traffic. This is only displayed when the COS trust mode is set to 'untrusted'.

slot/port

Valid slot and port number separated by forward slashes.

4.4.7 vlan port priority all

This command configures the port priority assigned for untagged packets for all ports presently plugged into the device. The range for the *priority* is 0..7. Any subsequent per port configuration will override this configuration setting.

Format

```
vlan port priority all <priority>
```

Mode

```
Global Config
```

4.4.8 vlan priority

This command configures the default 802.1p port priority assigned for untagged packets for a specific interface. The range for the *priority* is 0..7.

Default

0

Format

```
vlan priority <priority>
```

Mode

```
Interface Config
```

4.4.9 dvlan-tunnel ethertype

Note: This command is available for the RS20/RS30/RS40, RSB20, MS20/MS30, RSR20/RSR30, MACH100, MACH104, MACH1000, MACH1040,

MACH4002-24G/48G (XG), OCTOPUS, OS20/OS30 devices.

This command configures the ethertype for all core ports. The ethertype may have the values of 802.1q, vMAN or custom. The configured ethertype is used for VLAN classification on all ports which are configured as core ports.

Default

```
802.1Q
```

Format

```
dvlan-tunnel ethertype
                  {802.1Q | vman | custom <0-65535>}
```

Mode

```
Global Config
```

802.1Q

Configure the etherType as 0x8100.

custom

Custom configure the etherType for the DVlan tunnel.
Range for the optional value of the custom ethertype: 0 to 65535.

vman

Configure the etherType as 0x88A8.

4.4.10 mode dvlan-tunnel

Note: This command is available for the RS20/RS30/RS40, RSB20, MS20/MS30, RSR20/RSR30, MACH100, MACH104, MACH1000, MACH1040, MACH4002-24G/48G (XG), OCTOPUS, OS20/OS30 devices.

Use this command to configure the port either as core port or access port.

Default

```
Disabled
```

Format

```
mode dvlan-tunnel {access | core}
```

Mode

```
Interface Config
```

access

Configure this port as a customer port.

core

Configure this port as a provider network port.

no mode dvlan-tunnel

Use this command to configure the port as normal switch port and to disable the DVLAN tunneling.

Default

```
Disabled
```

Format

```
no mode dvlan-tunnel
```

Mode

```
Interface Config
```

4.4.11 show dvlan-tunnel

Note: This command is available for the RS20/RS30/RS40, RSB20, MS20/MS30, RSR20/RSR30, MACH100, MACH104, MACH1000, MACH1040, MACH4002-24G/48G (XG), OCTOPUS, OS20/OS30 devices.

Use this command to display the DVLAN-Tunnel mode and used ether-type for the specified interface(s).

Format

```
show dvlan-tunnel [interface {slot/port} | all]
```

Modes

```
Privileged EXEC
User EXEC
```

<slot/port>

Enter an interface in slot/port format.

all

Enter 'all' for all interfaces.

Interface

Display the number of the interface (slot/port).
Possible values (example): `1/1, 1/2, 2/1, 2/2, 2/3`.

Mode

Display the DVLAN-Tunnel mode.
Possible values: `normal`, ...

EtherType

Display the used ether-type.
Possible values: `802.1Q, vman, custom`.

4.5 Link Aggregation(802.3ad) Commands

4.5.1 link-aggregation staticcapability

This command enables the support of link-aggregations (static LAGs) on the device. By default, the static capability for all link-aggregations is disabled.

Default

disabled

Format

```
link-aggregation staticcapability
```

Mode

```
Global Config
```

- **no link-aggregation staticcapability**
  This command disables the support of static link-aggregations (LAGs) on the device.

Default

disabled

Format

```
no link-aggregation staticcapability
```

Mode

```
Global Config
```

4.5.2 show link-aggregation brief

This command displays the static capability of all link-aggregations (LAGs) on the device as well as a summary of individual link-aggregations.

Format

```
show link-aggregation brief
```

Mode

```
Privileged EXEC and User EXEC
```

Static Capability

This field displays whether or not the device has static capability enabled.

For each link-aggregation the following information is displayed:

Name

This field displays the name of the link-aggregation.

Link State

This field indicates whether the link is up or down.

Mbr Ports

This field lists the ports that are members of this link-aggregation, in <slot/port> notation.

Max. num. of LAGs

Displays the maximum number of concurrently configured link aggregations on this device.

Slot no. for LAGs

Displays the slot number for all configured link aggregations on this device.

4.6 Management Commands

These commands manage the switch and show current management settings.

4.6.1 telnet

This command establishes a new outbound telnet connection to a remote host. The host value must be a valid IP address. Valid values for port should be a valid decimal integer in the range of 0 to 65535, where the default value is `23`. If [debug] is used, the current telnet options enabled is displayed. The optional line parameter sets the outbound telnet operational mode as 'line-mode', where by default, the operational mode is 'character mode'. The echo option enables local echo and only takes effect when the local switch is accessed via the serial connection (V.24).

Format

```
telnet <host> <port> [debug] [line] [echo]
```

Mode

```
Privileged EXEC and User EXEC
```

4.6.2 transport input telnet

This command regulates new telnet sessions. If sessions are enabled, new telnet sessions can be established until there are no more sessions available. If sessions are disabled, no new telnet sessions are established. An established session remains active until the session is ended or an abnormal network error ends the session.

Default

enabled

Format

```
transport input telnet
```

Mode

```
Line Config
```

no transport input telnet

This command disables telnet sessions. If sessions are disabled, no new telnet sessions are established.

Format

```
no transport input telnet
```

Mode

```
Line Config
```

4.6.3 transport output telnet

This command regulates new outbound telnet connections. If enabled, new outbound telnet sessions can be established until it reaches the maximum number of simultaneous outbound telnet sessions allowed.
If disabled, no new outbound telnet session can be established. An established session remains active until the session is ended or an abnormal network error ends it.

Default

enabled

Format

```
transport output telnet
```

Mode

```
Line Config
```

no transport output telnet

This command disables new outbound telnet connections. If disabled, no new outbound telnet connection can be established.

Format

```
no transport output telnet
```

Mode

```
Line Config
```

4.6.4 session-limit

This command specifies the maximum number of simultaneous outbound telnet sessions. A value of 0 indicates that no outbound telnet session can be established.

Default

4

Format

`session-limit <0-5>`

Mode

`Line Config`

no session-limit

This command sets the maximum number of simultaneous outbound telnet sessions to the default value.

Format

`no session-limit`

Mode

`Line Config`

4.6.5 session-timeout

This command sets the telnet session timeout value.The timeout value unit of time is minutes.

Default

`5`

Format

`session-timeout <1-160>`

Mode

`Line Config`

no session-timeout

This command sets the telnet session timeout value to the default. The timeout value unit of time is minutes.

Format

`no session-timeout`

Mode

`Line Config`

4.6.6 bridge address-learning

To enable you to observe the data at all the ports, the Switch allows you to disable the learning of addresses. When the learning of addresses is disabled, the Switch transfers all the data from all ports to all ports. The default value is `enable`.

Format

`bridge address-learning {disable|enable}`

Mode

`Global Config`

4.6.7 bridge address-relearn detect operation

This command enables or disables Bridge Address Relearn Detection. The default value is `disable`.

Default

Disabled

Format

```
bridge address-relearn detect operation
{disable|enable}
```

Mode

`Global Config`

4.6.8 bridge address-relearn detect threshold

This command defines the value of relearned addresses to signal address relearn threshold exceeded.
The default relearn threshold is 1. Possible values to configure threshold count are `1` to `1024`.

Default

1

Format

```
bridge address-relearn-detect threshold <value>
```

Mode

`Global Config`

value

`1` to `1024`

4.6.9 bridge aging-time

This command configures the forwarding database address aging timeout in seconds.

Default

30

Format

`bridge aging-time <10-630>`

Mode

`Global Config`

Seconds

The <seconds> parameter must be within the range of 10 to 630 seconds.

no bridge aging-time

This command sets the forwarding database address aging timeout to 30 seconds.

Format

`no bridge aging-time`

Mode

`Global Config`

4.6.10 bridge fast-link-detection

This command enables or disables the Bridge Fast Link Detection.

Default

Enabled

Format

```
bridge fast-link-detection {disable|enable}
```

Mode

```
Global Config
```

4.6.11 bridge duplex-mismatch-detect operation

This command enables or disables Bridge Duplex Mismatch Detection.

Reasons for Duplex Mismatch can be:
- A local port is configured to fix full-duplex.
- A port is configured to auto-negotiation and has negotiated HalfDuplex-Mode.

Duplex Mismatch can be excluded, when the local port is configured to auto-negotiation and duplex mode is negotiated to full-duplex.

Note: If counters and configuration settings indicate a Duplex Mismatch, the reason can also be a bad cable and/or EMI.

Default

Enabled

Format

```
bridge duplex-mismatch-detect operation
{disable|enable}
```

Mode

```
Global Config
```

4.6.12 bridge vlan-learning

With ”independent” you set the Shared VLAN Learning mode to Independent. The switch will treat equal MAC source addresses from different VLANs as separate addresses.
With ”shared” you set the Shared VLAN Learning mode to Shared. The switch will treat equal MAC source addresses from different VLANs as the same adress.

Format

```
bridge vlan-learning {independent|shared}
```

Mode

```
Global Config
```

4.6.13 digital-input

This command configures the MICE IO-Module digital inputs.

Format

```
digital-input
  admin-state {enable | disable}
  refresh-interval <refresh-interval>
  log-event {all | <slot/input>} {enable|disable}
  snmp-trap {all | <slot/input>} {enable|disable}
```

Mode

```
Global Config
```

admin-state

This command enables or disables the polling task for digital inputs of the MICE IO-Module. When disabled, no event logging or SNMP traps will work. Default value: `disable`.

`disable` Disable the IO-Module digital inputs admin state.

`enable` Enable the IO-Module digital inputs admin state.

refresh-interval

This command configures the digital inputs refresh interval. Each input configured for event logging or SNMP traps is polled with this interval.

`<refresh-interval>` The refresh interval is in the range of 1..10 seconds. Default value: `1`.

log-event

This command enables or disables the event logging of input status changes for one or all digital inputs. Default value: `disable`.
The input state will be checked according to the interval set with IO-`<refresh-interval>`.

`all` Configure the IO-Module event logging for all digital inputs.

`<slot/input>` Configure the IO-Module event logging for a single digital input.

`disable` Disable event logging for digital input status changes.

`enable` Enable event logging for digital input status changes.

snmp-trap

This command enables or disables the sending of SNMP traps in case of input status changes for one or all digital inputs. Default value: `disable`.
The trap will be sent to all SNMP trap receivers configured with snmptrap.
The input state will be checked according to the interval set with IO-`<refresh-interval>`.

`all` Configure the IO-Module SNMP trap for all digital inputs.

`<slot/input>` Configure the IO-Module SNMP trap for a single digital input.

`disable` Disable SNMP traps for digital input status changes.

`enable` Enable SNMP traps for digital input status changes.

4.6.14 digital-output

This command configures the IO-Module digital outputs.

Format

```
digital-output
  admin-state {enable | disable}
  refresh-interval <refresh-interval>
  retry-count <refresh-interval>
  log-event {all | <slot/output>} {enable|disable}
  snmp-trap {all | <slot/output>} {enable|disable}
  mirror all | <slot>/<output> {disable |
                  from <IPaddress> <slot>/<input>}
```

Mode

`Global Config`

admin-state

This command enables or disables the polling task for digital outputs of the MICE IO-Module. When disabled, no event logging or SNMP traps will work. Default value: `disable`.

`disable` Disable the IO-Module digital outputs admin state.

`enable` Enable the IO-Module digital outputs admin state.

refresh-interval

This command configures the IO-Module digital outputs refresh interval. Each output configured for input mirroring is refreshed (input is polled) with this interval.

`<refresh-interval>` The refresh interval is in the range of 1..10 seconds. Default value: `1`.

retry-count

This command configures the number of retry counts for setting digital outputs of the MICE IO-Module. Each output configured for input mirroring is set to the default value (low) when after the number of configured retries no SNMP get request was answered.

`<refresh-interval>` The refresh interval is in the range of 1..10 seconds. Default value: `1`.

log-event

This command enables or disables the event logging of output status changes for one or all digital outputs. Default value: `disable`.
The output state will be checked according to the interval set with IO-

<refresh-interval>.
Configure the IO-Module event logging for one or all digital outputs.
all Configure the IO-Module event logging for all digital outputs.
<slot/output> Configure the IO-Module event logging for a single digital output.
disable Disable event logging for digital output status changes.
enable Enable event logging for digital output status changes.

snmp-trap

This command enables or disables the sending of SNMP traps in case of output status changes for one or all digital outputs. Default value: disable.
The trap will be sent to all SNMP trap receivers configured with snmptrap.
The output state will be checked according to the interval set with IO-<refresh-interval>.
all Configure the IO-Module SNMP trap for all digital outputs.
<slot/output> Configure the IO-Module SNMP trap for a single digital output.
disable Disable SNMP traps for digital output status changes.
enable Enable SNMP traps for digital output status changes.

mirror

Configure the IO-Module mirroring for one or all digital outputs.
This command determines the input mirrored to the currently selected output.
To disable mirroring, the following commands are equivalent:

```
digital-output mirror 1/2 disable
digital-output mirror 1/2 from 0.0.0.0 1/1
```

`<all>`: Configure the IO-Module mirroring for all digital outputs.

`<slot/output>`: Configure the IO-Module mirroring for a single digital output. The <slot> value determines the IO-module slot number on the device with the selected IP address.

`disable`: Disable the IO-Module mirroring for a single digital output.

`from`: Enable the IO-Module mirroring for a single digital output from <IP-address> <slot/input>

`<IPaddress>`: The IP address value determines the IP address used for reading the input value. Use IP address 127.0.0.1 or the system IP address to mirror inputs from a local IO module. When IP address is 0.0.0.0 no input is mirrored to the output (the output value is set to 'low'). Default value: `0.0.0.0`.

`<slot/input>`: The <input> value determines the input number on this device. Default value: `1/1`.

4.6.15 show digital-input

This command shows the input value or configuration from all available digital inputs of the MICE I/O Module.

Format

`show digital-input`

Mode

`Global Config`

Digital Input System Information:

Admin State

Show the IO-Module digital inputs Admin State.
Possible values: `Disabled, Enabled`.

Refresh Interval [s]

Show the IO-Module digital inputs Refresh Interval in seconds.
Value range: `1..10`.

Digital Input Information:

Input

Show numbers of the IO-Module digital input.
Possible values (example): `1/1, 1/2, 1/3, 1/4, 3/1, 3/2, 3/3, 3/4`

Value

Show the value of the IO-Module digital inputs.
Possible values: `Not available, High, Low`.

Log-Event

Show if Event logging is enabled or disabled for the IO-Module digital inputs.
Possible values: `Disabled, Enabled`.

SNMP-trap

Show if SNMP traps are enabled or disabled for the IO-Module digital inputs.
Possible values: `Disabled, Enabled`.

4.6.16 show digital-input config

This command shows the IO-Module digital inputs global configuration.

Format

```
show digital-input config
```

Mode

```
Global Config
```

Digital Input System Information:

Admin State

Show the IO-Module digital inputs Admin State.
Possible values: `Disabled, Enabled`.

Refresh Interval [s]

Show the IO-Module digital inputs Refresh Interval in seconds.
Value range: `1..10`.

4.6.17 show digital-input all

This command shows the IO-Module value or configuration for all inputs.

Format

```
show digital-input all {all | config | value}
```

Mode

```
Global Config
```

all

Show the IO-Module configuration and value for all inputs

config

Show the IO-Module configuration for all inputs.

value

Show the IO-Module value for all inputs.

Digital Input Information:

Input

Show numbers of the IO-Module digital input.
Possible values (example): `1/1, 1/2, 1/3, 1/4, 3/1, 3/2, 3/3, 3/4`

Value

Show the value of the IO-Module digital inputs.
Possible values: `Not available, High, Low`.

Log-Event

Show if Event logging is enabled or disabled for the IO-Module digital inputs. Possible values: `Disabled, Enabled`.

SNMP-trap

Show if SNMP traps are enabled or disabled for the IO-Module digital inputs. Possible values: `Disabled, Enabled`.

4.6.18 show digital-input <slot/input>

This command shows the IO-Module value or configuration for a single input.

Format

```
show digital-input <slot/input>
                                {all | config | value}
```

Mode

`Global Config`

all

Show the IO-Module configuration and value for one input.

config

Show the IO-Module configuration for one input.

value

Show the IO-Module value for one input.

Digital Input <slot/input> Value

Show the value of the IO-Module digital input.
Possible values: `Not available, High, Low`.

Digital Input <slot/input> Log-Event

Show if Event logging is enabled or disabled for the IO-Module digital input. Possible values: `Disabled, Enabled`.

Digital Input <slot/input> SNMP-trap

Show if SNMP traps are enabled or disabled for the IO-Module digital input. Possible values: `Disabled, Enabled`.

4.6.19 show digital-output

This command shows the output value or configuration from all available digital outputs of the MICE I/O Module.

Format

`show digital-output`

Mode

`Global Config`

Digital output System Information:

Admin State

Show the IO-Module digital outputs Admin State.
Possible values: `Disabled, Enabled`.

Refresh Interval [s]

Show the IO-Module digital outputs Refresh Interval in seconds.
Value range: `1..10`.

Retry Count

Show the value of the IO-Module digital outputs Retry count.
Value range: `1..10`.

Digital output Information:

Output

Show numbers of the IO-Module digital output.
Possible values (example): `1/1, 1/2, 1/3, 1/4, 3/1, 3/2, 3/3, 3/4`

Value

Show the value of the IO-Module digital outputs.
Possible values: `Not available, High, Low`.

Log-Event

Show if Event logging is enabled or disabled for the IO-Module digital outputs.
Possible values: `Disabled, Enabled`.

SNMP-trap

Show if SNMP traps are enabled or disabled for the IO-Module digital outputs.
Possible values: `Disabled, Enabled`.

Mirror from IP

Show the IP address used for reading the input value.
Possible values: `None, a.b.c.d` (valid IP address).

Input

Show the input number of the device used for reading the input value.
Possible values (example): `1/1, 1/2, 1/3, 1/4, 3/1, 3/2, 3/3, 3/4`

4.6.20 show digital-output config

This command shows the IO-Module digital outputs global configuration.

Format

```
show digital-output config
```

Mode

```
Global Config
```

Digital output System Information:

Admin State

Show the IO-Module digital outputs Admin State.
Possible values: `Disabled, Enabled`.

Refresh Interval [s]

Show the IO-Module digital outputs Refresh Interval in seconds.
Value range: `1..10`.

Retry Count

Show the value of the IO-Module digital outputs Retry count.
Value range: `1..10`.

4.6.21 show digital-output all

This command shows the IO-Module value or configuration for all outputs.

Format

`show digital-output all {all | config | value}`

Mode

`Global Config`

all

Show the IO-Module configuration and value for all outputs

config

Show the IO-Module configuration for all outputs.

value

Show the IO-Module value for all outputs.

Digital output Information:

output

Show numbers of the IO-Module digital output.
Possible values (example): `1/1, 1/2, 1/3, 1/4, 3/1, 3/2, 3/3, 3/4`

Value

Show the value of the IO-Module digital outputs.
Possible values: `Not available, High, Low`.

Log-Event

Show if Event logging is enabled or disabled for the IO-Module digital outputs. Possible values: `Disabled, Enabled`.

SNMP-trap

Show if SNMP traps are enabled or disabled for the IO-Module digital outputs. Possible values: `Disabled, Enabled`.

Mirror from IP

Show the IP address used for reading the input value.
Possible values: `None, a.b.c.d` (valid IP address).

Input

Show the input number of the device used for reading the input value.
Possible values (example): 1`/1, 1/2, 1/3, 1/4, 3/1, 3/2, 3/3, 3/4`

4.6.22 show digital-output <slot/output>

This command shows the IO-Module value or configuration for a single output.

Format

```
show digital-output <slot/output>
                                {all | config | value}
```

Mode

`Global Config`

all

Show the IO-Module configuration and value for one output.

config

Show the IO-Module configuration for one output.

value

Show the IO-Module value for one output.

Digital output <slot/output> Value

Show the value of the IO-Module digital output.
Possible values: `Not available, High, Low, Invalid`.

Digital output <slot/output> Log-Event

Show if Event logging is enabled or disabled for the IO-Module digital output.
Possible values: `Disabled, Enabled`.

Digital output <slot/output> SNMP-trap

Show if SNMP traps are enabled or disabled for the IO-Module digital output.
Possible values: `Disabled, Enabled`.

Digital Output <slot/output> Mirror from IP

Show the IP address used for reading the input value.
Possible values: `Not configured, a.b.c.d` (valid IP address).

4.6.23 ethernet-ip

This command controls the EtherNet/IP function on the switch.
Detailed information you can find in the User Manual Industrial Protocols.

Default

depends on the order code (standard = disable)

Format

`ethernet-ip admin-state {enable | disable}`

Mode

`Global Config`

Admin-state

`disable:` Disables the EtherNet/IP function on this device.
Note: The relevant MIB objects are still accessible.
`enable:` Enables the EtherNet/IP function on this device.

4.6.24 network mgmt-access add

This command is used to configure the restricted management access feature (RMA).
It creates a new empty entry at the <index> (if you enter the command with parameter <index>) or at the next free index (if you enter the command without parameter <index>).

Format

```
network mgmt-access add [index]
```

Mode

```
Global Config
```

[index]

Index of the entry in the range 1..16.

4.6.25 network mgmt-access delete

This command is used to configure the restricted management access feature (RMA).
It deletes an existing entry with <index>.

Format

```
network mgmt-access delete <index>
```

Mode

```
Global Config
```

<index>

Index of the entry in the range 1..16.

4.6.26 network mgmt-access modify

This command is used to configure the restricted management access feature (RMA).
The command modifies an existing rule with <index> to change IP address, net mask and allowed services.

Format

```
network mgmt-access modify <index>
                        { ip <address> |
                          mask <netmask> |
                          http {enable | disable} |
                          https {enable | disable} |
                          snmp {enable | disable} |
                          telnet {enable | disable} |
                          ssh {enable |disable } }
```

Mode

Global Config

<index>

Index of the entry in the range 1..16.

<ip>

Configure IP address which should have access to management

<mask>

Configure network mask to allow a subnet for management access.

<http>

Configure if HTTP is allowed to have management access.

<https>

Configure if HTTPS is allowed to have management access.

<snmp>

Configure if SNMP is allowed to have management access.

<telnet>

Configure if TELNET is allowed to have management access.

<ssh>

Configure if SSH is allowed to have management access.

enable

Allow the service to have management access.

disable

Do not allow the service to have management access.

4.6.27 network mgmt-access operation

This command is used to configure the restricted management access feature (RMA).
It enables or disables the service to have management access. The default value is `disable`.

Format

```
network mgmt-access operation {disable|enable}
```

Mode

```
Global Config
```

enable

Enable the restricted management access function globally.

disable

Disable the restricted management access function globally.

4.6.28 network mgmt-access status

This command is used to configure the restricted management access feature (RMA).
It activates/deactivates an existing rule with `<index>`.

Format

```
network mgmt-access status <index>
                                    {enable | disable}
```

Mode

```
Global Config
```

<index>

Index of the entry in the range 1..16.

enable

Allow the service to have management access.

disable

Do not allow the service to have management access.

4.6.29 network parms

This command sets the IP Address, subnet mask and gateway of the router. The IP Address and the gateway must be on the same subnet.

Format

```
network parms <ipaddr> <netmask> [gateway]
```

Mode

```
Privileged EXEC
```

4.6.30 network protocol

This command specifies the network configuration protocol to be used.
If you modify this value, change is effective immediately after you saved your changes.
The parameter `bootp` indicates that the switch periodically sends requests to a Bootstrap Protocol (BootP) server or a DHCP server until a response is received.
`none` indicates that the switch should be manually configured with IP information.

Independently of the BootP and DHCP settings, HiDiscovery can be configured as an additional protocol.

Default

DHCP

Format

```
network protocol {none | bootp | dhcp | hidiscovery
{off | read-only | read-write}}
```

Mode

`Privileged EXEC`

4.6.31 network priority

This command configures the VLAN priority or the IP DSCP value for outgoing management packets. The <ipdscp> is specified as either an integer from 0-63, or symbolically through one of the following keywords: af11,af12,af13,af21,af22,af23,af31,af32,af33,af41,af42,af43,be,cs0, cs1, cs2,cs3,cs4,cs5,cs6,cs7,ef.

Default

0 for both values

Format

```
network priority {dot1p-vlan <0-7> |
ip-dscp <ipdscp> }
```

Mode

```
Privileged EXEC
```

no network priority

This command sets the VLAN priority or the IP DSCP value for outgoing management packets to default which means VLAN priority 0 or IP DSCP value 0 (Best effort).

Format

```
no network priority {dot1p-vlan | ip-dscp }
```

Mode

```
Privileged EXEC
```

4.6.32 profinetio

This command controls the PROFINET IO function on the switch.
Detailed information you can find in the User Manual Industrial Protocols.

Default

depends on the order code (standard = disable)

Format

`profinetio admin-state {enable | disable}`

Mode

`Global Config`

Admin-state

`disable` Disables the PROFINET IO function on this device.
Note: The relevant MIB objects are still accessible.

`enable` Enables the PROFINET IO function on this device.

4.6.33 serial timeout

This command specifies the maximum connect time (in minutes) without console activity. A value of 0 indicates that a console can be connected indefinitely. The time range is 0 to 160.

Default

5

Format

```
serial timeout <0-160>
```

Mode

```
Line Config
```

- **no serial timeout**
  This command sets the maximum connect time without console activity (in minutes) back to the default value.

Format

```
no serial timeout
```

Mode

```
Line Config
```

4.6.34 set prompt

This command changes the name of the prompt. The length of name may be up to 64 alphanumeric characters.

Format

```
set prompt <prompt string>
```

Mode

```
Privileged EXEC
```

4.6.35 show ethernet-ip

This command displays the admin state of the EtherNet/IP function.

Format

```
show ethernet-ip
```

Mode

```
Privileged EXEC and User EXEC
```

4.6.36 show network

This command displays configuration settings associated with the switch's network interface. The network interface is the logical interface used for in-band connectivity with the switch via any of the switch's front panel ports. The configuration parameters associated with the switch's network interface do not affect the configuration of the front panel ports through which traffic is switched or routed.

Format

```
show network
```

Mode

```
Privileged EXEC and User EXEC
```

System IP Address

The IP address of the interface. The factory default value is `0.0.0.0`

Subnet Mask

The IP subnet mask for this interface. The factory default value is `0.0.0.0`

Default Gateway

The default gateway for this IP interface. The factory default value is `0.0.0.0`

Burned In MAC Address

The burned in MAC address used for in-band connectivity.

Network Configuration Protocol (BootP/DHCP)

Indicates which network protocol is being used. Possible values: `bootp` | `dhcp` | `none`.

DHCP Client ID (same as SNMP System Name)

Displays the DHCP Client ID.

Network Configuration Protocol HiDiscovery

Indicates in which way the HiDiscovery protocol is being used. Possible values: `off` | `read-only` | `read-write`.

HiDiscovery Version

Indicates the supported HiDiscovery protocol version.
Possible values: `v1` | `v2`.

Management VLAN ID

Specifies the management VLAN ID.

Management VLAN Priority

Specifies the management VLAN Priority.

Management VLAN IP-DSCP Value

Specifies the management VLAN IP-DSCP value.

Web Mode

Specifies if the switch will use Java Script to start the Management Applet. The factory default is `Enable`.

4.6.37 show network mgmt-access

This command displays the operating status and entries for restricted management access (RMA).

Format

`show network mgmt-access`

Mode

`Privileged EXEC and User EXEC`

Operation

Indicates whether the operation for RMA is enabled or not.
Possible values: `Enabled` | `Disabled`.

ID

Index of the entry for restricted management access (`1` to max. `16`).

IP address

The IP address which should have access to management.
The factory default value is `0.0.0.0`.

Netmask

The network mask to allow a subnet for management access.
The factory default value is `0.0.0.0`.

HTTP

Indicates whether HTTP is allowed to have management access or not. Possible values: `Yes` | `No`.

HTTPS

Indicates whether HTTPS is allowed to have management access or not. Possible values: `Yes` | `No`.

SNMP

Indicates whether SNMP is allowed to have management access or not. Possible values: `Yes` | `No`.

TELNET

Indicates whether TELNET is allowed to have management access or not. Possible values: `Yes` | `No`.

SSH

Indicates whether SSH is allowed to have management access or not. Possible values: `Yes` | `No`.

Active

Indicates whether the feature is active or not.
Possible values: `[x]` | `[ ]`.

4.6.38 show profinetio

This command displays the admin state of the PROFINET IO function.

Format

```
show profinetio
```

Mode

```
Privileged EXEC and User EXEC
```

4.6.39 show serial

This command displays serial communication settings for the switch.

Format

```
show serial
```

Mode

```
Privileged EXEC and User EXEC
```

Serial Port Login Timeout (minutes)

Specifies the time, in minutes, of inactivity on a Serial port connection, after which the Switch will close the connection. Any numeric value between 0 and 160 is allowed, the factory default is 5. A value of 0 disables the timeout.

4.6.40 show snmp-access

This command displays SNMP access information related to global and SNMP version settings. SNMPv3 is always enabled.

Format

```
show snmp-access
```

Mode

```
Privileged EXEC
```

4.6.41 show snmpcommunity

This command displays SNMP community information. Six communities are supported. You can add, change, or delete communities. The switch does not have to be reset for changes to take effect.
The SNMP agent of the switch complies with SNMP Version 1 (for more about the SNMP specification, see the SNMP RFCs). The SNMP agent sends traps through TCP/IP to an external SNMP manager based on the SNMP configuration (the trap receiver and other SNMP community parameters).

Format

```
show snmpcommunity
```

Mode

```
Privileged EXEC
```

SNMP Community Name

The community string to which this entry grants access. A valid entry is a case-sensitive alphanumeric string of up to 32 characters. Each row of this table must contain a unique community name.

Client IP Address -

An IP address (or portion thereof) from which this device will accept SNMP packets with the associated community. The requesting entity's IP address is ANDed with the Subnet Mask before being compared to the IP Address. Note that if the Subnet Mask is set to 0.0.0.0, an IP Address of 0.0.0.0 matches all IP addresses. The default value is 0.0.0.0

Client IP Mask -

A mask to be ANDed with the requesting entity's IP address before comparison with IP Address. If the result matches with IP Address then the address is an authenticated IP address. For example, if the IP Address = 9.47.128.0 and the corresponding Subnet Mask = 255.255.255.0 a range of incoming IP addresses would match, i.e. the incoming IP Address could equal 9.47.128.0 - 9.47.128.255. The default value is 0.0.0.0

Access Mode

The access level for this community string.

Status

The status of this community access entry.

4.6.42 show snmp sync

This command displays the status of the synchronization between the SNMPv1/v2 community table and the SNMPv3 password table and reverse.

Format

```
show snmp sync
```

Mode

```
Privileged EXEC
```

V1/V2 community to V3 password

Display the status of the synchronization between the SNMPv1/v2 community table and the SNMPv3 password table.

Enabled - Synchronization enabled.

Disabled - Synchronization disabled.

V3 password to V1/V2 community

Display the status of the synchronization between the SNMPv3 password table and the SNMPv1/v2 community table.

Enabled - Synchronization enabled.

Disabled - Synchronization disabled.

4.6.43 show snmptrap

This command displays SNMP trap receivers. Trap messages are sent across a network to an SNMP Network Manager. These messages alert the manager to events occurring within the switch or on the network. Six trap receivers are simultaneously supported.

Format

```
show snmptrap
```

Mode

```
Privileged EXEC
```

SNMP Trap Name

The community string of the SNMP trap packet sent to the trap manager. This may be up to 32 alphanumeric characters. This string is case sensitive.

IP Address

The IP address to receive SNMP traps from this device. Enter four numbers between `0` and `255` separated by periods.

Status

A pull down menu that indicates the receiver's status (enabled or disabled) and allows the administrator/user to perform actions on this user entry:

Enable - send traps to the receiver

Disable - do not send traps to the receiver.

Delete - remove the table entry.

4.6.44 show telnet

This command displays outbound telnet settings.

Format

`show telnet`

Mode

`Privileged EXEC and User EXEC`

Outbound Telnet Connection Login Timeout (minutes)

This object indicates the number of minutes a remote connection session is allowed to remain inactive before being logged off. May be specified as a number from `1` to `160`. The factory default is `5`.

Maximum Number of Outbound Telnet Sessions

This object indicates the number of simultaneous outbound connection sessions allowed. The factory default is `5`.

Allow New Outbound Telnet Sessions

Indicates that new outbound telnet sessions will not be allowed when set to no. The factory default value is `yes`.

4.6.45 show telnetcon

This command displays inbound telnet settings.

Format

`show telnetcon`

Mode

`Privileged EXEC and User EXEC`

Telnet Connection Login Timeout (minutes)

This object indicates the number of minutes a remote connection session is allowed to remain inactive before being logged off. May be specified as a number from `1` to `160`. The factory default is `4`.

Maximum Number of Remote Telnet Sessions

This object indicates the number of simultaneous remote connection sessions allowed. The factory default is `2` (`4` for version L2P)

Allow New Telnet Sessions

Indicates that new telnet sessions will not be allowed when set to no. The factory default value is `yes`.

4.6.46 show trapflags

This command displays trap conditions. Configure which traps the switch should generate by enabling or disabling the trap condition. If a trap condition is enabled and the condition is detected, the switch's SNMP agent sends the trap to all enabled trap receivers. The switch does not have to be reset to implement the changes. Cold and warm start traps are always generated and cannot be disabled.

Format

```
show trapflags
```

Mode

```
Privileged EXEC and User EXEC
```

Authentication Flag

May be enabled or disabled. The factory default is enabled. Indicates whether authentication failure traps will be sent.

Chassis

Indicates whether traps that are related to the chassis functionality of the switch will be sent. These functions include the signal contacts, the ACA, temperature limits exceeded, changes in the module map, addition or removal of SFP modules, status of power supply has changed and the LLDP and SNTP features. May be enabled or disabled.
Default value: enabled.

Layer 2 Redundancy

Indicates whether traps that are related to the layer 2 redundancy features of the switch will be sent. The HiPER-Ring and the Redundant Coupling will tell you with these traps when the main line has become inoperative or returned. May be enabled or disabled.
Default value: enabled.

Link Up/Down Flag

May be enabled or disabled. The factory default is enabled. Indicates whether link status traps will be sent.

Multiple Users Flag

May be enabled or disabled. The factory default is enabled. Indicates whether a trap will be sent when the same user ID is logged into the switch more than once at the same time (either via telnet or serial port).

Port Security (MAC, IP and 802.1X)

Enable/disable sending port security event traps (for MAC/IP port security as well as for 802.1X).

Spanning Tree Flag

May be enabled or disabled. The factory default is enabled. Indicates whether spanning tree traps will be sent.

4.6.47 snmp-access global

This command configures the global SNMP access setting (for all SNMP versions).

Format

```
snmp-access global {disable|enable|read-only}
```

Mode

```
Global Config
```

disable

Disable SNMP access to this switch, regardless of the SNMP version used.

enable

Enable SNMP read and write access to this switch, regardless of the SNMP version used.

read-only

Enable SNMP read-only access to this switch (disable write access), regardless of the SNMP version used.

4.6.48 snmp-access version

This command configures the SNMP version specific access mode for SNMPv1 and SNMPv2.

Format

```
snmp-access version {all|v1|v2} {disable|enable}
```

Mode

```
Global Config
```

all

Enable or disable SNMP access by all protocol versions (v1 and v2).

v1

Enable or disable SNMP access by v1.

v2

Enable or disable SNMP access by v2.

4.6.49 snmp-access version v3-encryption

Use this command to activate/deactivate SNMPv3 data encryption.

Format

```
snmp-access version v3-encryption
          {readonly | readwrite} {enable | disable}
```

Mode

```
Global Config
```

disable

Disable SNMP access to this switch by SNMPv3 protocol version.

enable

Enable SNMP read and write access to this switch by SNMPv3 protocol version.

readonly

Enable SNMP read-only access to this switch (disable write access) by SNMPv33 protocol version.

readwrite

Enable SNMP read-write access to this switch (enable write access) by SNMPv3 protocol version.

4.6.50 snmp-server

This command sets the name and the physical location of the switch, and the organization responsible for the network.The range for *name*, *location* and *contact* is from 0 to 64 alphanumeric characters.

Default

None

Format

```
snmp-server
 {community <name> |
  ipaddr <ipaddr> <name> |
  ipmask <ipmask> <name> |
  mode <name> |
  ro <name> |
  rw <name> |
  contact <con> |
  enable traps { chassis | l2redundancy |
    linkmode | multiusers | port-sec | stpmode }
  location <loc> |
  sysname <name> }
```

Mode

```
Global Config
```

4.6.51 snmp-server community

This command adds a new SNMP community name. A community name is a name associated with the switch and with a set of SNMP managers that manage it with a specified privileged level. The length of name can be up to 32 case-sensitive characters.

Note: Community names in the SNMP community table must be unique. When making multiple entries using the same community name, the first entry is kept and processed and all duplicate entries are ignored.

Default

Two default community names: Public and Private. You can replace these default community names with unique identifiers for each community. The default values for the remaining four community names are blank.

Format

```
snmp-server community <name>
```

Mode

```
Global Config
```

no snmp-server community

This command removes this community name from the table. The name is the community name to be deleted.

Format

```
no snmp-server community <name>
```

Mode

```
Global Config
```

4.6.52 snmp-server contact

This command adds a new SNMP server contact.

Format

```
snmp-server contact <con>
```

Mode

```
Global Config
```

con

Enter system contact up to 63 characters in length.
If the name contains spaces, enclose it in quotation marks (").

no snmp-server contact

This command removes this SNMP server contact from the table.
<con> is the SNMP server contact to be deleted.

Format

```
no snmp-server contact <con>
```

Mode

```
Global Config
```

4.6.53 snmp-server community ipaddr

This command sets a client IP address for an SNMP community. The address is the associated community SNMP packet sending address and is used along with the client IP mask value to denote a range of IP addresses from which SNMP clients may use that community to access the device. A value of 0.0.0.0 allows access from any IP address. Otherwise, this value is ANDed with the mask to determine the range of allowed client IP addresses. The name is the applicable community name.

Default

0.0.0.0

Format

```
snmp-server community ipaddr <ipaddr> <name>
```

Mode

```
Global Config
```

no snmp-server community ipaddr

This command sets a client IP address for an SNMP community to 0.0.0.0. The name is the applicable community name.

Format

```
no snmp-server community ipaddr <name>
```

Mode

```
Global Config
```

4.6.54 snmp-server community ipmask

This command sets a client IP mask for an SNMP community. The address is the associated community SNMP packet sending address and is used along with the client IP address value to denote a range of IP addresses from which SNMP clients may use that community to access the device. A value of 255.255.255.255 will allow access from only one station, and will use that machine's IP address for the client IP Address. A value of 0.0.0.0 will allow access from any IP address. The name is the applicable community name.

Default

0.0.0.0

Format

```
snmp-server community ipmask <ipmask> <name>
```

Mode

```
Global Config
```

no snmp-server community ipmask

This command sets a client IP mask for an SNMP community to 0.0.0.0. The name is the applicable community name. The community name may be up to 32 alphanumeric characters.

Format

```
no snmp-server community ipmask <name>
```

Mode

```
Global Config
```

4.6.55 snmp-server community mode

This command activates an SNMP community. If a community is enabled, an SNMP manager associated with this community manages the switch according to its access right. If the community is disabled, no SNMP requests using this community are accepted. In this case the SNMP manager associated with this community cannot manage the switch until the Status is changed back to Enable.

Default

The default private and public communities are enabled by default. The four undefined communities are disabled by default.

Format

```
snmp-server community mode <name>
```

Mode

```
Global Config
```

no snmp-server community mode

This command deactivates an SNMP community. If the community is disabled, no SNMP requests using this community are accepted. In this case the SNMP manager associated with this community cannot manage the switch until the Status is changed back to Enable.

Format

```
no snmp-server community mode <name>
```

Mode

```
Global Config
```

4.6.56 snmp-server community ro

This command restricts access to switch information. The access mode is read-only (also called public).

Format

```
snmp-server community ro <name>
```

Mode

```
Global Config
```

4.6.57 snmp-server community rw

This command restricts access to switch information. The access mode is read/write (also called private).

Format

```
snmp-server community rw <name>
```

Mode

```
Global Config
```

4.6.58 snmp-server location

This command configures the system location.

Format

```
snmp-server location <system location>
```

Mode

```
Global Config
```

4.6.59 snmp-server sysname

This command configures the system name.

Format

```
snmp-server sysname <system name>
```

Mode

```
Global Config
```

4.6.60 snmp-server enable traps

This command enables the Authentication Trap Flag.

Default

enabled

Format

```
snmp-server enable traps
```

Mode

```
Global Config
```

no snmp-server enable traps

This command disables the Authentication Trap Flag.

Format

```
no snmp-server enable traps
```

Mode

```
Global Config
```

4.6.61 snmp-server enable traps chassis

Configures whether traps that are related to the chassis functionality of the switch will be sent. These functions include the signal contacts, the ACA, temperature limits exceeded, changes in the module map, addition or removal of SFP modules, status of power supply has changed and the LLDP and SNTP features. May be enabled or disabled.
Default value: enabled.

Default

enabled

Format

```
snmp-server enable traps chassis
```

Mode

```
Global Config
```

no snmp-server enable traps chassis

This command disables chassis traps for the entire switch.

Format

```
no snmp-server enable traps chassis
```

Mode

```
Global Config
```

4.6.62 snmp-server enable traps l2redundancy

Indicates whether traps that are related to the layer 2 redundancy features of the switch will be sent. The HiPER-Ring and the Redundant Coupling will tell you with these traps when the main line has become inoperative or returned. May be enabled or disabled.
Default value: enabled.

Default

enabled

Format

```
snmp-server enable traps l2redundancy
```

Mode

```
Global Config
```

- **no snmp-server enable traps l2redundancy**
  This command disables layer 2 redundancy traps for the entire switch.

Format

```
no snmp-server enable traps l2redundancy
```

Mode

```
Global Config
```

4.6.63 snmp-server enable traps linkmode

This command enables Link Up/Down traps for the entire switch. When enabled, link traps are sent only if the Link Trap flag setting associated with the port is enabled (see ‘snmp trap link-status’ command).

Default

enabled

Format

```
snmp-server enable traps linkmode
```

Mode

```
Global Config
```

no snmp-server enable traps linkmode

This command disables Link Up/Down traps for the entire switch.

Format

```
no snmp-server enable traps linkmode
```

Mode

```
Global Config
```

4.6.64 snmp-server enable traps multiusers

This command enables Multiple User traps. When the traps are enabled, a Multiple User Trap is sent when a user logs in to the terminal interface (EIA 232 (serial port) or telnet) and there is an existing terminal interface session.

Default

enabled

Format

```
snmp-server enable traps multiusers
```

Mode

```
Global Config
```

no snmp-server enable traps multiusers

This command disables Multiple User traps.

Format

```
no snmp-server enable traps multiusers
```

Mode

```
Global Config
```

4.6.65 snmp-server enable traps port-sec

This command enables port security traps. When the traps are enabled, a Port Security Trap is sent if a port security event occurs (applies to MAC/IP Port Security as well as to 802.1X Port Security).

Default

enabled

Format

```
snmp-server enable traps port-sec
```

Mode

```
Global Config
```

no snmp-server enable traps port-sec

This command disables Port Security traps.

Format

```
no snmp-server enable traps port-sec
```

Mode

```
Global Config
```

4.6.66 snmp-server enable traps stpmode

This command enables the sending of new root traps and topology change notification traps.

Default

enabled

Format

```
snmp-server enable traps stpmode
```

Mode

```
Global Config
```

- **no snmp-server enable traps stpmode**
  This command disables the sending of new root traps and topology change notification traps.

Format

```
no snmp-server enable traps stpmode
```

Mode

```
Global Config
```

4.6.67 snmptrap

This command adds an SNMP trap name. The maximum length of name is 32 case-sensitive alphanumeric characters.

Default

The default name for the six undefined community names is Delete.

Format

```
snmptrap <name> <ipaddr> [snmpversion snmpv1]
```

Mode

```
Global Config
```

no snmptrap

This command deletes trap receivers for a community.

Format

```
no snmptrap <name> <ipaddr>
```

Mode

```
Global Config
```

4.6.68 snmptrap ipaddr

This command assigns an IP address to a specified community name. The maximum length of name is 32 case-sensitive alphanumeric characters.

Note: IP addresses in the SNMP trap receiver table must be unique. If you make multiple entries using the same IP address, the first entry is retained and processed. All duplicate entries are ignored.

Format

```
snmptrap ipaddr <name> <ipaddr> <ipaddrnew>
```

Mode

```
Global Config
```

ipaddr

Enter the old IP Address.

ipaddrnew

Enter the new IP Address.

4.6.69 snmptrap mode

This command activates or deactivates an SNMP trap. Enabled trap receivers are active (able to receive traps). Disabled trap receivers are inactive (not able to receive traps).

Format

```
snmptrap mode <name> <ipaddr>
```

Mode

```
Global Config
```

no snmptrap mode

This command deactivates an SNMP trap. Disabled trap receivers are inactive (not able to receive traps).

Format

```
no snmptrap mode <name> <ipaddr>
```

Mode

```
Global Config
```

4.6.70 snmptrap snmpversion

This command configures SNMP trap version for a specified community.

Format

```
snmptrap snmpversion <name> <ipAddr>
 {snmpv1 | snmpv2}
```

Mode

```
Global Config
```

name

Enter the community name.

ipAaddr

Enter the IP Address.

snmpv1

Use SNMP v1 to send traps.

snmpv2

Use SNMP v2 to send traps.

4.6.71 telnetcon maxsessions

Configure the number of remote telnet connections allowed.

Default

5

Format

```
telnetcon maxsessions <0-5>
```

Mode

```
Privileged EXEC
```

no telnetcon maxsessions

This command sets the maximum number of telnet connection sessions that can be established to the default value.

Format

```
no telnetcon maxsessions
```

Mode

```
Privileged EXEC
```

4.6.72 telnetcon timeout

This command sets the telnet connection session timeout value, in minutes. A session is active as long as the session has not been idle for the value set. The time is a decimal value from 1 to 160.

Default

5

Format

```
telnetcon timeout <1-160>
```

Mode

```
Privileged EXEC
```

no telnetcon timeout

This command sets the telnet connection session timeout value to the default.

Changing the timeout value for active sessions does not become effective until the session is reaccessed. Also, any keystroke activates the new timeout duration.

Format

```
no telnetcon timeout
```

Mode

```
Privileged EXEC
```

4.7 Syslog Commands

This section provides a detailed explanation of the Syslog commands. The commands are divided into two functional groups:

- Show commands display spanning tree settings, statistics, and other information.
- Configuration Commands configure features and options of the device. For every configuration command there is a show command that displays the configuration setting.

4.7.1 logging buffered

This command enables logging to an in-memory log where up to 128 logs are kept.

Default

`enabled`

Format

`logging buffered`

Mode

`Global Config`

no logging buffered

This command disables logging to in-memory log.

Format

`no logging buffered`

4.7.2 logging buffered wrap

This command enables wrapping of in-memory logging when full capacity reached. Otherwise when full capacity is reached, logging stops.

Default

`wrap`

Format

`logging buffered wrap`

Mode

`Privileged EXEC`

no logging buffered wrap

This command disables wrapping of in-memory logging and configures logging to stop when capacity is full.

Format

`no logging buffered wrap`

4.7.3 logging cli-command

This command enables the CLI command Logging feature. The Command Logging component enables the switch software to log all Command Line Interface (CLI) commands issued on the system.

Default

```
disabled
```

Format

```
logging cli-command
```

Mode

```
Global Config
```

no logging cli-command

This command disables the CLI command Logging feature.

Format

```
no logging cli-command
```

4.7.4 logging console

This command enables logging to the console. The <severitylevel> value is specified as either an integer from 0 to 7 or symbolically through one of the following keywords: emergency (0), alert (1), critical (2), error (3), warning (4), notice (5), informational (6), debug (7).

Default

```
disabled; alert
```

Format

```
logging console [severitylevel] | <[0-7]>
```

Mode

```
Global Config
```

severitylevel | [0-7]

Enter Logging Severity Level (emergency|0, alert|1, critical|2, error|3, warning|4, notice|5, info|6, debug|7).
Note: Selecting a lower severity level (larger number) will include all messages from higher severity levels (smaller numbers).
Possible severity levels: see Table 15

no logging console

This command disables logging to the console.

Format

```
no logging console
```

4.7.5 logging host

This command enables logging to a host where up to eight hosts can be configured.

Default

```
Port – 514; Level – Critical;
```

Format

```
logging host <hostaddress>
 [<port> [<severitylevel>]]
```

Mode

```
Global Config
```

Severity number	Severity name	Meaning
0	emergency	Minimum severity to be logged is 0. This is the highest level and will result in all other messages of lower levels not being logged.
1	alert	Minimum severity to be logged is 1.
2	critical	Minimum severity to be logged is 2.
3	error	Minimum severity to be logged is 3.
4	warning	Minimum severity to be logged is 4.
5	notice	Minimum severity to be logged is 5.
6	info	Minimum severity to be logged is 6.
7	debug	Minimum severity to be logged is 7. This is the lowest level and will result in messages of all levels being logged.

Tab. 15: Possible severity levels

4.7.6 logging host reconfigure

The Logging Host Index for which to change the IP Address.

Format

```
logging host reconfigure <hostindex> <hostaddress>
```

Mode

```
Global Config
```

4.7.7 logging host remove

The Logging Host Index to be removed.

Format

```
logging host remove <hostindex>
```

Mode

```
Global Config
```

4.7.8 logging snmp-requests get operation

This command enables or disables the logging of SNMP GET requests.

Default

```
Disabled
```

Format

```
logging snmp-requests get operation
  { enable | disable }
```

Mode

```
Global Config
```

4.7.9 logging snmp-requests set operation

This command enables or disables the logging of SNMP SET requests.

Default

`Disabled`

Format

```
logging snmp-requests set operation
  { enable | disable }
```

Mode

`Global Config`

4.7.10 logging snmp-requests get severity

With this command you can define the severity level of logging SNMP GET requests.

Default

`Disabled`

Format

```
logging snmp-requests get severity <level|[0-7]>
```

Mode

`Global Config`

level | [0-7]

Enter Logging Severity Level (`emergency|0, alert|1, critical|2, error|3, warning|4, notice|5, info|6, debug|7`).

Note: Selecting a lower severity level (larger number) will include all messages from higher severity levels (smaller numbers).

4.7.11 logging snmp-requests set severity

With this command you can define the severity level of logging SNMP SET requests.

Default

`Disabled`

Format

`logging snmp-requests set severity <level|[0-7]>`

Mode

`Global Config`

level | [0-7]

Enter Logging Severity Level (`emergency|0, alert|1, critical|2, error|3, warning|4, notice|5, info|6, debug|7`).

Note: Selecting a lower severity level (larger number) will include all messages from higher severity levels (smaller numbers).

4.7.12 logging syslog

This command enables syslog logging.

Default

`disabled`

Format

`logging syslog`

Mode

`Global Config`

no logging syslog

This command disables syslog logging.

Format

`no logging syslog`

4.7.13 logging syslog port

Enter the port number of the syslog server.

Default

`514`

Format

`logging syslog port <portid>`

Mode

`Global Config`

4.8 Scripting Commands

Configuration Scripting allows the user to generate text-formatted script files representing the current configuration. These configuration script files can be uploaded to a PC and edited, downloaded to the system and applied to the system. Configuration scripts can be applied to one or more switches with no/minor modifications.

Use the show running-config command to capture the running configuration into a script. Use the copy command to transfer the configuration script to and from the switch.

Scripts are intended to be used on systems with default configuration but users are not prevented from applying scripts on systems with non-default configurations.

Note:
- The file extension must be ".cli".
- A maximum of ten scripts are allowed on the switch.
- The combined size of all script files on the switch shall not exceed 1024 KB.

4.8.1 script apply

This command applies the commands in the script to the switch. We recommend that the system have default configurations but users are not prevented from applying scripts on systems with non-default configurations. The <scriptname> parameter is the name of the script to apply.

Format

```
script apply <scriptname>
```

Mode

```
Privileged EXEC
```

4.8.2 script delete

This command deletes a specified script where the <scriptname> parameter is the name of the script to be deleted. The ‘all’ option deletes all the scripts present on the switch.

Format

```
script delete {<scriptname> | all}
```

Mode

```
Privileged EXEC
```

4.8.3 script list

This command lists all scripts present on the switch as well as the remaining available space.

Format

```
script list [aca]
```

Mode

```
Privileged EXEC
```

Configuration Script

Name of the script.
Without the optional ACA parameter: Listing of the scripts in the switch´s flash memory.
With the optional ACA parameter: Listing of the scripts on the external ACA 21-USB.

Size

Size of the script.

4.8.4 script show

This command displays the contents of a script file. The parameter <script-name> is the name of the script file.

Format

```
script show <scriptname>
```

Mode

```
Privileged EXEC
```

The format of display is
`Line <no>: <Line contents>`

4.8.5 script validate

This command validates a script file by parsing each line in the script file where <scriptname> is the name of the script to validate.The validate option is intended to be used as a tool for script development.
Validation helps to identify potential errors concerning a script on the device.

Format

```
script validate <scriptname>
```

Mode

```
Privileged EXEC
```

4.9 Device Configuration Commands

4.9.1 addport

This command adds one port to the Link Aggregation (LAG). The given interface is a logical slot and port number of a configured Link Aggregation.

Note: Before adding a port to a Link Aggregation, set the physical mode of the port. See ‘speed’ command.

Format

addport <logical slot/port>

Mode

Interface Config

4.9.2 adminmode

This command enables the whole Link Aggregation as one single port.

Note: Before adding a port to a Link Aggregation, set the physical mode of the port. See ‘speed’ command.

Format

```
adminmode
```

Mode

```
Interface Config
```

no adminmode

This command disables the whole Link Aggregation as one single port.

Format

```
no adminmode
```

Mode

```
Interface Config
```

4.9.3 auto-disable reason

This command enables the port disabling on this device by reason.

Default

```
Disabled
```

Format

```
auto-disable reason {link-flap | crc-error |
overload-detection | speed-duplex | port-security}
```

Mode

```
Global Config
```

link-flap

Enable the port disabling on this device by link flap.

crc-error

Enable the port disabling on this device by CRC error.

overload-detection

Enable the port disabling on this device by overload detection.

speed-duplex

Enable the port disabling on this device by speed-duplex.

port-security

Enable the port disabling on this device by port-security.

no auto-disable reason

This command disables the port disabling on this device by reason.

Default

```
Disabled
```

Format

```
no auto-disable reason {link-flap | crc-error |
                overload-detection | speed-duplex}
```

Mode

```
Global Config
```

link-flap

Disable the port disabling on this device by link flap.

crc-error

Disable the port disabling on this device by CRC error.

overload-detection

Disable the port disabling on this device by overload detection.

port-security

Disable the port disabling on this device by port-security.

speed-duplex

Disable the port disabling on this device by speed-duplex.

4.9.4 auto-disable reset

Use this command to reset the specific interface and reactivate the port.

Format

```
auto-disable reset
```

Mode

```
Interface Config
```

4.9.5 auto-disable timer

This command defines the time after which a deactivated port is activated again.

Default

```
0
```

Format

```
auto-disable timer {0 | 30..2147483}
```

Mode

```
Interface Config
```

{0 | 30..2147483}

Timer value in seconds after a deactivated port is activated again.
Possible values:
`0` The value `0` disables the timer.
`30..2147483`.

4.9.6 auto-negotiate

This command enables automatic negotiation on a port. The default value is `enable`.

Format

```
auto-negotiate
```

Mode

```
Interface Config
```

no auto-negotiate

This command disables automatic negotiation on a port.

Format

```
no auto-negotiate
```

Mode

```
Interface Config
```

4.9.7 auto-negotiate all

This command enables automatic negotiation on all ports.
The default value is `enable`.

Format

```
auto-negotiate all
```

Mode

```
Global Config
```

- **no auto-negotiate all**
  This command disables automatic negotiation on all ports.

Format

```
no auto-negotiate all
```

Mode

```
Global Config
```

4.9.8 cable-crossing

Note: This function is available for the RS20/RS30/RS40, MS20/MS30, RSR20/RSR30, MACH1000, PowerMICE and OCTOPUS devices.

Use this command to enable or disable the cable crossing function.

Note: The `cable-crossing` settings become effective for a certain port, if `auto-negotiate` is disabled for this port.
The `cable-crossing` settings are irrelevant for a certain port, if `auto-negotiate` is enabled for this port.

Format

`cable-crossing {enable|disable}`

Mode

`Interface Config`

cable-crossing enable

The device swaps the port output and port input of the TP port.

cable-crossing disable

The device does not swap the port output and port input of the TP port.

4.9.9 media-module

Use this command to logically configure media modules.

Default

```
media-module enable all
```

Format

```
media-module { remove <1-7> |
               enable { <1-7> | all } |
               disable { <1-7> | all } }
```

Mode

```
Global Config
```

remove

Logically remove a media-module that has already been physically removed.

<1-7>

Enter the number of a media module that has already been physically removed but is logically still present in the configuration.

enable

Enable a media-module slot.

<1-7>

Enter the number of the media module to be enabled.

all

Enable all media modules on the device.

disable

Disable a media-module slot.

<1-7>

Enter the number of the media module to be disabled.

all

Disable all media modules on the device.

4.9.10 deleteport

This command deletes the port from the link-aggregation (LAG). The interface is a logical slot and port number of a configured link aggregation.

Note: This command has to be issued in the member port's interface config mode.

Format

```
deleteport <logical slot/port>
```

Mode

```
Interface Config
```

4.9.11 deleteport all

This command deletes all configured ports from the link-aggregation (LAG). The interface is a logical slot and port number of a configured link-aggregation.

Format

```
deleteport <logical slot/port> all
```

Mode

```
Global Config
```

4.9.12 dip-switch operation

Note: This command is available for the MICE, PowerMICE and RS20/RS30/RS40 devices.

Use this command to enable/disable the DIP switch configuration.

Default

```
disabled
```

Format

```
dip-switch operation { enable | disable }
```

Mode

```
Global Config
```

enable

Enable the DIP switch configuration.

disable

Disable the DIP switch configuration.
The device ignores DIP switch settings.

4.9.13 macfilter

This command adds a static MAC filter entry for the MAC address <macaddr> on the VLAN <vlanid>. The <macaddr> parameter must be specified as a 6-byte hexadecimal number in the format of b1:b2:b3:b4:b5:b6.

The restricted MAC Addresses are: 00:00:00:00:00:00, 01:80:C2:00:00:00 to 01:80:C2:00:00:0F, 01:80:C2:00:00:20 to 01:80:C2:00:00:21, and FF:FF:FF:FF:FF:FF.

The <vlanid> parameter must identify a valid VLAN (1 to 4042).

Up to 100 static MAC filters may be created.

Format

```
macfilter <macaddr> <vlanid>
```

Mode

```
Global Config
```

no macfilter

This command removes all filtering restrictions and the static MAC filter entry for the MAC address <macaddr> on the VLAN <vlanid>. The <macaddr> parameter must be specified as a 6-byte hexadecimal number in the format of b1:b2:b3:b4:b5:b6.

The <vlanid> parameter must identify a valid VLAN (1 to 4042).

Format

```
no macfilter <macaddr> <vlanid>
```

Mode

```
Global Config
```

4.9.14 macfilter adddest

This command adds the interface to the destination filter set for the MAC filter with the given <macaddr> and VLAN of <vlanid>. The <macaddr> parameter must be specified as a 6-byte hexadecimal number in the format of b1:b2:b3:b4:b5:b6.
The <vlanid> parameter must identify a valid VLAN (1-4042).

Format

```
macfilter adddest <macaddr> <vlanid>
```

Mode

```
Interface Config
```

no macfilter adddest

This command removes a port from the destination filter set for the MAC filter with the given <macaddr> and VLAN of <vlanid>. The <macaddr> parameter must be specified as a 6-byte hexadecimal number in the format of b1:b2:b3:b4:b5:b6.

The <vlanid> parameter must identify a valid VLAN (1-4042).

Format

```
no macfilter adddest <macaddr> <vlanid>
```

Mode

```
Interface Config
```

4.9.15 macfilter adddest all

This command adds all interfaces to the destination filter set for the MAC filter with the given <macaddr> and VLAN of <vlanid>. The <macaddr> parameter must be specified as a 6-byte hexadecimal number in the format of b1:b2:b3:b4:b5:b6.

The <vlanid> parameter must identify a valid VLAN (1 to 4042).

Format

```
macfilter adddest {all | <macaddr> <vlanid>}
```

Mode

```
Global Config
```

no macfilter adddest all

This command removes all ports from the destination filter set for the MAC filter with the given <macaddr> and VLAN of <vlanid>. The <macaddr> parameter must be specified as a 6-byte hexadecimal number in the format of b1:b2:b3:b4:b5:b6.

The <vlanid> parameter must identify a valid VLAN (1 to 4042).

Format

```
no macfilter adddest [all | <macaddr> <vlanid>}
```

Mode

```
Global Config
```

4.9.16 mac notification (Global Config)

Use this command to change the settings for MAC address change notification globally on the device. This command enables the sending of MAC notification traps or sets the MAC notification interval in seconds.

Format

```
mac notification {operation |
                 interval <0..2147483647> }
```

Mode

Global Config

operation

Enable sending of MAC notification traps.

interval

Set the MAC notification interval.

<0..2147483647>

MAC notification interval in seconds.

no mac notification operation

This command disables sending of MAC notification traps globally.

Format

```
no mac notification operation
```

Mode

Global Config

4.9.17 mac notification (Interface Config)

Use this command to change the settings for MAC address change notification for one port. This command enables MAC notification for this port or sets the mode for which action the device sends a MAC notification.

Format

```
mac notification {operation |
                  mode { add | remove | all } }
```

Mode

```
Interface Config
```

operation

Enable sending of MAC notification traps.

mode

Set the mode for which action the device sends a MAC notification.

add

The device sends MAC notification traps when entries are added to the FDB.

remove

The device sends MAC notification traps when entries are removed from the FDB.

all

The device sends MAC notification traps when entries are changed in the FDB.

no mac notification operation

This command disables sending of MAC notification traps for this port.

Format

```
no mac notification operation
```

Mode

```
Interface Config
```

4.9.18 monitor session <session-id>

This command configures a probe port and a monitored port for monitor session (port monitoring). The first slot/port is the source monitored port and the second slot/port is the destination probe port. If this command is executed while port monitoring is enabled, it will have the effect of changing the probe and monitored port values.

Format

```
monitor session <session-id>
 [ mode |
   source interface <slot/port>
              [direction { rx | tx | tx/rx } ] |
   destination interface <slot/port> ]
```

Mode

`Global Config`

session-id

Session number (currently, session number 1 is supported).

mode

Enable/Disable port mirroring session.
Note: does not affect the source or destination interfaces.

source interface <slot/port>

Configure the source interface (in `slot/port` notation).

direction

Configure the direction of the interface.´

rx

Configure the direction of the interface as rx (receive).

tx

Configure the direction of the interface as tx (transmit).

rx/tx

Configure the direction of the interface as rx/tx (receive and transmit).

destination interface <slot/port>

Configure the probe interface (in `slot/port` notation).

- **no monitor session<session-id>**
  This command removes the monitor session (port monitoring) designation from both the source probe port and the destination monitored portand removes the probe port from all VLANs. The port must be manually re-added to any desired VLANs.

Format

```
no monitor session <session-id> [mode]
```

Mode

```
Global Config
```

session-id

Session number (currently, session number 1 is supported).

4.9.19 monitor session <session-id> mode

This command configures the monitor session (port monitoring) mode to enable. The probe and monitored ports must be configured before monitor session (port monitoring) can be enabled. If enabled, the probe port will monitor all traffic received and transmitted on the physical monitored port. It is not necessary to disable port monitoring before modifying the probe and monitored ports.

Default

`disabled`

Format

`monitor session <session-id> mode`

Mode

`Global Config`

session-id

Session number (currently, session number 1 is supported).

no monitor session <session-id> mode

This command sets the monitor session (port monitoring) mode to disable.

Format

`no monitor session <session-id> mode`

Mode

`Global Config`

session-id

Session number (currently, session number 1 is supported).

4.9.20 monitor session <session-id> source/ destination

This command allows you to configure and activate the port mirroring function of the switch. Port mirroring is when the data traffic of a source port is copied to a specified destination port. The data traffic at the source port is not influenced by port mirroring. A management tool connected at the specified port, e.g., an RMON probe, can thus monitor the data traffic of the source port.
This command can be called multiple times with different ports to add more than one source port to the session.
It is possible to add/remove ports to/from an active session.

Note:
- The device supports a maximum of one session.
- The maximum number of source ports is 8.
- Ports configured as mirror source or destination ports have to be physical ports.

Note: In active port mirroring, the specified destination port is used solely for observation purposes.

Default

```
none
```

Format

```
monitor session <session-id> {source | destination}
interface <slot/port>
```

Mode

```
Global Config
```

session-id

Session number (currently, session number 1 is supported).

- **no monitor session <session-id> source/destination**
  This command resets the monitor session (port monitoring) source/destination. The port will be removed from port mirroring

Format

```
no monitor session <session-id> {source | destination} interface
```

Mode

```
Global Config
```

session-id

Session number (currently, session number 1 is supported).

4.9.21 link-aggregation

This command configures a new Link Aggregation (LAG) and generates a logical slot/port number for the Link Aggregation. Display this number using the “show link-aggregation”.

Note: Before including a port in a Link Aggregation, set the port physical mode. See ‘speed’ command.

Format

```
link-aggregation <name>
```

Mode

```
Global Config
```

4.9.22 link-aggregation adminmode

This command enables a Link Aggregation (LAG). The interface is a logical slot/port for a configured Link Aggregation. The option `all` sets every configured Link Aggregation with the same administrative mode setting.

Format

```
link-aggregation adminmode all
```

Mode

```
Global Config
```

no link-aggregation adminmode

This command disables a Link Aggregation (LAG). The interface is a logical slot/port for a configured Link Aggregation. The option `all` sets every configured Link Aggregation with the same administrative mode setting.

Format

```
no link-aggregation adminmode all
```

Mode

```
Global Config
```

4.9.23 link-aggregation linktrap

This command enables link trap notifications for the link-aggregation (LAG). The interface is a logical slot/port for a configured link-aggregation. The option `all` sets every configured link-aggregation with the same administrative mode setting.

Default

`enabled`

Format

`link-aggregation linktrap {<logical slot/port> | all}`

Mode

`Global Config`

no link-aggregation linktrap

This command disables link trap notifications for the link-aggregation (LAG). The interface is a logical unit, slot and port slot and port for a configured link-aggregation. The option `all` sets every configured link-aggregation with the same administrative mode setting.

Format

`no link-aggregation linktrap {<logical slot/port> | all]`

Mode

`GlobalConfig`

4.9.24 link-aggregation name

This command defines a name for the link-aggregation (LAG). The interface is a logical slot/port for a configured link-aggregation, and name is an alpha-numeric string up to 15 characters. This command is used to modify the name that was associated with the link-aggregation when it was created.

Format

```
link-aggregation name {<logical slot/port> | all |
<name>}
```

Mode

```
Global Config
```

4.9.25 rmon-alarm add

This command adds an RMON alarm.

Format

```
rmon-alarm add <index>
              [<mib-variable>
               <rising-threshold>
               <falling-threshold>]
```

Mode

```
Global Config
```

index

```
Enter the index of the RMON alarm.
```

mib-variable

```
Enter the MIB variable.
```

rising-threshold

```
Enter the rising threshold for the RMON alarm.
```

falling-threshold

```
Enter the falling threshold for the RMON alarm.
```

4.9.26 rmon-alarm delete

This command deletes an RMON alarm.

Format

```
rmon-alarm delete <index>
```

Mode

Global Config

index

Enter the index of the RMON alarm.

4.9.27 rmon-alarm enable

This command enables an RMON alarm.

Format

```
rmon-alarm enable <index>
```

Mode

Global Config

index

Enter the index of the RMON alarm.

4.9.28 rmon-alarm disable

This command disables an RMON alarm.

Format

```
rmon-alarm disable <index>
```

Mode

Global Config

index

Enter the index of the RMON alarm.

4.9.29 rmon-alarm modify mib-variable

This command modifies the mib-variable of an RMON alarm.

Format

```
rmon-alarm modify <index> mib-variable <mib-variable>
```

Mode

Global Config

index

Enter the index of the RMON alarm.

mib-variable

Enter the MIB variable.

4.9.30 rmon-alarm modify thresholds

This command modifies the thresholds of an RMON alarm.

Format

```
rmon-alarm modify <index> thresholds
                          <rising-threshold>
                          <falling-threshold>
```

Mode

Global Config

index

Enter the index of the RMON alarm.

rising-threshold

Enter the rising threshold for the RMON alarm.

falling-threshold

Enter the falling threshold for the RMON alarm.

4.9.31 rmon-alarm modify interval

This command modifies the interval of an RMON alarm.

Format

```
rmon-alarm modify <index> interval <interval>
```

Mode

Global Config

index

Enter the index of the RMON alarm.

interval

Enter the interval for the RMON alarm.

4.9.32 rmon-alarm modify sample-type

This command modifies the sample-type of an RMON alarm.

Format

```
rmon-alarm modify <index> sample-type {absolute|delta}
```

Mode

Global Config

index

Enter the index of the RMON alarm.

absolute

Sample-type for RMON alarm is absolute.

delta

Sample-type for RMON alarm is delta.

4.9.33 rmon-alarm modify startup-alarm

This command modifies the startup-alarm of an RMON alarm.

Format

```
rmon-alarm modify <index> startup-alarm
                  {rising | falling | risingorfalling}
```

Mode

Global Config

index

Enter the index of the RMON alarm.

rising

Start-up alarm if the value is rising.

falling

Start-up alarm if the value is falling.

risingorfalling

Start-up alarm if the value is rising or falling.

4.9.34 rmon-alarm modify rising-event

This command modifies the rising-event of an RMON alarm.

Format

```
rmon-alarm modify <index> rising-event
                          <rising-event-index>
```

Mode

Global Config

index

Enter the index of the RMON alarm.

rising-event-index

Enter the index for the rising event for the RMON alarm.

4.9.35 rmon-alarm modify falling-event

This command modifies the falling-event of an RMON alarm.

Format

```
rmon-alarm modify <index> falling-event
                          <falling-event-index>
```

Mode

Global Config

index

Enter the index of the RMON alarm.

falling-event-index

Enter the index for the falling event for the RMON alarm.

4.9.36 set garp timer join

This command sets the GVRP join time per port and per GARP. Join time is the interval between the transmission of GARP Protocol Data Units (PDUs) registering (or re-registering) membership for a VLAN or multicast group. This command has an effect only when GVRP is enabled. The time is from 10 to 100 (centiseconds). The value `20` centiseconds is 0.2 seconds.

Default

`20`

Format

`set garp timer join <10-100>`

Mode

`Global Config`
`Interface Config`

no set garp timer join
This command sets the GVRP join time per port and per GARP to 20 centiseconds (0.2 seconds). This command has an effect only when GVRP is enabled.

Format

`no set garp-timer join`

Mode

`Global Config`
`Interface Config`

4.9.37 set garp timer leave

This command sets the GVRP leave time per port. Leave time is the time to wait after receiving an unregister request for a VLAN or a multicast group before deleting the VLAN entry. This can be considered a buffer time for another station to assert registration for the same attribute in order to maintain uninterrupted service.time is 20 to 600 (centiseconds). The value `60` centiseconds is 0.6 seconds.

Note: This command has an effect only when GVRP is enabled.

Default

```
60
```

Format

```
set garp timer leave <20-600>
```

Mode

```
Global Config
Interface Config
```

no set garp timer leave

TThis command sets the GVRP leave time per port to 60 centiseconds (0.6 seconds).

Note: This command has an effect only when GVRP is enabled.

Format

```
no set garp timer leave
```

Mode

```
Global Config
Interface Config
```

4.9.38 set garp timer leaveall

This command sets how frequently *Leave All PDUs* are generated per port. A *Leave All PDU* indicates that all registrations will be unregistered. Participants would need to rejoin in order to maintain registration. The value applies per port and per GARP participation. The time may range from `200` to `6000` (centiseconds). The value `1000` centiseconds is 10 seconds.

Note: This command has an effect only when GVRP is enabled.

Default

`1000`

Format

`set garp timer leaveall <200-6000>`

Mode

`Global Config`
`Interface Config`

no set garp timer leaveall

This command sets how frequently *Leave All PDUs* are generated per port to 1000 centiseconds (10 seconds).

Note: This command has an effect only when GVRP is enabled.

Format

`no set garp timer leaveall`

Mode

`Global Config`
`Interface Config`

4.9.39 set gmrp adminmode

This command enables GARP Multicast Registration Protocol (GMRP) on the system. The default value is `disable`.

Format

```
set gmrp adminmode
```

Mode

```
Privileged EXEC and Global Config
```

no set gmrp adminmode
This command disables GARP Multicast Registration Protocol (GMRP) on the system.

Format

```
no set gmrp adminmode
```

Mode

```
Privileged EXEC and Global Config
```

4.9.40 set gmrp interfacemode

This command enables GARP Multicast Registration Protocol on a selected interface. If an interface which has GARP enabled is enlisted as a member of a Link Aggregation (LAG), GARP functionality will be disabled on that interface. GARP functionality will subsequently be re-enabled if Link Aggregation (LAG) membership is removed from an interface that has GARP enabled.

Default

```
enabled
```

Format

```
set gmrp interfacemode
```

Mode

```
Interface Config
```

no set gmrp interfacemode

This command disables GARP Multicast Registration Protocol on a selected interface. If an interface which has GARP enabled is enlisted as a member of a Link Aggregation (LAG), GARP functionality will be disabled on that interface. GARP functionality will subsequently be re-enabled if Link Aggregation (LAG) membership is removed from an interface that has GARP enabled.

Format

```
no set gmrp interfacemode
```

Mode

```
Interface Config
```

4.9.41 set gmrp interfacemode

This command enables GARP Multicast Registration Protocol on all interfaces. If an interface which has GARP enabled is enabled for routing or is enlisted as a member of a link-aggregation (LAG), GARP functionality will be disabled on that interface. GARP functionality will subsequently be re-enabled if routing is disabled and link-aggregation (LAG) membership is removed from an interface that has GARP enabled.

Default

```
disabled
```

Format

```
set gmrp interfacemode
```

Mode

```
Global Config
```

- **no set gmrp interfacemode**
  This command disables GARP Multicast Registration Protocol on a selected interface.

Format

```
no set gmrp interfacemode
```

Mode

```
Global Config
```

4.9.42 set gmrp forward-all-groups

This command enables the GMRP Multicast Registration Protocol feature 'Forward All Groups' for all ports.

Default

```
disabled
```

Format

```
set gmrp forward-all-groups
```

Mode

```
Interface Config
Global Config
```

no set gmrp forward-all-groups
This command disables the GMRP Multicast Registration Protocol feature 'Forward All Groups' for all ports.

Format

```
no set gmrp forward-all-groups
```

Mode

```
Interface Config
Global Config
```

4.9.43 set gmrp forward-unknown

Note: This command is available for the devices of the MS20/MS30, RS20/RS30/RS40, MACH102, MACH104, MACH1000, MACH1040, OCTOPUS, RSR20/RSR30 family.

Use this command to configure if the device should forward unknown GMRP multicast packets. The setting can be discard or flood. The default is flood.

Default

```
flood
```

Format

```
set gmrp forward-unknown {discard | flood}
```

Mode

```
Global Config
```

discard

The device discards unknown GMRP multicast packets.

flood

The device floods unknown GMRP multicast packets.

no set gmrp forward-unknown

This command disables the GMRP Multicast Registration Protocol feature 'Forward Unknown' for all ports.

Format

```
no set gmrp forward-unknown
```

Mode

```
Global Config
```

4.9.44 set igmp

This command enables IGMP Snooping on the system. The default value is `disable`.

Note: The IGMP snooping application supports the following:
- Global configuration or per interface configuration.
- Validation of the IP header checksum (as well as the IGMP header checksum) and discarding of the frame upon checksum error.
- Maintenance of the forwarding table entries based on the MAC address versus the IP address.
- Flooding of unregistered multicast data packets to all ports in the VLAN.

Format

```
set igmp
```

Mode

```
Global Config
```

no set igmp

This command disables IGMP Snooping on the system.

Format

```
no set igmp
```

Mode

```
Global Config
```

4.9.45 set igmp

This command enables IGMP Snooping on a selected interface.

Default

`enabled`

Format

`set igmp`

Mode

`Interface Config`

no set igmp

This command disables IGMP Snooping on a selected interface.

Format

`no set igmp`

Mode

`Interface Config`

4.9.46 set igmp aging-time-unknown

This command configures the IGMP Snooping aging time for unknown multicast frames (unit: seconds, min.: `3`, max.: `3600`, Default value: `260`).

Format

`set igmp aging-time-unknown <3-3600>`

Mode

`Global Config`

4.9.47 set igmp automatic-mode

If enabled, this port is allowed to be set as static query port automatically, if the LLDP protocol has found a switch or router connected to this port. Use the command's normal form to enable the feature, the 'no' form to disable it.

Default

```
disabled
```

Format

```
set igmp automatic-mode
```

Mode

```
Interface Config
```

4.9.48 set igmp forward-all

This command activates the forwarding of multicast frames to this interface even if the given interface has not received any reports by hosts. N. B.: this applies only to frames that have been learned via IGMP Snooping. The purpose is that an interface (e. g. a HIPER Ring's ring port) may need to forward all such frames even if no reports have been received on it. This enables faster recovery from ring interruptions for multicast frames.

Default

```
disabled
```

Format

```
set igmp forward-all
```

Mode

```
Interface Config
```

- **no set igmp forward-all**
  This command disables the forwarding of all multicast frames learned via IGMP Snooping on a selected interface.

Format

```
no set igmp forward-all
```

Mode

```
Interface Config
```

4.9.49 set igmp static-query-port

This command activates the forwarding of IGMP membership report frames to this interface even if the given interface has not received any queries. The purpose is that a port may need to forward such frames even if no queries have been received on it (e. g., if a router is connected to the interface that sends no queries).

Default

```
disabled
```

Format

```
set igmp static-query-port
```

Mode

```
Interface Config
```

- **no set igmp**
  This command disables the unconditional forwarding of IGMP membership report frames to this interface.

Format

```
no set igmp static-query-port
```

Mode

```
Interface Config
```

4.9.50 set igmp groupmembershipinterval

This command sets the IGMP Group Membership Interval time on the system. The Group Membership Interval time is the amount of time in seconds that a switch will wait for a report from a particular group on a particular interface before deleting the interface from the entry. This value must be greater than the IGMP Maximum Response time value. The range is `3` to `3,600` seconds.

Default

`260`

Format

`set igmp groupmembershipinterval <3-3600>`

Mode

`Global Config`

- **no set igmp groupmembershipinterval**
  This command sets the IGMP Group Membership Interval time on the system to 260 seconds.

Format

`no set igmp groupmembershipinterval`

Mode

`Global Config`

4.9.51 set igmp interfacemode

This command enables IGMP Snooping on all interfaces. If an interface which has IGMP Snooping enabled is enabled for port-based routing or is enlisted as a member of a link-aggregation (LAG), IGMP Snooping functionality will be disabled on that interface. IGMP Snooping functionality will subsequently be re-enabled if routing is disabled or link-aggregation (LAG) membership is removed from an interface that has IGMP Snooping enabled.

Format

```
set igmp interfacemode
```

Mode

```
Global Config
```

- **no set igmp interfacemode**
  This command disables IGMP Snooping on all interfaces.

Format

```
no set igmp interfacemode
```

Mode

```
Global Config
```

4.9.52 set igmp lookup-interval-unknown

This command configures the IGMP Snooping lookup response time for unknown multicast frames (unit: seconds, min.: 2, max.: 3599, Default value: 125).

Format

```
set igmp lookup-interval-unknown <2-3599>
```

Mode

```
Global Config
```

<2-3599>

Enter the IGMP Snooping lookup response time for unknown multicast frames (unit: seconds, min.: 2, max.: 3599, Default value: 125).

4.9.53 set igmp lookup-resp-time-unknown

This command configures the IGMP Snooping lookup interval for unknown multicast frames (unit: seconds, min.: 1, max.: 3,598, Default value: 10).

Format

```
set igmp lookup-resp-time-unknown <1-3598>
```

Mode

```
Global Config
```

<2-3598>

Enter the IGMP Snooping lookup interval for unknown multicast frames (unit: seconds, min.: 1, max.: 3598, Default value: 10).

4.9.54 set igmp maxresponse

This command sets the IGMP Maximum Response time on the system. The Maximum Response time is the amount of time in seconds that a switch will wait after sending a query in response to a received leave message, before deleting the multicast group received in the leave message. If the switch receives a report in response to the query within the maxresponse time, then the multicast group is not deleted. This value must be less than the IGMP Query Interval time value. The range is `1` to `3,598` seconds.

Default

`10`

Format

`set igmp maxresponse <1-3598>`

Mode

`Global Config`

Note: the IGMP Querier's max. response time was also set. It is always the same value as the IGMP Snooping max. response time.

no set igmp maxresponse

This command sets the IGMP Maximum Response time on the system to 10 seconds.

Format

`no set igmp maxresponse`

Mode

`Global Config`

4.9.55 set igmp querier max-response-time

Configure the IGMP Snooping Querier's maximum response time. The range is `1` to `3,598` seconds. The default value is `10` seconds.

Default

```
10
```

Format

```
set igmp querier max-response-time <1-3598>
```

Mode

```
Global Config
```

Note: The IGMP Snooping max. response time was also set. It is always the same value as the IGMP Querier´s max. response time.

4.9.56 set igmp querier protocol-version

Configure the IGMP Snooping Querier's protocol version (1, 2 or 3).

Default

```
2
```

Format

```
set igmp querier protocol-version {1 | 2 | 3}
```

Mode

```
Global Config
```

4.9.57 set igmp querier status

Configure the IGMP Snooping Querier's administrative status (enable or disable).

Default

```
disable
```

Format

```
set igmp querier status {enable | disable}
```

Mode

```
Global Config
```

4.9.58 set igmp querier tx-interval

Configure the IGMP Snooping Querier's transmit interval. The range is 2 to 3,599 seconds.

Default

```
125
```

Format

```
set igmp querier tx-interval <2-3599>
```

Mode

```
Global Config
```

4.9.59 set igmp query-ports-to-filter

This command enables or disables the addition of query ports to multicast filter portmasks. The setting can be enable or disable.

Default

`Disable`

Format

`set igmp query-ports-to-filter {enable | disable}`

Mode

`Global Config`

enable

Addition of query ports to multicast filter portmasks.

disable

No addition of query ports to multicast filter portmasks.

4.9.60 selftest ramtest

Enable or disable the RAM test for a cold start of the device.
Deactivating the RAM test reduces the booting time for a cold start of the device.
Default value: `enabled`.

Format

`selftest ramtest {disable|enable}`

Mode

`Global Config`

selftest ramtest disable

Disable the ramtest.

selftest ramtest enable

Enable the ramtest. This is the default.

4.9.61 selftest reboot-on-error

Enable or disable a restart due to an undefined software or hardware state. Default value: `disabled`.

Format

```
selftest reboot-on-error
        {disable | enable | seriousOnly}
```

Mode

`Global Config`

selftest reboot-on-error disable

Disable the reboot-on-error function. This is the default.

selftest reboot-on-error enable

Enable the reboot-on-error function.

selftest reboot-on-error seriousOnly

The device will only reboot on errors considered to be critical.

Note: Duplex mismatch errors are considered to be non-critical. In case of a detected duplex mismatch error, the device will not reboot. Reset the device to restore ports to an usable state.

4.9.62 serviceshell

Use this command to execute a service shell command.

Format

```
serviceshell [deactivate]
```

Mode

```
Privileged EXEC
```

deactivate

Disable the service shell access permanently **(Cannot be undone)**.

Note: If you execute this command the system asks for confirmation: When you disable the service shell function it is permanently disabled. Please see the Basic Configuration Manual for details.

4.9.63 update module-configuration

Note: This command is available for the MACH1020 and MACH1030 devices.

Use this command to update the product code of the device.

Format

```
update module-configuration
```

Mode

```
Global Config
```

Note: Update the product code specifically after you replaced or added a module to the device.

4.9.64 show auto-disable brief

Use this command to display the Auto Disable summary.

Format

`show auto-disable brief`

Mode

`Global Config`

Intf

Display the number of the interface in slot/port format.

Error reason

Display the error reason for auto-disable.
Possible values: `no error` | `link-flap` | `crc-error` | `overload-detection` | `port-security` | `speed-duplex`.

Component name

Display the name of the component for auto-disable.
Possible values: `PORTSEC` | `PORTMON`.

Remaining time (sec.)

Display the remaining time in seconds for auto-disable.
Possible values: `0` | `30..2147483`.

Auto-Disable time (sec.)

Display the time for auto-disable in seconds.
Possible values: `0` | `30..2147483`.

Auto-Disable oper state

Display the operational state of the auto-disable function.
Possible values: `active` | `inactive`.

4.9.65 show auto-disable reasons

Use this command to display the reasons for port auto-disable on this device.

Format

`show auto-disable reasons`

Mode

`Global Config`

Error reason

Display the error reasons of the port auto-disable function
Possible values: `link-flap` | `crc-error` | `overload-detection` | `port-security` | `speed-duplex`.

State

Display the state of the port auto-disable function.
Possible values: `enabled` | `disabled`.

4.9.66 show dip-switch

This command displays the DIP switch operation configuration.

Format

`show dip-switch`

Mode

`Global Config`

DIP Switch operation

This field displays the DIP Switch operation status.
Possible values: `Enabled`, `Disabled`

DIP Switch conflict

This field displays the DIP Switch conflict status.
Possible values: `True`, `False`

DIP Switch Red. Manager

This field displays the DIP Switch Redundancy Manager status.
Possible values: `Enabled`, `Disabled`

DIP Switch Standby

This field displays the DIP Switch Standby status.
Possible values: `Enabled`, `Disabled`

DIP Switch RingPort

Note: This command is available for the MICE devices.
This field displays the DIP Switch RingPort numbers.
Possible values: Interface number in `slot/port` notation.

DIP Switch SW config

Note: This command is available for the MICE devices.
This field displays the DIP Switch SW config status.
Possible values: `Enabled`, `Disabled`

4.9.67 show garp

This command displays Generic Attributes Registration Protocol (GARP) information.

Format

```
show garp
```

Mode

```
Privileged EXEC and User EXEC
```

GMRP Admin Mode

This displays the administrative mode of GARP Multicast Registration Protocol (GMRP) for the system.

4.9.68 show gmrp configuration

This command displays Generic Attributes Registration Protocol (GARP) information for one or all interfaces.

Format

```
show gmrp configuration {<slot/port> | all}
```

Mode

```
Privileged EXEC and User EXEC
```

Interface

This displays the slot/port of the interface that this row in the table describes.

Join Timer

Specifies the interval between the transmission of GARP PDUs registering (or re-registering) membership for an attribute. Current attributes are a VLAN or multicast group. There is an instance of this timer on a per-Port, per-GARP participant basis. Permissible values are `10..100` centiseconds (0.1 to 1.0 seconds). The factory default is `20` centiseconds (0.2 seconds). The finest granularity of specification is `1` centisecond (0.01 seconds).

Leave Timer

Specifies the period of time to wait after receiving an unregister request for an attribute before deleting the attribute. Current attributes are a VLAN or multicast group. This may be considered a buffer time for another station to assert registration for the same attribute in order to maintain uninterrupted service. There is an instance of this timer on a per-Port, per-GARP participant basis. Permissible values are `20..600` centiseconds (0.2 to 6.0 seconds). The factory default is `60` centiseconds (0.6 seconds). The finest granularity of specification is `1` centisecond (0.01 seconds).

LeaveAll Timer

This Leave All Time controls how frequently LeaveAll PDUs are generated. A LeaveAll PDU indicates that all registrations will shortly be deregistered. Participants will need to rejoin in order to maintain registration. There is an instance of this timer on a per-Port, per-GARP participant basis. The Leave All Period Timer is set to a random value in the range of LeaveAllTime to 1.5*LeaveAllTime. Permissible values are `200..6000` centiseconds (2 to 60 seconds). The factory default is `1000` centiseconds (10 seconds). The finest granularity of specification is `1` centisecond (0.01 seconds).

Port GMRP Mode

Indicates the GMRP administrative mode for the port. It may be enabled or disabled. If this parameter is disabled, Join Time, Leave Time and Leave All Time have no effect. The factory default is disabled.

4.9.69 show igmpsnooping

This command displays IGMP Snooping information. Configured information is displayed whether or not IGMP Snooping is enabled. Status information is only displayed when IGMP Snooping is enabled.

Format

```
show igmpsnooping
```

Mode

`Privileged EXEC and User EXEC`

Admin Mode

This indicates whether or not IGMP Snooping is globally enabled on the switch.

Forwarding of Unknown Frames

This displays if and how unknown multicasts are forwarded.
The setting can be Discard, Flood or Query Ports.
The default is Query Ports.

Group Membership Interval

This displays the IGMP Group Membership Interval. This is the amount of time a switch will wait for a report for a particular group on a particular interface before it sends a query on that interface. This value may be configured.

Multicast Control Frame Count

This displays the number of multicast control frames that are processed by the CPU.

Interfaces Enabled for IGMP Snooping

This is the list of interfaces on which IGMP Snooping is enabled. Additionally, if a port has a special function, it will be shown to the right of its slot/port number. There are 3 special functions: `Forward All`, `Static Query Port` and `Learned Query Port`.

Querier Status (the administrative state).

This displays the IGMP Snooping Querier's administrative status.

Querier Mode (the actual state, read only)

This displays the IGMP Snooping Querier's operating status.

Querier Transmit Interval

This displays the IGMP Snooping Querier's transmit interval in seconds.

Querier Max. Response Time

This displays the IGMP Snooping Querier's maximum response time in seconds.

Querier Protocol Version

This displays the IGMP Snooping Querier's protocol version number.

4.9.70 show mac-filter-table gmrp

This command displays the GARP Multicast Registration Protocol (GMRP) entries in the Multicast Forwarding Database (MFDB) table.

Format

```
show mac-filter-table gmrp
```

Mode

```
Privileged EXEC and User EXEC
```

Mac Address

A unicast MAC address for which the switch has forwarding and or filtering information. The format is 6 or 8 two-digit hexadecimal numbers that are separated by colons, for example 01:23:45:67:89:AB. In an IVL system the MAC address will be displayed as 8 bytes.

Type

This displays the type of the entry. Static entries are those that are configured by the end user. Dynamic entries are added to the table as a result of a learning process or protocol.

Description

The text description of this multicast table entry.

Interfaces

The list of interfaces that are designated for forwarding (Fwd:) and filtering (Flt:).

4.9.71 show mac-filter-table igmpsnooping

This command displays the IGMP Snooping entries in the Multicast Forwarding Database (MFDB) table.

Format

```
show mac-filter-table igmpsnooping
```

Mode

```
Privileged EXEC and User EXEC
```

Mac Address

A multicast MAC address for which the switch has forwarding and or filtering information. The format is two-digit hexadecimal numbers that are separated by colons, for example 01:23:45:67:89:AB.

Type

This displays the type of the entry. Static entries are those that are configured by the end user. Dynamic entries are added to the table as a result of a learning process or protocol.

Description

The text description of this multicast table entry.

Interfaces

The list of interfaces that are designated for forwarding (Fwd:) and filtering (Flt:).

4.9.72 show mac-filter-table multicast

This command displays the Multicast Forwarding Database (MFDB) information. If the command is entered with no parameter, the entire table is displayed. This is the same as entering the optional `all` parameter. The user can display the table entry for one MAC Address by specifying the MAC address as an optional parameter.

Format

```
show mac-filter-table multicast
            [<macaddr> <1-4042>]
```

Mode

`Privileged EXEC and User EXEC`

Mac Address

A multicast MAC address for which the switch has forwarding and or filtering information. The format is two-digit hexadecimal numbers that are separated by colons, for example 01:23:45:67:89:AB.

Type

This displays the type of the entry. Static entries are those that are configured by the end user. Dynamic entries are added to the table as a result of a learning process or protocol.

Component

The component that is responsible for this entry in the Multicast Forwarding Database. Possible values are `IGMP Snooping`, `GMRP` and `Static Filtering`.

Description

The text description of this multicast table entry.

Interfaces

The list of interfaces that are designated for forwarding (Fwd:) and filtering (Flt:).

Forwarding Interfaces

The resultant forwarding list is derived from combining all the component's forwarding interfaces and removing the interfaces that are listed as the static filtering interfaces.

4.9.73 show mac-filter-table static

This command displays the Static MAC Filtering information for all Static MAC Filters. If `all` is selected, all the Static MAC Filters in the system are displayed. If a macaddr is entered, a vlan must also be entered and the Static MAC Filter information will be displayed only for that MAC address and VLAN.

Format

```
show mac-filter-table static {<macaddr> <vlanid> | all}
```

Mode

```
Privileged EXEC and User EXEC
```

MAC Address

Is the MAC Address of the static MAC filter entry.

VLAN ID

Is the VLAN ID of the static MAC filter entry.

Source Port(s)

Indicates the source port filter set's slot and port(s).

Destination Port(s)

Indicates the destination port filter set's slot and port(s).

4.9.74 show mac-filter-table staticfiltering

This command displays the Static Filtering entries in the Multicast Forwarding Database (MFDB) table.

Format

```
show mac-filter-table staticfiltering
```

Mode

```
Privileged EXEC and User EXEC
```

Mac Address

A unicast MAC address for which the switch has forwarding and or filtering information. The format is 6 or 8 two-digit hexadecimal numbers that are separated by colons, for example 01:23:45:67:89:AB.

Type

This displays the type of the entry. Static entries are those that are configured by the end user. Dynamic entries are added to the table as a result of a learning process or protocol.

Description

The text description of this multicast table entry.

Interfaces

The list of interfaces that are designated for forwarding (Fwd:) and filtering (Flt:).

4.9.75 show mac-filter-table stats

This command displays the Multicast Forwarding Database (MFDB) statistics.

Format

```
show mac-filter-table stats
```

Mode

```
Privileged EXEC and User EXEC
```

Total Entries

This displays the total number of entries that can possibly be in the Multicast Forwarding Database table.

Most MFDB Entries Ever Used

This displays the largest number of entries that have been present in the Multicast Forwarding Database table. This value is also known as the MFDB high-water mark.

Current Entries

This displays the current number of entries in the Multicast Forwarding Database table.

4.9.76 show mac notification

This command displays the MAC address change notification configuration.

Format

```
show mac notification
```

Mode

```
Privileged EXEC
```

MAC notification settings

This table displays the MAC notification settings (status and interval) for the device.

MAC notification status

This field displays the status of MAC notification traps for the device.
Possible values: `enabled`, `disabled`.

MAC notification interval

This field displays the MAC notification interval for the device.
Possible values: `1..2147483647`.

Interface

This field displays the number of the interface in `slot/port` format.

MAC notify

This field displays the status of MAC notification traps for this port.
Possible values: `enabled`, `disabled`

Mode

This field displays the mode for which action the device sends a MAC notification trap.
Possible values: `add, remove, all`

Last MAC address

This field displays the last MAC address added or removed from the address table for this interface.
Possible values: Valid MAC address in `aa:bb:cc:dd:ee:ff` notation.

Last MAC status

This field displays the status of the last MAC address on this interface.
Possible values: `added`, `removed`, `other`.

4.9.77 show monitor session

This command displays the port monitoring information for the system.

Format

`show monitor session <Session Number>`

Mode

`Global Config, Privileged EXEC, User EXEC`

Session

Display port monitor session settings.

Session Number

Session number. Enter `1` for the session number.

Session ID

Displays the session number of the port monitor session.
Possible values: `1`.

Admin Mode

Displays the status of the port monitoring feature.
Possible values: `Enable`, `Disable`.

Probe Port

Displays the interface configured as the probe port (in slot/port notation). If this value has not been configured, '`Not Configured`' will be displayed.

Mirrored Port

Displays the interface configured as the mirrored port (in slot/port notation). If this value has not been configured, '`Not Configured`' will be displayed.

Direction

Displays the direction which has been configured for the port.
Possible values: `rx` (receive), `tx` (transmit), `rx/tx` (receive and transmit)
If this value has not been configured, '`Not Configured`' will be displayed.

4.9.78 show port

This command displays port information.

Format

`show port {<slot/port> | all} [name]`

Mode

`Privileged EXEC and User EXEC`

Slot/Port

Valid slot and port number separated by forward slashes.

Name

When the optional command parameter `name` was specified, the output is different. It specifically includes the Interface Name as the second column, followed by other basic settings that are also shown by the normal command without the command parameter `name`.

Type

If not blank, this field indicates that this port is a special type of port. The possible values are:

`Mon` – this port is a monitoring port. Look at the Port Monitoring screens to find out more information.

`LA Mbr` – this port is a member of a Link Aggregation (LAG).

`Probe` – this port is a probe port.

Admin Mode

Indicates the Port control administration state. The port must be enabled in order for it to be allowed into the network. - May be enabled or disabled. The factory default is enabled.

Physical Mode

Indicates the desired port speed and duplex mode. If auto-negotiation support is selected, then the duplex mode and speed will be set from the auto-negotiation process. Note that the port's maximum capability (full duplex -100M) will be advertised. Otherwise, this object will determine the port's duplex mode and transmission rate. The factory default is Auto.

Physical Status

Indicates the port speed and duplex mode.

Link Status

Indicates whether the Link is up or down.

Link Trap

This object determines whether or not to send a trap when link status changes. The factory default is enabled.

Flow

Indicates if enable flow control is enabled on this port.

Device Status

Indicates whether or not the given port's link status is monitored by the device status.

VLAN Prio

This object displays the port VLAN priority.

4.9.79 show link-aggregation

This command displays an overview of all link-aggregations (LAGs) on the switch.

Format

```
show link-aggregation {<logical slot/port> | all}
```

Mode

```
Privileged EXEC and User EXEC
```

Logical slot/port

Valid slot and port number separated by forward slashes.

Name

The name of this link-aggregation (LAG). You may enter any string of up to 15 alphanumeric characters.

Link State

Indicates whether the Link is up or down.

Admin Mode

May be enabled or disabled. The factory default is enabled.

Link Trap Mode

This object determines whether or not to send a trap when link status changes. The factory default is enabled.

STP Mode

The Spanning Tree Protocol Administrative Mode associated with the port or link-aggregation (LAG). The possible values are:

`Disable` – Spanning tree is disabled for this port.

`Enable` – Spanning tree is enabled for this port.

Mbr Ports

A listing of the ports that are members of this link-aggregation (LAG), in slot/port notation. There can be a maximum of eight ports assigned to a given link-aggregation (LAG).

Port Speed

Speed of the link-aggregation port.

Type

This field displays the status designating whether a particular link-aggregation (LAG) is statically or dynamically maintained. The possible values of this field are `Static`, indicating that the link-aggregation is statically maintained; and `Dynamic`, indicating that the link-aggregation is dynamically maintained.

Active Ports

This field lists the ports that are actively participating in the link-aggregation (LAG).

4.9.80 show rmon-alarm

This command displays switch configuration information.

Format

```
show rmon-alarm
```

Mode

```
Privileged EXEC and User EXEC
```

4.9.81 show selftest

This command displays switch configuration information.

Format

```
show selftest
```

Mode

```
Privileged EXEC and User EXEC
```

Ramtest state

May be enabled or disabled. The factory default is enabled.

Reboot on error

May be enabled, disabled or seriousOnly. The factory default is enabled.

4.9.82 show serviceshell

This command displays the admin state of the service shell access.

Format

```
show serviceshell
```

Mode

```
Privileged EXEC and User EXEC
```

Admin state of service shell

Display the admin state of the service shell access
Possible values: Disabled, Enabled.

4.9.83 show storm-control

This command displays switch configuration information.

Format

```
show storm-control
```

Mode

```
Privileged EXEC and User EXEC
```

Ingress Limiting

May be enabled or disabled. The factory default is disabled.

Ingress Limiter Mode

Note: This command is available for the MACH4000 and PowerMICE devices.
Sets the global mode for the ingress limiter. The factory default is: Broadcasts only.

Egress Broadcast Limiting

May be enabled or disabled. The factory default is disabled.

Egress Limiting (all traffic)

May be enabled or disabled. The factory default is disabled.

802.3x Flow Control Mode

May be enabled or disabled. The factory default is disabled.

4.9.84 show storm-control limiters port

This command displays the limiter settings per port. "0" means that the respective limiter is disabled.

Format

```
show storm-control limiters port {<slot/port>|all}
```

Mode

```
Privileged EXEC and User EXEC
```

Ingress Mode

Note: This command is available for the devices RS20/RS30/RS40, MS20/MS30 and OCTOPUS.
Shows the mode for the ingress limiter. The factory default is: Broadcasts only.

Ingress Limit

Shows the ingress rate limit. The factory default is: 0.

Egress Broadcast Limit

Shows the egress broadcast rate limit. The factory default is: 0.

Egress Limit (all traffic)

Note: This command is available for the devices RS20/RS30/RS40, MS20/MS30 and OCTOPUS.
Shows the egress rate limit for all frame types.
The factory default is: 0.

4.9.85 show vlan

This command displays detailed information, including interface information, for a specific VLAN. The ID is a valid VLAN identification number

Format

```
show vlan <vlanid>
```

Mode

```
Privileged EXEC and User EXEC
```

VLAN ID

There is a VLAN Identifier (VID) associated with each VLAN. The range of the VLAN ID is 1 to 4042.

VLAN Name

A string associated with this VLAN as a convenience. It can be up to 32 alphanumeric characters long, including blanks. The default is blank. VLAN ID 1 always has a name of `Default`. This field is optional.

VLAN Type

Type of VLAN, which can be Default, (VLAN ID = 1), a static (one that is configured and permanently defined), or Dynamic (one that is created by GVRP registration).

VLAN Creation Time

Time since VLAN has been created:
d days, hh:mm:ss (System Uptime).

Interface

Valid slot and port number separated by forward slashes. It is possible to set the parameters for all ports by using the selectors on the top line.

Current

Determines the degree of participation of this port in this VLAN. The permissible values are:

`Include` – This port is always a member of this VLAN. This is equivalent to registration fixed in the IEEE 802.1Q standard.

`Exclude` – This port is never a member of this VLAN. This is equivalent to registration forbidden in the IEEE 802.1Q standard.

`Autodetect` – Specifies to allow the port to be dynamically registered in this VLAN via GVRP. The port will not participate in this VLAN unless a join request is received on this port. This is equivalent to registration normal in the IEEE 802.1Q standard.

Configured

Determines the configured degree of participation of this port in this VLAN. The permissible values are:

`Include` – This port is always a member of this VLAN. This is equivalent to registration fixed in the IEEE 802.1Q standard.

`Exclude` – This port is never a member of this VLAN. This is equivalent to registration forbidden in the IEEE 802.1Q standard.

`Autodetect` – Specifies to allow the port to be dynamically registered in this VLAN via GVRP. The port will not participate in this VLAN unless a join request is received on this port. This is equivalent to registration normal in the IEEE 802.1Q standard.

Tagging

Select the tagging behavior for this port in this VLAN.

`Tagged -` specifies to transmit traffic for this VLAN as tagged frames.

`Untagged -` specifies to transmit traffic for this VLAN as untagged frames.

4.9.86 show vlan brief

This command displays a list of all configured VLANs.

Format

```
show vlan brief
```

Mode

```
Privileged EXEC and User EXEC
```

VLAN ID

There is a VLAN Identifier (vlanid)associated with each VLAN. The range of the VLAN ID is 1 to 4042.

VLAN Name

A string associated with this VLAN as a convenience. It can be up to 32 alphanumeric characters long, including blanks. The default is blank. VLAN ID 1 always has a name of `Default`. This field is optional.

VLAN Type

Type of VLAN, which can be Default, (VLAN ID = 1), a static (one that is configured and permanently defined), or a Dynamic (one that is created by GVRP registration).

VLAN Creation Time

Displays the time (as the system time up time) when the VLAN was created.

4.9.87 show vlan port

This command displays VLAN port information.

Format

```
show vlan port {<slot/port> | all}
```

Mode

```
Privileged EXEC and User EXEC
```

Slot/Port

Valid slot and port number separated by forward slashes. It is possible to set the parameters for all ports by using the selectors on the top line.

Port VLAN ID

The VLAN ID that this port will assign to untagged frames or priority tagged frames received on this port. The value must be for an existing VLAN. The factory default is `1`.

Acceptable Frame Types

Specifies the types of frames that may be received on this port. The options are 'VLAN only' and 'Admit All'. When set to 'VLAN only', untagged frames or priority tagged frames received on this port are discarded. When set to 'Admit All', untagged frames or priority tagged frames received on this port are accepted and assigned the value of the Port VLAN ID for this port. With either option, VLAN tagged frames are forwarded in accordance to the 802.1Q VLAN specification.

Ingress Filtering

May be enabled or disabled. When enabled, the frame is discarded if this port is not a member of the VLAN with which this frame is associated. In a tagged frame, the VLAN is identified by the VLAN ID in the tag. In an untagged frame, the VLAN is the Port VLAN ID specified for the port that received this frame. When disabled, all frames are forwarded in accordance with the 802.1Q VLAN bridge specification. The factory default is disabled.

GVRP

The protocol for VLAN administration, GVRP (GARP VLAN Registration Protocol) is particularly used for the adjustment of terminal devices and VLAN switches. In realtime, it traces users log-in and log-off and provides updated configuration data to the network management system. In order to be able to use this protocol, GVRP has

to be supported by every switch.
GVRP may be enabled or disabled. The factory default is disabled.

Default Priority

The 802.1p priority assigned to tagged packets arriving on the port.

4.9.88 show voice vlan

Use this command to display the current global Voice VLAN Administrative Mode.
Voice VLAN is a feature used to automatically separate voice and data traffic on a port, by VLAN and/or priority. A primary benefit of using Voice VLAN is to ensure that the sound quality of an IP phone is safeguarded from deteriorating when the data traffic on the port is high.

Format

```
show voice vlan
```

Mode

```
Privileged EXEC
```

Administrative Mode

Possible values: `Disable, Enable`

4.9.89 show voice vlan interface

Use this command to display Use this command to display a summary of the current Voice VLAN configuration for a specific interface.
`<slot/port>` indicates a specific physical interface.
all indicates all valid interfaces.

Format

```
show voice vlan interface {<slot/port> | all}
```

Mode

```
Privileged EXEC
```

<slot/port>

Indicates a specific physical interface.

all

Indicates all valid interfaces.

Interface

Displays the physical interface.

Voice VLAN Interface Mode

Displays the Voice VLAN Interface Mode.
Possible values: `Disabled, Enabled`.

Voice VLAN Authentication

Displays the Voice VLAN Authentication.
Possible values: `Disabled, Enabled`.

Voice VLAN Port Status

Displays the Voice VLAN Port Status.
Possible values: `Disabled, Enabled`.

4.9.90 shutdown

This command disables a port.

Default

`enabled`

Format

`shutdown`

Mode

`Interface Config`

no shutdown

This command enables a port.

Format

`no shutdown`

Mode

`Interface Config`

4.9.91 shutdown all

This command disables all ports.

Default

`enabled`

Format

`shutdown all`

Mode

`Global Config`

no shutdown all

This command enables all ports.

Format

`no shutdown all`

Mode

`Global Config`

4.9.92 snmp sync community-to-v3

This command enables the synchronization between the SNMPv1/v2 community table and the SNMPv3 password table.

Format

```
snmp sync community-to-v3
```

Mode

```
Global Config
```

- **no snmp sync community-to-v3**
  This command disables the synchronization between the SNMPv1/v2 community table and the SNMPv3 password table.

Format

```
no snmp sync community-to-v3
```

Mode

```
Global Config
```

4.9.93 snmp sync v3-to-community

This command enables the synchronization between the SNMPv3 password table and the SNMPv1/v2 community table.

Format

```
snmp sync v3-to-community
```

Mode

```
Global Config
```

- **no snmp sync v3-to-community**
  This command disables the synchronization between the SNMPv3 password table and the SNMPv1/v2 community table.

Format

```
no snmp sync v3-to-community
```

Mode

```
Global Config
```

4.9.94 snmp trap link-status

This command enables link status traps by interface.

Note: This command is valid only when the Link Up/Down Flag is enabled. See ‘snmp-server enable traps linkmode’ command.

Format

```
snmp trap link-status
```

Mode

```
Interface Config
```

no snmp trap link-status
This command disables link status traps by interface.

Note: This command is valid only when the Link Up/Down Flag is enabled. See ‘snmp-server enable traps linkmode’ command).

Format

```
no snmp trap link-status
```

Mode

```
Interface Config
```

4.9.95 snmp trap link-status all

This command enables link status traps for all interfaces.

Note: This command is valid only when the Link Up/Down Flag is enabled (see “snmp-server enable traps linkmode”).

Format

```
snmp trap link-status all
```

Mode

```
Global Config
```

no snmp trap link-status all
This command disables link status traps for all interfaces.

Note: This command is valid only when the Link Up/Down Flag is enabled (see “snmp-server enable traps linkmode”).

Format

```
no snmp trap link-status all
```

Mode

```
Global Config
```

4.9.96 spanning-tree bpdumigrationcheck

This command enables BPDU migration check on a given interface.
This will force the specified port to transmit RST or MST BPDUs.
The **all** option enables BPDU migration check on all interfaces.

Format

```
spanning-tree bpdumigrationcheck {<slot/port>|all}
```

Mode

```
Global Config
```

no spanning-tree bpdumigrationcheck
This command disables BPDU migration check on a given interface. The `all` option disables BPDU migration check on all interfaces.

Format

```
no spanning-tree bpdumigrationcheck {<slot/
port>|all}
```

Mode

```
Global Config
```

4.9.97 speed

This command sets the speed and duplex setting for the interface.

Format

```
speed {<100 | 10> <half-duplex | full-duplex> |
       1000 full-duplex}
```

Mode

```
Interface Config
```

Acceptable values are:

1000 full-duplex

Set speed for the interface to `1000 Mbps`.
Set duplex mode for the interface to `full duplex`.

100 full-duplex

Set speed for the interface to `100 Mbps`.
Set duplex mode for the interface to `full duplex`.

100 half-duplex

Set speed for the interface to `100 Mbps`.
Set duplex mode for the interface to `half duplex`.

10 full-duplex

Set speed for the interface to `10 Mbps`.
Set duplex mode for the interface to `full duplex`.

10 half-duplex

Set speed for the interface to `10 Mbps`.
Set duplex mode for the interface to `half duplex`.

4.9.98 storm-control broadcast

This command enables the egress broadcast limiter globally.

Format

```
storm-control broadcast
```

Mode

```
Global Config
```

no storm-control broadcast

This command disables the egress broadcast limiter globally.

Format

```
no storm-control broadcast
```

Mode

```
Global Config
```

4.9.99 storm-control egress-limiting

This command enables or disables the egress limiter globally for all frame types.

Format

```
storm-control egress-limiting {disable | enable}
```

Mode

```
Global Config
```

4.9.100 storm-control ingress-limiting

This command enables or disables the ingress limiter globally.

Format

```
storm-control ingress-limiting {disable | enable}
```

Mode

```
Global Config
```

4.9.101 storm-control ingress-mode

Note: This command is available for the MACH4000 and PowerMICE devices.

This command sets the frame type for the ingress limiter globally to: BC or BC+MC.

Format

```
storm-control ingress-mode {bc | mc+bc}
```

Mode

```
Global Config
```

4.9.102 storm-control broadcast (port-related)

This command enables the broadcast limiter per port.
Enter the maximum number of broadcasts that the given port is allowed to send (unit: frames per second, min.: `0` (no limit), Default value: `0` (no limit)).

Format

```
storm-control broadcast <max. broadcast rate>
```

Mode

```
Interface Config
```

4.9.103 storm-control egress-limit

Note: This command is available for the RS20/RS30/RS40, MS20/MS30 and OCTOPUS devices.

Sets the egress rate limit in kbit/s. "0" means: no limit.

Format

```
storm-control egress-limit <max. egress rate>
```

Mode

```
Interface Config
```

4.9.104 storm-control ingress-limit

Sets the ingress rate limit in kbit/s. "0" means: no limit.

Format

```
storm-control ingress-limit <max. ingress rate>
```

Mode

```
Interface Config
```

4.9.105 storm-control ingress-mode

Note: This command is available for the RS20/RS30/RS40, MS20/MS30, OCTOPUS devices.

This command sets the frame type for the ingress limiter to:
All, BC, BC+MC, BC+MC+uUC.

Format

```
storm-control ingress-mode {all | bc | mc+bc |
uuc+mc+bc}
```

Mode

```
Interface Config
```

4.9.106 storm-control flowcontrol

This command enables 802.3x flow control for the switch.

Note: This command only applies to full-duplex mode ports.

Default

```
disabled
```

Format

```
storm-control flowcontrol
```

Mode

```
Interface Config
Global Config
```

no storm-control flowcontrol

This command disables 802.3x flow control for the switch.

Note: This command only applies to full-duplex mode ports.

Format

```
no storm-control flowcontrol
```

Mode

```
Interface Config
Global Config
```

4.9.107 storm-control flowcontrol per port

This command enables 802.3x flow control for the port.

Note: This command only applies to full-duplex mode ports.

Default

`enabled`

Format

`storm-control flowcontrol`

Mode

`Interface Config`

no storm-control flowcontrol per port

This command disables 802.3x flow control for the port.

Note: This command only applies to full-duplex mode ports.

Format

`no storm-control flowcontrol`

Mode

`Interface Config`

4.9.108 vlan

This command creates a new VLAN and assigns it an ID. The ID is a valid VLAN identification number (ID 1 is reserved for the default VLAN). VLAN range is 1-4042.

Format

```
vlan <1-4042>
```

Mode

```
VLAN database
```

no vlan

This command deletes an existing VLAN. The ID is a valid VLAN identification number (ID 1 is reserved for the default VLAN). VLAN range is 1-4042.

Format

```
no vlan <1-4042>
```

Mode

```
VLAN database
```

4.9.109 vlan0-transparent-mode

Activate the “Transparent Mode“ to be able to switch priority tagged frames without a VLAN affiliation thus with VLAN-ID “0”.
In this mode the VLAN-ID “0” persists in the frame, irrespective of the Port VLAN ID setting in the “VLAN Port“ dialog.

Note: For PowerMICE, MACH100, MACH1000 and MACH4000:
In transparency mode devices ignore received vlan tags. Set the vlan membership of the ports to untagged for all vlans.

Note: For RS20/RS30/RS40, MS20/MS30 and OCTOPUS:
In transparency mode devices ignore the configured port vlan id. Set the vlan membership of the ports from vlan 1 to untagged or member.

Format

```
vlan0-transparent-mode {disable|enable}
```

Mode

```
VLAN database
```

4.9.110 vlan acceptframe

This command sets the frame acceptance mode per interface. For VLAN Only mode, untagged frames or priority frames received on this interface are discarded. For Admit All mode, untagged frames or priority frames received on this interface are accepted and assigned the value of the interface VLAN ID for this port. With either option, VLAN tagged frames are forwarded in accordance with the IEEE 802.1Q VLAN Specification.

Default

`Admit All`

Format

`vlan acceptframe <vlanonly | all | untaggedonly>`

Mode

`Interface Config`

all

Untagged frames or priority frames received on this interface are accepted and assigned the value of the interface VLAN ID for this port.

vlanonly

Only frames received with a VLAN tag will be forwarded. Other frames will be dropped.

untaggedonly

Only frames received without a VLAN tag will be forwarded. Other frames will be dropped.

Note: This command is available for devices of the RS20/RS30/RS40, MS20/MS30, MACH102, RSR20/RSR30, MACH1020/MACH1030 and OCTOPUS family.

- **no vlan acceptframe**
  This command sets the frame acceptance mode per interface to `Admit All`. For Admit All mode, untagged frames or priority frames received on this interface are accepted and assigned the value of the interface VLAN ID for this port. With either option, VLAN tagged frames are forwarded in accordance with the IEEE 802.1Q VLAN Specification.

Format

```
no vlan acceptframe
```

Mode

```
Interface Config
```

4.9.111 vlan database

This command switches into the global VLAN mode.

Default

```
Admit All
```

Format

```
vlan database
```

Mode

```
Privileged EXEC
```

4.9.112 vlan ingressfilter

This command enables ingress filtering. If ingress filtering is disabled, frames received with VLAN IDs that do not match the VLAN membership of the receiving interface are admitted and forwarded to ports that are members of that VLAN.

Default

`disabled`

Format

`vlan ingressfilter`

Mode

`Interface Config`

- **no vlan ingressfilter**
  This command disables ingress filtering. If ingress filtering is disabled, frames received with VLAN IDs that do not match the VLAN membership of the receiving interface are admitted and forwarded to ports that are members of that VLAN.

Format

`no vlan ingressfilter`

Mode

`Interface Config`

4.9.113 vlan name

This command changes the name of a VLAN. The name is an alphanumeric string of up to 32 characters, and the ID is a valid VLAN identification number. ID range is 1-4042.

Default

The name for VLAN ID 1 is always Default. The name for other VLANs is defaulted to a blank string.

Format

```
vlan name <1-4042> <newname>
```

Mode

```
VLAN database
```

no vlan name

This command sets the name of a VLAN to a blank string. The VLAN ID is a valid VLAN identification number. ID range is 1-4042.

Format

```
no vlan name <1-4042>
```

Mode

```
VLAN database
```

4.9.114 vlan participation

This command configures the degree of participation for a specific interface in a VLAN. The ID is a valid VLAN identification number, and the interface is a valid interface number.

Format

```
vlan participation
  <exclude | include | auto> <1-4042>
```

Mode

```
Interface Config
```

Participation options are:

include

The interface is always a member of this VLAN. This is equivalent to registration fixed.

exclude

The interface is never a member of this VLAN. This is equivalent to registration forbidden.

auto

The interface is dynamically registered in this VLAN by GVRP. The interface will not participate in this VLAN unless a join request is received on this interface. This is equivalent to registration normal.

4.9.115 vlan participation all

This command configures the degree of participation for all interfaces in a VLAN. The ID is a valid VLAN identification number.

Format

```
vlan participation all <exclude | include | auto>
<1-4042>
```

Mode

```
Global Config
```

Participation options are:

include

The interface is always a member of this VLAN. This is equivalent to registration fixed.

exclude

The interface is never a member of this VLAN. This is equivalent to registration forbidden.

auto

The interface is dynamically registered in this VLAN by GVRP. The interface will not participate in this VLAN unless a join request is received on this interface. This is equivalent to registration normal.

4.9.116 vlan port acceptframe all

This command sets the frame acceptance mode for all interfaces. For VLAN Only mode, untagged frames or priority frames received on this interface are discarded. For Admit All mode, untagged frames or priority frames received on this interface are accepted and assigned the value of the interface VLAN ID for this port. With either option, VLAN tagged frames are forwarded in accordance with the IEEE 802.1Q VLAN Specification.

Default

`Admit All`

Format

`vlan port acceptframe all <vlanonly | all>`

Mode

`Global Config`

no vlan port acceptframe all

This command sets the frame acceptance mode for all interfaces to `Admit All`. For Admit All mode, untagged frames or priority frames received on this interface are accepted and assigned the value of the interface VLAN ID for this port. With either option, VLAN tagged frames are forwarded in accordance with the IEEE 802.1Q VLAN Specification.

Format

`no vlan port acceptframe all`

Mode

`Global Config`

4.9.117 vlan port ingressfilter all

This command enables ingress filtering for all ports. If ingress filtering is disabled, frames received with VLAN IDs that do not match the VLAN membership of the receiving interface are admitted and forwarded to ports that are members of that VLAN.

Default

```
disabled
```

Format

```
vlan port ingressfilter all
```

Mode

```
Global Config
```

- **no vlan port ingressfilter all**
  This command disables ingress filtering for all ports. If ingress filtering is disabled, frames received with VLAN IDs that do not match the VLAN membership of the receiving interface are admitted and forwarded to ports that are members of that VLAN.

Format

```
no vlan port ingressfilter all
```

Mode

```
Global Config
```

4.9.118 vlan port pvid all

This command changes the VLAN ID for all interface.

Default

```
1
```

Format

```
vlan port pvid all <1-4042>
```

Mode

```
Global Config
```

no vlan port pvid all

This command sets the VLAN ID for all interfaces to 1.

Format

```
no vlan port pvid all <1-4042>
```

Mode

```
Global Config
```

4.9.119 vlan port tagging all

This command configures the tagging behavior for all interfaces in a VLAN to enabled. If tagging is enabled, traffic is transmitted as tagged frames. If tagging is disabled, traffic is transmitted as untagged frames. The ID is a valid VLAN identification number.

Format

```
vlan port tagging all <1-4042>
```

Mode

```
Global Config
```

- **no vlan port tagging all**
  This command configures the tagging behavior for all interfaces in a VLAN to disabled. If tagging is disabled, traffic is transmitted as untagged frames. The ID is a valid VLAN identification number.

Format

```
no vlan port tagging all <1-4042>
```

Mode

```
Global Config
```

4.9.120 vlan pvid

This command changes the VLAN ID per interface.

Default

1

Format

vlan pvid <1-4042>

Mode

Interface Config

no vlan pvid

This command sets the VLAN ID per interface to 1.

Format

no vlan pvid <1-4042>

Mode

Interface Config

4.9.121 vlan tagging

This command configures the tagging behavior for a specific interface in a VLAN to enabled. If tagging is enabled, traffic is transmitted as tagged frames. If tagging is disabled, traffic is transmitted as untagged frames. The ID is a valid VLAN identification number.

Format

```
vlan tagging <1-4042>
```

Mode

```
Interface Config
```

- **no vlan tagging**
  This command configures the tagging behavior for a specific interface in a VLAN to disabled. If tagging is disabled, traffic is transmitted as untagged frames. The ID is a valid VLAN identification number.

Format

```
no vlan tagging <1-4042>
```

Mode

```
Interface Config
```

4.9.122 voice vlan (Global Config Mode)

This command enables the Voice VLAN feature.

Voice VLAN is a feature used to automatically separate voice and data traffic on a port, by VLAN and/or priority. A primary benefit of using Voice VLAN is to ensure that the sound quality of an IP phone is safeguarded from deteriorating when the data traffic on the port is high.

Default

```
Disabled
```

Format

```
voice vlan
```

Mode

```
Global Config
```

no voice vlan

This command disables the Voice VLAN feature.

Default

```
Disabled
```

Format

```
no voice vlan
```

Mode

```
Global Config
```

4.9.123 voice vlan <id>

Use this command to configure VLAN tagging and 802.1p priority.

Format

```
voice vlan <id> [dot1p <priority>] }
```

Mode

```
Interface Config
```

<id>

Enter the Voice VLAN ID.

dot1p

Configure Voice VLAN 802.1p priority tagging for voice traffic.

<priority>

The priority tag range is 0–7.

no voice vlan

This command disables the Voice VLAN feature on the interface.

Default

```
Disabled
```

Format

```
no voice vlan
```

Mode

```
Interface Config
```

4.9.124 voice vlan dot1p

Use this command to configure Voice VLAN 802.1p priority tagging for voice traffic.

Format

```
voice vlan dot1p <priority>
```

Mode

```
Interface Config
```

<priority>

Configure Voice VLAN 802.1p priority tagging for voice traffic. The priority tag range is 0–7.

4.9.125 voice vlan none

Use this command to allow the IP phone to use its own configuration to send untagged voice traffic.

Format

```
voice vlan none
```

Mode

```
Interface Config
```

4.9.126 voice vlan untagged

Use this command to configure the phone to send untagged voice traffic.

Format

```
voice vlan untagged
```

Mode

```
Interface Config
```

4.9.127 voice vlan auth

Use this command to set Voice VLAN Authentication Mode. If disabled, VOIP devices which are detected via LLDP-med will have access to the Voice VLAN without authentication.

Default

```
Enabled
```

Format

```
voice vlan auth [enabled | disabled]
```

Mode

```
Interface Config
```

disable

VOIP devices which are detected via LLDP-MED will have access to the Voice VLAN without authentication.

enable

VOIP devices which are detected via LLDP-MED will not have access to the Voice VLAN without authentication.

4.10 User Account Management Commands

These commands manage user accounts.

4.10.1 disconnect

This command closes a telnet session.

Format

```
disconnect {<sessionID> | all}
```

Mode

```
Privileged EXEC
```

Session ID

Enter the session ID (1-11).

4.10.2 show loginsession

This command displays current telnet and serial port connections to the switch.

Format

```
show loginsession
```

Mode

```
Privileged EXEC and User EXEC
```

ID

```
Login Session ID
```

User Name

The name the user will use to login using the serial port or Telnet. A new user may be added to the switch by entering a name in a blank entry. The user name may be up to 8 characters, and is not case sensitive. Two users are included as the factory default, ‘admin’ and ‘user’.

Connection From

IP address of the telnet client machine or EIA-232 for the serial port connection.

Idle Time

Time this session has been idle.

Session Time

Total time this session has been connected.

4.10.3 show users

This command displays the configured user names and their settings. This command is only available for users with readwrite privileges. The SNMPv3 fields will only be displayed if SNMP is available on the system.

Format

```
show users
```

Mode

```
Privileged EXEC
```

User Name

The name the user will use to login using the serial port, Telnet or Web. A new user may be added to the switch by entering a name in a blank entry. The user name may be up to eight characters, and is not case sensitive. Two users are included as the factory default, ‘admin’ and ‘user’

Access Mode

Shows whether the operator is able to change parameters on the switch (Read/Write) or is only able to view them (Read Only). As a factory default, the ‘admin’ user has Read/Write access and the ‘user’ has Read Only access. There can only be one Read/Write user and up to five Read Only users.

SNMPv3 AccessMode

This field displays the SNMPv3 Access Mode. If the value is set to ReadWrite, the SNMPv3 user will be able to set and retrieve parameters on the system. If the value is set to ReadOnly, the SNMPv3 user will only be able to retrieve parameter information. The SNMPv3 access mode may be different than the CLI and Web access mode.

SNMPv3 Authentication

This field displays the authentication protocol to be used for the specified login user.

SNMPv3 Encryption

This field displays the encryption protocol to be used for the specified login user.

4.10.4 users defaultlogin

This command assigns the authentication login list to use for non-configured users when attempting to log in to the system. This setting is overridden by the authentication login list assigned to a specific user if the user is configured locally. If this value is not configured, users will be authenticated using local authentication only.

Format

```
users defaultlogin <listname>
```

Mode

```
Global Config
```

listname

Enter an alphanumeric string of not more than 15 characters.

4.10.5 users login <user>

Enter user name.

Format

```
users login <user> <listname>
```

Mode

```
Global Config
```

Note:

When assigning a list to the 'admin' account, include an authentication method that allows administrative access even when remote authentication is unavailable (use 'authentication login <listname> [method1 [method2 [method3]]]').

no users login <user>

This command removes an operator.

Format

```
no users login <user> <listname>
```

Mode

```
Global Config
```

Note:

The ‘admin’ user account cannot be deleted.

4.10.6 users access

This command sets access for a user: readonly/readwrite.

Format

```
users access <username> {readonly | readwrite}
```

Mode

```
Global Config
```

<username>

Enter a name up to 32 alphanumeric characters in length.

readonly

Enter the access mode as readonly.

readwrite

Enter the access mode as readwrite.

no users access

This command deletes access for a user.

Format

```
no users access <username>
```

Mode

```
Global Config
```

4.10.7 users name

This command adds a new user (account) if space permits. The account <username> can be up to eight characters in length. The name may be comprised of alphanumeric characters as well as the dash (‘-’) and underscore (‘_’). The <username> is not case-sensitive.
Six user names can be defined.

Format

```
users name <username>
```

Mode

```
Global Config
```

no users name

This command removes an operator.

Format

```
no users name <username>
```

Mode

```
Global Config
```

Note:

The ‘admin’ user account cannot be deleted.

4.10.8 users passwd

This command is used to change a password. The password should not be more than eight alphanumeric characters in length. If a user is authorized for authentication or encryption is enabled, the password must be at least eight alphanumeric characters in length. The username and password are case-sensitive. When a password is changed, a prompt will ask for the former password. If none, press enter.
Note: Make sure, that the passwords of the users differ from each other. If two or more users try to choose the same password, the CLI will display an error message.

Default

```
No Password
```

Format

```
users passwd <username> {<password>}
```

Mode

```
Global Config
```

no users passwd
This command sets the password of an existing operator to blank. When a password is changed, a prompt will ask for the operator's former password. If none, press enter.

Format

```
no users passwd <username> {<password>}
```

Mode

```
Global Config
```

4.10.9 users snmpv3 accessmode

This command specifies the snmpv3 access privileges for the specified login user. The valid accessmode values are `readonly` or `readwrite`. The `<username>` is the login user name for which the specified access mode applies. The default is `readwrite` for 'admin' user; `readonly` for all other users

Default

```
admin -- readwrite; other -- readonly
```

Format

```
users snmpv3 accessmode <username> <readonly | readwrite>
```

Mode

```
Global Config
```

no users snmpv3 accessmode

This command sets the snmpv3 access privileges for the specified login user as `readwrite` for the 'admin' user; `readonly` for all other users. The <username> is the login user name for which the specified access mode will apply.

Format

```
no users snmpv3 accessmode <username>
```

Mode

```
Global Config
```

4.10.10 users snmpv3 authentication

This command specifies the authentication protocol to be used for the specified login user. The valid authentication protocols are `none`, `md5` or `sha`. If md5 or sha are specified, the user login password is also used as the snmpv3 authentication password and therefore must be at least eight characters in length. The `<username>` is the login user name associated with the authentication protocol.

Default

```
no authentication
```

Format

```
users snmpv3 authentication <username> <none | md5 | sha>
```

Mode

```
Global Config
```

no users snmpv3 authentication

This command sets the authentication protocol to be used for the specified login user to `none`. The <username> is the login user name for which the specified authentication protocol will be used.

Format

```
users snmpv3 authentication <username>
```

Mode

```
Global Config
```

4.10.11 users snmpv3 encryption

This command specifies the encryption protocol to be used for the specified login user. The valid encryption protocols are des or `none`.
If des is specified, the required key may be specified on the command line. The `key` may be up to 16 characters long. If the `des` protocol is specified but a key is not provided, the user will be prompted for the key. When using the des protocol, the user login password is also used as the snmpv3 encryption password and therefore must be at least eight characters in length.
If `none` is specified, a key must not be provided. The `<username>` is the login user name associated with the specified encryption.

Default

```
no encryption
```

Format

```
users snmpv3 encryption <username> <none |
des[key]>
```

Mode

```
Global Config
```

no users snmpv3 encryption

This command sets the encryption protocol to `none`. The <username> is the login user name for which the specified encryption protocol will be used.

Format

```
no users snmpv3 encryption <username>
```

Mode

```
Global Config
```

4.11 System Utilities

This section describes system utilities.

4.11.1 address-conflict

This command configures the setting for detection possible address conflicts of the agent´s IP address with other devices´ IP addresses in the network.

Format

```
address-conflict
  {detection-mode { active-only | disable |
   enable | passive-only}|
   ongoing-detection { disable | enable } }
```

Mode

```
Global Config
```

detection mode

Configure the device's address conflict detection mode (active-only, disable, enable or passive-only). Default value: `enable`.

ongoing detection

Disable or enable the ongoing address conflict detection. Default value: `enable`.

4.11.2 boot skip-aca-on-boot

Use this command to skip external memory (AutoConfiguration Adapter ACA21) during boot phase to shorten startup duration.
The ACA21 functionality will be available after the boot phase.

Format

```
boot skip-aca-on-boot {disable | enable}
```

Mode

```
Global Config
```

Default

```
disabled
```

enable

Enable ACA21 skip during boot phase.

disable

Disable ACA21 skip during boot phase.

4.11.3 show boot skip-aca-on-boot

Use this command display the status of the option of skipping external memory (AutoConfiguration Adapter ACA21) during boot phase.

Format

```
show boot skip-aca-on-boot
```

Mode

```
Global Config
```

Default

```
disabled
```

Enabled

ACA21 skip during boot phase is enabled.

Disabled

ACA21 skip during boot phase is disabled.

4.11.4 cablestatus

This command tests the cable attached to an interface for short or open circuit. During the test the traffic is interrupted on this port.

Format

```
cablestatus <slot/port>
```

Mode

```
Privileged EXEC
```

4.11.5 clear eventlog

Clear the event log. The CLI will ask for confirmation.
Answer `y` (yes) or `n` (no).
The CLI displays the end of this operation.

Format

```
clear eventlog
```

Mode

```
Privileged EXEC
```

4.11.6 traceroute

This command is used to discover the routes that packets actually take when traveling to their destination through the network on a hop-by-hop basis. <ipaddr> should be a valid IP address.
The optional port parameter is the UDP port used as the destination of packets sent as part of the traceroute. This port should be an unused port on the destination system. [port] should be a valid decimal integer in the range of 0 (zero) to 65,535. The default value is `33434`.

Format

```
traceroute <ipaddr> [port]
```

Mode

```
Privileged EXEC
```

4.11.7 clear arp-table-switch

This command clears the agent´s ARP table (cache).

Format

```
clear arp-table-switch
```

Mode

```
Privileged EXEC
```

4.11.8 clear config

This command resets the configuration in RAM to the factory defaults without powering off the switch.

Format

```
clear config
```

Mode

```
Privileged EXEC
```

4.11.9 clear config factory

This command resets the whole configuration to the factory defaults. Configuration data and scripts stored in nonvolatile memory will also be deleted.

Format

```
clear config factory
```

Mode

```
Privileged EXEC
```

4.11.10 clear counters

This command clears the stats for a specified <slot/port>or for all the ports or for the entire switch based upon the argument.

Format

```
clear counters {<slot/port> | all}
```

Mode

```
Privileged EXEC
```

4.11.11 clear hiper-ring

This command clears the HIPER Ring configuration (deletes it).

Format

```
clear hiper-ring
```

Mode

```
Privileged EXEC
```

4.11.12 clear igmpsnooping

This command clears the tables managed by the IGMP Snooping function and will attempt to delete these entries from the Multicast Forwarding Database.

Format

```
clear igmpsnooping
```

Mode

```
Privileged EXEC
```

4.11.13 clear mac-addr-table

This command clears the switch's MAC address table (the forwarding database that contains the learned MAC addresses).

Note: this command does not affect the MAC filtering table.

Format

```
clear mac-addr-table
```

Mode

```
Privileged EXEC
```

4.11.14 clear pass

This command resets all user passwords to the factory defaults without powering off the switch. You are prompted to confirm that the password reset should proceed.

Format

```
clear pass
```

Mode

```
Privileged EXEC
```

4.11.15 clear link-aggregation

This command clears all link-aggregations (LAGs).

Format

```
clear link-aggregation
```

Mode

```
Privileged EXEC
```

4.11.16 clear signal-contact

This command clears the signal-contact output configuration.
Switches the signal contact 1´s mode to `auto` and its manual setting to `open`.
Switches the signal contact 2´s mode to `manual` and its manual setting to `closed`.
Enables the monitoring of the power supplies for signal contact 1 only.
Disables the sending of signal contact traps.

Format

```
clear signal-contact
```

Mode

```
Privileged EXEC
```

4.11.17 clear traplog

This command clears the trap log.

Format

```
clear traplog
```

Mode

```
Privileged EXEC
```

4.11.18 clear ring-coupling

This command clears the ring-coupling configuration.

Format

```
clear ring-coupling
```

Mode

```
Privileged EXEC
```

4.11.19 clear vlan

This command resets VLAN configuration parameters to the factory defaults.

Format

```
clear vlan
```

Mode

```
Privileged EXEC
```

4.11.20 config-watchdog

If the function is enabled and the connection to the switch is interrupted for longer than the time specified in “timeout [s]”, the switch then loads the last configuration saved.

Format

```
config-watchdog {admin-state {disable|enable}|
timeout <10..600>}
```

Mode

```
Global Config
```

admin-state

Enable or disable the Auto Configuration Undo feature
Default value: `disabled`.

timeout

Configure the Auto Configuration Undo timeout (unit: seconds).

4.11.21 copy

This command uploads and downloads to/from the switch. Remote URLs can be specified using tftp.
`copy` (without parameters) displays a brief explanation of the most important copy commands. A list of valid commands is provided below.
The command can be used to the save the running configuration to nvram by specifying the source as `system:running-config` and the destination as `nvram:startup-config`.

Default

```
none
```

Format

```
copy
copy aca:script <sourcefilename> nvram:script
  [targetfilename]
copy aca:capturefilter <sourcefilename>
  nvram:capturefilter [targetfilename]
```

```
copy aca:sfp-white-list <sourcefilename>
  nvram:sfp-white-list
copy nvram:backup-image system:image
copy nvram:clibanner <url>
copy nvram:capture aca:capture
copy nvram:capture <url>
copy nvram:capturefilter <sourcefilename>
  aca:capturefilter <targetfilename>
copy nvram:capturefilter <sourcefilename>
copy nvram:errorlog <url>
copy nvram:script <sourcefilename> aca:script
  [targetfilename]
copy nvram:script <sourcefilename> <url>
copy nvram:startup-config <url>
copy nvram:startup-config system:running-config
copy nvram:traplog <url>
copy system:running-config nvram:startup-config
<url>
copy system:running-config <url>
copy <tftp://ip/filepath/fileName>
  nvram:sfp-white-list
copy tftp://<server_ip>/<path_to_pem>
     nvram:httpscert
copy <url> nvram:clibanner
copy <url> nvram:capturefilter <destfilename>
copy aca:capturefilter <sourcefilename>
  nvram:capturefilter <destfilename>
copy <url> nvram:script <destfilename>
copy <url> nvram:startup-config
copy <url> system:image
copy <url> system:running-config
copy <url> system:bootcode
```

Mode

Privileged EXEC

- **copy aca:script <sourcefilename> nvram:script [targetfilename]**

  Copies the script from the Auto Configuration Adapter.

  – `sourcefilename`: Filename of source configuration Script. Filename length may be max. 20 characters, including extension '.cli' or '.CLI'.

  – `targetfilename`: Filename on the switch's NVRAM. Filename length may be max. 20 characters, including extension '.cli'.

- **copy aca:capturefilter <sourcefilename> nvram:capturefilter [targetfilename]**

  Copies a capture filter file from the Auto Configuration Adapter.

  – `sourcefilename`: Filename of source capture filter expressions file.

  – `targetfilename`: Filename on the switch's NVRAM.

- **copy aca:sfp-white-list <sourcefilename> nvram:sfp-white-list**

  Use this command to load the SFP white list file from a ACA21.
  Note: In order to delete the SFP white list file from the flash memory: use the command `clear sfp-white-list`.
  The `clear config factory` command deletes the SFP white list, too.

- **copy nvram:backup-image system:image**

  Use this command to swap current and backup images. The backup image (backup.bin) and current image (main.bin) will exchange the file name, after reboot the both OS and configuration files will be swapped.

- **copy <tftp://ip/filepath/fileName> nvram:sfp-white-list**

  Use this command to load the SFP white list file from a TFTP server.
  Note: In order to delete the SFP white list file from the flash memory: use the command `clear sfp-white-list`.
  The `clear config factory` command deletes the SFP white list, too.

- **copy tftp://<server_ip>/<path_to_pem> nvram:httpscert**

  Use this command for uploading a PEM certificate for HTTPS over TFTP
  Note: Reboot the device or re-enable the HTTPS server after uploading a PEM certificate.

- **copy nvram:clibanner <url>**

  Downloads the CLI banner file via TFTP using <tftp://ip/filepath/fileName>.

- **copy nvram:capture aca:capture**

  Save the internal packet capture file to the Auto Configuration Adapter ACA21 (file name: "capture.cap").

- **copy nvram:capture <url>**

  Save the internal packet capture file to a tftp URL using <tftp://ip/filepath/fileName>.

- **copy nvram:capturefilter <sourcefilename> aca:capturefilter <targetfilename>**

  Save a capture filter file from the flash memory to the Auto Configuration Adapter.

  – sourcefilename : Filename of source capture filter expressions file.

– targetfilename: Filename of target capture filter expressions file.

- **copy nvram:capturefilter <sourcefilename> <url>**

  Save the internal packet capture filter file from the flash memory to a tftp URL using <tftp://ip/filepath/fileName>.

  – sourcefilename: Filename of source capture filter expressions file.

- **copy nvram:errorlog <url>**

  Uploads Errorlog file.

  – <url>: Uploads Error log file using <tftp://ip/filepath/fileName>.

- **copy nvram:script <sourcefilename> aca:script [targetfilename]**

  Uploads configuration script file. Save the script to the AutoConfiguration Adapter.

  – `sourcefilename`: Filename length may be max. 20 characters, including extension '.cli' or '.CLI'.

  – `targetfilename`: Filename length may be max. 20 characters, including extension '.cli' or '.CLI'.

- **copy nvram:script <sourcefilename> <url>**

  Uploads Configuration Script file using <tftp://ip/filepath/fileName>. Filename length may be max. 20 characters, including extension '.cli'.

  – `sourcefilename`: Filename length may be max. 20 characters, including extension '.cli' or '.CLI'.

- **copy nvram:startup-config <url>**

  Uploads config file using <tftp://ip/filepath/fileName>.

- **copy nvram:startup-config system:running-config**

  Uploads/Copies config file. The target is the currently running configuration.

- **copy nvram:traplog <url>**

  Uploads Trap log file. Uploads Trap log file using <tftp://ip/filepath/fileName>.

- **copy system:running-config nvram:startup-config**

  Copies system config file. Save the running configuration to NVRAM.

- **copy system:running-config <url>**

  Copies system config file. Uploads system running-config via tftp using <tftp://ip/filepath/fileName>.

copy <url> nvram:clibanner

This feature provides a privileged user the capability to change the CLI default banner:

```
-------------------------------------------------
Copyright (c) 2004-2015 <Company Name>

          All rights reserved

     <Product Name> Release L3P-09.0.00

     (Build date 2015-02-02 02:02)


     System Name:  <Product Name>
     Mgmt-IP    :  a.b.c.d
     1.Router-IP:  0.0.0.0
     Base-MAC   :  aa:bb:cc:dd:ee:ff
     System Time:  2015-02-02 15:15:15
-------------------------------------------------
```

The command uploads the CLI banner file by tftp using `<tftp://ip/filepath/fileName>`.

After the upload you logout from CLI and the new CLI banner file will be displayed at the next login.

– `url`: Upload CLI banner file using <tftp://ip/filepath/fileName>.

If no cli banner file is defined, the default cli banner is displayed (see above).

Note: Note that the CLI banner file you created has the following properties:

- Use ASCII format (character codes `0x20` .. `0x7F`, `\n` and `\t` as C-like sequences)
- Do not use regular expressions
- Do not exeed the limit of 2048 byte
- Do not exceed the limit of 20 lines
- Do not exceed the limit of 80 characters per line
- A device can only have one banner file at the moment
- Save the CLI banner file as *.bnr.

Note: Alternatively, use the following command to define the text for the CLI login banner. This banner replaces the banner before login.
`set clibanner text <Max. 2048 characters>`
See “set clibanner” on page 335

no clibanner

This command deletes an existing CLI banner file.

copy <url> nvram:capturefilter <destfilename>

Load a Capture Filter file from a tftp URL into the flash memory using `<tftp://ip/filepath/fileName>`.
– `destfilename`: Destination filename of capture filter expressions file.

copy aca:capturefilter <sourcefilename> nvram:capturefilter <targetfilename>

Load a capture filter file from AutoConfiguration Adapter ACA21 into the flash memory.

– `sourcefilename`: Filename of source capture filter expressions file.

– `targetfilename`: Specify the file name on the switch's NVRAM.

copy <url> nvram:script <destfilename>

Downloads Configuration Script file using <tftp://ip/filepath/fileName>.
– `destfilename`: Filename length may be max. 20 characters, including extension '.cli' or '.CLI'.

copy <url> nvram:sshkey-dsa

Downloads IP secure shell (SSH) DSA key file by tftp using <tftp://ip/filepath/fileName>.

- **copy <url> nvram:sshkey-rsa1**

  Downloads IP secure shell (SSH) RSA1 key file by tftp using <tftp://ip/filepath/fileName>.

- **copy <url> nvram:sshkey-rsa2**

  Downloads IP secure shell (SSH) RSA2 key file by tftp using <tftp://ip/filepath/fileName>.

- **copy <url> nvram:startup-config**

  Downloads Config file by tftp using <tftp://ip/filepath/fileName>.

- **copy <url> system:image**

  Downloads code file by tftp using <tftp://ip/filepath/fileName>.

- **copy <url> system:running-config**

  Downloads Code/Config file using <tftp://ip/filepath/fileName>.
  The target is the currently running configuration.

- **copy <url> system:bootcode**

  Use the "copy <url> system:bootcode" command to load the boot-code file via tftp into the device. For <url> enter the path of the tftp server using the following notation: "<tftp://ip/filepath/fileName>", e.g. "tftp://10.1.112.214/switch/switch01.cfg".

- **clear sfp-white-list**

  Use this command to delete the SFP white list file from the flash memory.
  Note: The `clear config factory` command deletes the SFP white list, too.

4.11.22 device-status connection-error

This command configures the device status link error monitoring for this port.

Default

```
ignore
```

Format

```
device-status connection-error {ignore|propagate}
```

Mode

```
Interface Config
```

4.11.23 device-status monitor

This command configures the device-status.

Format

```
device-status monitor
 {aca-removal | all | connection-error |
hiper-ring |
  module-removal | power-supply-1 |
  power-supply-2 | power-supply-3-1 |
  power-supply-3-2 | power-supply-4-1 |
  power-supply-4-2 | ring-coupling | temperature }
   {error|ignore}
device-status trap {disable|enable}
```

Mode

`Global Config`

monitor

Determines the monitoring of the selected event or all events.
– `error` If the given event signals an error, the device state will also signal `error`,
– `ignore` Ignore the given event - even if it signals an error, the device state will not signal 'error' because of that.

trap

Configure if a trap is sent when the device status changes its state.
– `enable` enables sending traps,
– `disable` disables sending traps.

4.11.24 logout

This command closes the current telnet connection or resets the current serial connection.

Note: Save configuration changes before logging out.

Format

```
logout
```

Mode

```
Privileged EXEC
```

4.11.25 mac-address conflict operation

Use this command to enable sending a trap if the device detects a packet with its own MAC address in the network.
Possible values: `enabled`, `disabled`
Default value: `enabled`

Format

```
mac-address-conflict operation
```

Mode

```
Privileged EXEC
```

no mac-address conflict operation

Use this command to disable sending a trap if the device detects a packet with its own MAC address in the network.

Format

```
no mac-address conflict operation
```

Mode

```
Privileged EXEC
```

4.11.26 ping

This command checks if another computer is on the network and listens for connections. To use this command, configure the switch for network (in-band) connection. The source and target devices must have the ping utility enabled and running on top of TCP/IP. The switch can be pinged from any IP workstation with which the switch is connected through the default VLAN (VLAN 1), as long as there is a physical path between the switch and the workstation. The terminal interface sends, three pings to the target station.

Format

```
ping <ipaddr>
```

Mode

```
Privileged EXEC and User EXEC
```

4.11.27 signal-contact connection-error

This command configures the signal contact link error monitoring for this port.

Format

```
signal-contact connection-error {disable|enable}
```

Mode

```
Interface Config
```

disable

A link down event on this port will be not monitored by a signal contact (default).

enable

A link down event on this port will be monitored by a signal contact.

4.11.28 signal-contact

This command configures the signal contacts.

Format

```
signal-contact {1|2|all}
 {mode {auto|device-status|manual}
 |monitor {aca-removal|
   all|
   connection-error|hiper-ring|module-removal
   |power-supply-1| power-supply-2
   |power-supply-3-1|power-supply-3-2
   |power-supply-4-1|power-supply-4-2
   |ring-coupling|temperature} {disable|enable}
 |state {closed|open}
 |trap {disable|enable} }
```

Mode

`Global Config`

Contact No.

Selection of the signal contact:
– `1` signal contact 1,
– `2` signal contact 2,
– `all` signal contact 1 and signal contact 2.

mode

Selection of the operational mode:
– `auto` function monitoring,
– `device-status` the device-status determines the signal contact´s status.
– `manual` manually setting the signal contact.

monitor

Enables or disables the monitoring of the selected event or all events.
– `enable` monitoring,
– `disable` no monitoring.

state

Set the manual setting of the signal contact:
– `closed` ,
– `open`.
Only takes immediate effect in manual mode.

trap

Configures the sending of traps concerning the signal contact.
– `enable` enables sending traps,
– `disable` disables sending traps.

4.11.29 temperature

Note: The command is available for RS20/RS30/RS40, MS20/MS30, RSR20/RSR30, MACH100, MACH1000, PowerMICE, MACH4000 and OCTOPUS devices.

This command configures the lower and upper temperature limit for the device. If these limits are exceeded, a trap is sent. The unit for the temperature limit is °C (Celsius), the minimum value is `-99`, the maximum value is 99. The default for the lower limit is 0, for the upper limit, it is `70`.

Note: To give the temperature in Fahrenheit, use the suffix f.

Format

```
temperature {lower-limit|upper-limit} <temperature
value> [c|f]
```

Mode

`Global Config`

lower-limit

Configure the lower temperature limit.

upper-limit

Configure the upper temperature limit.

4.11.30 reboot

This command resets the switch (cold start) after a given time delay, for warm start See “reload” on page 333. Reset means that all network connections are terminated and the boot code executes. The switch uses the stored configuration to initialize the switch. You are prompted to confirm that the reset should proceed. A successful reset is indicated by the LEDs on the switch.

Format

```
reboot {delay <seconds>}
```

Mode

```
Privileged EXEC
```

<seconds>

The number of seconds after which the switch will reboot.
Value range: `None` (no reboot sceduled), `0 .. 2147483` sec (= 596 h + 31 min + 23 sec).

clear reboot

This command cancels a scheduled reboot.

4.11.31 show reboot

This command displays if a reboot is scheduled for the device. If scheduled, the command displays the number of seconds after which the switch will reboot.

Format

```
show reboot
```

Modes

```
Privileged EXEC
User Exec
```

<seconds>

The number of seconds after which the switch will reboot.
Value range: `None` (no reboot scheduled), `0 .. 2147483` sec (= 596 h + 31 min + 23 sec).

4.11.32 reload

This command enables you to reset the switch (warm start) after a given time delay, for cold start See “reboot” on page 331.
Note: First, the device is checking the software in the flash memory and then it resets. If a warm start is not possible, the device automatically executes a cold start.
Reset means that all network connections are terminated and the boot code executes. The switch uses the stored configuration to initialize the switch. You are prompted to confirm that the reset should proceed. A successful reset is indicated by the LEDs on the switch.

Format

```
reload {delay <seconds>}
```

Mode

```
Privileged EXEC
```

<seconds>

The number of seconds after which the switch will reload.
Value range: `0..2147483` sec.

clear reload

This command cancels a scheduled reload.

4.11.33 show reload

This command displays if a reload is scheduled for the device. If scheduled, the command displays the number of seconds after which the switch will reload.

Format

```
show reload
```

Modes

```
Privileged EXEC
User Exec
```

<seconds>

The number of seconds after which the switch will reload.
Possible values: `None` (no reload scheduled), `0..2147483` sec.

4.11.34 set clibanner

Use this command to set the preferences for the CLI login banner. Enable or disable the CLI login banner and define the text for the login banner.
This banner replaces the CLI banner before login.

Format

```
set clibanner {operation |
               text <Max. 2048 characters>}
```

Modes

```
Privileged EXEC
```

operation

Enable the CLI login banner.

text

Define the text for the CLI login banner.

Possible values: Max. 2048 characters in the range ASCII code 0x20 (space character, “ ”) to ASCII code 0x7E (tilde, “~”), except ASCII code 0x25 (percent sign, "`%`").

Use `\\n`: for new line and `\\t` for horizontal tabulator.

Enter the text with quotes, e.g.
`"This is a login banner text."`

Example:

```
**************************************************
*                                                *
*    Site:      <Name of the location>           *
*    Equipment: <Device name>                    *
*                                                *
*    Unauthorized access will be prosecuted.     *
*                                                *
**************************************************
```

no set clibanner operation

Use this command to disable the CLI login banner.

Format

```
no set clibanner operation
```

Mode

```
Privileged EXEC
```

4.11.35 set pre-login-banner

Use this command to set the preferences for the CLI pre-login banner. Enable or disable the CLI pre-login banner and define the text for the pre-login banner.
The device displays this banner additionally before login in CLI and Graphical User Interface.

Format

```
set pre-login-banner { operation |
                       text <max. 255 characters> }
```

Modes

```
Privileged EXEC
```

operation

Enable the CLI login banner.

text

Define the text for the CLI pre-login banner.

Default: `Empty string`
Possible values: Max. 255 characters in the range ASCII code 0x20 (space character, “ ”) to ASCII code 0x7E (tilde, “~”), except ASCII code 0x25 (percent sign, "%").

Use `\\n`: for new line and `\\t` for horizontal tabulator.

Enter the text within quotes, e.g.
`"This is a pre-login banner text."`

Example:

```
**************************************************
*                                                *
*    Site:      Name of the location             *
*    Equipment: Device name                      *
*                                                *
*    Unauthorized access will be prosecuted.     *
*                                                *
**************************************************
```

no set pre-login-banner operation

Use this command to disable the CLI pre-login banner.

Format

```
no set pre-login-banner operation
```

Mode

Privileged EXEC

4.12 LLDP - Link Layer Discovery Protocol

These commands show and configure the LLDP parameters in compliance with IEEE 802.1 AB.

4.12.1 show lldp

This command shows all LLDP settings.

Format

```
show lldp
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.2 show lldp config

This command shows all LLDP configuration settings.

Format

```
show lldp config
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.3 show lldp config chassis

This command shows all LLDP configuration settings concerning the entire device.

Format

```
show lldp config chassis
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.4 show lldp config chassis admin-state

Display the LLDP/IEEE802.1AB functionality on this device. If disabled, the LLDP protocol is inactive but the LLDP MIBs can still be accessed.

Format

```
show lldp config chassis admin-state
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.5 show lldp config chassis notification-interval

Display the LLDP minimum notification trap interval (unit: seconds).

Format

```
show lldp config chassis notification-interval
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.6 show lldp config chassis re-init-delay

Display the LLDP configuration's chassis re-initialization delay (unit: seconds).

Format

```
show lldp config chassis re-init-delay
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.7 show lldp config chassis tx-delay

Display the LLDP transmit delay (unit: seconds). It indicates the delay between successive LLDP frame transmissions.

Format

```
show lldp config chassis tx-delay
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.8 show lldp config chassis tx-hold-mult

Display the LLDP transmit hold multiplier, a time-to-live value expressed as a multiple of the LLDP Message Tx Interval (tx-interval).

Format

```
show lldp config chassis tx-hold-mult
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.9 show lldp config chassis tx-interval

Display the interval (unit: seconds) at which LLDP frames are transmitted on behalf of this LLDP agent.

Format

```
show lldp config chassis tx-interval
```

Mode

```
Privileged EXEC and User EXEC
```

4.12.10 show lldp config port

This command shows all LLDP configuration settings and states concerning one or all ports.

Format

```
show lldp config port <{slot/port|all}>
  admin-state | fdb-mode | hm-mode |
  max-neighbors | notification | tlv
```

Mode

```
Privileged EXEC and User EXEC
```

admin-state

Display the port's LLDP admin state (if LLDP/IEEE802.1AB frames will be transmitted and/or received).

fdb-mode

Display the port's LLDP FDB mode.

hm-mode

Display the port's LLDP Hirschmann mode.

.**max-neighbors**

Display the port's max. no. of LLDP neighbors.

notification

Display the port's LLDP notification (trap) setting.

tlv

Display the port's LLDP TLV settings (they determine which information is included in the LLDP frames that are sent). The command is a group command and will output several lines of data.

4.12.11 show lldp config port tlv

This command shows all LLDP TLV configuration settings (if the given information is included in the sent LLDP frames or not) concerning one or all ports.

Format

```
show lldp config port <{slot/port|all}> tlv
```

Mode

```
Privileged EXEC and User EXEC
```

inlinepower

Enable or disable the sending of the port's Power over Ethernet capabilities (PoE, IEEE 802.3af).
Note: This command is available for devices supporting PoE.

link-aggregation

Display the port's LLDP TLV inclusion of Link Aggregation.

mac-phy-config-state

Display the port's LLDP TLV inclusion of MAC Phy. Cfg. State.

max-frame-size

Display the port's LLDP TLV inclusion of Max. Frame Size.

PROFINET IO Status

Display the port's LLDP TLV inclusion of PROFINET IO Status.

PROFINET IO Alias

Display the port's LLDP TLV inclusion of PROFINET IO Alias.

PROFINET IO MRP

Display the port's LLDP TLV inclusion of PROFINET IO MRP.

mgmt-addr

Display the port's LLDP TLV inclusion of Management Address.

port-desc

Display the port's LLDP TLV inclusion of Port Description.

port-vlan

Display the port's LLDP TLV inclusion of Port VLAN.

protocol

Display the port's LLDP TLV inclusion of Protocol.

sys-cap

Display the port's LLDP TLV inclusion of System Capabilities.

sys-desc

Display the port's LLDP TLV inclusion of System Description.

sys-name

Display the port's LLDP TLV inclusion of System Name.

vlan-name

Display the port's LLDP TLV inclusion of VLAN Name.

4.12.12 show lldp med

Use this command to display a summary of the current LLDP MED global configuration.

Format

```
show lldp med
```

Mode

```
Privileged EXEC
```

Fast Start Repeat Count

Display the Fast Start Repeat Count, e.g. the number of LLDP PDUs that will be transmitted when the product is enabled.
Value range: `1..10`.

Device class

Display the Device class.

4.12.13 show lldp med interface

Use this command to display a summary of the current LLDP MED configuration for a specific interface.

Format

```
show lldp med interface {<unit/slot/port> | all}
```

Mode

```
Privileged EXEC
```

<unit/slot/port>

Indicates a specific physical interface.

all

Indicates all valid LLDP interfaces.

Interface

Displays the physical interface.

Link

Displays the link status.
Possible values: `Up, Down`.

configMED

Displays if confignotification for the Media Endpoint Devices is `Enabled/Disabled`.

operMED

Displays if operation for the Media Endpoint Devices is `Enabled/Disabled`.

ConfigNotify

Displays the ConfigNotify.
Possible values: `Enabled, Disabled`.

TLVsTx

Displays the TLVsTx.

4.12.14 show lldp med local-device detail

Use this command to display detailed information about the LLDP MED data that a specific interface transmits. `<unit/slot/port>` indicates a specific physical interface.

Format

```
show lldp med local-device detail {<slot/port>}
```

Mode

```
Privileged EXEC
```

<slot/port>

Indicates a specific physical interface.

Interface

Displays the physical interface.

Network Policies

Displays the Network Policies.

4.12.15 show lldp med remote-device

Use this command to display the summary information about remote devices that transmit current LLDP MED data to the system. You can show information about LLDP MED remote data received on all valid LLDP interfaces or on a specific physical interface.

Format

```
show lldp med remote-device{<slot/port> | all}
```

Mode

```
Privileged EXEC
```

<slot/port>

Indicates a specific physical interface.

all

Indicates all valid LLDP interfaces.

Local Interface

Displays the local interface.

RemoteID

Displays the RemoteID.

Device Class

Displays the Device Class.

4.12.16 show lldp med remote-device detail

Use this command to display detailed information about remote devices that transmit current LLDP MED data to an interface on the system.

Format

```
show lldp med remote-device detail <slot/port>
```

Mode

```
Privileged EXEC
```

Local Interface

Displays the local interface.

4.12.17 show lldp remote-data

This command shows all LLDP remote-data settings and states concerning one or all ports.

Format

```
show lldp remote-data <{slot/port|all}>
  chassis-id | detailed | ether-port-info |
  inlinepower | link-aggregation-info |
  mgmt-addr | profinetio-port-info |
  port-desc | port-id | summary | sys-desc |
  sys-name | vlan-info
```

Mode

```
Privileged EXEC and User EXEC
```

chassis-id

Display the remote data's chassis ID only.

detailed

Display remote data in detailed format (i. e., all available data).
Note: most important data is output first (not in alphabetic order of command names). This is the default command if no specific command is given.

ether-port-info

Display the remote data's port Ethernet properties only (group command, outputs: Port Autoneg. Supported, Port Autoneg. Enabled, Port Autoneg. Advertized Capabilities and Port Operational MAU Type).

inlinepower

Displays the remote port's Power over Ethernet capabilities (PoE, IEEE 802.3af). Included are if the remote device is a PSE (Power Source Device) or a PD (Powered Device), if PoE is supported and if the power pairs are selectable.

link-aggregation-info

Display the remote data's link aggregation information only (group command, outputs: Link Agg. Status and Link Agg. Port ID).

mgmt-addr

Display the remote data's management address only.

profinetio-port-info

Display the remote data's Port ProfinetIO properties only.

port-desc

Display the port's LLDP TLV inclusion of Port Description.

port-id

Display the remote data's port ID only.

summary

Display remote data in summary format (table with most important data only, strings will be truncated if necessary, indicated by an appended '>' character).

sys-desc

Display the remote data's system description only.

sys-name

Display the remote data's system name only.

vlan-info

Display the remote data's VLAN information only (group command, outputs: Port VLAN ID, Membership VLAN IDs and their respective names).

4.12.18 lldp

Enable/disable the LLDP/IEEE802.1AB functionality on this device. If disabled, the LLDP protocol will become inactive, but the LLDP MIBs can still be accessed. This command is a shorthand notation for `lldp config chassis admin-state {off|on}` (see “lldp config chassis admin-state” on page 352).

The default setting is `on`.

Format

```
lldp
```

Mode

```
Global Config
```

- **no lldp**
  Disable the LLDP/IEEE802.1AB functionality on this device.

Format

```
no lldp
```

Mode

```
Global Config
```

4.12.19 lldp config chassis admin-state

Configure the LLDP/IEEE802.1AB functionality on this device. If disabled, the LLDP protocol will become inactive, but the LLDP MIBs can still be accessed.

- `off`: Disable the LLDP/IEEE802.1AB functionality.
- `on`: Enable the LLDP/IEEE802.1AB functionality.

The default setting is `on`.

Format

```
lldp config chassis admin-state {off|on}
```

Mode

```
Global Config
```

4.12.20 lldp config chassis notification-interval

Configure the LLDP minimum notification interval (the minimum time after a notification trap has been sent until a new trap can be sent, unit: seconds, min.: `5` sec., max.: `3600` sec., Default value: `5` sec.).

Format

```
lldp config chassis notification-interval
 <notification interval>
```

Mode

```
Global Config
```

Notification interval

Configure the LLDP minimum notification interval (the minimum time after a notification trap has been sent until a new trap can be sent, unit: seconds, min.: `5` sec., max.: `3600` sec., Default value: `5` sec.).

4.12.21 lldp config chassis re-init-delay

Configure the LLDP re-initialization delay (unit: seconds, min.: 1 sec., max.: 10 sec., Default value: 2 sec.).

Format

```
lldp config chassis re-init-delay <re-init delay>
```

Mode

```
Global Config
```

Re-init-delay

Configure the LLDP re-initialization delay (unit: seconds, min.: 1 sec., max.: 10 sec., Default value: 2 sec.).

4.12.22 lldp config chassis tx-delay

Configure the LLDP transmit delay, the delay between successive LLDP frame transmissions (unit: seconds, min.: 1 sec., max.: 8192 sec., Default value: 2 sec.).

Format

```
lldp config chassis tx-delay <tx delay>
```

Mode

```
Global Config
```

Tx-delay

Configure the LLDP transmit delay, the delay between successive LLDP frame transmissions (unit: seconds, min.: 1 sec., max.: 8192 sec., Default value: 2 sec.).

4.12.23 lldp config chassis tx-hold-mult

Configure the LLDP transmit hold multiplier, a time-to-live value expressed as a multiple of the LLDP Message Tx Interval (tx-interval), min.: 2, max.: 10, Default value: 4.

Format

```
lldp config chassis tx-hold-mult
                                <tx hold multiplier>
```

Mode

Global Config

Tx-hold-mult

Configure the LLDP transmit hold multiplier, a time-to-live value expressed as a multiple of the LLDP Message Tx Interval (tx-interval), min.: 2, max.: 10, Default value: 4.

4.12.24 lldp chassis tx-interval

Configure the interval at which LLDP frames are transmitted on behalf of this LLDP agent (unit: seconds, min.: 5 sec., max.: 32768 sec., Default value: 30 sec.)

Format

```
lldp chassis tx-interval <tx interval>
```

Mode

Global Config

Tx-interval

Configure the interval at which LLDP frames are transmitted on behalf of this LLDP agent (unit: seconds, min.: 5 sec., max.: 32768 sec., Default value: 30 sec.).

4.12.25 clear lldp config all

Clear the LLDP configuration, i. e., set all configurable parameters to default values (all chassis- as well as port-specific parameters at once).
Note: LLDP Remote data remains unaffected.

Format

```
clear lldp config all
```

Mode

```
Privileged EXEC
```

4.12.26 lldp admin-state

Configure the port's LLDP admin state (if LLDP/IEEE802.1AB frames will be transmitted to and/or received from the standard IEEE multicast address 01:80:c2:00:00:0e).

The default setting is `tx-and-rx`.

Format

```
lldp admin-state <{tx-only|rx-only|tx-and-rx|off}>
```

Mode

```
Interface Config
```

4.12.27 lldp fdb-mode

Configure the port's LLDP FDB mode.

The default setting is `autodetect`.

Format

```
lldp fdb-mode <{lldp-only|mac-only|lldp-and-
mac|autodetect}>
```

Mode

```
Interface Config
```

4.12.28 lldp hm-mode

Configure the port's LLDP Hirschmann mode (if LLDP/IEEE802.1AB frames will be transmitted to and/or received from the Hirschmann-specific multicast address 01:80:63:2f:ff:0b).

The default setting is `tx-and-rx`.

Format

```
lldp hm-mode <{tx-only|rx-only|tx-and-rx|off}>
```

Mode

```
Interface Config
```

4.12.29 lldp max-neighbors

Configure the port's LLDP max. no. of neighbors (min.: `1`, max.: `50`, Default value: `10`).

Format

```
lldp max-neighbors <1..50>
```

Mode

```
Interface Config
```

4.12.30 lldp med

LLDP for Media Endpoint Devices (LLDP-MED) is an extension to LLDP that operates between endpoint devices such as IP phones, Voice / Media Gateways, Media Servers, IP Communications Controllers or other VoIP devices or servers, and network devices such as switches. It specifically provides support for voice over IP (VoIP) applications. In this purpose, it provides an additional set of common advertisement messages (TLVs), for capabilities discovery, network policy, Power over Ethernet, inventory management and location information.
Use this command to enable MED. By enabling MED, you will be effectively enabling the transmit and receive function of LLDP.

Default

```
Enabled
```

Format

```
lldp med
```

Mode

```
Interface Config
```

no lldp med

Use this command to disable MED.

Format

```
no lldp med
```

Mode

```
Interface Config
```

4.12.31 lldp med all

Use this command to configure LLDP-MED on all the ports.

Default

`Enabled`

Format

`lldp med all`

Mode

`Global Config`

4.12.32 lldp med confignotification

Use this command to configure all the ports to send the topology change notification.

Default

`Disabled`

Format

`lldp med confignotification`

Mode

`Interface Config`

no lldp med confignotification

Use this command to disable notifications.

Format

`no lldp med confignotification`

Mode

`Interface Config`

4.12.33 lldp med confignotification all

Use this command to configure all the ports to send the topology change notification.

Default

```
Disabled
```

Format

```
lldp med confignotification all
```

Mode

```
Global Config
```

4.12.34 lldp med faststartrepeatcount

Use this command to set the value of the fast start repeat count.

Default

3

Format

lldp med faststartrepeatcount [count]

Mode

Global Config

[count]

The number of LLDP PDUs that will be transmitted when the product is enabled. The range is 1 to 10.

no lldp med faststartrepeatcount

Use this command to return to the factory default value.

Format

no lldp med faststartrepeatcount

Mode

Global Config

4.12.35 lldp med transmit-tlv

Use this command to specify which optional Type Length Values (TLVs) in the LLDP-MED set will be transmitted in the Link Layer Discovery Protocol Data Units (LLDPDUs).

Default

```
By default, the capabilities and network policy
TLVs are included.
```

Format

```
lldp med transmit-tlv [capabilities]
                                    [network-policy]
```

Mode

```
Interface Config
```

capabilities

Include/Exclude LLDP capabilities TLV.

network-policy

Include/Exclude LLDP network policy TLV.

no lldp med transmit-tlv

Use this command to remove a TLV.

Format

```
no lldp med transmit-tlv [capabilities]
                                    [network-policy]
```

Mode

```
Interface Config
```

4.12.36 lldp med transmit-tlv all

Use this command to specify which optional Type Length Values (TLVs) in the LLDP MED set will be transmitted in the Link Layer Discovery Protocol Data Units (LLDPDUs).

Default

By default, the capabilities and network policy TLVs are included.

Format

```
lldp med transmit-tlv all [capabilities]
                                    [network-policy]
```

Mode

Global Config

capabilities

Include/Exclude LLDP capabilities TLV.

network-policy

Include/Exclude LLDP network policy TLV.

no lldp med med transmit-tlv all

Use this command to remove a TLV.

Format

```
no lldp med transmit-tlv all [capabilities]
                                    [network-policy]
```

Mode

Global Config

4.12.37 lldp notification

Configure the port's LLDP notification setting (on or off, Default value: off).

Format

```
lldp notification <{off|on}>
```

Mode

```
Interface Config
```

4.12.38 lldp tlv link-aggregation

Configure the port's LLDP TLV inclusion of Link Aggregation (on or off, default: on).

Format

```
lldp tlv link-aggregation <{off|on}>
```

Mode

```
Interface Config
```

4.12.39 lldp tlv mac-phy-config-state

Configure the port's LLDP TLV inclusion of MAC Phy. Cfg. State (on or off, default: on).

Format

```
lldp tlv mac-phy-config-state <{off|on}>
```

Mode

```
Interface Config
```

4.12.40 lldp tlv max-frame-size

Configure the port's LLDP TLV inclusion of Max. Frame Size (on or off, default: on).

Format

```
lldp tlv max-frame-size <{off|on}>
```

Mode

```
Interface Config
```

4.12.41 lldp tlv mgmt-addr

Configure the port's LLDP TLV inclusion of Management Address (on or off, default: on).

Format

```
lldp tlv mgmt-addr <{off|on}>
```

Mode

```
Interface Config
```

4.12.42 lldp tlv pnio

Configure the port's LLDP TLV inclusion of PROFINET IO Status (on or off, default: on).

Format

```
lldp tlv pnio <{off|on}>
```

Mode

```
Interface Config
```

4.12.43 lldp tlv pnio-alias

Configure the port's LLDP TLV inclusion of PROFINET IO Alias (on or off, default: on).

Format

```
lldp tlv pnio-alias <{off|on}>
```

Mode

```
Interface Config
```

4.12.44 lldp tlv pnio-mrp

Configure the port's LLDP TLV inclusion of PROFINET IO MRP (on or off, default: on).

Format

```
lldp tlv pnio-mrp <{off|on}>
```

Mode

```
Interface Config
```

4.12.45 lldp tlv port-desc

Configure the port's LLDP TLV inclusion of Port Description (on or off, default: on).

Format

```
lldp tlv port-desc <{off|on}>
```

Mode

```
Interface Config
```

4.12.46 lldp tlv port-vlan

Configure the port's LLDP TLV inclusion of Port VLAN (on or off, default: on).

Format

```
lldp tlv port-vlan <{off|on}>
```

Mode

```
Interface Config
```

4.12.47 lldp tlv gmrp

Configure the port's LLDP TLV inclusion of GMRP (on or off, default: on).

Format

```
lldp tlv gmrp <{off|on (on)}>
```

Mode

```
Interface Config
```

4.12.48 lldp tlv igmp

Configure the port's LLDP TLV inclusion of IGMP (on or off, default: on).

Format

```
lldp tlv igmp <{off|on (on)}>
```

Mode

```
Interface Config
```

4.12.49 lldp tlv portsec

Configure the port's LLDP TLV inclusion of PortSec (on or off, default: on).

Format

```
lldp tlv portsec <{off|on (on)}>
```

Mode

```
Interface Config
```

4.12.50 lldp tlv ptp

Configure the port's LLDP TLV inclusion of PTP (on or off, default: on).

Format

```
lldp tlv ptp <{off|on (on)}>
```

Mode

```
Interface Config
```

4.12.51 lldp tlv protocol

Configure the port's LLDP TLV inclusion of Protocol (on or off, default: on).

Format

```
lldp tlv protocol <{off|on (on)}>
```

Mode

```
Interface Config
```

4.12.52 lldp tlv sys-cap

Configure the port's LLDP TLV inclusion of System Capabilities (on or off, default: on).

Format

```
lldp tlv sys-cap <{off|on}>
```

Mode

```
Interface Config
```

4.12.53 lldp tlv sys-desc

Configure the port's LLDP TLV inclusion of System Description (on or off, default: on).

Format

```
lldp tlv sys-desc <{off|on}>
```

Mode

```
Interface Config
```

4.12.54 lldp tlv sys-name

Configure the port's LLDP TLV inclusion of System Name (on or off, default: on).

Format

```
lldp tlv sys-name <{off|on}>
```

Mode

```
Interface Config
```

4.12.55 lldp tlv vlan-name

Configure the port's LLDP TLV inclusion of VLAN Name.

Format

```
lldp tlv vlan-name <{off|on}>
```

Mode

```
Interface Config
```

4.12.56 name

Set or remove a descriptive name for the current interface (physical ports only).

Format

```
name <descriptive name>
```

Mode

```
Interface Config
```

<descriptive name>

Enter a descriptive name for the current interface (physical ports only). Max. length is 20 characters.

Note: If it contains blanks or exclamation marks (!), enclose it in quotation marks ("). The description itself must not contain any quotation marks (' or "), question marks (?) or backslashes (\).

no name

Delete the descriptive name for the current interface (physical ports only).

Format

```
no name
```

Mode

```
Interface Config
```

4.13 SNTP - Simple Network Time Protocol

These commands show and configure the SNTP parameters.

4.13.1 show sntp

This command shows all SNTP settings.

Format

```
show sntp
```

Mode

```
Privileged EXEC and User EXEC
```

SNTP Server Anycast Address

Show SNTP Server Anycast Address (a.b.c.d).

SNTP Server Anycast Transmit Interval

Show SNTP Anycast Transmit Interval (in seconds).

SNTP Server Anycast VLAN

Show SNTP Server Anycast VLAN.

SNTP Server Disable if Timesource is local

Show SNTP Server Disable if Timesource is local (Yes/No).

SNTP Client Accepts Broadcasts

Show SNTP Client Accepts Broadcasts (Yes/No).

SNTP Client Disable after Synchronization

Show SNTP Client Disable after Synchronization (Yes/No).

SNTP Client Request Interval

Show SNTP Client Request Interval (in seconds).

SNTP Client Local Time Offset

Show SNTP Client Local Time Offset (in minutes).

SNTP Client Primary Server IP Address

Show SNTP Client Primary Server IP Address (a.b.c.d).

SNTP Client Secondary Server IP Address

Show SNTP Client Secondary Server IP Address (a.b.c.d).

SNTP Client Threshold to Server Time

Show SNTP Client Threshold to Server Time (in milliseconds).

SNTP Operation Global

Show SNTP Operation Global (Disabled or Enabled).

SNTP Operation Server

Show SNTP Operation Server (Disabled or Enabled).

SNTP Operation Client

Show SNTP Operation Client (Disabled or Enabled).

SNTP Status

Show SNTP Status

SNTP Time

Show SNTP Time (yyyy-mm-dd hh:mm:ss).

SNTP System Time

Show SNTP system Time (yyyy-mm-dd hh:mm:ss).

4.13.2 show sntp anycast

This command shows all SNTP anycast configuration settings.

Format

```
show sntp anycast [address|transmit-interval|vlan]
```

Mode

```
Privileged EXEC and User EXEC
```

address

Show the SNTP server's anycast destination IP Address.

transmit-interval

Show the SNTP Server's interval for sending Anycast messages (unit: seconds).

vlan

Show the SNTP server's Anycast VLAN ID (used for sending Anycast messages).

4.13.3 show sntp client

This command shows all SNTP anycast configuration settings.

Format

```
show sntp client [accept-broadcast|
                  disable-after-sync|
                  offset|
                  request-interval|
                  server<primary|secondary>|
                  threshold]
```

Mode

```
Privileged EXEC and User EXEC
```

accept-broadcast

Show if the SNTP Client accepts SNTP broadcasts.

disable-after-sync

Show if the SNTP client will be disabled once it is synchronized to the time server.

offset

Show the local time's offset (in minutes) with respect to UTC (positive values for locations east of Greenwich).

request-interval

Show the SNTP Client's request interval (unit: seconds).

server

Show the SNTP Client's server IP addresses.

server primary

Show the SNTP Client's primary server IP addresses.

server secondary

Show the SNTP Client's redundant server IP addresses.

server threshold

Show the SNTP Client's threshold in milliseconds.

4.13.4 show sntp operation

This command shows if the SNTP function is enabled or disabled.

Format

```
show sntp operation
```

Mode

```
Privileged EXEC and User EXEC
```

4.13.5 show sntp server

This command shows the SNTP Server's configuration parameters.

Format

```
show sntp server [disable-if-local]
```

Mode

```
Privileged EXEC and User EXEC
```

disable-if-local

Show if the server will be disabled if the time is running from the local clock and not synchronized to an external time source.

4.13.6 show sntp status

This command shows the SNTP state, synchronization and error messages.

Format

```
show sntp status
```

Mode

```
Privileged EXEC and User EXEC
```

4.13.7 show sntp time

This command shows time and date.

Format

```
show sntp time [sntp|system]
```

Mode

```
Privileged EXEC and User EXEC
```

sntp

Show the current SNTP date and UTC time.

system

Show the local system's current date and time.

4.13.8 no sntp

This command disables sntp.

Format

```
no sntp
```

Mode

```
Global Config
```

4.13.9 sntp anycast address

Set the SNTP server's anycast destination IP Address, default: 0.0.0.0 (none).

Format

```
sntp anycast address <IPAddress>
```

Mode

```
Global Config
```

no sntp anycast address
Set the SNTP server's anycast destination IP Address to 0.0.0.0.

Format

```
no sntp anycast address
```

Mode

```
Global Config
```

4.13.10 sntp anycast transmit-interval

The transmit interval in seconds, default: 120.

Format

```
sntp anycast transmit-interval <1-3600>
```

Mode

```
Global Config
```

4.13.11 sntp anycast vlan

Set the SNTP server's Anycast VLAN ID used for sending Anycast messages, default: 1.

Format

```
sntp anycast vlan <1-4042>
```

Mode

```
Global Config
```

4.13.12 sntp client accept-broadcast

Enable/Disable that the SNTP Client accepts SNTP broadcasts.

Format

```
sntp client accept-broadcast <on | off>
```

Mode

```
Global Config
```

- **no sntp accept-broadcast**
  Disable the SNTP Client accepts SNTP broadcasts.

Format

```
no sntp client accept-broadcast
```

Mode

```
Global Config
```

4.13.13 sntp client disable-after-sync

If this option is activated, the SNTP client disables itself once it is synchronized to a server.

Format

```
sntp client disable-after-sync <on | off>
```

Mode

```
Global Config
```

off

Do not disable SNTP client when it is synchronized to a time server.

on

Disable SNTP client as soon as it is synchronized to a time server.

4.13.14 sntp client offset

The offset between UTC and local time in minutes, default: 60.

Format

```
sntp client offset <-1000 to 1000>
```

Mode

```
Global Config
```

4.13.15 sntp client request-interval

The synchronization interval in seconds, default: 30.

Format

```
sntp client request-interval <1-3600>
```

Mode

```
Global Config
```

4.13.16 no sntp client server

Disable the SNTP client servers.

Format

```
no sntp client server
```

Mode

```
Global Config
```

4.13.17 sntp client server primary

Set the SNTP Client's primary server IP Address, default: 0.0.0.0 (none).

Format

```
sntp client server primary <IP-Address>
```

Mode

```
Global Config
```

- **no sntp client server primary**
  Disable the primary SNTP client server.

Format

```
no sntp client server primary
```

Mode

```
Global Config
```

4.13.18 sntp client server secondary

Set the SNTP Client's secondary server IP Address, default: 0.0.0.0 (none).

Format

```
sntp client server secondary <IP-Address>
```

Mode

```
Global Config
```

no sntp client server secondary

Disable the secondary SNTP client server.

Format

```
no sntp client server secondary
```

Mode

```
Global Config
```

4.13.19 sntp client threshold

With this option you can reduce the frequency of time alterations. Enter this threshold as a positive integer value in milliseconds. The switch obtains the server timer as soon as the deviation to the server time is above this threshold.

Format

```
sntp client threshold <milliseconds>
```

Mode

```
Global Config
```

Milliseconds

```
Enter the allowed deviation to the server time as a
positive integer value in milliseconds.
```

no sntp client threshold
Disable the sntp client threshold.

Format

```
no sntp client threshold
```

Mode

```
Global Config
```

4.13.20 sntp operation

Enable/Disable the SNTP function.

Format

```
sntp operation <on | off> |
               client { on | off } |
               server { on | off }
```

Mode

```
Global Config
```

client

Enable or disable SNTP Client.

server

Enable or disable SNTP Server.

no sntp operation

Disable the SNTP Client and Server.

Format

```
no sntp operation
```

Mode

```
Global Config
```

4.13.21 sntp server disable-if-local

With this option enabled, the switch disables the SNTP Server Function if it is not synchronized to a time server itself.

Format

```
sntp server disable-if-local <on | off>
```

Mode

```
Global Config
```

off

Enable the SNTP Server even if it is not synchronized to a time server itself.

on

Disable the SNTP Server if it is not synchronized to a time server itself.

4.13.22 sntp time system

Set the current sntp time.

Format

```
sntp time system <YYYY-MM-DD HH:MM:SS>
```

Mode

```
Global Config
```

4.14 PTP - Precision Time Protocol

These commands show and configure the PTP (IEEE 1588) parameters.

Note: The operation parameter is available for all devices.
All other parameters are additionally available for MS20/MS30, MACH1040, MACH104 and PowerMICE.

4.14.1 show ptp

This command shows all PTP settings.

Format

`show ptp`

Mode

`Privileged EXEC and User EXEC`

PTP (Global) Operation

Show the global PTP (IEEE 1588) operation setting. This field shows if PTP is enabled/disabled on this device.
Possible values: `Enabled`, `Disabled`

PTP (Global) Clock Mode

Show which PTP clock mode is currently configured.
Possible values: `v1-simple-mode, v2-simple-mode, v1-boundary-clock, v2-boundary-clock-onestep, v2-boundary-clock-twostep, v2-transparent-clock}`

PTP (Global) Sync. Upper Bound

Show the upper bound for the PTP clock synchronization status (unit: nanoseconds).
Possible values: `31..1000000000 nsec`

PTP (Global) Sync. Lower Bound

Show the lower bound for the PTP clock synchronization status (unit: nanoseconds).
Possible values: `0..999999999 nsec`

PTP Preferred Master

Show if the local switch shall be regarded as a preferred master clock or not.
Possible values: `False`, `True`

PTP Subdomain Name

Show the PTP subdomain name.
Possible values: Up to 16 characters from ASCII hex value 0x21 (`!`) up to and including hex value 0x7e (~).

PTP Sync. Interval

Show the configured Precision Time Protocol sync interval.
The sync interval is the interval (in seconds) between successive sync messages issued by a master clock.
Possible values: `sec-1`, `sec-2`, `sec-8`, `sec-16`, `sec-64`

PTP Status, Is Synchronized

Show if the device is synchronized (true or false).
Possible values: `False`, `True`

PTP Status, Offset From Master

Show the device's offset from the master (unit: nanoseconds), i.e. the deviation of the local clock from the reference clock.

PTP Status, Max. Offset Absolute

Show the device's maximum offset absolute (unit: nanoseconds).

PTP Status, Delay To Master

Show the device's delay to the master (unit: nanoseconds), i.e. the single signal runtime between the local device and reference clock.

PTP Status, Grandmaster UUID

Show grandmaster Universally Unique IDentifier, i.e. the MAC address of the grandmaster clock (Unique Universal Identifier).
Possible values: 32 hexadecimal numbers (`hh hh hh hh hh hh hh hh`).

PTP Status, Parent UUID

Show parent Universally Unique IDentifier, i.e. the MAC address of the master clock with which the local time is directly synchronized.
Possible values: 32 hexadecimal numbers (`hh hh hh hh hh hh hh hh`).

PTP Status, Clock Stratum

Show the qualification of the local clock.

PTP Status, Clock Identifier

Show the device's clock properties (e.g. accuracy, epoch, etc.).

PTPv1 Boundary Clock Ports

Show port number, operation status, burst status of the PTPv1 Boundary Clock Ports.

Port

Show the number of the interface (in `slot/port` notation).

Operation

Show if sending and receiving / processing PTP synchronization messages is enabled or disabled on the device.
Possible values: `Enabled`, `Disabled`

Burst

Show the status of the burst feature for synchronization running during a synchronization interval.
Possible values: `Enabled`, `Disabled`

Status

Show the ports PTP status.
Possible values: `Initializing`, `faulty`, `disabled`, `listening`, `pre-master`, `master`, `passive`, `uncalibrated`, `slave`.

4.14.2 show ptp configuration

This command shows the configured PTP (IEEE 1588) values depending on the currently configured clock mode.

Format

```
show ptp configuration
```

Mode

```
Privileged EXEC and User EXEC
```

PTP (Global) Clock Mode

Show which PTP clock mode is currently configured.

PTP (Global) Sync. Upper Bound

Show the upper bound for the PTP clock synchronization status (unit: nanoseconds).

PTP (Global) Sync. Lower Bound

Show the lower bound for the PTP clock synchronization status (unit: nanoseconds).

4.14.3 show ptp operation

Show the global PTP (IEEE 1588) operation setting (the administrative setting).This command shows if PTP is enabled/disabled on this device.

Format

```
show ptp operation
```

Mode

```
Privileged EXEC and User EXEC
```

4.14.4 show ptp port

This command shows the PTP (IEEE 1588) port configuration settings depending on the currently configured clock mode.

Format

```
show port [<slot/port>|all]
```

Mode

```
Privileged EXEC and User EXEC
```

<slot/port>

Show the port-related PTP (IEEE 1588) settings for the given port.

all

Show the port-related PTP (IEEE 1588) settings for all ports.

4.14.5 show ptp status

This command shows the device´s global PTP (IEEE 1588) status (the operating states).

Format

```
show ptp status
```

Mode

```
Privileged EXEC and User EXEC
```

PTP Status, Is Synchronized

Show if the device is synchronized (true or false).

PTP Status, Offset From Master

Show the device's offset from the master (unit: nanoseconds).

PTP Status, Max. Offset Absolute

Show the device's maximum offset absolute (unit: nanoseconds).

PTP Status, Delay To Master

Show the device's delay to the master (unit: nanoseconds).

PTP Status, Grandmaster UUID

Show grandmaster Universally Unique IDentifier
(32 hexadecimal numbers).

PTP Status, Parent UUID

Show parent Universally Unique IDentifier
(32 hexadecimal numbers).

PTP Status, Clock Stratum

Show the device's clock stratum.

PTP Status, Clock Identifier

Show the device's clock identifier.

4.14.6 ptp clock-mode

Configure the Precision Time Protocol (PTP, IEEE 1588) clock mode. If the clock mode is changed, PTP will be initialized. The default is `disable`.

Format

```
ptp clock-mode {v1-simple-mode
               |v2-simple-mode
               |v1-boundary-clock
               |v2-boundary-clock-onestep
               |v2-boundary-clock-twostep
               |v2-transparent-clock}
```

Mode

`Global Config`

v1-simple-mode

Set the clock mode to 'v1 Simple Mode'. This is a client only mode without hardware support. The device only accepts PTPv1 sync messages and sets the time directly. No BMC algorithm will run.

v2-simple-mode

Set the clock mode to 'v2 Simple Mode'. This is a client only mode without hardware support. The device only accepts PTPv2 sync (or follow_up) messages and sets the time directly. No BMC algorithm will run.

v1-boundary-clock

Set the clock mode to 'v1 Boundary Clock'. This specifies the mode as described in the IEEE1588 standard.

v2-boundary-clock-onestep

Set the clock mode to 'v2 Boundary Clock one-step'. This specifies the boundary-clock mode as described in the IEEE1588-2008 (PTPv2) standard. The precise timestamp is inserted directly into the sync-packet (one-step Mode).

v2-boundary-clock-twostep

Set the clock mode to 'v2 Boundary Clock two-step'. This specifies the boundary-clock mode as described in the IEEE1588-2008 (PTPv2) standard. The precise timestamp is transmitted via a follow-up packet (two-step Mode).

v2-transparent-clock

Set the clock mode to 'v2 Transparent Clock'. This specifies the transparent-clock mode (one-step) as described in the IEEE1588-2008 (PTPv2) standard.

4.14.7 ptp operation

Enable or disable the Precision Time Protocol (IEEE 1588).
The default is "disable"

Format

```
ptp operation {disable|enable}
```

Mode

```
Global Config
```

disable

Disable the Precision Time Protocol (IEEE 1588).

enable

Enable the Precision Time Protocol (IEEE 1588).

4.14.8 ptp sync-lower-bound

Configure the lower bound for the PTP clock synchronization
(unit: nanoseconds, min.: 0, max.: 999999999 (10^9-1), default: 30).
Note: The lower bound always has to be smaller than the upper bound.

Format

```
ptp sync-lower-bound <0-999999999>
```

Mode

```
Global Config
```

4.14.9 ptp sync-upper-bound

Configure the upper bound for the PTP clock synchronization (unit: nanoseconds, min.: 31, max.: 1000000000 (10^9), default: 5000).
Note: The upper bound always has to be larger than the lower bound.

Format

```
ptp sync-upper-bound <31-1000000000>
```

Mode

```
Global Config
```

4.14.10 ptp v1 preferred-master

Configure the PTPv1 (IEEE1588-2002) specific settings.
Specify if the local switch shall be regarded as a preferred master clock (i. e., if it will remain master in the presence of disconnection or connection of other clocks).

Format

```
ptp v1 preferred-master {true|false}
```

Mode

```
Global Config
```

true

The local switch shall be regarded as a preferred master clock.

false

The local switch shall not be regarded as a preferred master clock.

4.14.11 ptp v1 re-initialize

Configure the PTPv1 (IEEE1588-2002) specific settings.
Re-initialize the clocks in the local subdomain with the currently configured settings. Changes in the subdomain name or the sync interval will only take effect after this command.

Format

```
ptp v1 re-initialize
```

Mode

```
Global Config
```

4.14.12 ptp v1 subdomain-name

Configure the PTPv1 (IEEE1588-2002) specific settings.
Enter a Precision Time Protocol subdomain name. The default is "_DFLT".
Note: Changes are only applied after the 're-initialize' command or after a re-boot if the configuration was saved.

Format

```
ptp v1 subdomain-name <subdomain name>
```

Mode

```
Global Config
```

<subdomain name>

Enter a PTP subdomain name (up to 16 characters). Valid characters range from hex value 0x21 (!) up to and including hex value 0x7e (~). Enter special characters (\, !, ', ", ?) by preceding them with the escape character (\), e. g., as \\, \!, \', \", \?. The subdomain name must not be empty. The default is "_DFLT".

4.14.13 ptp v1 sync-interval

Configure the PTPv1 (IEEE1588-2002) specific settings.
Configure the Precision Time Protocol sync interval. The sync interval is the interval (in seconds) between successive sync messages issued by a master clock.
Valid values are: `sec-1, sec-2, sec-8, sec-16`, and `sec-64`.
Default is `sec-2`.

Note: Changes are only applied after the 're-initialize' command or after a reboot if the configuration was saved.

Format

```
ptp v1 sync-interval {sec-1|sec-2|sec-8|sec-16|
                      sec-64}
```

Mode

`Global Config`

sec-1

Set the PTP sync interval to sec-1 (1 sec).

sec-2

Set the PTP sync interval to sec-2 (2 sec).

sec-8

Set the PTP sync interval to sec-8 (8 sec).

sec-16

Set the PTP sync interval to sec-16 (16 sec).

sec-64

Set the PTP sync interval to sec-64 (64 sec).

4.14.14 ptp v2bc priority1

Configure the PTPv2 Boundary Clock (IEEE1588-2008) specific settings. Configure the priority1 value (`0..255`) for the BMC as described in IEEE1588-2008.

Format

```
ptp v2bc priority1 <0-255>
```

Mode

```
Global Config
```

4.14.15 ptp v2bc priority2

Configure the PTPv2 Boundary Clock (IEEE1588-2008) specific settings. Configure the priority2 value (`0..255`) for the BMC as described in IEEE1588-2008.

Format

```
ptp v2bc priority2 <0-255>
```

Mode

```
Global Config
```

4.14.16 ptp v2bc domain

Configure the PTPv2 Boundary Clock (IEEE1588-2008) specific settings. Configure the domain number (0..255) as described in IEEE1588-2008.

Format

```
ptp v2bc domain <0-255>
```

Mode

```
Global Config
```

4.14.17 ptp v2bc utc-offset

Configure the PTPv2 Boundary Clock (IEEE1588-2008) specific settings. Configure the current UTC offset in seconds.

Format

```
ptp v2bc utc-offset <seconds>
```

Mode

```
Global Config
```

4.14.18 ptp v2bc utc-offset-valid

Configure the PTPv2 Boundary Clock (IEEE1588-2008) specific settings. Configure the UTC offset valid flag.

Format

```
ptp v2bc utc-offset-valid {true|false}
```

Mode

```
Global Config
```

4.14.19 ptp v2bc vlan

Configure the PTPv2 Boundary Clock (IEEE1588-2008) specific settings. Use this command to configure the VLAN in which PTP packets are send. With a value of none all packets are send untagged.

Format

```
ptp v2bc vlan {none | <0-4042>}
```

Mode

```
Interface Config
```

4.14.20 ptp v2bc vlan-priority

Configure the PTPv2 Boundary Clock (IEEE1588-2008) specific settings. Use this command to configure the VLAN priority.

Format

```
ptp v2bc vlan-priority <0-7>
```

Mode

```
Interface Config
```

4.14.21 ptp v1 burst

Enable or disable the burst feature for synchronization runs during a synchronization interval. Default is disable.

Format

```
ptp v1 burst {enable|disable}
```

Mode

```
Interface Config
```

enable

During a synchronization interval, there are 2 to 8 synchronization runs. This permits faster synchronization when the network load is high.

disable

During a synchronization interval, there is only one synchronization run.

4.14.22 ptp v1 operation

Enable or disable the sending and receiving / processing of PTP synchronization messages. Default is enable.

Format

```
ptp v1 operation {enable|disable}
```

Mode

```
Interface Config
```

enable

Port sends and receives/ processes PTP synchronization messages.

disable

Port blocks PTP synchronization messages.

4.14.23 ptp v2bc operation

Enable or disable the sending and receiving / processing of PTP synchronization messages.

Format

```
ptp v2bc operation {disable|enable}
```

Mode

```
Interface Config
```

enable

Port sends and receives/ processes PTP synchronization messages.

disable

Port blocks PTP synchronization messages.

4.14.24 ptp v2bc announce-interval

Configure the Announce Interval in seconds {1|2|4|8|16}.

Format

```
ptp v2bc announce-interval {1|2|4|8|16}
```

Mode

```
Interface Config
```

4.14.25 ptp v2bc announce-timeout

Configure the Announce Receipt Timeout (2..10).

Format

```
ptp v2bc announce-timeout <2-10>
```

Mode

```
Interface Config
```

4.14.26 ptp v2bc sync-interval

Configure the Sync Interval in seconds {0.5|1|2}.

Format

```
ptp v2bc sync-interval {0.25|0.5|1|2}
```

Mode

```
Interface Config
```

4.14.27 ptp v2bc delay-mechanism

Configure the delay mechanism {e2e|p2p|disabled} of the transparent-clock.

Format

```
ptp v2bc delay-mechanism {e2e|p2p|disabled}
```

Mode

```
Interface Config
```

4.14.28 ptp v2bc pdelay-interval

Configure the Peer Delay Interval in seconds {1|2|4|8|16|32}.
This interval is used if delay-mechanism is set to p2p.

Format

```
ptp v2bc pdelay-interval {1|2|4|8|16|32}
```

Mode

```
Interface Config
```

4.14.29 ptp v2bc network-protocol

Configure the network-protocol {ieee802_3|udp_ipv4} of the transparent-clock.

Format

```
ptp v2bc network-protocol {ieee802_3 | udp_ipv4}
```

Mode

```
Interface Config
```

4.14.30 ptp v2bc v1-compatibility-mode

Set the PTPv1 Hardware compatibility mode {auto|on|off}.

Format

```
ptp v2bc v1-compatibility-mode {auto|on|off}
```

Mode

```
Interface Config
```

4.14.31 ptp v2bc asymmetry

Specifies the asymmetrie in nanoseconds of the link connected to this port {+-1000000000}.

Format

```
ptp v2bc asymmetry <value in ns>
```

Mode

```
Interface Config
```

4.14.32 ptp v2tc asymmetry

Specifies the asymmetrie in nanoseconds of the link connected to this port {+-1000000000}.

Format

```
ptp v2tc asymmetry <value in ns>
```

Mode

```
Interface Config
```

4.14.33 ptp v2tc delay-mechanism

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Configure the delay mechanism {e2e | p2p | disabled} of the transparent-clock.

Format

```
ptp v2tc delay-mechanism {e2e|p2p}
```

Mode

```
Global Config
```

4.14.34 ptp v2tc management

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Enable or disable the management of the transparent-clock (disable for fast packet rates).

Format

```
ptp v2tc management {enable|disable}
```

Mode

```
Global Config
```

4.14.35 ptp v2tc multi-domain-mode

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Enable or disable the transparent-clock for one (primary-domain) or all domain numbers.

Format

```
ptp v2tc multi-domain-mode {enable|disable}
```

Mode

```
Global Config
```

4.14.36 ptp v2tc network-protocol

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Configure the network-protocol {ieee802_3|udp_ipv4} of the transparent-clock.

Format

```
ptp v2tc network-protocol {ieee802_3|udp_ipv4}
```

Mode

```
Global Config
```

4.14.37 ptp v2tc operation

Enable or disable the sending and receiving/ processing of PTP synchronization messages.

Format

```
ptp v2tc operation {disable|enable}
```

Mode

```
Interface Config
```

enable

Port sends and receives/ processes PTP synchronization messages.

disable

Port blocks PTP synchronization messages.

4.14.38 ptp v2tc pdelay-interval

Configure the Peer Delay Interval in seconds {1|2|4|8|16|32}. This interval is used if delay-mechanism is set to p2p.

Format

```
ptp v2tc pdelay-interval {1|2|4|8|16|32}
```

Mode

```
Interface Config
```

4.14.39 ptp v2tc primary-domain

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Configure the primary-domain {for syntonization} of the transparent-clock.

Format

```
ptp v2tc primary-domain <0-255>
```

Mode

```
Global Config
```

4.14.40 ptp v2tc profile

Note: This command is available for the devices of the MACH104, MACH1040, PowerMICE and MS20/MS30 family.

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Use this command to configure the PTP v2TC parameters to match the default of a profile.

Format

```
ptp v2tc profile
            { power | default-e2e | default-p2p }
```

Mode

```
Global Config
```

default-e2e

Configure the PTP v2TC parameters to match the default of a profile (end-to-end transparent clock).

default-p2p

Configure the PTP v2TC parameters to match the default of a profile (peer-to-peer transparent clock).

power

Configure the PTP v2TC parameters to match the default of a profile (power profile C37.238).

4.14.41 ptp v2tc syntonization

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Enable or disable the syntonization of the transparent-clock.

Format

```
ptp v2tc syntonization {enable|disable}
```

Mode

```
Global Config
```

4.14.42 ptp v2tc vlan

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Use the command to configure the VLAN in which PTP packets are send. With a value of none all packets are send untagged.

Format

```
ptp v2tc vlan {none | <0-4042>}
```

Mode

```
Global Config
```

4.14.43 ptp v2tc power-tlv-check

Note: This command is available for the devices of the MACH104, MACH1040, PowerMICE and MS20/MS30 family.

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Use the command to configure the Power TLV Check.

Default

```
Disable
```

Format

```
ptp v2tc power-tlv-check {enable | disable}
```

Mode

```
Global Config
```

enable

Only announce messages including the TLVs specified in the power profile (C37.238) are accepted for syntonization.

disable

Disable v2tc power-tlv-check.

4.14.44 ptp v2tc vlan-priority

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Use the command to configure the VLAN priority of tagged ptp packets.

Format

```
ptp v2tc vlan-priority <0-7>
```

Mode

```
Global Config
```

4.14.45 ptp v2tc sync-local-clock

Configure the PTPv2 Transparent Clock (IEEE1588-2008) specific settings. Use the command to enable or disable synchronization of the local clock (only valid if syntonization is enabled).

Format

```
ptp v2tc sync-local-clock {enable | disable}
```

Mode

```
Global Config
```

4.15 PoE - Power over Ethernet

These commands show and configure the Power over Ethernet (IEEE 802.3af) parameters.

4.15.1 show inlinepower

This command shows global PoE inline power settings.

Format

```
show inlinepower
```

Mode

```
Privileged EXEC and User EXEC
```

4.15.2 show inlinepower port

This command shows the configuration settings and states per port.

Format

`show inlinepower port [<slot/port> | all]`

Mode

`Privileged EXEC and User EXEC`

<slot/port>

Enter the interface (in `<slot/port>` notation).

Admin Mode

Display the PoE inline power administrative settings on the specific interface.
- Possible values: `Enabled`, `Disabled`
- Default value: `Enabled`

Status

Display the PoE inline power status on the specific interface.
- Possible values: `Delivering Power`, `Disabled`

Class

Display the PoE class of the specific interface.
- Value range: `0..4`
- Default value: `0`

Current Power

Display the PoE power in Watts on the specific interface being currently delivered by the device.

Max Observed

Display the maximum PoE power in Watts on the specific interface which has been observed by the device.

Power Limit

Display the maximum PoE power that can be reserved on the specific interface. The power limit is ignored if the maximum observed power consumption exceeds this limit.
- Possible values: `0..30.000` (in Watts)
- Default value: `0`. (disable the limitation of PoE inline power)

Interface Name

Display the name of the specific interface.
- Possible values: `<None>`, ...
- Default value: `<None>`

all

Display the global PoE inline power configuration settings and states for the interfaces of the device.

Intf

Display the interface (in `<slot/port>` notation).

Admin Mode

Display the PoE inline power administrative settings for each interface of the device.
- Possible values: `Enabled`, `Disabled`
- Default value: `Enabled`

Operating Status

Display the PoE inline power status for each interface of the device.
- Possible values: `Delivering Power`, `Disabled`

Priority

Display the PoE inline power priority for each interface of the device. In case of power scarcity, inline power on ports configured with the lowest priority is dropped first.
- Possible values: `Critical, High, Low`.
- Default value: `Low`
  The highest priority is `critical`.

Note: This parameter is available for MACH1000, MACH4000 and devices which support Power over Ethernet Plus (MACH104-16TX-PoEP devices and MACH102 devices with media module M1-8TP-RJ45 PoE).

Class

Display the PoE class for each interface of the device.
- Value range: `0..4`
- Default value: `0`

Curr. Power

Display the PoE power in Watts being currently delivered by the device for each interface.

Max. Observed

Display the maximum PoE power in Watts for each interface which has been observed by the device.

Power Limit

Display the maximum PoE power that can be reserved for each interface of the device. The power limit is ignored if the maximum observed power consumption exceeds this limit.
- Possible values: `0..30.000` (in Watts)
- Default value: `0`. (disable the limitation of PoE inline power)

4.15.3 inlinepower (Global Config)

Configure the global inline power parameters.

Format

```
inlinepower {admin-mode {disable|enable} |
trap {disable|enable} | threshold <1-99> |
fast-startup {enable|disable} }
```

Mode

```
Global Config
```

admin-mode

Configure the global inline power administrative setting.
- Possible values: `enable` or `disable`.
- Default value: `enable`.

trap

Configure the inline power notification (trap) setting.
- Possible values: `enable` or `disable`.
- Default value: `disable`.

threshold

Configure the inline power notification (trap) threshold (unit: percent of maximum rated power.
- Value range: `1..99`.
- Default value: `90`.

fast-startup

Configure the inline power to be enabled at the beginning of the start phase.
- Possible values: `enable` or `disable`.
- Default value: `disable`.

4.15.4 inlinepower (Interface Config)

Configure the port related inline power parameters.
Note: The interface name you enter in the `name`-command.

Format

```
inlinepower {admin-mode {disable|enable} |
             power-limit <watts> | priority
             {critical|high|low} }|
```

Mode

`Interface Config`

admin-mode

Configure the port-related inline power administrative setting
- Possible values: `enable` or `disable`.
- Default value: `enable`.

power-limit

Configure the maximum power that can be reserved on the port. If set to `0` then the limitation is disabled. The power limit is ignored if the maximum observed power consumption exceeds this limit.
- Possible values: `0…30.000` (in watts)
- Default value: `0`. (disable the limitation of inline power)

priority

Configure the inline power priority for this port. In case of power scarcity, inline power on ports configured with the lowest priority is dropped first.
- Possible values: `critical, high` or `low`.
  The highest priority is `critical`.
- Default value: `low`.

Note: This parameter is available for MACH1000, MACH4000 and devices which support Power over Ethernet Plus (MACH104-16TX-PoEP devices and MACH102 devices with media module M1-8TP-RJ45 PoE).

4.15.5 clear inlinepower

Reset the inline power parameters to default settings.

Format

```
clear inlinepower
```

Mode

```
Privileged EXEC
```

4.16 PoE+ - Power over Ethernet Plus

Additionally to the PoE (Power over Ethernet) commands, these commands show and configure the Power over Ethernet Plus (IEEE 802.3at) parameters.

Note: PoE+ is available for:
- MACH104-16TX-PoEP devices
- MACH 102 devices with media module M1-8TP-RJ45 PoEP

4.16.1 show inlinepower slot

This command shows the PoE+ configuration settings and states per slot.

Format

```
show inlinepower slot [<slot> | all]
```

Mode

```
Privileged EXEC and User EXEC
```

Slot

For MACH102 devices with M1-8TP-RJ45 PoEP media modules:
Slot = Slot number of the PoE+ module (valid range: 1 - 2)
For MACH104-16TX-PoEP devices: Slot = 1

Nominal Power

Shows the configured nominal power budget which the device provides for the PoE+ ports of the PoE+ module.

Maximum Power

Shows the nominal power which the device provides for the PoE+ ports of the PoE+ module (valid range: 0 - 248 W).

Reserved Power

Shows the maximum power which the device provides for all PoE+ devices together which are connected to the PoE+ module, based on their classification.

Delivered Power

Shows the current demand for power on all PoE+ ports of the module (valid range: 0 - 248 W).

Send Traps

Shows, if the function is enabled/disabled. If send traps is enabled, the device will send a trap if the power threshold exceeds or falls below the power limit or if the PoE+ power supply is switched on/off on one or more ports.

Power Threshold

Power threshold in per cent of the nominal power. If the power is exceeding/falling below this threshold, the device will send a trap.

4.16.2 inlinepower budget slot

Configure the available power budget per slot in Watts.

Format

```
inlinepower budget slot <slot> <0..1000>
```

Mode

```
Global Config
```

Slot

For MACH102 devices with M1-8TP-RJ45 PoEP media modules:
Slot = Slot number of the PoE+ module (valid range: 1 - 2)

For MACH104-16TX-PoEP devices: Slot = 1

4.16.3 inlinepower threshold slot

Configure the usage power threshold expressed in per cents for comparing the measured power for this slot and initiating an alarm if the threshold is exceeded.

Format

```
inlinepower threshold slot <slot> <0..99>
```

Mode

```
Global Config
```

Slot

For MACH102 devices with M1-8TP-RJ45 PoEP media modules:
Slot = Slot number of the PoE+ module (valid range: 1 - 2)
For MACH104-16TX-PoEP devices: Slot = 1

4.16.4 inlinepower trap slot

Configure the alarm that is send if the configured threshold for this slot is exceeded.

Format

```
inlinepower trap slot <slot> {enable | disable}
```

Mode

```
Global Config
```

Slot

For MACH102 devices with M1-8TP-RJ45 PoEP media modules:
Slot = Slot number of the PoE+ module (valid range: 1 - 2)
For MACH104-16TX-PoEP devices: Slot = 1

4.17 Port monitor

These commands show and configure the port monitor parameters.

The port monitor feature monitors certain port (or global) states or changes and performs a certain action, when the specified condition occurs.

Using this commands, you can disable a port and send a trap (see "port admin shutdown").

Disabling a port by condition will not modify the configuration and therefore not keep the port in disabled state after reload/reboot.

To enable the action if a port state occurs
- enable the port monitor globally,
- enable the port monitor on the port,
- configure condition(s) that is (are) performed in port state on a port and
- an action that is performed on that port, when the condition complies.

The condition can be link flapping or CRC/Fragments error, an action can be sending a trap or disabling that port (and send a trap).

If a port was disabled by the Port-Monitor the port can be enabled again with a port monitor reset command (see “port-monitor reset”).

4.17.1 show port-monitor

Use this command to display the global Port Monitor settings.

Format

```
show port-monitor
```

Mode

```
Global Config
```

Port Monitor

Display if Port Monitor function is enabled or disabled.

Condition crc-fragment interval (seconds)

Display the condition of the CRC fragment interval in seconds.

Condition crc-fragment count

Display the condition of the CRC fragment count.

Condition link flap interval (seconds)

Display the condition of the link flap interval in seconds.

Condition link flap count

Display the condition of the link flap count.

4.17.2 show port-monitor <slot/port>

Use this command to display the Port Monitor details for the port.

Format

```
show port-monitor <slot/port>
```

Mode

```
Global Config
```

Port Monitor

Display if Port Monitor is enabled or disabled.

Link Flap

Display if Link Flap is enabled or disabled.

Crc-Fragment

Display if CRC Fragment is enabled or disabled.

Speed-duplex

Display the link speed and duplex condition for the port.
Possible values: `Enabled, Disabled`.

Active Condition

Display the active condition for the port.
Possible values: `Link-Flap, None`.

Action

Display the action (disable port or send trap) to be triggered on the port. Possible values: Disable-Port, Trap-Only.

Port Oper State

Display the link state of the port. Possible values: `Up, Down`.

4.17.3 show port-monitor brief

Use this command to display the Port Monitor brief summary.

Format

`show port-monitor brief`

Mode

`Global Config`

Intf

Display the number of the interface (`slot/port`).

Admin Mode

Display if Port Monitor is enabled or disabled.

Link Flap

Display if Link Flap is enabled or disabled.

Crc Fragment

Display if CRC Fragment is enabled or disabled.

Speed duplex

Display the link speed and duplex condition for the port.
Possible values: `Enabled, Disabled`.

Active Condition

Display the active condition for the port.
Possible values: `Link-Flap, None`.

Action

Display the action (disable port or send trap) to be triggered on the port. Possible values: `Disable-Port, Trap-Only`.

Port Oper State

Display the link state of the port. Possible values: `Up, Down`.

4.17.4 show port-monitor crc-fragment

Use this command to display the CRC fragment counter.

Format

```
show port-monitor crc-fragment <slot/port>
```

Mode

```
Global Config
```

<slot/port>

Display the Port Monitor interface details.

Crc_fragments in last interval

Display the CRC fragments in last interval.

Crc_fragments total

Display the CRC fragments total.

4.17.5 show port-monitor link-flap

Use this command to display the Link Flap counter for the port.

Format

```
show port-monitor link-flap <slot/port>
```

Mode

```
Global Config
```

<slot/port>

Display the Port Monitor interface details.

Link flaps in last interval

Display the Link flaps in last interval.

Link flaps total

Display the Link flaps total.

4.17.6 show port-monitor overload-detection

Use this command to display the overload detection details for the port.

Format

```
show port-monitor overload-detection <slot/port>
```

Mode

```
Global Config
```

<slot/port>

Display the Port Monitor interface details.

Overload-detection traffic type

Display the overload-detection traffic type for the interface.

Overload-detection threshold type

Display the overload-detection threshold type for the interface.

Overload-detection lower threshold

Display the overload-detection lower threshold for the interface.

Overload-detection upper threshold

Display the overload-detection upper threshold for the interface.

4.17.7 show port-monitor speed-duplex

Use this command to display the link speed and duplex configured modes.

Format

```
show port-monitor speed-duplex <slot/port>
```

Mode

```
Global Config
```

<slot/port>

Display the Port Monitor interface details for link speed and duplex condition.

Intf

Display the number of the interface (`slot/port`).

Allowed values

Display the allowed values for link speed and duplex combinations for the interfaces of the device.
Possible values: `hdx-10, fdx-10, hdx-100, fdx-100, hdx-1000, fdx-1000, fdx-10000`.

Allowed modes

Speed-duplex

Display the allowed link speed and duplex combinations for the specific interface.
Possible values: `hdx-10, fdx-10, hdx-100, fdx-100, hdx-1000, fdx-1000, fdx-10000`.

4.17.8 port-monitor (Global Config)

Use this command to enable or disable the Port Monitor globally.
Note: This command does not reset the port disable states.

Default

```
Disable
```

Format

```
port-monitor {enable | disable}
```

Mode

```
Global Config
```

4.17.9 port-monitor (Interface Config)

Use this command to enable or disable the Port Monitor on the port.
Note: This command does not reset the port disable states.

Default

```
Disable
```

Format

```
port-monitor {enable | disable}
```

Mode

```
Interface Config
```

4.17.10 port-monitor action

Use this command to configure the Port Monitor action (disable a port or send a trap).
Note: Disable the Port Monitor action will reset the port from port-state.

Default

```
auto-disable
```

Format

```
port-monitor action
          {port-disable | trap-only | auto-disable}
```

Mode

```
Interface Config
```

port-disable

Disable the port when the configured Port Monitor condition triggers.

trap-only

Send a trap when the configured Port Monitor condition triggers.

auto-disable

Notify Auto Disable when the configured Port Monitor condition triggers.

4.17.11 port-monitor condition link-flap (Global Config)

Use this command to configure the Link Flap settings (Link Flap counter and interval for Link Flap detection).

Default

`Disable`

Format

```
port-monitor condition link-flap
            {count <1..100>| interval <1..180>}
```

Mode

`Global Config`

count

Configure the Link Flap counter.
Default: `5`. Value range: `1 ..100`.

interval

Configure the measure interval in seconds for Link Flap detection.
Default: `10` seconds. Value range: `1 ..180` seconds.

4.17.12 port-monitor condition link-flap (Interface Config)

Use this command to enable or disable Link Flap condition on a port to trigger an action.

Default

`Disable`

Format

`port-monitor condition link-flap {enable | disable}`

Mode

`Interface Config`

4.17.13 port-monitor condition crc-fragment (Global Config)

Use this command to configure the crc-fragment settings (crc-fragment counter and interval for crc-fragment detection).

Default

```
Disable
```

Format

```
port-monitor condition crc-fragment
     {count <1..1000000> | interval <5..180>}
```

Mode

```
Global Config
```

count

Configure the crc-fragment counter.
Default: `1000`. Value range: `1..1000000`.

interval

Configure the measure interval in seconds for crc-fragment detection.
Default: `10` seconds. Value range: `5..180` seconds.

4.17.14 port-monitor condition crc-fragment (Interface Config)

Use this command to enable or disable crc-fragment settings on a port to trigger an action.

Default

```
Disable
```

Format

```
port-monitor condition crc-fragment
             {enable | disable}
```

Mode

```
Interface Config
```

4.17.15 port-monitor condition speed-duplex-monitor (Interface Config)

Use this command to enable or disable the link speed and duplex condition on a port to trigger an action.

Default

```
Disable
```

Format

```
port-monitor condition speed-duplex-monitor
                       {enable | disable}
```

Mode

```
Interface Config
```

4.17.16 port-monitor condition speed-duplex-monitor speed (Interface Config)

Use this command to configure the allowed link speed and duplex combinations on a port.

Default

```
{hdx-10, fdx-10, hdx-100, fdx-100, hdx-1000,
 fdx-1000, fdx-10000}
```

Format

```
port-monitor condition speed-duplex-monitor speed
  <speed-duplex1>
   [<speed-duplex2>
     [<speed-duplex3>
       [<speed-duplex4>
         [<speed-duplex5>
           [<speed-duplex6>
             [<speed-duplex7>]]]]]]
```

Mode

```
Interface Config
```

4.17.17 port-monitor condition speed-duplex-monitor clear (Interface Config)

Use this command to clear the allowed link speed and duplex combinations on a port. This will trigger the configured action if the link speed and duplex condition is enabled.

Default

```
{hdx-10, fdx-10, hdx-100, fdx-100, hdx-1000,
 fdx-1000, fdx-10000}
```

Format

```
port-monitor condition speed-duplex-monitor clear
```

Mode

```
Interface Config
```

5 CLI Commands: Switching

This section provides detailed explanation of the Switching commands. The commands are divided into two functional groups:

- Show commands display spanning tree settings, statistics, and other information.
- Configuration Commands configure features and options of the switch. For every configuration command there is a show command that displays the configuration setting.

5.1 Spanning Tree Commands

5.1.1 show spanning-tree

This command displays spanning tree settings for the common and internal spanning tree, when the optional parameter “brief” is not included in the command. The following details are displayed.

Format

```
show spanning-tree [brief]
```

Mode

Privileged EXEC and User EXEC

Spanning Tree Adminmode

```
Enabled or Disabled
```

Bridge Priority

```
Configured value.
```

Bridge Identifier

The bridge identifier for the CST (CST = Classical Spanning Tree IEEE 802.1d). It is made up using the bridge priority and the base MAC address of the bridge.

Time Since Topology Change

in seconds

Topology Change Count

Number of times changed.

Topology Change

Boolean value of the Topology Change parameter for the switch indicating if a topology change is in progress on any port assigned to the common and internal spanning tree.

Designated Root

The bridge identifier of the root bridge. It is made up from the bridge priority and the base MAC address of the bridge.

Root Path Cost

Value of the Root Path Cost parameter for the common and internal spanning tree.

Root Port Identifier

Identifier of the port to access the Designated Root for the CST.

Root Port Max Age

Derived value

Root Port Bridge Forward Delay

Derived value

Hello Time

Configured value

Bridge Hold Time

Minimum time between transmission of Configuration Bridge Protocol Data Units (BPDUs)

CST Regional Root

Bridge Identifier of the CST Regional Root. It is made up using the bridge priority and the base MAC address of the bridge.

Regional Root Path Cost

Path Cost to the CST Regional Root.

Associated FIDs

List of forwarding database identifiers currently associated with this instance.

Associated VLANs

List of VLAN IDs currently associated with this instance.

show spanning-tree brief

When the “brief” optional parameter is included, this command displays a brief overview of the spanning tree settings for the bridge. In this case, the following details are displayed.

Bridge Priority

Configured value.

Bridge Identifier

The bridge identifier for the selected MST instance. It is made up using the bridge priority and the base MAC address of the bridge.

Bridge Max Age

Configured value.

Bridge Hello Time

Configured value.

Bridge Forward Delay

Configured value.

Bridge Hold Time

Minimum time between transmission of Configuration Bridge Protocol Data Units (BPDUs)

Rstp Mrp Mode

Rapid spanning tree mrp (Media Redundancy Protocol) mode (Enabled/Disabled)

Rstp Mrp configuration error

Configuration error in Rapid spanning tree mrp (Media Redundancy Protocol) (No/Yes)

5.1.2 show spanning-tree interface

This command displays the settings and parameters for a specific switch port within the common and internal spanning tree. The <slot/port> is the desired switch port. The following details are displayed on execution of the command.

Format

```
show spanning-tree interface <slot/port>
```

Mode

Privileged EXEC and User EXEC

Port mode

Enabled or disabled.

Port Up Time Since Counters Last Cleared

Time since port was reset, displayed in days, hours, minutes, and seconds.

STP BPDUs Transmitted

Spanning Tree Protocol Bridge Protocol Data Units sent

STP BPDUs Received

Spanning Tree Protocol Bridge Protocol Data Units received.

RST BPDUs Transmitted

Rapid Spanning Tree Protocol Bridge Protocol Data Units sent

RST BPDUs Received

Rapid Spanning Tree Protocol Bridge Protocol Data Units received.

MSTP BPDUs Transmitted

Multiple Spanning Tree Protocol Bridge Protocol Data Units sent

MSTP BPDUs Received

Multiple Spanning Tree Protocol Bridge Protocol Data Units received.

5.1.3 show spanning-tree mst detailed

This command displays settings and parameters for the specified multiple spanning tree instance. The instance <mstid> is a number that corresponds to the desired existing multiple spanning tree instance ID. The following details are displayed.

Format

```
show spanning-tree mst detailed <mstid>
```

Mode

Privileged EXEC and User EXEC

mstid

Enter a multiple spanning tree instance identifier.
Valid values: 0 - 4094.

MST Instance ID

Valid value: 0

MST Bridge Priority

Valid values: 0-61440 in increments of 4096.

Time Since Topology Change

in seconds

Topology Change Count

Number of times the topology has changed for this multiple spanning tree instance.

Topology Change in Progress

Value of the Topology Change parameter for the multiple spanning tree instance.

Designated Root

Identifier of the Regional Root for this multiple spanning tree instance.

Root Path Cost

Path Cost to the Designated Root for this multiple spanning tree instance

Root Port Identifier

Port to access the Designated Root for this multiple spanning tree instance

Associated FIDs

List of forwarding database identifiers associated with this instance.

Associated VLANs

List of VLAN IDs associated with this instance.

5.1.4 show spanning-tree mst port detailed

This command displays the detailed settings and parameters for a specific switch port within a particular multiple spanning tree instance. The instance <mstid> is a number that corresponds to the desired existing multiple spanning tree instance. The <slot/port> is the desired switch port.

Format

```
show spanning-tree mst port detailed <mstid> <slot/
port>
```

Mode

Privileged EXEC and User EXEC

MST Instance ID

Valid value: 0

Port Identifier

Port priority as a two digit hex number followed by the port number as a two digit hex number.

Port Priority

Decimal number.

Port Forwarding State

Current spanning tree state of this port

Port Role

The port´s current RSTP port role.

Port Path Cost

Configured value of the Internal Port Path Cost parameter

Designated Root

The Identifier of the designated root for this port.

Designated Port Cost

Path Cost offered to the LAN by the Designated Port

Designated Bridge

Bridge Identifier of the bridge with the Designated Port.

Designated Port Identifier

Port on the Designated Bridge that offers the lowest cost to the LAN

If 0 (defined as the default CIST ID) is passed as the <mstid>, then this command displays the settings and parameters for a specific switch port within the common and internal spanning tree. The <slot/port> is the desired switch port. In this case, the following are displayed.

Port Identifier

The port identifier for this port within the CST.

Port Priority

The priority of the port within the CST.

Port Forwarding State

The forwarding state of the port within the CST.

Port Role

The role of the specified interface within the CST.

Port Path Cost

The configured path cost for the specified interface.

Designated Root

Identifier of the designated root for this port within the CST.

Designated Port Cost

Path Cost offered to the LAN by the Designated Port.

Designated Bridge

The bridge containing the designated port

Designated Port Identifier

Port on the Designated Bridge that offers the lowest cost to the LAN

Topology Change Acknowledgement

Value of flag in next Configuration Bridge Protocol Data Unit (BPDU) transmission indicating if a topology change is in progress for this port.

Hello Time

The hello time in use for this port.

Edge Port

The configured value indicating if this port is an edge port.

Edge Port Status

The derived value of the edge port status. True if operating as an edge port; false otherwise.

Point To Point MAC Status

Derived value indicating if this port is part of a point to point link.

CST Regional Root

The regional root identifier in use for this port.

CST Port Cost

The configured path cost for this port.

5.1.5 show spanning-tree mst port summary

This command displays the settings of one or all ports within the specified multiple spanning tree instance. The parameter <mstid> indicates a particular MST instance. The parameter {<slot/port> | all} indicates the desired switch port or all ports.

If 0 (defined as the default CIST ID) is passed as the <mstid>, then the status summary is displayed for one or all ports within the common and internal spanning tree.

Format

```
show spanning-tree mst port summary <mstid> {<slot/
port> | all}
```

Mode

Privileged EXEC and User EXEC

MST Instance ID

The MST instance associated with this port. Valid value: 0.

Interface

Valid slot and port number separated by forward slashes.

STP Mode

Current STP mode of this port in the specified spanning tree instance.

Type

Currently not used.

Port Forwarding State

The forwarding state of the port in the specified spanning tree instance

Port Role

The role of the specified port within the spanning tree.

5.1.6 show spanning-tree mst summary

This command displays settings and parameters for the specified multiple spanning tree instance. The following details are displayed.

Format

```
show spanning-tree mst summary
```

Mode

Privileged EXEC and User EXEC

MST Instance ID

Valid value: 0

Associated FIDs

List of forwarding database identifiers associated with this instance.

Associated VLANs

List of VLAN IDs associated with this instance.

5.1.7 show spanning-tree summary

This command displays spanning tree settings and parameters for the switch. The following details are displayed on execution of the command.

Format

```
show spanning-tree summary
```

Mode

Privileged EXEC and User EXEC

Spanning Tree Adminmode

Enabled or disabled.

Spanning Tree Version

Version of 802.1 currently supported (IEEE 802.1Q-2005, IEEE 802.1D-2004) based upon the Force Protocol Version parameter

Configuration Name

Configured name.

Configuration Revision Level

Configured value.

Configuration Digest Key

Calculated value.

Configuration Format Selector

Configured value.

MST Instances

List of all multiple spanning tree instances configured on the switch

5.1.8 show spanning-tree vlan

This command displays the association between a VLAN and a multiple spanning tree instance. The <vlanid> corresponds to an existing VLAN ID (1-4042).

Format

```
show spanning-tree vlan <vlanid>
```

Mode

Privileged EXEC and User EXEC

vlanid

Enter a VLAN identifier (1 - 4042).

VLAN Identifier

The VLANs associated with the selected MST instance.

Associated Instance

Identifier for the associated multiple spanning tree instance or "CST" if associated with the common and internal spanning tree

5.1.9 spanning-tree

This command sets the spanning-tree operational mode to enabled.

Default

```
disabled
```

Format

```
spanning-tree
```

Mode

```
Global Config
```

no spanning-tree

This command sets the spanning-tree operational mode to disabled. While disabled, the spanning-tree configuration is retained and can be changed, but is not activated.

Format

```
no spanning-tree
```

Mode

```
Global Config
```

5.1.10 spanning-tree auto-edgeport

This command specifies that this port is an Edge Port within the common and internal spanning tree. This will allow this port to transition to Forwarding State without delay.

Format

```
spanning-tree auto-edgeport
```

Mode

```
Interface Config
```

- **no spanning-tree auto-edgeport**
  This command specifies that this port is not an Edge Port within the common and internal spanning tree.

Format

```
no spanning-tree auto-edgeport
```

Mode

```
Interface Config
```

5.1.11 spanning-tree bpduguard

This command sets the BPDU (Bridge Protocol Data Units) Guard on the switch to enabled.

Default

```
disabled
```

Format

```
spanning-tree bpduguard
```

Mode

```
Global Config
```

- **no spanning-tree bpduguard**
  This command sets the BPDU (Bridge Protocol Data Units) Guard to disabled.

Format

```
no spanning-tree bpduguard
```

Mode

```
Global Config
```

5.1.12 spanning-tree configuration name

This command sets the Configuration Identifier Name for use in identifying the configuration that this switch is currently using. The <name> is a string of at most 32 characters.

Default

The base MAC address displayed using hexadecimal notation as specified in IEEE 802 standard.

Format

```
spanning-tree configuration name <name>
```

Mode

```
Global Config
```

no spanning-tree configuration name

This command resets the Configuration Identifier Name to its default.

Format

```
no spanning-tree configuration name
```

Mode

```
Global Config
```

5.1.13 spanning-tree configuration revision

This command sets the Configuration Identifier Revision Level for use in identifying the configuration that this switch is currently using. The Configuration Identifier Revision Level is a number in the range of 0 to 65535.

Default

```
0
```

Format

```
spanning-tree configuration revision <0-65535>
```

Mode

```
Global Config
```

no spanning-tree configuration revision

This command sets the Configuration Identifier Revision Level for use in identifying the configuration that this switch is currently using to the default value, i.e. 0.

Format

```
no spanning-tree configuration revision
```

Mode

```
Global Config
```

5.1.14 spanning-tree edgeport

This command specifies that this port is an Edge Port within the common and internal spanning tree. This will allow this port to transition to Forwarding State without delay.

Format

```
spanning-tree edgeport
```

Mode

```
Interface Config
```

no spanning-tree edgeport

This command specifies that this port is not an Edge Port within the common and internal spanning tree.

Format

```
no spanning-tree edgeport
```

Mode

```
Interface Config
```

5.1.15 spanning-tree forceversion

This command sets the Force Protocol Version parameter to a new value. The Force Protocol Version can be one of the following:

- 802.1d - ST BPDUs are transmitted (802.1Q-2005 functionality supported)
- 802.1s - ST BPDUs are transmitted (802.1Q-2005 functionality supported)
- 802.1w - RST BPDUs are transmitted (802.1Q-2005 functionality supported)

Default

```
802.1w
```

Format

```
spanning-tree forceversion
                          <802.1d | 802.1s | 802.1w>
```

Mode

```
Global Config
```

no spanning-tree forceversion
This command sets the Force Protocol Version parameter to the default value, i.e. 802.1w.

Format

```
no spanning-tree forceversion
```

Mode

```
Global Config
```

5.1.16 spanning-tree forward-time

This command sets the Bridge Forward Delay parameter to a new value for the common and internal spanning tree. The forward-time value is in seconds within a range of 4 to 30, with the value being greater than or equal to "(Bridge Max Age / 2) + 1".

Default

```
15
```

Format

```
spanning-tree forward-time <4-30>
```

Mode

```
Global Config
```

no spanning-tree forward-time

This command sets the Bridge Forward Delay parameter for the common and internal spanning tree to the default value, i.e. 15.

Format

```
no spanning-tree forward-time
```

Mode

```
Global Config
```

5.1.17 spanning-tree guard loop

This command enables loop guard and disables root guard on an interface.

Default

```
disabled
```

Format

```
spanning-tree guard loop
```

Mode

```
Interface Config
```

- **no spanning-tree guard**
  This command disables the guard for this port.

Format

```
no spanning-tree guard
```

Mode

```
Interface Config
```

5.1.18 spanning-tree guard none

This command disables root guard and disables loop guard on an interface.

Default

```
disabled
```

Format

```
spanning-tree guard none
```

Mode

```
Interface Config
```

no spanning-tree guard

This command disables the guard for this port.

Format

```
no spanning-tree guard
```

Mode

```
Interface Config
```

5.1.19 spanning-tree guard root

This command enables root guard and disables loop guard on an interface.

Default

```
disabled
```

Format

```
spanning-tree guard root
```

Mode

```
Interface Config
```

no spanning-tree guard

This command disables the guard for this port.

Format

```
no spanning-tree guard
```

Mode

```
Interface Config
```

5.1.20 spanning-tree hello-time

This command sets the Hello Time parameter to a new value for the common and internal spanning tree. The hellotime <value> is in whole seconds within a range of 1 to 2 with the value being less than or equal to "(Bridge Max Age / 2) - 1".

Default

```
2
```

Format

```
spanning-tree hello-time <1-2>
```

Mode

```
Interface Config
Global Config
```

no spanning-tree hello-time
This command sets the Hello Time parameter for the common and internal spanning tree to the default value, i.e. 2.

Format

```
no spanning-tree hello-time
```

Mode

```
Interface Config
Global Config
```

5.1.21 spanning-tree hold-count

This command sets the bridge hold count parameter.

Default

```
disabled
```

Format

```
spanning-tree hold-count <1-40>
```

Mode

`Global Config`

<1-40>

Enter the bridge parameter for hold count as an integer in the range 1 - 40.

no spanning-tree hold-count

This command sets bridge hold count to disabled.

Format

`no spanning-tree hold-count`

Mode

`Global Config`

5.1.22 spanning-tree max-age

This command sets the Bridge Max Age parameter to a new value for the common and internal spanning tree. The max-age value is in seconds within a range of 6 to 40, with the value being less than or equal to "2 times (Bridge Forward Delay - 1)".

Default

`20`

Format

`spanning-tree max-age <6-40>`

Mode

`Global Config`

no spanning-tree max-age

This command sets the Bridge Max Age parameter for the common and internal spanning tree to the default value, i.e. 20.

Format

```
no spanning-tree max-age
```

Mode

```
Global Config
```

5.1.23 spanning-tree max-hops

This command sets the Bridge Max Hops parameter to a new value for the common and internal spanning tree. The max-hops value is an integer within a range of 1 to127.

Format

```
spanning-tree max-hops <1-127>
```

Mode

```
Global Config
```

no spanning-tree max-hops

This command sets the Bridge Max Hops parameter for the common and internal spanning tree to the default value, i.e. 20.

Format

```
no spanning-tree max-age
```

Mode

```
Global Config
```

5.1.24 spanning-tree mst

This command sets the Path Cost or Port Priority for this port within the multiple spanning tree instance or in the common and internal spanning tree. If the <mstid> parameter corresponds to an existing multiple spanning tree instance, then the configurations are done for that multiple spanning tree instance. If however 0 (defined as the default CIST ID) is passed as the <mstid>, then the configurations are performed for the common and internal spanning tree instance.
This command accepts the value 0 for the mstid, meaning the common and internal spanning tree.

If the ‘cost’ token is specified, this command sets the path cost for this port within a multiple spanning tree instance or the common and internal spanning tree instance, depending on the <mstid> parameter. The pathcost can be specified as a number in the range of 1 to 200000000 or auto. If "auto" is specified, the pathcost value will be set based on Link Speed.

If the ‘port-priority’ token is specified, this command sets the priority for this port within a specific multiple spanning tree instance or the common and internal spanning tree instance, depending on the <mstid> parameter. The port-priority value is a number in the range of 0 to 240 in increments of 16.

Default

```
cost : auto; external-cost : auto;
port-priority : 128
```

Format

```
spanning-tree mst <mstid>
     {{cost <1-200000000> | auto } |
      {external-cost <1-200000000> | auto } |
       port-priority <0-240>}
```

Mode

```
Interface Config
```

no spanning-tree mst

This command sets the Path Cost or Port Priority for this port within the multiple spanning tree instance or in the common and internal spanning tree to the respective default values. If the <mstid> parameter corresponds to an existing multiple spanning tree instance, then the configurations are done for that multiple spanning tree instance. If however 0 (defined as the default CIST ID) is passed as the <mstid>, then the configurations are performed for the common and internal spanning tree instance.
This command accepts the value 0 for the mstid, meaning the common and internal spanning tree.
If the ‘cost’ token is specified, this command sets the path cost for this port within a multiple spanning tree instance or the common and internal spanning tree instance, depending on the <mstid> parameter, to the default value, i.e. a pathcost value based on the Link Speed.
If the ‘port-priority’ token is specified, this command sets the priority for this port within a specific multiple spanning tree instance or the common and internal spanning tree instance, depending on the <mstid> parameter, to the default value, i.e. 128.

Format

```
no spanning-tree mst <mstid> <cost | port-priority>
```

Mode

```
Interface Config
```

5.1.25 spanning-tree mst priority

This command sets the bridge priority for a specific multiple spanning tree instance. The instance <mstid> is a number that corresponds to the desired existing multiple spanning tree instance. The priority value is a number within a range of 0 to 61440 in increments of 4096.
This command accepts the value 0 for the mstid.

If 0 (defined as the default CIST ID) is passed as the <mstid>, then this command sets the Bridge Priority parameter to a new value for the common and internal spanning tree. The bridge priority value again is a number within a range of 0 to 61440. The twelve least significant bits will be masked according to the 802.1s specification. This will cause the priority to be rounded down to the next lower valid priority.

Default

```
32768
```

Format

```
spanning-tree mst priority <mstid> <0-61440>
```

Mode

```
Global Config
```

no spanning-tree mst priority

This command sets the bridge priority for a specific multiple spanning tree instance to the default value, i.e. 32768. The instance <mstid> is a number that corresponds to the desired existing multiple spanning tree instance.
This command accepts the value 0 for the mstid.
If 0 (defined as the default CIST ID) is passed as the <mstid>, then this command sets the Bridge Priority parameter for the common and internal spanning tree to the default value, i.e. 32768.

Format

```
spanning-tree mst priority <mstid>
```

Mode

```
Global Config
```

5.1.26 spanning-tree mst vlan

This command adds an association between a multiple spanning tree instance and a VLAN. The VLAN will no longer be associated with the common and internal spanning tree. The instance <mstid> is a number that corresponds to the desired existing multiple spanning tree instance. The <vlanid> corresponds to an existing VLAN ID (1-4042).
This command accepts the value 0 for the mstid.

Format

```
spanning-tree mst vlan <mstid> <vlanid>
```

Mode

```
Global Config
```

no spanning-tree mst vlan

This command removes an association between a multiple spanning tree instance and a VLAN. The VLAN will again be associated with the common and internal spanning tree. The instance <mstid> is a number that corresponds to the desired existing multiple spanning tree instance. The <vlanid> corresponds to an existing VLAN ID.
This command accepts the value 0 for the mstid.

Format

```
no spanning-tree mst vlan <mstid> <vlanid>
```

Mode

```
Global Config
```

5.1.27 spanning-tree mst instance

This command creates a MST instance.

Format

```
spanning-tree mst instance <1-4094>
```

Mode

```
Global Config
```

<1-4094>

Enter a multiple spanning tree instance identifier.

no spanning-tree mst instance

This command removes a MST instance.

Format

```
no spanning-tree mst instance <1-4094>
```

Mode

```
Global Config
```

<1-4094>

Enter a multiple spanning tree instance identifier.

5.1.28 spanning-tree port mode

This command sets the Administrative Switch Port State for this port to enabled.

Default

```
disabled
```

Format

```
spanning-tree port mode
```

Mode

```
Interface Config
```

no spanning-tree port mode

This command sets the Administrative Switch Port State for this port to disabled.

Format

```
no spanning-tree port mode
```

Mode

```
Interface Config
```

5.1.29 spanning-tree port mode all

This command sets the Administrative Switch Port State for all ports to enabled.

Default

disabled

Format

```
spanning-tree port mode all
```

Mode

Global Config

no spanning-tree port mode all

This command sets the Administrative Switch Port State for all ports to disabled.

Format

```
no spanning-tree port mode all
```

Mode

Global Config

5.1.30 spanning-tree stp-mrp-mode

This command sets the spanning tree mrp (Media Redundancy Protocol) mode to enabled.

Default

disabled

Format

```
spanning-tree stp-mrp-mode
```

Mode

Global Config

no spanning-tree stp-mrp-mode

This command sets the spanning tree mrp (Medium Redundancy Protocol) mode to disabled.

Format

```
no spanning-tree stp-mrp-mode
```

Mode

Global Config

5.1.31 spanning-tree tcnguard

This command enables tcn guard on an interface.

Default

```
disabled
```

Format

```
spanning-tree guard tcnguard
```

Mode

```
Interface Config
```

- **no spanning-tree tcnguard**
  This command disables tcn guard for this port.

Format

```
no spanning-tree tcnguard
```

Mode

```
Interface Config
```

5.2 MRP

The concept of the MRP-Ring enables the construction of high-availability, ring-shaped network structures.

The two ends of a backbone in a line-type configuration can be closed to form a redundant ring - the MRP-Ring - by using the RM function (Redundancy Manager) of the Switch.

It is possible to mix the devices that support this function in any combination within the MRP ring.

If a line section becomes inoperable, the ring structure of up to 50 switches typically transforms back to a line-type configuration within 150 ms (maximum 500 ms).

5.2.1 show mrp

This command displays the settings and states of the MRP-Ring. The following details are displayed on execution of the command.

Format

show mrp [current-domain]

Mode

Privileged EXEC and User EXEC

current-domain

Specify the optional keyword "current-domain" to show the current MRP domain's settings. If you omit the keyword "current-domain", the show command will display the settings of all existing MRP domains. **Note:** Currently, it is only possible to configure one MRP domain, so the keyword keyword "current-domain" can be omitted (it exists for future compatibility reasons).

5.2.2 show mrp current-domain

This command displays the settings and states of the MRP-Ring´s current domain. The following details are displayed on execution of the command. If you omit the optional keywords (e. g., advanced-mode), all settings will be displayed.

Format

```
show mrp current-domain [advanced-mode |
  domain-id | info | manager-priority | mode |
  name | recovery-delay | operation |
  port [primary | secondary] | summary | vlan]
```

Mode

Privileged EXEC and User EXEC

advanced mode

Show the switch's advanced mode setting for the given MRP domain.

domain-id

Show the given MRP domain's ID.

info

Show status information for the given MRP domain.
Note: The information displayed depends on the switch's mode (Client or Manager) because only a subset of them are useful for each mode.

manager-priority

Show the switch's manager priority for the given MRP domain.

mode

Show the switch's mode for the given MRP domain.

name

Show the given MRP domain's name.

recovery-delay

Show the given MRP domain's recovery delay.

operation

Show the switch's administrative setting for the given MRP domain (enabled or disabled).

port

Show the ports for the given MRP domain

port primary

Show the primary port for the given MRP domain.

port secondary

Show the secondary port for the given MRP domain.

summary

Show a summary for the given MRP domain.

vlan

Show the VLAN ID for the given MRP domain.

5.2.3 mrp current-domain

Specify that you want to configure the current MRP domain's settings.

Default

```
none
```

Format

```
mrp current-domain {advanced-mode {disable|enable}
| manager-priority <0-65535>
| mode {client|manager} | name <domain-name>
| recovery-delay {500ms|200ms}
| operation {disable|enable}
| port {primary|secondary} <slot/port>
| vlan <0-4042>}
```

Mode

```
Global Config
```

advanced-mode

Enable or disable the switch's advanced mode for the given MRP domain.

manager-priority

Configure the given MRP domain's manager priority (0-65535).

mode

Configure the switch's MRP mode for the given domain (client or manager).
`client`: Switch is client for the given MRP domain.
`manager`: Switch is manager for the given MRP domain.

name

Set a name for the given MRP domain.

recovery-delay

Configure the MRP recovery delay for the given domain.
`500ms`: Recovery delay is 500 ms for the given MRP domain.
`200ms`: Recovery delay is 200 ms for the given MRP domain.

operation

Enable or disable the switch for the given MRP domain.

port

Specify the switch's ports for the given MRP domain (in slot/port notation).
`primary`: Specify the switch's primary port for the given MRP domain.

`secondary`: Specify the switch's secondary port for the given MRP domain.

vlan

Enter the VLAN for the given MRP domain
Possible values: `0..4042`
Default Value: `0`

5.2.4 mrp delete-domain

Delete current MRP domain.

Format

```
mrp delete-domain current-domain
```

Mode

```
Global Config
```

5.2.5 mrp new-domain

Create a new MRP domain. The configuration will consist of default parameters and its operation will be disabled.

Default

`n/a` not set

Format

```
mrp new-domain (<domain-id> | default-domain)
```

Mode

```
Global Config
```

domain-id

Enter a new MRP domain id. Format: 16 bytes in decimal notation, example: 1.2.3.4.5.6.7.8.9.10.11.12.13.14.15.16
The MRP domain id 0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0 is invalid.

default-domain

Create a default MRP domain (ID: 255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255).

5.2.6 arc

Use this command to configure ARC (Automatic Ring Configuration). ARC supports MRP.

The ARC protocol is a simple protocol that checks a ring configuration and, if suitable, configures all clients of this ring automatically.

The check cycle includes an analysis of the ARC devices for an already active ring configuration and wrong ring configuration values. The ARC devices can detect loop situations and other ARC Managers in the ring. Errors are reported to the ARC Manager. With this information the ARC Manager can decide whether a configuration of the ring clients is possible or not.

Format

```
arc { manager {enable | disable} |
      client {enable | disable | checkOnly} |
      check |
      configure}
```

Mode

Global Config

client

Configure the ARC client.
- `enable`: Enable the ARC client for configuring and checking.
- `disable`: Disable the ARC client for configuring and checking.
- `checkOnly`: The device can only be checked but not configured by ARC.

manager

Configure the ARC manager.
- `enable`: Enable the ARC manager for configuring and checking.
- `disable`: Disable the ARC manager for configuring and checking.

check

Check the topology. All important values will be taken from the current ring configuration on the devices.

configure

Configure the topology. All important values will be taken from the current ring configuration of the ARC manager.

5.2.7 show arc

This command displays the current ARC configuration and the result of the last action.

Format

```
show arc
```

Mode

```
Global Config
```

Client Settings:

Display the Client Settings for the current ARC configuration.

Admin Status

Display if the ARC client is enabled or disabled.

MAC address of the ARC Manager

Display the MAC address of the ARC Client.

IP address of the ARC Manager

Display the IP address of the ARC Client.

Port 1

Display the number of Ring Port 1 for the client (slot/port).

Port 2

Display the number of Ring Port 2 for the client (slot/port).

Manager Settings:

Display the Manager Settings for the current ARC configuration.

Admin Status

Display the ARC manager is enabled or disabled

Protocol

Display the Protocol. Possible values: mrp, ...

Port 1

Display the number of Ring Port 1 for the manager (slot/port).

Port 2

Display the number of Ring Port 2 for the manager (slot/port).

VLAN ID

Display the VLAN ID. Possible values: 0 - ....

Last Action Result

Display the Result of the Last Action.
Possible values: Ring is open, Already Configured, Loop Source, Multiple RM, Configuration failed, Port not in full duplex mode, ARC not supported by the ring devices.

Last Check result:

Display the Result of the last check.
- `Nr:` Display the number of the check result.
- `Mac Address:` Display the concerned MAC address.
- `IP Address:` Display the concerned IP address.
- `Type:` Display the type of the result. Possible values: `Error, Warning.`

Possible check results (examples):

```
Error - Ring is open
Warning - Already Configured - HIPER Ring - Port1: 1.1 - Port2: 1.2
Warning - Already Configured - MRP - Port1: 1.9 - Port2: 1.10 - VLAN ID: 0
Warning - Already Configured - Fast HIPER Ring - Port1: 1.3 - Port2: 1.4
Error - Loop Source - Hop count: 1 - Port1: 1.1 - Port2: 1.4 - Port3: 1.15
Error - Multiple RM - MRP
Error - Configuration failed - MRP
Warning - Port not in full duplex mode - Port1: 1.1 Half - Port2: 1.2 Full
Warning - ARC not supported by the ring devices
```

5.3 HIPER-Ring

The concept of the HIPER-Ring enables the construction of high-availability, ring-shaped network structures. Within such a ring topology, network components supporting the HIPER-Ring are connected with each other via their ring ports. Exactly one redundancy manager assumes control of the ring. These commands are for configuring the Hirschmann High Performance Redundancy Ring.

Further information concerning this function you will find in the User Manual ”Redundancy Configuration”.

5.3.1 show hiper-ring

This command displays the settings and states of the HIPER-Ring. The following details are displayed on execution of the command.

Format

```
show hiper-ring
  {info | mode | port [primary | secondary] |
  redundancy-state | rm-state | recovery-delay}
```

Mode

Privileged EXEC and User EXEC

info

Display the information about the HIPER-Ring configuration (cabling).

mode

Display the HIPER-Ring mode settings.

port

Display the HIPER-Ring's primary and secondary port properties.

port primary

Display the HIPER Ring's primary port properties.

port secondary

Display the HIPER Ring's secondary port properties.

redundancy-state

Display the actual state of the HIPER-Ring redundancy.

rm-state

Display the state of the HIPER Ring redundancy manager.

recovery-delay

Display the value of the recovery delay.

5.3.2 hiper-ring

Configure the HIPER-Ring.
Press Enter for a list of valid commands and their recommended order.

Format

```
hiper-ring
```

Mode

```
Global Config
```

- **no hiper-ring**
  Clear the HIPER Ring configuration (delete it).

Format

```
no hiper-ring
```

Mode

```
Global Config
```

5.3.3 hiper-ring mode

This command sets the HIPER-Ring mode. Possible values are:

- `ring-manager` Set the switch's HIPER Ring mode to Ring Manager.
- `rm` Abbreviation of Ring Manager.
- `ring-switch` Set the switch's HIPER Ring mode to Ring Switch.
- `rs` Abbreviation of Ring Switch.

Default

```
none
```

Format

```
hiper-ring mode <{ring-manager|ring-switch|rm|rs}>
```

Mode

```
Global Config
```

5.3.4 hiper-ring port primary

Enter the switch's primary HIPER Ring port.

Default

`n/a` (not set)

Format

`hiper-ring port primary <primary ring port>`

Mode

`Global Config`

primary ring port

Enter the switch's primary HIPER Ring port (`<slot/port>`).

5.3.5 hiper-ring port secondary

Enter the switch's secondary HIPER Ring port.

Default

`n/a` not set

Format

`hiper-ring port secondary <secondary ring port>`

Mode

`Global Config`

secondary ring port

Enter the switch's secondary HIPER Ring port (`<slot/port>`).

5.3.6 hiper-ring recovery-delay

Defines the maximum recovery delay of ring recovery in the HIPER Ring (`500` or `300` ms).

Default

`n/a` not set

Format

```
hiper-ring recovery-delay (<500/300>)
```

Mode

```
Global Config
```

5.4 Fast-HIPER-Ring

The concept of the Fast-HIPER-Ring enables the construction of high-availability, ring-shaped network structures. Within such a ring topology, network components supporting the Fast-HIPER-Ring are connected with each other via their ring ports. Exactly one redundancy manager assumes control of the ring.
These commands are for configuring the Hirschmann Fast High Performance Redundancy Ring.

Further information concerning this function you will find in the User Manual ”Redundancy Configuration”.

This command displays the settings and states of the HIPER-Ring. The following details are displayed on execution of the command.

Format

```
show fast-hiper-ring
```

Mode

Privileged EXEC and User EXEC

Ring ID

Display the Ring ID.

Mode of Switch (administrative setting)

Display the HIPER-Ring mode administrative settings.

Mode of Switch (real operating state)

Display the HIPER-Ring operation mode.

Ring Name

Display theFast-HIPER-Ring's name.

Number of nodes in the ring

Display the number of nodes in the ring.

Port Number, Primary

Display the HIPER-Ring's primary port number and its properties.

Port Number, Secondary

Display the HIPER-Ring's secondary port number and its properties.

Operation

Display the admin state of the HIPER-Ring configuration.

General Operating States

Display general information concerning the fast-hiper-ring state.

Specify that you want to show the current Fast HIPER-Ring ID's settings.

Format

```
show fast-hiper-ring current-id
  {id | info | mode | operation | port |
  port [primary |secondary] | summary |
  ring-name | nodes | vlan}
```

Mode

Privileged EXEC and User EXEC

id

Display the given Fast HIPER-Ring's ID.

info

Display status information for the given Fast HIPER-Ring ID.

mode

Display the switch's mode for the given Fast HIPER-Ring ID.

operation

Display the switch's operative setting for the given Fast HIPER-Ring ID.
Note: In case of configuration problems, this value may differ from the administrative setting (may become 'Disabled').

port

Display the ports for the given Fast HIPER-Ring ID.

port primary

Display the primary port for the given Fast HIPER-Ring ID.

port secondary

Display the secondary port for the given Fast HIPER-Ring ID.

summary

Display a summary for the given Fast HIPER-Ring ID.

ring-name

Display the ring name for the given Fast HIPER-Ring ID.

nodes

Display the number of nodes in the ring for the given Fast HIPER-Ring ID.

vlan

Display the VLAN ID for the given Fast HIPER-Ring ID.

5.4.1 fast-hiper-ring

Configure the Fast-HIPER-Ring.

Format

```
fast-hiper-ring {current-id
 {mode {ring-manager|ring-switch|rm|rs} |
 operation {disable|enable} |
 port {primary|secondary} <slot/port> |
 ring-name <ring-name> |
 nodes <1-n> |
 vlan <0-4042>} |
delete-id current-id |
new-id {<id>|default-id}}
```

Mode

Global Config

current-id

Specify that you want to configure the current Fast-HIPER-Ring ID's settings.

mode

Configure the switch's Fast HIPER-Ring mode for the given ID (ring-manager or ring-switch).
rm: Abbreviation for 'ring-manager'.
rs: Abbreviation for 'ring-switch'.

mode ring-manager

Switch is ring-manager for the given Fast HIPER-Ring ID.

mode ring-switch

Switch is ring-switch for the given Fast HIPER-Ring ID.

mode rm

Abbreviation for 'ring-manager'.

mode rs

Abbreviation for 'ring-switch'.

operation

Enable or disable the switch for the given Fast-HIPER-Ring ID.

port

Specify the switch's ports for the given Fast-HIPER-Ring ID.

ring-name

Set a ring name for the given Fast HIPER-Ring ID.

nodes

Specify the number of nodes in the ring for the given Fast HIPER-Ring ID.

vlan

Specify the VLAN for the given Fast HIPER-Ring ID.

delete-id

Delete the given Fast HIPER-Ring ID.

new-id

Create a new Fast HIPER-Ring ID. The configuration will consist of default parameters and its operation will be disabled.

<id>

Enter a new Fast HIPER-Ring ID. Format: a number in the range 1-2147483647 (2^31 - 1). An ID of 0 is invalid.

default-id

Create a default Fast HIPER-Ring ID (1).

5.5 Redundant Coupling

The control intelligence built into the switch allows the redundant coupling of HIPER-Rings and network segments. Two network segments can be connected via two separate paths with one of the following switches:

- RS2-16M
- RS20/RS30/RS40
- RSR20/RSR30
- MICE (Rel. 3.0 or higher)
- MS20/MS30
- PowerMICE
- MACH1000
- MACH3000 (Rel. 3.3 or higher)
- MACH4000

The switch in the redundant line and the switch in the main line inform each other about their operating states by using control frames via the ethernet or via the control line.

Note: For redundancy security reasons, the Rapid Spanning Tree protocol and redundant network/ring coupling may not be enabled simultaneously.

Note: The network that connects the master and the slave must always be a HiPER-Ring. The coupling switch in single mode also must have a HiPER-Ring Configured.

Further information concerning this function you will find in the User Manual ”Redundancy Configuration”.

These commands allow you to configure the redundant coupling of network segments.

5.5.1 show ring-coupling

This command displays the settings and states of the network coupling / ring coupling.

To set up a new Ring Coupling configuration when no configuration is currently present (e. g., after a clear command), always set the local port first. Please refer to: ring-coupling port local <slot/port>.

The following details are displayed on execution of the command.

Format

```
show ring-coupling <config | info |
net-coupling | operation | partner-ip |
port [ all | control | local | partner] |
redundancy-mode>
```

Mode

Privileged EXEC and User EXEC

config

Display the Ring Coupling's configuration
- single
- dual-master-inband
- dual-master-outband
- dual-slave-inband
- dual-slave-outband.

info

Display information about the Ring Coupling's states:
- configuration failure,
- Extended diagnosis,
- redundancy guaranteed.

net-coupling

Display the Ring Coupling's ring/network coupling setting (network/ring-only).

operation

Display the Ring Coupling's operation setting
- on
- off

partner IP

Display the switch's Ring Coupling partner IP address (only valid for remote configurations).

port

Display the switch's Ring Coupling ports
– `all`
– `local`
– `partner` (only takes effect in dual configurations)
– `control` (only takes effect in outband configurations).

redundancy-mode

Display the Ring Coupling's redundancy mode
– `normal`
– `extended`.

Ring/Network Coupling Mode

Display the Ring/Network Coupling mode
– `ring-only` if you wish to couple a HIPER-Ring.
– `network` if you wish to couple a line-type configuration.

5.5.2 ring-coupling

Configure the redundant coupling of HIPER-Rings / network segments. This command, if called without arguments, lists the available subcommands, their recommended order and tips how to set up a new configuration.

Format

```
ring-coupling
```

Mode

```
Global Config
```

- **no ring-coupling**
  Clear the ring-coupling configuration (delete it).

Format

```
no ring-coupling
```

Mode

```
Global Config
```

5.5.3 ring-coupling config

This command sets the Ring Coupling configuration.

Possible values are:

- `single` Configure the Ring Coupling's basic setting to single (both coupling ports are local to the switch, switch performs master and slave functions).
- `dual-master-inband` Configure the Ring Coupling's basic setting to dual-master-inband (2nd coupling port is on a remote switch, local switch is master, communication over network).
- `dual-master-outband` Configure the Ring Coupling's basic setting to dual-master-outband (2nd coupling port is on a remote switch, local switch is master, communication over dedicated control port).
- `dual-slave-inband` Configure the Ring Coupling's basic setting to dual-slave-inband (2nd coupling port is on a remote switch, local switch is slave, communication over network).
- `dual-slave-outband` Configure the Ring Coupling's basic setting to dual-slave-outband (2nd coupling port is on a remote switch, local switch is slave, communication over dedicated control port).
- `dmi` Abbreviation for `dual-master-inband`.
- `dmo` Abbreviation for `dual-master-outband`.
- `dsi` Abbreviation for `dual-slave-inband`.
- `dso` Abbreviation for `dual-slave-outband`.

Default

```
none
```

Format

```
ring-coupling config <{ single |
dual-master-inband | dual-master-outband |
dual-slave-inband | dual-slave-outband |
dmi | dmo | dsi | dso }>
```

Mode

```
Global Config
```

5.5.4 ring-coupling net-coupling

Coupling mode refers to the type of coupled network.

Possible values are:

- `network` ,if you wish to couple a line-type configuration.
- `ring-only` ,if you wish to couple a HIPER-Ring.

Default

`none`

Format

`ring-coupling net-coupling <{network|ring-only}>`

Mode

`Global Config`

5.5.5 ring-coupling operation

Configure the Ring Coupling's operation setting. Possible values are:

- `on` Enable the current Ring Coupling configuration.
- `off` Disable the current Ring Coupling configuration.

Default

`off`

Format

`ring-coupling operation <{off|on}>`

Mode

`Global Config`

5.5.6 ring-coupling port

Configure the Ring Coupling's ports. Possible values are:

- `control` Enter the Ring Coupling's control coupling port in outband configurations.
- `local` Enter the Ring Coupling's local coupling port.
- `partner` Enter the Ring Coupling's partner coupling port in single mode configuration.

Default

`none`

Format

`ring-coupling port <{control|local|partner}> <slot/port>`

Mode

`Global Config`

5.5.7 ring-coupling redundancy-mode

Configure the Ring Coupling's redundancy mode. Possible values are:

- `extended` Slave responds to a failure in the remote ring or network.
- `normal` Slave does not respond to a failure in the remote ring or network.

Default

`extended`

Format

`ring-coupling redundancy-mode <{extended|normal}>`

Mode

`Global Config`

5.6 Port Security

With the Port Securitiy function you can specify for each port from which terminal devices data can be received and sent to other ports. This function helps to protect the network from unauthorized access.

5.6.1 show port-sec dynamic

Use this command to display the dynamic MAC limit port-related settings (dynamic limit,current MAC count, current action and current port state).

Format

```
show port-sec dynamic {all | <slot/port>}
```

Mode

```
Global Config
```

all

Display information for each port.

<slot|port>

Display information for one specific port.

Port

Display the number of the port (`slot/port`).
Possible values: `1/1`, `1/2`, ...

State

Display state of dynamic MAC limit port-related settings.
Possible values: `Disabled`, `Enabled`
Default value: `Enabled`

Limit

Display the currently configured dynamic limit of MAC addresses allowed to be learned on the interface.

Possible values: `0..50`
Default value: `0`

Current

Display current number of MAC addresses learned on the interface.
Possible values: `0..50`
Default value: `0`

Action

Display the currently configured action to be taken if port security is violated at this port.
Possible values: `None, Auto Disable, Port Disable, Trap Only`
Default value: `Auto Disable`

5.6.2 show port-sec mode

Display the MAC/IP Based Port Security global setting for all ports.

Format

```
show port-sec mode
```

Mode

Privileged EXEC and User EXEC

5.6.3 show port-sec port

Display the MAC/IP Based Port Security port-related settings (allowed MAC address, current MAC address, allowed IP address, current action and current port state).

Format

```
show port-sec port <{all|<slot/port>}>
```

Mode

Privileged EXEC and User EXEC

5.6.4 port-sec mode

Configure the global MAC/IP Based Port Security mode:

- `ip-based` Port security is based on a given, allowed source IP address.
- `mac-based` Port security is based on a given, allowed source MAC address.

Format

```
port-sec mode <{ip-based|mac-based}>
```

Mode

```
Global Config
```

5.6.5 port-sec action

Configure the action to be taken if port security is violated at this port.

- `none`
  No action is taken if port security is violated at this port.
- `auto-disable`
  The port is auto-disabled for traffic if port security is violated
- `port-disable`
  The port is disabled for traffic if port security is violated.
- `trap-only`
  A trap is sent if port security is violated at this port (this port remains open for traffic).

Configure the allowed IP source address for this port.
Configure the allowed MAC source address for this port.

Format

```
port-sec {action {none | auto-disable |
          port-disable | trap-only}
         |allowed-ip <IP1> [IP2 [IP3 [IP4 [IP5
              [IP6 [IP7 [IP8 [IP9 [IP10]]]]]]]]]
         |allowed-mac <MAC1> [MAC2 [MAC3 [MAC4
              [MAC5 [MAC6 [MAC7 [MAC8 [MAC9
              [MAC10]]]]]]]]] }
```

Mode

`Interface Config`

- **no port-sec**
  No action is taken if port security is violated at this port.

Format

```
no port-sec
```

Mode

`Interface Config`

5.6.6 port-sec allowed-ip

Enter the allowed IP source address for this port, format: nnn.nnn.nnn.nnn (nnn: decimal number 0..255) (up to 10).

Format

```
port-sec allowed-ip <IP Address 1> <IP Address 2>
... <IP Address 10>
```

Mode

```
Interface Config
```

5.6.7 port-sec allowed-ip add

Enter the allowed IP source address for this port, format: nnn.nnn.nnn.nnn (nnn: decimal number 0..255) (up to 50).

Format

```
port-sec allowed-ip add <IP Address 1>
                  <IP Address 2> ... <IP Address 50>
```

Mode

```
Interface Config
```

5.6.8 port-sec allowed-ip remove

Enter the allowed IP source address for this port, format: nnn.nnn.nnn.nnn (nnn: decimal number 0..255) (up to 50).

Format

```
port-sec allowed-ip remove <IP Address 1>
                  <IP Address 2> ... <IP Address 50>
```

Mode

```
Interface Config
```

5.6.9 port-sec allowed-mac

Enter the allowed MAC source address for this port, format: nn:nn:nn:nn:nn:nn (n: hexadecimal digit) or format: nn:nn:nn:nn:nn:nn/m (n: hexadecimal digit) (m: decimal digit (1..48)) (up to 10).

Format

```
port-sec allowed-mac <MAC Address 1>
<MAC Address 2> ... <MAC Address 10>
```

Mode

```
Interface Config
```

5.6.10 port-sec allowed-mac add

Enter the allowed MAC source address for this port,
format: nn:nn:nn:nn:nn:nn (n: hexadecimal digit) or
format: nn:nn:nn:nn:nn:nn/m
n: hexadecimal digit, m: decimal digit (1..48)
(up to 50).

Format

```
port-sec allowed-mac add <MAC Address 1>
             <MAC Address 2> ... <MAC Address 50>
```

Mode

```
Interface Config
```

5.6.11 port-sec allowed-mac remove

Enter the allowed MAC source address for this port,
format: nn:nn:nn:nn:nn:nn (n: hexadecimal digit) or
format: nn:nn:nn:nn:nn:nn/m
n: hexadecimal digit, m: decimal digit (1..48)
(up to 50).

Format

```
port-sec allowed-mac remove <MAC Address 1>
             <MAC Address 2> ... <MAC Address 50>
```

Mode

```
Interface Config
```

5.6.12 port-sec dynamic

Use this command to configure the dynamic limit of MAC addresses allowed to be learned on the interface. A value of `0` disables the dynamic limit.

Format

```
port-sec dynamic <max-count>
```

Mode

```
Interface Config
```

<max-count>

Enter the maximum number of dynamically learned allowed MAC addresses
– Possible values: `0..50`
– Default: `0`
– A value of `0` disables the dynamic limit.

5.6.13 clear port-sec

Clear the MAC/IP Based Port Security by setting each port's security action (applied when port security is violated) to None. Additionally, the global mode is set to MAC Based.

Note: This does not clear the 802.1X Port Security.

Format

```
clear port-sec
```

Mode

```
User EXEC and Global Config
```

5.7 DHCP Relay Commands

These commands configure the DHCP Relay parameters. The commands are divided by functionality into these different groups:

- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Show commands are used to display switch settings, statistics and other information.
- Commands that start with the keyword ’no’ (so-called ’no commands’) are used to clear some or all of the settings to factory defaults.

5.7.1 dhcp-relay

Set different options for BOOTP/DHCP relay and option 82 inclusion.

Format

```
dhcp-relay
 {opt82
   {operation {disable|enable}|
    man-id <Manual Remote ID>|
    remote-id-type {client-id|ip|mac|other}}|
  server-address <Server-ID (1..16)>
      <Server IP Address> [<slot/port> | all] }
```

Mode

Global Config

dhcp-relay opt82 operation {disable|enable}

Enable/Disable option 82 globally. Default: enable.

dhcp-relay opt82 man-id <Manual Remote ID>

Configure the DCHP Relay's Option 82 Manual Value for the Remote ID Type (only effective, if Remote ID is set to ”other“). Default: no ID.

dhcp-relay opt82 remote-id-type {client-id|ip|mac|other}

Configure the DCHP Relay's Option 82 Remote ID Type.
Default: mac

dhcp-relay server-address
<Server ID (1..16)> <Server IP Address> [<slot/port> | all]

Set the server IP address for one of the 16 possible server IDs.
Default: 0.0.0.0.
Optionally, configure this entry to a specific interface. If an interface is set, only DHCP packets from this interface are relayed to the server.

no dhcp-relay

Clear the DCHP Relay configuration (set all server addresses to 0.0.0.0).

Format

```
no dhcp-relay
```

Mode

Global Config

5.7.2 dhcp-relay

Set different port specific options for option 82 inclusion.

Format

```
dhcp-relay {admin-state {disable|enable} |
            operation {disable|enable} |
            hirschmann-device {disable|enable} |
            hirschmann-agent {disable|enable}}
```

Mode

```
Interface Config
```

dhcp-relay admin-state {disable|enable}

Enable or disable the DHCP Realy's Admin State on this port. Default: enable.
Note: Make sure that "Active Protocol" is "Relay" for both ports involved in DHCP Relaying (the one connected to DHCP client and the one connected to DHCP server).

dhcp-relay operation {disable|enable}

Enable or disable the DHCP Relay's Option 82 on this port. Default: enable.

dhcp-relay hirschmann-device {disable|enable}

Enable this parameter if a Hirschmann DHCP client is connected to this port.
- It disables the forwarding of DHCP multicast requests that are received on this port.
- It will send its own DHCP multicast requests to be relayed by the DHCP relay; this will reduce the load in your network.

Disable this parameter if a Non-Hirschmann DHCP client is connected to this port (these devices send normal broadcast DHCP requests; this enables the relaying of DHCP broadcast requests that are received on this port).

dhcp-relay hirschmann-agent {disable|enable}

Enable or disable the forwarding of DHCP requests that are received on this port. Enable this parameter if a Hirschmann DHCP client is connected to this port. Default: disable.
Disable this parameter if a Non-Hirschmann DHCP client is connected to this port (these devices send normal broadcast DHCP requests; this enables the relaying of DHCP broadcast requests that

are received on this port)
Enable this parameter if a Hirschmann DHCP client is connected to this port (it will send its own DHCP multicast requests to be relayed by the DHCP relay; this will reduce the load in your network).

5.7.3 show dhcp-relay

Display the settings of the BOOTP/DHCP relay.

Format

```
show dhcp-relay [opt82 | port {<slot/port>|all} |
server-address]
```

Mode

Privileged EXEC and User EXEC

opt82

Show the DHCP Relay's Option 82 settings exclusively.

port

Display the DHCP Relay's port-related settings for the specified port exclusively.

<slot/port>

Show the DHCP Relay's port-related settings for the specified port exclusively.

all

Show the DHCP Relay's port-related settings for all ports.

server-address

Display the DHCP Relay's server address settings exclusively.
`ID:` The ID of the DHCP server `(1..16)`.
`Server IP:` The DHCP server's IP address (`a.b.c.d`).
`Interface:` The number of the interface (`<slot/port>` or `all`).
`Operation:` The operational status (`Enabled`, `Disabled`).

Port

Display the port number in `<slot/port>` notation.

Admin State

Display the DHCP Relay's admin state settings.
Possible values: `Disabled`, `Enabled`

Active Protocol

Display the DHCP Relay's active protocol settings.
Possible values: `Relay`, `Disabled`, `Server`, `Inaccessible`

Option 82

Display the DHCP Relay's option 82 settings.
Possible values: `Disabled`, `Enabled`

Hirschmann Device

Display the DHCP Relay's Hirschmann device settings.
Possible values: `Disabled`, `Enabled`

5.8 DHCP Server Commands

These commands configure the DHCP server parameters. The commands are divided by functionality into these different groups:

- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Show commands are used to display switch settings, statistics and other information.
- Commands that start with the keyword ’no’ (so-called ’no commands’) clear some or all of the settings to factory defaults.

5.8.1 DHCP server configuration example

The example shown below has the following task: The IP address is only to be served, if a request is coming via interface 1/1 with specified Mac address.

```
<Hirschmann PowerMICE> >enable
<Hirschmann PowerMICE> #configure
<Hirschmann PowerMICE> <Config>#dhcp-server operation
enable
<Hirschmann PowerMICE> <Config>#dhcp-server pool add 1
static 192.168.0.10
<Hirschmann PowerMICE> <Config>#dhcp-server pool modify
1 mode interface 1/1
<Hirschmann PowerMICE> <Config>#dhcp-server pool modify
1 mode mac 00:80:63:12:34:56
<Hirschmann PowerMICE> <Config>#dhcp-server pool modify
1 option gateway 192.168.0.1
<Hirschmann PowerMICE> <Config>#dhcp-server pool enable
1
<Hirschmann PowerMICE> <Config>#interface 1/1
<Hirschmann PowerMICE> <interface 1/1>#dhcp-server oper-
ation enable
```

```
<Hirschmann PowerMICE> <config>#dhcp-server pool modify
1 option vendor-specific <f1 08 0a 7e 7e 02 0a 7f 7f 02>
```

This configuration leads to the following result:

```
<Hirschmann PowerMICE> #show dhcp-server pool 1

ID.............................. 1
Status.......................... Enabled
Start Address................... 192.168.0.10
End Address..................... 192.168.0.10
Leasetime....................... 86400
Hirschmann Device............... Disabled
Mode............................ Interface(1/1)
MAC............................. 00:80:63:12:34:56
Options:
Configpath.....................
Gateway......................... 192.168.0.1
Subnet Mask..................... 255.255.255.0
WINS............................ 0.0.0.0
DNS............................. 0.0.0.0
Hostname.......................
Vendor Specific Information..... "f1 08 0a 7e 7e 02 0a
7f 7f 02"
```

5.8.2 show dhcp-server

Display DHCP Server global and interface information.

Format

`show dhcp-server`

Mode

Privileged EXEC and User EXEC

DHCP Server

Display the DCHP server operation setting.
Possible values: `Enabled`, `Disabled`

DHCP Address Probe

Display the DCHP server address probe setting.
Possible values: `Enabled`, `Disabled`

DHCP, Port-Related Settings:

Port

Display the port number in <slot/port> notation.

Mode

Display the DCHP server interface information.
Possible values: `enable`, `disable`

DHCP, Pools:

Display the DCHP server pool related information.

5.8.3 show dhcp-server operation

Display DHCP Server global information.

Format

```
show dhcp-server operation
```

Mode

Privileged EXEC and User EXEC

DHCP Server

Display the DCHP server operation setting.
Possible values: `Enabled`, `Disabled`

DHCP Address Probe

Display the DCHP server address probe setting.
Possible values: `Enabled`, `Disabled`

5.8.4 show dhcp-server port

Display the DCHP port-related settings for all ports or specific port only.

Format

```
show dhcp-server port {all | <slot/port>}
```

Mode

Privileged EXEC and User EXEC

show dhcp-server port all

Display the DCHP port-related settings for all ports.

show dhcp-server port <slot/port>

Display the DCHP port-related settings for the specified port only.

5.8.5 show dhcp-server pool

Display DHCP server pool information for all pool or detailed information for a specific pool.

Format

```
show dhcp-server pool {all | <id>}
```

Mode

Privileged EXEC and User EXEC

show dhcp-server pool all

Display the DCHP server pool information for all IDs.

show dhcp-server pool <id>

Display the DCHP server pool information for the specified ID only.

5.8.6 dhcp-server addr-probe

Use this command tio enable or disable the probing of allocated addresses with an ICMP Echo request.

Format

```
dhcp-server addr-probe {disable|enable}
```

Mode

```
Global Config
```

dhcp-server addr-probe enable

Enable the DHCP server address probe. This is the default.
The DHCP server will send ICMP echo request before offering an IP.

dhcp-server addr-probe disable

Disable the DHCP server address probe.
The DHCP server will offer an IP without checking if already in use.

5.8.7 dhcp-server operation

Enable or disable the DHCP server globally. Default: disable.

Format

```
dhcp-server operation {disable|enable}
```

Mode

```
Interface Config
```

dhcp-server operation disable

Disable the DHCP server. This is the default.

dhcp-server operation enable

Enable the DHCP server.

5.8.8 dhcp-server pool add <id>

Add a pool with a single IP address (static) or with an IP range (dynamic)

Format

```
dhcp-server pool {add <id> {static <ipaddr>
                 |dynamic <start ipaddr> <end ipaddr>}
```

Mode

```
Global Config
```

dhcp-server pool add <id> {static <ipaddr>}

Add a pool with a single IP address (static).

dhcp-server pool add <id> {dynamic <start ipaddr> <end ipaddr>}

Add a pool with an IP range (dynamic).

5.8.9 dhcp-server pool modify <id> mode

Add or delete one or more pool modes.

Format

```
dhcp-server pool modify <id> mode
            {interface {all | <slot/port>} 1)
            |mac {none | <macaddr>} 1)
            |clientid {none | <clientid>} 1)
            |relay {none | <ipaddr>}
            |remoteid {none | <remoteid>} 1)
            |circuitid {none | < circuitid >} 1)}
```

Mode

Global Config

dhcp-server pool modify <id> mode interface all 1)

Set pool to all interfaces.

dhcp-server pool modify <id> mode interface <slot/port> 1)

Set pool to a specific interface.

dhcp-server pool modify <id> mode mac none 1)

Use none to remove the mode.

dhcp-server pool modify <id> mode mac <macaddr> 1)

Enter macaddr in xx:xx:xx:xx:xx:xx format.

dhcp-server pool modify <id> mode clientid none 1)

Use none to remove the mode.

dhcp-server pool modify <id> mode clientid <clientid> 1)

Enter clientid in xx:xx:...:xx format.

dhcp-server pool modify <id> mode relay none

Use none to remove the mode.

dhcp-server pool modify <id> mode relay <ipaddr>

Enter IP address of the relay.

dhcp-server pool modify <id> mode remoteid none [1)]

Use none to remove the mode.

dhcp-server pool modify <id> mode remoteid <remoteid> [1)]

Enter remoteid in xx:xx:...:xx format.

dhcp-server pool modify <id> mode circuitid none [1)]

Use none to remove the mode.

dhcp-server pool modify <id> mode circuitid <circuitid> [1)]

Enter circuitid in xx:xx:...:xx format.

[1)] Available for pools with single IP address only.

5.8.10 dhcp-server pool modify <id> option

Modify pool options.

Format

```
dhcp-server pool modify <id> option
       {configpath <url> |
        gateway <ipaddr> |
        netmask <netmask> |
        wins <ipaddr> |
        dns <ipaddr> |
        hostname <name>}
        vendor-specific <string>}
```

Mode

Global Config

dhcp-server pool modify <id> option configpath <url>

Option configpath. Enter the configpath URL in 'tftp://<servername-or-ip>/<file>' format.

dhcp-server pool modify <id> option gateway <ipaddr>

Option default gateway. Enter the gateway IP address.

dhcp-server pool modify <id> option netmask <netmask>

Option netmask. Enter the netmask.

dhcp-server pool modify <id> option wins <ipaddr>

Option wins. Enter WINS IP address.

dhcp-server pool modify <id> option dns <ipaddr>

Option DNS. Enter the DNS IP address.

dhcp-server pool modify <id> option hostname <name>

Option hostname. Enter the host name.

dhcp-server pool modify <id> option vendor-specific <string>

Option vendor-specific information. Enter vendor specific information as hex in `xx:xx:...:xx` format..

5.8.11 dhcp-server pool modify leasetime

Modify pool leasetime. Enter the leasetime in seconds.

Format

```
dhcp-server pool modify leasetime <seconds>
```

Mode

```
Global Config
```

5.8.12 dhcp-server pool modify <id> hirschmann-device

Set this pool to Hirschmann devices only or to all devices.

Format

```
dhcp-server pool modify <id> hirschmann-device
{enable|disable}
```

Mode

```
Global Config
```

dhcp-server pool modify <id> hirschmann-device disable

Use pool for all devices.

dhcp-server pool modify <id> hirschmann-device enable

Use pool for Hirschmann devices only.

5.8.13 dhcp-server pool enable

Enable a specific pool.

Format

```
dhcp-server pool enable <id>
```

Mode

```
Global Config
```

5.8.14 dhcp-server pool disable

Disable a specific pool.

Format

```
dhcp-server pool disable <id>
```

Mode

```
Global Config
```

5.8.15 dhcp-server pool delete

Delete a specific pool.

Format

```
dhcp-server pool delete <id>
```

Mode

```
Global Config
```

5.9 Sub-Ring Commands

These commands configure the sub-ring parameters.
The commands are divided by functionality into these different groups:

- Configuration commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Show commands are used to display switch settings, statistics and other information.

5.9.1 show sub-ring

Display sub-ring information for all sub-rings or detailed information for a specific sub-ring.

Format

```
show sub-ring {all-ids | <id>}
  {id | info | mode | operation | protocol | port |
  summary | ring-name | vlan | mrp-domainID |
  partner-mac}
```

Mode

Privileged EXEC and User EXEC

show sub-ring

Display the sub-ring information.

show sub-ring all-ids

Display the sub-ring information for all existing Sub-Ring IDs.

show sub-ring <id>

Display the sub-ring information for the specified ID.

id

Display the given Sub-Ring's ID.

info

Display status information for the given Sub-Ring ID.

mode

Display the switch's mode for the given Sub-Ring ID.

operation

Display the switch's operative setting for the given Sub-Ring ID.
Note: In case of configuration problems, this value may differ from the administrative setting (may become 'Disabled').

protocol

Display the switch's protocol setting for the given Sub-Ring ID.

port

Display the ports for the given Sub-Ring ID.

summary

Display a summary for the given Sub-Ring ID.

ring-name

Display ring name for the given Sub-Ring ID.

vlan

Display the VLAN ID for the given Sub-Ring ID.

mrp-domainID

Display the MRP domain ID for the given Sub-Ring ID.

partner-mac

Display the partner MAC for the given Sub-Ring ID.

5.9.2 sub-ring <id> mode

Configure the switch's Sub-Ring mode for the given ID (manager or redundant-manager).

Format

```
sub-ring <id> mode {manager |
                    redundant-manager |
                    single-manager}
```

Mode

```
Global Config
```

<id>

Specify the Sub-Ring ID whose settings you want to configure.

manager

Switch is manager for the given Sub-Ring ID.

redundant-manager

Switch is redundant-manager for the given Sub-Ring ID.

single-manager

Switch is single-manager for the given Sub-Ring ID.

5.9.3 sub-ring <id> operation

Enable or disable the switch for the given Sub-Ring ID.

Format

```
sub-ring <id> operation {enable|disable}
```

Mode

```
Global Config
```

<id>

Specify the Sub-Ring ID whose settings you want to configure.

enable

Enable the switch for the given Sub-Ring ID.

disable

Disable the switch for the given Sub-Ring ID.

5.9.4 sub-ring <id> protocol

Set MRP or FHR as sub-ring protocol for the given Sub-Ring ID.

Format

```
sub-ring <id> protocol standard_mrp
```

Mode

```
Global Config
```

<id>

Specify the Sub-Ring ID whose settings you want to configure.

standard_mrp

Set MRP as sub-ring protocol for the given Sub-Ring ID.

5.9.5 sub-ring <id> port

Specify the switch's ports for the given Sub-Ring ID.

Format

```
sub-ring <id> port <slot/port>
```

Mode

```
Global Config
```

<id>

Specify the Sub-Ring ID whose settings you want to configure.

<slot/port>

Specify the port (in slot/port notation).

5.9.6 sub-ring <id> ring-name

Set a ring name for the given Sub-Ring ID.

Format

```
sub-ring <id> ring-name <ring-name>
```

Mode

```
Global Config
```

<id>

Specify the Sub-Ring ID whose settings you want to configure.

<ring-name>

Enter a name for the given Sub-Ring ID. The name may be up to 254 characters long and contain only printable characters. If you do not give a name, the current name will be set to an empty string ("").

5.9.7 sub-ring <id> vlan

Specify the VLAN for the given Sub-Ring ID.

Format

```
sub-ring <id> vlan <0-4042>
```

Mode

```
Global Config
```

<id>

Specify the Sub-Ring ID whose settings you want to configure.

<0-4042>

Enter the VLAN for the given Sub-Ring ID
(min.: 0, max.: 4042, default: 0).

5.9.8 sub-ring <id> mrp-domainID

Set an MRP domain ID for the given Sub-Ring ID.

Format

```
sub-ring <id> mrp-domainID {<id> |
                            default-domainID}
```

Mode

```
Global Config
```

<id>

sub-ring <id>: Specify the Sub-Ring ID whose settings you want to configure.

<id>

Enter an MRP domainID for the given Sub-Ring ID.
The ID has to be 16 bytes long and contain only printable characters.

default-domainID

Enter the default MRP domainID for the given Sub-Ring ID.
The MRP domainID will be set to 255.255.255.255.255.255 255.255.255.255.255.255.255.255.255.255

5.9.9 sub-ring delete-ring

Delete all existing Sub-Rings IDs or a specific Sub-Ring ID.

Format

```
sub-ring delete-ring {all-ids | <id>}
```

Mode

```
Global Config
```

all-ids

Delete all existing Sub-Ring IDs.

<id>

Delete the given Sub-Ring ID. Format: a number in the range 1-2147483647 (2^{31} - 1). An ID of 0 is invalid.

5.9.10 sub-ring new-ring

Create a new Sub-Ring ID. The configuration will consist of default parameters and its operation will be disabled.

Format

```
sub-ring new-ring <id>
```

Mode

```
Global Config
```

<id>

Enter a new Sub-Ring ID. Format: a number in the range 1-2147483647 (2^{31} - 1). An ID of 0 is invalid.

6 CLI Commands: Security

This chapter provides a detailed explanation of the Security commands. The following Security CLI commands are available in the software Switching Package. Use the security commands to configure security settings for login users and port users.

The commands are divided into these different groups:

- Show commands are used to display device settings, statistics and other information.
- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.

6.1 Security Commands

6.1.1 authentication login

This command creates an authentication login list. The `<listname>` is up to 15 alphanumeric characters and is not case sensitive. Up to 10 authentication login lists can be configured on the switch. When a list is created, the authentication method “local” is set as the first method.
When the optional parameters “Option1”, “Option2” and/or “Option3” are used, an ordered list of methods are set in the authentication login list. If the authentication login list does not exist, a new authentication login list is first created and then the authentication methods are set in the authentication login list. The maximum number of authentication login methods is three. The possible method values are `local, radius` and `reject`.
The value of `local` indicates that the user’s locally stored ID and password are used for authentication. The value of `radius` indicates that the user’s ID and password will be authenticated using the RADIUS server. The value of `reject` indicates the user is never authenticated.
To authenticate a user, the authentication methods in the user’s login will be attempted in order until an authentication attempt succeeds or fails.

Note: The default login list included with the default configuration can not be changed.

Note: When assigning a list to the 'admin' account, include an authentication method that allows administrative access even when remote authentication is unavailable.

Format

```
authentication login <listname> [method1 [method2
[method3]]]
```

Mode

```
Global Config
```

no authentication login

This command deletes the specified authentication login list.
You will be unable to delete if any of the following conditions are true:

- The login list name is invalid or does not match an existing authentication login list
- The specified authentication login list is assigned to any user or to the non configured user for any component
- The login list is the default login list included with the default configuration and was not created using ‘authentication login’. The default login list cannot be deleted.

Format

```
no authentication login <listname>
```

Mode

```
Global Config
```

6.1.2 authorization network radius

Use this command to enable the switch to accept VLAN assignment by the RADIUS server.

Format

```
authorization network radius
```

Mode

```
Privileged EXEC
```

no authorization network radius

Use this command to disable the switch to accept VLAN assignment by the RADIUS server.

Format

```
no authorization network radius
```

Mode

```
Global Config
```

6.1.3 clear dot1x statistics

This command resets the 802.1X statistics for the specified port or for all ports.

Format

```
clear dot1x statistics {<slot/port> | all}
```

Mode

```
Privileged EXEC
```

6.1.4 clear radius statistics

This command is used to clear all RADIUS statistics.

Format

```
clear radius statistics
```

Mode

```
Privileged EXEC
```

6.1.5 dot1x defaultlogin

This command assigns the authentication login list to use for non-configured users for 802.1X port security. This setting is over-ridden by the authentication login list assigned to a specific user if the user is configured locally. If this value is not configured, users will be authenticated using local authentication only.

Format

```
dot1x defaultlogin <listname>
```

Mode

```
Global Config
```

6.1.6 dot1x dynamic-vlan enable

Use this command to enable the switch to create VLANs dynamically when a RADIUS-assigned VLAN does not exist in the switch.

Default

```
disabled
```

Format

```
dot1x dynamic-vlan enable
```

Mode

```
Global Config
```

no dot1x dynamic-vlan enable

Use this command to disable the switch to create VLANs dynamically when a RADIUS-assigned VLAN does not exist in the switch.

Default

```
disabled
```

Format

```
no dot1x dynamic-vlan enable
```

Mode

```
Global Config
```

6.1.7 dot1x guest-vlan

This command configures VLAN as guest vlan on an interface. The command specifies an active VLAN as an IEEE 802.1x guest VLAN. The range is 1 to the maximum VLAN ID supported by the platform.

Format

```
dot1x guest-vlan <vlan-id>
```

Mode

```
Interface Config
```

<vlan-id>

Enter an existing VLAN ID.

no dot1x guest-vlan

This command is used to disable Guest VLAN for the port.

Format

```
no dot1x guest-vlan
```

Mode

```
Global Config
```

6.1.8 dot1x initialize

This command begins the initialization sequence on the specified port. This command is only valid if the control mode for the specified port is 'auto'. If the control mode is not 'auto' an error will be returned.

Format

```
dot1x initialize <slot/port>
```

Mode

```
Privileged EXEC
```

6.1.9 dot1x login

This command assigns the specified authentication login list to the specified user for 802.1X port security. The <user> parameter must be a configured user and the <list-name> parameter must be a configured authentication login list.

Format

```
dot1x login <user> <listname>
```

Mode

```
Global Config
```

6.1.10 dot1x mac-auth-bypass

This command enables the MAC-authorized-bypass on that interface.

Default

```
disabled
```

Format

```
dot1x mac-auth-bypass
```

Mode

```
Interface Config
```

no dot1x mac-auth-bypass

This command disables the MAC-authorized-bypass on that interface.

Default

```
disabled
```

Format

```
no dot1x mac-auth-bypass
```

Mode

```
Interface Config
```

6.1.11 dot1x max-req

This command sets the maximum number of times the authenticator state machine on this port will transmit an EAPOL EAP Request/Identity frame before timing out the supplicant. The <count> value must be in the range 1 - 10.

Default

```
2
```

Format

```
dot1x max-req <count>
```

Mode

```
Interface Config
```

no dot1x max-req

This command sets the maximum number of times the authenticator state machine on this port will transmit an EAPOL EAP Request/Identity frame before timing out the supplicant.

Format

```
no dot1x max-req
```

Mode

```
Interface Config
```

6.1.12 dot1x max-users

Use this command to set the maximum number of clients supported on an interface when MAC-based 802.1X authentication is enabled on the port. The count value is in the range 1-16 and the default value is 16.

Default

```
16
```

Format

```
dot1x max-users <count>
```

Mode

```
Interface Config
```

no dot1x max-users

The ‘no’ form of this command resets the maximum number of clients allowed to its default value of 16.

Format

```
no dot1x max-users
```

Mode

```
Interface Config
```

6.1.13 dot1x port-control

This command sets the authentication mode to be used on the specified port. The control mode may be one of the following.

- `force-unauthorized`: The authenticator PAE unconditionally sets the controlled port to unauthorized. Thus the port is always blocked.
- `force-authorized`: The authenticator PAE unconditionally sets the controlled port to authorized. Thus the port is always opened.
- `auto`: The authenticator PAE sets the controlled port mode to reflect the outcome of the authentication exchanges between the supplicant, authenticator and the authentication server. The port mode is controlled by the protocol.
- `mac-based`: Enable MAC-based 802.1X authentication on the port.

Default

```
force-authorized
```

Format

```
dot1x port-control {force-unauthorized | force-
authorized | auto | mac-based}
```

Mode

```
Interface Config
```

no dot1x port-control
This command sets the port-control mode for the specified port to the default mode (force-authorized).

Format

```
no dot1x port-control
```

Mode

```
Interface Config
```

6.1.14 dot1x port-control all

This command sets the authentication mode to be used on all ports. The control mode may be one of the following.

- `force-unauthorized`: The authenticator PAE unconditionally sets the controlled port to unauthorized. Thus the ports are always blocked.
- `force-authorized`: The authenticator PAE unconditionally sets the controlled port to authorized. Thus the ports are always opened.
- `auto`: The authenticator PAE sets the controlled port mode to reflect the outcome of the authentication exchanges between the supplicant, authenticator and the authentication server. The port mode is controlled by the protocol.
- `mac-based`: Enable the MAC-based 802.1X authentication on the port.

Default

```
force-authorized
```

Format

```
dot1x port-control all {force-unauthorized | force-
authorized | auto |mac-based}
```

Mode

```
Global Config
```

no dot1x port-control all
This command sets the port-control mode for all the ports to the default mode (force-authorized).

Format

```
no dot1x port-control all
```

Mode

```
Global Config
```

6.1.15 dot1x re-authenticate

This command begins the re-authentication sequence on the specified port. This command is only valid if the control mode for the specified port is 'auto'. If the control mode is not 'auto' an error will be returned.

Format

```
dot1x re-authenticate <slot/port>
```

Mode

```
Privileged EXEC
```

6.1.16 dot1x re-authentication

This command enables re-authentication of the supplicant for the specified port.

Default

```
disabled
```

Format

```
dot1x re-authentication
```

Mode

```
Interface Config
```

no dot1x re-authentication
This command disables re-authentication of the supplicant for the specified port.

Format

```
no dot1x re-authentication
```

Mode

```
Interface Config
```

6.1.17 dot1x safe-vlan

Use this command to enable the safe-vlan assignment on the switch.

Note: This command is available for the RS20/RS30/RS40, RSB20, MS20/MS30, RSR20/RSR30, MACH100, MACH1000, PowerMICE, MACH4000, OCTOPUS devices.

Default

```
disabled
```

Format

```
dot1x safe-vlan
```

Mode

```
Global Config
```

no dot1x safe-vlan

Use this command to disable the safe-vlan assignment on the switch.

Default

```
disabled
```

Format

```
no dot1x safe-vlan
```

Mode

```
Global Config
```

6.1.18 dot1x system-auth-control

This command is used to enable the dot1x authentication support on the switch. By default, the authentication support is disabled. While disabled, the dot1x configuration is retained and can be changed, but is not activated.

Default

```
disabled
```

Format

```
dot1x system-auth-control
```

Mode

```
Global Config
```

no dot1x system-auth-control

This command is used to disable the dot1x authentication support on the switch.

Format

```
no dot1x system-auth-control
```

Mode

```
Global Config
```

6.1.19 dot1x timeout

This command sets the value, in seconds, of the timer used by the authenticator state machine on this port. Depending on the token used and the value (in seconds) passed, various timeout configurable parameters are set. The following tokens are supported.

- reauth-period: Sets the value, in seconds, of the timer used by the authenticator state machine on this port to determine when re-authentication of the supplicant takes place. The reauth-period must be a value in the range 1 - 65535.

- quiet-period: Sets the value, in seconds, of the timer used by the authenticator state machine on this port to define periods of time in which it will not attempt to acquire a supplicant. The quiet-period must be a value in the range 0 - 65535.
- tx-period: Sets the value, in seconds, of the timer used by the authenticator state machine on this port to determine when to send an EAPOL EAP Request/Identity frame to the supplicant. The quiet-period must be a value in the range 1 - 65535.
- supp-timeout: Sets the value, in seconds, of the timer used by the authenticator state machine on this port to timeout the supplicant. The supp-timeout must be a value in the range 1 - 65535.
- server-timeout: Sets the value, in seconds, of the timer used by the authenticator state machine on this port to timeout the authentication server. The supp-timeout must be a value in the range 1 - 65535.

Defaults

```
reauth-period: 3600 seconds
quiet-period: 60 seconds
tx-period: 30 seconds
supp-timeout: 30 seconds
server-timeout: 30 seconds
```

Format

```
dot1x timeout {{reauth-period <seconds>} | {quiet-
period <seconds>} | {tx-period <seconds>} | {supp-
timeout <seconds>} | {server-timeout <seconds>}}
```

Mode

```
Interface Config
```

no dot1x timeout

This command sets the value, in seconds, of the timer used by the authenticator state machine on this port to the default values. Depending on the token used, the corresponding default values are set.

Format

```
no dot1x timeout {reauth-period | quiet-period |
tx-period | supp-timeout | server-timeout}
```

Mode

```
Interface Config
```

6.1.20 dot1x timeout guest-vlan-period

Use this command to configure the timeout value for the guest-vlan-period. The time, in seconds, for which the authenticator waits to see if any EAPOL packets are received on a port before authorizing the port and placing the port in the guest vlan (if configured). The guest vlan timer is only relevant when guest vlan has been configured on that specific port.
Default guest-vlan-period: 90 seconds.

Default

```
90
```

Format

```
dot1x timeout guest-vlan-period <seconds>
```

Mode

```
Interface Config
```

<seconds>

Enter an integer in the range of 1-300.

no dot1x timeout guest-vlan-period

The ‘no’ form of this command resets the timeout value for the guest-vlan-period to its default value (90 seconds).

Format

```
no dot1x timeout guest-vlan-period
```

Mode

```
Interface Config
```

6.1.21 dot1x unauthenticated-vlan

Use this command to configure the unauthenticated VLAN associated with the specified interface. The unauthenticated VLAN ID can be a valid VLAN ID from 0 to maximum supported VLAN ID. The unauthenticated VLAN must be statically configured in the VLAN database to be operational. By default, the unauthenticated VLAN is 0, i.e. invalid and not operational.

Default

```
0
```

Format

```
dot1x unauthenticated-vlan <vlan-id>
```

Mode

```
Interface Config
```

<vlan-id>

Enter an existing VLAN ID.

no dot1x unauthenticated-vlan

The ‘no’ form of this command resets the value for the unauthenticated VLAN to its default value.

Format

```
no dot1x unauthenticated-vlan
```

Mode

```
Interface Config
```

6.1.22 dot1x user

This command adds the specified user to the list of users with access to the specified port or all ports. The <user> parameter must be a configured user.

Format

```
dot1x user <user> {<slot/port> | all}
```

Mode

```
Global Config
```

no dot1x user
This command removes the user from the list of users with access to the specified port or all ports.

Format

```
no dot1x user <user> {<slot/port> | all}
```

Mode

```
Global Config
```

6.1.23 ip ssh protocol

Use this command to configure the IP secure shell (SSH) parameters, the first and the optional second SSH protocol level).
Possible settings: v1, v2 or v1 & v2.

Format

```
ip ssh [protocol <protocollevel1>
                 [<protocollevel2>]]
```

Default

```
2 1
```

Mode

```
Privileged Exec
```

<protocollevel1>

Enter the first SSH Protocol Level (Version).
Possible values: `1`, `2`

<protocollevel2>

Optionally enter the second SSH Protocol Level (Version).
Possible values: `1`, `2`

no ip ssh
This command sets IP secure shell (SSH) parameters to default value.

Format

```
no ip ssh
```

Mode

```
Privileged Exec
```

6.1.24 radius accounting mode

This command is used to enable the RADIUS accounting function.

Default

```
disabled
```

Format

```
radius accounting mode
```

Mode

```
Global Config
```

no radius accounting mode
This command is used to set the RADIUS accounting function to the default value - i.e. the RADIUS accounting function is disabled.

Format

```
no radius accounting mode
```

Mode

```
Global Config
```

6.1.25 radius server host

This command is used to configure the RADIUS authentication and accounting server.

If the 'auth' token is used, the command configures the IP address to use to connect to a RADIUS authentication server. Up to 3 servers can be configured per RADIUS client. If the maximum number of configured servers is reached, the command will fail until one of the servers is removed by executing the no form of the command. If the optional <port> parameter is

used, the command will configure the UDP port number to use to connect to the configured RADIUS server. In order to configure the UDP port number, the IP address must match that of a previously configured RADIUS authentication server. The port number must lie between 1 - 65535, with 1812 being the default value.
If the 'acct' token is used, the command configures the IP address to use for the RADIUS accounting server. Only a single accounting server can be configured. If an accounting server is currently configured, it must be removed from the configuration using the no form of the command before this command succeeds. If the optional <port> parameter is used, the command will configure the UDP port to use to connect to the RADIUS accounting server. The IP address specified must match that of a previously configured accounting server. If a port is already configured for the accounting server then the new port will replace the previously configured value. The port must be a value in the range 1 - 65535, with 1813 being the default value.

Format

```
radius server host {auth | acct} <ipaddr> [<port>]
```

Mode

```
Global Config
```

no radius server host

This command is used to remove the configured RADIUS authentication server or the RADIUS accounting server. If the 'auth' token is used, the previously configured RADIUS authentication server is removed from the configuration. Similarly, if the 'acct' token is used, the previously configured RADIUS accounting server is removed from the configuration. The <ipaddr> parameter must match the IP address of the previously configured RADIUS authentication / accounting server.

Format

```
no radius server host {auth | acct} <ipaddress>
```

Mode

```
Global Config
```

6.1.26 radius server key

This command is used to configure the shared secret between the RADIUS client and the RADIUS accounting / authentication server. Depending on whether the 'auth' or 'acct' token is used, the shared secret will be configured for the RADIUS authentication or RADIUS accounting server. The IP address provided must match a previously configured server. When this command is executed, the secret will be prompted. The secret must be an alphanumeric value not exceeding 20 characters.

Format

```
radius server key {auth | acct} <ipaddr>
```

Mode

```
Global Config
```

6.1.27 radius server msgauth

This command enables the message authenticator attribute for a specified server.

Default

```
radius server msgauth <ipaddr>
```

Mode

```
Global Config
```

6.1.28 radius server primary

This command is used to configure the primary RADIUS authentication server for this RADIUS client. The primary server is the one that is used by default for handling RADIUS requests. The remaining configured servers are only used if the primary server cannot be reached. A maximum of three servers can be configured on each client. Only one of these servers can be configured as the primary. If a primary server is already configured prior to this command being executed, the server specified by the IP address used in this command will become the new primary server. The IP address must match that of a previously configured RADIUS authentication server.

Format

```
radius server primary <ipaddr>
```

Mode

```
Global Config
```

6.1.29 radius server retransmit

This command sets the maximum number of times a request packet is retransmitted when no response is received from the RADIUS server. The retries value is an integer in the range of 1 to 15.

Default

```
4
```

Format

```
radius server retransmit <retries>
```

Mode

```
Global Config
```

no radius server retransmit
This command sets the maximum number of times a request packet is re-transmitted, when no response is received from the RADIUS server, to the default value, i.e. 10.

Format

```
no radius server retransmit
```

Mode

```
Global Config
```

6.1.30 radius server timeout

This command sets the timeout value (in seconds) after which a request must be retransmitted to the RADIUS server if no response is received. The timeout value is an integer in the range of 1 to 30.

Default

```
6
```

Format

```
radius server timeout <seconds>
```

Mode

```
Global Config
```

no radius server timeout
This command sets the timeout value (in seconds) after which a request must be retransmitted to the RADIUS server if no response is received, to the default value, i.e. 6.

Format

```
no radius server timeout
```

Mode

```
Global Config
```

6.1.31 show radius accounting

This command is used to display the configured RADIUS accounting mode, accounting server and the statistics for the configured accounting server.

Format

```
show radius accounting [statistics <ipaddr>]
```

Mode

```
Privileged EXEC and User EXEC
```

If the optional token 'statistics <ipaddr>' is not included, then only the accounting mode and the RADIUS accounting server details are displayed.

Mode

Enabled or disabled

IP Address

The configured IP address of the RADIUS accounting server

Port

The port in use by the RADIUS accounting server

Secret Configured

Yes or No

If the optional token 'statistics <ipaddr>' is included, the statistics for the configured RADIUS accounting server are displayed. The IP address parameter must match that of a previously configured RADIUS accounting server. The following information regarding the statistics of the RADIUS accounting server is displayed.

Accounting Server IP Address

IP Address of the configured RADIUS accounting server

Round Trip Time

The time interval, in hundredths of a second, between the most recent Accounting-Response and the Accounting-Request that matched it from the RADIUS accounting server.

Requests

The number of RADIUS Accounting-Request packets sent to this accounting server. This number does not include retransmissions.

Retransmission

The number of RADIUS Accounting-Request packets retransmitted to this RADIUS accounting server.

Responses

The number of RADIUS packets received on the accounting port from this server.

Malformed Responses

The number of malformed RADIUS Accounting-Response packets received from this server. Malformed packets include packets with an

invalid length. Bad authenticators and unknown types are not included as malformed accounting responses.

Bad Authenticators

The number of RADIUS Accounting-Response packets containing invalid authenticators received from this accounting server.

Pending Requests

The number of RADIUS Accounting-Request packets sent to this server that have not yet timed out or received a response.

Timeouts

The number of accounting timeouts to this server.

Unknown Types

The number of RADIUS packets of unknown types, which were received from this server on the accounting port.

Packets Dropped

The number of RADIUS packets received from this server on the accounting port and dropped for some other reason.

6.1.32 show authentication

This command displays the ordered authentication methods for all authentication login lists.

Format

```
show authentication
```

Mode

```
Privileged EXEC and User EXEC
```

Authentication Login List

This displays the authentication login listname.

Method 1

This displays the first method in the specified authentication login list, if any.

Method 2

This displays the second method in the specified authentication login list, if any.

Method 3

This displays the third method in the specified authentication login list, if any.

6.1.33 show authentication users

This command displays information about the users assigned to the specified authentication login list. If the login is assigned to non-configured users, the user “default” will appear in the user column.

Format

```
show authentication users <listname>
```

Mode

```
Privileged EXEC and User EXEC
```

User

This field displays the user assigned to the specified authentication login list.

Component

This field displays the component (User or 802.1X) for which the authentication login list is assigned.

6.1.34 show dot1x

This command is used to show a summary of the global dot1x configuration, summary information of the dot1x configuration for a specified port or all ports, the detailed dot1x configuration for a specified port and the dot1x statistics for a specified port - depending on the tokens used.

Format

```
show dot1x [{summary {<slot/port> | all} | {detail
<slot/port>} | {statistics <slot/port>}]
```

Mode

```
Privileged EXEC and User EXEC
```

If none of the optional parameters are used, the global dot1x configuration summary is displayed.

Administrative mode

Indicates whether authentication control on the switch is enabled or disabled.

VLAN Assignment Mode

Indicates whether the VLAN Assignment Mode is enabled or disabled.

Dynamic VLAN Creation Mode

Indicates whether the Dynamic VLAN Creation Mode is enabled or disabled.

Safe VLAN Mode

Indicates whether the Safe VLAN Mode is enabled or disabled.

If the optional parameter 'summary {<slot/port> | all}' is used, the dot1x configuration for the specified port or all ports are displayed.

Port

The interface whose configuration is displayed.

Control Mode

The configured control mode for this port. Possible values are `force-unauthorized | force-authorized | auto | mac-based`

Operating Control Mode

The control mode under which this port is operating. Possible values are `authorized | unauthorized`

Reauthentication Enabled

Indicates whether re-authentication is enabled on this port

Key Transmission Enabled

Indicates if the key is transmitted to the supplicant for the specified port

If the optional parameter 'detail <slot/port>' is used, the detailed dot1x configuration for the specified port are displayed.

Port

The interface whose configuration is displayed

Protocol Version

The protocol version associated with this port. The only possible value is 1, corresponding to the first version of the dot1x specification.

PAE Capabilities

The port access entity (PAE) functionality of this port.
Possible values: `Authenticator, Supplicant`.

Control Mode

Display the state of the Control Mode.
Possible values: `auto, forceauthorized`, ...

Authenticator PAE State

Current state of the authenticator PAE state machine.
Possible values: `Initialize, Disconnected, Connecting, Authenticating, Authenticated, Aborting, Held, ForceAuthorized, and ForceUnauthorized`.

Backend Authentication State

Current state of the backend authentication state machine.
Possible values: `Request, Response, Success, Fail, Time-out, Idle, Initialize`.

Quiet Period

The timer used by the authenticator state machine on this port to define periods of time in which it will not attempt to acquire a supplicant. The value is expressed in seconds and will be in the range `0..65535`.

Transmit Period

The timer used by the authenticator state machine on the specified port to determine when to send an EAPOL EAP Request/Identity frame to the supplicant. The value is expressed in seconds and will be in the range of `1..65535`.

Guest VLAN ID

Display the Guest VLAN ID.
Default value: `0`.

Guest VLAN Period (secs)

Display the Guest VLAN Period.
Default value: `90` seconds.

Supplicant Timeout

The timer used by the authenticator state machine on this port to timeout the supplicant. The value is expressed in seconds and will be in the range of `1..65535`.

Server Timeout

The timer used by the authenticator on this port to timeout the authentication server. The value is expressed in seconds and will be in the range of `1..65535`.

Maximum Requests

The maximum number of times the authenticator state machine on this port will retransmit an EAPOL EAP Request/Identity before timing out the supplicant. The value will be in the range of `1..10`.

VLAN Id

Display the VLAN Id.

VLAN Assigned Reason

Display the state of the VLAN Assigned Reason parameter.
Possible values: `RADIUS, Not Assigned`.

Reauthentication Period

The timer used by the authenticator state machine on this port to determine when reauthentication of the supplicant takes place. The value is expressed in seconds and will be in the range of `1..65535`.

Reauthentication Enabled

Indicates if reauthentication is enabled on this port.
Possible values: `True, False`

Key Transmission Enabled

Indicates if the key is transmitted to the supplicant for the specified port.
Possible values: `True, False`.

Control Direction

Indicates the control direction for the specified port or ports.
Possible values: `both, in`.

Maximum Users

Display the value of Maximum Users.

Unauthenticated VLAN ID

Display the value of Unauthenticated VLAN ID

Session Timeout

Display the value of Session Timeout

Session Termination Action

Display the value of Session Termination Action

MAC-Authorized-Bypass

Display the value of MAC-Authorized-Bypass

If the optional parameter 'statistics **<**slot/port**>**' is used, the dot1x statistics for the specified port are displayed.

Port

The interface whose statistics are displayed.

EAPOL Frames Received

The number of valid EAPOL frames of any type that have been received by this authenticator.

EAPOL Frames Transmitted

The number of EAPOL frames of any type that have been transmitted by this authenticator.

EAPOL Start Frames Received

The number of EAPOL start frames that have been received by this authenticator.

EAPOL Logoff Frames Received

The number of EAPOL logoff frames that have been received by this authenticator.

Last EAPOL Frame Version

The protocol version number carried in the most recently received EAPOL frame.

Last EAPOL Frame Source

The source MAC address carried in the most recently received EAPOL frame.

EAP Response/Id Frames Received

The number of EAP response/identity frames that have been received by this authenticator.

EAP Response Frames Received

The number of valid EAP response frames (other than resp/id frames) that have been received by this authenticator.

EAP Request/Id Frames Transmitted

The number of EAP request/identity frames that have been transmitted by this authenticator.

EAP Request Frames Transmitted

The number of EAP request frames (other than request/identity frames) that have been transmitted by this authenticator.

Invalid EAPOL Frames Received

The number of EAPOL frames that have been received by this authenticator in which the frame type is not recognized.

EAP Length Error Frames Received

The number of EAPOL frames that have been received by this authenticator in which the frame type is not recognized.

6.1.35 show dot1x users

This command displays 802.1X port security user information for locally configured users.

Format

```
show dot1x users <slot/port>
```

Mode

```
Privileged EXEC and User EXEC
```

User

Users configured locally to have access to the specified port.

6.1.36 show dot1x clients

This command displays 802.1X port security client information for locally configured clients.

Format

```
show dot1x clients <slot/port>
```

Mode

```
Privileged EXEC
```

Logical Interface

Display the Logical Interface.

Interface

Display the Interface.

User Name

Display the User Name.

Supp MAC Address

Display the Supp MAC Address.

Session Time

Display the Session Time.

Vlan Id

Display the Vlan Id.

Vlan Assigned Reason

Display the Vlan Assigned Reason.
Possible values: RADIUS, ...

Session Timeout

Display the Session Timeout.

Session Termination Action

Display the Session Termination Action.
Possible values: Reauthenticate, ...

6.1.37 show ip ssh

This command displays the IP secure shell (SSH) information.

Format

`show ip ssh`

Mode

`Privileged EXEC`

Administrative Mode

Display the SSH administrative mode setting.
Possible values: `Disabled`, `Enabled`.

Protocol Levels

Display the SSH protocol levels setting.
Possible values: `Versions 1 and 2`, `Version 1`, `Version 2`
(default setting: `Versions 1 and 2`).

SSH Sessions Currently Active

Display the number of SSH sessions being currently set up.
Possible values: `1..5`.

Max SSH Sessions Allowed

Display the max. number of SSH sessions that can be set up simultaneously.
Possible values: `1..5` (default setting: `5`).

SSH Timeout

Display the SSH timeout in minutes.
Possible values: `1..160` (default setting: `5`).

6.1.38 show radius

This command is used to display the various RADIUS configuration items for the switch as well as the configured RADIUS servers. If the optional token 'servers' is not included, the following RADIUS configuration items will be displayed.

Format

`show radius [servers]`

Mode

`Privileged EXEC and User EXEC`

Primary Server IP Address

Indicates the configured server currently in use for authentication

Number of configured servers

The configured IP address of the authentication server

Max number of retransmits

The configured value of the maximum number of times a request packet is retransmitted

Timeout Duration

The configured timeout value, in seconds, for request re-transmissions

Accounting Mode

Yes or No

If the optional token 'servers' is included, the following information regarding the configured RADIUS servers is displayed.

IP Address

IP Address of the configured RADIUS server

Port

The port in use by this server

Type

Primary or secondary

Secret Configured

Yes / No

6.1.39 show radius statistics

This command is used to display the statistics for RADIUS or configured server . To show the configured RADIUS server statistic, the IP Address specified must match that of a previously configured RADIUS server. On execution, the following fields are displayed.

Format

```
show radius statistics [ipaddr]
```

Mode

```
Privileged EXEC and User EXEC
```

If ip address is not specified than only Invalid Server Address field is displayed. Otherwise other listed fields are displayed.

Invalid Server Addresses

The number of RADIUS Access-Response packets received from unknown addresses.

Server IP Address

Round Trip Time

The time interval, in hundredths of a second, between the most recent Access-Reply | Access-Challenge and the Access-Request that matched it from the RADIUS authentication server.

Access Requests

The number of RADIUS Access-Request packets sent to this server. This number does not include retransmissions.

Access Retransmission

The number of RADIUS Access-Request packets retransmitted to this RADIUS authentication server.

Access Accepts

The number of RADIUS Access-Accept packets, including both valid and invalid packets, which were received from this server.

Access Rejects

The number of RADIUS Access-Reject packets, including both valid and invalid packets, which were received from this server.

Access Challenges

The number of RADIUS Access-Challenge packets, including both valid and invalid packets, which were received from this server.

Malformed Access Responses

The number of malformed RADIUS Access-Response packets received from this server. Malformed packets include packets with an invalid length. Bad authenticators or signature attributes or unknown types are not included as malformed access responses.

Bad Authenticators

The number of RADIUS Access-Response packets containing invalid authenticators or signature attributes received from this server.

Pending Requests

The number of RADIUS Access-Request packets destined for this server that have not yet timed out or received a response.

Timeouts

The number of authentication timeouts to this server.

Unknown Types

The number of RADIUS packets of unknown types, which were received from this server on the authentication port.

Packets Dropped

The number of RADIUS packets received from this server on the authentication port and dropped for some other reason.

6.1.40 show users authentication

This command displays all user and all authentication login information. It also displays the authentication login list assigned to the default user.

Format

```
show users authentication
```

Mode

```
Privileged EXEC
```

User

This field lists every user that has an authentication login list assigned.

System Login

This field displays the authentication login list assigned to the user for system login.

802.1x Port Security

This field displays the authentication login list assigned to the user for 802.1X port security.

6.1.41 users login

This command assigns the specified authentication login list to the specified user for system login. The <user> must be a configured <user> and the <listname> must be a configured login list.
If the user is assigned a login list that requires remote authentication, all access to the interface from all CLI, web, and telnet sessions will be blocked until the authentication is complete.

Note: Note that the login list associated with the ‘admin’ user can not be changed to prevent accidental lockout from the switch.

Format

`users login <user> <listname>`

Mode

`Global Config`

user

Enter user name.

listname

Enter an alphanumeric string of not more than 15 characters.
Note: When assigning a list to the 'admin' account, include an authentication method that allows administrative access even when remote authentication is unavailable (use 'authentication login <listname> [method1 [method2 [method3]]]').

6.2 HTTP Commands

6.2.1 ip http server

This command enables access to the switch‘s graphical user interface (web-based interface) via a web browser. When access is enabled, the user can login to the switch from the web-based interface. When access is disabled, the user cannot login to the switch's web server.

Disabling the web-based interface takes effect immediately. All interfaces are effected.

Default

```
enabled
```

Format

```
ip http server
```

Mode

```
Privileged EXEC
```

no ip http server

This command disables access to the switch‘s graphical user interface (web-based interface) via a web browser. When access is disabled, the user cannot login to the switch's web server.

Format

```
no ip http server
```

Mode

```
Privileged EXEC
```

6.2.2 show ip http

This command displays the http settings for the switch.

Format

```
show ip http
```

Mode

```
Privileged EXEC and User EXEC
```

HTTP Mode (Unsecure)

THis field indicates whether the HTTP mode is enabled or disabled.

6.2.3 ip https server

This command is used to turn on the HTTPS server 3.
This command enables access to the switch‘s graphical user interface (web-based interface) via a web browser. When access is enabled, the user can login to the switch from the web interface. When access is disabled, the user cannot login to the switch's web server.

Default

```
disabled
```

Format

```
ip https server
```

Mode

```
Privileged EXEC
```

no ip https server

This command is used to turn off the HTTPS server 3.
This command disables access to the switch‘s graphical user interface (web-based interface) via a web browser. When access is disabled, the user cannot login to the switch's web server.

Format

```
no ip https server
```

Mode

```
Privileged EXEC
```

6.2.4 ip https port

This command is used to set the HTTPS listening port.
The acceptable range is 1-65535. The default is 443

Note: After this setting, re-enable the HTTPS server.
See “ip http server” on page 573.

Default

```
443
```

Format

```
ip https port <port_no>
```

Mode

```
Privileged EXEC
```

no ip https port

This command is used to reset the https port to the default value.

Format

```
no ip https port
```

Mode

```
Privileged EXEC
```

6.2.5 ip https certgen

Use this command to generate an X509/PEM certificate in-place.

Format

```
ip https certgen
```

Mode

```
Privileged EXEC
```

6.2.6 show ip https

This command displays the status of the HTTPS server (status of the server and port number).

Format

```
show ip https
```

Mode

```
Privileged EXEC and User EXEC
```

HTTPS Mode

Displays the status of the HTTPS server (enabled, disabled).

HTTPS Port

Displays the port number of the HTTPS server (default: 443).

7 Appendix- VLAN Example

LAN switches can segment networks into logically defined virtual work-groups.This logical segmentation is commonly referred as a virtual LAN (VLAN). This logical segmentation of devices provides better LAN administration, security, and management of broadcast activity over the network. Virtual LANs have become an integral feature of switched LAN solutions.

The VLAN example below demonstrates a simple VLAN configuration.

If a single port is a member of VLANs 2, 3 and 4, the port expects to see traffic tagged with either VLAN 2,3 or 4.

The PVID (Port Virtual Identification) could be something entirely different, for example '12' and things would still work fine, just so incoming traffic was tagged.

Example:
Project A = (VLAN2, ports 1,2)
Project B = (VLAN3, ports 3,4)
Project C = (VLAN4, ports 5,6)
Project P = (VLAN 9, port 7)

7.1 SOLUTION 1

All traffic entering the ports is tagged traffic. Since the traffic is tagged, the PVID configuration for each port is not a concern.

- The network card configuration for devices on Project A must be set to tag all traffic with 'VLAN 2'
- The network card configuration for devices on Project B must be set to tag all traffic with 'VLAN 3'
- The network card configuration for devices on Project C must be set to tag all traffic with 'VLAN 4'
- The network card configuration for devices on Project P must be set to tag all traffic with 'VLAN 9'

7.2 SOLUTION 2

The network card configuration for devices on Project A, B and C should be set to NOT tag traffic.

To take care of these untagged frames configure the following:

- vlan pvid 2 (in interface 0/1)
- vlan pvid 2 (in interface 0/2)
- vlan pvid 3 (in interface 0/3)
- vlan pvid 3 (in interface 0/4)
- vlan pvid 4 (in interface 0/5)
- vlan pvid 4 (in interface 0/6)

8 Routing Commands

This chapter provides a detailed explanation of the Routing commands.

8.1 ARP Commands

This chapter provides a detailed explanation of the Address Resolution Protocol (ARP) commands. The commands are divided by functionality into the following different groups:

- Show commands are used to display switch settings, statistics and other information.
- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Copy commands are used to transfer configuration and informational files to and from the switch.

8.1.1 arp

This command creates an ARP entry. The value for <*ipaddress*> is the IP address of a device on a subnet attached to an existing routing interface. <*macaddr*> is a unicast MAC address for that device.

The format is 6 two-digit hexadecimal numbers that are separated by colons, for example 00:06:29:32:81:40.

Format

```
arp <ipaddress> <macaddr>
```

Mode

```
Global Config
```

no arp

This command deletes an ARP entry. The value for <*arpentry*> is the IP address of the interface. The value for <*ipaddress*> is the IP address of a device on a subnet attached to an existing routing interface. <*macaddr*> is a unicast MAC address for that device.

Format

```
no arp <ipaddress> <macaddr>
```

Mode

```
Global Config
```

8.1.2 ip proxy-arp

This command enables proxy ARP on a router interface.
Without proxy ARP, a device only responds to an ARP request if the target IP address is an address configured on the interface where the ARP request arrived. With proxy ARP, the device may also respond if the target IP address is reachable. The device only responds if all next hops in its route to the destination are through interfaces other than the interface that received the ARP request.

Default

```
enabled
```

Format

```
ip proxy-arp
```

Mode

```
Interface Config
```

no ip proxy-arp

This command disables proxy ARP on a router interface.

Format

```
no ip proxy-arp
```

Mode

```
Interface Config
```

8.1.3 arp cachesize

This command configures the ARP cache size.

Format

```
arp cachesize <288-2048>
```

Mode

```
Global Config
```

no arp cachesize

This command configures the default ARP cache size which is 2048.

Format

```
no arp cachesize
```

Mode

```
Global Config
```

8.1.4 arp dynamicrenew

This command enables ARP component to automatically renew ARP entries of type dynamic when they age out.

Format

```
arp dynamicrenew
```

Mode

```
Global Config
```

no arp dynamicrenew

This command disables ARP component from automatically renewing ARP entries of type dynamic when they age out.

Format

```
no arp dynamicrenew
```

Mode

```
Global Config
```

8.1.5 arp purge

This command causes the specified IP address to be removed from the ARP cache. Only entries of type dynamic or gateway are affected by this command.

Format

```
arp purge <ipaddr>
```

Mode

```
Privileged EXEC
```

8.1.6 arp resptime

This command configures the ARP request response timeout.

The value for <*seconds*> is a valid positive integer, which represents the IP ARP entry response timeout time in seconds.
The range for <*seconds*> is 1..10 seconds.

Default

1

Format

arp resptime <*1-10*>

Mode

Global Config

no arp resptime

This command configures the default ARP request response timeout.

Format

no arp resptime

Mode

Global Config

8.1.7 arp retries

This command configures the ARP count of maximum requests for retries.

The value for *<retries>* is an integer, which represents the maximum number of requests for retries.
The range for *<retries>* is an integer between 0..10 retries.

Default

4

Format

arp retries *<0-10>*

Mode

Global Config

no arp retries

This command configures the default ARP count of maximum requests for retries.

Format

no arp retries

Mode

Global Config

8.1.8 arp selective-learning

This command enables selective learning of ARPs. Normally, the router learns ARP entries from every ARP request it sees. With this feature enabled it will learn only from ARP requests that ask for one of its own interfaces.

Default

```
Disabled
```

Format

```
arp selective-learning
```

Mode

```
Global Config
```

no arp selective-learning

This command disables selective learning of ARPs

Format

```
no arp selective-learning
```

Mode

```
Global Config
```

8.1.9 arp timeout

This command configures the ARP entry ageout time.

The value for <*seconds*> is a valid positive integer, which represents the IP ARP entry ageout time in seconds.
The range for <*seconds*> is between 15..21600 seconds.

Default

1200

Format

arp timeout <*15-21600*>

Mode

Global Config

no arp timeout

This command configures the default ARP entry ageout time.

Format

no arp timeout

Mode

Global Config

8.1.10 clear arp-cache

This command causes all ARP entries of type dynamic to be removed from the ARP cache. If the *gateway* parameter is specified, the dynamic entries of type gateway are purged as well.

Format

clear arp-cache *[gateway]*

Mode

Privileged EXEC

8.1.11 show arp

This command displays the Address Resolution Protocol (ARP) cache. The displayed results are not the total ARP entries. To view the total ARP entries, the operator should view the `show arp` results in conjunction with the `show arp switch` results.

Format

`show arp`

Mode

`Privileged EXEC`

Age Time (seconds)

`Is the time it takes for an ARP entry to age out. This value was configured into the unit. Age time is measured in seconds.`

Response Time (seconds)

`Is the time it takes for an ARP request timeout. This value was configured into the unit. Response time is measured in seconds.`

Retries

`Is the maximum number of times an ARP request is retried. This value was configured into the unit.`

Cache Size

`Is the maximum number of entries in the ARP table. This value was configured into the unit.`

Dynamic Renew Mode

`Displays whether the ARP component automatically attempts to renew dynamic ARP entries when they age out.`

Selective Learning Mode

`Shows whether the router learns from all ARP requests (Disabled) or only from those targeted to one of its own interfaces (Enabled).`

Total Entry Count Current / Peak

`Field listing the total entries in the ARP table and the peak entry count in the ARP table.`

Static Entry Count Current / Max

Field listing the static entry count in the ARP table and maximum static entry count in the ARP table.

The following are displayed for each ARP entry.

IP Address

Is the IP address of a device on a subnet attached to an existing routing interface.

MAC Address

Is the hardware MAC address of that device.

Interface

Is the routing slot/port associated with the device ARP entry.

Type

Is the type that was configured into the unit. The possible values are Local, Gateway, Dynamic and Static.

Age

This field displays the current age of the ARP entry since last refresh (in hh:mm:ss format

8.1.12 show arp brief

This command displays the brief Address Resolution Protocol (ARP) table information.

Format

```
show arp brief
```

Mode

```
Privileged EXEC
```

Age Time (seconds)

```
Is the time it takes for an ARP entry to age out.
This value was configured into the unit. Age time
is measured in seconds.
```

Response Time (seconds)

```
Is the time it takes for an ARP request timeout.
This value was configured into the unit. Response
time is measured in seconds.
```

Retries

```
Is the maximum number of times an ARP request is
retried. This value was configured into the unit.
```

Cache Size

```
Is the maximum number of entries in the ARP table.
This value was configured into the unit.
```

Dynamic Renew Mode

```
Displays whether the ARP component automatically
attempts to renew dynamic ARP entries when they age
out.
```

Selective Learning Mode

```
Shows whether the router learns from all ARP
requests (Disabled) or only from those targeted to
one of its own interfaces (Enabled).
```

Total Entry Count Current / Peak

```
Field listing the total entries in the ARP table
and the peak entry count in the ARP table.
```

Static Entry Count Current / Max

Field listing the static entry count in the ARP table and maximum static entry count in the ARP table.

8.1.13 show arp switch

This command displays connectivity between the switch and other devices. The Address Resolution Protocol (ARP) cache identifies the MAC addresses of the IP stations communicating with the switch.

Format

`show arp switch`

Mode

`Privileged EXEC`

MAC Address

`A unicast MAC address for which the switch has forwarding and/or filtering information. The format is 6 two-digit hexadecimal numbers that are separated by colons, for example 01:23:45:67:89:AB`

IP Address

`The IP address assigned to each interface.`

Interface

`Valid slot and port number separated by forward slashes.`

8.2 IP Routing

This chapter provides a detailed explanation of the IP Routing commands. The commands are divided by functionality into the following different groups:

- Show commands are used to display switch settings, statistics and other information.
- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.

Note: Shared VLAN learning and routing are mutually exclusive. Make sure that shared VLAN learning is disabled before using IP routing (see “bridge vlan-learning” on page 120).

8.2.1 routing

This command enables routing for an interface.

The current value for this function is displayed under "show ip interface" labeled as "Routing Mode".

Default

```
disabled
```

Format

```
routing
```

Mode

```
Interface Config
```

no routing

This command disables routing for an interface.

The current value for this function is displayed under "show ip interface" labeled as "Routing Mode".

Format

```
no routing
```

Mode

```
Interface Config
```

8.2.2 ip routing

This command enables the IP Router Admin Mode for the master switch.

Format

```
ip routing
```

Mode

```
Global Config
```

no ip routing

This command disables the IP Router Admin Mode for the master switch.

Format

```
no ip routing
```

Mode

```
Global Config
```

8.2.3 ip address

This command configures an IP address on an interface. The IP address may be a secondary IP address.

The value for <*ipaddr*> is the IP Address of the interface.

The value for <*subnetmask*> is a 4-digit dotted-decimal number which represents the subnet mask of the interface. This changes the label IP address in `show ip interface`.

Format

`ip address <ipaddr> <subnetmask> [secondary]`

Mode

`Interface Config`

no ip address

This command deletes an IP address from an interface.

The value for <*ipaddr*> is the IP Address of the interface.

The value for <*subnetmask*> is a 4-digit dotted-decimal number which represents the Subnet Mask of the interface.

Format

`no ip address <ipaddr> <subnetmask> [secondary]`

Mode

`Interface Config`

8.2.4 ip mtu

This command configures the MTU size (maximum transfer unit) for IP protocol on the specified interface.

The value for <*68-9000*> is the MTU value for IP protocol.

Default

`1500`

Format

`ip mtu <68-9000>`

Mode

`Interface Config`

no ip mtu

This command sets the MTU size (maximum transfer unit) for IP protocol on the specified interface to the default value (`1500`).

Format

`no ip mtu`

Mode

`Interface Config`

8.2.5 ip netdirbcast

This command enables net directed broadcasts of IP frames.
Use no command to disable.

The current value for this function is displayed under "show ip interface" labeled as "Forward Net Directed Broadcasts".

Default

```
disabled
```

Format

```
ip netdirbcast
```

Mode

```
Interface Config
```

no ip netdirbcast

This command disables net directed broadcasts of IP frames.

The current value for this function is displayed under "show ip interface" labeled as "Forward Net Directed Broadcasts".

Format

```
no ip netdirbcast
```

Mode

```
Interface Config
```

8.2.6 ip route

This command configures a static route. The <*ip_addr*> is a valid ip address. The <*subnet_mask*> is a valid subnet mask. The <*nextHopRtr*> is a valid IP address of the next hop router.
The <*preference*> is an integer value from 1 to 255. The user can specify the preference value (sometimes called "administrative distance") of an individual static route. Among routes to the same destination, the route with the lowest preference value is the route entered into the forwarding database. By specifying the preference of a static route, the user controls whether a static route is more or less preferred than routes from dynamic routing protocols. The preference also controls whether a static route is more or less preferred than other static routes to the same destination.
The value 255 stands for „unreachable“. This means that the appropriate route is never entered into the forwarding database.

If the optional parameter <*track*> and a tracking id are given, the route is removed from the routing table if the tracking instance is down. When the tracking instance comes up, the route is added to the route table again.

Note: The following must be present before the static routes are visible:
- Enable ip routing globally.
- Enable ip routing for the interface.
- The associated link must also be up.

To see all configured static routes use the command
`show ip route static.`

Default

`preference – 1`

Format

`ip route <ip_addr> <subnet_mask> <nextHopRtr> [<preference>] [track<trackid>]`

Mode

`Global Config`

no ip route

This command deletes all next hops to a destination static route. If the optional <nextHopRtr> parameter is designated, the next hop is deleted and if the optional preference value is designated, the preference value of the static route is reset to its default.

If the optional parameter *<track>* is given, tracking is disabled for this nextHop.

Format

```
no ip route <ip_addr> <subnet_mask> [{<nextHopRtr>
[track] | <preference>}]
```

Mode

```
Global Config
```

8.2.7 ip route default

This command configures the default route. The value for *<nextHopRtr>* is a valid IP address of the next hop router. The *<preference>* is an integer value from 1 to 255.

If the optional parameter *<track>* and a tracking id are given, the route is removed from the routing table if the tracking instance is down. When the tracking instance comes up, the route is added to the route table again.

Default

```
preference – 1
```

Format

```
ip route default <nextHopRtr> [<preference>]
[track<trackid>]
```

Mode

```
Global Config
```

no ip route default

This command deletes all configured default routes. If the optional *<nextHopRtr>* parameter is designated, the specific next hop is deleted from the configured default route and if the optional preference value is designated, the preference of the configured default route is reset to its default.

If the optional parameter *<track>* is given, tracking is disabled for this nextHop.

Format

```
no ip route default [{<nextHopRtr> [track]
| <preference>}]
```

Mode

```
Global Config
```

8.2.8 ip route distance

This command sets the default distance for static routes. Lower route preference values are preferred when determining the best route. The `ip route` and `ip route default` commands allow you to optionally set the distance of an individual static route. The default distance is used when no distance is specified in these commands. Changing the default distance does not update the distance of existing static routes, even if they were assigned the original default distance. The new default distance will only be applied to static routes created after invoking the `ip route distance` command.
The value 255 stands for „unreachable“. This means that the appropriate route is never entered into the forwarding database.

Default

`1`

Format

`ip route distance <1-255>`

Mode

`Global Config`

no ip route distance

This command sets the default static route preference value in the router. Lower route preference values are preferred when determining the best route.

Format

`no ip route distance`

Mode

`Global Config`

8.2.9 ip forwarding

This command enables forwarding of IP frames.

Default

`enabled`

Format

`ip forwarding`

Mode

`Global Config`

no ip forwarding

This command disables forwarding of IP frames.

Format

`no ip forwarding`

Mode

`Global Config`

8.2.10 ip vlan-single-mac

PowerMICE and MACH4000 without MACH4002-24G.../MACH4002-48G...: In normal operating mode, packets that routed over VLAN router interfaces, are not sent with the VLAN router interface's MAC address as the source MAC address but with the physical port's MAC Address. This is compliant with the standard. Some terminal devices with incorrect IP implementation may have problems with that situation, resulting in them being unreachable via a VLAN router interface. For that reason, the SW Release 02.0.02 introduces the feature "Single MAC Mode". In this mode, all VLAN interfaces and all physical ports (except the port based router interfaces) use the same MAC address.

Default

```
enabled
```

Format

```
ip vlan-single-mac
```

Mode

```
Global Config
```

no ip vlan-single-mac

This command disables VLAN Single Mac Address Mode.

Format

```
no ip vlan-single-mode
```

Mode

```
Global Config
```

8.2.11 show ip brief

This command displays all the summary information of the IP. This command takes no options.

Format

```
show ip brief
```

Modes

```
Privileged EXEC
User EXEC
```

Default Time to Live

The computed TTL (Time to Live) of forwarding a packet from the local router to the final destination.

Routing Mode

Shows whether the routing mode is enabled or disabled.

IP Forwarding Mode

Shows whether forwarding of IP frames is enabled or disabled. This is a configured value.

Maximum Next Hops

The maximum number of next hops which can be used for a given destination.

Vlan Single Mac Address Mode

Shows if the Vlan Single Mac Address Mode is enabled or disabled.

Note: This output is available for the MACH4002-48+4G and PowerMICE devices.

8.2.12 show ip interface

This command displays all pertinent information about the IP interface.

Format

```
show ip interface <slot/port>
```

Modes

```
Privileged EXEC
User EXEC
```

Primary IP Address

Is an IP address representing the subnet configuration of the router interface. This value was configured into the unit.

Subnet Mask

Is a mask of the network and host portion of the IP address for the router interface. This value was configured into the unit.

Secondary IP Address

The secondary ip addresses of the router interface in case of multinetting.

Routing Mode

Is the administrative mode of router interface participation. The possible values are enable or disable. This value was configured into the unit.

Administrative Mode

Is the administrative mode of the specified interface. The possible values of this field are enable or disable. This value was configured into the unit.

Forward Net Directed Broadcasts

Indicates if IP forwards net-directed broadcasts on this interface. Possible values are Enable or Disable.

Proxy ARP

Shows if the Proxy ARP is enabled or disabled on this router interface.

Active State

Displays whether the interface is active or inactive. An interface is considered active if its link is up and it is in forwarding state.

Link Speed Data Rate

Is an integer representing the physical link data rate of the specified interface. This is measured in Megabits per second (Mbps).

MAC Address

Is the burned in physical address of the specified interface. The format is 6 two-digit hexadecimal numbers that are separated by colons.

Encapsulation Type

Is the encapsulation type for the specified interface. The types are: Ethernet or SNAP.

IP MTU

The maximum transfer unit for the specified interface.

8.2.13 show ip interface brief

This command displays summary information about IP configuration settings for all ports in the router. This command takes no options.

Format

```
show ip interface brief
```

Modes

```
Privileged EXEC
User EXEC
```

Interface

Valid slot and port number separated by forward slashes.

IP Address

The IP address of the routing interface in 32-bit dotted decimal format.

IP Mask

The IP mask of the routing interface in 32-bit dotted decimal format.

Netdir Bcast

Indicates if IP forwards net-directed broadcasts on this interface. Possible values are Enable or Disable.

MultiCast Fwd

Indicates the multicast forwarding operational mode on the interface. Possible values are Enable or Disable.

8.2.14 show ip route

This command displays the entire route table. This commands takes no options.

Format

`show ip route`

Mode

`Privileged EXEC`

Network Address

`Is an IP address identifying the network on the specified interface.`

Subnet Mask

`Is a mask of the network and host portion of the IP address for the router interface.`

Protocol

`Tells which protocol added the specified route. The possibilities are: local, static, OSPF or RIP.`

Total Number of Routes

`The total number of routes.`

For each Next Hop

Next Hop Intf

`The outgoing router interface to use when forwarding traffic to the next destination.`

Next Hop IP Address

`The outgoing router IP address to use when forwarding traffic to the next router (if any) in the path toward the destination.`

8.2.15 show ip route bestroutes

This command causes the entire route table to be displayed. This commands takes no options.

Format

```
show ip route bestroutes
```

Mode

```
Privileged EXEC
```

Network Address

```
Is an IP route prefix for the destination.
```

Subnet Mask

```
Is a mask of the network and host portion of the IP
address for the specified interface.
```

Protocol

```
Tells which protocol added the specified route. The
possibilities are: local, static, OSPF or RIP.
```

Total Number of Routes

```
The total number of routes in the route table.
```

For each Next Hop

Next Hop Intf

```
The outgoing router interface to use when forward-
ing traffic to the next destination.
```

Next Hop IP Address

```
The outgoing router IP address to use when forward-
ing traffic to the next router (if any) in the path
toward the destination. The next router will always
be one of the adjacent neighbors or the IP address
of the local interface for a directly attached net-
work.
```

8.2.16 show ip route entry

This command displays the entire route table.

Format

`show ip route entry`

Mode

`Privileged EXEC`

Network Address

`Is a valid network address identifying the network on the specified interface.`

Subnet Mask

`Is a mask of the network and host portion of the IP address for the attached network.`

Protocol

`Tells which protocol added the specified route. The possibilities are: local, static, OSPF or RIP.`

For each Next Hop

Next Hop Interface

`The outgoing router interface to use when forwarding traffic to the next destination.`

Next Hop IP Address

`The outgoing router IP address to use when forwarding traffic to the next router (if any) in the path toward the destination.`

Metric

`The cost associated with this route.`

Preference

`The administrative distance associated with this route.`

8.2.17 show ip route preferences

This command displays detailed information about the route preferences. Route preferences are used in determining the best route. Lower router preference values are preferred over higher router preference values.

Format

```
show ip route preferences
```

Modes

```
Privileged EXEC
User EXEC
```

Local

```
This field displays the local route preference
value.
```

Static

```
This field displays the static route preference
value.
```

OSPF Intra

```
This field displays the OSPF Intra route preference
value.
```

OSPF Inter

```
This field displays the OSPF Inter route preference
value.
```

OSPF Ext T1

```
This field displays the OSPF Type-1 route prefer-
ence value.
```

OSPF Ext T2

```
This field displays the OSPF Type-2 route prefer-
ence value.
```

RIP

```
This field displays the RIP route preference value.
```

8.2.18 show ip route static

This command displays the entire static route table.

Format

```
show ip route static
```

Mode

```
Privileged EXEC
```

Network Address

```
Is a valid network address identifying the network
on the specified interface.
```

Subnet Mask

```
Is a mask of the network and host portion of the IP
address for the attached network.
```

For each Next Hop

Pref

```
The administrative distance associated with this
route.
```

Next Hop IP Address

```
The outgoing router IP address to use when forwarding
traffic to the next router in the path toward the desti-
nation.
```

Intf.

```
The outgoing router interface to use when forwarding
traffic to the next destination. This is only shown if
there is a working router interface with a subnet
matching the next hop ip address.
```

Track ID

```
The id of the tracked object (if any).
```

Track State

```
The state of the tracked object (up or down) if the route
uses tracking.
```

8.2.19 show ip stats

This command displays IP statistical information. Refer to RFC 1213 for more information about the fields that are displayed.

Format

```
show ip stats
```

Modes

```
Privileged EXEC
User EXEC
```

Received on routing interfaces:

IpInReceives

Display the total number of input datagrams.

Received by CPU:

IpInHdrErrors

Display the number of input datagrams discarded due to errors in their IP headers.

IpInAddrErrors

Display the number of input datagrams discarded because the IP address in their IP header's destination field was not a valid.

Routed by the device:

IpForwDatagrams

Display number of input datagrams for which this entity was not their final IP destination, as a result of which an attempt was made to find a route to forward them to that final destination. In entities which do not act as IP Gateways, this counter will include only those packets which were Source-Routed via this entity, and the Source-Route option processing was successful.

Received by CPU:

IpInUnknownProtos

Display number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol.

IpInDiscards

Display the The number of input IP datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g., for lack of buffer space).
Note that this counter does not include any datagrams discarded while awaiting re-assembly.

IpInDelivers

Display the total number of input datagrams successfully delivered to IP user-protocols (including ICMP).

IpOutRequests

Display the total number of IP datagrams which local IP user-protocols (including ICMP) supplied to IP in requests for transmission.
Note that this counter does not include any datagrams counted in ipForwDatagrams.

IpOutDiscards

Display the number of output IP datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space).
Note that this counter would include datagrams counted in ipForwDatagrams if any such packets met this (discretionary) discard criterion.

IpOutNoRoutes

Display the number of IP datagrams discarded because no route could be found to transmit them to their destination.
Note that this counter includes any packets counted in ipForwDatagrams which meet this `no-route' criterion.
Note that this includes any datagarms which a host cannot route because all of its default gateways are down.

Reassembly/fragmentation (not supported):

IpReasmTimeout

Display the maximum number of seconds which received fragments are held while they are awaiting reassembly at this entity.

IpReasmReqds

Display the number of IP fragments received which needed to be reassembled at this entity.

IpReasmOKs

Display the number of IP datagrams successfully re-assembled.

IpReasmFails

Display the number of failures detected by the IP re-assembly algorithm (for whatever reason: timed out, errors, etc).
Note that this is not necessarily a count of discarded IP fragments since some algorithms (notably the algorithm in RFC 815) can lose track of the number of fragments by combining them as they are received.

IpFragOKs

Display the number of IP datagrams that have been successfully fragmented at this entity.

Received by CPU:

IpFragFails

Display the number of IP datagrams that have been discarded because they needed to be fragmented at this entity but could not be, e.g., because their Don't Fragment flag was set.

IpFragCreates

Display the number of IP datagram fragments that have been generated as a result of fragmentation at this entity.

Faulty packets:

IpRoutingDiscards

Display the number of routing entries which were chosen to be discarded even though they are valid. One possible reason for discard-

ing such an entry could be to free-up buffer space for other routing entries.

Received / sent by CPU:

IcmpInMsgs

Display the total number of ICMP messages which the entity received.
Note that this counter includes all those counted by icmpInErrors.

IcmpInErrors

Display the number of ICMP messages which the entity received but determined as having ICMP-specific errors (bad ICMP checksums, bad length, etc.).

IcmpInDestUnreachs

Display the number of ICMP Destination Unreachable messages received.

IcmpInTimeExcds

Display the number of ICMP Time Exceeded messages received.

IcmpInParmProbs

Display the number of ICMP Parameter Problem messages received.

IcmpInSrcQuenchs

Display the number of ICMP Source Quench messages received.

IcmpInRedirects

Display the number of ICMP Redirect messages received.

IcmpInEchos

Display the number of ICMP Echo (request) messages received.

IcmpInEchoReps

Display the number of ICMP Echo (request) messages received.

IcmpInTimestamps

Display the number of ICMP Timestamp (request) messages received.

IcmpInTimestampReps

Display the number of ICMP Timestamp Reply messages received.

IcmpInAddrMasks

Display the number of ICMP Address Mask Request messages received.

IcmpInAddrMaskReps

Display the number of ICMP Address Mask Reply messages received.

IcmpOutMsgs

Display the total number of ICMP messages which this entity attempted to send.
Note that this counter includes all those counted by icmpOutErrors.

IcmpOutErrors

Display the number of ICMP messages which this entity did not send due to problems discovered within ICMP such as a lack of buffers. This value should not include errors discovered outside the ICMP layer such as the inability of IP to route the resultant datagram. In some implementations there may be no types of error which contribute to this counter's value.

IcmpOutDestUnreachs

Display the number of ICMP Destination Unreachable messages sent.

IcmpOutTimeExcds

Display the number of ICMP Time Exceeded messages sent.

IcmpOutParmProbs

Display the number of ICMP Parameter Problem messages sent.

IcmpOutSrcQuenchs

Display the number of ICMP Source Quench messages sent.

IcmpOutRedirects

Display the number of ICMP Redirect messages sent. For a host, this object will always be zero, since hosts do not send redirects.

IcmpOutEchoReps

Display the number of ICMP Echo Reply messages sent.

IcmpOutTimestamps

Display the number of ICMP Timestamp (request) messages sent.

IcmpOutTimestampReps

Display the number of ICMP Timestamp Reply messages sent.

IcmpOutAddrMasks

Display the number of ICMP Address Mask Request messages sent.

IcmpOutAddrMaskReps

Display the number of ICMP Address Mask Reply messages sent.

Outgoing ICMP packets dropped by limiter

Display the number of outgoing ICMP packets dropped by limiter.

8.3 Router Discovery Protocol Commands

This chapter provides a detailed explanation of the Router Discovery commands. The commands are divided by functionality into the following different groups:

- Show commands are used to display switch settings, statistics and other information.
- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Copy commands are used to transfer configuration and informational files to and from the switch.

8.3.1 ip irdp

This command enables Router Discovery on an interface.

Default

```
disabled
```

Format

```
ip irdp
```

Mode

```
Interface Config
```

no ip irdp

This command disables Router Discovery on an interface.

Format

```
no ip irdp
```

Mode

```
Interface Config
```

8.3.2 ip irdp address

This command configures the address to be used to advertise the router for the interface. The valid values for ipaddr are 224.0.0.1 and 255.255.255.255.

Default

```
224.0.0.1
```

Format

```
ip irdp address <ipaddr>
```

Mode

```
Interface Config
```

no ip irdp address

This command configures the default address to be used to advertise the router for the interface.

Format

```
no ip irdp address
```

Mode

```
Interface Config
```

8.3.3 ip irdp holdtime

This command configures the value, in seconds, of the holdtime field of the router advertisement sent from this interface.
The range is the `maxadvertinterval` to `9000` seconds.

Default

`3 * maxinterval`

Format

`ip irdp holdtime <maxadvertinterval-9000>`

Mode

`Interface Config`

no ip irdp holdtime

This command configures the default value, in seconds, of the holdtime field of the router advertisement sent from this interface.

Format

`no ip irdp holdtime`

Mode

`Interface Config`

8.3.4 ip irdp maxadvertinterval

This command configures the maximum time, in seconds, allowed between sending router advertisements from the interface.
The range for maxadvertinterval is `4` to `1800` seconds.

Default

`600`

Format

`ip irdp maxadvertinterval <4-1800>`

Mode

`Interface Config`

no ip irdp maxadvertinterval

This command configures the default maximum time, in seconds.

Format

`no ip irdp maxadvertinterval`

Mode

`Interface Config`

8.3.5 ip irdp minadvertinterval

This command configures the minimum time, in seconds, allowed between sending router advertisements from the interface.
The range for minadvertinterval is `3` to the value of `maxadvertinterval`.

Default

`0.75 * maxadvertinterval`

Format

`ip irdp minadvertinterval <3-maxadvertinterval>`

Mode

`Interface Config`

no ip irdp minadvertinterval

This command sets the default minimum time to the default.

Format

`no ip irdp minadvertinterval`

Mode

`Interface Config`

8.3.6 ip irdp preference

This command configures the preferability of the address as a default router address, relative to other router addresses on the same subnet.
The range is `-2147483648` to `-1` to `0` to `1` to `2147483647`.

Default

`0`

Format

`ip irdp preference <-2147483648-2147483647>`

Mode

`Interface Config`

no ip irdp preference

This command configures the default preferability of the address as a default router address, relative to other router addresses on the same subnet.

Format

`no ip irdp preference`

Mode

`Interface Config`

8.3.7 show ip irdp

This command displays the router discovery information for all interfaces, or a specified interface.

Format

`show ip irdp {<slot/port> | all}`

Modes

`Privileged EXEC`

`User EXEC`

Ad Mode

Displays the advertise mode which indicates whether router discovery is enabled or disabled on this interface.

Advertise Address

Displays the address which is used to advertise the router on this interface.

Max Int

Displays the maximum advertise interval which is the maximum time allowed between sending router advertisements from the interface in seconds.

Min Int

Displays the minimum advertise interval which is the minimum time allowed between sending router advertisements from the interface in seconds.

Hold Time

Displays advertise lifetime which is the value of the lifetime field of the router advertisement sent from the interface in seconds.

Preferences

Displays the preference of the address as a default router address, relative to other router addresses on the same subnet.

8.4 Virtual LAN Routing Commands

This chapter provides a detailed explanation of the Virtual LAN Routing commands. The commands are divided by functionality into the following different groups:

- Show commands are used to display switch settings, statistics and other information.
- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Copy commands are used to transfer configuration and informational files to and from the switch.

8.4.1 vlan routing

This command creates routing on a VLAN. The <*vlanid*> value has a range from 1 to 4042. Submitting this command creates a new logical interface 9/x.

Format

```
vlan routing <vlanid>
```

Mode

```
VLAN Database
```

no vlan routing

This command deletes routing on a VLAN. The <*vlanid*> value has a range from 1 to 4042. Submitting this command deletes the logical interface 9/x.

Format

```
no vlan routing <vlanid>
```

Mode

```
VLAN Database
```

8.4.2 show ip vlan

This command displays the VLAN routing information for all VLANs with routing enabled in the system.

Format

```
show ip vlan
```

Modes

```
Privileged EXEC
User EXEC
```

VLAN ID

```
Is the identifier of the VLAN.
```

Logical Interface

```
Indicates the logical slot/port associated with the
VLAN routing interface.
```

IP Address

```
Displays the IP Address associated with this VLAN.
```

Subnet Mask

```
Indicates the subnet mask that is associated with
this VLAN.
```

MAC Address

```
Displays the MAC Address associated with this VLAN.
```

8.5 Tracking Commands

This chapter provides a detailed explanation of the Tracking commands. The commands are divided by functionality into the following different groups:

- Show commands are used to display tracking information.
- Configuration Commands are used to configure the tracking function.

8.5.1 track interface

Connects a trackid to an interface to monitor. The trackid is an integer value from 1 to 128. Link-up-delay and link-down-delay can be configured from 0 to 255 seconds. If a delay parameter is omitted, the default delay is 0.

Format

```
track <trackid> interface <slot/port>
[link-up-delay <0-255>] [link-down-delay <0-255>]
```

Mode

```
Global Config
```

no track

Frees a `<trackid>` and track object and end tracking for this object. The `<trackid>` is an integer value from 1 to 128 and the id of an existing track object.

Format

```
no track <trackid>
```

Mode

```
Global Config
```

8.5.2 track logical

Combines up to eight tracking instances into one single instance using a logical operation (AND or OR). The trackids are integer values from 1 to 128.

Format

```
track <trackid> logical {and|or} <trackid1>
[<trackid2> [ … [<trackid8]…]]
```

Mode

```
Global Config
```

8.5.3 track mode

Enables a track object. The trackid is an integer value from 1 to 128 and the id of an existing track object.

Format

```
track <trackid> mode
```

Mode

```
Global Config
```

no track mode

Disables a track object. The trackid is an integer value from 1 to 128 and the id of an existing track object. A disabled track object is
defined to be up regardless of the state of the monitored object.

Format

```
no track <trackid> mode
```

Mode

```
Global Config
```

8.5.4 track ping

Enables tracking of a remote ip host or router by sending ICMP echo requests (ping). The trackid is an integer value from 1 to 128.
The timeout is given in milliseconds. If <miss> consecutive answers are not received, the object switches to down, if <success> consecutive answers are received, the object switches to up. If interface is set to auto, the best route is used automatically.

The parameters can be omitted, but those given must be in the order shown below.

Note: To enable the ping to be sent via the interface, make sure that it concerns a routing interface.

Format

```
track <trackid> ping <remote-ip>
<interface {<slot/port> | auto}>
[interval  <1-10>] [miss <1-10>]
[success <1-10>] [timeout <10-10000>]
```

Defaults

```
Interface: auto
Interval: 1 second
Miss: 3
Success: 2
Timeout: 100 milliseconds
```

Mode

```
Global Config
```

8.5.5 track trap

Enables sending of a state change trap for a track object. The <trackid> is an integer value from 1 to 128 and the id of an existing track object.

Format

```
track <trackid> trap
```

Mode

```
Global Config
```

no track trap

Disables sending of the state change trap for a track object. The <trackid> is an integer value from 1 to 128 and the id of an existing track object.

Format

```
no track <trackid> trap
```

Mode

```
Global Config
```

8.5.6 show track

Displays information about all configured track objects.
Depending on the configuration, up to five tables are shown. There are separate tables for each tracking type (interface, logical, ping) and one for instances that do not yet have a valid type.
Additionally, a list of unconfigured track objects with registered applications (e.g. VRRP) is displayed.

Format

```
show track
```

Modes

```
Privileged EXEC
User EXEC
```

General Information

ID

The id of the track object.

Type

The type of the track object.

Status

Shows whether the monitored tracking object is up or down.

Mode

Shows whether the track object is activated.

No. Of Changes

Shows how often the State of the object changed since the track object was enabled.

Time since last change

Shows the time elapsed between the last change in state or mode.

Additional Information for Interface Objects

Intf

The Interface that is tracked by this object.

Link Delay Down

The time before a down event is signalled to the applications.

Link Delay Up

The time before an up event is signalled to the applications.

Additional Information for Logical Objects

Instances

A comma separated list of tracking instances combined into this object. If the list is incomplete (ends with "…") see show track <id> for the complete list.

Additional Information for Ping Objects

IP Address

The target IP address to monitor.

Intvl

The time interval between sending ping packets.

8.5.7 show track <id>

Displays detailed information about the given track object. The <trackid> is an integer value from 1 to 128 and the id of an existing track object.

Format

show track <trackid>

Modes

Privileged EXEC

User EXEC

General Information

ID

The id of the track object.

Type

The type of the track object.

Status

Shows whether the monitored object is up or down.

Send State Change Traps

Shows whether the track trap is activated.

Mode

Shows whether the track object is activated.

No. Of Changes

Shows how often the State of the object changed since the track object was enabled.

Time since last change

Shows the time elapsed between the last change in State or mode.

Applications

The list of applications registered to this track object.

Additional Information for Interface Objects

Interface

The slot and port of the tracked interface.

Link-down-delay

Time in seconds before a link-down event is announced to the applications.

Link-up-delay

Time in seconds before a link-up event is announced to the applications.

Additional Information for Logical Objects

Operator

The logical operator used to combine the states of the members (AND or OR).

Instances included

A comma separated list of tracking instances combined into this entry.

Additional Information for Ping Objects

Target IP Address

The IP address of the remote host that is monitored.

Interface

The slot and port of the interface used to reach the remote host. If none is configured, the interface of the current best route is shown.

Ping Interval

The time between sending ping packets for this object.

Lost pings until down

Number of consecutive ping answers that must be lost (not received before the timeout) to change the state to Down.

Replies until up

Number of consecutive ping answers that must be received (before the timeout) to change the state to up.

Timeout for each Ping

The ping replies must arrive within this timeout in milliseconds to be counted as received.

8.5.8 show track applications

Displays a List of all applications registered to a track object. An application is shown for each track object it is registered to. If the track object is not yet configured, the last two columns are empty.

Format

show track applications

Modes

Privileged EXEC

User EXEC

TrackId

The id of the track object.

Application

The identifier string of the application.

Changes

Shows how often the State of the object changed since the track object was enabled.

Time since last change

Shows the time elapsed between the last change in state or mode.

8.6 VRRP Commands

This chapter provides a detailed explanation of the Virtual Router Redundancy Protocol (VRRP) commands. The commands are divided by functionality into the following different groups:

- Show commands are used to display switch settings, statistics and other information.
- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Copy commands are used to transfer configuration and informational files to and from the switch.

8.6.1 ip vrrp

This command enables the global administrative mode of VRRP in the router.

Default

```
disabled
```

Format

```
ip vrrp
```

Mode

```
Global Config
```

no ip vrrp

This command disables the global administrative mode of VRRP in the router.

Format

```
no ip vrrp
```

Mode

```
Global Config
```

8.6.2 ip vrrp domain send-member-advertisements

This command controls whether the members of a VRRP domain send advertisements themselves as a fallback if the supervisor is still up but can't get advertisements from the master because of a single vlan failure.

Default

```
disabled
```

Format

```
ip vrrp domain <domain-id> send-member-advertise-
ments
```

Mode

```
Global Config
```

no ip vrrp domain send-member-advertisements

This command disables the sending of advertisements for the members of the domain.

Format

```
no ip vrrp domain <domain-id> send-member-adver-
tisements
```

Mode

```
Global Config
```

8.6.3 ip vrrp trap

This command enables vrrp traps.

Default

disabled

Format

ip vrrp trap {authentication-failure|new-master}

Mode

Global Config

authentication-failure

Enable or disable the sending of a trap if this router detects an authentication failure on any of its VRRP interfaces.

new-master

Enable or disable the sending of a trap if this router becomes new master for any of its VRRP interfaces.

no ip vrrp trap

This command disables vrrp traps.

Format

no ip vrrp trap {authentication-failure|new-master}

Mode

Global Config

8.6.4 ip vrrp

This command enables the VRRP protocol on an interface.
The parameter <*vrID*> is the virtual router ID which has an integer value ranging from 1 to 255.

Default

none

Format

ip vrrp <*vrID*>

Mode

Interface Config

no ip vrrp

This command disables the VRRP protocol on an interface.
The parameter <*vrID*> is the virtual router ID which has an integer value ranging from 1 to 255.
Note: If you intend to disable the protocol instance, first deactivate it using the no ip vrrp <*vrID*> mode command.

Format

no ip vrrp <*vrID*>

Mode

Interface Config

8.6.5 ip vrrp mode

This command enables the virtual router configured on the specified interface. Enabling the status field starts a virtual router. The parameter <vrID> is the virtual router ID which has an integer value ranging from 1 to 255.

Default

```
disabled
```

Format

```
ip vrrp <vrID> mode
```

Mode

```
Interface Config
```

no ip vrrp mode

This command disables the virtual router configured on the specified interface. Disabling the status field stops a virtual router.

Format

```
no ip vrrp <vrID> mode
```

Mode

```
Interface Config
```

8.6.6 ip vrrp ip

This command sets the virtual router ipaddress value for an interface. The value for <*ipaddr*> is the IP Address which is to be configured on that interface for VRRP. This may be a secondary virtual IP address. The parameter <*vrID*> is the virtual router ID which has an integer value ranging from 1 to 255.

Default

none

Format

ip vrrp <*vrID*> ip <*ipaddr*> *[secondary]*

Mode

Interface Config

8.6.7 ip vrrp authentication

This command sets the authorization details value for the virtual router configured on a specified interface. The parameter *{none | simple}* specifies the authorization type for virtual router configured on the specified interface. The parameter *[key]* is optional, it is only required when authorization type is simple text password. The parameter *<vrID>* is the virtual router ID which has an integer value ranging from 1 to 255.

Default

```
no authorization
```

Format

```
ip vrrp <vrID> authentication {none | simple <key>}
```

Mode

```
Interface Config
```

no ip vrrp authentication

This command sets the default authorization details value for the virtual router configured on a specified interface.

Format

```
no ip vrrp <vrID> authentication
```

Mode

```
Interface Config
```

8.6.8 ip vrrp preempt

This command sets the preemption mode value for the virtual router configured on a specified interface. The parameter <*vrID*> is the virtual router ID which has an integer value ranging from 1 to 255.

Default

`enabled`

Format

`ip vrrp <vrID> preempt`

Mode

`Interface Config`

no ip vrrp preempt

This command sets the default preemption mode value for the virtual router configured on a specified interface.

Format

`no ip vrrp <vrID> preempt`

Mode

`Interface Config`

8.6.9 ip vrrp delay-preemption

This command enables a delay before a virtual router preempts a master with a lower priority. This way dynamic routing protocols have some time to set up the routing tables before the router actually becomes Master. The delay time is given in seconds, the parameter <vrID> is the virtual router ID which is an integer value ranging from 1 to 255.

Default

```
Disabled (0 seconds)
```

Format

```
ip vrrp <vrID> delay-preemption <seconds>
```

Mode

```
Interface Config
```

no ip vrrp delay-preemption

This command disables the delay before a virtual router preempts a master with a lower priority.

Format

```
no ip vrrp <vrID> delay-preemption
```

Mode

```
Interface Config
```

8.6.10 ip vrrp priority

This command sets the priority value for the virtual router configured on a specified interface. The priority of the interface is a priority integer from 1 to 254. The parameter <*vrID*> is the virtual router ID which has an integer value ranging from 1 to 255.
The priority of a virtual router cannot be set to a value lower than the sum of the decrement values of all tracking entries for that virtual router.

Default

100

Format

ip vrrp <*vrID*> priority <*1-254*>

Mode

Interface Config

no ip vrrp priority

This command sets the default priority value for the virtual router configured on a specified interface.

Format

no ip vrrp <*vrID*> priority

Mode

Interface Config

8.6.11 ip vrrp timers advertise

This command sets the virtual router's advertisement packet interval. The parameter is an integer representing the advertisement interval from 1 to 255 seconds. The parameter <vrID> is the virtual router ID which is an interger value ranging from 1 to 255.

Default

```
1
```

Format

```
ip vrrp <vrID> timers advertise <1-255>
```

Mode

```
Interface Config
```

ip vrrp timers advertise milliseconds

This command sets the virtual router's advertisement packet interval. Use this command, if you want to set an interval below 1 second. Use the above command to set intervals greater than one second. The parameter is an integer representing the advertisement interval in milliseconds. The parameter <vrID> is the virtual router ID which is an interger value ranging from 1 to 255.

Default

```
1000 milliseconds (1 second)
```

Format

```
ip vrrp <vrID> timers advertise milliseconds <100-
1000>
```

Mode

```
Interface Config
```

no ip vrrp timers advertise

This command sets the default advertisement interval for a virtual router.

Format

```
no ip vrrp <vrID> timers advertise
```

Mode

```
Interface Config
```

8.6.12 ip vrrp advertisement-address

This command sets the destination address for the VRRP advertisement packets. This can either be the multicast group address for all vrrp routers (224.0.0.18) or the unicast address of a backup router for this virtual interface. A Unicast address must be within the same subnet as the interface's ip address but must not be equal to it. The parameter <vrID> is the virtual router ID which is an integer value ranging from 1 to 255.

Default

```
224.0.0.18
```

Format

ip vrrp <vrID> advertisement-address <ipaddress>

Mode

```
Interface Config
```

no ip vrrp advertisement-address

This command resets the destination address for the VRRP advertisement packets to its default value 224.0.0.18

Format

```
no ip vrrp <vrID> advertisement-address
```

Mode

```
Interface Config
```

8.6.13 ip vrrp link-down-notification

This command enables a notification to a backup router when the virtual router looses its link. The parameter <vrID> is the virtual router ID which is an integer value ranging from 1 to 255. Give a unicast IP address of a backup router as the last parameter.

Default

```
Disabled (0.0.0.0)
```

Format

```
ip vrrp <vrID> link-down-notification <ipAddress>
```

Mode

```
Interface Config
```

no ip vrrp link-down-notification

This command disables the link down notification.

Format

```
no ip vrrp <vrID> link-down-notification
```

Mode

```
Interface Config
```

8.6.14 ip vrrp track

With this command the virtual router is configured to observe a tracked object. The trackid and the object to track are configured with the command „track“. The Parameter trackid is an integer value, the range is determined by the tracking module. The decrement value is an integer from 1 to 253. The sum of all decrement values for a given virtual router must not exceed the priority configured for that virtual router.

Default

`20`

Format

`ip vrrp <vrID> track <trackid> [decrement <1-253>]`

Mode

`Interface Config`

no ip vrrp track

This command configures the virtual router to stop observing a tracked object.

Format

`no ip vrrp <vrID> track <trackid>`

Mode

`Interface Config`

8.6.15 ip vrrp domain

This command configures a virtual router into a VRRP domain and can make it the supervisor of that domain.

Default

0 (no domain)

Format

ip vrrp <*vrID*> domain <*1-8*> [supervisor]

Mode

Interface Config

no ip vrrp domain supervisor

This command configures the virtual router not to be the supervisor of the domain. It will still be a member of the domain.

Format

no ip vrrp <*vrID*> domain <*1-8*> supervisor

Mode

Interface Config

no ip vrrp domain

This command removes the virtual router from any domain it is in. If the domain-id is given, the virtual router will only be removed from that domain.

Format

no ip vrrp <*vrID*> domain [<*1-8*>]

Mode

Interface Config

8.6.16 show ip vrrp interface stats

This command displays the statistical information about each virtual router configured on the switch.

Format

show ip vrrp interface stats <slot/port> <*vrID*>

Modes

Privileged EXEC

User EXEC

Uptime

The time that the virtual router has been up, in days, hours, minutes and seconds.

Protocol

Represents the protocol configured on the interface.

State Transitioned to Master

Represents the total number of times the virtual router state has changed to MASTER.

Advertisement Received

Represents the total number of VRRP advertisements received by this virtual router.

Advertisement Interval Errors

Represents the total number of VRRP advertisements received for which advertisement interval is different than the configured value for this virtual router.

Authentication Failure

Represents the total number of VRRP packets received that don't pass the authentication check.

IP TTL errors

Represents the total number of VRRP packets received by the virtual router with IP TTL (time to live) not equal to 255.

Zero Priority Packets Received

Represents the total number of VRRP packets receivedbyvirtualrouterwithapriorityof'0'.

Zero Priority Packets Sent

Represents the total number of VRRP packets sent by the virtual router with a priority of '0'.

Invalid Type Packets Received

Represents the total number of VRRP packets received by the virtual router with invalid 'type' field.

Address List Errors

Represents the total number of VRRP packets received for which address list does not match the locally configured list for the virtual router.

Invalid Authentication Type

Represents the total number of VRRP packets received with unknown authentication type.

Authentication Type Mismatch

Represents the total number of VRRP advertisements received for which 'auth type' not equal to locally configured one for this virtual router.

Packet Length Errors

Represents the total number of VRRP packets received with packet length less than length of VRRP header.

8.6.17 show ip vrrp

This command displays whether VRRP functionality is enabled or disabled on the switch. It also displays some global parameters which are required for monitoring This command takes no options.

Format

`show ip vrrp`

Modes

`Privileged EXEC`

`User EXEC`

Admin Mode

`Displays the administrative mode for VRRP functionality on the switch.`

Authentication Failure Trap

`Represents the administrative mode for VRRP authentication failure trap function.`

New Master Trap

`Represents the administrative mode of the New Master Trap function.`

Fast instances configured

`Shows the number of virtual routers with an advertisement intervall of less than one second. 16 of these fast instances can be configured at a time.`

Router Checksum Errors

`Represents the total number of VRRP packets received with an invalid VRRP checksum value.`

Router Version Errors

`Represents the total number of VRRP packets received with Unknown or unsupported version number.`

Router VRID Errors

`Represents the total number of VRRP packets received with invalid VRID for this virtual router.`

8.6.18 show ip vrrp domain

This command displays information about a VRRP domain.

Format

`show ip vrrp domain <1-8>`

Modes

`Privileged EXEC`

`User EXEC`

Interface

`Valid slot and port number separated by forward slashes.`

VRID

`Represents the router ID of the virtual router.`

State

`Represents the state (Master/backup) of the virtual router.`

Role

`Represents the role of the virtual router in this domain (Member or Supervisor).`

Members Send Advertisements

`Displays whether the members of the domain send advertisements themselves.`

Supervisor Priority

`Displays the current priority of the supervisor of the domain. This priority is used by all members.`

Supervisor Advertisement Address

`The IP address the supervisor sends its advertisement packets to.`

8.6.19 show ip vrrp interface

This command displays all configuration information and VRRP router statistics of a virtual router configured on a specific interface.

Format

`show ip vrrp interface <slot/port> <vrID>`

Modes

`Privileged EXEC`

`User EXEC`

Primary IP Address

`This field represents the configured primary IP Address for the Virtual router.`

Secondary IP Addresses

`This field represents the configured secondary IP Address for the Virtual router.`

VMAC address

`Represents the VMAC address of the specified router.`

Authentication type

`Represents the authentication type for the specific virtual router.`

Priority

`Represents the priority value for the specific virtual router.`

Advertisement interval

`Represents the advertisement interval for the specific virtual router.`

Pre-Empt Mode

`Is the preemption mode configured on the specified virtual router.`

Administrative Mode

`Represents the status (Enable or Disable) of the specific router.`

State

`Represents the state (Master/backup) of the virtual router.`

Current Priority

Displays the current priority used by this virtual router. This can be different from the configured priority if tracking or domains are used.

Preemption Delay

Shows the time preemption of a master with lower priority is delayed.

Link Down Notification

Shows the IP address link down notifications are sent to.

VRRP Domain

Displays the domain this virtual router is in.

VRRP Domain Role

Shows the role that this virtual router has in its domain (Member or Supervisor)

VRRP Domain State

Shows if the domain is completely configured or if the supervisor is missing or down.

Advertisement Address

Shows the IP address the virtual router sends its advertisement packets to.

Tracking

Shows the trackids this virtual router is observing.

Decrement

The value by which the priority of the virtual router is decremented when the tracked object goes down.

State

Shows if the tracked object is up or down. If the trackid is not a configured tracking object, it is always shown as up.

8.7 RIP Commands

This chapter provides a detailed explanation of the Routing Information Protocol (RIP) commands. The commands are divided by functionality into the following different groups:

- Show commands are used to display switch settings, statistics and other information.
- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Copy commands are used to transfer configuration and informational files to and from the switch.

8.7.1 enable (RIP)

This command sets the administrative mode of RIP in the router to active.

Default

```
enabled
```

Format

```
enable
```

Mode

```
Router RIP Config
```

no enable (RIP)

This command sets the administrative mode of RIP in the router to inactive.

Format

```
no enable
```

Mode

```
Router RIP Config
```

8.7.2 ip rip

This command enables RIP on a router interface.

Default

```
disabled
```

Format

```
ip rip
```

Mode

```
Interface Config
```

no ip rip

This command disables RIP on a router interface.

Format

```
no ip rip
```

Mode

```
Interface Config
```

8.7.3 auto-summary

This command enables the RIP auto-summarization mode.

Default

```
disabled
```

Format

```
auto-summary
```

Mode

```
Router RIP Config
```

no auto-summary

This command disables the RIP auto-summarization mode.

Format

```
no auto-summary
```

Mode

```
Router RIP Config
```

8.7.4 default-information originate (RIP)

This command is used to control the advertisement of default routes.

Format

```
default-information originate
```

Mode

```
Router RIP Config
```

no default-information originate (RIP)

This command is used to control the advertisement of default routes.

Format

```
no default-information originate
```

Mode

```
Router RIP Config
```

8.7.5 default-metric (RIP)

This command is used to set a default for the metric of distributed routes.

Format

```
default-metric <0-15>
```

Mode

```
Router RIP Config
```

no default-metric (RIP)

This command is used to reset the default metric of distributed routes to its default value.

Format

```
no default-metric
```

Mode

```
Router RIP Config
```

8.7.6 distance rip

This command sets the route preference value of RIP in the router. Lower route preference values are preferred when determining the best route.

Default

```
15
```

Format

```
distance rip <1-255>
```

Mode

```
Router RIP Config
```

no distance rip

This command sets the default route preference value of RIP in the router.

Format

```
no distance rip
```

Mode

```
Router RIP Config
```

8.7.7 distribute-list out

This command is used to specify the access list to filter routes received from the source protocol.

Default

0

Format

distribute-list *<1-199>* out *{bgp | static | connected}*

Mode

Router RIP Config

no distribute-list out

This command is used to specify the access list to filter routes received from the source protocol.

Format

no distribute-list *<1-199>* out *{bgp | static | connected}*

Mode

Router RIP Config

no default-information originate

This command is used to control the advertisement of default routes.

Format

no default-information originate

Mode

Router RIP Config

8.7.8 ip rip authentication

This command sets the RIP Version 2 Authentication Type and Key for the specified interface. The value of <*type*> is either `none`, `simple`, or `encrypt`.

The value for authentication key [*key*] must be 16 bytes or less. The [*key*] is composed of standard displayable, non-control keystrokes from a Standard 101/102-key keyboard. If the value of <*type*> is `encrypt`, a keyid in the range of 0 and 255 must be specified.

Default

`The default authentication type is none.`

Default

`The default password key is an empty string. Unauthenticated interfaces do not need an authentication key.`

Default

`The default key id is not defined. Unauthenticated interfaces do not need an authentication key id.`

Format

`ip rip authentication` *{none | {simple <key>} | {encrypt <key> <keyid>}}*

Mode

`Interface Config`

no ip rip authentication

This command sets the default RIP Version 2 Authentication Type for an interface.

Format

`no ip rip authentication`

Mode

`Interface Config`

8.7.9 ip rip receive version

This command configures the interface to allow RIP control packets of the specified version(s) to be received.

The value for <*mode*> is one of: `rip1` to receive only RIP version 1 formatted packets, `rip2` for RIP version 2, `both` to receive packets from either format, or `none` to not allow any RIP control packets to be received.

Default

`both`

Format

`ip rip receive version` *{rip1 | rip2 | both | none}*

Mode

`Interface Config`

no ip rip receive version

This command configures the interface to allow RIP control packets of the default version(s) to be received.

Format

`no ip rip receive version`

Mode

`Interface Config`

8.7.10 ip rip send version

This command configures the interface to allow RIP control packets of the specified version to be sent.

The value for <*mode*> is one of: `rip1` to broadcast RIP version 1 formatted packets, `rip1c` (RIP version 1 compatibility mode) which sends RIP version 2 formatted packets via broadcast, `rip2` for sending RIP version 2 using multicast, or `none` to not allow any RIP control packets to be sent.

Default

`rip2`

Format

`ip rip send version {rip1 | rip1c | rip2 | none}`

Mode

`Interface Config`

no ip rip send version

This command configures the interface to allow RIP control packets of the default version to be sent.

Format

`no ip rip send version`

Mode

`Interface Config`

8.7.11 hostroutesaccept

This command enables the RIP hostroutesaccept mode.

Default

`enabled`

Format

`hostroutesaccept`

Mode

`Router RIP Config`

no hostroutesaccept

This command disables the RIP hostroutesaccept mode.

Format

`no hostroutesaccept`

Mode

`Router RIP Config`

8.7.12 redistribute

This command configures RIP protocol to redistribute routes from the specified source protocol/routers. There are five possible match options. When you submit the command redistribute ospf match <match-type> the match-type or types specified are added to any match types presently being redistributed. Internal routes are redistributed by default.

Default

`metric -- not-configured; match -- internal`

Format for OSPF as source protocol

`redistribute ospf` *`[metric <0-15>] [match [internal] [external 1] [external 2] [nssa-external 1] [nssa-external-2]]`*

Format for other source protocol

`redistribute` *`{bgp | static | connected} [metric <0-15>]`*

Mode

`Router RIP Config`

no redistribute

This command de-configures RIP protocol to redistribute routes from the specified source protocol/routers.

Format

`no redistribute` *`{ospf | bgp | static | connected} [metric] [match [internal] [external 1] [external 2] [nssa-external 1] [nssa-external-2]]`*

Mode

`Router RIP Config`

8.7.13 split-horizon

This command sets the RIP split horizon mode.

Default

```
simple
```

Format

```
split-horizon {none | simple | poison}
```

Mode

```
Router RIP Config
```

no split-horizon

This command sets the default RIP split horizon mode.

Format

```
no split-horizon
```

Mode

```
Router RIP Config
```

8.7.14 update-timer

This command configures the RIP update interval in seconds. Shorter update intervals can improve the RIP convergence time significally. However, update intervals shorter than 10 seconds should be used only for small networks. The other RIP timers are set by the switch accordingly:
Timeout: 6 times the update interval.
Gabage Collection : 10 times the update interval.

Default

```
30
```

Format

```
update-timer <1-1000>
```

Mode

```
Router RIP Config
```

no update-timer

This command sets the default RIP update interval.

Format

```
no update-timer
```

Mode

```
Router RIP Config
```

8.7.15 show ip rip

This command displays information relevant to the RIP router.

Format

```
show ip rip
```

Modes

```
Privileged EXEC
User EXEC
```

RIP Admin Mode

Enable or disable.

Split Horizon Mode

None, simple or poison reverse. Split horizon is a technique for avoiding problems caused by including routes in updates sent to the router from which the route was originally learned. The options are: None – no special processing for this case. Simple – a route will not be included in updates sent to the router from which it was learned. Poisoned reverse – a route will be included in updates sent to the router from which it was learned, but the metric will be set to infinity. The default is simple

Auto Summary Mode

Enable or disable. If enabled, groups of adjacent routes are summarized into single entries, in order to reduce the total number of entries The default is enable.

Host Routes Accept Mode

Enable or disable. If enabled the router accepts host routes. The default is enable.

Update Timer Interval

Current RIP update interval in seconds.

Global Route Changes

The number of route changes made to the IP Route Database by RIP. This does not include the refresh of a route's age.

Global queries -

The number of responses sent to RIP queries from other systems.

Default Metric

Sets a default for the metric of redistributed routes.This field displays the default metric if one has already been set or blank if not configured earlier. The valid values are (1 to 15)

Default Route Advertise

The default route.

8.7.16 show ip rip interface brief

This command displays general information for each RIP interface. For this command to display successful results routing must be enabled per interface (i.e. ip rip).

Format

`show ip rip interface brief`

Modes

`Privileged EXEC`

`User EXEC`

Interface

`Valid slot and port number separated by forward slashes.`

IP Address

`The IP source address used by the specified RIP interface.`

Send Version

`The RIP version(s) used when sending updates on the specified interface. The types are none, RIP-1, RIP-1c, RIP-2.`

Receive Version

`The RIP version(s) allowed when receiving updates from the specified interface. The types are none, RIP-1, RIP-2, Both`

RIP Mode

`RIP administrative mode of router RIP operation; enable activates, disable de-activates it.`

Link State

`The mode of the interface (up or down).`

8.7.17 show ip rip interface

This command displays information related to a particular RIP interface.

Format

```
show ip rip interface <slot/port>
```

Modes

```
Privileged EXEC
User EXEC
```

Interface

Valid slot and port number separated by forward slashes. This is a configured value.

IP Address

The IP source address used by the specified RIP interface. This is a configured value.

Send version

The RIP version(s) used when sending updates on the specified interface. The types are none, RIP-1, RIP-1c, RIP-2. This is a configured value.

Receive version

The RIP version(s) allowed when receiving updates from the specified interface. The types are none, RIP-1, RIP-2, Both. This is a configured value.

RIP Admin Mode

RIP administrative mode of router RIP operation; enable activates, disable de-activates it. This is a configured value.

Link State

Indicates whether the RIP interface is up or down. This is a configured value.

Authentication Type

The RIP Authentication Type for the specified interface. The types are none, simple, and encrypt. This is a configured value.

Default Metric

A number which represents the metric used for default routes in RIP updates originated on the specified interface. This is a configured value.

The following information will be invalid if the link state is down.

Bad Packets Received

The number of RIP response packets received by the RIP process which were subsequently discarded for any reason.

Bad Routes Received

The number of routes contained in valid RIP packets that were ignored for any reason.

Updates Sent

The number of triggered RIP updates actually sent on this interface.

9 Quality of Service (QoS) Commands

This chapter provides a detailed explanation of the Quality of Service (QOS) commands.
The commands are divided into these different groups:

- Show commands are used to display device settings, statistics and other information.
- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.

9.1 MAC ACL Commands

MAC Access Control Lists (ACLs) ensure that only authorized users have access to specific resources while blocking off any unwarranted attempts to reach network resources.

Note:

- The maximum number of ACLs of any type that can be created is 100.
- ACLs are supported in the inbound direction only.
- Only Ethernet II frame types are supported.
- The maximum number of rules per MAC ACL is 10.
- The maximum number of rules per interface is 20 (100 for Software Version L3P).
- ACLs are configured separately for Layer 2 and Layer 3 / Layer 4 and cannot be applied to the same interface (PowerMICE, MACH104, MACH1040 and MACH4000 without MACH4002-24G.../MACH4002-48G...).
- ACLs are configured separately for Layer 2 and Layer 3/Layer 4 and can be applied to the same interface (MACH4002-24G.../MACH4002-48G...).
- Wildcard masking for MAC ACLs (srcmacmask, dstmacmask) operates differently from a subnet mask. A wildcard mask is in essence the inverse of a subnet mask. With a subnet mask, the mask has ones (1's) in the bit positions that are used for the network address, and has zeros (0's) for the bit positions that are not used. In contrast, a wildcard mask has (0’s) in a bit position that must be checked. A ‘1’ in a bit position of the ACL mask indicates the corresponding bit can be ignored.

9.1.1 mac access-list extended

Note: This command is available for the devices of the MACH104, MACH1040 and MACH4000 families and for the PowerMICE devices.

This command creates a MAC Access Control List (ACL) identified by <name>, consisting of classification fields defined for the Layer 2 header of an Ethernet frame. The <name> parameter is a case-sensitive alphanumeric string from 1 to 31 characters uniquely identifying the MAC access list.
If a MAC ACL by this name already exists, this command enters Mac-Access-List config mode to allow updating the existing MAC ACL.

Note: The CLI mode is changed to Mac-Access-List Config when this command is successfully executed.

Format

```
mac access-list extended <name>
```

Mode

```
Interface Config
Global Config
```

name

```
Enter access-list name up to 31 characters in
length.
```

no mac access-list extended

This command deletes a MAC ACL identified by <name> from the system.

Format

```
no mac access-list extended <name>
```

Mode

```
Global Config
```

name

```
Enter access-list name up to 31 characters in
length.
```

9.1.2 mac access-list extended rename

Note: This command is available for the devices of the MACH104, MACH1040 and MACH4000 families and for the PowerMICE devices.

This command changes the name of a MAC Access Control List (ACL). The <*oldname*> parameter is the name of an existing MAC ACL. The <*newname*> parameter is a case-sensitive alphanumeric string from 1 to 31 characters uniquely identifying the MAC access list.
This command fails if a MAC ACL by the name <*newname*> already exists.

Format

```
mac access-list extended rename <oldname> <newname>
```

Mode

```
Global Config
```

9.1.3 {deny|permit}

This command creates a new rule for the current MAC access list. Each rule is appended to the list of configured rules for the list.

Note: The 'no' form of this command is not supported, since the rules within a MAC ACL cannot be deleted individually. Rather, the entire MAC ACL must be deleted and re-specified.

Note: An implicit 'deny all' MAC rule always terminates the access list.

A rule may either deny or permit traffic according to the specified classification fields. At a minimum, the source and destination MAC value and mask pairs must be specified, each of which may be substituted using the keyword any to indicate a match on any value in that field. The bpdu keyword may be specified for the destination MAC value/mask pair indicating a well-known BPDU MAC value of 01-80-c2-xx-xx-xx (hex), where 'xx' indicates a don't care. The remaining command parameters are all optional, but the most frequently used parameters appear in the same relative order as shown in the command format.
The Ethertype may be specified as either a keyword or a four-digit hexadecimal value from 0x0600-0xFFFF. The currently supported <*ethertypekey*> values are: appletalk, arp, ibmsna, ipv4, ipv6, ipx, mplsmcast, mplsucast, netbios, novell, pppoe, rarp. Each of these translates into its equivalent Ethertype value(s).

Ethertype Keyword	Corresponding Value
appletalk	0x809B
arp	0x0806
ibmsna	0x80D5
ipv4	0x0800
ipv6	0x86DD
ipx	0x8037
mplsmcast	0x8848
mplsucast	0x8847
netbios	0x8191
novell	0x8137, 0x8138

Table 16: Ethertype Keyword and 4-digit Hexadecimal Value

Ethertype Keyword	Corresponding Value
pppoe	0x8863, 0x8864
rarp	0x8035

Table 16: Ethertype Keyword and 4-digit Hexadecimal Value

The vlan and cos parameters refer to the VLAN identifier and 802.1p user priority fields, respectively, of the VLAN tag. For packets containing a double VLAN tag, this is the first (or outer) tag.
The assign-queue parameter allows specification of a particular 802.1p user priority for traffic that matches this rule. The allowed *<queue-id>* value is 0-7. The matching traffic is transmitted with the modified 802.1p user priority and also with modified IP-DSCP value for IP frames.
The redirect parameter allows the traffic matching this rule to be forwarded to the specified *<slot/port>*. The assign-queue and redirect parameters are only valid for a 'permit' rule.

Format

{deny|permit} {{<srcmac> <srcmacmask>} | any} {{<dstmac> <dstmacmask>} | any| bpdu} [<ethertypekey> | <0x0600-0xFFFF>] [vlan eq <0-4095> | cos <0-7>] [secondary-vlan eq <0-4095>] [secondary-cos <0-7>] [assign-queue <queue-id>] [redirect <slot/port>]

Note: The special command form *{deny|permit}* any is used to match all Ethernet layer 2 packets, and is the equivalent of the IP access list "match every" rule.

Mode

Mac-Access-List Config

9.1.4 mac access-group

This command attaches a specific MAC Access Control List (ACL) identified by <*name*> to an interface in the inbound direction. The <*name*> parameter must be the name of an existing MAC ACL.
An optional sequence number may be specified to indicate the order of this MAC access list relative to other MAC access lists already assigned to this interface and direction. A lower number indicates higher precedence order. If a sequence number is already in use for this interface, the specified MAC access list replaces the currently attached MAC access list using that sequence number. If the sequence number is not specified for this command, a sequence number that is one greater than the highest sequence number currently in use for this interface and direction is used.
This command specified in Interface Config mode only affects a single interface, whereas the Global Config mode setting is applied to all interfaces.

Format

```
mac access-group <name> in [sequence <1-4294967295>]
```

Modes

```
Global Config
Interface Config
```

name

```
Enter name of MAC Access Control List.
```

<1-4294967295>

```
Enter the sequence number (greater than 0) to rank
precedence for this interface and direction. A
lower sequence number has higher precedence.
```

no mac access-group

This command removes a MAC ACL identified by <*name*> from the interface in a given direction.

Format

```
no mac access-group <name> [in]
```

Modes

```
Global Config
Interface Config
```

name

```
Enter name of MAC Access Control List.
```

9.1.5 show mac access-lists

Note: This command is available for the devices of the MACH104, MACH1040 and MACH4000 families and for the PowerMICE devices.

This command displays a MAC access list and all of the rules that are defined for the MAC ACL. The *[name]* parameter is used to identify a specific MAC ACL to display.

Format

```
show mac access-lists [name]
```

name

```
Enter name of MAC Access Control List.
```

Mode

```
Privileged EXEC
```

Rule Number

```
The ordered rule number identifier defined within
the MAC ACL.
```

Action

```
Displays the action associated with each rule. The
possible values are permit or deny.
```

Source MAC Address

Displays the source MAC address for this rule.

Source MAC Mask

Displays the source MAC mask for this rule.

Destination MAC Address

Displays the destination MAC address for this rule.

Destination MAC Mask

Displays the destination MAC mask for this rule.

Ethertype

Displays the Ethertype keyword or custom value for this rule.

VLAN ID

Displays the VLAN identifier value or range for this rule.

COS

Displays the COS (802.1p) value for this rule.

Secondary VLAN

Displays the Secondary VLAN identifier value or range for this rule.This field is contained in the inner tag of a double VLAN-tagged packet.

Secondary COS

Displays the Secondary COS (802.1p) value for this rule. This field is contained in the inner tag of a double VLAN-tagged packet.

Assign Queue

Displays the 802.1p user priority to which packets matching this rule are assigned.

Redirect Interface

Displays the slot/port to which packets matching this rule are forwarded.

9.2 IP ACL Commands

IP Access Control Lists (ACLs) ensure that only authorized users have access to specific resources while blocking off any unwarranted attempts to reach network resources.

Note:

- IP ACL configuration for IP packet fragments is not supported.
- ACLs are supported in the inbound direction only.
- The maximum number of ACLs of any type that can be created is 100.
- The maximum number of rules per IP ACL is 10.
- The maximum number of rules per interface is 20 (100 for Software Version L3P).
- ACLs are configured separately for Layer 2 and Layer 3/Layer 4 and cannot be applied to the same interface. (PowerMICE and MACH4000 without MACH4002-24G.../MACH4002-48G...)
- ACLs are configured separately for Layer 2 and Layer 3/Layer 4 and can be applied to the same interface. (MACH4002-24G.../MACH4002-48G...)
- Wildcard masking for IP ACLs (srcmask, dstmask) operates differently from a subnet mask. A wildcard mask is in essence the inverse of a subnet mask. With a subnet mask, the mask has ones (1's) in the bit positions that are used for the network address, and has zeros (0's) for the bit positions that are not used. In contrast, a wildcard mask has (0’s) in a bit position that must be checked. A ‘1’ in a bit position of the ACL mask indicates the corresponding bit can be ignored. The mask for the TOS value (tosmask) uses the common notation, i.e. the mask has ones (1's) in the bit positions that must be checked.

9.2.1 access-list

Note: This command is available for the devices of the MACH4000 family, for the PowerMICE devices and for the MACH1040 devices.

This command creates an IP Access Control List (ACL) that is identified by the parameter <*accesslistnumber*>.
The IP ACL number (<*accesslistnumber*>) is an integer from 1 to 199. The <*accesslistnumber*> range 1 to 99 is for an IP standard ACL and the <*accesslistnumber*> range 100 to 199 is for an IP extended ACL.
The IP ACL rule is specified with either a *permit or deny* action.
The protocol to filter for an IP ACL rule is specified by giving the protocol to be used like i*cmp, igmp, ip, tcp, udp.*
The command specifies a source ipaddress and source mask for match condition of the IP ACL rule specified by the *srcip* and *srcmask* parameters.
The source layer 4 port match condition for the IP ACL rule is specified by the *port value* parameter. The range of values is from 0 to 65535. The <*startport*> and <*endport*> parameters identify the first and last ports that are part of the port range. They have values from 0 to 65535. The ending port must have a value equal or greater than the starting port. The starting port, ending port, and all ports in between will be part of the destination port range.
The <*portvalue*> parameter uses a single keyword notation and currently has the values of *domain, echo, ftp, ftpdata, http, smtp, snmp, telnet, tftp*, and *www*. Each of these values translates into its equivalent port number, which is used as both the start and end of a port range.
The command specifies a destination ipaddress and destination mask for match condition of the IP ACL rule specified by the *dstip* and *dstmask* parameters.
The command specifies the TOS for an IP ACL rule depending on a match of precedence or DSCP values using the parameters *dscp, precedence*, *tos/tosmask*.
The assign-queue parameter allows specification of a particular 802.1p user priority for traffic that matches this rule. The allowed <*queue-id*> value is 0-7. The matching traffic is transmitted with the modified 802.1p user priority and also with modified IP-DSCP value for IP frames.
The command specifies the redirect interface which is the slot/port to which packets matching this rule are forwarded.

Default

none

(IP Standard ACL)

Format

```
access-list <1-99>
  {deny | permit}
  {every | <srcip> <srcmask>}
  [assign-queue <queue-id>] |
                            [redirect <slot/port>]
```

Mode

```
Global Config
```

(IP Extended ACL)

Format

```
access-list <100-199>
  {deny | permit}
  {every | icmp | igmp | ip | tcp | udp | <number>}
  {<srcip> <srcmask> | any}
  [{eq {<portkey> | <portvalue>}]]
  {<dstip> <dstmask> | any}
  [{eq {<portkey>|  <portvalue>}] |
  [precedence <precedence> | tos <tos> <tosmask> |
   dscp <dscp>] | [assign-queue <queue-id>] |
  [redirect <slot/port>]}}
```

Mode

```
Global Config
```

no access-list

This command deletes an IP ACL that is identified by the parameter <*accesslistnumber*> from the system.

Format

```
no access-list <accesslistnumber>
```

Mode

```
Global Config
```

accesslistnumber

```
Vaild range: 1-99, 100-199
```

9.2.2 access-list fragments

Note: This command is available for the devices of the MACH104 and MACH1040 family and for the MACH4002-24G... and MACH4002-48G... devices.

This command enables IP fragments processing.

Default

```
none
```

Format

```
access-list fragments
```

Modes

```
Global Config
```

no access-list fragments

This command disables IP fragments processing.

Default

```
none
```

Format

```
no access-list fragments
```

Mode

```
Global Config
```

9.2.3 ip access-group

Note: This command is available for the devices of the MACH4000 family and for the PowerMICE devices.

This command attaches a specified IP ACL to one interface or to all interfaces.
An optional sequence number may be specified to indicate the order of this IP access list relative to other IP access lists already assigned to this interface. A lower number indicates higher precedence order. If a sequence number is already in use for this interface, the specified access list replaces the currently attached IP access list using that sequence number. If the sequence number is not specified for this command, a sequence number that is one greater than the highest sequence number currently in use for this interface and direction is used.

Default

none

Format

ip access-group *<accesslistnumber> in> [<1-4294967295>]*

Modes

Interface Config

Global Config

accesslistnumber

Enter the ACL ID in the range of 1 to 199.

<1-4294967295>

Enter the sequence number (greater than 0) to rank precedence for this interface and direction. A lower sequence number has higher precedence.

no ip access-group

This command removes a specified IP ACL from an interface.

Default

none

Format

no ip access-group <*accesslistnumber*> <in>

Mode

Interface Config
Global Config

accesslistnumber

Enter the ACL ID in the range of 1 to 199.

9.2.4 show ip access-lists

Note: This command is available for the devices of the MACH4000 family and for the PowerMICE devices.

This command displays an IP ACL.
<*accesslistnumber*> is the number used to identify the IP ACL.

Format

show ip access-lists <*accesslistnumber*>

Modes

Privileged EXEC

accesslistnumber

Enter the ACL ID in the range of 1 to 199.

Rule Number

This displays the number identifier for each rule that is defined for the IP ACL.

Action

This displays the action associated with each rule. The possible values are permit or deny.

Protocol

This displays the protocol to filter for this rule.

Source IP Address

This displays the source IP address for this rule.

Source IP Mask

This field displays the source IP Mask for this rule.

Source L4 Port

This field displays the source port for this rule.

Destination IP Address

This displays the destination IP address for this rule.

Destination IP Mask

This field displays the destination IP Mask for this rule.

Destination L4 Port

This field displays the destination port for this rule.

Service Type Field Match

This field indicates whether an IP DSCP, IP Precedence, or IP TOS match condition is specified for this rule.

Service Type Field Value

This field indicates the value specified for the Service Type Field Match (IP DSCP, IP Precedence, or IP TOS).

9.2.5 show access-lists global

Note: This command is available for the devices of the MACH104 and MACH1040 family and for the MACH4002-24G... and MACH4002-48G... devices.

This command displays global access list information.

Format

```
show access-lists global
```

Modes

```
Privileged EXEC
```

L4 Fragment Processing

```
This field displays the status of IP fragments
processing.
Possible values: Enabled, Disabled.
```

9.2.6 show access-lists

Note: This command is available for the devices of the MACH4000 family and for the PowerMICE devices.

This command displays IP ACLs and MAC access control lists information for a designated interface and direction.

Format

show access-lists interface <*slot/port*> <in>

Modes

Privileged EXEC

ACL Type

Type of access list (IP or MAC).

ACL ID

Access List name for a MAC access list or the numeric identifier for an IP access list.

Sequence Number

An optional sequence number may be specified to indicate the order of this access list relative to other access lists already assigned to this interface and direction. A lower number indicates higher precedence order. If a sequence number is already in use for this interface and direction, the specified access list replaces the currently attached access list using that sequence number. If the sequence number is not specified by the user, a sequence number that is one greater than the highest sequence number currently in use for this interface and direction is used. Valid range is (1 to 4294967295).

9.3 CoS Commands

This chapter provides a detailed explanation of the QoS Class of Service (CoS) commands. The following commands are available.
The commands are divided into these different groups:

- Configuration Commands are used to configure features and options of the switch. For every configuration command there is a show command that will display the configuration setting.
- Show commands are used to display device settings, statistics and other information.

Note: The 'Interface Config' mode only affects a single interface, whereas the 'Global Config' mode is applied to all interfaces.

9.3.1 cos-queue max-bandwidth

This command specifies the maximum transmission bandwidth limit for each interface queue. Also known as rate shaping, this has the effect of smoothing temporary traffic bursts over time so that the transmitted traffic rate is bounded. The switch supports 8 queues per interface. A value from 0-100 (percentage of link rate) must be specified for each supported queue, with 0 indicating no maximum bandwidth is in effect.

Format

```
cos-queue max-bandwidth <bw-0> <bw-1> ... <bw-n>
```

Modes

```
Global Config
Interface Config (not MACH 4002 24G/48G)
```

<bw-n>

```
Enter the minimum bandwidth percentage for Queue n.
Valid range: n = 0 ...7.
```

no cos-queue max-bandwidth

This command restores the default for each queue's maximum bandwidth value.

Format

```
no cos-queue max-bandwidth
```

Mode

```
Global Config
Interface Config (not MACH 4002 24G/48G)
```

9.3.2 cos-queue min-bandwidth

This command specifies the minimum transmission bandwidth guarantee for each interface queue. The switch supports 8 queues per interface. A value from 0-100 (percentage of link rate) must be specified for each supported queue, with 0 indicating no guaranteed minimum bandwidth. The sum of all values entered must not exceed 100.

Format

```
cos-queue min-bandwidth <bw-0> <bw-1> ... <bw-n>
```

Modes

```
Global Config
Interface Config (not MACH 4002 24G/48G)
```

<bw-n>

```
Enter the minimum bandwidth percentage for Queue n.
Valid range: n = 0 ...7.
```

no cos-queue min-bandwidth

This command restores the default for each queue's minimum bandwidth value.

Format

```
no cos-queue min-bandwidth
```

Modes

```
Global Config
Interface Config (not MACH 4002 24G/48G)
```

9.3.3 cos-queue strict

This command activates the strict priority scheduler mode for each specified queue. A queue cannot be a member of a queuing algorithm higher than its next higher priority queue. That is, any strict priority queue must start at class 7 and be consecutive.

Format

```
cos-queue strict <queue-id-1> [<queue-id-2> ...
<queue-id-n>]
```

Modes

```
Global Config
Interface Config (not MACH 4002 24G/48G)
```

<queue-id-n>

```
Enter a Queue Id from 0 to 7.
```

no cos-queue strict

This command activates the weighted round robin (WRR) scheduler mode for each specified queue. A queue cannot be a member of a queuing algorithm lower than its next lowe priority queue. That is, any WRR queue must start at class 0 and be consecutive.

Format

```
no cos-queue strict <queue-id-1> [<queue-id-2> ...
<queue-id-n>]
```

Modes

```
Global Config
Interface Config (not MACH 4002 24G/48G)
```

<queue-id-n>

```
Enter a Queue Id from 0 to 7.
```

9.3.4 traffic-shape

This command specifies the maximum transmission bandwith limit for the interface as a whole. Also known as rate shaping, this has the effect of smoothing temporary traffic bursts over time so that the transmission traffic rate is bounded. A value from 0-100 (percentage of link rate) must be specified, with 0 indicating no traffic shaping is in effect. When interface shaping is enabled on a port which has some queues in WRR group, then the minimum bandwith configuration of the weighted queues is not honored.

Format

```
traffic-shape <bw>
```

Modes

```
Global Config
Interface Config
```

<bw>

```
Enter the shaping bandwidth percentage from 0 to
100 in increments of 5.
```

no traffic-shape

This command disables the traffic shaping.

Format

```
no traffic-shape
```

Modes

```
Global Config
Interface Config
```

9.3.5 show interfaces cos-queue

This command displays the class-of-service queue configuration for the specified interface. The slot/port parameter is optional. If specified, the class-

of-service queue configuration of the interface is displayed. If omitted, the most recent global configuration settings are displayed.

Format

```
show interfaces cos-queue [slot/port]
```

Mode

```
Privileged EXEC
```

Interface

```
This displays the slot/port of the interface. If
displaying the global configuration, this line is
replaced by a Global Configuration indication.
```

Intf Shaping Rate

```
The maximum transmission bandwidth limit for the
interface as a whole. It is independent of any per-
queue maximum bandwidth value(s) in effect for the
interface. This is a configured value.
```

The following information is repeated for each queue on the interface.

Queue Id

```
An interface supports 8 queues numbered 0 to 7.
```

Minimum Bandwidth

```
The minimum transmission bandwidth guarantee for
the queue, expressed as a percentage. A value of 0
means bandwidth is not guaranteed and the queue
operates using best-effort. This is a configured
value.
```

Maximum Bandwidth

```
The maximum transmission bandwidth limit for the
queue, expressed as a percentage. A value of 0
means no upper limit is enforced, so the queue may
use any or all of the available bandwidth of the
interface. This is a configured value.
```

Scheduler Type

```
Indicates whether this queue is scheduled for
transmission using a strict priority or a weighted
scheme. This is a configured value.
```

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Symbols

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11 Glossary

Numerics

802.1D. The IEEE designator for Spanning Tree Protocol (STP). STP, a link management protocol, is part of the 802.1D standard for media access control bridges. Using the spanning tree algorithm, STP provides path redundancy while preventing endless loops in a network. An endless loop is created by multiple active paths between stations where there are alternate routes between hosts. To establish path redundancy, STP creates a logical tree that spans all of the switches in an extended network, forcing redundant paths into a standby, or blocked, state. STP allows only one active path at a time between any two network devices (this prevents the loops) but establishes the redundant links as a backup if the initial link should fail. If STP costs change, or if one network segment in the STP becomes unreachable, the spanning tree algorithm reconfigures the spanning tree topology and reestablishes the link by activating the standby path. Without spanning tree in place, it is possible that both connections may be simultaneously live, which could result in an endless loop of traffic on the LAN.

802.1P. The IEEE protocol designator for Local Area Network (LAN). This Layer 2 network standard improves support of time critical traffic, and limits the extent of high bandwidth multicast traffic within a bridged LAN. To do this, 802.1P defines a methodology for introducing traffic class priorities. The 802.1P standard allows priority to be defined in all 802 MAC protocols (Ethernet, Token Bus, Token Ring), as well as in FDDI. For protocols (such as Ethernet) that do not contain a priority field, 802.1P specifies a method for indicating frame priority based on the new fields defined in the 802.1Q (VLAN) standard.

802.1Q VLAN. The IEEE protocol designator for Virtual Local Area Network (VLAN). This standard provides VLAN identification and quality of service (QoS) levels. Four bytes are added to an Ethernet frame to allow eight priority levels (QoS) and to identify up to 4096 VLANs. See “VLAN” on page 737 for more information.

A

ABR. See “Area Border Router” on page 722.

Access Control List. An ACL is a database that an Operating System uses to track each user’s access

rights to system objects (such as file directories and/or files).

ACL. See “Access Control List” on page 721.

Address Resolution Protocol. An Internet Protocol that dynamically maps Internet addresses to physical (hardware) addresses on a LAN.

Advanced Network Device Layer/ Software. Hirschmann term for the Device Driver level.

Aging. When an entry for a node is added to the lookup table of a switch, it is given a timestamp. Each time a packet is received from a node, the timestamp is updated. The switch has a user-configurable timer that erases the entry after a certain length of time with no activity from that node.

API. See “Application Programming Interface” on page 722.

Application Programming Interface. An API is an interface used by an programmer to interface with functions provided by an application.

Area Border Router. A router located on the border of one or more OSPF areas that connects those areas to the backbone network. ABRs are considered members of both the OSPF backbone and the attached areas. They therefore maintain routing tables describing both the backbone topology and the topology of the other areas. (Cisco Systems Inc.)

ARP. See “Address Resolution Protocol” on page 722.

ASAM. See “ATM Subscriber Access Multiplexer” on page 722.

ASBR. See “Autonomous System Boundary Router” on page 722.

ATM Subscriber Access Multiplexer. A telephone central office multiplexer that supports SDL ports over a wide range of network interfaces. An ASAM sends and receives subscriber data (often Internet services) over existing copper telephone lines, concentrating all traffic onto a single high-speed trunk for transport to the Internet or the enterprise intranet. This device is similar to a DSLAM (different manufacturers use different terms for similar devices). (Cisco Systems Inc.)

Autonomous System Boundary Router. ABR located between an OSPF autonomous system and a non-OSPF network. ASBRs run both OSPF and another routing protocol, such as RIP. ASBRs must reside in a non-stub OSPF area. See also ABR, non-stub area, and OSPF. (Cisco Systems Inc.)

AVL tree. Binary tree having the property that for any node in the tree, the difference in height between the left and right subtrees of that node is no more than 1.

B

BPDU. See “Bridge Protocol Data Unit” on page 723.

BGP. See “Border Gateway Protocol” on page 723.

BootP. See “Bootstrap Protocol.” on page 723.

Bootstrap Protocol. An Internet protocol that enables a diskless workstation to discover its own IP address, the IP address of a BootP server on the network, and a file to be loaded into memory to boot the machine. This enables the workstation to boot without requiring a hard or floppy disk drive.

Border Gateway Protocol. BGP is a protocol for exchanging routing information between gateway host (each with its own router) in a network of autonomous systems. BGP is often the protocol used between gateway hosts on the Internet. The routing table contains a list of known routers, the addresses they can reach, and a cost metric associated with the path to each router so that the best available route is chosen. Hosts using BGP communicate using the Transmission Control Protocol (TCP) and send updated router table information only when one host has detected a change. Only the affected part of the routing table is sent. BGP-4, the latest version, lets administrators configure cost metrics based on policy statements. (BGP-4 is sometimes called BGP4, without the hyphen.) BGP communicates with autonomous (local) networks using Internal BGP (IBGP) since it doesn't work well with IGP. The routers inside the autonomous network thus maintain two routing tables: one for the interior gateway protocol and one for IBGP. BGP-4 makes it easy to use Classless Inter-Domain Routing (Classless Inter-Domain Routing), which is a way to have more addresses within the network than with the current IP address assignment scheme.

Bridge Protocol Data Unit. BPDU is the IEEE 802.1D MAC Bridge Management protocol that is the standard implementation of STP (Spanning Tree Protocol). It uses the STP algorithm to insure that physical loops in the network topology do not result in logical looping of network traffic. Using one bridge configured as root for reference, the BPDU switches one of two bridges forming a network loop into standby mode, so that only one side of a potential loop passes traffic. By examing frequent 802.1d configuration updates, a bridge in the standby mode can switch automatically into the forward mode if the other bridge forming the loop fails.

C

cards.h. A file that instructs the base code driver how to construct the driver.

card_db. A database that contains everything from port maps to module information.

Checksum. A simple error-detection scheme in which each transmitted message is identified with a numerical value based on the number of set bits in the message. The receiving station then applies a formula to the message and checks to make sure the accompanying numerical value is the same. If not, the receiver can assume that the message has been corrupted.

CLI. See “Command Line Interface” on page 724.

Command Line Interface. CLI is a line-item interface for configuring systems.

Common Open Policy Service Protocol. A proposed standard protocol for exchanging network policy information between a Policy Decision Point (PDP) in a network and Policy Enforcement Points (PEPs) as part of overall Quality of Service (QoS) - the allocation of network traffic resources according to desired priorities of service. The policy decision point might be a network server controlled directly by the network administrator who enters policy statements about which kinds of traffic (voice, bulk data, video, teleconferencing, and so forth) should get the highest priority. The policy enforcement points might be router or layer 3 switches that implement the policy choices as traffic moves through the network. Currently, COPS is designed for use with the Resource Reservation Protocol (RSVP), which lets you allocate traffic priorities in advance for temporary high-bandwidth requirements (for example, video broadcasts or multicasts). It is possible that COPS will be extended to be a general policy communications protocol.

Complex Programmable Logic Device. CPLD is a programmable circuit on which a logic network can be programmed after its construction.

COPS. See “Common Open Policy Service Protocol.” on page 724.

CPLD. See “Complex Programmable Logic Device.” on page 724.

D

DAPI. See “Device Application Programming Interface” on page 724.

Device Application Programming Interface. DAPI is the software interface that facilitates communication of both data and

control information between the Application Layer and HAPI, with support from System Support.

DHCP. See “Dynamic Host Configuration Protocol.” on page 725.

Differentiated Services. Diffserv is a protocol for specifying and controlling network traffic by class so that certain types of traffic get precedence - for example, voice traffic, which requires a relatively uninterrupted flow of data, might get precedence over other kinds of traffic. Differentiated Services is the most advanced method for managing traffic in terms of what is called Class of Service (CoS). Unlike the earlier mechanisms of 802.1P tagging and Type of Service (ToS), Differentiated Services avoids simple priority tagging and depends on more complex policy or rule statements to determine how to forward a given network packet. An analogy is made to travel services, in which a person can choose among different modes of travel - train, bus, airplane - degree of comfort, the number of stops on the route, standby status, the time of day or period of year for the trip, and so forth. For a given set of packet travel rules, a packet is given one of 64 possible forwarding behaviors - known as per hop behaviors (PHBs). A six-bit field, known as the Differentiated Services Code Point (DSCP), in the Internet Protocol (Internet Protocol) header specifies the per hop behavior for a given flow of packets. Differentiated Services and the Class of Service approach provide a way to control traffic that is both more flexible and more scalability than the Quality of Service approach.

Diffserv. See “Differentiated Services.” on page 725..

Distance-Vector Multicast Routing Protocol. DVMRP is a distance vector routing protocol used between routers in an intranet. This hop-based protocol describes a method of building multicast trees from the multicast source to all the receivers (or leaves) of the tree.

DVMRP. See “Distance-Vector Multicast Routing Protocol.” on page 725.

Dynamic Host Configuration Protocol. DHCP is a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network. In some systems, the device's IP address can even change while it is still connected. DHCP also supports a mix of static and dynamic IP addresses. Dynamic addressing simplifies network administration because the software tracks IP addresses rather than requiring an administrator to manage the task. A new computer can be added to a network without the hassle of

manually assigning it a unique IP address.

E

EEPROM. See “Electronically Erasable Programmable Read Only Memory” on page 726.

Electronically Erasable Programmable Read Only Memory. EEPROM is also known as Flash memory. This is re-programmable memory.

F

Fast STP. A high-performance Spanning Tree Protocol. See “STP” on page 736 for more information.

FIFO. First In First Out.

Flash Memory. See “EEPROM” on page 726.

Flow Control. The process of adjusting the flow of data from one network device to another to ensure that the receiving device can handle all of the incoming data. This is particularly important where the sending device is capable of sending data much faster than the receiving device can receive it. There are many flow control mechanisms. One of the most common flow control protocols for asynchronous communication is called xon-xoff. In this case, the receiving device sends a an “xoff” message to the sending device when its buffer is full. The sending device then stops sending data. When the receiving device is ready to receive more data, it sends an “xon” signal.

Forwarding. When a frame is received on an input port on a switch, the address is checked against the lookup table. If the lookup table has recorded the destination address, the frame is automatically forwarded on an output port.

Frame Check Sequence. The extra characters added to a frame for error detection and correction. FCS is used in X.25, HDLC, Frame Relay, and other data link layer protocols.

G

GARP. See “Generic Attribute Registration Protocol.” on page 727.

GARP Information Propagation.

GIP is the propagation of information between GARP participants for the same application in a bridge is carried out by a GIP component.

GARP Multicast Registration Protocol. GMRP provides a mechanism that allows Bridges and end stations to dynamically register (and subsequently, de-register) Group membership information with the MAC Bridges attached to the same LAN segment, and for that information to be disseminated

across all Bridges in the Bridged LAN that support Extended Filtering Services. The operation of GMRP relies upon the services provided by the GARP.

GARP VLAN Registration Protocol. GVRP allows workstations to request admission to a particular VLAN for multicast purposes.

GE. See “Gigabit Ethernet” on page 727.

General Purpose Chip-select Machine. GPCM provides interfacing for simpler, lower-performance memory resources and memory mapped-devices. The GPCM does not support bursting and is used primarily for boot-loading.

Generic Attribute Registration Protocol. GARP provides a generic attribute dissemination capability that is used by participants in GARP Applications (called GARP Participants) to register and de-register attribute values with other GARP Participants within a Bridged LAN. The definition of the attribute types, the values that they can carry, and the semantics that are associated with those values when registered are specific to the operation of the GARP Application concerned.

Gigabit Ethernet. A high-speed Ethernet connection.

GIP. See “GARP Information Propagation” on page 726.

GMRP. See “GARP Multicast Registration Protocol” on page 726.

GPCM. See “General Purpose Chip-select Machine” on page 727.

GVD. GARP VLAN Database.

GVRP. See “GARP VLAN Registration Protocol.” on page 727.

H

.h file. Header file in C code. Contains function and coding definitions.

HAPI. See “Hardware Abstraction Programming Interface” on page 727.

Hardware Abstraction Programming Interface. HAPI is the module that contains the NP specific software that interacts with the hardware.

hop count. The number of routers that a data packet passes through on its way to its destination.

I

ICMP. See “Internet Control Message Protocol” on page 728.

IGMP. See “Internet Group Management Protocol” on page 728.

IGMP Snooping. A series of operations performed by

intermediate systems to add logic to the network to optimize the flow of multicast traffic; these intermediate systems (such as Layer 2 switches) listen for IGMP messages and build mapping tables and associated forwarding filters, in addition to reducing the IGMP protocol traffic. See “Internet Group Management Protocol” on page 728 for more information.

Internet Control Message Protocol. ICMP is an extension to the Internet Protocol (IP) that supports packets containing error, control, and informational messages. The PING command, for example, uses ICMP to test an Internet connection.

Internet Group Management Protocol. IGMP is the standard for IP Multicasting on the Internet. IGMP is used to establish host memberships in particular multicast groups on a single network. The mechanisms of the protocol allow a host to inform its local router, using Host Membership Reports, that it wants to receive messages addressed to a specific multicast group. All hosts conforming to Level 2 of the IP Multicasting specification require IGMP.

IP. See “Internet Protocol” on page 728.

IP Multicasting. Sending out data to distributed servers on the MBone (Multicast Backbone). For large amounts of data, IP Multicast is more efficient than normal Internet transmissions because the server can broadcast a message to many recipients simultaneously. Unlike traditional Internet traffic that requires separate connections for each source-destination pair, IP Multicasting allows many recipients to share the same source. This means that just one set of packets is transmitted for all the destinations.

Internet Protocol. The method or protocol by which data is sent from one computer to another on the Internet. Each computer (known as a host) on the Internet has at least one IP address that uniquely identifies it among all other computers on the Internet. When you send or receive data (for example, an e-mail note or a Web page), the message gets divided into little chunks called packets. Each of these packets contains both the sender's Internet address and the receiver's address. Any packet is sent first to a gateway computer that understands a small part of the Internet. The gateway computer reads the destination address and forwards the packet to an adjacent gateway that in turn reads the destination address and so forth across the Internet until one gateway recognizes the packet as belonging to a computer within its immediate neighborhood or domain. That gateway then forwards the

packet directly to the computer whose address is specified.

Because a message is divided into a number of packets, each packet can, if necessary, be sent by a different route across the Internet. Packets can arrive in a different order than they were sent. The Internet Protocol just delivers them. It's up to another protocol, the Transmission Control Protocol (TCP) to put them back in the right order. IP is a connectionless protocol, which means that there is no continuing connection between the end points that are communicating. Each packet that travels through the Internet is treated as an independent unit of data without any relation to any other unit of data. (The reason the packets do get put in the right order is because of TCP, the connection-oriented protocol that keeps track of the packet sequence in a message.) In the Open Systems Interconnection (OSI) communication model, IP is in Layer 3, the Networking Layer. The most widely used version of IP today is IP version 4 (IPv4). However, IP version 6 (IPv6) is also beginning to be supported. IPv6 provides for much longer addresses and therefore for the possibility of many more Internet users. IPv6 includes the capabilities of IPv4 and any server that can support IPv6 packets can also support IPv4 packets.

J

Joint Test Action Group. An IEEE group that specifies test framework standards for electronic logic components.

JTAG. See “Joint Test Action Group” on page 729.

L

LAN. See “Local Area Network” on page 730.

LDAP. See “Lightweight Directory Access Protocol” on page 729.

Lightweight Directory Access Protocol. A set of protocols for accessing information directories. LDAP is based on the standards contained within the X.500 standard, but is significantly simpler. Unlike X.500, LDAP supports TCP/IP, which is necessary for any type of Internet access. Although not yet widely implemented, LDAP should eventually make it possible for almost any application running on virtually any computer platform to obtain directory information, such as e-mail addresses and public keys. Because LDAP is an open protocol, applications need not worry about the type of server hosting the directory.

Learning. The bridge examines the Layer 2 source addresses of every frame on the attached networks (called listening) and then maintains

a table, or cache, of which MAC addresses are attached to each of its ports.

Link-State. In routing protocols, the declared information about the available interfaces and available neighbors of a router or network. The protocol's topological database is formed from the collected link-state declarations.

LLDP. The IEEE 802.1AB standard for link layer discovery in Ethernet networks provides a method for switches, routers and access points to advertise their identification, configuration and capabilities to neighboring devices that store the data in a MIB (management information base). Link layer discovery allows a network management system to model the topology of the network by interrogating the MIB databases in the devices.

Local Area Network. A group of computers that are located in one area and are connected by less than 1,000 feet of cable. A typical LAN might interconnect computers and peripherals on a single floor or in a single building. LANs can be connected together, but if modems and telephones connect two or more LANs, the larger network constitutes what is called a WAN or Wide Area Network.

M

MAC. (1) Medium Access Control. In LANs, the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control (LLC) sublayer. The MAC sublayer includes the method of determing when a device has access to the transmission medium. (2) Message Authentication Code. In computer security, a value that is a part of a message or accompanies a message and is used to determine that the contents, origin, author, or other attributes of all or part of the message are as they appear to be. (*IBM Glossary of Computing Terms*)

Management Information Base.

When SNMP devices send SNMP messages to the management console (the device managing SNMP messages), it stores information in the MIB.

MBONE. See “Multicast Backbone” on page 731.

MDC. Management Data Clock.

MDI. Management Data Interface.

MDIO. Management Data Input/ Output.

MDIX. Management Dependent Interface Crossover.

MIB. See “Management Information Base” on page 730.

MOSPF. See “Multicast OSPF” on page 731.

MPLS. See “Multi-Protocol Label Switching” on page 731.

Multicast Backbone. The MBONE is a virtual network. It is layered on top of portions of the physical Internet to support routing of IP multicast packets since that function has not yet been integrated into many production routers. The network is composed of islands that can directly support IP multicast, such as multicast LANs like Ethernet, linked by virtual point-to-point links called "tunnels". The tunnel endpoints are typically workstation-class machines having operating system support for IP multicast and running the "mrouted" multicast routing daemon.

Multicasting. To transmit a message to specific recipients across a network. A simple example of multicasting is sending an e-mail message to a mailing list. Teleconferencing and videoconferencing also use multicasting, but require more robust protocols and networks. Standards are being developed to support multicasting over a TCP/IP network such as the Internet. These standards, IP Multicast and Mbone, will allow users to easily join multicast groups. Note that multicasting refers to sending a message to a select group whereas broadcasting refers to sending a message to everyone connected to a network. The terms multicast and narrowcast are often used interchangeably, although narrowcast usually refers to the business model whereas multicast refers to the actual technology used to transmit the data.

Multicast OSPF. With a MOSPF specification, an IP Multicast packet is routed based both on the packet's source and its multicast destination (commonly referred to as source/destination routing). As it is routed, the multicast packet follows a shortest path to each multicast destination. During packet forwarding, any commonality of paths is exploited; when multiple hosts belong to a single multicast group, a multicast packet will be replicated only when the paths to the separate hosts diverge. See “OSPF” on page 733 for more information.

Multiplexing. A function within a layer that interleaves the information from multiple connections into one connection.

Multi-Protocol Label Switching.

An initiative that integrates Layer 2 information about network links (bandwidth, latency, utilization) into Layer 3 (IP) within a particular autonomous system—or ISP—in order to simplify and improve IP-

packet exchange. MPLS gives network operators a great deal of flexibility to divert and route traffic around link failures, congestion, and bottlenecks. From a QoS standpoint, ISPs will better be able to manage different kinds of data streams based on priority and service plan. For instance, those who subscribe to a premium service plan, or those who receive a lot of streaming media or high-bandwidth content can see minimal latency and packet loss. When packets enter into a MPLS-based network, Label Edge Routers (LERs) give them a label (identifier). These labels not only contain information based on the routing table entry (i.e., destination, bandwidth, delay, and other metrics), but also refer to the IP header field (source IP address), Layer 4 socket number information, and differentiated service. Once this classification is complete and mapped, different packets are assigned to corresponding Labeled Switch Paths (LSPs), where Label Switch Routers (LSRs) place outgoing labels on the packets. With these LSPs, network operators can divert and route traffic based on data-stream type and Internet-access customer.

MT-RJ connector. A type of fiber-optic cable jack that is similar in shape and concept to a standard telephone jack, enabling duplex fiber-optic cables to be plugged into compatible devices as easily as plugging in a telephone cable.

MUX. See “Multiplexing” on page 731.

N

NAT. See “Network Address Translation” on page 732.

Network Address Translation.

Sometimes referred to as Transparent Proxying, IP Address Overloading, or IP Masquerading. Involves use of a device called a Network Address Translator, which assigns a contrived, or logical, IP address and port number to each node on an organization's internal network and passes packets using these assigned addresses.

NM. Network Module.

nm. Nanometer (1 x $10e^9$) meters.

non-stub area. Resource-intensive OSPF area that carries a default route, static routes, intra-area routes, interarea routes, and external routes. Non-stub areas are the only OSPF areas that can have virtual links configured across them, and are the only areas that can contain an ASBR. Compare with stub area. See also ASAM and OSPF. (Cisco Systems Inc.)

NP. Network Processor.

O

Open Shortest Path First. A link-state (algorithm used by the router to determine the current topology of a network), Interior Gateway (distributes routing information between routers belonging to a single Autonomous System) routing protocol. This protocol's algorithm determines the shortest path from its router to all the other routers in the network. This protocol is rapidly replacing RIP on the Internet.

Open Systems Interconnection.

OSI is a seven (7) layer architecture model for communications systems developed by the ISO for the interconnection of data communications systems. Each layer uses and builds on the services provided by those below it.

Operating System Application Programming Interface. OSAPI is a module within the System Support software that provides a set of interfaces to OS support functions.

OS. Operating System.

OSAPI. See “Operating System Application Programming Interface” on page 733.

OSI. See “Open Systems Interconnection” on page 733.

OSPF. See “Open Shortest Path First” on page 733.

P

PDU. See “Protocol Data Unit” on page 734.

PHY. The OSI Physical Layer: The physical layer provides for transmission of cells over a physical medium connecting two ATM devices. This physical layer is comprised of two sublayers: the Physical Medium Dependent (PMD) sublayer, and the Transmission Convergence (TC) sublayer.

PIM-DM. See “Protocol Independent Multicast – Dense Mode” on page 734.

PMC. Packet Mode Channel.

Port Mirroring. Also known as a roving analysis port. This is a method of monitoring network traffic that forwards a copy of each incoming and outgoing packet from one port of a network switch to another port where the packet can be studied. A network administrator uses port mirroring as a diagnostic tool or debugging feature, especially when fending off an attack. It enables the administrator to keep close track of switch performance and alter it if necessary. Port mirroring can be managed locally or remotely. An administrator configures port mirroring by assigning a port from which to copy all packets and another port where those packets will be sent. A packet bound for or heading away from the

first port will be forwarded onto the second port as well. The administrator places a protocol analyzer on the port receiving the mirrored data to monitor each segment separately. The analyzer captures and evaluates the data without affecting the client on the original port. The monitor port may be a port on the same SwitchModule with an attached RMON probe, a port on a different SwitchModule in the same hub, or the SwitchModule processor. Port mirroring can consume significant CPU resources while active. Better choices for long-term monitoring may include a passive tap like an optical probe or an Ethernet repeater.

Protocol Data Unit. PDU is a packet of data passed across a network. The term implies a specific layer of the OSI model and a specific protocol.

Protocol Independent Multicast – Dense Mode. Like DVMRP, PIM-DM uses a flood and prune protocol for building multicast trees. However, unlike DVMRP, PIM-DM uses existing unicast protocols for determing the route to the source.

Q

QoS. See “Quality of Service” on page 734.

Quality of Service. QoS is a networking term that specifies a guaranteed level of throughput. Throughput is the amount of data transferred from one device to another or processed in a specified amount of time - typically, throughputs are measured in bytes per second (Bps).

R

Real-Time Operating System.

RTOS is a component of the OSAPI module that abstracts operating systems with which other systems can interface.

Resource Reservation Setup Protocol. RSVP is a new Internet protocol being developed to enable the Internet to support specified Qualities-of-Service (QoS). Using RSVP, an application will be able to reserve resources along a route from source to destination. RSVP-enabled routers will then schedule and prioritize packets to meet the prioritization assigned by QoS. RSVP is a chief component of a new type of Internet being developed, known broadly as an integrated services Internet. The general idea is to enhance the Internet to support transmission of real-time data.

RFC. Request For Comment.

RIP. See “Routing Information Protocol” on page 734.

Routing Information Protocol.

RIP is the routing protocol used by the routed process on Berkeley-

derived UNIX systems. Many networks use RIP; it works well for small, isolated, and topologically simple networks.

RIPng. Routing Information Protocol, new generation.

RMON. Short for remote monitoring, a network management protocol that allows network information to be gathered at a single workstation. Whereas SNMP gathers network data from a single type of Management Information Base (MIB), RMON 1 defines nine additional MIBs that provide a much richer set of data about network usage. For RMON to work, network devices, such as hubs and switches, must be designed to support it. The newest version of RMON, RMON 2, provides data about traffic at the network layer in addition to the physical layer. This allows administrators to analyze traffic by protocol.

RP. Rendezvous Point. Used with IP Multicast.

RPU. Remote Power Unit.

RSVP. See “Resource Reservation Setup Protocol” on page 734.

RTOS. See “Real-Time Operating System” on page 734.

S

SDL. Synchronous Data Link.

Simple Network Management Protocol. SNMP is the protocol governing network management and the monitoring of network devices and their functions. It is not necessarily limited to TCP/IP networks. The versions have the following differences:

SNMPv1 (full): Security is based on community strings.

SNMPsec (historic): Security is based on parties. Few, if any, vendors implemented this version of the protocol, which is now largely forgotten.

SNMPv2p (historic): For this version, much work was done to update the SNMPv1 protocol and the SMIv1, and not just security. The result was updated protocol operations, new protocol operations and data types, and party-based security from SNMPsec.

SNMPv2c (experimental): This version of the protocol is called community string-based SNMPv2. It is an update of the protocol operations and data types of SNMPv2p, and uses community-based security from SNMPv1.

SNMPv2u (experimental): This version of the protocol uses the protocol operations and data types of SNMPv2c and security based on users.

*SNMPv2** (experimental): This version combined the best features

of SNMPv2p and SNMPv2u. (It is also called SNMPv2star.) The documents defing this version were never published as RFCs.

SNMPv3 (proposed): This version of the protocol is a combination of user-based security and the protocol operations and data types from SNMPv2p and support for proxies. The security is based on that found in SNMPv2u and SNMPv2*, and updated after much review. The documents defing this protocol will soon be published as RFCs.

SimpleX signaling. SX is one of IEEE 802.3's designations for media. For example, 1000SX indicates 1000 Gigabit Ethernet over "short haul" or "short wavelength" optical fiber.

SMC1. A model of Serial Management Controller from Motorola.

SMII. Serial Media Independent Interface.

SNMP. See “Simple Network Management Protocol” on page 735.

SODIMM. Small Outline Dual Inline Memory Module.

SRAM. Static Random Access Memory.

STP. Spanning Tree Protocol. See “802.1D” on page 721 for more information.

stub area. OSPF area that carries a default route, intra-area routes, and interarea routes, but does not carry external routes. Virtual links cannot be configured across a stub area, and they cannot contain an ASBR. Compare with non-stub area. See also ASAM and OSPF. (Cisco Systems Inc.)

SX. See “SimpleX signaling” on page 736.

SYSAPI. See “Systems Application Programming Interface” on page 736.

Systems Application Programming Interface. SYSAPI is a module within the System Support software that provides system-wide routines for network and mbuf support and provides the interface into the system registry.

T

TBI. Ten Bit Interface.

Telnet. A character-based UNIX application that enables users with a Telnet server account to log on to a UNIX computer and utilize its resources.

TFTP. See “Trivial File Transfer Protocol” on page 736.

Trivial File Transfer Protocol.

TFTP is a simple form of the File Transfer Protocol (FTP). TFTP uses the User Datagram Protocol (UDP, a

direct protocol used to communicate datagrams over a network with little error recovery) and provides no security features. It is often used by servers to boot diskless workstations, X-terminals, and routers.

Trunking. The process of combing a set of trunks that are traffic-engineered as a unit for the establishment of connections between switching systems in which all of the communications paths are interchangeable.

U

UPM. User Programmable Machine.

UPMA. The first of two UPMs in Motorola's MPC855T processor.

UPMB. The second of two UPMs in Motorola's MPC855T processor.

USP. An abbreviation that represents Unit, Slot, Port.

V

Virtual Local Area Network.

Operating at the Data Link Layer (Layer 2 of the OSI model), the VLAN is a means of parsing a single network into logical user groups or organizations, as if they physically resided on a dedicated LAN segment of their own. In reality, this virtually defined community may have individual members peppered across a large, extended LAN. The VLAN identifier is part of the 802.1Q tag, which is added to an Ethernet frame by an 802.1Q-compliant switch or router. Devices recognizing 802.1Q-tagged frames maintain appropriate tables to track VLANs. The first three bits of the 802.1Q tag are used by 802.1P to establish priority for the packet.

Virtual Router Redundancy Protocol. VRRP specifies an election protocol that dynamically assigns responsibility for a virtual router to one of the VRRP routers on a LAN. The VRRP router controlling the IP address(es) associated with a virtual router is called the Master, and forwards packets sent to these IP addresses. The election process provides dynamic fail-over in the forwarding responsibility should the Master become unavailable. This allows any of the virtual router IP addresses on the LAN to be used as the default first hop router by end-hosts. The advantage gained from using VRRP is a higher availability default path without requiring configuration of dynamic routing or router discovery protocols on every end-host.

VLAN. See “Virtual Local Area Network” on page 737.

vMAN. Virtual Metropolitan Area Network.

VRRP. See “Virtual Router Redundancy Protocol” on page 737.

W

WAN. See “Wide Area Network” on page 738.

Web. Also known as World-Wide Web (WWW) or W3. An Internet client-server system to distribute information, based upon the hypertext transfer protocol (HTTP).

Wide Area Network. A WAN is a computer network that spans a relatively large geographical area. Typically, a WAN consists of two or more local-area networks (LANs).

X

X.500. A directory standard that enables applications like e-mail to access information that can either be central or distributed. The benefit of a directory is the ability to minimize the impact on the user of changes to a network. The standard is broken down under subsequent standards, as follows:

X.501 Models

X.509 Authentication framework

X.511 Abstract service definition

X.518 Procedures for distributed operation

X.519 Protocol specifications

X.520 Selected attribute types

X.521 Selected object types

XModem. One of the most popular file transfer protocols (FTPs). Xmodem is fairly effective at detecting errors. It sends blocks of data together with a checksum and then waits for acknowledgment of the block's receipt. The waiting slows down the rate of data transmission considerably, but it ensures accurate transmission. Xmodem can be implemented either in software or in hardware. Many modems, and almost all communications software packages, support Xmodem. However, it is useful only at relatively slow data transmission speeds (less than 4,800 bps). Enhanced versions of Xmodem that work at higher transmission speeds are known as Ymodem and Zmodem.

Further support

Technical Questions

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User Manual

Basic Configuration
Industrial ETHERNET (Gigabit-)Switch
PowerMICE, MACH 4000

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Contents

Safety Information

⚠ WARNING

UNCONTROLLED MACHINE ACTIONS
To avoid uncontrolled machine actions caused by data loss, configure all the data transmission devices individually.
Before you start any machine which is controlled via data transmission, be sure to complete the configuration of all data transmission devices.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

About this Manual

The “Basic Configuration” user manual contains the information you need to start operating the device. It takes you step by step from the first startup operation through to the basic settings for operation in your environment.

The following thematic sequence has proven itself in practice:

- Set up device access for operation by entering the IP parameters
- Check the status of the software and update it if necessary
- Load/store any existing configuration
- Configure the ports
- Set up protection from unauthorized access
- Optimize the data transmission with network load control
- Synchronize system time in the network
- Perform an operation diagnosis
- Store the newly created configuration in the non-volatile memory

The “Installation” user manual contains a device description, safety instructions, a description of the display, and the other information that you need to install the device.

The “Redundancy Configuration” user manual document contains the information you require to select the suitable redundancy procedure and configure it.

The “Industry Protocols” user manual describes how the device is connected by means of a communication protocol commonly used in the industry, such as EtherNet/IP and PROFINET IO.

The “Routing Configuration User Manual” document contains the information you need to start operating the routing function. It takes you step-by-step from a small router application through to the router configuration of a complex network.
The manual enables you to configure your router by following the examples.

The “GUI” reference manual contains detailed information on using the graphical interface to operate the individual functions of the device.

The “Command Line Interface” reference manual contains detailed information on using the Command Line Interface to operate the individual functions of the device.

The Industrial HiVision network management software provides you with additional options for smooth configuration and monitoring:

- ActiveX control for SCADA integration
- Auto-topology discovery
- Browser interface
- Client/server structure
- Event handling
- Event log
- Simultaneous configuration of multiple devices
- Graphical user interface with network layout
- SNMP/OPC gateway

Maintenance

Hirschmann are continually working on improving and developing their software. Check regularly whether there is an updated version of the software that provides you with additional benefits. You find information and software downloads on the Hirschmann product pages on the Internet (www.hirschmann.com).

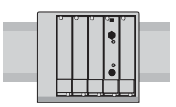
Key

The designations used in this manual have the following meanings:

▶	List
☐	Work step
■	Subheading
Link	Cross-reference with link
Note:	A note emphasizes an important fact or draws your attention to a dependency.
`Courier`	ASCII representation in the graphical user interface
	Execution in the Graphical User Interface
	Execution in the Command Line Interface

Symbols used:

	WLAN access point
	Router with firewall
	Switch with firewall
	Router
	Switch

	Bridge
	Hub
	A random computer
	Configuration Computer
	Server
	PLC - Programmable logic controller
	I/O - Robot

Introduction

The device has been developed for use in a harsh industrial environment. Accordingly, the installation process has been kept simple. Thanks to the selected default settings, you only have to enter a few settings before starting to operate the device.

Note: The changes you make in the dialogs are copied into the volatile memory of the device when you click on "Set".
To save the changes to the device into permanent memory, select the saving location in the `Basic Settings:Load/Save` dialog box and click on "Save".

1 Access to the user interfaces

The device has 3 user interfaces, which you can access via different interfaces:

- System monitor via the V.24 interface (out-of-band)
- Command Line Interface (CLI) via the V.24 connection (out-of-band) as well as Telnet or SSH (in-band)
- Graphical User Interface via Ethernet (in-band).

1.1 System Monitor

The system monitor enables you to

- select the software to be loaded
- perform a software update
- start the selected software
- shut down the system monitor
- delete the configuration saved and
- display the boot code information.

Starting the System Monitor

Prerequisites

- Terminal cable for connecting the device to your PC (available as an optional accessory).
- PC with VT100 terminal emulation (such as PuTTY) or serial terminal

Perform the following work steps:

☐ Use the terminal cable to connect the V.24 port of the device with the “COM” port of the PC.
☐ Start the VT100 terminal emulation on the PC.
☐ Define the following transmission parameters:
  – Speed: 9600 Baud
  – Data: 8 bit
  – Parity: None
  – Stopbit: 1 bit
  – Flow control: None

Speed	9600 Baud
Data	8 bit
Parity	None
Stopbit	1 bit
Handshake	Off

Table 1: Data transfer parameters

☐ Start the terminal program on the PC and set up a connection with the device.

When you boot the device, the message
"Press <1> to enter System Monitor 1"
appears on the terminal.

```
< Device Name  (Boot) Release: 1.00 Build: 2005-09-17 15:36 >

Press <1> to enter System Monitor 1 ...
 1
```

Figure 1: Screen display during the boot process

☐ Press the <1> key within one second to start system monitor 1.

```
System Monitor

(Selected OS: L3P-06.0.00 (2010-09-09 09:09))

1  Select Boot Operating System
2  Update Operating System
3  Start Selected Operating System
4  End (reset and reboot)
5  Erase main configuration file




sysMon1>
```

Figure 2: System monitor 1 screen display

☐ Select a menu item by entering the number.
☐ To leave a submenu and return to the main menu of system monitor 1, press the <ESC> key.

1.2 Command Line Interface

The Command Line Interface enables you to use the functions of the device via a local or remote connection.
The Command Line Interface provides IT specialists with a familiar environment for configuring IT devices.
The script compatibility of the Command Line Interface enables you, among other things, to feed multiple devices with the same configuration data, to create and use partial configurations, or to compare 2 configurations using 2 script files.

You will find a detailed description of the Command Line Interface in the “Command Line Interface” reference manual.

You can access the Command Line Interface via:

- the V.24 port (out-of-band)
- Telnet (in-band)
- SSH (in-band)

Note: To facilitate making entries, the CLI gives you the option of abbreviating keywords. Type in the beginning of a keyword. When you press the tab key, the CLI finishes the keyword.

Opening the Command Line Interface

☐ Connect the device to a terminal or to a “COM” port of a PC using terminal emulation based on VT100, and press any key (see on page 18 “System Monitor”) or
call up the Command Line Interface via Telnet.
A window for entering the user name appears on the screen.
Up to 5 users can access the Command Line Interface.

```
        Copyright (c) 2004-2010 Hirschmann Automation and Control GmbH

                             All rights reserved

                          PowerMICE Release L3P-06.0.00

                          (Build date 2010-09-09 12:13)



                        System Name:   PowerMICE
                        Mgmt-IP     :  10.0.1.105
                        1.Router-IP:   0.0.0.0
                        Base-MAC    :  00:80:63:51:74:00
                        System Time:   2010-09-09 13:14:15


User:
```

Figure 3: Logging in to the Command Line Interface program

☐ Enter a user name. The default setting for the user name is **admin** .
Press the Enter key.

☐ Enter the password. The default setting for the password is **private** .
Press the Enter key.
You can change the user name and the password later in the Command Line Interface.
Please note that these entries are case-sensitive.

The start screen appears.

```
NOTE: Enter '?' for Command Help. Command help displays all options
      that are valid for the 'normal' and 'no' command forms.  For
      the syntax of a particular command form, please consult the
      documentation.


(Hirschmann Product) >
```

Figure 4: CLI screen after login

1.3 Graphical User Interface

The graphical user Interface (GUI) allows you to conveniently define and monitor the settings of the device from a computer on the network.

You reach the graphical user interface (GUI) with the following programs:
- HiView
- Web browser

System requirements

Use HiView to open the graphical user interface. This application offers you the possibility to use the graphical user interface without other applications such as a Web browser or an installed Java Runtime Environment (JRE).

Alternatively you have the option to open the graphical user interface in a Web browser, e.g. in Mozilla Firefox version 3.5 or higher or Microsoft Internet Explorer version 6 or higher. You need to install the Java Runtime Environment (JRE) in the most recently released version. You can find installation packages for your operating system at http://java.com.

Starting the graphical user interface

The prerequisite for starting the graphical user interface, first configure the IP parameters of the device correctly.

Starting the graphical user interface in HiView:

☐ Start HiView.

☐ In the URL field of the start window, enter the IP address of your device.

☐ Click "Open".

HiView sets up the connection to the device and displays the login window.

Start the graphical user interface in the Web browser:

– This requires that Java is enabled in the security settings of your Web browser.

☐ Start your Web browser.

☐ Write the IP address of the device in the address field of the Web browser. Use the following form: `https://xxx.xxx.xxx.xxx`

The Web browser sets up the connection to the device and displays the login window.

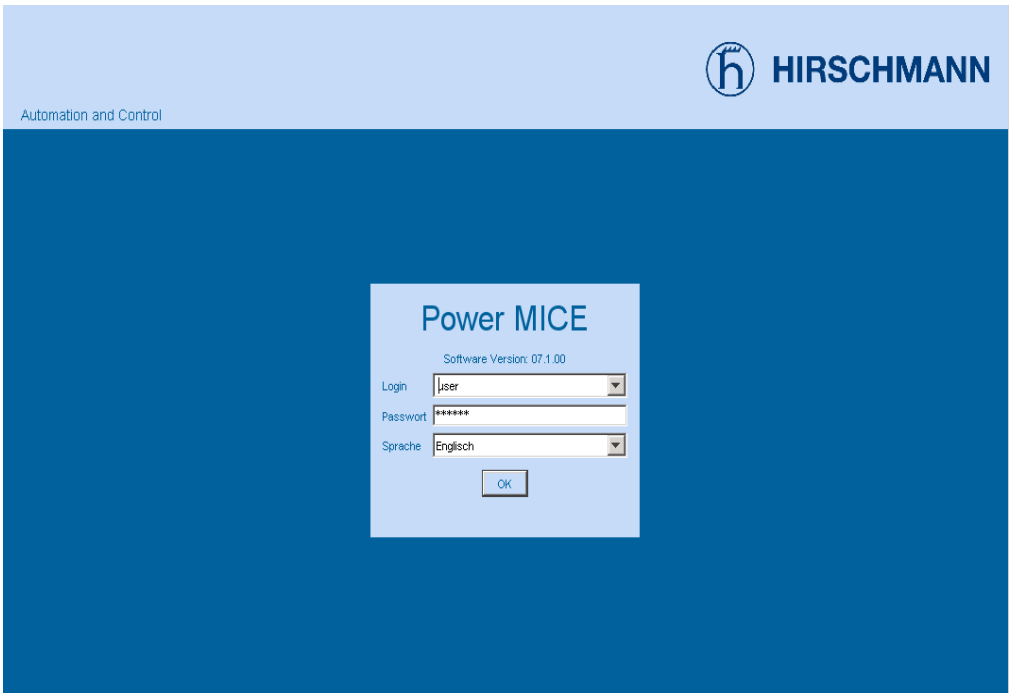


Figure 5: Login window

☐ Select the user name and enter the password.
  – Select the user name `user` to have read access to the device.
  – Select the user name `admin` to have read and write access to the device.

☐ Select the language in which you want to use the graphical user interface.

☐ Click "Ok".

The Web browser displays the graphical user interface.

2 Entering the IP Parameters

When you install the device for the first time enter the IP parameters.

The device provides the following options for entering the IP parameters during the first installation:

- Entry using the Command Line Interface (CLI).
  You choose this “out of band” method if
  - you preconfigure your device outside its operating environment, or
  - you need to restore network access (“in-band”) to the device
- Entry using the HiDiscovery protocol.
  You choose this “in-band” method on a previously installed network device or if you have another Ethernet connection between your PC and the device
- Configuration using the AutoConfiguration Adapter (ACA).
  You choose this method if you are replacing a device with a device of the same type and have already saved the configuration on anACA.
- Using BOOTP.
  You choose this “in-band” method to configure the installed device using BOOTP. You need a BOOTP server for this method. The BOOTP server assigns the configuration data to the device using its MAC address. The DHCP mode is the default mode for the configuration data reference, set the parameter to the BOOTP mode for this method.
- Configuration via DHCP.
  You choose this “in-band” method to configure the installed device using DHCP. You need a DHCP server for this method. The DHCP server assigns the configuration data to the device using its MAC address or its system name.

- Configuration via DHCP Option 82.
  You choose this “in-band” method if you want to configure the installed device using DHCP Option 82. You need a DHCP server with Option 82 for this. The DHCP server assigns the configuration data to the device using its physical connection (see on page 51 “System Configuration via DHCP Option 82”).
- Configuration using the graphical user interface.
  If the device already has an IP address and is reachable via the network, then the graphical user interface provides you with another option for configuring the IP parameters.

2.1 IP Parameter Basics

2.1.1 IP Address (Version 4)

The IP addresses consist of 4 bytes. These 4 bytes are written in decimal notation, separated by a decimal point.

Since 1992, five classes of IP address have been defined in the RFC 1340.

Class	Network address	Host address	Address range
A	1 byte	3 bytes	0.0.0.0 to 127.255.255.255
B	2 bytes	2 bytes	128.0.0.0 to 191.255.255.255
C	3 bytes	1 byte	192.0.0.0 to 223.255.255.255
D			224.0.0.0 to 239.255.255.255
E			240.0.0.0 to 255.255.255.255

Table 2: IP address classes

The network address is the fixed part of the IP address. The worldwide leading regulatory board for assigning network addresses is the IANA (Internet Assigned Numbers Authority). If you require an IP address block, contact your Internet service provider. Internet service providers should contact their local higher-level organization:

- APNIC (Asia Pacific Network Information Center) - Asia/Pacific Region
- ARIN (American Registry for Internet Numbers) - Americas and Sub-Sahara Africa
- LACNIC (Regional Latin-American and Caribbean IP Address Registry) – Latin America and some Caribbean Islands
- RIPE NCC (Réseaux IP Européens) - Europe and Surrounding Regions

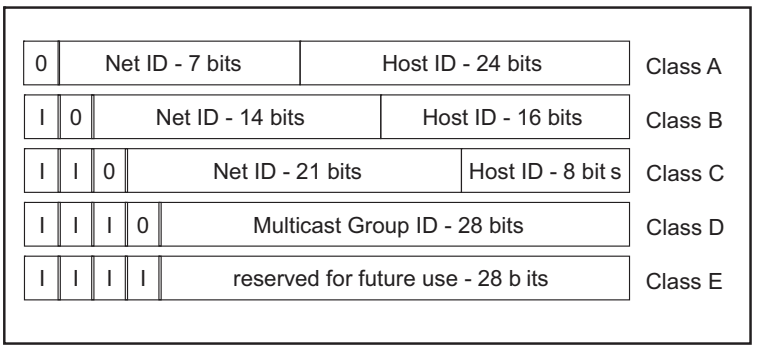


Figure 6: Bit representation of the IP address

All IP addresses belong to class A when their first bit is a zero, i.e. the first decimal number is less than 128.
The IP address belongs to class B if the first bit is a one and the second bit is a zero, i.e. the first decimal number is between 128 and 191.
The IP address belongs to class C if the first two bits are a one, i.e. the first decimal number is higher than 191.

Assigning the host address (host ID) is the responsibility of the network operator. He alone is responsible for the uniqueness of the IP addresses he assigns.

2.1.2 Netmask

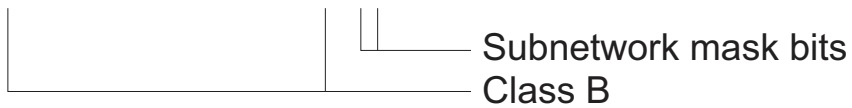
Routers and gateways subdivide large networks into subnetworks. The netmask assigns the IP addresses of the individual devices to a particular subnetwork.

The division into subnetworks with the aid of the netmask is performed in much the same way as the division of the network addresses (net id) into classes A to C.

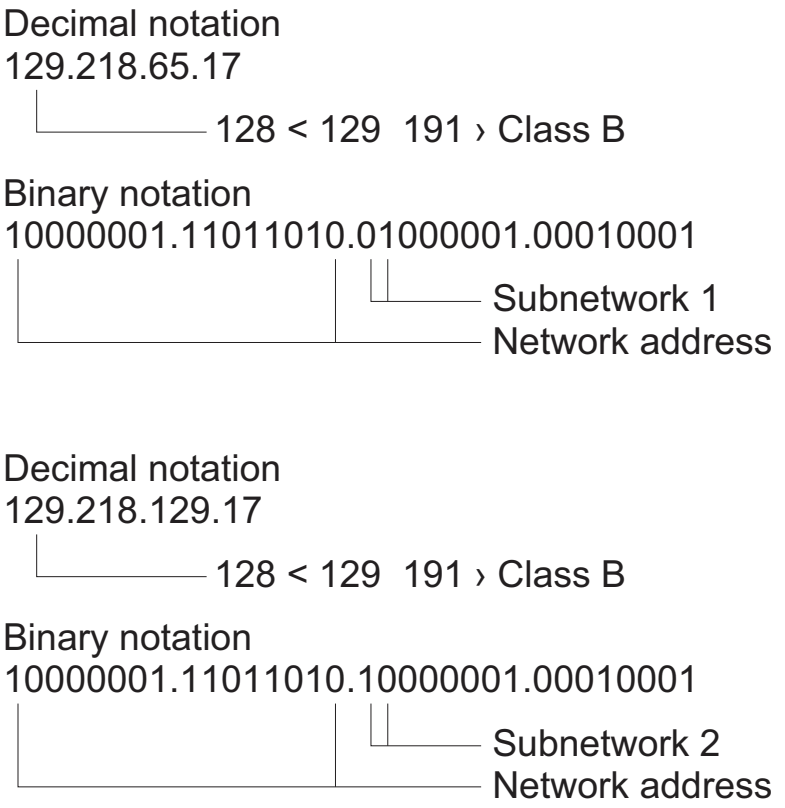
The bits of the host address (host id) that represent the mask are set to one. The remaining bits of the host address in the netmask are set to zero (see the following examples).
Example of a netmask:

Decimal notation
255.255.192.0

Binary notation
11111111.11111111.11000000.00000000



Example of IP addresses with subnetwork assignment when the above subnet mask is applied:


Decimal notation
129.218.65.17
128 < 129 191 › Class B
Binary notation
10000001.11011010.01000001.00010001
Subnetwork 1
Network address
Decimal notation
129.218.129.17
128 < 129 191 › Class B
Binary notation
10000001.11011010.10000001.00010001
Subnetwork 2
Network address

Example of how the network mask is used

In a large network it is possible that gateways and routers separate the management agent from its management station. How does addressing work in such a case?

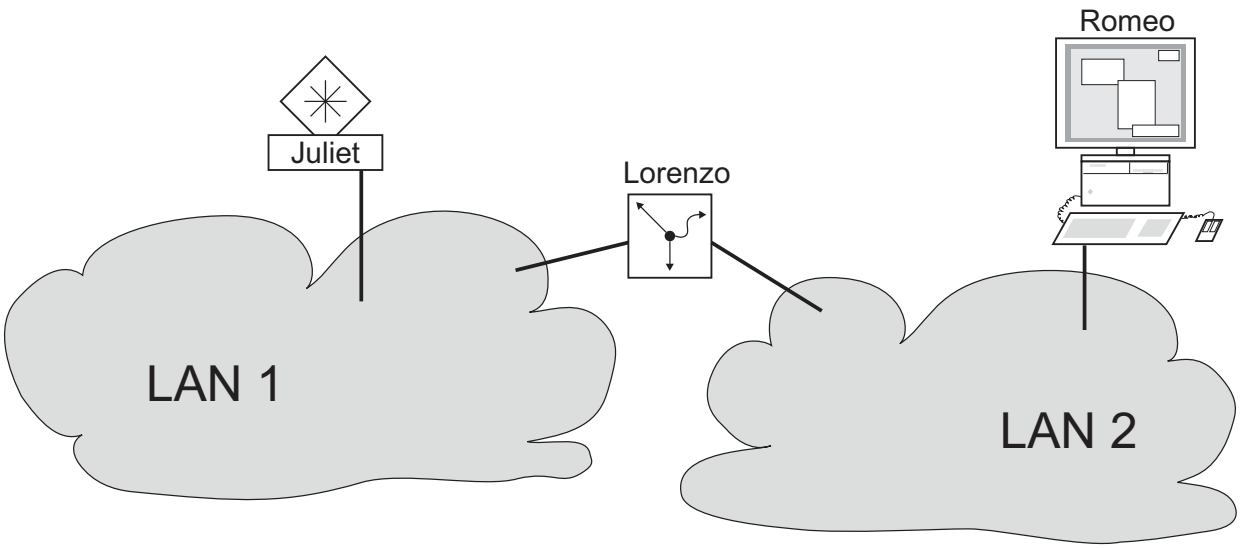


Figure 7: Management agent that is separated from its management station by a router

The management station "Romeo" wants to send data to the management agent "Juliet". Romeo knows Juliet's IP address and also knows that the router "Lorenzo" knows the way to Juliet.

Romeo therefore puts his message in an envelope and writes Juliet's IP address as the destination address. For the source address he writes his own IP address on the envelope.

Romeo then places this envelope in a second one with Lorenzo's MAC address as the destination and his own MAC address as the source. This process is comparable to going from layer 3 to layer 2 of the ISO/OSI base reference model.

Finally, Romeo puts the entire data packet into the mailbox. This is comparable to going from layer 2 to layer 1, i.e. to sending the data packet over the Ethernet.

Lorenzo receives the letter and removes the outer envelope. From the inner envelope he recognizes that the letter is meant for Juliet. He places the inner envelope in a new outer envelope and searches his address list (the ARP table) for Juliet's MAC address. He writes her MAC address on the outer envelope as the destination address and his own MAC address as the source address. He then places the entire data packet in the mail box.

Juliet receives the letter and removes the outer envelope. She finds the inner envelope with Romeo's IP address. Opening the inner envelope and reading its contents corresponds to transferring the message to the higher protocol layers of the SO/OSI layer model.

Juliet would now like to send a reply to Romeo. She places her reply in an envelope with Romeo's IP address as destination and her own IP address as source. But where is she to send the answer? For she did not receive Romeo's MAC address. It was lost when Lorenzo replaced the outer envelope.

In the MIB, Juliet finds Lorenzo listed under the variable hmNetGatewayIPAddr as a means of communicating with Romeo. She therefore puts the envelope with the IP addresses in a further envelope with Lorenzo's MAC destination address.

The letter now travels back to Romeo via Lorenzo, the same way the first letter traveled from Romeo to Juliet.

2.1.3 Classless Inter-Domain Routing

Class C with a maximum of 254 addresses was too small, and class B with a maximum of 65,534 addresses was too large for most users. This resulted in ineffective usage of the class B addresses available.
Class D contains reserved multicast addresses. Class E is reserved for experimental purposes. A gateway not participating in these experiments ignores datagrams with these destination addresses.

Since 1993, RFC 1519 has been using Classless Inter-Domain Routing (CIDR) to provide a solution. CIDR overcomes these class boundaries and supports classless address ranges.

With CIDR, you enter the number of bits that designate the IP address range. You represent the IP address range in binary form and count the mask bits that designate the netmask. The netmask indicates the number of bits that are identical to the network part for the IP addresses in a given address range. Example:

IP address, decimal	Network mask, decimal	IP address, binary
149.218.112.1	255.255.255.128	10010101 11011010 01110000 00000001
149.218.112.127		10010101 11011010 01110000 01111111

25 mask bits

CIDR notation: 149.218.112.0/25

Mask bits

The combination of a number of class C address ranges is known as “supernetting”. This enables you to subdivide class B address ranges to a very fine degree.

2.2 Entering IP parameters via CLI

If you do not configure the system via BOOTP/DHCP, DHCP Option 82, the HiDiscovery protocol or the AutoConfiguration Adapter ACA, then you perform the configuration via the V.24 interface using the CLI.

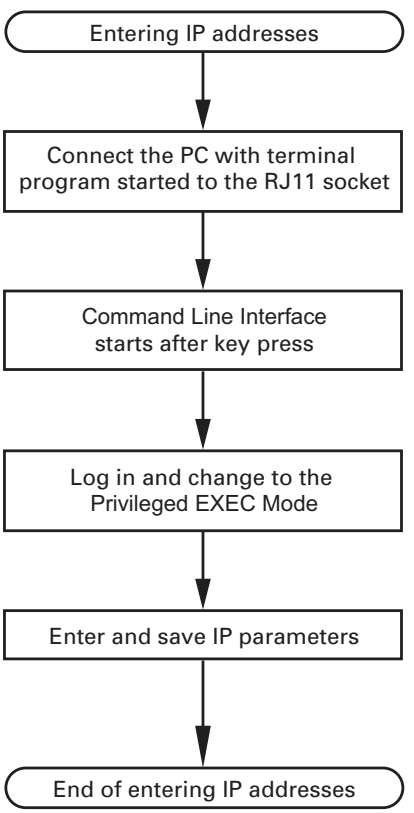


Figure 8: Flow chart for entering IP addresses

Note: If a terminal or PC with terminal emulation is unavailable in the vicinity of the installation location, you can configure the device at your own workstation, then take it to its final installation location.

☐ Set up a connection to the device (see on page 18 “Starting the System Monitor”).

The start screen appears.

```
NOTE: Enter '?' for Command Help. Command help displays all options
      that are valid for the 'normal' and 'no' command forms.  For
      the syntax of a particular command form, please consult the
      documentation.


(Hirschmann PowerMICE) >
```

☐ Deactivate DHCP.

☐ Enter the IP parameters.

- Local IP address
  On delivery, the device has the local IP address `0.0.0.0`.
- Netmask
  If you divided your network into subnetworks, and if these are identified with a netmask, then enter the netmask here.

The default setting of the netmask is `0.0.0.0`.

- IP address of the gateway.
  You require this entry when installing the device in a different subnetwork as the management station or TFTP server (see on page 33 “Example of how the network mask is used”).
  Enter the IP address of the gateway between the subnetwork with the device and the path to the management station.
  The default setting of the IP address is `0.0.0.0`.

☐ Save the configuration entered using
`copy system:running-config nvram:startup-config`.

`enable`	Switch to the privileged EXEC mode.
`network protocol none`	Deactivate DHCP.
`network parms 10.0.1.23 255.255.255.0`	Assign the device the IP address 10.0.1.23 and the netmask 255.255.255.0. You have the option of also assigning a gateway address.
`copy system:running-config nvram:startup-config`	Save the current configuration to the non-volatile memory.

After entering the IP parameters, you easily configure the device via the graphical user interface (see the “GUI” reference manual).

2.3 Entering the IP Parameters via HiDiscovery

The HiDiscovery protocol enables you to assign IP parameters to the device via the Ethernet.
You can easily configure other parameters via the graphical user interface (see the "GUI" Graphic User Interface reference manual).

Install the HiDiscovery software on your PC. The software is on the CD supplied with the device.

☐ To install it, you start the installation program on the CD.

☐ Start the HiDiscovery program.
When you start HiDiscovery, it automatically searches the network for those devices which support the HiDiscovery protocol.
HiDiscovery uses the first network interface found for the PC. If your computer has several network cards, you select the one you desire in the HiDiscovery toolbar.

HiDiscovery displays a line for every device that reacts to the HiDiscovery protocol.

HiDiscovery enables you to identify the devices displayed.
☐ Select a device line.
☐ Click the „Signal“ symbol on the tool bar to set the LEDs for the selected device to flashing on. To switch off the flashing, click on the symbol again.
☐ By double-clicking a line, you open a window in which you enter the device name and the IP parameters.

Note: When the IP address is entered, the device copies the local configuration settings (see on page 57 “Loading/saving settings”).

Note: For security reasons, switch off the HiDiscovery function for the device in the graphical user interface, after you have assigned the IP parameters to the device (see on page 52 “Graphical User Interface IP Configuration”).

Note: Save the settings so that you will still have the entries after a restart (see on page 57 “Loading/saving settings”).

2.4 Loading the system configuration from the ACA

The AutoConfiguration Adapter (ACA) is a device for

- for saving the device configuration data and
- saving the device software.

If a device becomes inoperative, the ACA allows you to transfer the configuration data to a replacement device of the same type.

When you start the device, it checks to see whether an ACA is present. If an ACA is present with a valid password and valid software, the device loads the configuration data from the ACA.

The password is valid if

- the entered password matches the password in the ACA, or
- the preset password in the device is entered.

To save the configuration data in the ACA, See 67 “Saving locally (and on the ACA)”.

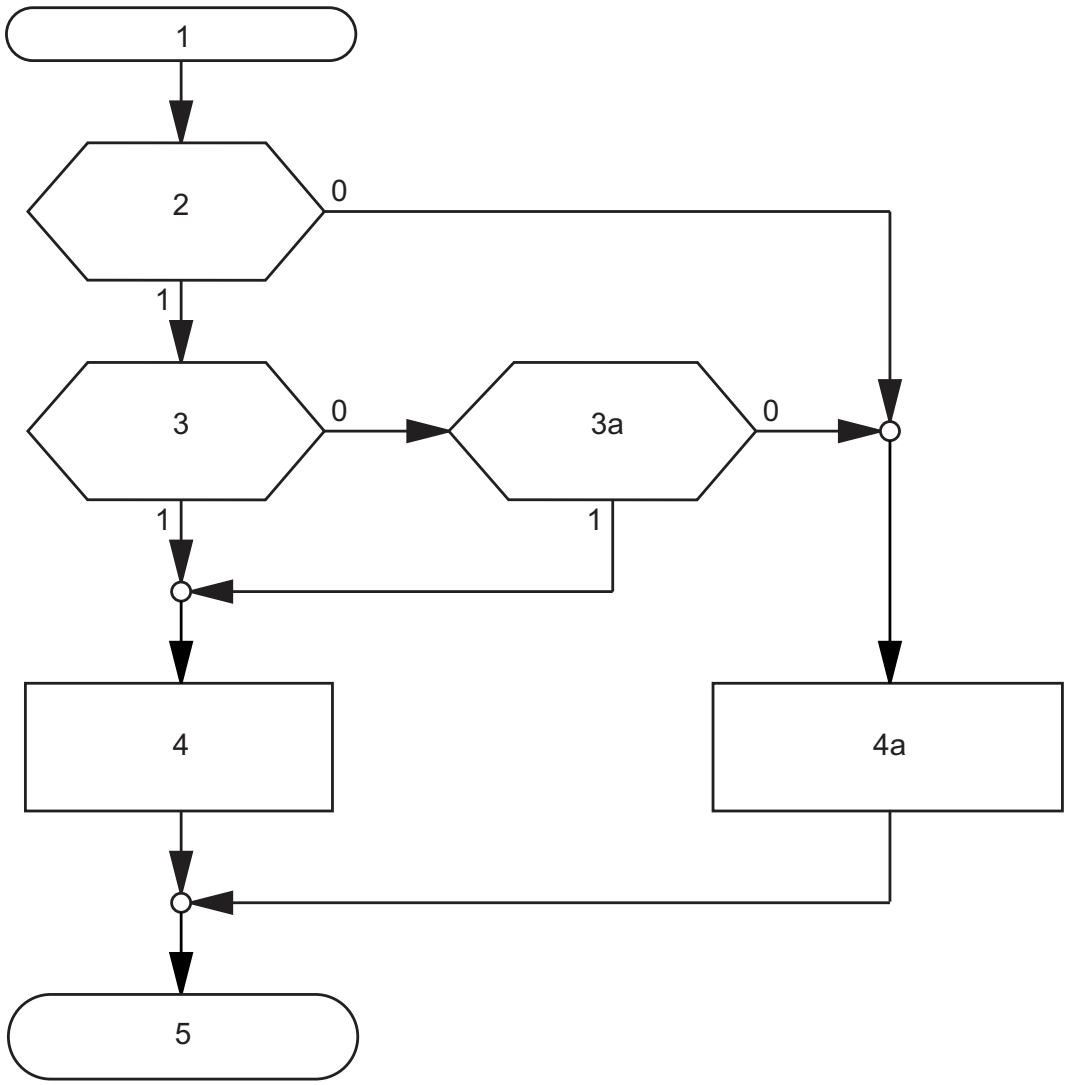


Figure 9: Flow chart of loading configuration data from the ACA
1 – Device start-up
2 – ACA plugged-in?
3 – Password in device and ACA identical?
3a – Default password in device?
4 – Load configuration from ACA,
ACA LEDs flashing synchronously
4a –Load configuration from local memory,
ACA LEDs flashing alternately
5 – Configuration data loaded

2.5 System configuration via BOOTP

When it is started up via BOOTP (bootstrap protocol), a device receives its configuration data in accordance with the “BOOTP process” flow chart (see figure 10).

Note: In its delivery state, the device gets its configuration data from the DHCP server.

☐ Activate BOOTP to receive the configuration data (see on page 52 “Graphical User Interface IP Configuration”), or see the CLI:

`enable`	Switch to the privileged EXEC mode.
`network protocol bootp`	Activate BOOTP.
`copy system:running-config nvram:startup-config`	Activate BOOTP.
`y`	Confirm save.

☐ Provide the BOOTP server with the following data for a device:

```
# /etc/bootptab for BOOTP-daemon bootpd
#
# gw -- gateway
# ha -- hardware address
# ht -- hardware type
# ip -- IP address
# sm -- subnet mask
# tc -- template

.global:\
:gw=0.0.0.0:\
:sm=255.255.240.0:
```

```
switch_01:ht=ethernet:ha=008063086501:ip=10.1.112.83:tc=.global:
switch_02:ht=ethernet:ha=008063086502:ip=10.1.112.84:tc=.global:
.
.
```

Lines that start with a '#' character are comment lines.

The lines under ".global:" make the configuration of several devices easier. With the template (tc) you allocate the global configuration data (tc=.global:) to each device .
The direct allocation of hardware address and IP address is performed in the device lines (switch-0...).

☐ Enter one line for each device.
☐ After ha= enter the hardware address of the device.
☐ After ip= enter the IP address of the device.

In the appendix, you will find an example for the configuration of a BOOTP/DHCP server.
See "Setting up a DHCP/BOOTP Server" on page 256.

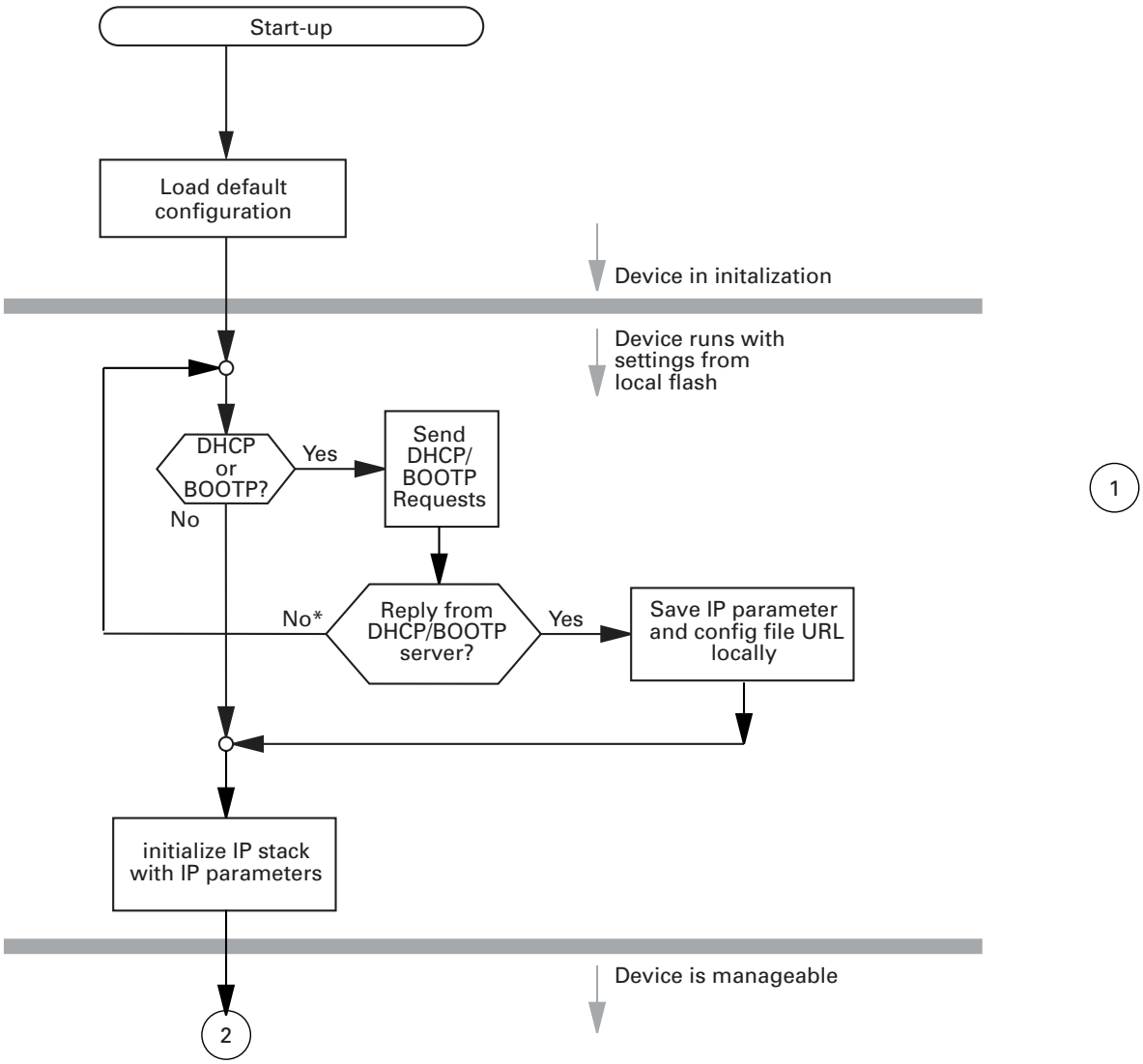


Figure 10: Flow chart for the BOOTP/DHCP process, part 1
** see note figure 11*

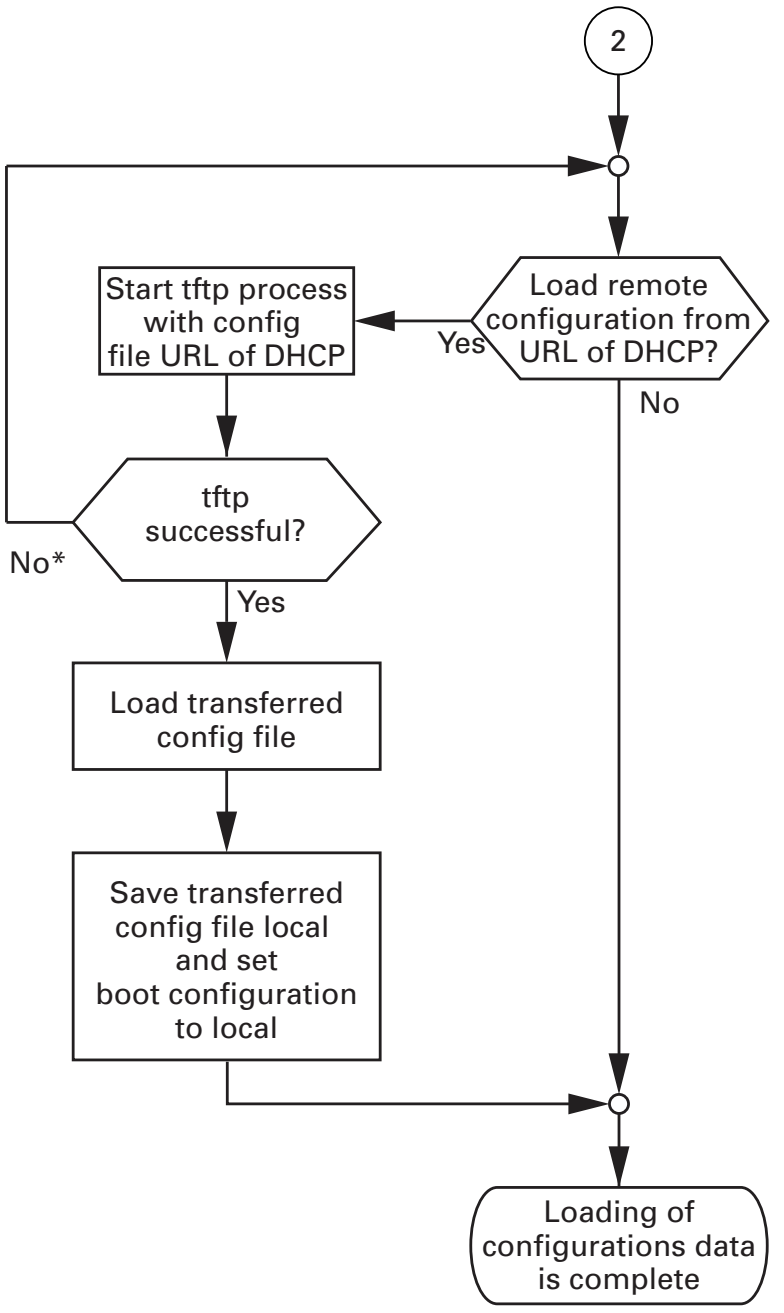


Figure 11: Flow chart for the BOOTP/DHCP process, part 2

Note: The loading process started by DHCP/BOOTP (see on page 43 “System configuration via BOOTP”) shows the selection of “from URL & save locally” in the “Load” frame. If you get an error message when saving a configuration, this could be due to an active loading process. DHCP/BOOTP only finishes a loading process when a valid configuration has been loaded. If DHCP/BOOTP does not find a valid configuration, then finish the loading process by loading the local configuration in the “Load” frame.

2.6 System Configuration via DHCP

The DHCP (Dynamic Host Configuration Protocol) is a further development of BOOTP, which it has replaced. The DHCP additionally allows the configuration of a DHCP client via a name instead of via the MAC address. For the DHCP, this name is known as the “client identifier” in accordance with RFC 2131.
The device uses the name entered under sysName in the system group of the MIB II as the client identifier. You can enter this system name directly via SNMP, the Web-based management (see system dialog), or the Command Line Interface.

During startup operation, a device receives its configuration data according to the “DHCP process” flowchart (see figure 10).

The device sends its system name to the DHCP server. The DHCP server can then use the system name to allocate an IP address as an alternative to the MAC address.

In addition to the IP address, the DHCP server sends

- the netmask
- the default gateway (if available)
- the tftp URL of the configuration file (if available)

The device accepts this data as configuration parameters (see on page 52 “Graphical User Interface IP Configuration”). If an IP address was assigned by a DHCP server, it will be permanently saved locally.

Option	Meaning
1	Subnet Mask
2	Time Offset
3	Router
4	Time server

Table 3: DHCP options which the device requests

Option	Meaning
12	Host Name
42	NTP server
61	Client Identifier
66	TFTP Server Name
67	Bootfile Name

Table 3: DHCP options which the device requests

The advantage of using DHCP instead of BOOTP is that the DHCP server can restrict the validity of the configuration parameters (“Lease”) to a specific time period (known as dynamic address allocation). Before this period (“Lease Duration”) elapses, the DHCP client can attempt to renew this lease. Alternatively, the client can negotiate a new lease. The DHCP server then allocates a random free address.
To help avoid this, DHCP servers provide the explicit configuration option of assigning a specific client the same IP address based on a unique hardware ID (known as static address allocation).

On delivery, DHCP is activated. As long as DHCP is activated, the device attempts to obtain an IP address. If it cannot find a DHCP server after restarting, it will not have an IP address. Activate or deactivate DHCP in the `Basic Settings:Network:Global` dialog.

Note: When using Industrial HiVision network management, the user checks to see that DHCP allocates the original IP address to each device every time.

The appendix contains an example configuration of the BOOTP/DHCP-server .(see on page 256 “Setting up a DHCP/BOOTP Server”)

Example of a DHCP-configuration file:

```
# /etc/dhcpd.conf for DHCP Daemon
#
subnet 10.1.112.0 netmask 255.255.240.0 {
option subnet-mask 255.255.240.0;
option routers 10.1.112.96;
```

```
}
#
# Host berta requests IP configuration
# with her MAC address
#
host berta {
hardware ethernet 00:80:63:08:65:42;
fixed-address 10.1.112.82;
}
#
# Host hugo requests IP configuration
# with his client identifier.
#
host hugo {
#
option dhcp-client-identifier "hugo";
option dhcp-client-identifier 00:68:75:67:6f;
fixed-address 10.1.112.83;
server-name "10.1.112.11";
filename "/agent/config.dat";
}
```

Lines that begin with the #-character contain comments.
The lines that precede the individual devices indicate settings that apply to the following device.
The fixed-address line assigns a fixed IP address to the device.
Please refer to your DHCP-Server manual for more details.

2.7 System Configuration via DHCP Option 82

As with the classic DHCP, on startup an agent receives its configuration data according to the “BOOTP/DHCP process” flow chart (see figure 10).

While the system configuration is based on the classic DHCP protocol on the device being configured (see on page 48 “System Configuration via DHCP”), Option 82 is based on the network topology. This procedure gives you the option of assigning the same IP address to any device which is connected to a particular location (port of a device) on the LAN.
The installation of a DHCP server is described in the chapter “Setting up a DHCP Server with Option 82” on page 262.

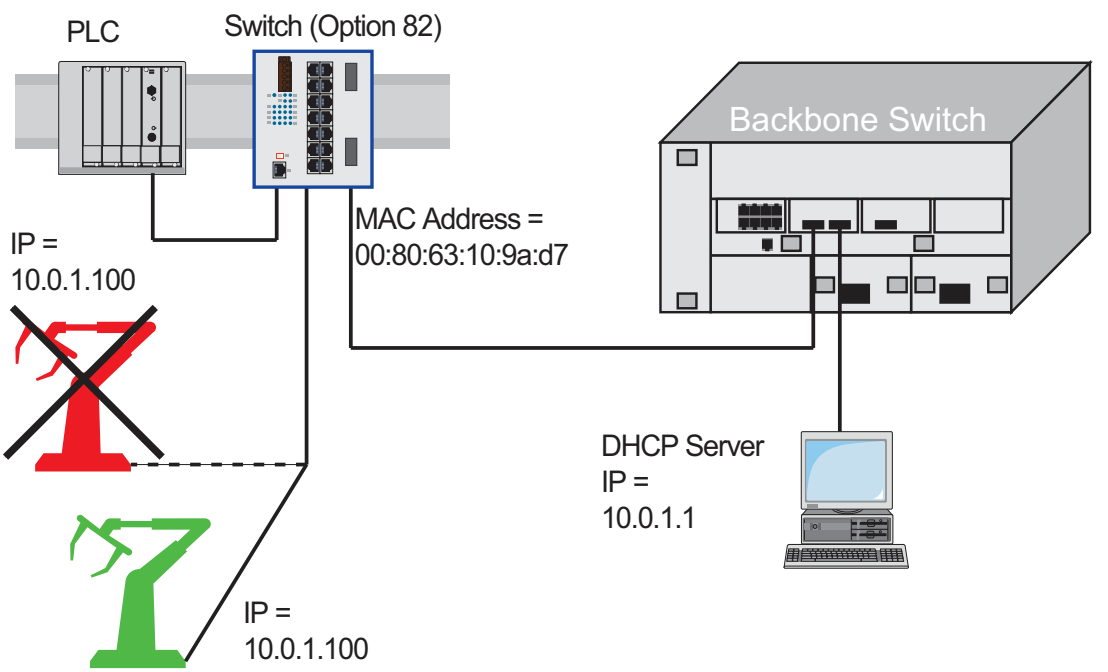


Figure 12: Application example of using Option 82

2.8 Graphical User Interface IP Configuration

Use the `Basic Settings:Network` dialog to define the source from which the device receives its IP parameters after startup, assign the IP parameters and VLAN ID, and configure the HiDiscovery access.

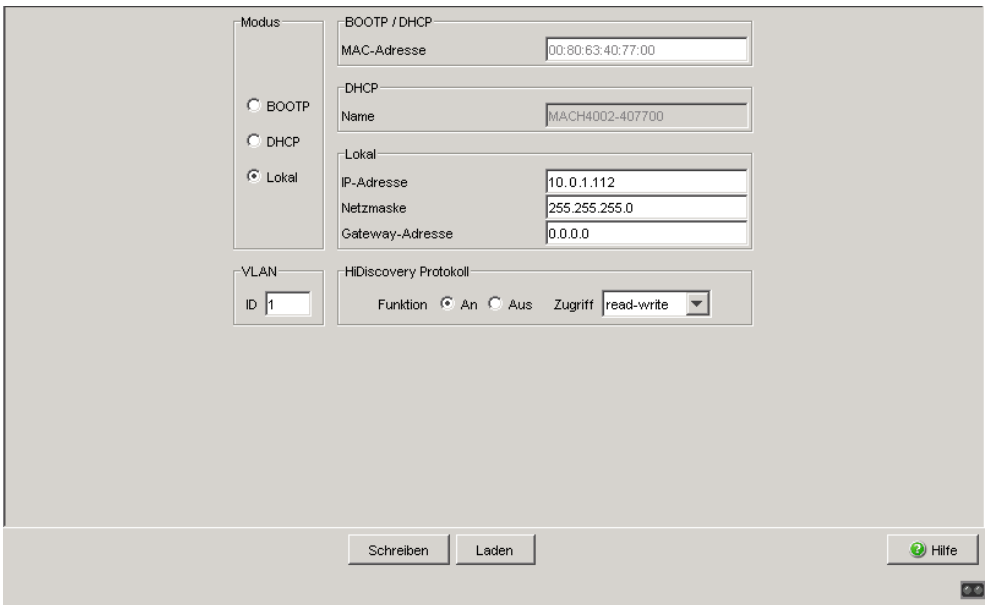


Figure 13: Network parameters dialog

☐ Under “Mode”, you enter where the device gets its IP parameters:
- ▶ In the BOOTP mode, the configuration is via a BOOTP or DHCP server on the basis of the MAC address of the device.
  See “Setting up a DHCP/BOOTP Server” on page 256.
- ▶ In the DHCP mode, the configuration is via a DHCP server on the basis of the MAC address or the name of the device.
  See “Setting up a DHCP Server with Option 82” on page 262.
- ▶ In the “local” mode the net parameters in the device memory are used.

☐ Enter the parameters on the right according to the selected mode.

☐ You enter the name applicable to the DHCP protocol in the “Name” line in the `Basic Settings:System` dialog of the graphical user interface.

☐ The “VLAN” frame enables you to assign a VLAN to the management CPU of the device. If you enter 0 here as the VLAN ID (not included in the VLAN standard version), the management CPU will then be accessible from all VLANs.

☐ The HiDiscovery protocol allows you to allocate an IP address to the device. Activate the HiDiscovery protocol if you want to allocate an IP address to the device from your PC with the enclosed HiDiscovery software (default setting: "Operation" `On`, "Access" `read-write`).

Note: Save the settings so that you will still have the entries after a restart (see on page 57 “Loading/saving settings”).

2.9 Faulty Device Replacement

The device provides 2 plug-and-play solutions for replacing a faulty device with a device of the same type (faulty device replacement):

- Configuring the new device using an AutoConfiguration Adapter (see on page 41 “Loading the system configuration from the ACA”) or
- configuration via DHCP Option 82 (see on page 262 “Setting up a DHCP Server with Option 82”)

In both cases, when the new device is started, it is given the same configuration data that the replaced device had.

Note: If you are replacing a device with DIP switches, check the DIP switch settings to ensure they are the same.

3 Loading/saving settings

The device saves settings such as the IP parameters and the port configuration in the temporary memory. These settings are lost when you switch off or reboot the device.
The device allows you to do the following:

- Load settings from a non-volatile memory into the temporary memory
- Save settings from the temporary memory in a non-volatile memory

If you change the current configuration (for example, by switching a port off), the graphical user interface changes the “load/save” symbol in the navigation tree from a disk symbol to a yellow triangle. After saving the configuration, the graphical user interface displays the “load/save” symbol as a disk again.

3.1 Loading settings

When it is restarted, the device loads its configuration data from the local non-volatile memory. The prerequisites for this are:

- You have not connected an AutoConfiguration Adapter (ACA) and
- the IP configuration is “local”.

During a restart, the device also allows you to load settings from the following sources:

- a binary file of the AutoConfiguration Adapter. If an ACA is connected to the device, the device automatically loads its configuration from the ACA during the boot procedure.
- from a script file of the AutoConfiguration Adapter. If an ACA is connected to the device, the device automatically loads its configuration from the script file of the ACA during the boot procedure (see on page 63 “Loading a script from the ACA”).

Note: Details of times required for a reboot:

- The time required for a cold start is the time taken by the device from the moment power is switched on until it is fully connected and its Management-CPU is fully accessible.
- Depending on the device type and the extent of the configuration settings, a cold start takes at least about 10 seconds.
- Extensive configuration settings will increase the time required for a reboot, especially if they contain a high number of VLANs. In extreme cases, a reboot can take up to about 200 seconds.
- A warm start is quicker, since in this case the device skips the software loading from NVRAM.

During operation, the device allows you to load settings from the following sources:

- the local non-volatile memory
- a file in the connected network (setting on delivery)
- a binary file or an editable and readable script on the PC and
- the firmware (restoration of the configuration on delivery).

Note: When loading a configuration, hold off any accesses to the device until it has loaded the configuration file and applied the new configuration settings. Depending on the device type and the extent of the configuration settings, this process can take between 10 and 200 seconds.

3.1.1 Loading from the local non-volatile memory

When loading the configuration data locally, the device loads the configuration data from the local non-volatile memory if no ACA is connected to the device.

☐ Select the `Basics: Load/Save` dialog.
☐ In the “Load” frame, click “from Device”.
☐ Click “Restore”.

```
enable
copy nvram:startup-config
  system:running-config
```

Switch to the privileged EXEC mode.
The device loads the configuration data from the local non-volatile memory.

3.1.2 Loading from a file

The device allows you to load the configuration data from a file in the connected network if there is no AutoConfiguration Adapter connected to the device.

☐ Select the `Basics: Load/Save` dialog.
☐ In the “Load” frame, click
- “from URL” if you want the device to load the configuration data from a file and retain the locally saved configuration.
- “from URL & save to Switch” if you want the device to load the configuration data from a file and save this configuration locally.
- “via PC” if you want the device to load the configuration data from a file on the PC and retain the locally saved configuration.

☐ In the “URL” frame, enter the path under which the device will find the configuration file, if you want to load from the URL.
☐ Click “Restore”.

Note: When restoring a configuration using one of the options in the “Load” frame, note the following particulars:
- The device can restore the configuration from a binary or script file:
  - The option “from Device” restores the configuration exclusively from the device-internal binary file.
  - The 3 options “from URL”, “from URL and save to Device” or “via PC” can restore the configuration both from a binary file and from a script file. The script file can be an offline configuration file (*.ocf) or a CLI script file (*.cli). The device determines the file type automatically.
- When restoring the configuration from a script file, you first delete the device configuration so that the default settings are overwritten correctly. For further information (see on page 62 “Resetting the configuration to the default settings”)

The URL identifies the path to the tftp server from which the device loads the configuration file. The URL is in the format tftp://IP address of the tftp server/path name/file name (e.g. `tftp://10.1.112.5/switch/config.dat`).

Example of loading from a tftp server

☐ Before downloading a file from the tftp server, you have to save the configuration file in the corresponding path of the tftp servers with the file name, e.g. `switch/switch_01.cfg` (see on page 69 “Saving in a binary file or a script file on a URL”).

☐ In the “URL” line, enter the path of the tftp server, e.g. `tftp://10.1.112.214/switch/switch_01.cfg`.

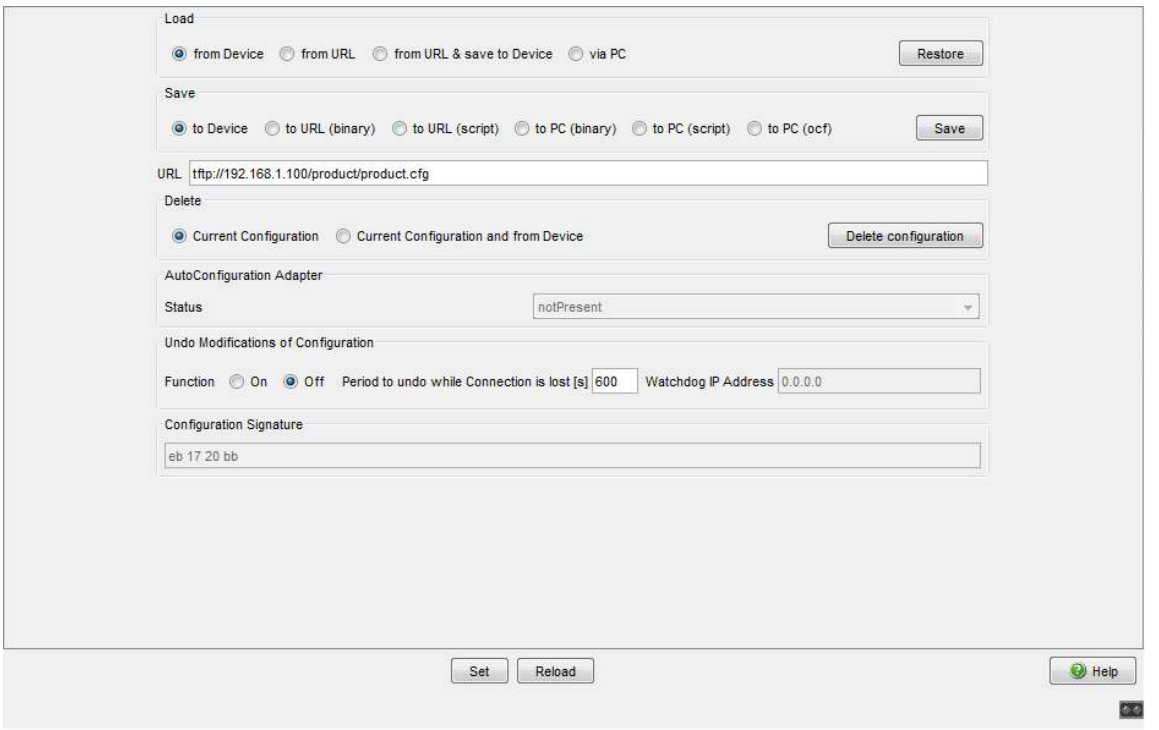


Figure 14: Load/Save dialog

```
enable
copy
tftp://10.1.112.159/switch/c
onfig.dat
  nvram:startup-config
```

Switch to the privileged EXEC mode.

The device loads the configuration data from a tftp server in the connected network.

Note: The loading process started by DHCP/BOOTP (see on page 43 “System configuration via BOOTP”) shows the selection of “from URL & save locally” in the “Load” frame. If you get an error message when saving a configuration, this could be due to an active loading process. DHCP/BOOTP only finishes a loading process when a valid configuration has been loaded. If DHCP/BOOTP does not find a valid configuration, then finish the loading process by loading the local configuration in the “Load” frame.

3.1.3 Resetting the configuration to the default settings

The device enables you to

- reset the current configuration to the default setting. The locally saved configuration is kept.
- reset the device to the default setting. After the next restart, the IP address is also in the default setting.

☐ Select the `Basics: Load/Save` dialog.
☐ Make your selection in the "Delete" frame.
☐ Click "Delete configuration". The device will delete its configuration immediately.

Resetting the device using the system monitor

☐ Select `5` “Erase main configuration file”
This menu item allows you to reset the current configuration, stored in non volatile memory, to its default setting. The device also stores a backup configuration, and a configuration associated with the firmware, in its Flash memory.
☐ Press the Enter key to delete the configuration file.

3.1.4 Loading from the AutoConfiguration Adapter

Loading a configuration during the boot procedure

If you connect an ACA to the device and if the passwords on the device are in the default setting, missing, or the same as those on the ACA, the device automatically loads its configuration from the ACA during the boot procedure. After booting, the device updates its configuration in the local non-volatile memory with the configuration from the ACA.

Note: During the boot procedure, the configuration on the ACA has priority over the configuration in the local non-volatile memory.

The chapter “Saving locally (and on the ACA)” on page 67 describes how you can save a configuration file on an ACA.

Loading a script from the ACA

If the ACA contains a script file, the device automatically loads its configuration from the script file on the ACA during the boot procedure. The prerequisites for this are:

- The ACA is connected during the boot procedure.
- There is no binary configuration in the main directory of the ACA.
- The main directory of the ACA contains a file with the name “autoupdate.txt”.
- The file “autoupdate.txt” is a text file and contains a line whose content has the format `script=<file_name>`. Here `<file_name>` stands for the name of the script file to be loaded, e.g. `custom.cli`.
- The file specified using `script=<file_name>`, e.g. `custom.cli`, is located in the main directory of the ACA and is a valid script file.

If the local non-volatile memory of the device contains a configuration, the device ignores this.
After applying the script, the device updates the configuration in the local non-volatile memory with the configuration from the script.
In the process, it also writes the current binary configuration to the ACA.

Note: During the boot procedure, a binary configuration on the ACA has priority over a script on the ACA.

The chapter “Saving locally (and on the ACA)” describes how you can save a script file on an ACA.

- **Reporting configuration differences**
  The device allows you to trigger the following events when the configuration stored on the ACA does not match the configuration on the device:
  - send a trap (see on page 213 “Configuring Traps”),
  - update the device status (see on page 216 “Configuring the Device Status”),
  - update the status of the signal contacts (see on page 219 “Controlling the Signal Contact”).

3.1.5 Using the offline configurator

The offline configurator allows you to create configurations for devices in advance. You create the configuration virtually on your PC and load it onto your device in a 2nd step.

In this way you can prepare and manage the device configuration efficiently, thus saving time and effort both when creating the configuration and loading it to the devices.

For more details on using the offline configurator, see the chapter “Loading a configuration from the offline configurator” in the “GUI” Reference Manual.

Example of using the offline configurator

An IT employee already creates the configuration files for the devices of a production cell during the planning phase. In doing so, he uses existing configuration files for a similar production cell and modifies these.
He makes the offline configuration files available to the field service employee, who mounts the devices on site and then loads the configuration to the devices. All that is required for this is for the devices to be reachable and have received an IP address, e.g. via HiDiscovery.

Data format

The offline configurator reads and writes configuration data in an XML-based format. The file name extension of these files is ".ocf" (Offline Configurator Format).

You can use the graphical user interface of the devices to load these files and thus configure your devices very quickly.

The XML format also allows you to use other tools to create, edit and manage the offline configuration files and thus optimize your administration processes.

Installation and operating requirements

A requirement for the installation is a PC with a Windows™ XP operating system (with Service Pack 3) or higher.
You install the offline configurator from the product CD included with the device. To do so, start the "Setup.exe" installation file from the "ocf_setup" folder.

The offline configurator - like the graphical user interface - uses Java software 6 ("Java™ Runtime Environment (JRE) Version 1.6.x").
Install the software from www.java.com.

Using the offline configurator

Start the offline configurator by double-clicking the "Offline Management" desktop symbol.

For more details on using the offline configurator, see the chapter “Loading a configuration from the offline configurator” in the “GUI” Reference Manual.

3.2 Saving settings

In the “Save” frame, you have the option to

- save the current configuration on the device,
- save the current configuration in binary form in a file under the specified URL, or as an editable and readable script,
- save the current configuration in binary form or as an editable and readable CLI script on the PC,
- save the current configuration for the offline configurator on the PC in XML format.

3.2.1 Saving locally (and on the ACA)

The device allows you to save the current configuration data in the local non-volatile memory and in the ACA.

☐ Select the `Basics: Load/Save` dialog.
☐ In the "Load" options, click on "From device".
☐ Click on "Save".
The device saves the current configuration data in the local non-volatile memory and also, if a ACA is connected, in the ACA.

```
enable
copy system:running-config
  nvram:startup-config
```

Switch to the privileged EXEC mode.

The device saves the current configuration data in the local non-volatile memory and also, if a ACA is connected, in the ACA

Note: After you have successfully saved the configuration on the device, the device sends a trap `hmConfigurationSavedTrap` together with the information about the AutoConfiguration Adapter (ACA), if one is connected. When you change the configuration for the first time after saving it, the device sends a trap `hmConfigurationChangedTrap`.

Note: The device allows you to trigger the following events when the configuration stored on the ACA does not match the configuration on the device:

- send a trap (see on page 213 “Configuring Traps”),
- update the device status (see on page 216 “Configuring the Device Status”),
- update the status of the signal contacts (see on page 219 “Controlling the Signal Contact”).

Skip ACA21 during the boot phase

The device allows you to skip the ACA21 AutoConfiguration Adapter (if connected) during the boot phase. In this case, the device ignores the ACA21 during the boot phase. This shortens the boot phase of the device by 1 to 4 seconds. If you have enabled this function, ACA21-functionality becomes available as usual after the boot phase. The device simply skips the ACA21-loading procedures during the boot phase.

`enable`	Switch to Privileged EXEC mode..
`configure`	Switch to Global Configure mode.
`#boot skip-aca-on-boot enable`	Skip ACA during the boot phase. (default setting: disabled).
`#boot skip-aca-on-boot disable`	Include the ACA during the boot phase.
`#show boot skip-aca-on-boot`	Show whether the "Skip ACA during boot phase"function is enabled.

3.2.2 Saving in a binary file or a script file on a URL

The device allows you to save the current configuration data in a file in the connected network.

Note: The configuration file includes all configuration data, including the password. Therefore pay attention to the access rights on the tftp server.

☐ Select the `Basics: Load/Save` dialog.
☐ In the “Save” frame, choose “to URL (binary)” to create a binary file, or “to URL (script)” to create an editable and readable script file.
☐ In the “URL” frame, enter the path under which you want the device to save the configuration file.

The URL identifies the path to the tftp server on which the device saves the configuration file. The URL is in the format tftp://IP address of the tftp server/path name/file name (e.g. `tftp://10.1.112.5/switch/config.dat`).

☐ Click "Save".

`enable`	Switch to the privileged EXEC mode.
`copy nvram:startup-config tftp://10.1.112.159/ switch/config.dat`	The device saves the configuration data in a binary file on a tftp server in the connected network
`copy nvram:script tftp://10.0.1.159/switch/ config.txt`	The device saves the configuration data in a script file on a tftp server in the connected network.

Note: If you save the configuration in a binary file, the device saves all configuration settings in a binary file.
In contrast to this, the device only saves those configuration settings that deviate from the default setting when saving to a script file.

When loading script files, these are only intended for overwriting the default setting of the configuration.

3.2.3 Saving to a binary file on the PC

The device allows you to save the current configuration data in a binary file on your PC.

- ☐ Select the `Basics: Load/Save` dialog.
- ☐ In the "Save" frame, click "on the PC (binary)".
- ☐ In the save dialog, enter the name of the file in which you want the device to save the configuration file.
- ☐ Click "Save".

3.2.4 Saving as a script on the PC

The device allows you to save the current configuration data in an editable and readable file on your PC.

- ☐ Select the `Basics: Load/Save` dialog.
- ☐ In the “Save” frame, click “to PC (script)”.
- ☐ In the save dialog, enter the name of the file in which you want the device to save the configuration file.
- ☐ Click "Save".

3.2.5 Saving as an offline configuration file on the PC

The device allows you to save the current configuration data for the offline configurator in XML form in a file on your PC.

- ☐ Select the `Basics: Load/Save` dialog.
- ☐ In the “Save” frame, click “to PC (ocf)”.
- ☐ In the save dialog, enter the name of the file in which you want the device to save the configuration file.
- ☐ Click "Save".

3.3 Configuration Signature

The device assigns a checksum or signature to identify a configuration so that changes to that configuration are visible. Every time you save a configuration, the device generates a random sequence of numbers and/or letters for the configuration signature. This signature changes every time you change the configuration. Each configuration has a unique identifier.

The device stores the random generated signature with the configuration to verify that the device maintained the configuration after a reboot.

The signature consists of a configuration file checksum and a random number. The device checks the signature to verify that it is different from previous generated numbers.

4 Loading Software Updates

Hirschmann is working constantly to improve the performance of their procucts. Therefore, on the Hirschmann web page (www.hirschmann.com) you may find a newer release of the device software than the one installed on your device.

Checking the installed Software Release

☐ Open the `Basic Settings:Software` dialog.
☐ This dialog indicates the Release Number of the software installed in the device.

```
enable                                  Switch to Privileged EXEC mode.
show sysinfo                            Show system information.

Alarm..................................... None

System Description........................ Hirschmann Railswitch
System Name............................... RS-1F1054
System Location........................... Hirschmann Railswitch
System Contact............................ Hirschmann Automation
  and Control GmbH
System Up Time............................ 0 days 0 hrs 45 mins
  57 secs
System Date and Time (local time zone)..... 2009-11-12 14:15:16
System IP Address......................... 10.0.1.13
Boot Software Release..................... L2B-05.2.00
Boot Software Build Date.................. 2009-11-12 13:14
OS Software Release....................... L2B-03.1.00
OS Software Build Date.................... 2009-11-12 13:14
Hardware Revision......................... 1.22 / 4 / 0103
Hardware Description...................... RS20-1600T1T1SDAEHH
Serial Number............................. 943434023000001191
Base MAC Address.......................... 00:80:63:1F:10:54
Number of MAC Addresses................... 32 (0x20)
```

Loading the software

The device gives you 4 options for loading the software:

- manually from the ACA (out-of-band),
- automatically from the ACA (out-of-band),
- via TFTP from a tftp server (in-band) and
- via a file selection dialog from your PC.

Note: The existing configuration of the device is still there after the new software is installed.

4.1 Loading the Software manually from the ACA

You can connect the AutoConfiguration Adapter (ACA) to a USB port of your PC like a conventional USB stick and copy the device software into the main directory of the ACA.

☐ Copy the device software from your computer to the ACA.

☐ Now connect the ACA to the device‘s USB port.

☐ Open the system monitor (see on page 18 “Starting the System Monitor”).

☐ Select 2 and press the Enter key to copy the software from the ACA into the local memory of the device.
At the end of the update, the system monitor asks you to press any key to continue.

☐ Select 3 to start the new software on the device.

The system monitor offers you additional options in connection with the software on your device:

- selecting the software to be loaded
- starting the software
- performing a cold start

4.1.1 Selecting the software to be loaded

In this menu item of the system monitor, you select one of two possible software releases that you want to load.
The following window appears on the screen:

```
Select Operating System Image

(Available OS: Selected: 05.0.00 (2009-08-07 06:05), Backup: 04.2.00
 (2009-07-06 06:05 (Locally selected: 05.0.00 (2009-08-07 06:05))

1  Swap OS images
2  Copy image to backup
3  Test stored images in Flash mem.
4  Test stored images in USB mem.
5  Apply and store selection
6  Cancel selection
```

Figure 15: Update operating system screen display

Swap OS images
The memory of the device provides space for two images of the software. This allows you, for example, to load a new version of the software without deleting the existing version.
☐ Select 1 to load the other software in the next booting process.

Copy image to backup
☐ Select 2 to save a copy of the active software.

Test stored images in flash memory
☐ Select 3 to check whether the images of the software stored in the flash memory contain valid codes.

Test stored images in USB memory
☐ Select 4 to check whether the images of the software stored in the ACA contain valid codes.

Apply and store selection
☐ Select 5 to confirm the software selection and to save it.

Cancel selection
☐ Select 6 to leave this dialog without making any changes.

4.1.2 Starting the software

This menu item (Start Selected Operating System) of the system monitor

allows you to start the software selected.

4.1.3 Performing a cold start

This menu item (End (reset and reboot)) of the system monitor allows you to reset the hardware of the device and perform a restart.

4.2 Automatic software update by ACA

☐ For a software update via the ACA, first copy the new device software into the main directory of the AutoConfiguration Adapter. If the version of the software on the ACA is newer or older than the version on the device, the device performs a software update.

Note: Software versions with release 06.0.00 and higher in the non-volatile memory of the device support the software update via the ACA. If the device software is older, you have the option of loading the software manually from the ACA. See “Loading the Software manually from the ACA” on page 75.

☐ Give the file the name that matches the device type and the software variant, e.g. rsL2P.bin for device type RS2 with the software variant L2P. Please note the case-sensitivity here.
If you have copied the software from a product CD or from a Web server of the manufacturer, the software already has the correct file name.

☐ Also create an empty file with the name “autoupdate.txt” in the main directory of the ACA. Please note the case-sensitivity here.

☐ Connect the AutoConfiguration Adapter to the device and restart the device.

☐ The device automatically performs the following steps:
- During the booting process, it checks whether an ACA is connected.
- It checks whether the ACA has a file with the name “autoupdate.txt” in the main directory.
- It checks whether the ACA has a software file with a name that matches the device type in the main directory.
- If compares the software version stored on the ACA with the one stored on the device.
- If these conditions are fulfilled, the device loads the software from the ACA to its non-volatile memory as the main software.
- The device keeps a backup of the existing software in the non-volatile memory.
- The device then performs a cold start, during which it loads the new software from the non-volatile memory.

One of the following messages in the log file indicates the result of the update process:

- S_watson_AUTOMATIC_SWUPDATE_SUCCESSFUL: Update completed successfully.
- S_watson_AUTOMATIC_SWUPDATE_FAILED_WRONG_FILE: Update failed. Reason: incorrect file.
- S_watson_AUTOMATIC_SWUPDATE_FAILED_SAVING_FILE: Update failed. Reason: error when saving.

☐ In your browser, click on “Reload” so that you can use the graphical user interface to access the device again after it is booted.

4.3 Loading the software from the TFTP server

For a software update via TFTP, you need a TFTP server on which the software to be loaded is stored (see on page 266 “TFTP Server for Software Updates”).

☐ Select the `Basics:Software` dialog.

The URL identifies the path to the software stored on the tftp server. The URL is in the format
tftp://IP address of the tftp server/path name/file name
(e.g. `tftp://192.168.1.1/device/device.bin`).

☐ Enter the path of the device software.

☐ Click on “tftp Update” to load the software from the tftp server to the device.

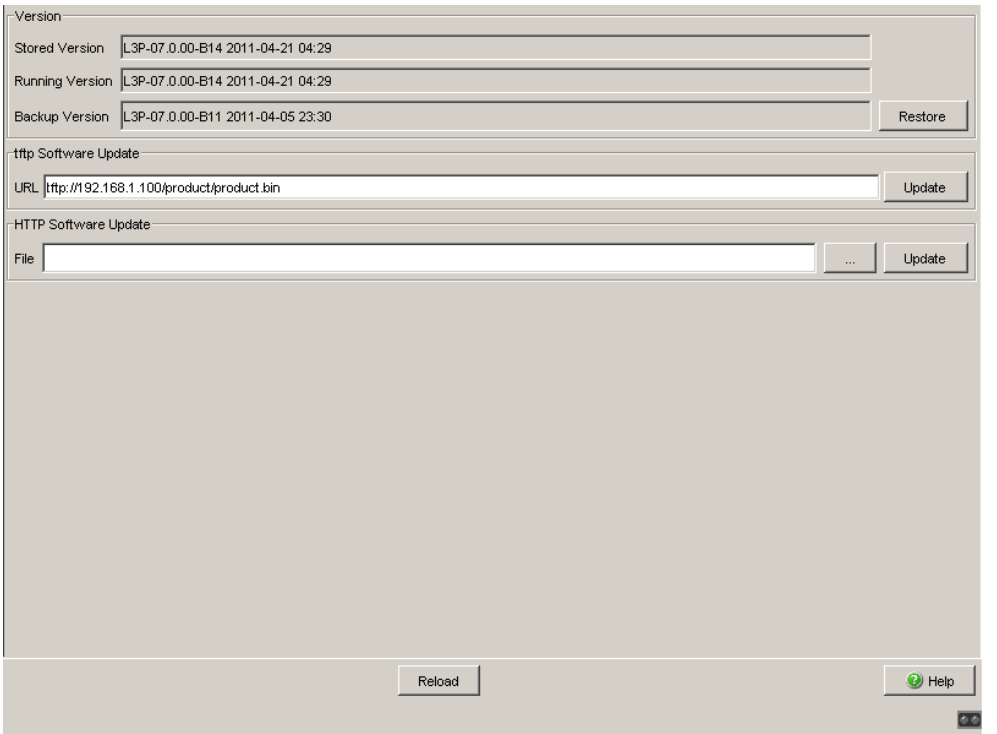


Figure 16: Software update dialog

☐ After successfully loading it, you activate the new software:
Select the dialog `Basic Settings:Restart` and perform a cold start.
In a cold start, the device reloads the software from the permanent memory, restarts, and performs a self-test.

☐ After booting the device, click “Reload” in your browser to access the device again.

`enable`	Switch to the privileged EXEC mode.
`copy tftp://10.0.1.159/product.bin system:image`	Transfer the “product.bin” software file to the device from the tftp server with the IP address 10.0.1.159.

4.4 Loading the Software via File Selection

For a software update via a file selection window, the device software must be on a data carrier that you can access from your PC.

☐ Select the `Basics:Software` dialog.
☐ In the file selection frame, click on “...”.
☐ In the file selection window, select the device software (name type: *.bin, e.g. device.bin) and click on “Open”.
☐ Click on “Update” to transfer the software to the device.

The end of the update is indicated by one of the following messages:
- Update finished.
- Update aborted. Reason: incorrect file.
- Update aborted. Reason: saving unsuccessful.
- File not found (reason: file name not found or does not exist).
- Unsuccessful Connection (reason: path without file name).

☐ After the update is completed successfully, you activate the new software:
Select the `Basic settings: Restart` dialog and perform a cold start.
In a cold start, the device reloads the software from the non-volatile memory, restarts, and performs a self-test.
☐ In your browser, click on “Reload” so that you can access the device again after it is booted.

4.5 Bootcode Update via TFTP

In very rare cases, a bootcode with an expanded functionality is required to perform a software update. In such a case the service desk requests that you update the bootcode before performing the software update.

4.5.1 Updating the Bootcode file

For a tftp update, you need a tftp server to store the bootcode.
The URL identifies the path to the bootcode stored on the tftp server. The URL is in the format
tftp://IP address of the tftp server/path name/file name
(for example:).`tftp://192.168.1.1/device/device_bootrom.img`

- ☐ Open the `Basic Settings:Software` dialog.
- ☐ In the "tftp Software Update" frame, click the "Bootcode" radio button.
- ☐ Enter the path to the bootcode bin file in the "URL" text box.
- ☐ To start the update, click "Update".
- ☐ To start the new bootcode after loading, open the `Basic Settings:Restart` dialog and click "Cold start...".

Note: You need read-write access for this dialog.

`enable`	Change to the privileged EXEC mode.

`configure`	Change to the Configuration mode.
`copy <url> system:bootcode`	Copy the bootcode bin file from the tftp server to the device.

5 Configuring the Ports

The port configuration consists of:

- Switching the port on and off
- Selecting the operating mode
- Activating the display of connection error messages
- Configuring Power over ETHERNET.

Switching the port on and off

In the default setting, every port is switched on. For a higher level of access security, switch off the ports for which you are not making any connection.

☐ Select the `Basics:Port Configuration` dialog.
☐ In the "Port on" column, select the ports that are connected to another device.

Selecting the operating mode

In the default setting, the ports are set to "Automatic Configuration" operating mode.

Note: The active automatic configuration has priority over the manual configuration.

☐ Select the `Basics:Port Configuration` dialog.
☐ If the device connected to this port requires a fixed setting
  – select the operating mode (transmission rate, duplex mode) in the "Manual configuration" column and
  – deactivate the port in the "Automatic configuration" column.

Disable unused module slots

This function is available for the MS, PowerMICE, MACH102 and MACH4000 devices.

When you plug a module in an empty slot on modular devices, the device configures the module with the default settings. The default settings allow access to the network. To help prevent network access, the feature adds the possibility to disable an unused slot.

- ☐ Open the `Basics:Modules` dialog.
- ☐ Deactivate the unused slots in the "Enabled" column.

Displaying detected loss of connection

In the default setting, the device displays a detected connection error via the signal contact and the LED display. The device allows you to suppress this display, because you do not want to interpret a switched off device as an interrupted connection, for example.

- ☐ Select the `Basics:Port Configuration` dialog.
- ☐ In the "Propagate connection error" column, select the ports for which you want to have link monitoring.

Power over Ethernet konfigurieren

If the device is equipped with PoE media modules, it will then allow you to supply current to devices such as IP phones via the twisted-pair cable. PoE media modules support Power over ETHERNET according to IEEE 802.3af.
On delivery, the Power over ETHERNET function is activated globally and on all PoE-capable ports.

Nominal power for MS20/30, MACH 1000 and PowerMICE:
The device provides the nominal power for the sum of all PoE ports plus a surplus. Because the PoE media module gets its PoE voltage externally, the device does not know the possible nominal power.
The device therefore assumes a “nominal power” of 60 Watt per PoE media module for now.

Nominal power for MACH 4000:
The device provides the nominal power for the sum of all PoE ports plus a surplus. Should the connected devices require more PoE power than is provided, the device then switches PoE off at the ports. Initially, the device switches PoE off at the ports with the lowest PoE priority. If multiple ports have the same priority, the device first switches PoE off at the ports with the higher port number.

☐ **Global settings**
- For devices with **PoE** select the `Basic Settings:Power over Ethernet` dialog.
- For devices with **PoE** select the `Basic Settings:Power over Ethernet Plus:Global` dialog.

Frame "Operation":

☐ With “Function On/Off” you turn the PoE on or off.

Frame "Configuration":

☐ With “Send Trap” you can get the device to send a trap in the following cases:
- If a value exceeds/falls below the performance threshold.
- If the PoE supply voltage is switched on/off on at least one port.

☐ Enter the power threshold in “Threshold”. When the device exceeds or is below this value, the device will send a trap, provided that you enable the “Send Trap” function. For the power threshold you enter the power yielded as a percentage of the nominal power.

☐ “Budget [W]” displays the power that the device nominally provides to the PoE ports.

☐ “Reserved [W]” displays the maximum power that the device provides to the connected PoE devices on the basis of their classification.

☐ “Delivered [W]” shows how large the current power requirement is on the PoE ports.

The difference between the "nominal" and "reserved" power indicates how much power is still available to the free PoE+ ports.

☐ **Port settings**

– For devices with **PoE** select the `Basic Settings:Power over Ethernet` dialog.
– For devices with **PoE+** select the `Basic Settings:Power over Ethernet Plus:Port` dialog.

The table only shows ports that support PoE.

☐ In the “POE on” column, you can enable/disable PoE at this port.
☐ The “Status” column indicates the PoE status of the port.
☐ In the “Priority” column (MACH 4000), set the PoE priority of the port to “low”, “high” or “critical”.
☐ The "Class" column indicates the class of the connected device:
Class: Maximum delivered power
0: 15.4 W = As-delivered state
1: 4.0 W
2: 7.0 W
3: 15.4 W
4: reserved, treated as Class 0
☐ The column „Consumption [W]“ displays the current power delivered at the respective port.
☐ The “Name” column indicates the name of the port, see `Basic settings:Port configuration`.

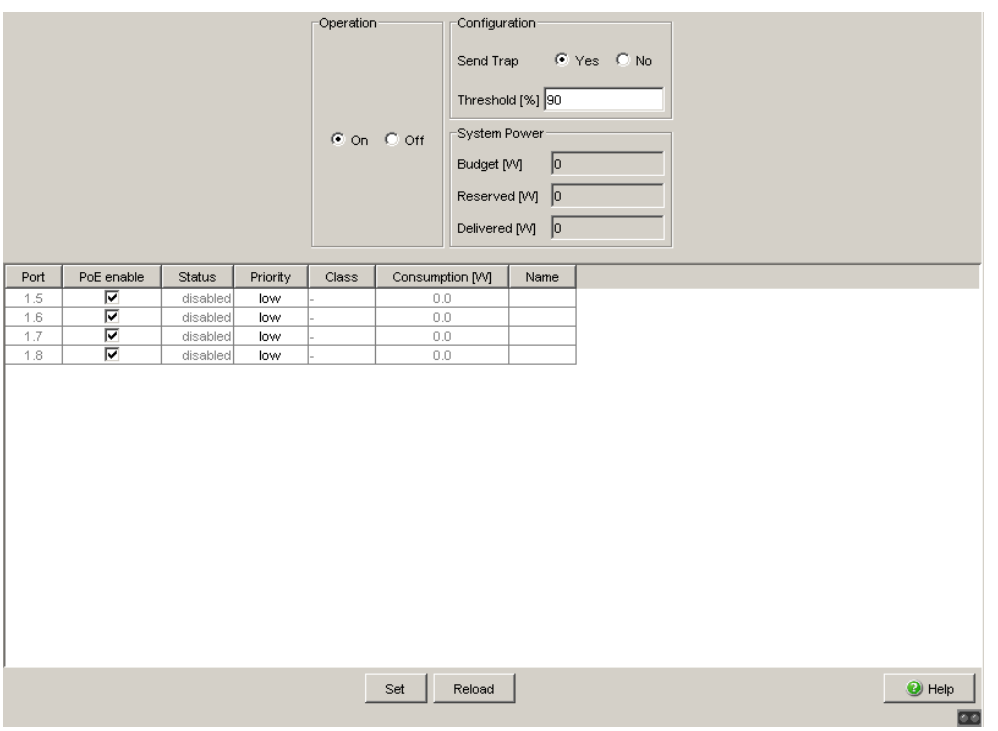


Figure 17: Power over Ethernet dialog

Switch on PoE power supply

OCTOPUS PoE devices let you switch on the PoE power supply before loading and starting the software. This means that the connected PoE devices (powered devices) are supplied with the PoE voltage more quickly and the start phase of the whole network is shorter.

`enable`	Switch to Privileged EXEC mode.
`configure`	Switch to Global Configure mode.
`#inlinepower fast-startup enable`	Switch on Inline Power Fast Startup (disabled in the as-delivered state).
`#inlinepower fast-startup disable`	Switch off Inline Power Fast Startup.
`#show inlinepower`	Show Power over Ethernet System Information (Fast Startup and other information).

Cold start with detected errors

This function lets you reset the device automatically with a cold start in the following cases:

- if an error is detected
  (selftest reboot-on-error enable)
  or
- only if a serious error is detected
  (selftest reboot-on-error seriousOnly)

If the function `selftest reboot-on-error seriousOnly` is enabled, the device behaves as follows:

- If an error is detected in a subsystem (for example, if an HDX/FDX mismatch is detected on a port), cold starts of the device are dropped.
- However, if an error affecting the function of the entire device is detected, the device still carries out a cold start.
- The device sends a trap (see on page 210 “Sending Traps”).

Note: If the `selftest reboot-on-error seriousOnly` function is enabled and the device detects an HDX/FDX mismatch, automatic cold starts of the device are dropped. In this case, to return the affected port(s) to a usable condition, open the `Basic Settings:Reboot` dialog and carry out a cold start of the device.

`enable`	Switch to Privileged EXEC mode.
`configure`	Switch to Global Configure mode.

`#selftest reboot-on-error enable`	Switch on the "Cold start if error detected“ function.
`#selftest reboot-on-error seriousOnly`	Switch on the "Cold start only if serious error detected“ function.
`#selftest reboot-on-error disable`	Switch off the "Cold start if error detected“ function (enabled in the as-delivered state).
`#show selftest`	Show status of the "Cold start if error detected" function (Enabled/Disabled/seriousOnly).

6 Assistance in the Protection from Unauthorized Access

The device provides the following functions to help prevent unauthorised accesses.

- Password for SNMP access
- Telnet/internet/SSH access can be switched off
- Restricted Management access
- HiDiscovery-Function can be switched off
- Port access control by IP or MAC address
- IEEE 802.1X standard port authentication
- Access Control Lists (ACL)
- Login Banner

6.1 Protecting the device

If you want to maximize the protection of the device against unauthorized access in just a few steps, you can perform the following steps on the device as required:

- ☐ Deactivate SNMPv1 and SNMPv2 and select a password for SNMPv3 access other than the standard password (see on page 96 “Entering the password for SNMP access”).
- ☐ Deactivate the Web access after you have downloaded the applet for the graphical user interface onto your management station. You can start the applet as an independent program in order to have SNMPv3 access to the device.
  Deactivate Telnet access.
  If necessary, deactivate SSH access.
  See “Switching Telnet/Internet/SSH access on/off” on page 102.
- ☐ Deactivate HiDiscovery access.

Note: Retain at least one option to access the device. Connecting to the device via V.24 serial access is possible, since it cannot be deactivated.

6.2 Password for SNMP access

6.2.1 Description of password for SNMP access

A network management station communicates with the device via the Simple Network Management Protocol (SNMP).
Every SNMP packet contains the IP address of the sending computer and the password with which the sender of the packet wants to access the device MIB.

The device receives the SNMP packet and compares the IP address of the sending computer and the password with the entries in the device MIB.
If the password has the appropriate access right, and if the IP address of the sending computer has been entered, then the device will allow access.

In the delivery state, the device is accessible via the password "public" (read only) and "private" (read and write) to every computer.

To help protect your device from unwanted access:

☐ First define a new password with which you can access from your computer with all rights.

☐ Treat this password as confidential, because everyone who knows the password can access the device MIB with the IP address of your computer.

☐ Limit the access rights of the known passwords or delete their entries.

6.2.2 Entering the password for SNMP access

☐ Select the `Security:Password/SNMP Access` dialog.
This dialog gives you the option of changing the read and read/write passwords for access to the device via the graphical user interface, via the CLI, and via SNMPv3 (SNMP version 3).
Set different passwords for the read password and the read/write password so that a user that only has read access (user name “user”) does not know, or cannot guess, the password for read/write access (user name “admin”).
If you set identical passwords, when you attempt to write this data the device reports a general error.

The graphical user interface and the command line interface (CLI) use the same passwords as SNMPv3 for the users “admin” and “user”.

Note: Passwords are case-sensitive.

☐ Select “Modify Read-Only Password (User)” to enter the read password.
☐ Enter the new read password in the “New Password” line and repeat your entry in the “Please retype” line.
☐ Select “Modify Read-Write Password (Admin)” to enter the read/write password.
☐ Enter the read/write password and repeat your entry.
☐ The "Accept only encrypted requests" function encrypts the data of the Web-based management that is transferred between your PC and the device with SNMPv3. You can set the funtion differently for access with a read password and access with a read/write password.
☐ When you activate the "Synchronize password to v1/v2 community" function, when the password is changed the device synchronizes the corresponding community name.
  – When you change the password for the read/write access, the device updates the readWrite community for the SNMPv1/v2 access to the same value.
  – When you change the password for the read access, the device updates the readOnly community for the SNMPv1/v2 access to the same value.

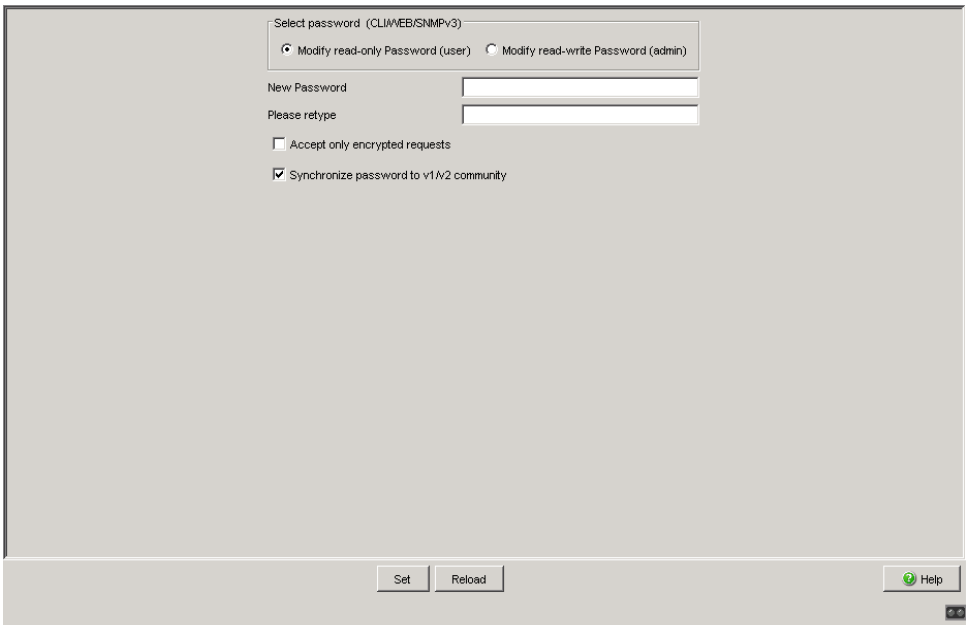


Figure 18: Password/SNMP Access dialog

Note: If you do not know a password with “read/write” access, you will not have write access to the device.

Note: For security reasons, the device does not display the passwords. Make a note of every change. You cannot access the device without a valid password.

Note: For security reasons, SNMPv3 encrypts the password. With the “SNMPv1” or “SNMPv2” setting in the dialog `Security:SNMPv1/v2 access`, the device transfers the password unencrypted, so that this can also be read.

Note: Use between 5 and 32 characters for the password in SNMPv3, since many applications do not accept shorter passwords.

☐ Select the Security:SNMPv1/v2 access dialog.
With this dialog you can select the access via SNMPv1 or SNMPv2. In the state on delivery, both protocols are activated. You can thus manage the device with HiVision and communicate with earlier versions of SNMP.

If you select SNMPv1 or SNMPv2, you can specify in the table via which IP addresses the device may be accessed, and what kinds of passwords are to be used.
Up to 8 entries can be made in the table.
For security reasons, the read password and the read/write password must not be identical.
Please note that passwords are case-sensitive.

Index	Serial number for this table entry
Community Name	Password with which this computer can access the device. This password is independent of the SNMPv3 password. If you activate the "Synchronize community to v3 password" function in the "Configuration" frame, the device synchronizes the corresponding SNMPv3 password when you change the community name.
IP Address	IP address of the computer that can access the device.
IP Mask	IP mask for the IP address
Access Mode	The access mode determines whether the computer has read-only or read-write access.
Active	Enable/disable this table entry.

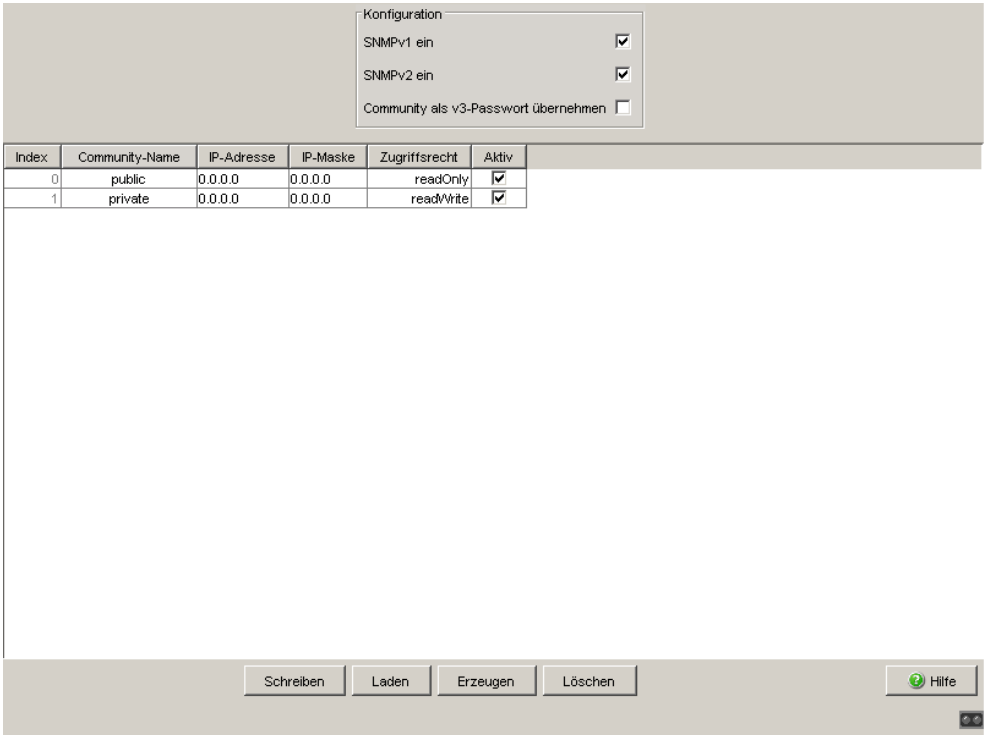


Figure 19: SNMPv1/v2 access dialog

- ☐ To create a new line in the table click “Create”.
- ☐ To delete an entry, select the line in the table and click “Remove”.

6.3 Telnet/internet/SSH access

6.3.1 Description of Telnet Access

The Telnet server of the device allows you to configure the device using the Command Line Interface (in-band). You can deactivate the Telnet server to inactivate Telnet access to the device.
The server is activated in its default setting.
After the Telnet server has been deactivated, you will no longer be able to access the device via a new Telnet connection. If a Telnet connection already exists, it is retained.

Note: The Command Line Interface (out-of-band) and the `Security:Telnet/Web/SSH Access` dialog in the graphical user interface allows you to reactivate the Telnet server.

6.3.2 Description of Web Access (http)

The device's Web server allows you to configure the device by using the graphical user interface. You can deactivate the Web server to prevent Web access to the device.
The server is activated in its default setting.

After you switch the http Web server off, it is no longer possible to log in via a http Web browser. The http session in the open browser window remains active.

6.3.3 Description of SSH Access

The device's SSH server allows you to configure the device using the Command Line Interface (in-band). You can deactivate the SSH server to prevent SSH access to the device.
The server is deactivated in its default setting.
After the SSH server has been deactivated, you will no longer be able to access the device via a new SSH connection. If an SSH connection already exists, it is retained.

Note: The Command Line Interface (out-of-band) and the `Security:Telnet/Web/SSH Access` dialog in the graphical user interface allows you to reactivate the SSH server.

Note: To be able to access the device via SSH, you require a key that has to be installed on the device. See “Preparing access via SSH” on page 271.

The device supports SSH version 1 and version 2. You have the option to define the protocol to be used.

- ☐ Open the `Security:Telnet/Web/SHH Access` dialog.
- ☐ Select the protocol to be used in the "Configuration" frame, "SSH Version" field.

`enable`	Change to the privileged EXEC mode.
`no ip ssh`	Deactivates the SSH server.
ip ssh protocol 2	The SSH server uses SSH version 2.
ip ssh protocol 1	The SSH server uses SSH version 1.
ip ssh protocol 1 2	The SSH server uses SSH versions 1 and 2.
`ip ssh`	Activates the SSH server.

6.3.4 Switching Telnet/Internet/SSH access on/off

The Web server copies a Java applet for the graphical user interface onto your computer. The applet then communicates with the device by SNMPv3 (Simple Network Management Protocol). The Web server of the device allows you to configure the device using the graphical user interface. You can switch off the Web server in order to prevent the applet from being copied.

☐ Select the `Security:Telnet/Web/SHH access` dialog.

☐ Disable the server to which you want to refuse access.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`lineconfig`	Switch to the configuration mode for CLI.
`transport input telnet`	Enable Telnet server.
`no transport input telnet`	Disable Telnet server.
`exit`	Switch to the Configuration mode.
`exit`	Switch to the privileged EXEC mode.
`ip http server`	Enable Web server.
`no ip http server`	Disable Web server.
`ip ssh`	Enable SSH function on Switch
`no ip ssh`	Disable SSH function on Switch

6.3.5 Web access through HTTPS

The HTTPS communication protocol (HyperText Transfer Protocol Secure) helps protect data transfers from interception. The device uses the HTTPS protocol to encrypt and authenticate the communications between web server and browser.
The Web server uses HTTP to load a Java applet for the graphical user interface onto your computer. This applet then communicates with the device by SNMP (Simple Network Management Protocol). If you have enabled the `Web Server (HTTPS)` function, the Java applet starts setting up a connection to the device via HTTPS. The device creates an HTTPS tunnel through the SNMP. It uses DES encoding on 56 bits. You can upload HTTPS certificates to the device.

Certificate

An X.509/PEM Standard certificate (Public Key Infrastructure) is required for the encryption. In the as-delivered state, a self-generated certificate is already present on the device.

- ☐ You can create an X509/PEM certificate using the following CLI command: `# ip https certgen`
- ☐ You can upload a new certificate using the following CLI command:
  `copy tftp://<server_ip>/<path_to_pem> nvram:httpscert`
- ☐ You can switch the HTTPS server off and on again using the following CLI command sequence:
  ```
  # no ip https server
  # ip https server
  ```

Note: If you upload a new certificate, reboot the device or the HTTPS server in order to activate the certificate.

HTTPS connection

Note: The standard port for HTTPS connection is 443. If you change the number of the HTTPS port, reboot the device or the HTTPS server in order to make the change effective.

☐ You can change the HTTPS port number using the following CLI-command (where <port_no> is the number of the HTTPS port):
`#ip https port <port_no>`

Note: If you want to use HTTPS, switch on both HTTPS and HTTP. This is required in order to load the applet. In the as-delivered state, HTTPS is switched off.

☐ Open the `Security:Telnet/Internet/SSH Access` dialog.

☐ Tick the boxes `Telnet Server active`, `Web Server(http)` and `Web Server(https)`. In the `HTTPS Port Number` box, enter the value `443`.

☐ To access the device by HTTPS, enter HTTPS instead of HTTP in your browser, followed by the IP address of the device.

`enable`	Switch to Privileged EXEC mode.
`# ip https server`	Switch on HTTPS-server.
`# ip https port <port_no>`	Set the HTTPS port number for a secure HTTP connection. - As-delivered state: 443. - Value range: 1-65535
`# no ip https server` `# ip https server`	If you change the HTTPS port number, switch the HTTPS server off and then on again in order to make the change effective.
`# show ip https`	Optional: Show the status of the HTTPS server and HTTPS port number.
`# ip https certgen`	Create X509/PEM certificates.
`# copy tftp://<server_ip>/<path_to_pem> nvram:httpscert`	Upload an X509/PEM certificate for HTTPS using TFTP.
`# no ip https server` `# ip https server`	After uploading the HTTPS certificate, switch the HTTPS server off and then on again in order to activate the certificate.:

The device uses HTTPS protocol and establishes a new connection. When the session is ended and the user logs out, the device terminates the connection.

Note: The device allows you to open HTTPS- and HTTP connections at the same time. The maximum number of HTTP(S) connections that can be open at the same time is 16.

6.4 Restricted Management Access

The device allows you to differentiate the management access to the device based on IP address ranges, and to differentiate these in turn based on management services (http, snmp, telnet, ssh). You thus have the option to set finely differentiated management access rights.

If you only want the device, which is located, for example, in a production plant, to be managed from the network of the IT department via the Web interface, but also want the administrator to be able to access it remotely via SSH, you can achieve this with the “Restricted management access” function.

You can configure this function using the graphical user interface or the CLI. The graphical user interface provides you with an easy configuration option. Make sure you do not unintentionally block your access to the device. The CLI access to the device via V.24 provided at all times is excluded from the function and cannot be restricted.

In the following example, the IT network has the address range 192.168.1.0/24 and the remote access is from a mobile phone network with the IP address range 109.237.176.0 - 109.237.176.255.

The device is already prepared for the SSH access (see on page 271 “Preparing access via SSH”) and the SSH client application already knows the fingerprint of the host key on the device.

Parameter	IT network	Mobile phone network
Network address	192.168.1.0	109.237.176.0
Netmask	255.255.255.0	255.255.255.0
Desired management access	http, snmp	ssh

Table 4: Example parameter for the restricted management access

☐ Select the `Security:Restricted Management Access` dialog.

- ☐ Leave the existing entry unchanged and use the “Create” button to create a new entry for the IT network.
- ☐ Enter the IP address 192.168.1.0.
- ☐ Enter the netmask 255.255.255.0.
- ☐ Leave the HTTP and SNMP management services activated and deactivate the Telnet and SSH services by removing the checkmarks from the respective boxes.
- ☐ Use the “Create” button to create a new entry for the mobile phone network.
- ☐ Enter the IP address 109.237.176.0.
- ☐ Enter the netmask 255.255.255.0.
- ☐ Deactivate the HTTP, SNMP and Telnet services and leave SSH activated.
- ☐ Make sure you have CLI access to the device via V.24.
- ☐ Deactivate the preset entry, because this allows everything and would cause your subsequent entries to have no effect.
- ☐ Activate the function.
- ☐ Click on “Write” to temporarily save the data.
- ☐ If your current management station is also located in the IT network, you continue to have access to the graphical user interface. Otherwise the device ignores operations via the graphical user interface, and it also rejects a restart of the graphical user interface.
- ☐ Check whether you can access the device from the IT network via http and snmp: Open the graphical user interface of the device in a browser, login on the start screen, and check whether you can read data (as user “user”) or read and write data (as user “admin”).
  Check whether the device rejects connections via telnet and ssh.
- ☐ Check whether you can access the device from the mobile phone network via ssh: Open an SSH client, make a connection to the device, login, and check whether you can read data, or read and write data.
  Check whether the device rejects connections via http, snmp and telnet.
- ☐ When you have successfully completed both tests, save the settings in the non-volatile memory. Otherwise check your configuration. If the device rejects access with the graphical user interface, use the CLI of the device to initially deactivate the function via V.24.

`enable`	Switch to the privileged EXEC mode.
`show network mgmt-access`	Display the current configuration.
`network mgmt-access add`	Create an entry for the IT network. This is given the smallest free ID - in the example, 2.
`network mgmt-access modify 2 ip 192.168.1.0`	Set the IP address of the entry for the IT network.
`network mgmt-access modify 2 netmask 255.255.255.0`	Set the netmask of the entry for the IT network.
`network mgmt-access modify 2 telnet disable`	Deactivate telnet for the entry of the IT network.
`network mgmt-access modify 2 ssh disable`	Deactivate SSH for the entry of the IT network.
`network mgmt-access add`	Create an entry for the mobile phone network. In the example, this is given the ID 3.
`network mgmt-access modify 3 ip 109.237.176.0`	Set the IP address of the entry for the mobile phone network.
`network mgmt-access modify 3 netmask 255.255.255.0`	Set the netmask of the entry for the mobile phone network.
`network mgmt-access modify 3 http disable`	Deactivate http for the entry of the mobile phone network.
`network mgmt-access modify 3 snmp disable`	Deactivate snmp for the entry of the mobile phone network.
`network mgmt-access modify 3 telnet disable`	Deactivate telnet for the entry of the mobile phone network.
`network mgmt-access status 1 disable`	Deactivate the **preset** entry.
`network mgmt-access operation enable`	Activate the function **immediately**.
`show network mgmt-access`	Display the current configuration of the function.
`copy system:running-config nvram:startup-config`	Save the entire configuration in the non-volatile memory.

6.5 HiDiscovery Access

6.5.1 Description of the HiDiscovery Protocol

The HiDiscovery protocol allows you to allocate an IP address to the device (see on page 39 “Entering the IP Parameters via HiDiscovery”). HiDiscovery v1 is a Layer 2 protocol. HiDiscovery v2 is a Layer 3 protocol.

Note: For security reasons, restrict the HiDiscovery function for the device or disable it after you have assigned the IP parameters to the device.

6.5.2 Enabling/disabling the HiDiscovery function

☐ Select the `Basic settings:Network` dialog.

☐ Disable the "HiDiscovery function in the “HiDiscovery Protocol v1/v2" frame or limit the access to `read-only`.

`enable`	Switch to the privileged EXEC mode.
`network protocol hidiscovery off`	Disable HiDiscovery function.
`network protocol hidiscovery read-only`	Enable HiDiscovery function with “read-only” access
`network protocol hidiscovery read-write`	Enable HiDiscovery function with “read-write” access

6.6 Port access control

6.6.1 Description of the port access control

You can configure the device in such a way that it helps to protect every port from unauthorized access. Depending on your selection, the device checks the MAC address or the IP address of the connected device.
The following functions are available for monitoring every individual port:

- The device can distinguish between authorized and unauthorized access and supports 2 types of access control:
  - Access for all:
    – No access restriction.
    – MAC address 00:00:00:00:00:00 or
    – IP address 0.0.0.0.
  - Access exclusively for defined MAC and IP addresses:
    – Only devices with defined MAC or IP addresses have access.
    – You can define up to 10 IP addresses and up to 50 MAC addresses or maskable MAC addresses.
- The device reacts to an unauthorized access with the following selectable actions:
  - none: no reaction
  - trapOnly: message by sending a trap
  - portDisable: message by sending a trap and disabling the port
  - autoDisable: disabling the port via the AutoDisable function with the option to enable the port again after a definable time has elapsed.

6.6.2 Application Example for Port Access Control

You have a LAN connection in a room that is accessible to everyone. To set the device so that only defined users can use this LAN connection, activate the port access control on this port. An unauthorized access attempt will cause the device to shut down the port and alert you with an alarm message. The following is known:

Parameter	Value	Explanation
Allowed IP Addresses	10.0.1.228 10.0.1.229	The defined users are the device with the IP address 10.0.1.228 and the device with the IP address 10.0.1.229
Action	portDisable	Disable the port with the corresponding entry in the port configuration table (see on page 87 “Configuring the Ports”) and send an alarm

Prerequisites for further configuration:

- The port for the LAN connection is enabled and configured correctly (see on page 87 “Configuring the Ports”)
- Prerequisites for the device to be able to send an alarm (trap) (see on page 213 “Configuring Traps”):
  - You have entered at least one recipient
  - You have set the flag in the “Active” column for at least one recipient
  - In the “Selection” frame, you have selected “Port Security”

☐ Configure the port security.

☐ Select the `Security:Port Security` dialog.

☐ In the “Configuration” frame, select “IP-Based Port Security”.

☐ In the table, click on the row of the port to be protected, in the “Allowed IP addresses” cell.
☐ Enter in sequence:
– the IP subnetwork group: 10.0.1.228
– a space character as a separator
– the IP address: 10.0.1.229
Entry: `10.0.1.228 10.0.1.229`
☐ In the table, click on the row of the port to be protected, in the “Action” cell, and select `portDisable`.

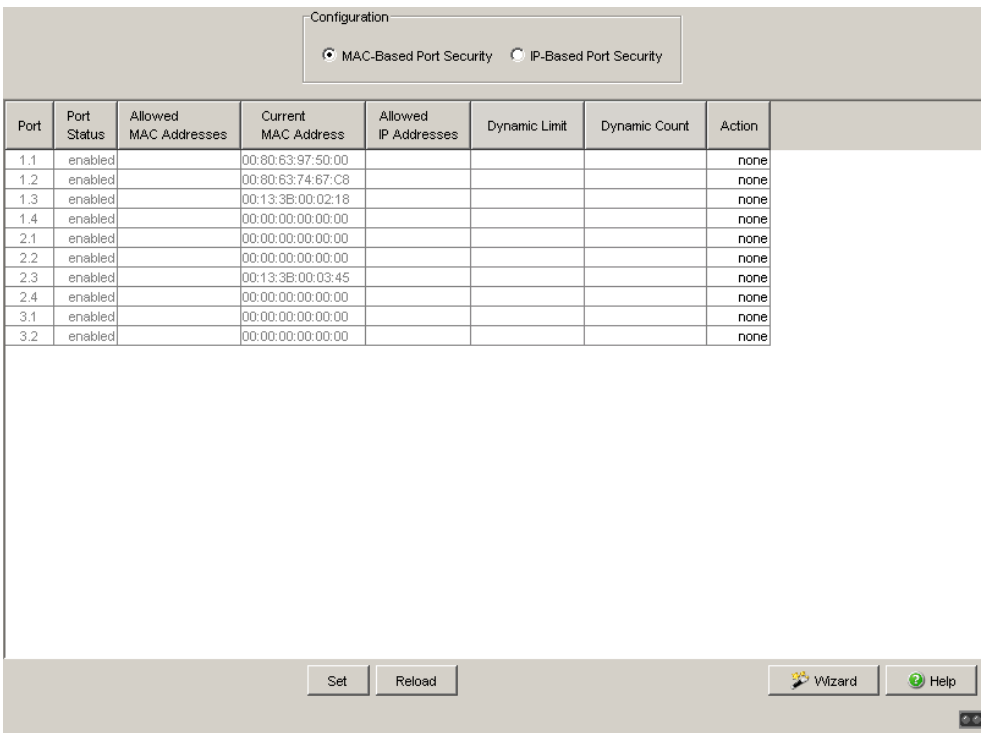


Figure 20: Port Security dialog

☐ Save the settings in the non-volatile memory.

☐ Select the dialog `Basic Settings:Load/Save`.
☐ In the “Save” frame, select “To Device” for the location and click “Save” to permanently save the configuration in the active configuration.

6.7 Port Authentication IEEE 802.1X

6.7.1 Description of Port Authentication according to IEEE 802.1X

The port-based network access control is a method described in norm IEEE 802.1X to help protect IEEE 802 networks from unauthorized access. The protocol controls the access to this port by authenticating and authorizing a terminal device that is connected to one of the device's ports.
The authentication and authorization is carried out by the authenticator, in this case the device. The device authenticates the supplicant (the querying device, e.g. a PC, etc.), which means that it permits the access to the services it provides (e.g. access to the network to which the device is connected) or denies it. In the process, the device accesses an external authentication server (RADIUS server), which checks the authentication data of the supplicant. The device exchanges the authentication data with the supplicant via the Extensible Authentication Protocol over LANs (EAPOL), and with the RADIUS server via the RADIUS protocol.

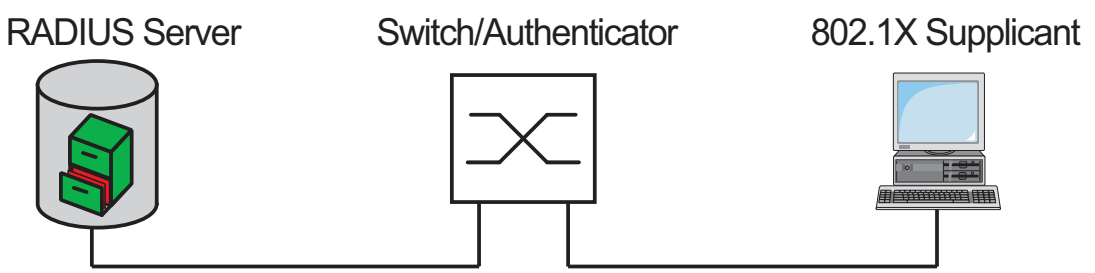


Figure 21: Radius server connection

6.7.2 Authentication Process according to IEEE 802.1X

A supplicant attempts to communicate via a device port.

- The device requests authentication from the supplicant. At this time, only EAPOL traffic is allowed between the supplicant and the device.
- The supplicant replies with its identification data.
- The device forwards the identification data to the authentication server.
- The authentication server responds to the request in accordance with the access rights.
- The device evaluates this response and provides the supplicant with access to this port (or leaves the port in the blocked state).

6.7.3 Preparing the Device for the IEEE 802.1X Port Authentication

- ☐ Configure your own IP parameters (for the device).
- ☐ Globally enable the 802.1X port authentication function.
- ☐ Set the 802.1X port control to "auto". The default setting is "force-authorized".
- ☐ Enter the "shared secret" between the authenticator and the Radius server. The shared secret is a text string specified by the RADIUS server administrator.
- ☐ Enter the IP address and the port of the RADIUS server. The default UDP port of the RADIUS server is port 1812.

6.7.4 IEEE 802.1X Settings

Configurating the RADIUS Server

☐ Select the `Security:802.1x Port Authentication:RADIUS Server` dialog.

This dialog allows you to enter the data for 1, 2 or 3 RADIUS servers.

☐ Click "Create entry" to open the dialog window for entering the IP address of a RADIUS server.
☐ Confirm the IP address entered using "OK".
You thus create a new row in the table for this RADIUS server.
☐ In the "Shared secret" column you enter the character string which you get as a key from the administrator of your RADIUS server.
☐ With "Primary server" you name this server as the first server which the device should contact for port authentication queries. If this server is not available, the device contacts the next server in the table.
☐ "Selected server" shows which server the device actually sends its queries to.
☐ With "Delete entry" you delete the selected row in the table.

Selecting Ports

☐ Select the `Security:802.1x Port Authentication:Port Configuration` dialog.
☐ In the "Port control" column you select "auto" for the ports for which you want to activate the port-related network access control.

Activating Access Control

☐ Select the `Security:802.1x Port Authentication:Global` dialog.
☐ With "Function" you enable the function.

6.8 Access Control Lists (ACL)

You can use Access Control Lists (ACL) to filter out, forward, divert or prioritize data packets as they are received. The device provides

- MAC-based ACLs and
- IP-based ACLs.

The device considers the ACLs when it receives a package. This is why the lists are called Ingress ACLs.

You configure Access Control Lists via the Command Line Interface. You will find details on this in the document “Reference Manual Command Line Interface“.

The device provides the following ACL capabilities:

- Up to 100 ACLs
- 10 rules per ACL,
- Up to 20 rules per interface,
- Up to 1000 rules on all interfaces combined
- Possible actions:
  - permit and deny,
  - in combination with permit: assign queue and redirect - i.e. if a rule applies, the packet is forwarded to the specific interface.
- “Deny everything” is always the (invisible) final rule. It comes into effect if no other rules apply to this interface.

The configuration of ACLs consists of the following steps:

☐ First define ACL and then
☐ attach the ACL to one or all interfaces.
You can attach ACLs to all physical ports and to all link aggregation interfaces.

Note: You configure Access Control Lists via the Command Line Interface. You will find details on this in the document “Reference Manual Command Line Interface“.

The sequence used in defining the rules of a list and the sequence in which these lists are connected to an interface determines the sequence in which the rules and lists are used (see on page 125 “Specifying the Sequence of the Rules”).

Note: With PowerMICE and MACH 4000, you can use either MAC-based or IP-based ACLs for each interface.
With MACH 4002-24G/48G, you can use both MAC-based and IP-based ACLs for each interface.

6.8.1 Description of prioritizing with ACLs

Prioritizing with ACLs provides you with an extension of the prioritizing function. Using the “assign queue” ACL action, you can perform extended prioritizing using protocols, source and destination addresses, VLAN ID, and so on (see on page 118 “Description of IP-based ACLs”),(see on page 119 “Description of MAC-based ACLs”).

If an ACL rule containing an assign queue action applies to a packet received, the device modifies the priority information in the data packet (see on page 175 “QoS/Priority”) according to the specified (see table 5) assign queue parameter. This procedure is known as ACL remarking. The device sends the data packets with the modified priority information.

Assign queue parameter	VLAN priority	DSCP
0	0	CS0 (0)
1	1	CS1 (8)
2	2	CS2 (16)
3	3	CS3 (24)
4	4	CS4 (32)
5	5	CS5 (40)
6	6	CS6 (48)
7	7	CS7 (56)

Table 5: Assigning the assign queue parameters to the modified VLAN priority and to the modified DSCP value

6.8.2 Description of IP-based ACLs

The device differentiates between standard and extended IP-based ACLs. ACLs with an ID number (ACL ID)

- 1 to 99 are standard IP-based ACLs and
- 100 to 199 are extended IP-based ACLs.

Standard IP-based ACLs provide the following criteria for filtering:

- IP source address with netmask
- All data packets (match any)

Extended IP-based ACLs provide the following criteria for filtering:

- All data packets (every)
- Protocol number or protocol (IP, ICMP, IGMP, TCP, UDP)
- IP source address with netmask or all IP source addresses (any)
- Layer 4 protocol port number of the source (UDP port, TCP port)
- IP destination address with netmask or all IP destination addresses (any)
- Layer 4 protocol port number of the destination (UDP port, TCP port)
- ToS field with mask

- DSCP field
- IP precedence field

Note: If you are using IP ACLs at ports which are located in the HIPER-Ring or which participate in the Ring/network coupling, you add the following rule to the ACLs:

- PERMIT
- Protocol: UDP
- Source IP: ANY
- Destination IP: 0.0.0.0/32
- Source port: 0
- Destination port: 0
- CLI command (1xx stands for 100..199):

```
access-list 1xx permit udp any eq 0
0.0.0.0 0.0.0.0 eq 0
```

Note: IP address masks in the rules of ACLs are inverse.
This means that if you want to mask a single IP address, you select the netmask 0.0.0.0.

6.8.3 Description of MAC-based ACLs

While you use an ID number to identify IP-based ACLs, you use a unique name of your choice to identify MAC-based ACLs.

MAC-based ACLs provide the following criteria for filtering:

- Source MAC address with masks or all sources (any)
- Destination MAC address or all destinations (any)
- Ethernet type

- VLAN ID
- VLAN priority (COS)
- Secondary VLAN ID
- Secondary VLAN priority

Note: If you are using MAC ACLs at ports which are located in the HIPER-Ring or which participate in the Ring/network coupling, you add the following rule to the ACLs:

- PERMIT
- Source MAC: ANY
- Destination MAC: 00:80:63:00:00:00
- Destination MAC mask: 01:00:00:ff:ff:ff
- CLI command in Config-mac-access mode:
  `permit any 00:80:63:00:00:00 01:00:00:ff:ff:ff`

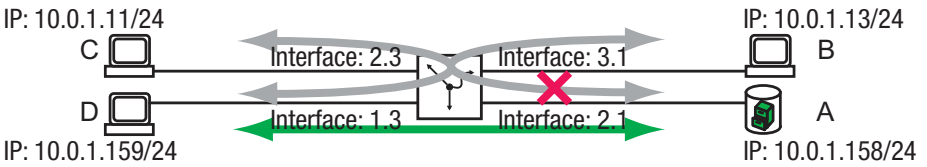
Note: If you are using MAC ACLs at ports located in the MRP-Ring, you add the following rule to the ACLs:

- PERMIT
- Source MAC: ANY
- Destination MAC: 01:15:4E:00:00:00
- Destination MAC mask: 00:00:00:00:00:03
- CLI command in the Config-mac-access mode:
  `permit any 01:15:4E:00:00:00 00:00:00:00:00:03`

Note: MAC address masks in the rules of ACLs are inverse.
This means that if you want to mask a single MAC address, you select the network mask 00:00:00:00:00:00.
If you want to mask MAC addresses in the range from 00:80:63:00:00:00 to 00:80:63:FF:FF:FF, you select the network mask 00:00:00:FF:FF:FF.

6.8.4 Configuring IP ACLs

Example: Extended ACL



B and C are not allowed to communicate with A.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`access-list 100 deny ip 10.0.1.11 0.0.0.0 10.0.1.158 0.0.0.0`	Erzeugt die erweiterte ACL 100 mit der 1. Regel. Diese verweigert den Datenverkehr von der IP-Quelladresse 10.0.1.11 zur IP-Zieladresse 10.0.1.158.
`access-list 100 permit ip any any`	Fügt der ACL 100 eine weitere Regel hinzu. Diese erlaubt den Datenverkehr von jeder IP-Quelladresse zu jeder IP-Zieladresse.
`access-list 110 deny ip 10.0.1.13 0.0.0.0 10.0.1.158 0.0.0.0`	Erzeugt die erweiterte ACL 110 mit der 1. Regel. Diese verweigert den Datenverkehr von der IP-Quelladresse 10.0.1.13 zur IP-Zieladresse 10.0.1.158.
`access-list 110 permit ip any any`	Fügt der ACL 110 eine weitere Regel hinzu. Diese erlaubt den Datenverkehr von jeder IP-Quelladresse zu jeder IP-Zieladresse.
`exit`	Change to the privileged EXEC mode.
`show ip access-lists 100`	Zeigt die Regeln von ACL 100 an.

```
ACL ID: 100


Rule Number: 1
Action..................................... deny
Match All.................................. FALSE
Protocol................................... 255(ip)
Source IP Address.......................... 10.0.1.11
Source IP Mask............................. 0.0.0.0
Destination IP Address..................... 10.0.1.158
Destination IP Mask........................ 0.0.0.0

Rule Number: 2
Action..................................... permit
Match All.................................. TRUE
```

`configure`	Change to the Configuration mode.
`interface 2/3`	Change to the Interface Configuration mode of interface 2/3.
`ip access-group 100 in`	Bindet die ACL 100 für empfangene Daten an das Interface 2.3.
`exit`	Change to the Configuration mode.
`interface 3/1`	Wechsel in den Interface-Konfigurationsmodus von Interface 3.1.
`ip access-group 110 in`	Bindet die ACL 110 für empfangene Daten an das Interface 3.1.
`exit`	Change to the Configuration mode.
`exit`	Change to the privileged EXEC mode.

```
show access-lists interface 2/3 in

ACL Type             ACL ID                Sequence Number
-------- ------------------------------ ---------------
IP       100                            1
```

6.8.5 Configuring MAC ACLs

Example: MAC ACL
Filtering AppleTalk and IPX from the entire network.

```
enable                              Switch to the privileged EXEC mode.
configure                           Switch to the Configuration mode.
mac access-list extended            Create the extended ACL “ipx-apple”.
  ipx-apple
  deny any any ipx                  Add the rule “deny IPX” to the list.
  deny any any appletalk            Add the rule “deny AppleTalk” to the list.
  permit any any                    Add the rule “permit all other data” to the list.
exit                                Switch to the Configuration mode.

mac access-group ipx-apple          Attach the ACL “ipx-apple” to all interfaces.
  in
exit                                Switch to the privileged EXEC mode.

show mac access-lists               Display the ACLs..
     MAC ACL Name                    Rules Direction      Interface(s)
------------------------------- ----- --------- ------------------
ipx-apple                        3     inbound   1/1,1/2,1/3,1/4,2/
                                                 1,2/2,2/3,2/4,3/1,3/2
show access-lists interface         Display the ACLs of interface 1.1.
  1/1 in
ACL Type             ACL ID              Sequence Number
-------- ------------------------------ ---------------
MAC      ipx-apple                      1
```

6.8.6 Configuring Priorities with IP ACLs

Example: Prioritizing Multicast streams.

- Assign priority 6 to the Multicast streams with the IP Multicast destination addresses 239.1.1.1 to 239.1.1.255 and
- Assign priority 5 to the Multicast streams with the IP Multicast destination addresses 237.1.1.1 to 237.1.1.255 and

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`access-list 102 permit ip any 239.1.1.1 0.0.0.255 assign-queue 6`	Create the extended ACL 102 with the first rule. This rule assigns priority 6 to the IP Multicast destination addresses 239.1.1.1 with the mask 0.0.0.255.
`access-list 102 permit ip any 237.1.1.1 0.0.0.255 assign-queue 5`	Add another rule to the ACL 102. This rule assigns priority 5 to the IP Multicast destination addresses 237.1.1.1 with the mask 0.0.0.255.
`exit`	Switch to the privileged EXEC mode.
`show ip access-lists 102`	Displays the rules of ACL 102.

```
ACL ID: 102

Rule Number: 1
Action..................................... permit
Match All.................................. FALSE
Protocol................................... 255(ip)
Destination IP Address..................... 239.1.1.1
Destination IP Mask........................ 0.0.0.255
Assign Queue............................... 6

Rule Number: 2
Action..................................... permit
Match All.................................. FALSE
Protocol................................... 255(ip)
Destination IP Address..................... 237.1.1.1
Destination IP Mask........................ 0.0.0.255
Assign Queue............................... 5
```

Example: Extended ACL with prioritizing using the Simple Network Management Protocol (SNMP, Layer 4)

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`access-list 104 permit udp any any eq snmp assign-queue 5`	Create the extended ACL 104 with the first rule. This rule assigns priority 5 to all SNMP packets with the UDP destination port (=161). This rule overwrites any priority contained in a VLAN tag with the value 5, and also overwrites the IP-DSCP value with cs5.
`exit`	Change to the privileged EXEC mode.
`show ip access-lists 104`	Displays the rules of ACL 104.

```
ACL ID: 104


Rule Number: 1
Action..................................... permit
Match All.................................. FALSE
Protocol................................... 17(udp)
Destination L4 Port Keyword................ 161(snmp)
Assign Queue............................... 5
```

`configure`	Change to the Configuration mode.
`interface 2/1`	Switch to the Interface Configuration mode of interface 2/1.
`ip access-group 104 in`	Attaches ACL 104 to interface 2.1.
`exit`	Change to the Configuration mode.
`exit`	Change to the privileged EXEC mode.
`show access-lists interface 2/1 in`	Display the ACLs attached to interface 2.1 forreceived data packets.

```
ACL Type             ACL ID                 Sequence Number
-------- ------------------------------ ---------------
IP       100                            1
IP       102                            3
IP       104                            4
```

ACL 100 contains the rule “permit all” at the end. Thus the ACLs 102 and 104 are never applied. You can use the sequence number to alter the sequence for processing the ACLs (see on page 125 “Specifying the Sequence of the Rules”).

6.8.7 Specifying the Sequence of the Rules

The sequence of the ACLs determines their usage. The first list that applies is used, and all subsequent rules are ignored. You can influence the sequence by assigning the sequence number. A small sequence number has precedence over a higher one.

```
enable                          Switch to the privileged EXEC mode.
configure                       Switch to the Configuration mode.
ip access-group 100 in 30       Assign sequence number 30 to ACL 100.
ip access-group 102 in 10       Assign sequence number 10 to ACL 102.
ip access-group 104 in 20       Assign sequence number 20 to ACL 104.
exit                            Switch to the privileged EXEC mode.
show access-lists interface     Display the ACLs attached to interface 2.1 for
  2/1 in                        received data packets.

ACL Type             ACL ID                 Sequence Number
-------- ------------------------------ ---------------
IP       100                            30
IP       104                            20
IP       102                            10
```

6.8.8 ACLs for Layer 4 fragments

Splitting a long data packet into a number of shorter data packets is known as fragmenting. For example, some transferring routers fragment a Layer 4 data packet into a number of Layer 3 data packets if the length of the data packet is greater than the MTU (Maximum Transmission Unit) of the transferring interface.

Only the first Layer 3 data packet contains the Layer 4 header, e.g. TCP or UDP. The following data packets with the Layer 4 fragments do not contain any Layer 4 headers that can be evaluated. Therefore, ACLs drop these data packets. The MACH104, MACH1040 and MACH4002 24G/48G devices process Layer 4 fragments and allow you to forward these data packets also.

When you set up an ACL for Layer 4, the device uses the user-defined rule to automatically create a second rule for the fragments:

- The user-defined rule processes the data packet with the first Layer 4 fragment.
- The automatically created rule processes the data packets with the following Layer 4 fragments.

Therefore, when the fragment processing is activated, the maximum possible number of ACLs in the device is reduced.

You activate the processing of Layer 4 fragments globally in the device:

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`access-list fragments`	Activate the fragment processing in the device.
`exit`	Change to the privileged EXEC mode.
`show access-lists global`	Display the global ACL settings of the device.

```
L4 Fragment Processing..................... Enabled
```

6.9 Login Banner

The device gives you the option of displaying a greeting text to users before they login to the device. The users see this greeting text in the login dialog of the graphical user interface (GUI) and of the Command Line Interface (CLI).

Users logging in with SSH see the greeting text - depending on the client used - before or during the login.

Perform the following work steps:

- ☐ Open the `Security:Login Banner` dialog, "Login Banner" tab.
- ☐ Enter the greeting text in the "Banner Text" frame.
  Max. 255 characters allowed.
- ☐ To switch on the function, in the "Operation" frame, mark the "On" radio button.
- ☐ Click "Set" to save the changes temporarily.

`enable`	Change to the privileged EXEC mode.
`set pre-login-banner text "<string>"`	Assign the greeting text: – Put the text in quotation marks. – Max. 255 characters allowed. – Insert tab using string `\\t`. – Insert line break using string `\\n`.
`set pre-login-banner operation`	Switching the function on.
`logout`	Logout from device. The text is visible before you login again.

6.10 CLI Banner

In the default setting, the CLI start screen shows information about the device, such as the software version and the device settings. The "CLI Banner" function allows you to replace this information with an individual text.

Perform the following work steps:

- ☐ Open the `Security:Login/CLI Banner` dialog, "CLI Banner" tab.
- ☐ In the "Banner Text" frame, enter the text of your choice. Max. 2048 characters allowed.
- ☐ To switch on the function, in the "Operation" frame, mark the "On" radio button.
- ☐ Click "Set" to save the changes temporarily.

`enable`	Change to the privileged EXEC mode.
`set clibanner text "<string>"`	Assign the text to: – Put the text in quotation marks. – Max. 2048 characters allowed. – Insert tab using string `\\t`. – Insert line break using string `\\n`.
`set clibanner operation`	Switching the function on.
`logout`	Logout from device. The text is visible before you login again.

7 Synchronizing the System Time in the Network

The actual meaning of the term “real time” depends on the time requirements of the application.

The device provides two options with different levels of accuracy for synchronizing the time in your network.

The Simple Network Time Protocol (SNTP) is a simple solution for low accuracy requirements. Under ideal conditions, SNTP achieves an accuracy in the millisecond range. The accuracy depends on the signal delay.

IEEE 1588 with the Precision Time Protocol (PTP) achieves accuracies on the order of fractions of microseconds. This method is suitable even for demanding applications up to and including process control.

Examples of application areas include:
- Log entries
- Time stamping of production data
- Process control

Select the method (SNMP or PTP) that best suits your requirements. You can also use both methods simultaneously if you consider that they interact.

7.1 Setting the time

If no reference clock is available, you have the option of entering the system time in a device and then using it like a reference clock (see on page 136 “Configuring SNTP”), (see on page 147 “Application Example”).

The device is equipped with a buffered hardware clock. This keeps the current time

- if the power supply fails or
- if you disconnect the device from the power supply.

Thus the current time is available to you again, e.g. for log entries, when the device is started.
The hardware clock bridges a power supply downtime of 1 hour. The prerequisite is that the power supply of the device has been connected continually for at least 5 minutes beforehand.

Note: When setting the time in zones with summer and winter times, make an adjustment for the local offset. The device can also get the SNTP server IP address and the local offset from a DHCP server.

☐ Open the `Time:Basic Settings` dialog.

With this dialog you can enter time-related settings independently of the time synchronization protocol selected.

- “System time (UTC)” displays the time determined using SNTP or PTP.
  The display is the same worldwide. Local time differences are not taken into account.

  Note: If the time source is PTP, consider that the PTP time uses the TAI time scale. TAI time is 34 s ahead of UTC time (as of 01.01.2011).
  If the UTC offset is configured correctly on the PTP reference clock, the device corrects this difference automatically when displaying “System time (UTC)”.
- The "System Time" uses "System Time (UTC)", allowing for the local time difference from "System Time (UTC)".
  "System Time" = "System Time (UTC)" + "Local Offset".
- Time Source displays the source of the following time data. The device automatically selects the source with the greatest accuracy. Possible sources are: `local`, `ptp` and `sntp`. The source is initially `local`.
  If PTP is activated and the device receives a valid PTP frame, it sets its time source to `ptp`. If SNTP is activated and if the device receives a valid SNTP packet, the device sets its time source to `sntp`. The device gives the PTP time source priority over SNTP.
- ☐ With "Set Time from PC", the device takes the PC time as the system time and calculates the "System Time (UTC)" using the local time difference.
  "System Time (UTC)" = "System Time" - "Local Offset"
- ☐ The "Local Offset" is for displaying/entering the time difference between the local time and the "System Time (UTC)".

  With "Set Offset from PC", the device determines the time zone on your PC and uses it to calculate the local time difference.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`sntp time <YYYY-MM-DD HH:MM:SS>`	Set the system time of the device.
`sntp client offset <-1000 to 1000>`	Enter the time difference between the local time and the "System Time (UTC)".

7.2 SNTP

7.2.1 Description of SNTP

The Simple Network Time Protocol (SNTP) enables you to synchronize the system time in your network.
The device supports the SNTP client and the SNTP server function.

The SNTP server makes the UTC (Universal Time Coordinated) available. UTC is the time relating to the coordinated world time measurement. The time displayed is the same worldwide. Local time differences are not taken into account.

SNTP uses the same packet format as NTP. In this way, an SNTP client can receive the time from an SNTP server as well as from an NTP server.

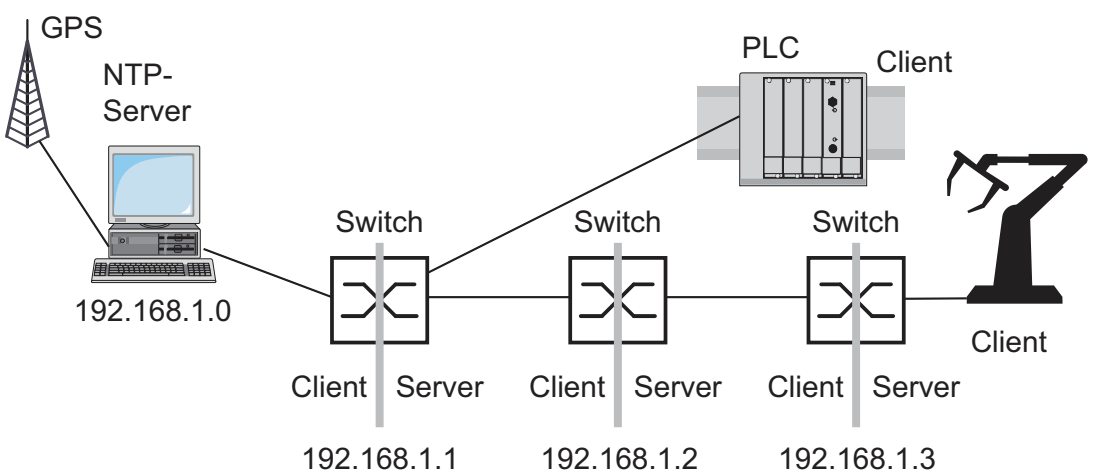


Figure 22: SNTP cascade

7.2.2 Preparing the SNTP Configuration

☐ To get an overview of how the time is passed on, draw a network plan with the devices participating in SNTP. When planning, bear in mind that the accuracy of the time depends on the signal runtime.

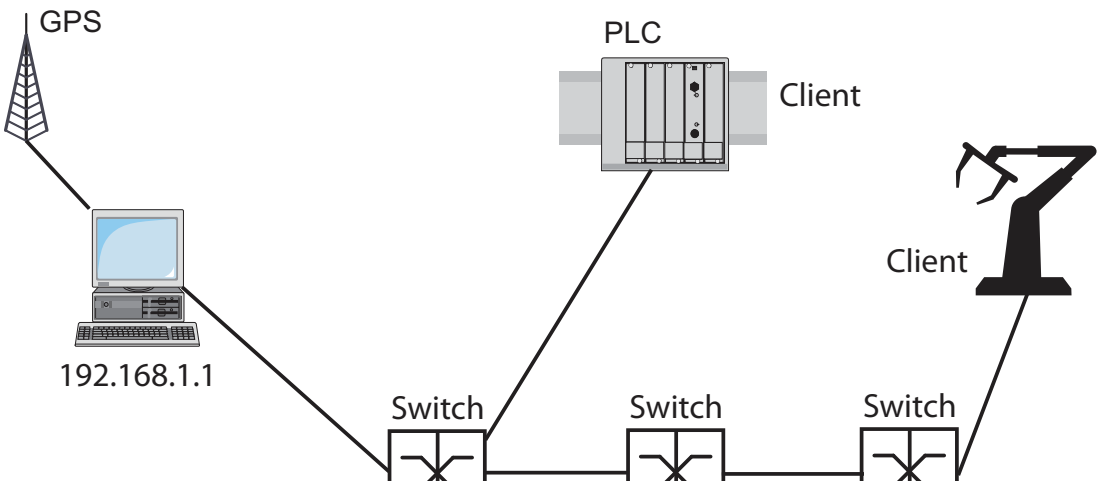


Figure 23: Example of SNTP cascade

☐ Enable the SNTP function on the devices whose time you want to set using SNTP.
The SNTP server of the device responds to Unicast requests as soon as it is enabled.

☐ If no reference clock is available, specify a device as the reference clock and set its system time as accurately as possible.

Note: For accurate system time distribution with cascaded SNTP servers and clients, use only network components (routers, switches, hubs) in the signal path between the SNTP server and the SNTP client which forward SNTP packets with a minimized delay.

7.2.3 Configuring SNTP

☐ Select the `Time:SNTP` dialog.

▶ Operation

☐ In this frame you switch the SNTP function on/off globally.

▶ SNTP Status

☐ The “Status message” displays statuses of the SNTP client as one or more test messages, `e.g. Server 2 not responding`.

▶ Configuration SNTP Client

☐ In “Client status” you switch the SNTP client of the device on/off.

☐ In “External server address” you enter the IP address of the SNTP server from which the device periodically requests the system time.

☐ In “Redundant server address” you enter the IP address of the SNTP server from which the device periodically requests the system time, if it does not receive a response to a request from the “External server address” within 1 second.

Note: If you are receiving the system time from an external/redundant server address, enter the dedicated server adress(es) and disable the setting `Accept SNTP Broadcasts` (see below). You thus ensure that the device uses the time of the server(s) entered and does not synchronize to broadcasts that might not be trustworthy.

☐ In “Server request interval” you specify the interval at which the device requests SNTP packets (valid entries: 1 s to 3600 s, on delivery: 30 s).

☐ With “Accept SNTP Broadcasts” the device takes the system time from SNTP Broadcast/Multicast packets that it receives.

☐ With “Deactivate client after synchronization”, the device only synchronizes its system time with the SNTP server one time after the client status is activated, then it switches the client off.

Note: If you have enabled PTP at the same time, the SNTP client first collects 60 time stamps before it deactivates itself. The device thus determines the drift compensation for its PTP clock. With the preset server request interval, this takes about half an hour.

SNTP server configuration

- ☐ In "Server-Status", switch the device's SNTP server on/off.
- ☐ In “Anycast destination address” you enter the IP address to which the SNTP server of the device sends its SNTP packets (see table 6).
- ☐ In "VLAN ID", enter the VLAN over which the device will be cyclically sending its SNTP packets.
- ☐ In “Anycast send interval” you specify the interval at which the device sends SNTP packets (valid entries: 1 s to 3600 s, on delivery: 120 s).
- ☐ With “Disable Server at local time source” the device disables the SNTP server function if the source of the time is `local` (see `Time` dialog).

IP destination address	Send SNTP packet to
0.0.0.0	Nobody
Unicast address (0.0.0.1 - 223.255.255.254)	Unicast address
Multicast address (224.0.0.0 - 239.255.255.254), especially 224.0.1.1 (NTP address)	Multicast address
255.255.255.255	Broadcast address

Table 6: Destination address classes for SNTP and NTP packets

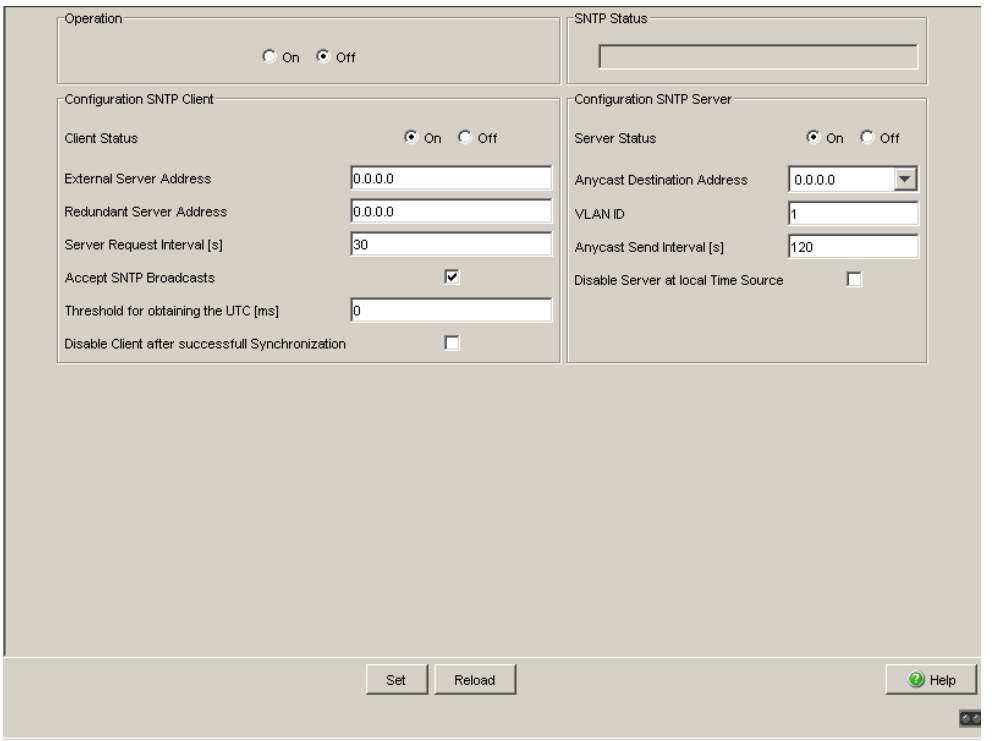


Figure 24: SNTP Dialog

Device	192.168.1.1	192.168.1.2	192.168.1.3
Operation	On	On	On
Server destination address	0.0.0.0	0.0.0.0	0.0.0.0
Server VLAN ID	1	1	1
Send interval	120	120	120
Client external server address	192.168.1.0	192.168.1.1	192.168.1.2
Request interval	30	30	30
Accept Broadcasts	No	No	No

Table 7: Settings for the example (see figure 23)

7.3 Precision Time Protocol

7.3.1 Description of PTP Functions

Precise time management is required for running time-critical applications via a LAN.
The IEEE 1588 standard with the Precision Time Protocol (PTP) describes a procedure that determines the best master clock in a LAN and thus enables precise synchronization of the clocks in this LAN.

This procedure enable the synchronization of the clocks involved to an accuracy of a few 100 ns. The synchronization messages have virtually no effect on the network load. PTP uses Multicast communication.

Factors influencing precision are:

- Accuracy of the reference clock
  IEEE 1588 classifies clocks according to their accuracy. An algorithm that measures the accuracy of the clocks available in the network specifies the most accurate clock as the "Grandmaster" clock.

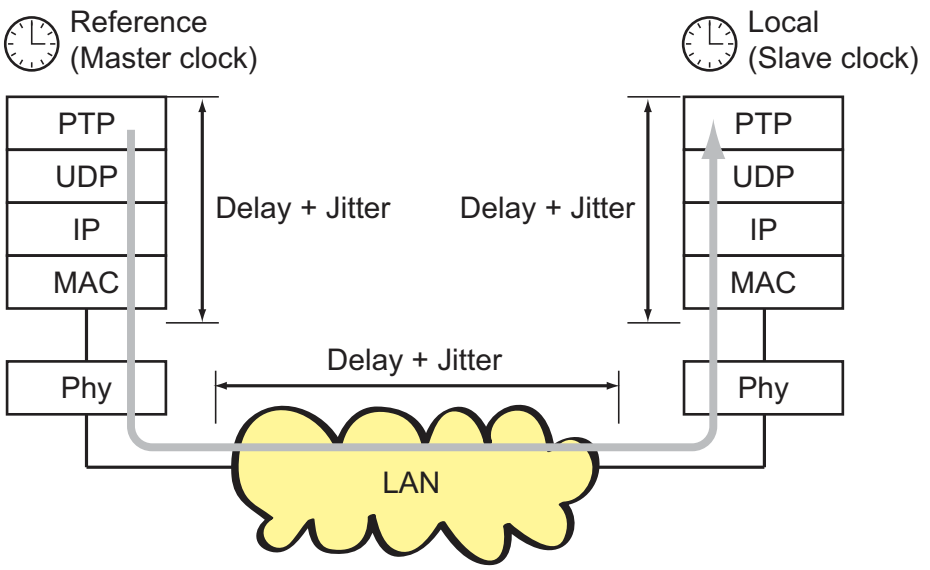
PTPv1 Stratum number	PTPv2 Clock class	Specification
0	– (priority 1 = 0)	For temporary, special purposes, in order to assign a higher accuracy to one clock than to all other clocks in the network.
1	6	Indicates the reference clock with the highest degree of accuracy. The clock can be both a boundary clock and an ordinary clock. Stratum 1/ clock class 6 clocks include GPS clocks and calibrated atomic clocks. A stratum 1 clock cannot be synchronized using the PTP from another clock in the PTP system.
2	6	Indicates the second-choice reference clock.

Table 8: Stratum – classifying the clocks

PTPv1 Stratum number	PTPv2 Clock class	Specification
3	187	Indicates the reference clock that can be synchronized via an external connection.
4	248	Indicates the reference clock that cannot be synchronized via an external connection. This is the standard setting for boundary clocks.
5–254	–	Reserved.
255	255	Such a clock should never be used as the so-called best master clock.

Table 8: Stratum – classifying the clocks

- Cable delays; device delays
  The communication protocol specified by IEEE 1588 enables delays to be determined. Algorithms for calculating the current time cancel out these delays.
- Accuracy of local clocks
  The communication protocol specified by IEEE 1588 takes into account the inaccuracy of local clocks in relation to the reference clock. Calculation formulas permit the synchronization of the local time, taking into account the inaccuracy of the local clock in relation to the reference clock.



PTP	Precision Time Protocol (Application Layer)
UDP	User Datagramm Protocol (Transport Layer)
IP	Internet Protocol (Network Layer)
MAC	Media Access Control
Phy	Physical Layer

Figure 25: Delay and jitter for clock synchronization

To get around the delay and jitter in the protocol stack, IEEE 1588 recommends inserting a special hardware time stamp unit between the MAC and Phy layers.
Devices/modules with the “-RT” suffix in their names are equipped with this time stamp unit and support PTP version 1. Media modules MM23 and MM33 support PTP version 1 and PTP version 2.

The delay and jitter in the LAN increase in the media and transmission devices along the transmission path.

With the introduction of PTP version 2, two procedures are available for the delay measurement:

- End-to-End (E2E)
  E2E corresponds to the procedure used by PTP version 1. Every slave clock measures only the delay to its master clock.
- Peer-to-Peer (P2P)
  With P2P, like in E2E, every slave clock measures the delay to its master clock. In addition, in P2P every master clock measures the delay to the slave clock. For example, if a redundant ring is interrupted, the slave clock can become the master clock and the master clock can become the slave clock. This switch in the synchronization direction takes place without any loss of precision, as with P2P the delay in the other direction is already known.

The cable delays are relatively constant. Changes occur very slowly. IEEE 1588 takes this fact into account by regularly making measurements and calculations.

IEEE 1588 eliminates the inaccuracy caused by delays and jitter by defining boundary clocks. Boundary clocks are clocks integrated into devices. These clocks are synchronized on the one side of the signal path, and on the other side of the signal path they are used to synchronize the subsequent clocks (ordinary clocks).
PTP version 2 also defines what are known as transparent clocks. A transparent clock cannot itself be a reference clock, nor can it synchronize itself with a reference clock. However, it corrects the PTP messages it transmits by its own delay time and thus removes the jitter caused by the transmission. When cascading multiple clocks in particular, you can use transparent clocks to achieve greater time precision for the connected terminal devices than with boundary clocks

The Power Profile TLV Check is available on Mice, PowerMICE, MACH1040, MACH104 devices. When enabled this function checks for the presents of Power TLVs. Use the following worksteps to enable the device to check for announce messages containing Power Profile TLVs and use the TLVs for syntonization:

☐ Open the `Time:PTP:Version 2(TC):Global` dialog.

☐ Select the "Power TLV Check" checkbox

☐ Select the "Syntonize" checkbox

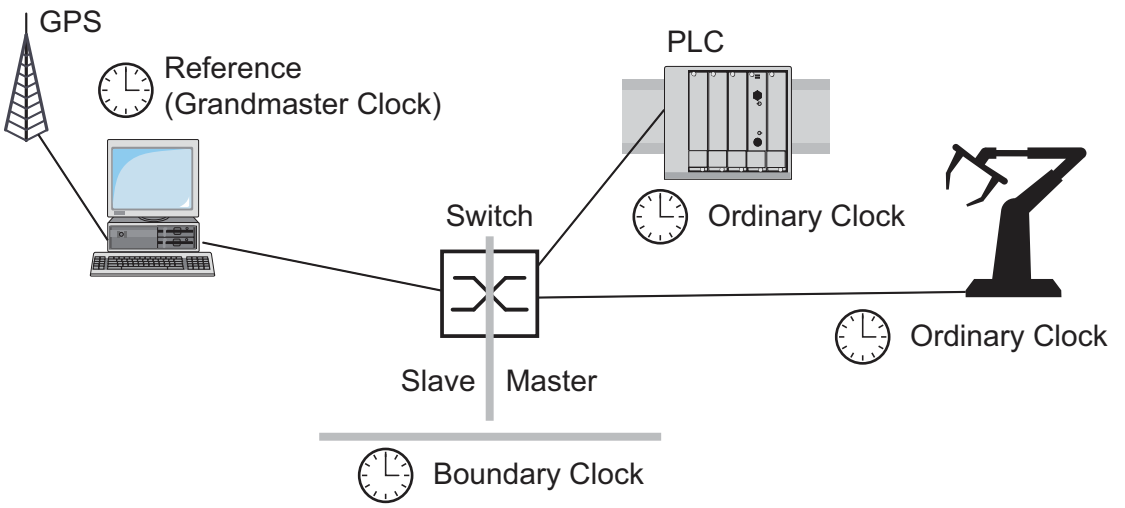


Figure 26: Position of the boundary clock in a network

Irrespective of the physical communication paths, the PTP allocates logical communication paths which you define by setting up PTP subdomains. The purpose of subdomains is to form groups of clocks which are chronologically independent from the other domains. The clocks in one group typically use the same communication paths as other clocks.

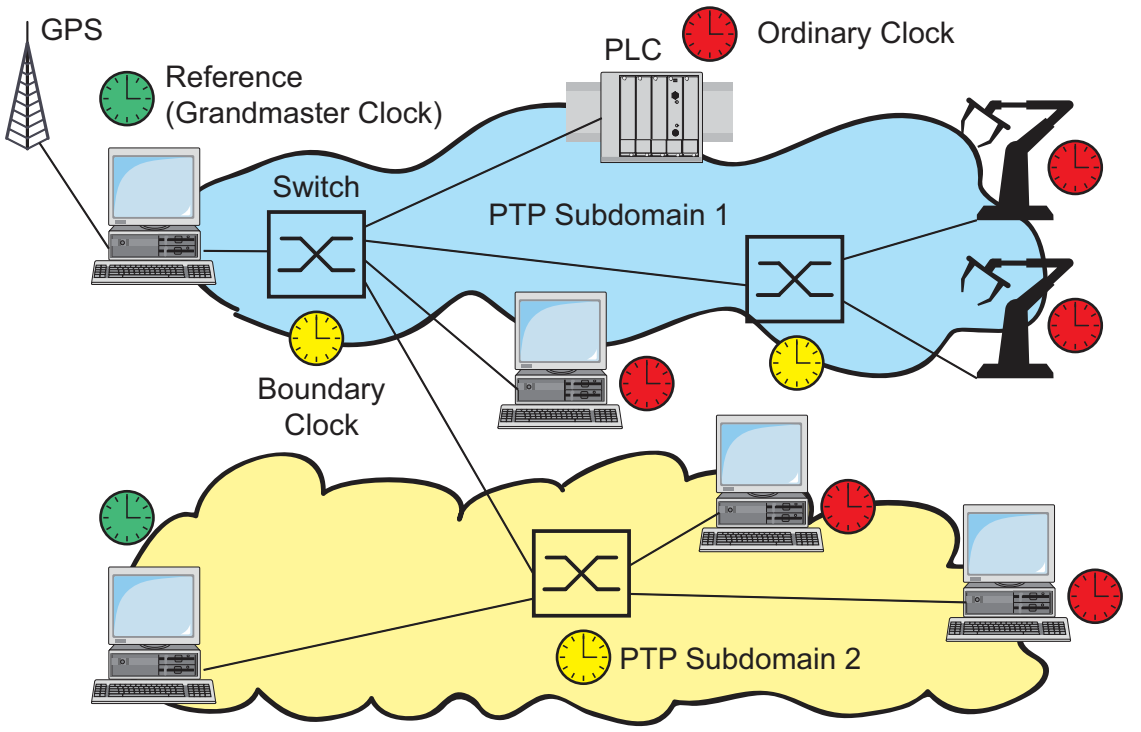


Figure 27: PTP subdomains

7.3.2 Preparing the PTP Configuration

After the function is activated, the PTP takes over the configuration automatically.

☐ To gain an overview of the distribution of clocks, draw a network plan with the devices involved in PTP.

Note: Connect all the connections you need to distribute the PTP information to connections with an integrated time stamp unit (RT modules).
Devices without a time stamp unit take the information from the PTP and use it to set their clocks. They are not involved in the protocol.

☐ Enable the PTP function on devices whose time you want to synchronize using PTP.

☐ Select the PTP version and the PTP mode. Select the same PTP version for all the devices that you want to synchronize.

PTP mode	Application
v1-simple-mode	Support for PTPv1 without special hardware. The device synchronizes itself with received PTPv1 messages. Select this mode for devices without a timestamp unit (RT module).
v1-boundary-clock	Boundary Clock function based on IEEE 1588-2002 (PTPv1).
v2-boundary-clock-onestep	Boundary Clock function based on IEEE 1588-2008 (PTPv2) for devices with MM23 and MM33 media modules. The one-step mode determines the precise PTP time with one message.
v2-boundary-clock-twostep	Boundary Clock function based on IEEE 1588-2008 (PTPv2) for devices with RT modules. The two-step mode determines the precise PTP time with two messages.

Table 9: Selecting a PTP mode

PTP mode	Application
v2-simple-mode	Support for PTPv2 without special hardware. The device synchronizes itself with received PTPv2 messages. Select this mode for devices without a timestamp unit (RT module).
v2-transparent-clock	Transparent Clock (one-step) function based on IEEE 1588-2008 (PTPv2) for devices with MM23 and MM33 media modules.

Table 9: Selecting a PTP mode

☐ If no reference clock is available, you specify a device as the reference clock and set its system time as accurately as possible.

7.3.3 Application Example

PTP is used to synchronize the time in the network. As an SNTP client, the left device (see figure 28) gets the time from the NTP server via SNTP. The device assigns PTP clock stratum 2 (PTPv1) or clock class 6 (PTPv2) to the time received from an NTP server. Thus the left device becomes the reference clock for the PTP synchronization and is the “preferred master”. The “preferred master” forwards the exact time signal via its connections to the RT module. The device with the RT module receives the exact time signal at a connection of its RT module and thus has the clock mode “v1-boundary-clock”. The devices without an RT module have the clock mode “v1-simple-mode”.

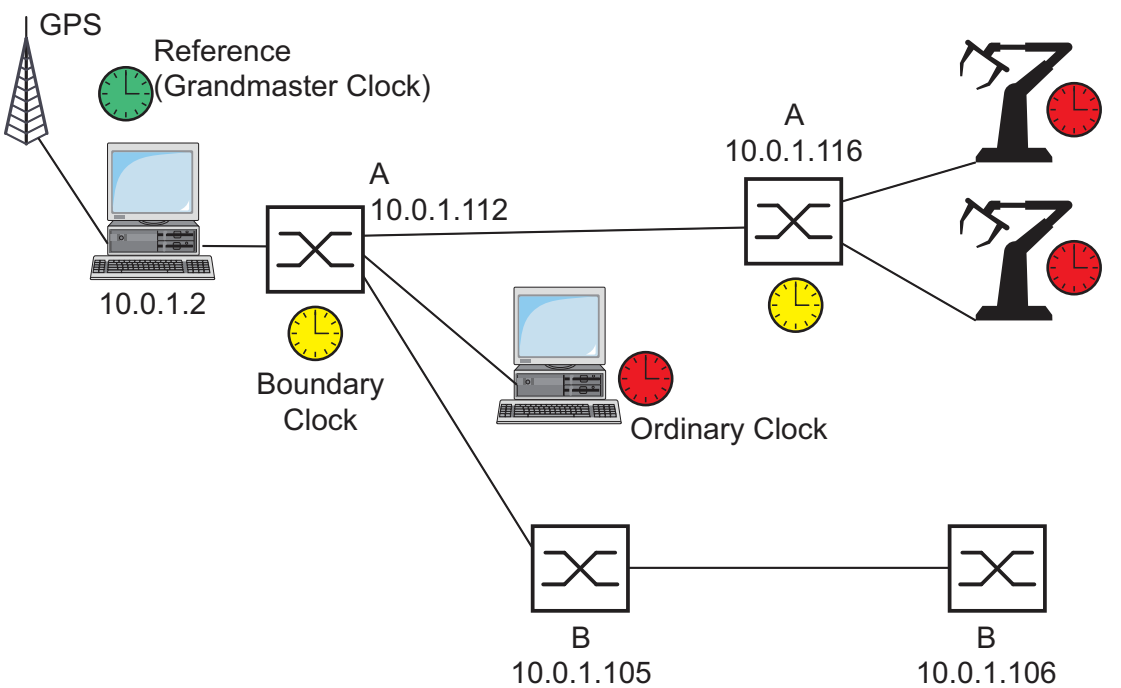


Figure 28: Example of PTP synchronization
A: Device with RT module
B: Device without RT module:

Device	10.0.1.112	10.0.1.116	10.0.1.105	10.0.1.106
PTP Global				
Operation	on	on	on	on
Clock Mode	v1-boundary-clock	v1-boundary-clock	v1-simple-mode	v1-simple-mode
Preferred Master	true	false	false	false
SNTP				
Operation	on	off	off	off
Client Status	on	off	off	off
External server address	10.0.1.2	0.0.0.0	0.0.0.0	0.0.0.0
Server request interval	30	any	any	any
Accept SNTP Broadcasts	No	any	any	any
Server status	on	off	off	off
Anycast destination address	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0
VLAN ID	1	1	1	1

Table 10: Settings for the example (see figure 28)

The following configuration steps apply to the device with the IP address 10.0.1.112. Configure the other devices in the same way with the values from the table above.

☐ Enter the SNTP parameters.

☐ Select the `Time:SNTP` dialog.
☐ Activate SNTP globally in the “Operation” frame.
☐ Activate the SNTP client (client status) in the “Configuration SNTP Client” frame.
☐ In the “Configuration SNTP Client” frame, enter:
– “External server address”: 10.0.1.2
– “Request interval”: 30
– “Accept SNTP Broadcasts”: No

- ☐ Activate the SNTP server (server status) in the “Configuration SNTP Server” frame.
- ☐ In the “Configuration SNTP Server” frame, enter:
  – “Anycast destination address”: 0.0.0.0
  – “VLAN ID”: 1
- ☐ Click "Set" to save the changes temporarily.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`sntp operation on`	Switch on SNTP globally.
`sntp operation client on`	Switch on SNTP client.
`sntp client server primary 10.0.1.2`	Enter the IP address of the external SNTP server 10.0.1.2.
`sntp client request-interval 30`	Enter the value 30 seconds for the SNTP server request interval.
`sntp client accept-broadcast off`	Deactivate “Accept SNTP Broadcasts”.
`sntp operation server on`	Switch on SNTP server.
`sntp anycast address 0.0.0.0`	Enter the SNTP server Anycast destination address 0.0.0.0.
`sntp anycast vlan 1`	Enter the SNTP server VLAN ID 1.

☐ Enter the global PTP parameters.

- ☐ Select the `Time:PTP:Global` dialog.
- ☐ Activate the function in the “Operation IEEE 1588 / PTP” frame.
- ☐ Select `v1-boundary-clock` for “PTP version mode”.
- ☐ Click "Set" to save the changes temporarily.

`ptp operation enable`	Switch on PTP globally.
`ptp clock-mode v1-boundary-clock`	Select PTP version and clock mode.

☐ In this example, you have chosen the device with the IP address 10.0.1.112 as the PTP reference clock. You thus define this device as the “Preferred Master”.

☐ Select the `Time:PTP:Version1:Global` dialog.
☐ In the “Operation IEEE 1588 / PTP” frame, select `true` for the “Preferred Master”.
☐ Click "Set" to save the changes temporarily.

`ptp v1 preferred-master true` Define this device as the “Preferred Master”.

☐ Get PTP to apply the parameters.

☐ In the `Time:PTP:Version1:Global` dialog, click on “Reinitialize” so that PTP applies the parameters entered.

`ptp v1 re-initialize` Apply PTP parameters.

☐ Save the settings in the non-volatile memory.

☐ Select the `Basics: Load/Save` dialog.

☐ In the “Save” frame, select “To Device” for the location and click “Save” to permanently save the configuration in the active configuration.

`copy system:running-config nvram:startup-config`	Save the current configuration to the non-volatile memory.

7.4 Interaction of PTP and SNTP

According to the PTP and SNTP standards, both protocols can exist in parallel in the same network. However, since both protocols affect the system time of the device, situations may occur in which the two protocols compete with each other.

Note: Configure the devices so that each device only receives the time from one source.
If the device gets its time via PTP, you enter the “External server address” 0.0.0.0 in the SNTP client configuration and do not accept SNTP Broadcasts.
If the device gets its time via SNTP, make sure that the “best” clock is connected to the SNTP server. Then both protocols will get the time from the same server. The example (see figure 29) shows such an application.

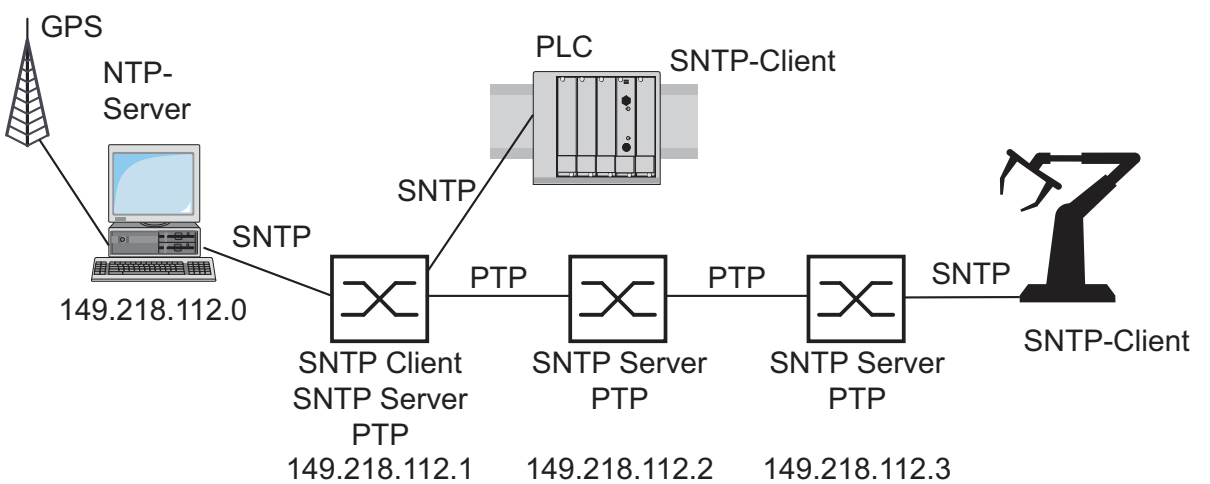


Figure 29: Example of the coexistence of PTP and SNTP

Application Example

The requirements with regard to the accuracy of the time in the network are quite high, but the terminal devices only support SNTP (see figure 29).

Device	149.218.112.1	149.218.112.2	149.218.112.3
PTP			
Operation	on	on	on
Clock Mode	v1-boundary-clock	v1-boundary-clock	v1-boundary-clock
Preferred Master	false	false	false
SNTP			
Operation	on	on	on
Client Status	on	off	off
External server address	149.218.112.0	0.0.0.0	0.0.0.0
Server request interval	any	any	any
Accept SNTP Broadcasts	No	No	No
Server status	on	on	on
Anycast destination address	224.0.1.1	224.0.1.1	224.0.1.1
VLAN ID	1	1	1
Anycast send interval	30	30	30

Table 11: Settings for the example

In the example, the left device, as an SNTP client, gets the time from the NTP server via SNTP. The device assigns PTP clock stratum 2 (PTPv1) or clock class 6 (PTPv2) to the time received from an NTP server. Thus the left device becomes the reference clock for the PTP synchronization. PTP is active for all 3 devices, thus enabling precise time synchronization between them. As the connectable terminal devices in the example only support SNTP, all 3 devices act as SNTP servers.

8 Network Load Control

To optimize the data transmission, the device provides you with the following functions for controlling the network load:

- Settings for direct packet distribution (MAC address filter)
- Multicast settings
- Rate limiter
- Prioritization - QoS
- Flow control
- Virtual LANs (VLANs)

8.1 Direct Packet Distribution

With direct packet distribution, you help protect the device from unnecessary network loads. The device provides you with the following functions for direct packet distribution:

- Store-and-forward
- Multi-address capability
- Aging of learned addresses
- Static address entries
- Disabling the direct packet distribution

8.1.1 Store and Forward

The device stores receive data and checks the validity. The device rejects invalid and defective data packets (> 1522 bytes or CRC errors) as well as fragments (> 64 bytes). The device then forwards valid data packets.

8.1.2 Multi-Address Capability

The device learns all the source addresses for a port. Only packets with

- unknown destination addresses
- these destination addresses or
- a multi/broadcast destination address

in the destination address field are sent to this port. The device enters learned source addresses in its filter table (see on page 158 “Entering Static Addresses”).

The device can learn up to 8,000 addresses. This is necessary if more than one terminal device is connected to one or more ports. It is thus possible to connect several independent subnets to the device.

8.1.3 Aging of learned MAC addresses

The device monitors the age of the learned addresses. Address entries which exceed a particular age - the aging time - are deleted by the device from its address table.
Data packets with an unknown destination address are flooded by the device.
Data packets with known destination addresses are selectively transmitted by the device.

Note: A reboot deletes the learned address entries.

- ☐ Select the `Switching:Global` dialog.
- ☐ Enter the aging time for all dynamic entries in the range from 10 to 630 seconds (unit: 1 second; default setting: 30).
  In connection with the router redundancy, select a time ≥ 30 seconds.

8.1.4 Entering Static Addresses

An important function of the device is the filter function. It selects data packets according to defined patterns, known as filters. These patterns are assigned distribution rules. This means that a data packet received by a device at a port is compared with the patterns. If there is a pattern that matches the data packet, a device then sends or blocks this data packet according to the distribution rules at the relevant ports.

The following are valid filter criteria:

- Destination address
- Broadcast address
- Multicast address
- VLAN membership

The individual filters are stored in the filter table (Forwarding Database, FDB). It consists of 3 parts: a static part and two dynamic parts.

- The management administrator describes the static part of the filter table (`dot1qStaticTable`).
- During operation, the device is capable of learning which of its ports receive data packets from which source address (see on page 156 “Multi-Address Capability”). This information is written to a dynamic part (`dot1qTpFdbTable`).
- Addresses learned dynamically from neighboring agents and those learned via GMRP are written to the other dynamic part.

Addresses already located in the static filter table are automatically transferred to the dynamic part by the device.
An address entered statically cannot be overwritten through learning.

Note: If the ring manager is active, it is not possible to make permanent unicast entries.

Note: The filter table allows you to create up to 100 filter entries for Multicast addresses.

☐ Select the `Switching:Filters for MAC Addresses` dialog.

Each row of the filter table represents one filter. Filters specify the way in which data packets are sent. They are set automatically by the Switch (learned status) or created manually. Data packets whose destination address is entered in the table are sent from the receiving port to the ports marked in the table. Data packets whose destination address is not in the table are sent from the receiving port to all other ports. In the "Create filter" dialog you can set up new filters. The following status settings are possible:

- `learned`: The filter was created automatically by the device.
- `permanent`: The filter is stored permanently in the device or on the URL (see on page 67 “Saving settings”)
- `invalid`: With this status you delete a manually created filter.
- `gmrp`: The filter was created by GMRP.
- `gmrp/permanent`: GMRP added further port markings to the filter after it was created by the administrator. The port markings added by the GMRP are deleted by a restart.
- `igmp`: The filter was created by IGMP Snooping.

To delete entries with the "learned" status from the filter table, select the `Basics:Restart` dialog and click "Reset MAC address table".

8.1.5 Disabling the Direct Packet Distribution

To enable you to observe the data at all the ports, the device allows you to disable the learning of addresses. When the learning of addresses is disabled, the device transfers all the data from all ports to all ports.

☐ Select the `Switching:Global` dialog.

- UnCheck "Address Learning" to observe the data at all ports.

8.2 Multicast Application

8.2.1 Description of the Multicast Application

The data distribution in the LAN differentiates between 3 distribution classes on the basis of the addressed recipients:

- Unicast - one recipient
- Multicast - a group of recipients
- Broadcast - every recipient that can be reached

In the case of a Multicast address, the device forwards all data packets with a Multicast address to all ports. This leads to an increased bandwidth requirement.
Protocols such as GMRP and procedures such as IGMP Snooping enable the device to exchange information via the direct transmission of Multicast data packets. The bandwidth requirement can be reduced by distributing the Multicast data packets only to those ports to which recipients of these Multicast packets are connected.

You can recognize IGMP Multicast addresses by the range in which the address lies:

- MAC Multicast Address
  01:00:5E:00:00:00 - 01:00:5E:FF:FF:FF
  (in mask form 01:00:5E:00:00:00/24)
- Class D IP Multicast address
  224.0.0.0 - 239.255.255.255
  (in mask form 224.0.0.0/4)

8.2.2 Example of a Multicast Application

The cameras for monitoring machines normally transmit their images to monitors located in the machine room and to the control room.
In an IP transmission, a camera sends its image data with a Multicast address via the network.
To prevent all the video data from slowing down the entire network, the device uses the GMRP to distribute the Multicast address information. As a result, the image data with a Multicast address is only distributed to those ports that are connected to the associated monitors for surveillance.

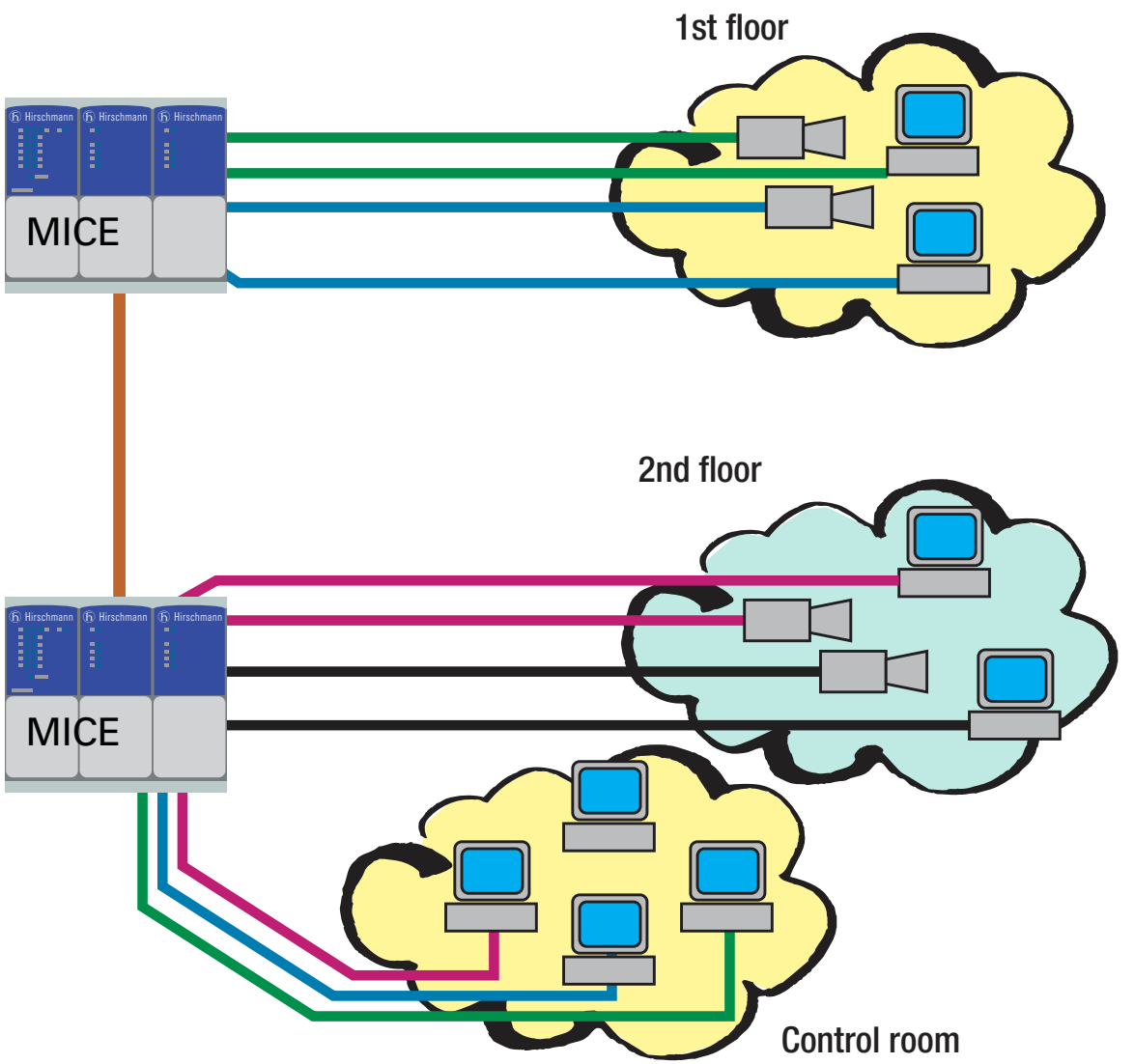


Figure 30: Example: Video surveillance in machine rooms

8.2.3 Description of IGMP Snooping

The Internet Group Management Protocol (IGMP) describes the distribution of Multicast information between routers and terminal devices on Layer 3.

Routers with an active IGMP function periodically send queries to find out which IP Multicast group members are connected to the LAN. Multicast group members reply with a Report message. This Report message contains all the parameters required by the IGMP. The router records the IP Multicast group address from the Report message in its routing table. The result of this is that it transfers frames with this IP Multicast group address in the destination field only in accordance with the routing table.

Devices which no longer want to be members of a Multicast group can cancel their membership by means of a Leave message (from IGMP version 2), and they do not transmit any more Report messages. In IGMP versions 1 and 2, the router removes the routing table entry if it does not receive any Report messages within a specified period of time (aging time).

If there are a number of routers with an active IGMP function in the network, then they work out among themselves (in IGMP version 2) which router carries out the Query function. If there is no router in the network, then a suitably equipped Switch can perform the Query function.

A Switch that connects a Multicast receiver with a router can evaluate the IGMP information using the IGMP Snooping procedure.

IGMP Snooping translates IP Multicast group addresses into MAC Multicast addresses, so that the IGMP functions can also be used by Layer 2 Switches. The Switch records the MAC addresses of the Multicast receivers, with are obtained via IGMP Snooping from the IP addresses, in the static address table. The Switch thus transmits these Multicast packets exclusively at the ports at which Multicast receivers are connected. The other ports are not affected by these packets.

A special feature of the device is that you can specify whether it should drop data packets with unregistered Multicast addresses, transmit them to all ports, or only to those ports at which the device received query packets. You also have the option of additionally sending known Multicast packets to query ports.

Default setting: “Off”.

8.2.4 Setting IGMP Snooping

☐ Select the `Switching:Multicast:IGMP` dialog.

Operation

The “Operation” frame allows you to enable/disable IGMP Snooping globally for the entire device.
If IGMP Snooping is disabled, then

- the device does not evaluate Query and Report packets received, and
- it sends (floods) received data packets with a Multicast address as the destination address to every port.

Settings for IGMP Querier and IGMP

With these frames you can enter global settings for the IGMP settings and the IGMP Querier function.
Prerequisite: The IGMP Snooping function is activated globally.

IGMP Querier

“IGMP Querier active” allows you to enable/disable the Query function.

“Protocol version” allow you to select IGMP version 1, 2 or 3.

In “Send interval [s]” you specify the interval at which the device sends query packets (valid entries: 2-3,599 s, default setting: 125 s).

Note the connection between the parameters Max. Response Time, Send Interval and Group Membership Interval (see on page 165 “Parameter Values”).

IGMP-capable terminal devices respond to a query with a report message, thus generating a network load.
Select large sending intervals if you want to reduce the load on your network and can accept the resulting longer switching times.
Select small sending intervals if you require short switching times and can accept the resulting network load.

IGMP Settings

“Current querier IP address” shows you the IP address of the device that has the query function.

In “Max. Response Time” you specify the period within which the Multicast group members respond to a query (valid values: 1-3,598 s, default setting: 10 s).

Note the connection between the parameters Max. Response Time, Send Interval and Group Membership Interval (see on page 165 “Parameter Values”).

The Multicast group members select a random value within the maximum response time for their response, to prevent all the Multicast group members responding to the query at the same time.
Select a large value if you want to reduce the load on your network and can accept the resulting longer switching times.
Select a small value if you require short switching times and can accept the resulting network load.
In “Group Membership Interval” you specify the period for which a dynamic Multicast group remains entered in the device if it does not receive any report messages (valid values: 3-3,600 s, default setting: 260 s).

Note the connection between the parameters Max. Response Time, Send Interval and Group Membership Interval (see on page 165 “Parameter Values”).

Parameter Values

The parameters
– Max. Response Time,
– Transmit Interval and
– Group Membership Interval
have a relationship to one another:

Max. Response Time < Transmit Interval < Group Membership Interval.

If you enter values that contradict this relationship, the device then replaces these values with a default value or with the last valid values.

Parameter	Protocol Version	Value Range	Default Setting
Max. Response Time	1, 2 3	1-25 seconds 1-3,598 seconds	10 seconds
Transmit Interval	1, 2, 3	2-3,599 seconds	125 seconds
Group Membership Interval	1, 2, 3	3-3,600 seconds	260 seconds

Table 12: Value range for Max. Response Time, Transmit Interval and Group Membership Interval

Multicasts

With these frames you can enter global settings for the Multicast functions.
Prerequisite: The IGMP Snooping function is activated globally.

Unknown Multicasts

In this frame you can determine how the device in IGMP mode sends packets with known and unknown MAC/IP Multicast addresses that were not learned through IGMP Snooping..

“Unknown Muilticasts” allows you to specify how the device transmits unknown Multicast packets:

- “Send to Query Ports”.
  The device sends the packets with an unknown MAC/IP Multicast address to all query ports.
- “Send to All Ports”.
  The device sends the packets with an unknown MAC/IP Multicast address to all ports.
- “Discard”.
  The device discards all packets with an unknown MAC/IP Multicast address.

Note: The way in which unlearned Multicast addresses are handled also applies to the reserved IP addresses from the “Local Network Control Block” (224.0.0.0 - 224.0.0.255). This can have an effect on higher-level routing protocols.

Known Multicasts
In this frame you can determine how the device in IGMP mode sends packets with known MAC/IP Multicast addresses that were learned through IGMP Snooping.

- “Send to query and registered ports”.
  The device sends the packets with a known MAC/IP Multicast address to all query ports and to registered ports.
  This standard setting sends all Multicasts to all query ports and to registered ports. The advantage of this is that it works in most applications without any additional configuration.
  Application: “Flood and Prune” routing in PIM-DM.
- “Send to registered ports”.
  The device sends the packets with a known MAC/IP Multicast address to registered ports.
  The advantage of this setting, which deviates from the standard, is that it uses the available bandwidth optimally through direct distribution. It requires additional port settings.
  Application: Routing protocol PIM-SM.

Settings per Port (Table)

- “IGMP on”
  This table column enables you to enable/disable the IGMP for each port when the global IGMP Snooping is enabled. Port registration will not occur if IGMP is disabled.

- “IGMP Forward All”
  This table column enables you to enable/disable the “Forward All” IGMP Snooping function when the global IGMP Snooping is enabled. With the “Forward All” setting, the device sends to this port all data packets with a Multicast address in the destination address field.

  Note: If a number of routers are connected to a subnetwork, you must use IGMP version 1 so that all the routers receive all the IGMP reports.

  Note: If you use IGMP version 1 in a subnetwork, then you must also use IGMP version 1 in the entire network.

- “IGMP Automatic Query Port”
  This table column shows you which ports the device has learned as query ports, if “automatic” is selected in “Static Query Port”.

- "Static Query Port“
  The device sends IGMP Report messages to the ports on which it receives IGMP requests (disabled=as-delivered state).
  This table column also lets you send IGMP Report messages to:
  other selected ports (enable) or
  connected Hirschmann devices (automatic).

- “Learned Query Port”
  This table column shows you at which ports the device has received IGMP queries, if “disable” is selected in “Static Query Port”.

Note: If the device is incorporated into a HIPER-Ring, you can use the following settings to quickly reconfigure the network for data packets with registered Multicast destination addresses after the ring is switched:

- Switch on the IGMP Snooping on the ring ports and globally, and
- activate “IGMP Forward All” per port on the ring ports.

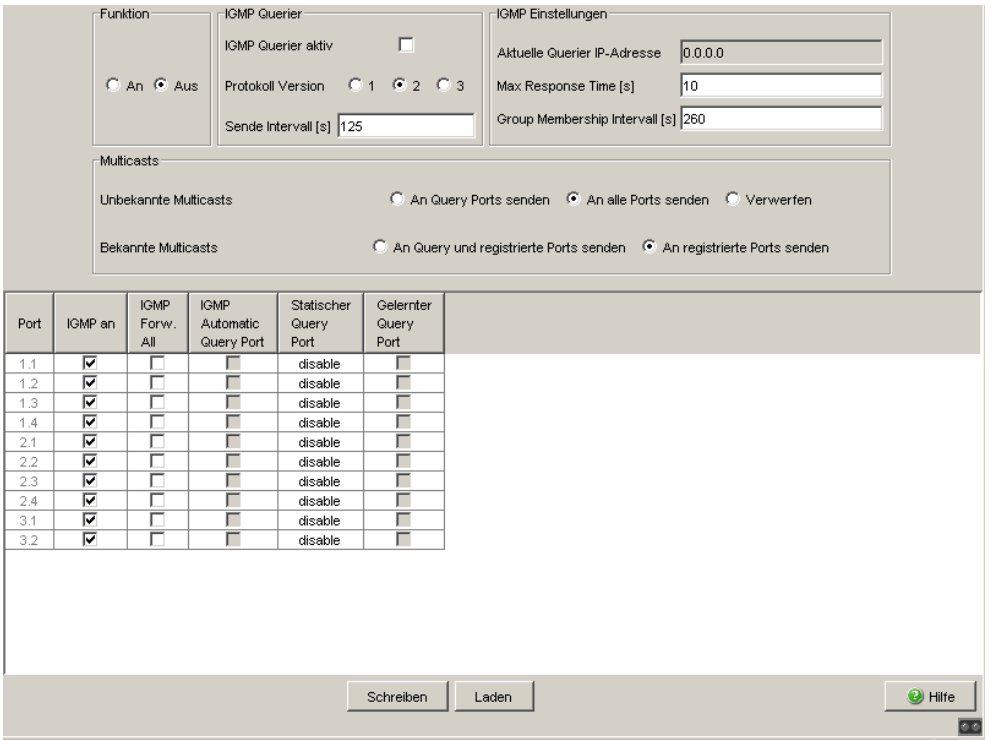


Figure 31: IGMP Snooping dialog

8.2.5 Description of GMRP

The GARP Multicast Registration Protocol (GMRP) describes the distribution of data packets with a multicast address as the destination address on Layer 2.

Devices that want to receive data packets with a multicast address as the destination address use the GMRP to perform the registration of the multicast address. For a switch, registration involves entering the multicast addresses in the filter table. When you enter a multicast address in the filter table, the switch sends this information in a GMRP packet to the ports. As a result, the connected switches forward the multicast address entered in the filter table to this switch. The GMRP sends packets with a Multicast address in the destination address field to the ports entered.

The feature is available on MS, RS, MACH102, MACH1020/30, Octopus, RSR and MACH1040, MACH104 devices. Depending on the configuration, the switch either discards unknown multicast addresses, or sends the data packets with unknown multicast addresses to the ports.

Default setting: “Off”.

8.2.6 Setting GMRP

☐ Select the `Switching:Multicasts:GMRP` dialog.

Operation

The “Operation” frame allows you to enable GMRP globally for the entire device.

If GMRP is disabled, then

- the device does not generate any GMRP packets,
- does not evaluate any GMRP packets received, and
- sends (floods) received data packets to all ports.

The device is transparent for received GMRP packets, regardless of the GMRP setting.

Multicasts

The "Multicasts" frame allows you to configure GMRP to discard multicasts addresses or send them to the ports.

Enable GMRP, then:

- when you select "Discard", the device deletes unknown multicasts
- when you select "Send To All Ports", the device evaluates the GMRP packets received, and sends (floods) received data packets to the ports.

Settings per Port (Table)

- „GMRP”
  This table column enables you to enable/disable the GMRP for each port when the GMRP is enabled globally. When you switch off the GMRP at a port, no registrations can be made for this port, and GMRP packets cannot be forwarded at this port.

- “GMRP Service Requirement”
  Devices that do not support GMRP can be integrated into the Multicast addressing by means of
  - a static filter address entry on the connecting port.
  - selecting “Forward all groups” in the table column “GMRP Service Requirement”. The device enters ports with the selection “Forward all groups” in all Multicast filter entries learned via GMRP.

Note: If the device is incorporated into a HIPER-Ring, you can use the following settings to quickly reconfigure the network for data packets with registered Multicast destination addresses after the ring is switched:
- Activate GMRP on the ring ports and globally, and
- activate “Forward all groups” on the ring ports.

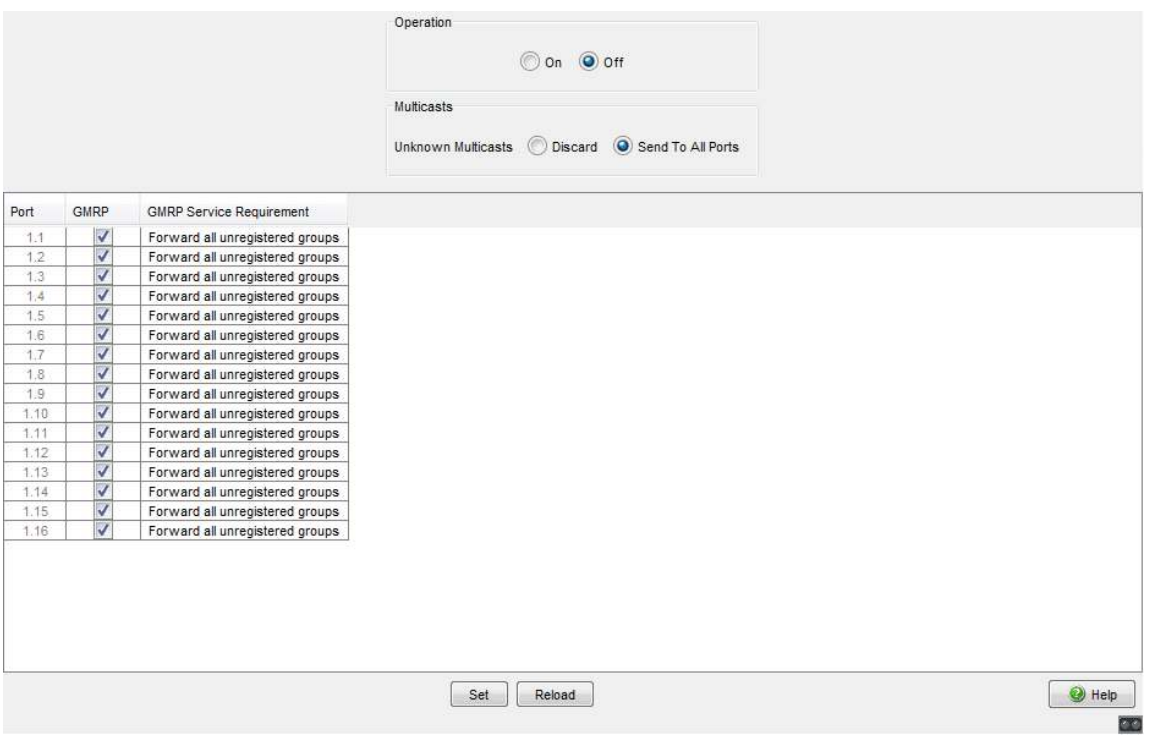


Figure 32: Multicasts dialog

8.3 Rate Limiter

8.3.1 Description of the Rate Limiter

To ensure reliable operation at a high level of traffic, the device allows you to limit the rate of traffic at the ports.

Entering a limit rate for each port determines the amount of traffic the device is permitted to transmit and receive.

If the traffic at this port exceeds the maximum rate entered, then the device suppresses the overload at this port.

A global setting enables/disables the rate limiter function at all ports.

Note: The limiter functions only work on Layer 2 and are used to limit the effect of storms by frame types that the Switch floods (typically broadcasts). In doing so, the limiter function disregards the protocol information of higher layers, such as IP or TCP. This can affect on TCP traffic, for example.

To minimize these effects, use the following options:

- limiting the limiter function to particular frame types (e.g. to broadcasts, multicasts and unicasts with unlearned destination addresses) and receiving unicasts with destination addresses established by the limitation,
- using the output limiter function instead of the input limiter function because the former works slightly better together with the TCP flow control due to switch-internal buffering.
- increasing the aging time for learned unicast addresses.

8.3.2 Rate limiter settings

☐ Select the `Switching:Rate Limiter` dialog.

- "Ingress Limiter (kbit/s)" allows you to enable or disable the ingress limiter function for all ports and to select the ingress limitation on all ports (either broadcast packets only or broadcast packets and Multicast packets).
- "Egress Limiter (Pkt/s)" allows you to enable or disable the egress limiter function for broadcasts on all ports.

Setting options per port:

- Ingress Limiter Rate for the packet type selected in the Ingress Limiter frame:
  - = 0, no ingress limit at this port.
  - > 0, maximum ingress traffic rate in kbit/s that can be sent at this port.
- Egress Limiter Rate for broadcast packets:
  - = 0, no rate limit for egress broadcast packets at this port.
  - > 0, maximum number of egress broadcasts per second sent at this port.

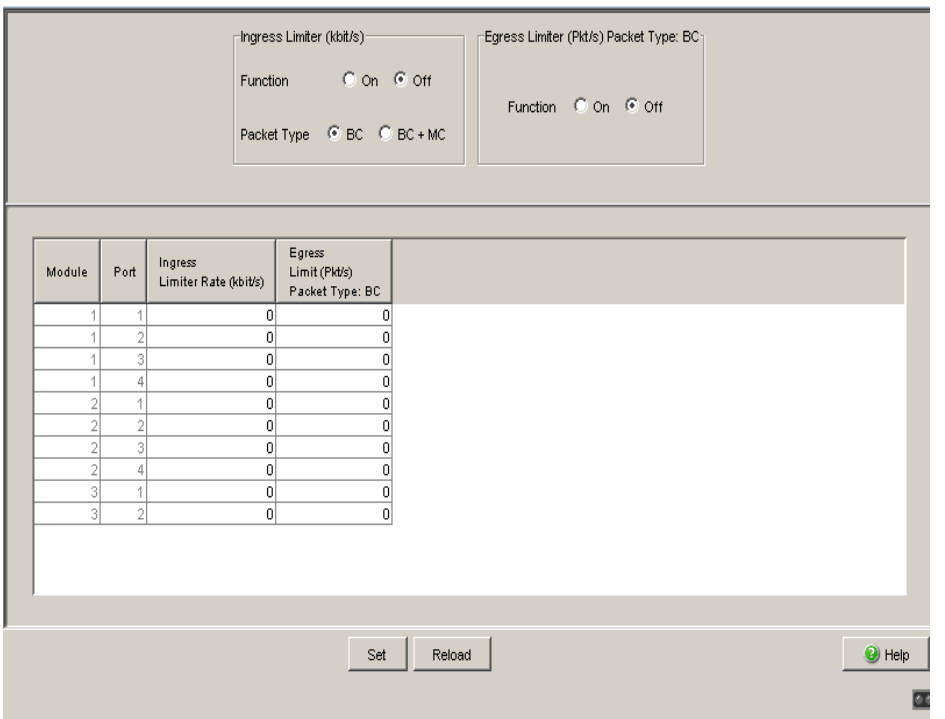


Figure 33: Rate Limiter dialog

8.4 QoS/Priority

8.4.1 Description of Prioritization

This function helps prevent time-critical data traffic such as language/video or real-time data from being disrupted by less time-critical data traffic during periods of heavy traffic. By assigning high traffic classes for time-critical data and low traffic classes for less time-critical data, this provides optimal data flow for time-critical data traffic.

The device supports 8 priority queues (IEEE 802.1D standard traffic classes). Received data packets are assigned to these classes by

- Access Control Lists, MAC- or IP-based ACLs (see on page 116 “Access Control Lists (ACL)”).
- the priority of the data packet contained in the VLAN tag when the receiving port was configured to “trust dot1p”.
- the QoS information (ToS/DiffServ) contained in the IP header when the receiving port was configured to “trust ip-dscp”.
- the port priority when the port was configured to “untrusted”.
- the port priority when receiving non-IP packets when the port was configured to “trust ip-dscp”.
- the port priority when receiving data packets without a VLAN tag (see on page 87 “Configuring the Ports”) and when the port was configured to “trust dot1p”.
  Default setting: “trust dot1p”.

The device takes account of the classification mechanisms in the above order. This means that the Access-Control Lists always take priority over the following mechanisms. AccessControl Lists can classify the data packets relative to Layer 2, Layer 3 and Layer 4 (e.g. MAC addresses, IP addresses, protocols, TCP/UDP ports).

Data packets can contain prioritizing/QoS information:

- VLAN priority based on IEEE 802.1Q/ 802.1D (Layer 2)
- Type of Service (ToS) or DiffServ (DSCP) for IP packets (Layer 3)

8.4.2 VLAN tagging

The VLAN tag is integrated into the MAC data frame for the VLAN and Prioritization functions in accordance with the IEEE 802 1Q standard. The VLAN tag consists of 4 bytes. It is inserted between the source address field and the type field.

For data packets with a VLAN tag, the device evaluates:
- the priority information and
- the VLAN information if VLANs have been set.

Data packets with VLAN tags containing priority information but no VLAN information (VLAN ID = 0), are known as Priority Tagged Frames.

Priority entered	Traffic class (default setting)	IEEE 802.1D traffic type
0	2	Best effort (default)
1	0	Background
2	1	Standard
3	3	Excellent effort (business critical)
4	4	Controlled load (streaming multimedia)
5	5	Video, less than 100 milliseconds of latency and jitter
6	6	Voice, less than 10 milliseconds of latency and jitter
7	7	Network control reserved traffic

Table 13: Assignment of the priority entered in the tag to the traffic classes

Note: Network protocols and redundancy mechanisms use the highest traffic class 7. Therefore, select other traffic classes for application data.

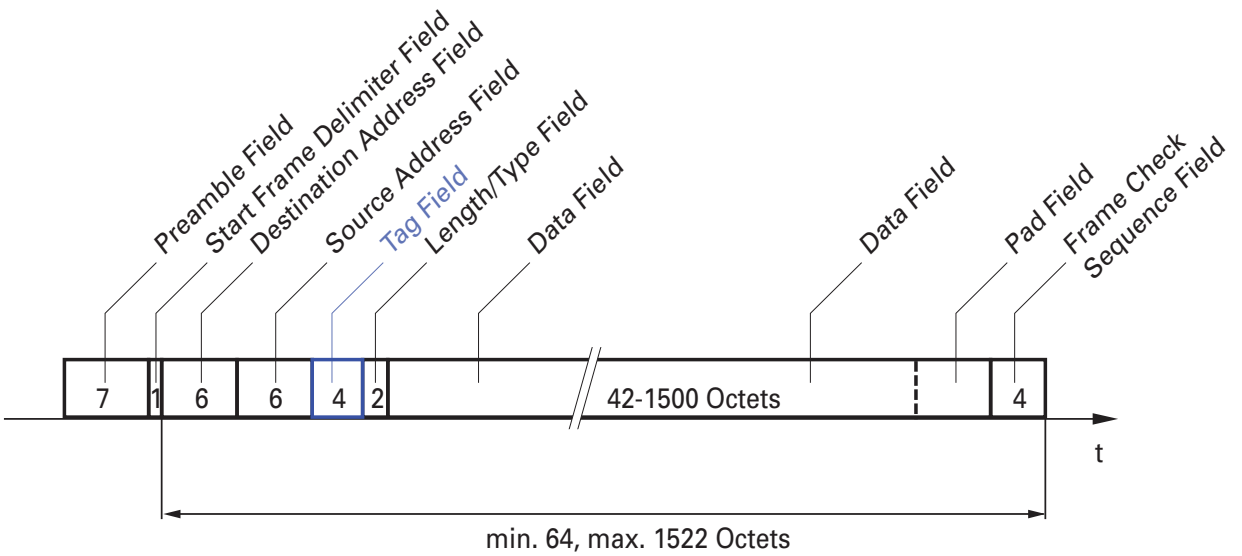


Figure 34: Ethernet data packet with tag

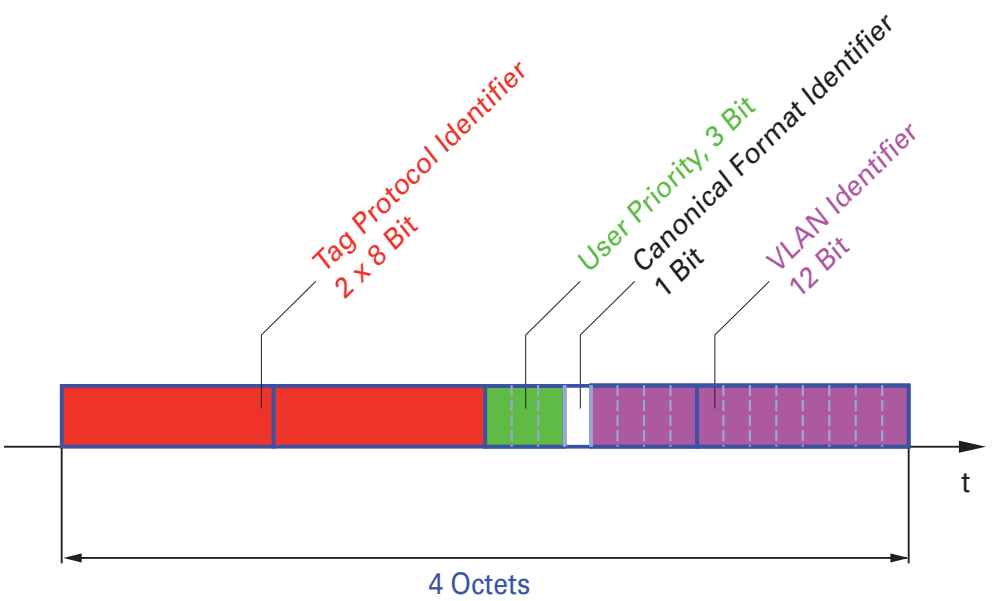


Figure 35: Tag format

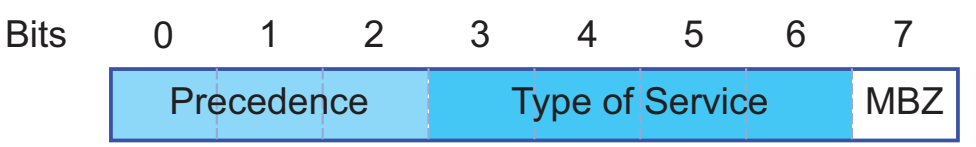
When using VLAN prioritizing, note the following special features:

- End-to-end prioritizing requires the VLAN tags to be transmitted to the entire network, which means that all network components must be VLAN-capable.
- Routers cannot receive or send packets with VLAN tags via port-based router interfaces.

8.4.3 IP ToS / DiffServ

TYPE of Service

The Type of Service (ToS) field in the IP header (see table 14) has been part of the IP protocol from the start, and it is used to differentiate various services in IP networks. Even back then, there were ideas about differentiated treatment of IP packets, due to the limited bandwidth available and the unreliable connection paths. Because of the continuous increase in the available bandwidth, there was no need to use the ToS field. Only with the real-time requirements of today's networks has the ToS field become significant again. Selecting the ToS byte of the IP header enables you to differentiate between different services. However, this field is not widely used in practice.



Bits (0-2): IP Precedence Defined	Bits (3-6): Type of Service Defined	Bit (7)
111 - Network Control	0000 - [all normal]	0 - Must be zero
110 - Internetwork Control	1000 - [minimize delay]	
101 - CRITIC / ECP	0100 - [maximize throughput]	
100 - Flash Override	0010 - [maximize reliability]	
011 - Flash	0001 - [minimize monetary cost]	

Table 14: ToS field in the IP header

Bits (0-2): IP Precedence Defined	Bits (3-6): Type of Service Defined	Bit (7)
010 - Immediate		
001 - Priority		
000 - Routine		

Table 14: ToS field in the IP header

Differentiated Services

The Differentiated Services field in the IP header (see figure 36) newly defined in RFC 2474 - often known as the DiffServ code point or DSCP - replaces the ToS field and is used to mark the individual packets with a DSCP. Here the packets are divided into different quality classes. The first 3 bits of the DSCP are used to divide the packets into classes. The next 3 bits are used to further divide the classes on the basis of different criteria. In contrast to the ToS byte, DiffServ uses 6 bits for the division into classes. This results in up to 64 different service classes.

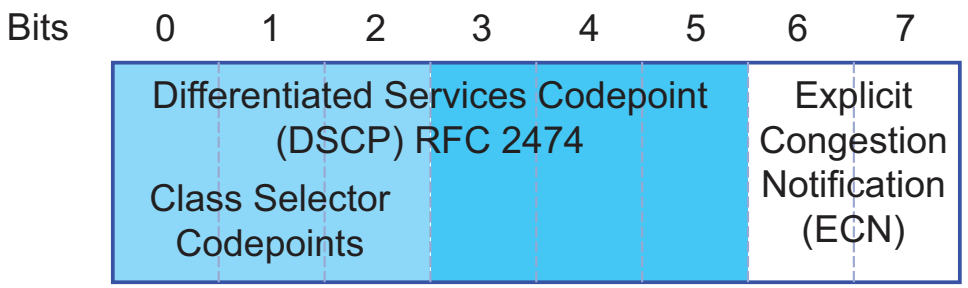


Figure 36: Differentiated Services field in the IP header

The different DSCP values get the device to employ a different forwardingbehavior, namely Per-Hop Behavior (PHB). PHB classes:

- Class Selector (CS0-CS7): For reasons of compatibility to TOS/IP Precedence
- Expedited Forwarding (EF): Premium service.
  Reduced delay, jitter + packet loss (RFC 2598)
- Assured Forwarding (AF): Provides a differentiated schema for handling different data traffic (RFC 2597).
- Default Forwarding/Best Effort: No particular prioritizing.

The PHB class selector assigns the 7 possible IP precedence values from the old ToS field to specific DSCP values, thus ensuring the downwards compatibility.

ToS Meaning	Precedence Value	Assigned DSCP
Network Control	111	CS7 (111000)
Internetwork Control	110	CS6 (110000)
Critical	101	CS5 (101000)
Flash Override	100	CS4 (100000)
Flash	011	CS3 (011000)
Immidiate	010	CS2 (010000)
Priority	001	CS1 (001000)
Routine	000	CS0 (000000)

Table 15: Assigning the IP precedence values to the DSCP value

DSCP value	DSCP name	Traffic Class (default setting)
0	Best Effort /CS0	2
1-7		2
8	CS1	0
9,11,13,15		0
10,12,14	AF11,AF12,AF13	0
16	CS2	1
17,19,21,23		1
18,20,22	AF21,AF22,AF23	1
24	CS3	3
25,27,29,31		3
26,28,30	AF31,AF32,AF33	3
32	CS4	4
33,35,37,39		4
34,36,38	AF41,AF42,AF43	4
40	CS5	5
41,42,43,44,45,47		5
46	EF	5
48	CS6	6
49-55		6
56	CS7	7
57-63		7

Table 16: Mapping the DSCP values onto the traffic classes

8.4.4 Management prioritization

To have full access to the management of the device, even in situations of high network load, the device enables you to prioritize management packets. In prioritizing management packets (SNMP, SSH, etc.), the device sends the management packets with priority information.

- On Layer 2 the device modifies the VLAN priority in the VLAN tag.
  For this function to be useful, the configuration of the corresponding ports must permit the sending of packets with a VLAN tag.
- On Layer 3 the device modifies the IP-DSCP value.

8.4.5 Handling of Received Priority Information

The device offers the following options for evaluating this priority information:

- trust dot1p
  The device assigns VLAN-tagged packets to the different traffic classes according to their VLAN priorities. The assignment is based on the pre-defined table (see on page 176 “VLAN tagging”). You can modify this assignment. The device assigns the port priority to packets that it receives without a tag.
- untrusted
  The device ignores the priority information in the packet and always assigns the packets the port priority of the receiving port.
- trust ip-dscp
  The device assigns the IP packets to the different traffic classes according to the DSCP value in the IP header, even if the packet was also VLAN-tagged. The assignment is based on the pre-defined values (see table 16). You can modify this assignment.
  The device prioritizes non-IP packets according to the port priority.

8.4.6 Handling of traffic classes

For the handling of traffic classes, the device provides:

- Strict Priority
- Weighted Fair Queuing
- Strict Priority combined with Weighted Fair Queuing

Default setting: Strict Priority.

Description of Strict Priority

With the Strict Priority setting, the device first transmits data packets that have a higher traffic class (higher priority) before transmitting a data packet with the next highest traffic class. The device transmits a data packet with the lowest traffic class (lowest priority) when there are no other data packets remaining in the queue. In unfortunate cases, the device never sends packets with a low priority if there is a high volume of high-priority traffic waiting to be sent on this port.
In applications that are time- or latency-critical, such as VoIP or video, Strict Priority enables high-priority data to be sent immediately(see on page 183 “Maximum bandwidth”).

Description of Weighted Fair Queuing

With Waited Fair Queuing, also called WeightedRoundRobin (WRR), the user assigns a minimum or reserved bandwidth to each traffic class. This ensures that data packets with a lower priority are also sent when the network is very busy.

The weighting values range from 0% to 100% of the available bandwidth, in steps of 5%.

- A weighting of 0 is equivalent to a "no bandwidth" setting.
- The sum of the individual bandwidths may add up to 100%.

If you assign Weighted Fair Queuing to every traffic class, the entire bandwidth for the corresponding port is available to you.

When you combine Weighted Fair Queuing with Strict Priority, make sure that the highest traffic class of Weighted Fair Queuing is smaller than the lowest traffic class of Strict Priority.
In this case, a high Strict Priority network load can significantly reduce the bandwidth available for Weighted Fair Queuing.

Maximum bandwidth

By entering a maximum bandwidth you can limit the bandwidth for each traffic class to a maximum value, regardless of whether you selected “Weighted Fair Queuing” or “Strict Priority”.

- Weighted Fair Queuing (see on page 182 “Description of Weighted Fair Queuing”) requires that the maximum bandwidth is at least as big as the minimum bandwidth.
- With “Strict Priority”, individual high-priority packets with low latency are processed (see on page 182 “Description of Strict Priority”). If the maximum bandwidth is configured to a value less than 100%, even data packets with lower traffic classes can be sent in periods of high-priority overloading.
  The weighting values range from 0% to 100% of the available bandwidth, in steps of 5%.

Description of Traffic Shaping

With Traffic Shaping you have the option of restricting the maximum bandwidth of an interface.

The values for the bandwidth restriction range from 0% to 95%, in steps of 5%.

- The value "0" is equivalent to a "no bandwidth restriction" setting.
- The value "95" means that 95% of the bandwidth is available.

If the bandwidth set is temporarily exceeded, the device saves the data and sends it when the bandwidth load has decreased again. Traffic Shaping thus smooths out any overload situations.

If Traffic Shaping is active on an interface, the device ignores the bandwidths reserved for Weighted Fair Queuing.

8.4.7 Setting prioritization

Assigning the Port Priority

- ☐ Select the `QoS/Priority:Port Configuration` dialog.
- ☐ In the “Port Priority” column, you can specify the priority (0-7) with which the device sends data packets which it receives without a VLAN tag at this port.
- ☐ In the column "Trust Mode“, you have the option to control which criterion the the device uses to assign a traffic class to received data packets (see on page 175 “Description of Prioritization”).

Note: If you have set up VLANs, pay attention to the “VLAN 0 Transparent mode” (see `Switching:VLAN:Global`)

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/1`	Switch to the Interface Configuration mode of interface 1/1.
`vlan priority 3`	Assigns port priority 3 to interface 1/1.
`exit`	Switch to the Configuration mode.

Assigning VLAN priority to a traffic class

- ☐ Select the `QOS/Priority:802.1D/p-Mapping` dialog.
- ☐ In the "Traffic Class" column, enter the desired values.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`classofservice dot1p-mapping 0 2`	Assign traffic class 2 to VLAN priority 0.
`classofservice dot1p-mapping 1 2`	Also assign traffic class 2 to VLAN priority 1.
`exit`	Switch to the privileged EXEC mode.
`show classofservice dot1p-mapping`	Display the assignment.

```
User Priority    Traffic Class
-------------    -------------
      0                2
      1                2
      2                0
      3                1
      4                2
      5                2
      6                3
      7                3
```

Always assign port priority to received data packets (PowerMICE, MACH 104, MACH 1040 and MACH 4000)

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/1`	Switch to the Interface Configuration mode of interface 1/1.
`no classofservice trust vlan priority 1`	Assign the “no trust” mode to the interface. Set the port priority to 1.
`exit`	Switch to the Configuration mode.
`exit`	Switch to the privileged EXEC mode.
`show classofservice trust 1/1`	Display the trust mode on interface 1/1.

```
Class of Service Trust Mode: Untrusted

Untrusted Traffic Class: 4
```

Assigning the traffic class to a DSCP

☐ Select the `QOS/Priority:IP DSCP Mapping` dialog.
☐ In the "Traffic Class" column, enter the desired values.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`classofservice ip-dscp-mapping cs1 1`	Assign traffic class 1 to DSCP CS1.

```
show classofservice ip-dscp-mapping

    IP DSCP       Traffic Class
 -------------    -------------
   0(be/cs0)           2
   1                   2
   .
   .
   8(cs1)              1
   .
```

Always assign DSCP priority per interface to received IP data packets (PowerMICE, MACH 104, MACH 1040 and MACH 4000)

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 6/1`	Switch to the interface configuration mode of interface 6/1.
`classofservice trust ip-dscp`	Assign the “trust ip-dscp” mode to the interface.
`exit`	Switch to the Configuration mode.
`exit`	Switch to the privileged EXEC mode.
`show classofservice trust 6/1`	Display the trust mode on interface 6/1.

```
Class of Service Trust Mode: IP DSCP

Non-IP Traffic Class: 2
```

Always assign the DSCP priority to received IP data packets globally

☐ Open the `QoS/Priority:Global` dialog.
☐ Select `trustIPDSCP` in the "Trust Mode" line.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`classofservice trust ip-dscp`	Assign the "trust ip-dscp" mode globally.
`exit`	Switch to the Configuration mode.
`exit`	Switch to the privileged EXEC mode.
`show classofservice trust`	Display the trust mode.

```
Class of Service Trust Mode: IP DSCP
```

Configuration of Weighted Fair Queuing and Traffic Shaping

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`no cos-queue strict 0 1 2 3 4 5`	Switches off Strict Priority for traffic classes 0 to 5 and thus switches on Weighted Fair Queuing. Traffic classes 6 and 7 remain in Strict Priority mode.
`cos-queue min-bandwidth 10 10 15 15 20 30 0 0`	Assigns the weighting to the Weighted Fair Queuing traffic classes. In the case of Strict Priority, because the device first transmits all the data packets with a high priority, you can enter the weighting 0 for the Strict Priority traffic classes and distribute 100% among the remaining traffic classes. The device distributes the remaining bandwidth in accordance with the percentage weighting.
`cos-queue max-bandwidth 20 20 20 20 20 30 30 30`	Assign a maximum bandwidth to all traffic classes (Shaping). Because the two Strict Priority traffic classes are limited to a maximum of 30%, the remaining queues have at least 40% of the bandwidth at their disposal. The device immediately sends Strict Priority data up to a maximum bandwidth of 30%.
`exit`	Switch to the privileged EXEC mode.
`show interfaces cos-queue`	Display the configuration.

```
Global Configuration
Interface Shaping Rate..................... 0

Queue Id   Min. Bandwidth   Max. Bandwidth   Scheduler Type
--------   --------------   --------------   --------------
0          10               20               Weighted
1          10               20               Weighted
2          15               20               Weighted
3          15               20               Weighted
4          20               20               Weighted
5          30               30               Weighted
6          0                30               Strict
7          0                30               Strict
```

Configuring Traffic Shaping on a port

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/2`	Switch to the interface configuration mode for port 1.2.

```
traffic-shape 50                    Restricts the maximum bandwidth of
                                    interface 1/2 to 50%.
exit                                Switch to the Configuration mode.
exit                                Switch to the privileged EXEC mode.
show interfaces cos-queue           Display the configuration of interface 1/2.
  1/2
Interface..................................... 1/2
Interface Shaping Rate........................ 50

Queue Id   Min. Bandwidth   Max. Bandwidth   Scheduler Type
--------   --------------   --------------   --------------
0          10               20               Weighted
1          10               20               Weighted
2          15               20               Weighted
3          15               20               Weighted
4          20               20               Weighted
5          30               30               Weighted
6          0                30               Strict
7          0                30               Strict
```

```
enable                              Switch to the privileged EXEC mode.
configure                           Switch to the Configuration mode.
interface 1/2                       Switch to the interface configuration mode for
                                    port 1.2.
traffic-shape 50                    Restricts the maximum bandwidth of
                                    interface 1/2 to 50%.
exit                                Switch to the Configuration mode.
exit                                Switch to the privileged EXEC mode.
show interfaces cos-queue           Display the configuration of interface 1/2.
  1/2
Interface..................................... 1/2
Interface Shaping Rate........................ 50

Queue Id   Min. Bandwidth   Max. Bandwidth   Scheduler Type
--------   --------------   --------------   --------------
0          10               20               Weighted
1          10               20               Weighted
2          15               20               Weighted
3          15               20               Weighted
4          20               20               Weighted
5          30               30               Weighted
6          0                30               Strict
7          0                30               Strict
```

Configuring Layer 2 management priority

☐ Configure the VLAN ports to which the device sends management packets as a member of the VLAN that sends data packets with a tag (see on page 195 “Examples of VLANs”).

☐ Open the `QoS/Priority:Global` dialog.
☐ In the "VLAN Priority for Management packets" field, you enter the value of the VLAN priority.

`enable`	Switch to the privileged EXEC mode.
`network priority dot1p-vlan 7`	Assign the value 7 to the management priority so that management packets with the highest priority are sent.
`exit`	Switch to the privileged EXEC mode.
`show network`	Displays the management VLAN priority.

```
System IP Address.............................. 10.0.1.116
Subnet Mask.................................... 255.255.255.0
Default Gateway................................ 10.0.1.200
Burned In MAC Address.......................... 00:80:63:51:7A:80
Network Configuration Protocol (BootP/DHCP).... None
DHCP Client ID (same as SNMP System Name)...... "PowerMICE-517A80"
Network Configuration Protocol HiDiscovery..... Read-Write
HiDiscovery Version............................ v1, v2
Management VLAN ID............................. 1
Management VLAN Priority....................... 7
Management IP-DSCP Value....................... 0(be/cs0)
Web Mode....................................... Enable
```

Configuring Layer 3 management priority

☐ Open the `QoS/Priority:Global` dialog.
☐ In the "IP DSCP Value for Management packets" field, you enter the IP DSCP value with which the device sends management packets.

`enable`	Switch to the privileged EXEC mode.
`network priority ip-dscp cs7`	Assign the value cs7 to the management priority so that management packets with the highest priority are handled.
`exit`	Switch to the privileged EXEC mode.
`show network`	Displays the management VLAN priority.

```
System IP Address.............................. 10.0.1.116
Subnet Mask.................................... 255.255.255.0
Default Gateway................................ 10.0.1.200
Burned In MAC Address.......................... 00:80:63:51:7A:80
Network Configuration Protocol (BootP/DHCP).... None
DHCP Client ID (same as SNMP System Name)...... "PowerMICE-517A80"
Network Configuration Protocol HiDiscovery..... Read-Write
HiDiscovery Version............................ v1, v2
Management VLAN ID............................. 1
Management VLAN Priority....................... 7
Management IP-DSCP Value....................... 56(cs7)
Web Mode....................................... Enable
```

8.5 Flow Control

8.5.1 Description of Flow Control

Flow control is a mechanism which acts as an overload protection for the device. During periods of heavy traffic, it holds off additional traffic from the network.

The example (see figure 37) shows a graphic illustration of how the flow control works. Workstations 1, 2 and 3 want to simultaneously transmit a large amount of data to Workstation 4. The combined bandwidth of Workstations 1, 2 and 3 to the device is larger than the bandwidth of Workstation 4 to the device. This leads to an overflow of the send queue of port 4. The funnel on the left symbolizes this status.

If the flow control function at ports 1, 2 and 3 of the device is turned on, the device reacts before the funnel overflows. Ports 1, 2 and 3 send a message to the connected devices that no data can be received at present.

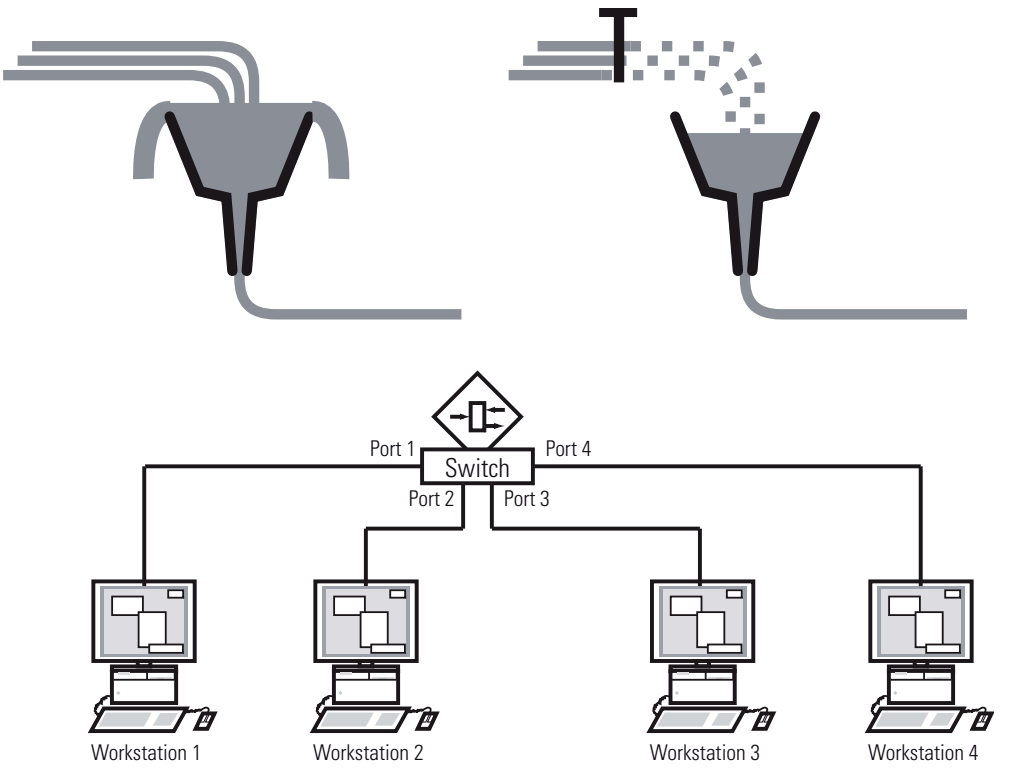


Figure 37: Example of flow control

Flow Control with a full duplex link

In the example (see figure 37) there is a full duplex link between Workstation 2 and the device.
Before the send queue of port 2 overflows, the device sends a request to Workstation 2 to include a small break in the sending transmission.

Note: The devices RS20/30/40, MS20/30, Octopus, MACH 100, RSR and MACH 1000 support flow control in full duplex mode only.

Flow Control with a half duplex link

In the example (see figure 37) there is a half duplex link between Workstation 2 and the device.
Before the send queue of port 2 overflows, the device sends data back so that Workstation 2 detects a collision and interrupts the sending process.

Note: The devices RS20/30/40, MS20/30, Octopus, MACH 100, RSR and MACH 1000 do not support flow control in half duplex mode.

8.5.2 Setting the Flow Control

☐ Select the `Basics:Port Configuration` dialog.
In the "Flow Control on" column, you checkmark this port to specify that flow control is active here. You also activate the global "Flow Control" switch in the `Switching:Global` dialog.

☐ Select the `Switching:Global` dialog.
With this dialog you can

- switch off the flow control at all ports or
- switch on the flow control at those ports for which the flow control is selected in the port configuration table.

Note: When you are using a redundancy function, you deactivate the flow control on the participating device ports. If the flow control and the redundancy function are active at the same time, there is a risk that the redundancy function will not operate as intended.

8.6 VLANs

8.6.1 VLAN Description

In the simplest case, a virtual LAN (VLAN) consists of a group of network participants in one network segment who can communicate with each other as if they belonged to a separate LAN.

More complex VLANs span out over multiple network segments and are also based on logical (instead of only physical) connections between network participants. Thus VLANs are an element of flexible network design, as you can reconfigure logical connections centrally more easily than cable connections.

The IEEE 802.1Q standard defines the VLAN function.

The most important benefits of VLANs are:

- Network load limiting
  VLANs reduce the network load considerably as the devices transmit broadcast, multicast, and unicast packets with unknown (unlearned) destination addresses exclusively inside the virtual LAN. The rest of the data network forwards traffic as normal.

- Flexibility
  You have the option of forming user groups flexibly based on the function of the participants and not on their physical location or medium.

- Clarity
  VLANs give networks a clear structure and make maintenance easier.

8.6.2 Examples of VLANs

The following practical examples provide a quick introduction to the structure of a VLAN.

Example 1

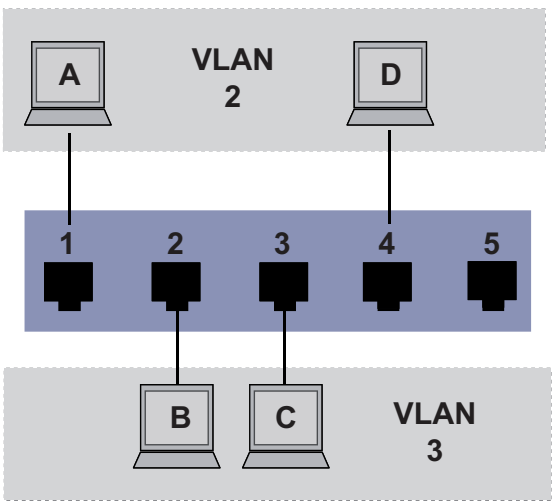


Figure 38: Example of a simple port-based VLAN

The example shows a minimal VLAN configuration (port-based VLAN). An administrator has connected multiple terminal devices to a transmission device and assigned them to 2 VLANs. This effectively prohibits any data transmission between the VLANs, whose members communicate only within their own VLANs.
When setting up the VLANs, you create communication rules for every port, which you enter in incoming (ingress) and outgoing (egress) tables. The ingress table specifies which VLAN ID a port assigns to the incoming data packets. Hereby, you use the port address of the terminal device to assign it to a VLAN.
The egress table specifies at which ports the Switch may send the frames from this VLAN. Your entry also defines whether the Switch marks (tags) the Ethernet frames sent from this port.

- `T` = with tag field (T = tagged, marked)
- `U` = without tag field (U = untagged, not marked)

For this example, the status of the TAG field of the data packets has no relevance, so you set it to "U“.

Terminal	Port	Port VLAN identifier (PVID)
A	1	2
B	2	3
C	3	3
D	4	2
	5	1

Table 17: Ingress table

VLANID	Port				
	1	2	3	4	5
1					U
2	U			U	
3		U	U		

Table 18: Egress table

Proceed as follows to perform the example configuration:

☐ Configure VLAN

☐ Open the `Switching:VLAN:Static` dialog.

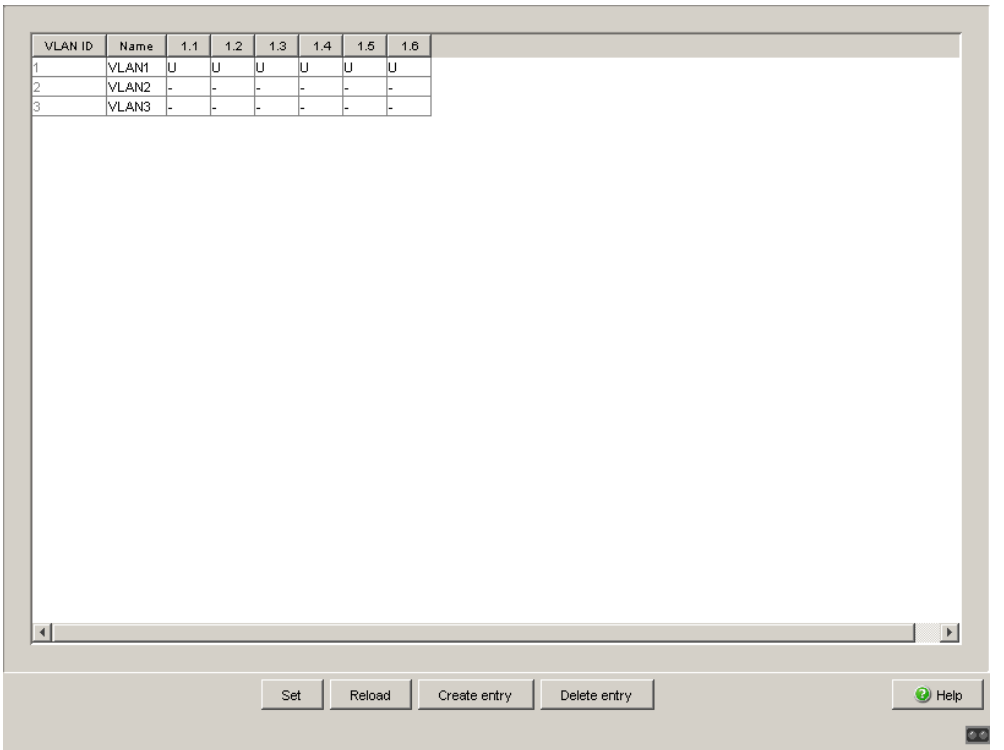


Figure 39: Creating and naming new VLANs

- ☐ Click on "Create" to open the window for entering the VLAN ID.
- ☐ Assign VLAN ID `2` to the VLAN.
- ☐ Click "OK".
- ☐ You give this VLAN the name VLAN2 by clicking on the field and entering the name. Also change the name for VLAN 1 from `Default` to `VLAN1`.
- ☐ Repeat the previous steps and create another VLAN with the VLAN ID `3` and the name `VLAN3`.

`enable`	Switch to the privileged EXEC mode.
`vlan database`	Switch to the VLAN configuration mode.
`vlan 2`	Create a new VLAN with the VLAN ID 2.
`vlan name 2 VLAN2`	Give the VLAN with the VLAN ID 2 the name VLAN2.
`vlan 3`	Create a new VLAN with the VLAN ID 3.
`vlan name 3 VLAN3`	Give the VLAN with the VLAN ID 3 the name VLAN3.
`vlan name 1 VLAN1`	Give the VLAN with the VLAN ID 1 the name VLAN1.
`exit`	Leave the VLAN configuration mode.

```
show vlan brief                    Display the current VLAN configuration.
Max. VLAN ID..................................... 4042
Max. supported VLANs.............................  255
Number of currently configured VLANs...........    3
VLAN 0 Transparent Mode (Prio. Tagged Frames).. Disabled
VLAN ID VLAN Name                       VLAN Type VLAN Creation Time
---- -------------------------------- --------- -------------------
1       VLAN1                           Default    0 days, 00:00:05
2       VLAN2                           Static     0 days, 02:44:29
3       VLAN3                           Static     0 days, 02:52:26
```

☐ Configuring the ports

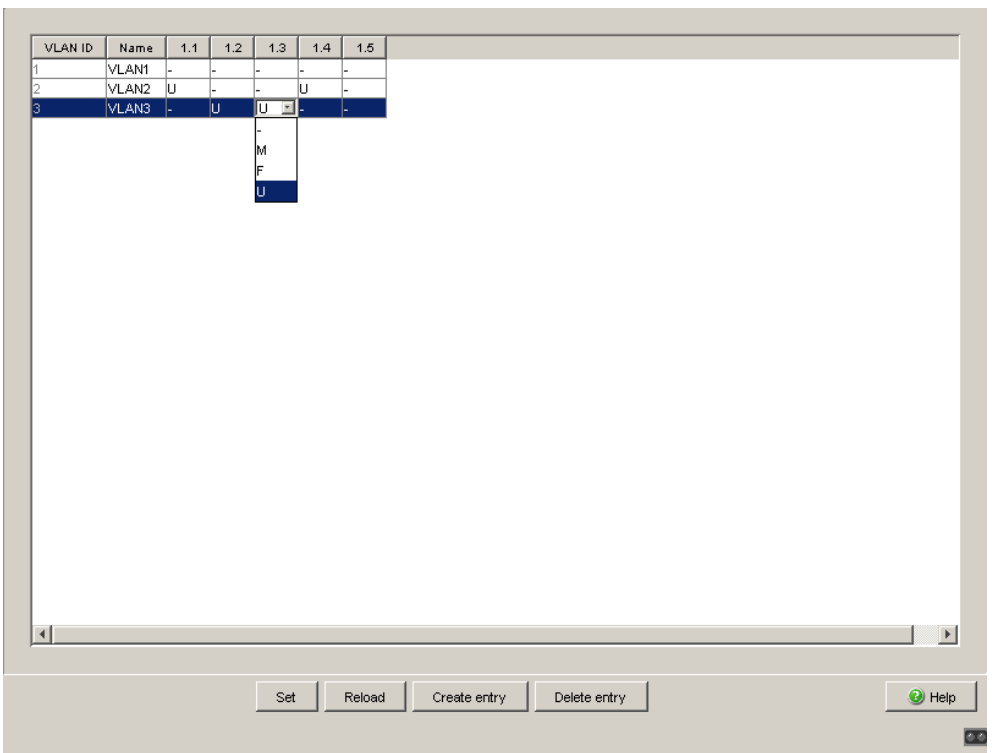


Figure 40: Defining the VLAN membership of the ports.

☐ Assign the ports of the device to the corresponding VLANs by clicking on the related table cell to open the selection menu and define the status. The selection options are:

- `-` = currently not a member of this VLAN (GVRP allowed)
- `T` = member of VLAN; send data packets with tag
- `U` = Member of the VLAN; send data packets without tag
- `F` = not a member of the VLAN (also disabled for GVRP)

Because terminal devices usually interpret untagged data packets exclusivly, you select the `U` setting here.

☐ To temporarily save the changes, click "Set".

☐ Open the `Switching:VLAN:Port` dialog.

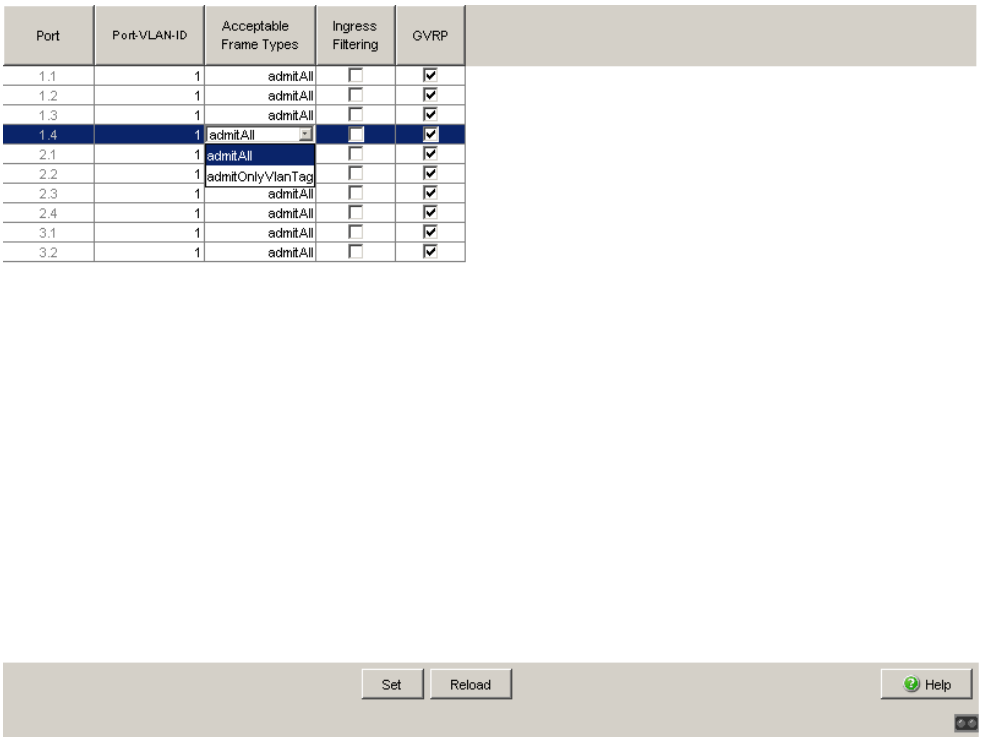


Figure 41: Assigning and saving "Port VLAN ID", "Acceptable Frame Types" and "Ingress Filtering"

- ☐ Assign the Port VLAN ID of the related VLANs (2 or 3) to the individual ports - see table.
- ☐ Because terminal devices usually send data packets as untagged, you select the `admitAll` setting for the "Acceptable Frame Types".
- ☐ The settings for `GVRP` and `Ingress Filter` do not affect how this example functions.
- ☐ Click "Set" to save the changes temporarily.
- ☐ Select the `Basics: Load/Save` dialog.
- ☐ In the “Save” frame, select “To Device” for the location and click “Save” to permanently save the configuration in the active configuration.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/1`	Switch to the Interface Configuration mode of interface 1/1.
`vlan participation include 2`	Port 1/1 becomes member untagged in VLAN 2.
`vlan pvid 2`	Port 1/1 is assigned the port VLAN ID 2.
`exit`	Switch to the Configuration mode.

```
interface 1/2                    Switch to the interface configuration mode for
                                 port 1.2.
vlan participation include 3     Port 1/2 becomes member untagged in VLAN 3.
vlan pvid 3                      Port 1/2 is assigned the port VLAN ID 3.
exit                             Switch to the Configuration mode.
interface 1/3                    Switch to the Interface Configuration mode of
                                 Interface 1/3.
vlan participation include 3     Port 1/3 becomes member untagged in VLAN 3.
vlan pvid 3                      Port 1/3 is assigned the port VLAN ID 3.
exit                             Switch to the Configuration mode.
interface 1/4                    Switch to the interface configuration mode of
                                 interface 1/4.
vlan participation include 2     Port 1/4 becomes member untagged in VLAN 2.
vlan pvid 2                      Port 1/4 is assigned the port VLAN ID 2.
exit                             Switch to the Configuration mode.
exit                             Switch to the privileged EXEC mode.
show VLAN 3                      Show details for VLAN 3.
VLAN ID           : 3
VLAN Name         : VLAN3
VLAN Type         : Static
VLAN Creation Time: 0 days, 02:52:26 (System Uptime)
Interface   Current   Configured   Tagging
----------  --------  -----------  --------
1/1         Exclude   Autodetect   Tagged
1/2         Include   Include      Untagged
1/3         Include   Include      Untagged
1/4         Exclude   Autodetect   Tagged
1/5         Exclude   Autodetect   Tagged
```

Example 2

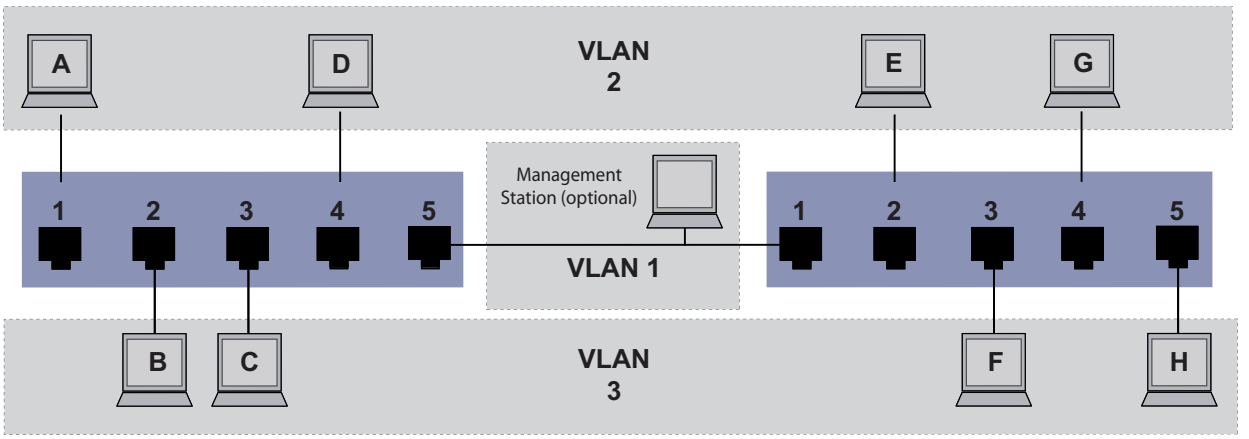


Figure 42: Example of a more complex VLAN configuration

The second example shows a more complex configuration with 3 VLANs (1 to 3). Along with the Switch from example 1, you use a 2nd Switch (on the right in the example).

The simple network divides the terminal devices, A - H, of the individual VLANs over 2 transmission devices (Switches). VLANs configured in this manner are „distributed VLANs“. When configured correctly the VLANs allow the optional Management Station to access the network components.

Note: In this case, VLAN 1 has no significance for the terminal device communication, but it is required for the administration of the transmission devices via what is known as the Management VLAN.

As in the previous example, uniquely assign the ports with their connected terminal devices to a VLAN. With the direct connection between the 2 transmission devices (uplink), the ports transport packets for both VLANs. To differentiate these uplinks you use “VLAN tagging”, which handles the frames accordingly. Thus, you maintain the assignment to the respective VLANs.

Proceed as follows to perform the example configuration:

Add Uplink Port 5 to the ingress and egress tables from example 1. Create new ingress and egress tables for the right switch, as described in the first example.

The egress table specifies at which ports the Switch may send the frames from this VLAN. Your entry also defines whether the Switch marks (tags) the Ethernet frames sent from this port.

- `T` = with tag field (T = tagged, marked)
- `U` = without tag field (U = untagged, not marked)

In this example, the devices use tagged frames in the communication between the transmission devices (uplink), the ports differentiate the frames for different VLANs.

Terminal	Port	Port VLAN identifier (PVID)
A	1	2
B	2	3
C	3	3
D	4	2
Uplink	5	1

Table 19: Ingress table for device on left

Terminal	Port	Port VLAN identifier (PVID)
Uplink	1	1
E	2	2
F	3	3
G	4	2
H	5	3

Table 20: Ingress table for device on right

VLAN ID	Port				
	1	2	3	4	5
1					U
2	U			U	T
3		U	U		T

Table 21: Egress table for device on left

VLAN ID	Port				
	1	2	3	4	5
1	U				

Table 22: Egress table for device on right

VLAN ID	Port					
2	T	U		U		
3	T		U		U	

Table 22: Egress table for device on right

The communication relationships here are as follows: terminal devices at ports 1 and 4 of the left device and terminal devices at ports 2 and 4 of the right device are members of VLAN 2 and can thus communicate with each other. The behavior is the same for the terminal devices at ports 2 and 3 of the left device and the terminal devices at ports 3 and 5 of the right device. These belong to VLAN 3.

The terminal devices “see” their respective part of the network. Participants outside this VLAN cannot be reached. The device also sends broadcast, multicast, and unicast packets with unknown (unlearned) destination addresses exclusively inside a VLAN.

Here, VLAN tagging (IEEE 801.1Q) is used within the VLAN with the ID 1 (Uplink). You can see this from the letter `T` in the egress table of the ports.

The configuration of the example is the same for the device on the right. Proceed in the same way, using the ingress and egress tables created above to adapt the previously configured left device to the new environment.

Proceed as follows to perform the example configuration:

☐ Configure VLAN

☐ Open the `Switching:VLAN:Static` dialog.

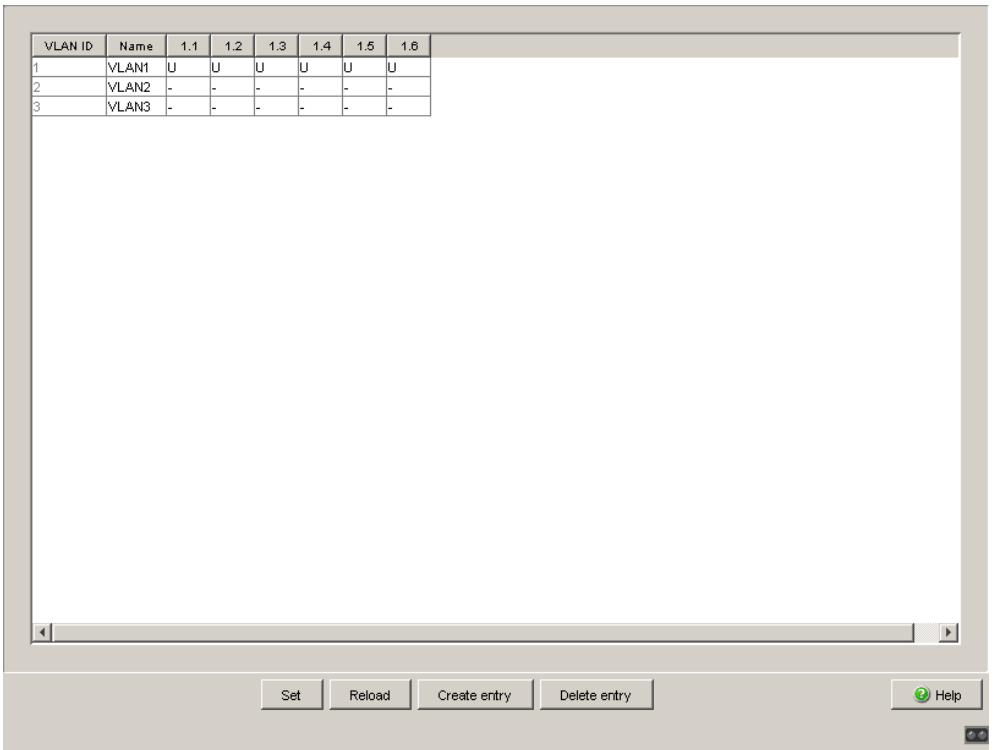


Figure 43: Creating and naming new VLANs

- ☐ Click on "Create" to open the window for entering the VLAN ID.
- ☐ Assign VLAN ID `2` to the VLAN.
- ☐ You give this VLAN the name VLAN2 by clicking on the field and entering the name. Also change the name for VLAN 1 from `Default` to `VLAN1`.
- ☐ Repeat the previous steps and create another VLAN with the VLAN ID 3 and the name `VLAN3`.

`enable`	Switch to the privileged EXEC mode.
`vlan database`	Switch to the VLAN configuration mode.
`vlan 2`	Create a new VLAN with the VLAN ID 2.
`vlan name 2 VLAN2`	Give the VLAN with the VLAN ID 2 the name VLAN2.
`vlan 3`	Create a new VLAN with the VLAN ID 3.
`vlan name 3 VLAN3`	Give the VLAN with the VLAN ID 3 the name VLAN3.
`vlan name 1 VLAN1`	Give the VLAN with the VLAN ID 1 the name VLAN1.
`exit`	Switch to the privileged EXEC mode.

```
show vlan brief                    Display the current VLAN configuration.
Max. VLAN ID..................................... 4042
Max. supported VLANs.............................  255
Number of currently configured VLANs...........    3
VLAN 0 Transparent Mode (Prio. Tagged Frames).. Disabled
VLAN ID VLAN Name                       VLAN Type VLAN Creation Time
---- -------------------------------- --------- -------------------
1       VLAN1                            Default    0 days, 00:00:05
2       VLAN2                            Static     0 days, 02:44:29
3       VLAN3                            Static     0 days, 02:52:26
```

☐ Configuring the ports

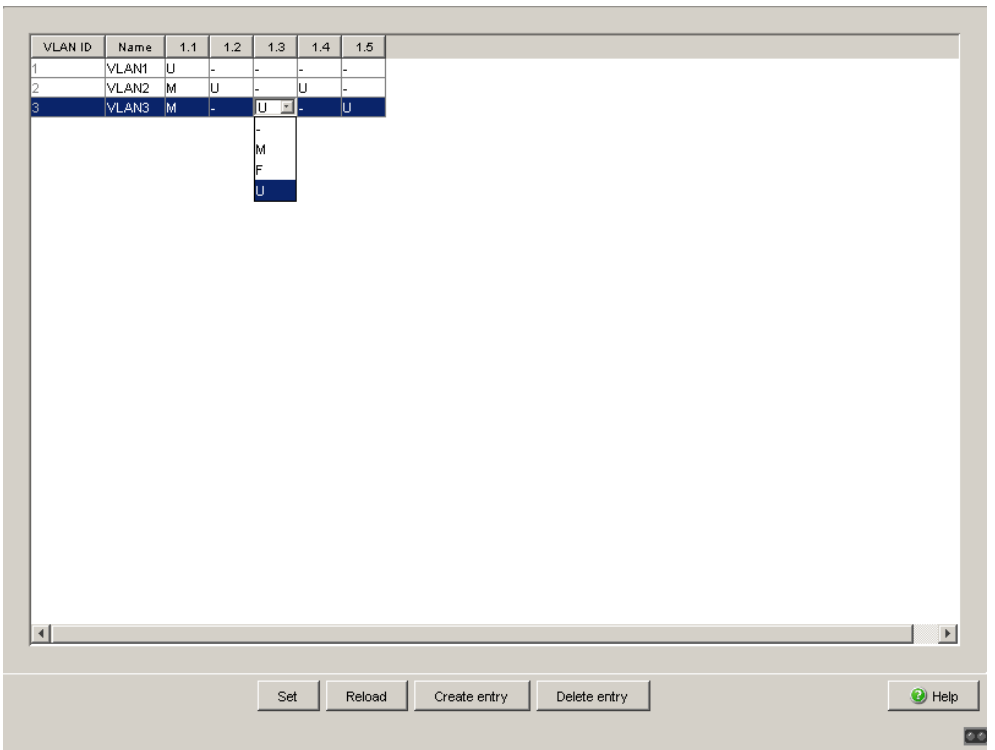


Figure 44: Defining the VLAN membership of the ports.

☐ Assign the ports of the device to the corresponding VLANs by clicking on the related table cell to open the selection menu and define the status. The selection options are:

- `-` = currently not a member of this VLAN (GVRP allowed)
- `T` = member of VLAN; send data packets with tag
- `U` = Member of the VLAN; send data packets without tag
- `F` = not a member of the VLAN (also disabled for GVRP)

Because terminal devices usually interpret untagged data packets, you select the `U` setting. You select the `T`setting on the uplink port on which the VLANs communicate with each other.

☐ Click "Set" to save the changes temporarily.

☐ Open the `Switching:VLAN:Port` dialog.

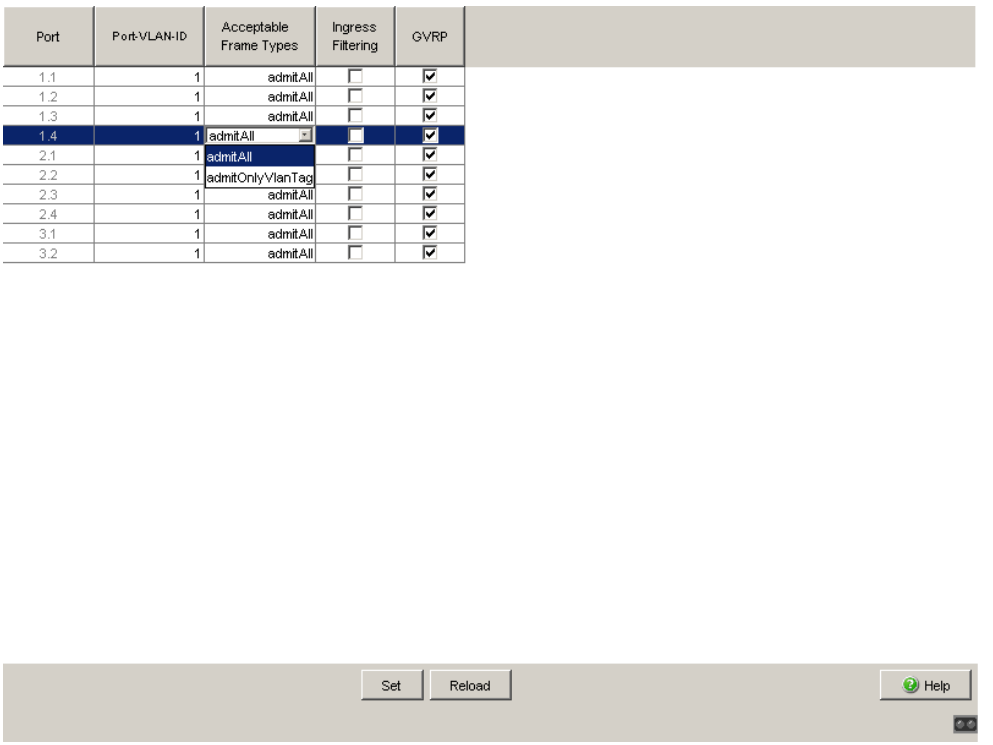


Figure 45: Assigning and saving "Port VLAN ID", "Acceptable Frame Types" and "Ingress Filtering"

☐ Assign the ID of the related VLANs (1 to 3) to the individual ports.

☐ Because terminal devices usually send data packets as untagged, you select the `admitAll` setting for the terminal device ports. Configure the uplink port with `admit only VLAN tags`.

☐ To evaluate the VLAN tag on this port, activate "Ingress Filtering" on the uplink port.

☐ Click "Set" to save the changes temporarily.

☐ Select the `Basics: Load/Save` dialog.

☐ In the “Save” frame, select “To Device” for the location and click “Save” to permanently save the configuration in the active configuration.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 1/1`	Switch to the Interface Configuration mode of interface 1/1.
`vlan participation include 1`	Port 1/1 becomes member untagged in VLAN 1.
`vlan participation include 2`	Port 1/1 becomes member untagged in VLAN 2.
`vlan tagging 2`	Port 1/1 becomes member tagged in VLAN 2.

`vlan participation include 3`	Port 1/1 becomes member untagged in VLAN 3.
`vlan tagging 3`	Port 1/1 becomes member tagged in VLAN 3.
`vlan pvid 1`	Port 1/1 is assigned the port VLAN ID 1.
`vlan ingressfilter`	Port 1/1 ingress filtering is activated.
`vlan acceptframe vlanonly`	Port 1/1 only forwards frames with a VLAN tag.
`exit`	Switch to the Configuration mode.
`interface 1/2`	Switch to the interface configuration mode for port 1.2.
`vlan participation include 2`	Port 1/2 becomes member untagged in VLAN 2.
`vlan pvid 2`	Port 1/2 is assigned the port VLAN ID 2.
`exit`	Switch to the Configuration mode.
`interface 1/3`	Switch to the Interface Configuration mode of Interface 1/3.
`vlan participation include 3`	Port 1/3 becomes member untagged in VLAN 3.
`vlan pvid 3`	Port 1/3 is assigned the port VLAN ID 3.
`exit`	Switch to the Configuration mode.
`interface 1/4`	Switch to the interface configuration mode of interface 1/4.
`vlan participation include 2`	Port 1/4 becomes member untagged in VLAN 2.
`vlan pvid 2`	Port 1/4 is assigned the port VLAN ID 2.
`exit`	Switch to the Configuration mode.
`interface 1/5`	Switch to the interface configuration mode for port 1.5.
`vlan participation include 3`	Port 1/5 becomes member untagged in VLAN 3.
`vlan pvid 3`	Port 1/5 is assigned the port VLAN ID 3.
`exit`	Switch to the Configuration mode.
`exit`	Switch to the privileged EXEC mode.
`show vlan 3`	Show details for VLAN 3.

```
VLAN ID           : 3
VLAN Name         : VLAN3
VLAN Type         : Static
VLAN Creation Time: 0 days, 00:07:47 (System Uptime)
Interface   Current   Configured   Tagging
----------  --------  -----------  --------
1/1         Include   Include      Tagged
1/2         Exclude   Autodetect   Untagged
1/3         Include   Include      Untagged
1/4         Exclude   Autodetect   Untagged
1/5         Include   Include      Untagged
```

For further information on VLANs, see the reference manual and the integrated help function in the program.

9 Operation Diagnosis

The device provides you with the following diagnostic tools:

- Sending traps
- Monitoring the device status
- Out-of-band signaling via signal contact
- Port status indication
- Event counter at port level
- Detecting non-matching duplex modes
- SFP status display
- TP cable diagnosis
- Topology Discovery
- Detecting IP address conflicts
- Detecting loops
- Reports
- Monitoring data traffic at a port (port mirroring)
- Syslog
- Event log

9.1 Sending Traps

The device reports unusual events which occur during normal operation immediately to the management station. This is done by messages called traps that bypass the polling procedure ("Polling" means querying the data stations at regular intervals). Traps allow you to react quickly to unusual events.

Examples of such events are:

- Hardware reset
- Changes to the configuration
- Segmentation of a port

The device sends traps to various hosts to increase the transmission reliability for the messages. The unacknowledged trap message consists of a packet containing information about an unusual event.

The device sends traps to those hosts entered in the trap destination table. The device allows you to configure the trap destination table with the management station via SNMP.

9.1.1 List of SNMP traps

The following table shows a list of the traps that can be sent by the device.

Trap name	Meaning
authenticationFailure	this is sent if a station attempts to access an agent without authorisation.
coldStart	this is sent during the boot phase for both cold starts and warm starts, after successful initialisation of the network management.
hmAutoconfigAdapterTrap	this is sent when the AutoConfiguration AdapterACA is disconnected or connected.
linkDown	this is sent if the connection to a port is interrupted.
linkUp	this is sent when connection is established to a port.
hmTemperature	this is sent if the temperature exceeds the set threshold limits.
hmPowerSupply	this is sent if the power supply status changes.
hmSigConRelayChange	this is sent if the status of the signal contact changes in the function monitoring.
newRoot	this is sent if the sending agent becomes the new root of the spanning tree.
topologyChange	this is sent if the switching mode of a port changes.
risingAlarm	this is sent if an RMON alarm input exceeds its upper threshold.
fallingAlarm	this is sent if an RMON alarm input goes below its lower threshold.
hmModuleMapChange	this is sent if the hardware configuration changes.
hmBPDUGuardTrap	this is sent if a BPDU is received on a port while the BPDU Guard function is active.
hmMrpReconfig	this is sent if the configuration of the MRP Ring changes.
hmRingRedReconfig	this is sent if the configuration of the HIPER Ring changes.
hmRingRedCplReconfig	this is sent if the configuration of the redundant ring/network coupling changes.
hmSNTPTrap	this is sent if an error occurs in relation to the SNTP (e.g. server not available).
hmRelayDuplicateTrap	this is sent if a duplicate IP address is detected in relation to DHCP Option 82.
lldpRemTablesChangeTrap	this is sent if an entry in the Remote Table topology changes.
vrrpTrapNewMaster	this is sent if another router becomes the master router for an interface or a virtual address.
vrrpTrapAuthFailure	this is sent if the router receives a packet with an invalid authentication from another VRRP router.
hmConfigurationSavedTrap	this is sent after the device has successfully saved its configuration locally.
hmConfigurationChangedTrap	this is sent if you change the configuration of the device after saving locally for the first time.

Table 23: Possible traps

Trap name	Meaning
hmAddressRelearnDetectTrap	this is sent if Address Relearn Detection is active and the relearn threshold for MAC addresses on different ports is exceeded. This process indicates high probability of a loop situation on the network.
hmDuplexMismatchTrap	this is sent if the device detects a possible problem with duplex mode on a port.
hmTrapRebootOnError	this is sent if the device detects an error which is to be corrected by a cold start.

Table 23: Possible traps

9.1.2 SNMP Traps when Booting

The device sends the ColdStart trap during every booting.

9.1.3 Configuring Traps

☐ Open the `Diagnostics:Alarms (Traps)` dialog.

This dialog allows you to determine which events trigger an alarm (trap) and where these alarms should be sent.

☐ Click "Create".

☐ In the "IP Address“ column, enter the IP address of the management station to which the traps should be sent.

☐ In the "Enabled“ column, you mark the entries that the device should take into account when it sends traps. Default setting: inactive.

☐ In the column "Password", enter the community name that the device uses to identify itself as the trap's source.

☐ In the “Configuration” frame, select the trap categories from which you want to send traps. Default setting: all trap categories are active.

Note: You need read-write access for this dialog.

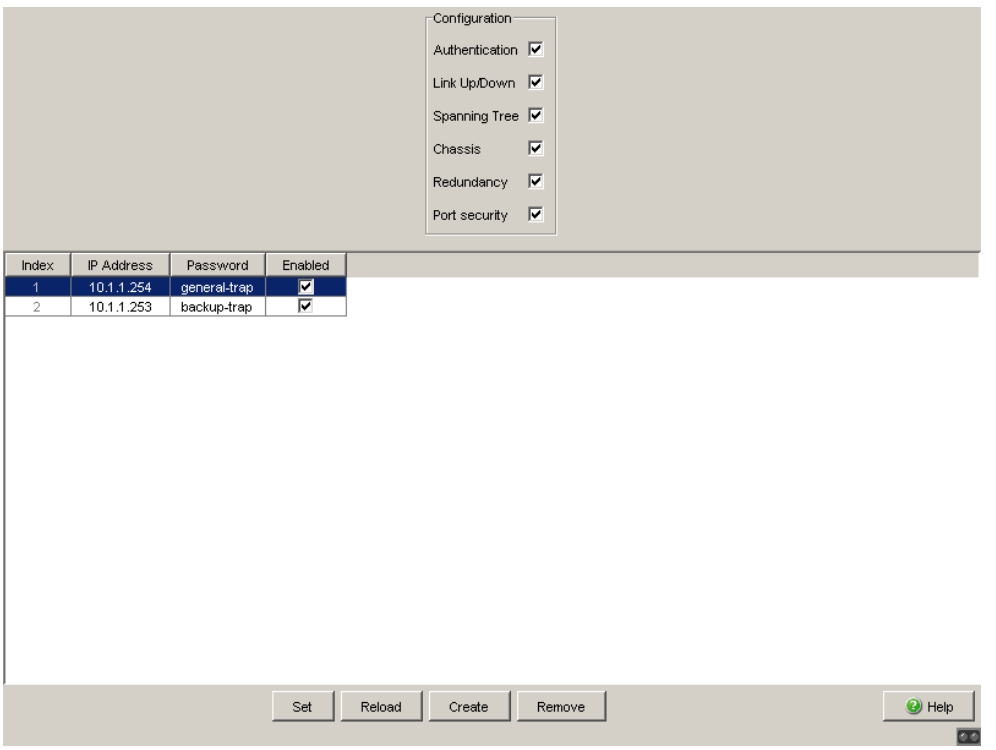


Figure 46: Alarms dialog

The events which can be selected are:

Name	Meaning
Authentication	The device has rejected an unauthorized access attempt (see the `Access for IP Addresses and Port Security` dialog).
Link Up/Down	At one port of the device, the link to another device has been established/interrupted.
Spanning Tree	The topology of the Rapid Spanning Tree has changed.
Chassis	Summarizes the following events: – The status of a supply voltage has changed (see the `System` dialog). – The status of the signal contact has changed. To take this event into account, you activate “Create trap when status changes” in the `Diagnostics:Signal Contact 1/2` dialog. - The AutoConfiguration Adapter (ACA), has been added or removed. - The configuration on the AutoConfiguration Adapter(ACA) does not match that in the device. – The temperature thresholds have been exceeded/not reached. – A media module has been added or removed (only for modular devices). – The receiver power status of a port with an SFP module has changed (see dialog `Diagnostics:Ports:SFP Modules`).
	The redundancy status of the ring redundancy (redundant line active/inactive) or (for devices that support redundant ring/network coupling) the redundant ring/network coupling (redundancy exists) has changed.
Port security	On one port a data packet has been received from an unauthorized terminal device (see the `Port Security` dialog).

Table 24: Trap categories

9.2 Monitoring the Device Status

The device status provides an overview of the overall condition of the device. Many process visualization systems record the device status for a device in order to present its condition in graphic form.

The device displays its current status as "Error" or "OK" in the "Device Status" frame. The device determines this status from the individual monitoring results.
The device enables you to

- signal the device status out-of-band via a signal contact (see on page 220 “Monitoring the Device Status via the Signal Contact”)
- signal the device status by sending a trap when the device status changes
- detect the device status in the graphical user interface on the system side.
- query the device status in the Command Line Interface.

The `Diagnostics:Device Status` dialog of the device includes:

- Incorrect supply voltage
  - at least one of the 2 supply voltages is not operating,
  - the internal supply voltage is not operating.
- The temperature threshold has been exceeded or has not been reached.
- The removal of a module (for modular devices).
- The removal of the ACA.
- The configuration on the external memory does not match that in the device.
- The interruption of the connection at at least one port. In the `Basic Settings:Port Configuration` menu, you define which ports the device signals if the connection is down (see on page 88 “Displaying detected loss of connection”). On delivery, there is no link monitoring.
- Events for ring redundancy:
  Loss of the redundancy (in ring manager mode). On delivery, ring redundancy monitoring is inactive.
  The device is a normal ring participant and detects an error in the local configuration.

- Event in the ring/network coupling:
  Loss of the redundancy. On delivery, there is no ring redundancy monitoring.
  The following conditions are also reported by the device in standby mode:
  – Defective link status of the control line
  – Partner device is in standby mode
- Failure of a fan (MACH 4000).

Select the corresponding entries to decide which events the device status includes.

Note: With a non-redundant voltage supply, the device reports the absence of a supply voltage. If you do not want this message to be displayed, feed the supply voltage over both inputs or switch off the monitoring (see on page 220 “Monitoring the Device Status via the Signal Contact”).

9.2.1 Configuring the Device Status

- ☐ Open the `Diagnostics:Device Status` dialog.
- ☐ In the “Monitoring” field, you select the events you want to monitor.
- ☐ To monitor the temperature, you also set the temperature thresholds in the `Basic settings:System` dialog at the end of the system data.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`device-status monitor all error`	Include all the possible events in the device status determination.
`device-status trap enable`	Enable a trap to be sent if the device status changes.

Note: The above CLI commands activate the monitoring and the trapping respectively for all the supported components. If you want to activate or deactivate monitoring only for individual components, you will find the corresponding syntax in the CLI manual or in the help of the CLI console (enter a question mark “?“ at the CLI prompt).

9.2.2 Displaying the Device Status

☐ Select the `Basics:System` dialog.

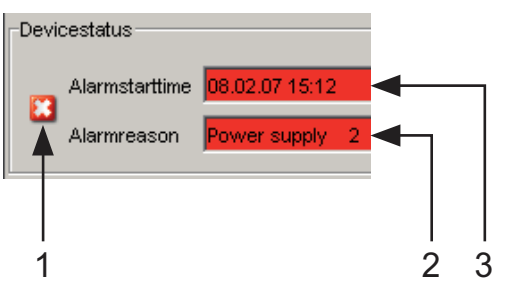


Figure 47: Device status and alarm display
1 - The symbol displays the device status
2 - Cause of the oldest existing alarm
3 - Start of the oldest existing alarm

`exit`	Change to the privileged EXEC mode.
`show device-status`	Display the device status and the setting for the device status determination.

9.3 Out-of-band Signaling

The signal contact is used to control external devices and monitor the operation of the device. Function monitoring enables you to perform remote diagnostics.
The device reports the operating status via a break in the potential-free signal contact (relay contact, closed circuit):

- Incorrect supply voltage
  - at least one of the 2 supply voltages is not operating,
  - the internal supply voltage is not operating.
- The temperature threshold has been exceeded or has not been reached.
- The removal of a module (for modular devices).
- The removal of the ACA.
- The configuration on the external memory does not match that in the device.
- The interruption of the connection at at least one port. In the `Basic Settings:Port Configuration` menu, you define which ports the device signals if the connection is down (see on page 88 “Displaying detected loss of connection”). On delivery, there is no link monitoring.
- Events for ring redundancy:
  Loss of the redundancy (in ring manager mode). On delivery, ring redundancy monitoring is inactive.
  The device is a normal ring participant and detects an error in the local configuration.
- Event in the ring/network coupling:
  Loss of the redundancy. On delivery, there is no ring redundancy monitoring.
  The following conditions are also reported by the device in standby mode:
  – Defective link status of the control line
  – Partner device is in standby mode
- Failure of a fan (MACH 4000).

Select the corresponding entries to decide which events the device status includes.

Note: With a non-redundant voltage supply, the device reports the absence of a supply voltage. If you do not want this message to be displayed, feed the supply voltage over both inputs or switch off the monitoring (see on page 220 “Monitoring the Device Status via the Signal Contact”).

9.3.1 Controlling the Signal Contact

With this mode you control this signal contact remotely.

Application options:

- Simulation of an error detected during SPS error monitoring
- Remote control of a device via SNMP, such as switching on a camera

☐ Select the `Diagnostics:Signal Contact 1/2)` dialog.

☐ In the "Mode Signal contact" frame, you select the "Manual setting" mode to switch the contact manually.

☐ Select "Opened" in the "Manual setting" frame to open the contact.

☐ Select "Closed" in the "Manual setting" frame to close the contact.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`signal-contact 1 mode manual`	Select the manual setting mode for signal contact 1.
`signal-contact 1 state open`	Open signal contact 1.
`signal-contact 1 state close`	Close signal contact 1.

9.3.2 Monitoring the Device Status via the Signal Contact

The "Device Status" option enables you, like in the operation monitoring, to monitor the device state (see on page 220 “Monitoring the Device Status via the Signal Contact”) via the signal contact.

9.3.3 Monitoring the Device Functions via the Signal Contact

Configuring the operation monitoring

- ☐ Select the `Diagnostics:Signal Contact` dialog.
- ☐ Select "Monitoring correct operation" in the "Mode signal contact" frame to use the contact for operation monitoring.
- ☐ In the "Monitoring correct operation" frame, you select the events you want to monitor.
- ☐ To monitor the temperature, you set the temperature thresholds in the `Basics:System` dialog at the end of the system data.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`signal-contact 1 monitor all`	Includes all the possible events in the operation monitoring.
`signal-contact 1 trap enable`	Enables a trap to be sent if the status of the operation monitoring changes.

Displaying the signal contact’s status

The device gives you 3 additional options for displaying the status of the signal contact:

- LED display on device,
- display in the graphical user interface,
- query in the Command Line Interface.

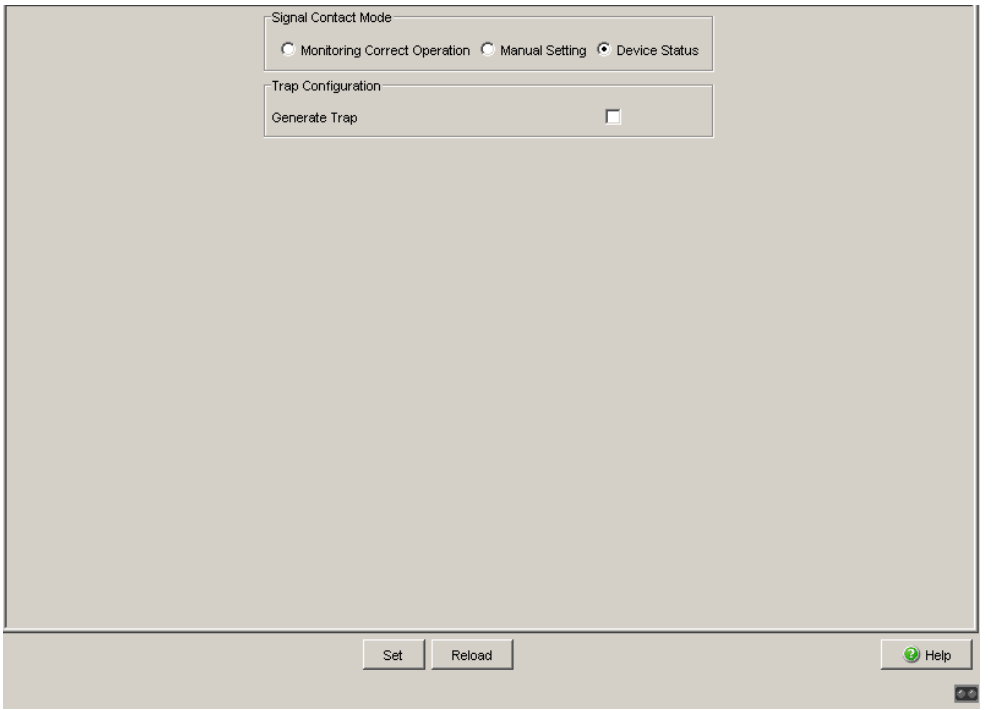


Figure 48: Signal Contact dialog

```
exit
show signal-contact 1
```

Change to the privileged EXEC mode.
Displays the status of the operation monitoring and the setting for the status determination.

9.3.4 Monitoring the Fan

Devices in the Mach 4000 family have a replaceable plug-in fan unit. This plug-in fan helps considerably in reducing the internal temperature of the device.
Fans are subject to natural wear. The failure of one or more fans in the plug-in fan can have a negative effect on the operation and life span of the device, or can lead to a total failure of the device.

The device enables you

- to signal changes to the status of the plug-in fan out-of-band (outside the data flow) via a signal contact (see on page 220 “Monitoring the Device Status via the Signal Contact”)
- to signal changes to the status of the plug-in fan by sending a trap when the device status changes
- to detect status changes to the plug-in fan in the Web-based interface on the system side and
- to query changes to the status of the plug-in fan in the Command Line Interface.

Proceed as follows to signal changes to the fan status via a signal contact and with an alarm message:

- ☐ Select the `Diagnostics:Signal Contact` dialog.
- ☐ Select the signal contact you want to use (in the example, signal contact 1) in the corresponding tab page “Signal contact 1” or “Signal contact 2”.
- ☐ In the “Signal contact mode” frame, select “Function monitoring”.
- ☐ In the “Function monitoring” frame, select the fan monitoring.
- ☐ Click "Set" to save the changes temporarily.
- ☐ Select the `Basics: Load/Save` dialog.
- ☐ In the “Save” frame, select “To Device” for the location and click “Save” to permanently save the configuration in the active configuration.

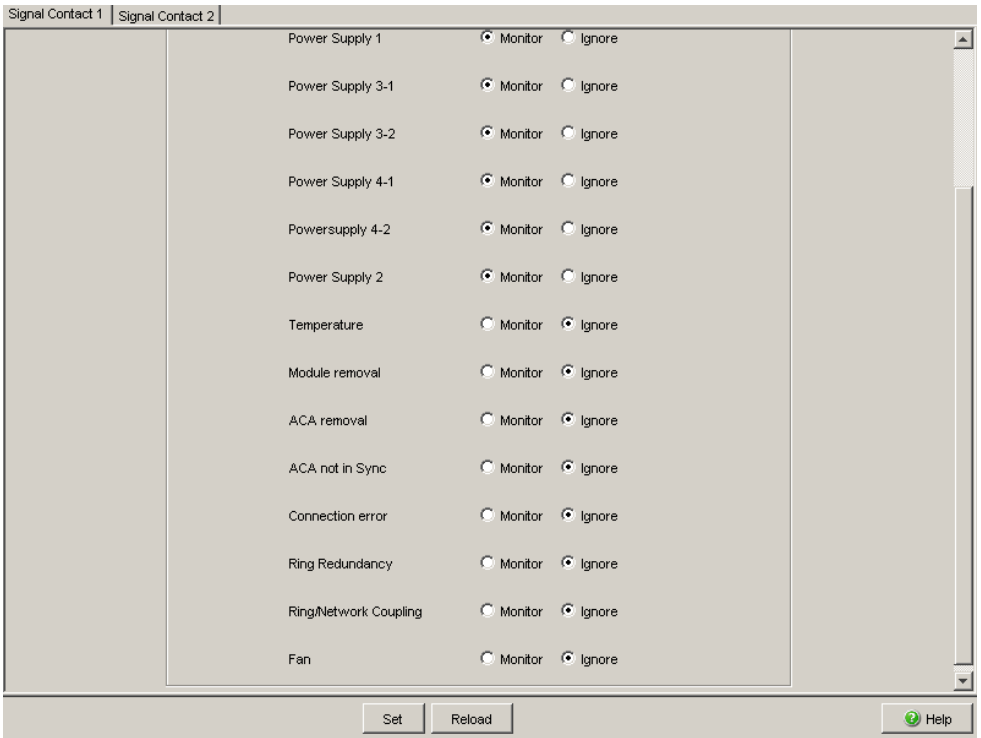


Figure 49: Monitoring the fan with the signal contact and trap

9.4 Port Status Indication

☐ Select the `Basics:System` dialog.

The device view shows the device with the current configuration. The status of the individual ports is indicated by one of the symbols listed below. You will get a full description of the port's status by positioning the mouse pointer over the port's symbol.

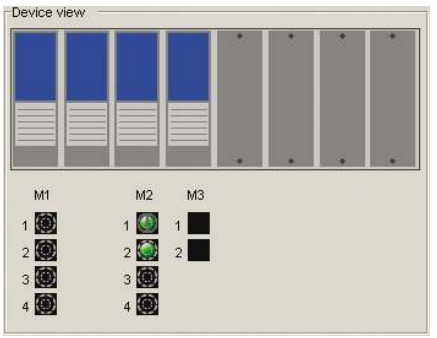


Figure 50: Device View

Meaning of the symbols:

The port (10, 100 Mbit/s, 1, 10 Gbit/s) is enabled and the connection is OK.

The port is disabled by the management and it has a connection.

The port is disabled by the management and it has no connection.

The port is in autonegotiation mode.

The port is in HDX mode.

The port (100 MBit/s) is in the discarding mode of a redundancy protocol such as Spanning Tree or HIPER-Ring.

The port is in routing mode (100 Mbit/s).

9.5 Event Counter at Port Level

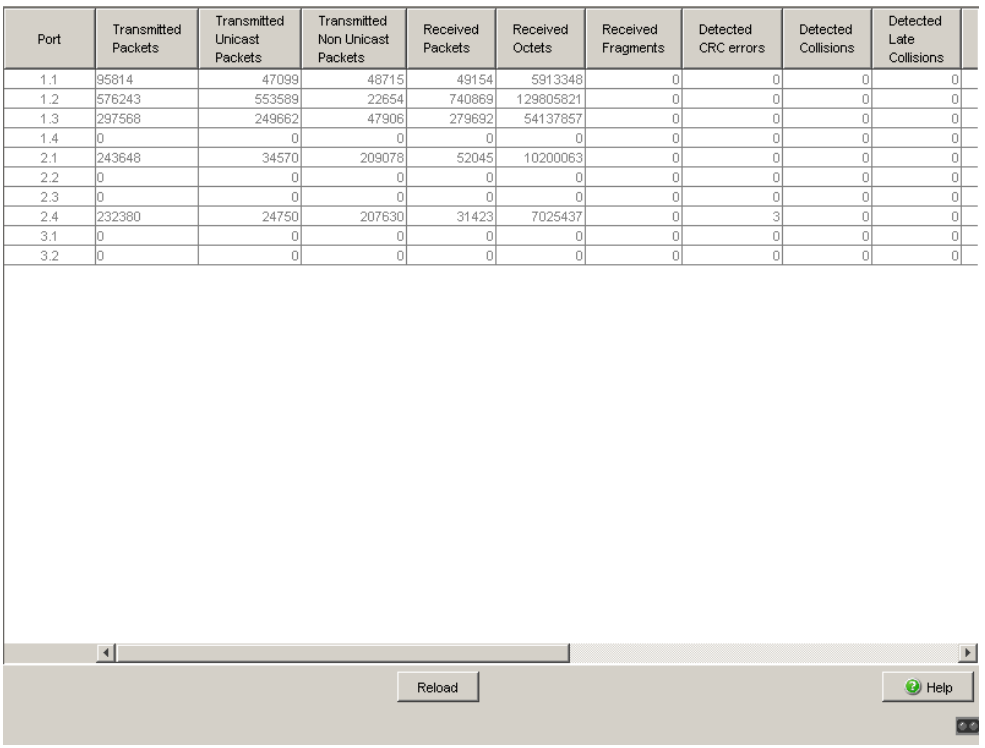
The port statistics table enables experienced network administrators to identify possible detected problems in the network.
This table shows you the contents of various event counters. In the Restart menu item, you can reset the event counters to zero using "Warm start", "Cold start" or "Reset port counter".
The packet counters add up the events sent and the events received.

Counter	Indication of known possible weakness
Received fragments	– Non-functioning controller of the connected device – Electromagnetic interference in the transmission medium
CRC error	– Non-functioning controller of the connected device – Electromagnetic interference in the transmission medium – Inoperable component in the network
Collisions	– Non-functioning controller of the connected device – Network over extended/lines too long – Collision or a detected fault with a data packet

Table 25: Examples indicating known weaknesses

☐ Select the `Diagnostics:Ports:Statistics` dialog.

☐ To reset the counters, click on “Reset port counters” in the Basic Settings:Restart dialog.



Port	Transmitted Packets	Transmitted Unicast Packets	Transmitted Non Unicast Packets	Received Packets	Received Octets	Received Fragments	Detected CRC errors	Detected Collisions	Detected Late Collisions
1.1	95814	47099	48715	49154	5913348	0	0	0	0
1.2	576243	553589	22654	740869	129805821	0	0	0	0
1.3	297568	249662	47906	279692	54137857	0	0	0	0
1.4	0	0	0	0	0	0	0	0	0
2.1	243648	34570	209078	52045	10200063	0	0	0	0
2.2	0	0	0	0	0	0	0	0	0
2.3	0	0	0	0	0	0	0	0	0
2.4	232380	24750	207630	31423	7025437	0	3	0	0
3.1	0	0	0	0	0	0	0	0	0
3.2	0	0	0	0	0	0	0	0	0

Figure 51: Port Statistics dialog

9.5.1 Detecting Non-matching Duplex Modes

If the duplex modes of 2 ports directly connected to each other do not match, this can cause problems that are difficult to track down. The automatic detection and reporting of this situation has the benefit of recognizing it before problems occur.

This situation can arise from an incorrect configuration, e.g. if you deactivate the automatic configuration at the remote port.

A typical effect of this non-matching is that at a low data rate, the connection seems to be functioning, but at a higher bi-directional traffic level the local device records a lot of CRC errors, and the connection falls significantly below its nominal capacity.

The device allows you to detect this situation and report it to the network management station. In the process, the device evaluates the error counters of the port in the context of the port settings.

Possible causes of port error events

The following table lists the duplex operating modes for TX ports, with the possible fault events. The meanings of terms used in the table are as follows:

- Collisions: In half-duplex mode, collisions mean normal operation.
- Duplex problem: Mismatching duplex modes.
- EMI: Electromagnetic interference.
- Network extension: The network extension is too great, or too many cascading hubs.
- Collisions, late collisions: In full-duplex mode, no incrementation of the port counters for collisions or late collisions.
- CRC error: The device evaluates these errors as non-matching duplex modes in the manual full duplex mode.

No.	Automatic configuration	Current duplex mode	Detected error events (≥ 10 after link up)	Duplex modes	Possible causes
1	On	Half duplex	None	OK	
2	On	Half duplex	Collisions	OK	
3	On	Half duplex	Late collisions	Duplex problem detected	Duplex problem, EMI, network extension
4	On	Half duplex	CRC error	OK	EMI
5	On	Full duplex	None	OK	
6	On	Full duplex	Collisions	OK	EMI
7	On	Full duplex	Late collisions	OK	EMI
8	On	Full duplex	CRC error	OK	EMI
9	Off	Half duplex	None	OK	
10	Off	Half duplex	Collisions	OK	
11	Off	Half duplex	Late collisions	Duplex problem detected	Duplex problem, EMI, network extension
12	Off	Half duplex	CRC error	OK	EMI
13	Off	Full duplex	None	OK	
14	Off	Full duplex	Collisions	OK	EMI

Table 26: Evaluation of non-matching of the duplex mode

No.	Automatic configuration	Current duplex mode	Detected error events (≥ 10 after link up)	Duplex modes	Possible causes
15	Off	Full duplex	Late collisions	OK	EMI
16	Off	Full duplex	CRC error	Duplex problem detected	Duplex problem, EMI

Table 26: Evaluation of non-matching of the duplex mode (cont.)

Activating the detection

☐ Select the Switching:Switching Global dialog.

☐ Select “Activate Duplex Mismatch Detection”. The device then checks whether the duplex mode of a port might not match that of the remote port.
If the device detects a potential mismatch, it creates an entry in the event log and sends an alarm (trap).

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`bridge duplex-mismatch-detect operation enable`	Activates the detection and reporting of non-matching duplex modes.
`bridge duplex-mismatch-detect operation disable`	Deactivates the detection and reporting of non-matching duplex modes.

9.5.2 TP Cable Diagnosis

The TP cable diagnosis allows you to check the connected cables for short-circuits or interruptions.

Note: While the check is running, the data traffic at this port is suspended.

The check takes a few seconds. After the check, the "Result" row contains the result of the cable diagnosis. If the result of the check shows a cable problem, then the "Distance" row contains the cable problem location's distance from the port.

Result	Meaning
normal	The cable is okay.
open	The cable is interrupted.
short circuit	There is a short-circuit in the cable.
unknown	No cable check was performed yet, or it is currently running

Table 27: Meaning of the possible results

Prerequisites for correct TP cable diagnosis:

- 1000BASE-T port, connected to a 1000BASE-T port via 8-core cable or
- 10BASE-T/100BASE-TX port, connected to a 10BASE-T/100BASE-TX port.

9.5.3 Port Monitor

When you enable this feature the device monitors the port states. The device offers you the ability to disable individual ports or send a trap when user-defined conditions occur.

Definable port conditions are:
- Link Flap
- CRC/Fragments
- Overload Detection
- Speed and duplex combination

In the Global dialog, you activate the configurations defined in the "Link Flap", "CRC/Fragments" and "Overload Detection" tabs. The device detects these conditions when you activate the functions. If the device detects the user defined condition on a port, it produces the response defined for that port.

Link Flapping occurs when a link alternately advertises its link state as up and down. You configure the device to detect this condition and then define whether to send a trap or shut the port off.

Using the Cyclical Redundancy Check (CRC) the device detects data packets modified during the transmission based on the checksum. The device detects the total number of packets received that were less than 64 octets in length, excluding framing bits, but including FCS octets, and had either a FCS error or an Alignment Error.
- A FCS error is a bad Frame Check Sequence (FCS) with an integral number of octets.
- An Alignment Error is a bad FCS with a non-integral number of octets.

The device monitors both criteria if you enable the function in the "Global" tab. If the number of occurred CRC/fragment errors exceeds the specified threshold, the device executes the user-specified action.

Overload Detection prevents a broadcast, multicast, or unicast storm from disrupting traffic on a port. The Overload Detection function monitors packets passing from a port to the switching bus to determine if the packet is unicast, multicast, or broadcast. The switch counts the number of user-defined packets received within the "Sampling Interval "and compares the measurement with a user-defined threshold. The port blocks traffic after reaching the "Upper Threshold". When you activate the recovery function for Overload Detection, the port remains blocked until the traffic rate drops below the "Lower Threshold" and then forwards traffic as normal.

The device allows you to define which duplex mode is allowed for which speed for a specific port. The monitoring of the combination of speed and duplex mode prevents any undesired connections.

- ☐ Open the `Diagnositics:Ports:Port Monitor` dialog.

- ☐ Open the "Link Flap" tab.
- ☐ Define the number of times that a port cycles between link up and link down before the function disables the port, in the "Link Flap Count" text box, in the "Parameter" frame.
- ☐ Define the elapse time in the "Sample Interval [s]" text box in the "Parameter" frame.

- ☐ Open the "CRC/Fragments" tab.
- ☐ Define the number of packets received containing changes in raw data or fragment packets received before the function disables the port, in the "CRC/Fragments count [ppm]" text box, in the "Parameter" frame.
- ☐ Define the elapse time in the "Sample Interval [s]" text box in the "Parameter" frame.

- ☐ Open the "Overload Detection" tab.
- ☐ Define the elapse time in the "Sample Interval [s]" text box in the "Parameter" frame.
- ☐ For each port, define the type of traffic to monitor in the "Traffic Type" column.
- ☐ For each port, define the type of threshold to use in the "Threshold Type" column.
- ☐ For each port, define the threshold at which the device enables the port in the "Lower Threshold" column.
- ☐ For each port, define the threshold at which the device disables the port in the "Upper Threshold" column.

- ☐ Open the "Speed Duplex" tab.

☐ You define for each port which duplex mode is allowed for which speed.
- "hdx" = half duplex
- "fdx" = full duplex
- "10" = 10 Mbit/s
- "100" = 100 Mbit/s

  etc.

☐ Open the "Global" tab.

☐ In the "Port Monitor on" column of the "Global" tab, select the ports to monitor.

☐ To activate the Port Monitor function, click `On` in the "Operation" frame.

9.5.4 Auto Disable

If the configuration shows a port as enabled, but the device detects an error, the software shuts down that port. In other words, the device software disables the port because of a detected error condition.

When a port is auto-disabled, the device effectively shuts down the port and the port blocks traffic. The port LED blinks green 3 times per period and identifies the reason for the shutdown. In addition, the device generates a log entry listing the reason for the auto-disable. When you enable the port after a timeout by auto-disable, the device generates a log entry.

This feature provides a recovery function which automatically enables an auto-disabled port after a user-defined time. When this function enables a port, the device sends a trap with the port number and an empty "Reason" entry.

The auto-disable function serves the following purposes:
- It assists the network administrator in port analysis.
- It eliminates the possibility that this port causes other ports on the module (or the entire module) to shut down.

Note: The "Reset" button allows you to enable the port before the "Reset Timer [s]" counts down.

So that the device enables the ports again that were disabled because of a detected error state, complete the following steps:

- ☐ Open the `Diagnositics:Ports:Auto Disable` dialog.
- ☐ To enable ports again that the device has disabled due to link flaps, in the "Configuration" frame mark the "Link Flap" checkbox.
  You define the parameters that cause the ports to be disabled due to link flaps in the `Diagnostics:Ports:Port Monitor` dialog, on the "Link Flap" tab.

- ☐ To enable ports again that the device has disabled due to CRC or fragment errors, on the "Configuration" frame mark the "CRC Error" checkbox.
  You define the parameters that cause the ports to be disabled due to CRC or fragment errors in the `Diagnostics:Ports:Port Monitor` dialog, on the "CRC/Fragments" tab.
- ☐ To enable ports again that the device has disabled due to an overload, in the "Configuration" frame mark the "Overload Detection" checkbox.
  You define the parameters that cause the ports to be disabled due to an overload in the `Diagnostics:Ports:Port Monitor` dialog, on the "Overload Detection" tab.
- ☐ To enable ports again that the device disabled due to an incorrect speed and duplex combination, in the "Configuration" frame mark the "Speed Duplex" checkbox.
  You define the parameters that cause the ports to be disabled due to an incorrect speed and duplex combination in the `Diagnostics:Ports:Port Monitor` dialog, on the "Speed Duplex" tab.
- ☐ To enable ports again that the device disabled due to an unauthorized access to the port, in the "Configuration" frame you mark the "Port Security" checkbox.
  You define the parameters that cause the ports to be disabled due to unauthorized access in the `Security:Port Security` dialog.
- ☐ You define the time until each port is automatically enabled again in the "Reset Timer [s]" column in the table.

9.6 Displaying the SFP Status

The SFP status display allows you to look at the current SFP module connections and their properties. The properties include:

- module type
- support provided in media module
- temperature in ° C
- transmission power in mW
- receive power in mW

☐ Select the `Diagnostics:Ports:SFP modules` dialog.

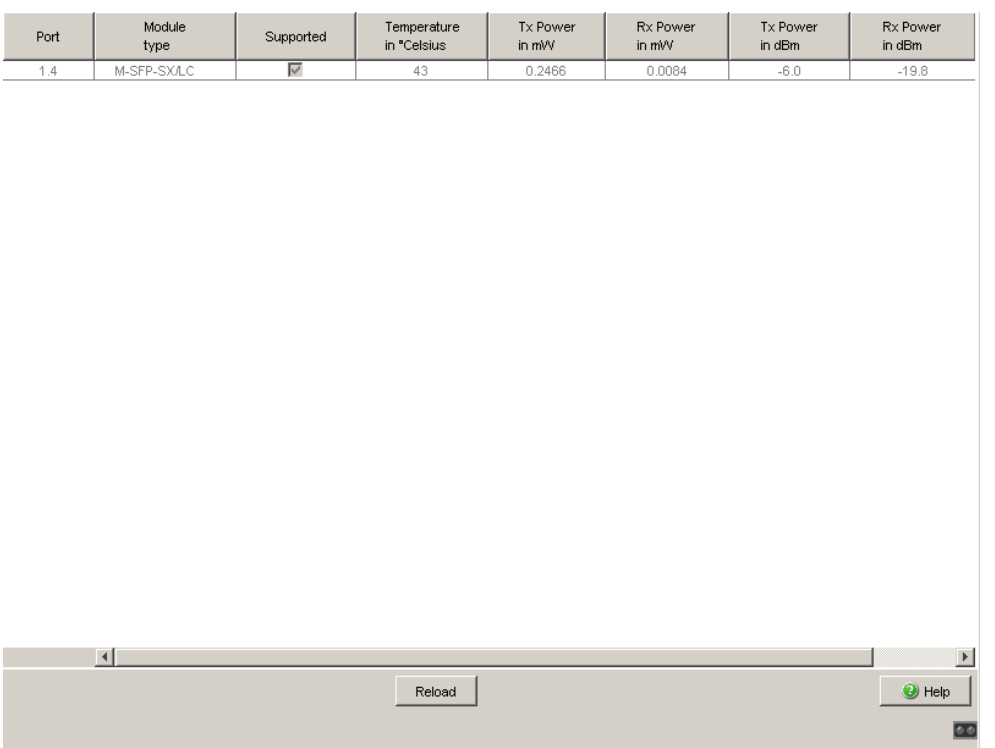


Figure 52: SFP Modules dialog

9.7 Topology Discovery

9.7.1 Description of Topology-Detection

IEEE 802.1AB defines the Link Layer Discovery Protocol (LLDP). LLDP allows the user to automatically detect the LAN network topology.

Devices with LLDP active

- broadcast their connection and management information to adjacent devices on the shared LAN. These devices can then be evaluated provided they also have LLDP active.
- receive connection and management information from adjacent devices on the shared LAN, provided these devices also have LLDP active.
- builds a management-information table and object definitions for storing information about adjacent devices with LLDP active.

As the main element, the connection information contains an exact, unique identifier for the connection end point: MSAP (MAC Service Access Point). This is made up of a device identifier which is unique on the entire network and a unique port identifier for this device.
Content of the connection and management-information:

- Chassis identifier (its MAC address)
- Port identifier (its port-MAC address)
- Description of port
- System name
- System description
- Supported system capabilities
- System capabilities currently active
- Interface ID of the management address
- VLAN-ID of the port
- Auto-negotiation status at the port
- Medium, half/full duplex setting and port speed setting

- Indication whether a redundancy protocol is enabled at the port, and which one (e.g. RSTP, HIPER-Ring, FastHIPER Ring, MRP, ring coupling).
- Information about the VLANs installed in the device (VLAN-ID and VLAN name, irrespective of whether the port is a VLAN participant).

A network management station can query this information from devices that have LLDP active. This information allows the network management station to form a description of the network topology.

For information exchanges, the LLDP uses an IEEE MAC address, which devices do not normally communicate. Devices without LLDP therefore do not allow support for LLDP packets. If a device without LLDP capability is located between two devices with LLDP capability, then LLDP information exchanges are prevented between these two devices. To work around this, Hirschmann devices send and receive additional LLDP packets with the Hirschmann Multicast-MAC address 01:80:63:2F:FF:0B. Hirschmann-Devices with the LLDP function are therefore able to exchange LLDP information with each other even across devices that do not have LLDP capability.

The Management Information Base (MIB) for a Hirschmann device with LLDP capability holds the LLDP information in the lldp MIB and in the private hmLLDP.

9.7.2 Displaying the Topology Discovery Results

☐ Select the `Diagnostics:Topology Discovery` dialog.
The table on the “LLDP” tab page shows you the collected LLDP information for neighboring devices. This information enables the network management station to map the structure of your network.

Activating “Display FDB entries” below the table allows you to add entries for devices without active LLDP support to the table. In this case, the device also includes information from its FDB (forwarding database).

If several devices are connected to one port, for example via a hub, the table will contain one line for each connected device.

If
- devices with active topology discovery function and
- devices without active topology discovery function are connected to a port

then
- the topology table hides the devices without active topology discovery.

If
- only devices without active topology discovery are connected to a port

then
- the table will contain one line for this port to represent all devices. This line contains the number of connected devices.
  MAC addresses of devices that the topology table hides for the sake of clarity, are located in the address table (FDB), (see on page 158 “Entering Static Addresses”).

9.8 Detecting IP Address Conflicts

9.8.1 Description of IP Address Conflicts

By definition, each IP address may only be assigned once within a subnetwork. Should two or more devices erroneously share the same IP address within one subnetwork, this will inevitably lead to communication disruptions with devices that have this IP address. In his Internet draft, Stuart Cheshire describes a mechanism that industrial Ethernet devices can use to detect and eliminate address conflicts (Address Conflict Detection, ACD).

Mode	Meaning
enable	Enables active and passive detection.
disable	Disables the function
activeDetectionOnly	Enables active detection only. After connecting to a network or after an IP address has been configured, the device immediately checks whether its IP address already exists within the network. If the IP address already exists, the device will return to the previous configuration, if possible, and make another attempt after 15 seconds. The device therefore avoids to participate in the network traffic with a duplicate IP address.
passiveOnly	Enables passive detection only. The device listens passively on the network to determine whether its IP address already exists. If it detects a duplicate IP address, it will initially defend its address by employing the ACD mechanism and sending out gratuitous ARPs. If the remote device does not disconnect from the network, the management interface of the local device will then disconnect from the network. Every 15 seconds, it will poll the network to determine if there is still an address conflict. If there isn't, it will connect back to the network.

Table 28: Possible address conflict operation modes

9.8.2 Configuring ACD

☐ Select the Diagnostics:IP Address Conflict Detection dialog.
☐ With "Status" you enable/disable the IP address conflict detection or select the operating mode (see table 28).

9.8.3 Displaying ACD

☐ Select the `Diagnostics:IP Address Conflict Detection` dialog.
▶ In the table, the device logs IP address conflicts with its IP address. The device logs the following data for each conflict:
  ▶ the time („Timestamp“ column)
  ▶ the conflicting IP address („IP Address“ column)
  ▶ the MAC address of the device with which the IP address conflicted („MAC Address“ column).

  For each IP address, the device logs a line with the last conflict that occurred.
☐ During a restart, the device deletes the table.

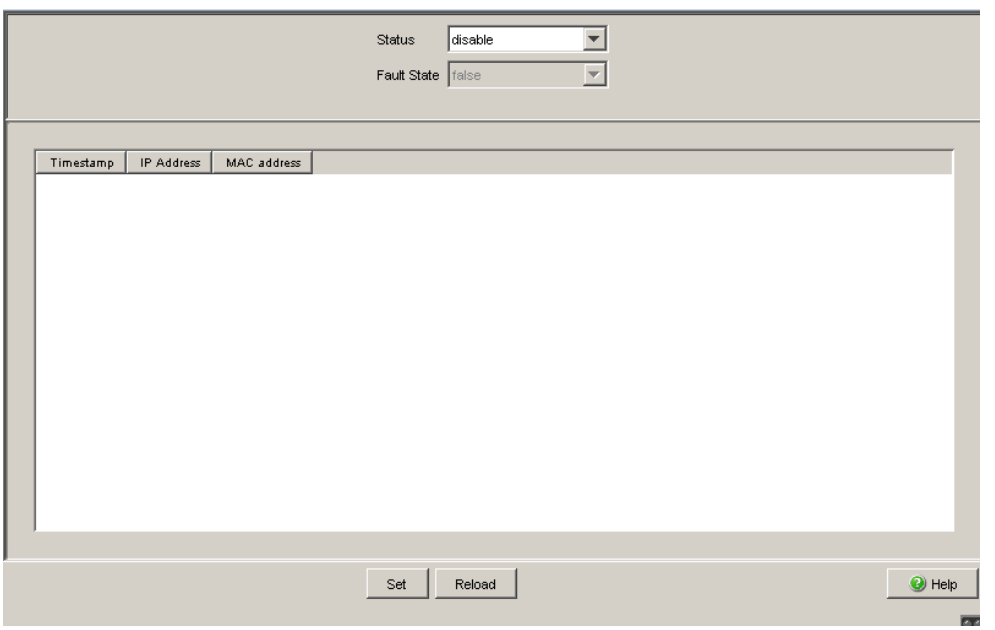


Figure 53: IP Address Conflict Detection dialog

9.9 Detecting Loops

Loops in the network, even temporary loops, can cause connection interruptions or data losses that may cause unintended equipment operation. The automatic detection and reporting of this situation allows you to detect it faster and diagnose it more easily.

An incorrect configuration can cause a loop, for example, if you deactivate Spanning Tree.

The device allows you to detect the effects typically caused by loops and report this situation automatically to the network management station. You have the option here to specify the magnitude of the loop effects that triggers the device to send a report.

A typical effect of a loop is that frames from multiple different MAC source addresses can be received at different ports of the device within a short time. The device evaluates how many of the same MAC source addresses it has learned at different ports within a time period. This process detects loops when the same MAC address is received at different ports.
Conversely, the same MAC address being received at different ports can also have other causes than a loop.

☐ Select the `Switching:Switching Global` dialog.
☐ Select “Enable address relearn detection”. Enter the desired threshold value in the “Address relearn threshold” field.

If the address relearn detection is enabled, the device checks whether it has repeatedly learned the same MAC source addresses at different ports. This process very probably indicates a loop situation.
If the device detects that the threshold value set for the MAC addresses has been exceeded at its ports during the evaluation period (a few seconds), the device creates an entry in the log file and sends an alarm (trap). The preset threshold value is 1.

9.10 Reports

The following reports and buttons are available for the diagnostics:

- Log file.
  The log file is an HTML file in which the device writes all the important device-internal events.
- System information.
  The system information is an HTML file containing the system-relevant data.
- Download Support Information.
  This button allows you to download system information as files in a ZIP archive.

In service situations, these reports provide the technician with the necessary information.

The following button is available as an alternative for operating the Web-based interface:

- Download JAR file.
  This button allows you to download the applet of the Web-based interface as a JAR file. Then you have the option to start the applet outside of a browser.
  This facilitates the device administration even when you have disabled its web server for security reasons.

☐ To display the HTML file with system-relevant data, select the dialog `Diagnosis:Report:System Information`.
☐ To view the log file with important device-internal events, select the dialog `Diagnosis:Report:Event Log`.

☐ Select the `Diagnosis:Report` dialog.

☐ Click “Download Switch Dump”.

☐ Select the directory in which you want to save the switch dump.

☐ Click “Save”.

The device creates the file name of the switch dumps automatically in the format <IP address>_<system name>.zip, e.g. for a device of the type PowerMICE: “10.0.1.112_PowerMICE-517A80.zip”.

☐ Click “Download JAR-File”.

☐ Select the directory in which you want to save the applet.

☐ Click “Save”.

The device creates the file name of the applet automatically in the format <device type><software variant><software version)>_<software revision of applet>.jar, e.g. for a device of type PowerMICE with software variant L3P: “pmL3P06000_00.jar”.

9.11 Monitoring Data Traffic on the Ports (Port Mirroring)

The MACH4002 24/48 + 4G and the Power MICE support up to 8 ports.

The port mirroring function enables you to review the data traffic from a group of ports on the device for diagnostic purposes (N:1). The device forwards (mirrors) the data for these ports to another port. This process is port mirroring.
The ports from which the device copies the traffic are source ports. The port on which you review the data is the destination port. You use physical ports as source or destination ports.

In port mirroring, the device copies valid data packets of the source port to the destination port. The device does not affect the data traffic on the source ports during port mirroring.
A management tool connected at the destination port, e.g. an RMON probe, can thus monitor the data traffic of the source ports in the sending and receiving directions.

When selecting "RX" as the monitoring direction on a source port, only frames received on the source port will be copied/mirrored to the destination port (monitoring ingress).
When selecting "TX" as the monitoring direction on a source port, only frames transmitted on the source port will be copied/mirrored to the destination port (monitoring egress).

With port mirroring active, the device copies the traffic received and/or forwarded on a source port to the destination port.

The PowerMICE and MACH4000 devices use the destination port for the port mirroring task exclusively. The source port forwards and receives traffic as normal.

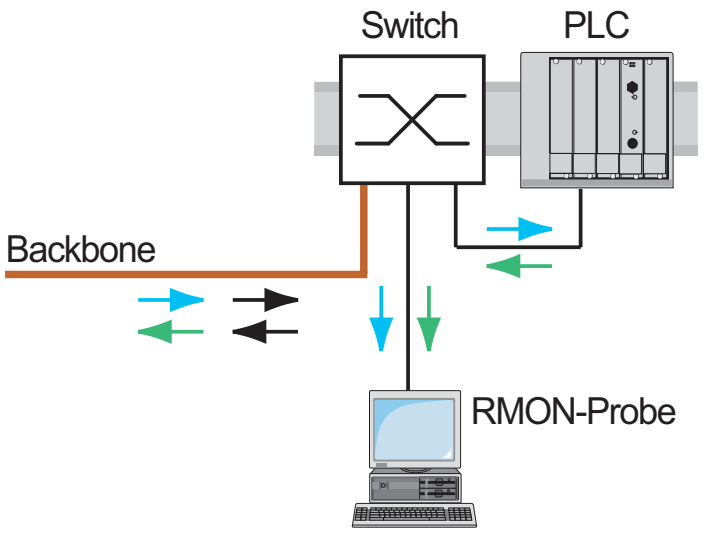


Figure 54: Port mirroring

☐ Select the `Diagnostics:Port Mirroring` dialog.

This dialog allows you to configure and activate the port mirroring function of the device.

- ☐ Select the source ports whose data traffic you want to review from the physical ports list by checkmarking the relevant boxes.
  The device displays the "Source Port" currently used as the "Destination Port" as grayed out in the table. Default setting: no source ports.
- ☐ Select the destination port to which you have connected your management tool from the drop-down menu in the "Destination Port" frame.
  Selecting a destination port is mandatory for a valid port mirroring configuration. The drop-down menu displays available ports exclusively, for example, the list excludes the ports currently in use as source ports. Default setting: port - (no destination port).
- ☐ To select the monitoring traffic direction, checkmark the relevant "RX" and "TX" boxes for ingress and egress monitoring directions.
- ☐ To switch on the function, select `On` in the "Operation" frame. Default setting: `Off`.

The “Reset configuration” button in the dialog allows you to reset all the port mirroring settings of the device to the state on delivery.

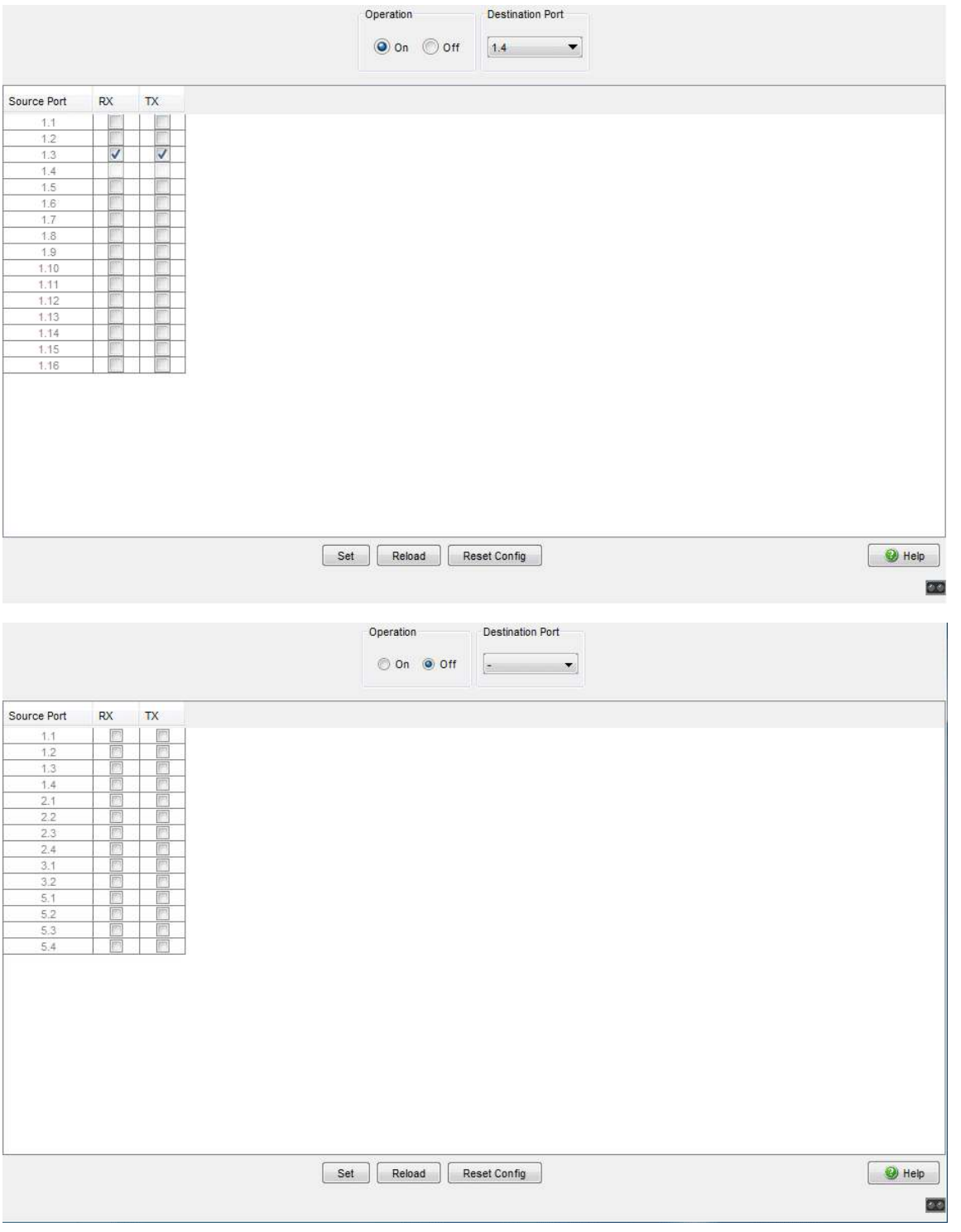


Figure 55: Port Mirroring dialog

9.12 Syslog

The device enables you to send messages about important device-internal events to one or more syslog servers (up to 8). Additionally, you can also include SNMP requests to the device as events in the syslog.

Note: You will find the actual events that the device has logged in the “Event Log” (see on page 252 “Trap log”) and in the log file (see on page 243 “Reports”), a HTML page with the title “Event Log”.

- ☐ Select the `Diagnostics:Syslog` dialog.

- ☐ Activate the syslog function in the “Operation” frame.
- ☐ Click on “Create”
- ☐ In the “IP Address” column, enter the IP address of the syslog server to which the log entries should be sent.
- ☐ In the “Port” column, enter the UDP port of the syslog server at which the syslog receives log entries. The default setting is 514.
- ☐ In the “Minimum level to report” column, you enter the minimum level of seriousness an event must attain for the device to send a log entry to this syslog server.
- ☐ In the “Active” column, you select the syslog servers that the device takes into account when it is sending logs.

“SNMP Logging” frame:

- ☐ Activate “Log SNMP Get Request” if you want to send reading SNMP requests to the device as events to the syslog server.
- ☐ Select the level to report at which the device creates the events from reading SNMP requests.
- ☐ Activate “Log SNMP Set Request” if you want to send writing SNMP requests to the device as events to the syslog server.
- ☐ Activate “Log SNMP Set Request” if you want to send writing SNMP requests to the device as events to the syslog server.

Note: For more details on setting the SNMP logging, see the “Syslog” chapter in the “GUI” (Graphical User Interface / Web-based Interface) reference manual.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`logging host 10.0.1.159 514 3`	Select the recipient of the log messages and its port 514. The “3” indicates the seriousness of the message sent by the device. “3” means “error”.
`logging syslog`	Enable the Syslog function.
`exit`	Switch to the privileged EXEC mode.
`show logging hosts`	Display the syslog host settings.

```
Index     IP Address       Severity   Port     Status
-----  -----------------  ----------  ----  -------------
1      10.0.1.159         error       514   Active
```

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`logging snmp-requests get operation enable`	Create log events from reading SNMP requests.
`logging snmp-requests get severity 5`	The “5” indicates the seriousness of the message that the device allocates to messages from reading SNMP requests. “5” means “note”.
`logging snmp-requests set operation enable`	Create log events from writing SNMP requests.
`logging snmp-requests set severity 5`	The “5” indicates the seriousness of the message that the device allocates to messages from writing SNMP requests. “5” means “note”.
`exit`	Switch to the privileged EXEC mode.
`show logging snmp-requests`	Display the SNMP logging settings.

```
Log SNMP SET requests                : enabled
Log SNMP SET severity                : notice
Log SNMP GET requests                : enabled
Log SNMP GET severity                : notice
```

9.13 Trap log

The device allows you to call up a log of the system events. The table of the “Trap Log” dialog lists the logged events with a time stamp.

- ☐ Click “Reload” to update the content of the trap log.
- ☐ Click “Clear” to delete the content of the trap log.

Note: You have the option to also send the logged events to one or more syslog servers (see on page 249 “Syslog”).

9.14 MAC Notification

MAC notification, also known as MAC address change notification, tracks users on a network by storing the MAC address change activity. When the switch learns or removes a MAC address, the device sends an SNMP trap to a configured trap destination. The device generates MAC address change notifications for dynamic unicast MAC addresses.

The device buffer contains up to 20 addresses. If the buffer is full before the user -defined interval expires, then the device sends a trap to the management station.

This function is intended solely for ports on which you connect end devices and thus the MAC address changes infrequently.

- ☐ Open the `Diagnositics:MAC Notification` dialog.
- ☐ Select the activity for which the device sends a trap in the "Mode"column.
- ☐ To select the ports for which the device sends a trap, activate the checkbox in the "Enabled" column.
- ☐ Define the number of seconds between trap transmissions in the "Interval [s]" textbox.
- ☐ To enable the function, click `On` in the "Operation" frame.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`mac notification interval 20`	Set MAC notification interval to 20 seconds.
`interface 1/1`	Change to the Interface Configuration mode of port 1/1.
`mac notification mode`	Set the mode for which the device sends a MAC notification.
`mac notification operation`	Enable sending of MAC notification traps for this port.
`exit`	Change to the Configuration mode.
`mac notification operation`	Enable the MAC notification function globally.

A Setting up the Configuration Environment

A.1 Setting up a DHCP/BOOTP Server

On the product CD supplied with the device you will find the software for a DHCP server from the software development company IT-Consulting Dr. Herbert Hanewinkel. You can test the software for 30 calendar days from the date of the first installation, and then decide whether you want to purchase a license.

☐ To install the DHCP servers on your PC
put the product CD in the CD drive of your PC and
under Additional Software select “haneWIN DHCP-Server”.
To carry out the installation, follow the installation assistant.

☐ Start the `DHCP Server` program.

Figure 56: Start window of the DHCP server

Note: The installation procedure includes a service that is automatically started in the basic configuration when Windows is activated. This service is also active if the program itself has not been started. When started, the service responds to DHCP queries.

☐ Open the window for the program settings in the menu bar: `Options:Preferences` and select the `DHCP` tab page.
☐ Enter the settings shown in the illustration and click `OK`.

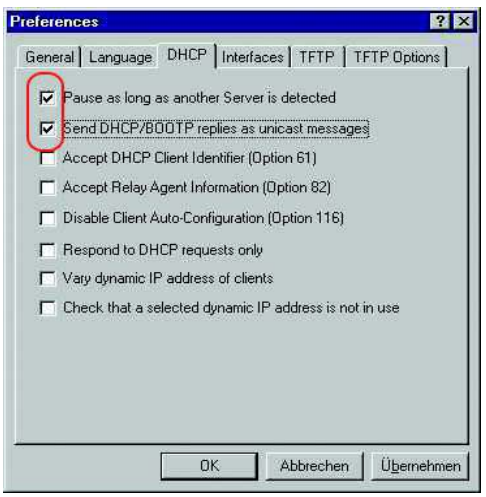


Figure 57: DHCP setting

☐ To enter the configuration profiles, select `Options:Configuration Profiles` in the menu bar.
☐ Enter the name of the new configuration profile and click `Add`.

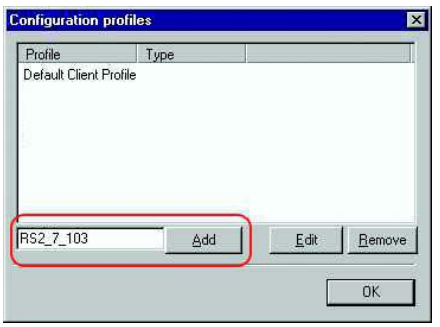


Figure 58: Adding configuration profiles

☐ Enter the netmask and click `Apply`.

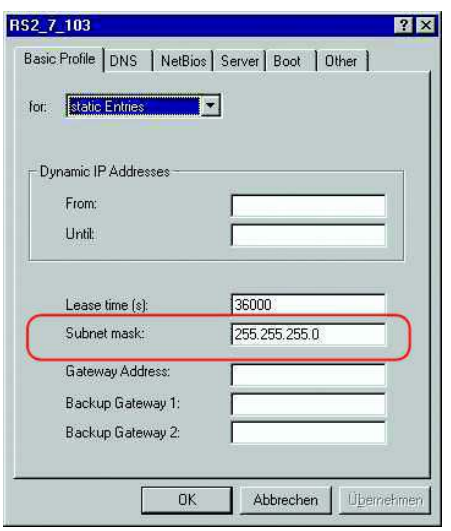


Figure 59: Netmask in the configuration profile

☐ Select the `Boot` tab page.
☐ Enter the IP address of your tftp server.
☐ Enter the path and the file name for the configuration file.
☐ Click `Apply` and then `OK`.

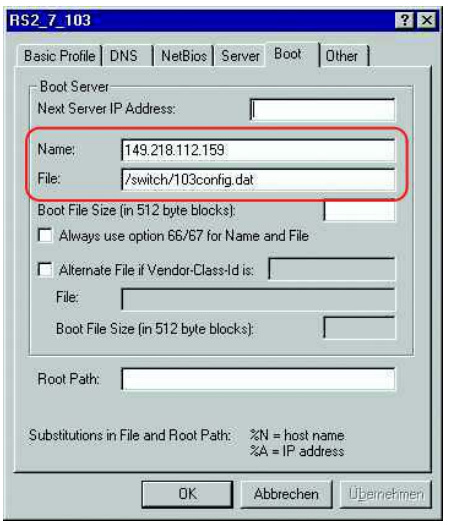


Figure 60: Configuration file on the tftp server

☐ Add a profile for each device type.
If devices of the same type have different configurations, then you add a profile for each configuration.
To complete the addition of the configuration profiles, click `OK`.

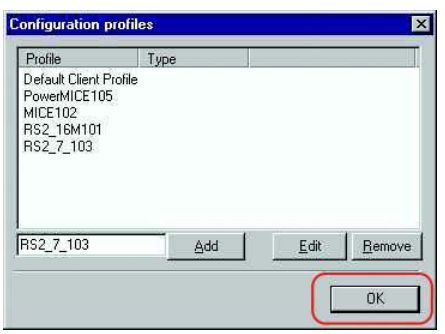


Figure 61: Managing configuration profiles

☐ To enter the static addresses, click `Static` in the main window.

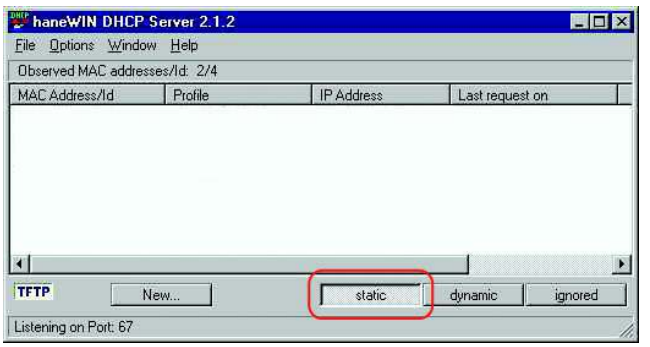


Figure 62: Static address input

☐ Click `New`.

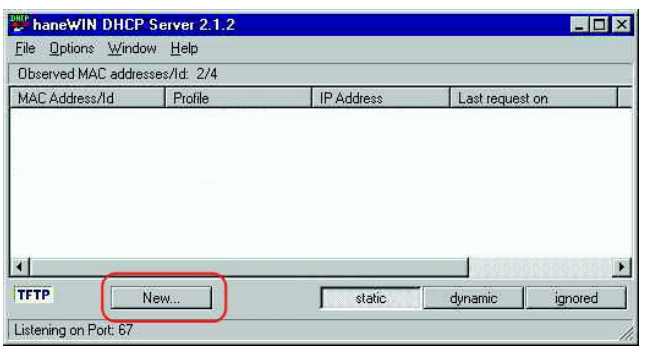


Figure 63: Adding static addresses

☐ Enter the MAC address of the device.
☐ Enter the IP address of the device.
☐ Select the configuration profile of the device.
☐ Click `Apply` and then `OK`.

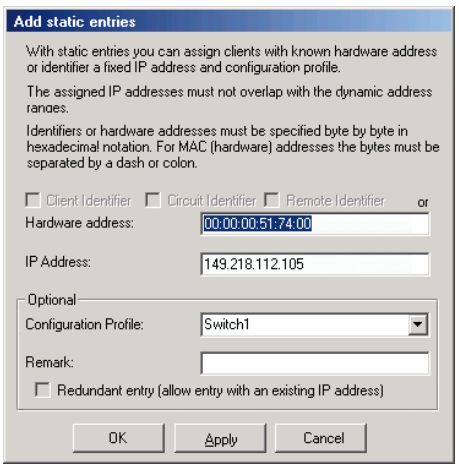


Figure 64: Entries for static addresses

☐ Add an entry for each device that will get its parameters from the DHCP server.

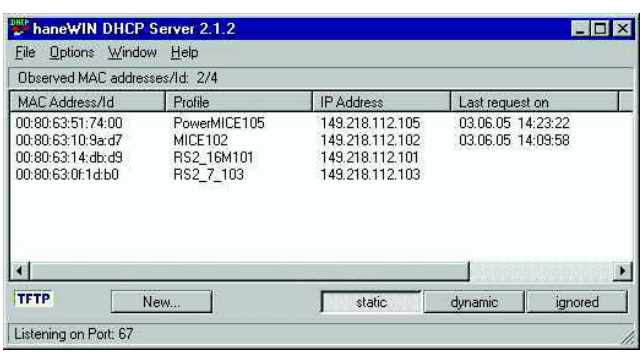


Figure 65: DHCP server with entries

A.2 Setting up a DHCP Server with Option 82

On the product CD supplied with the device you will find the software for a DHCP server from the software development company IT-Consulting Dr. Herbert Hanewinkel. You can test the software for 30 calendar days from the date of the first installation, and then decide whether you want to purchase a license.

☐ To install the DHCP servers on your PC
put the product CD in the CD drive of your PC and
under Additional Software select “haneWIN DHCP-Server”.
To carry out the installation, follow the installation assistant.

☐ Start the `DHCP Server` program.

Figure 66: Start window of the DHCP server

Note: The installation procedure includes a service that is automatically started in the basic configuration when Windows is activated. This service is also active if the program itself has not been started. When started, the service responds to DHCP queries.

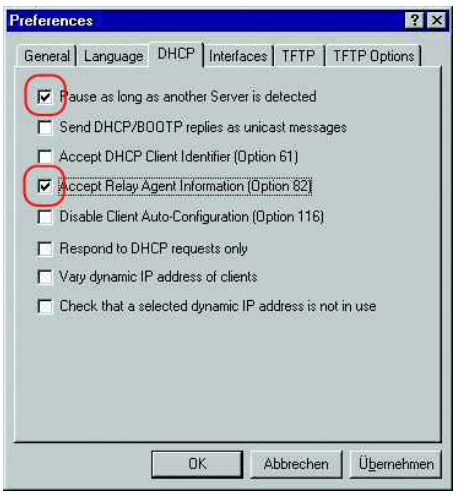


Figure 67: DHCP setting

☐ To enter the static addresses, click `New`.

Figure 68: Adding static addresses

☐ Select `Circuit Identifier` and **Remote Identifier**.

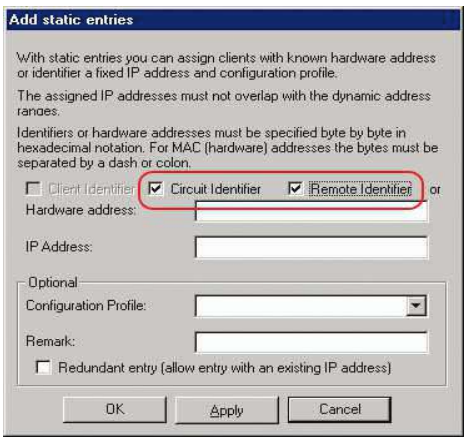


Figure 69: Default setting for the fixed address assignment

☐ In the `Hardware address` field, you enter the `Circuit Identifier` and the `Remote Identifier` (see "DHCP Relay Agent" in the "Web-based Interface" reference manual).
With `Hardware address` you identify the device and the port to which that device is connected, to which you want the assign the `IP address` in the line below it.

The hardware address is in the following form:

ciclhhvvvvssmmpprirlxxxxxxxxxxxx

- ci: sub-identifier for the type of the circuit ID
- cl: length of the circuit ID
- hh: Hirschmann ID: 01 if a Hirschmann device is connected to the port, otherwise 00.
- vvvv: VLAN ID of the DHCP request (default: 0001 = VLAN 1)
- ss: socket of device at which the module with that port is located to which the device is connected. Enter the value 00.
- mm: module with the port to which the device is connected.
- pp: port to which the device is connected.
- ri: sub-identifier for the type of the remote ID
- rl: length of the remote ID
- xxxxxxxxxxxx: remote ID of the device (e.g. MAC address) to which a device is connected.

Figure 70: Entering the addresses

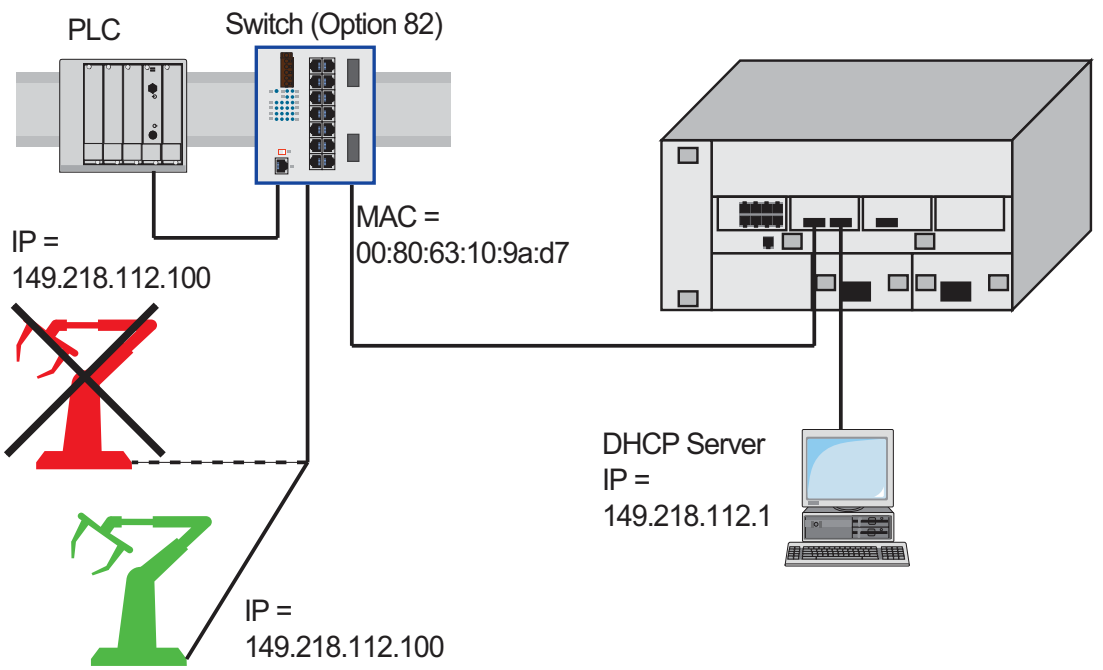


Figure 71: Application example of using Option 82

A.3 TFTP Server for Software Updates

On delivery, the device software is held in the local flash memory. The device boots the software from the flash memory.
Software updates can be performed via a TFTP server. This presupposes that a TFTP server has been installed in the connected network and that it is active.

Note: An alternative to the TFTP update is the HTTP update. The HTTP update saves you having to configure the TFTP server.

The device requires the following information to be able to perform a software update from the TFTP server:
- its own IP address (entered permanently),
- the IP address of the TFTP server or of the gateway to the TFTP server,
- the path in which the operating system of the TFTP server is kept

The file transfer between the device and the TFTP server is performed via the Trivial File Transfer Protocol (tftp).

The management station and the TFTP server may be made up of one or more computers.

The preparation of the TFTP server for the device software involves the following steps:
- Setting up the device directory and copying the device software
- Setting up the TFTP process

A.3.1 Setting up the TFTP Process

General prerequisites:

- The local IP address of the device and the IP address of the TFTP server or the gateway are known to the device.
- The TCP/IP stack with tftp is installed on TFTP server.

The following sections contain information on setting up the TFTP process, arranged according to operating system and application.

SunOS and HP

☐ First check whether the tftp daemon (background process) is running, i.e. whether the file /etc/inetd.conf contains the following line (see figure 72) and whether the status of this process is "IW":

SunOS

```
tftp dgram udp wait root /usr/etc/in.tftpd in.tftpd -
s /tftpboot
```

HP

```
tftp dgram udp wait root /usr/etc/in.tftpd tftpd
```

If the process is not entered or only entered as a comment line (#), modify /etc/inetd.conf accordingly and then re-initialize the INET daemon. This is performed with the command "kill -1 PID", where PID is the process number of inetd.
This re-initialization can be executed automatically by entering the following UNIX commands:

SunOS

```
ps -ax | grep inetd | head -1 | awk -e {print $1} |
kill -1
```

HP

```
/etc/inetd -c
```

You can obtain additional information about the tftpd daemon tftpd with the UNIX command "man tftpd".

Note: The command "`ps`" does not show the tftp daemon every time, although it is actually running.

Special steps for HP workstations:

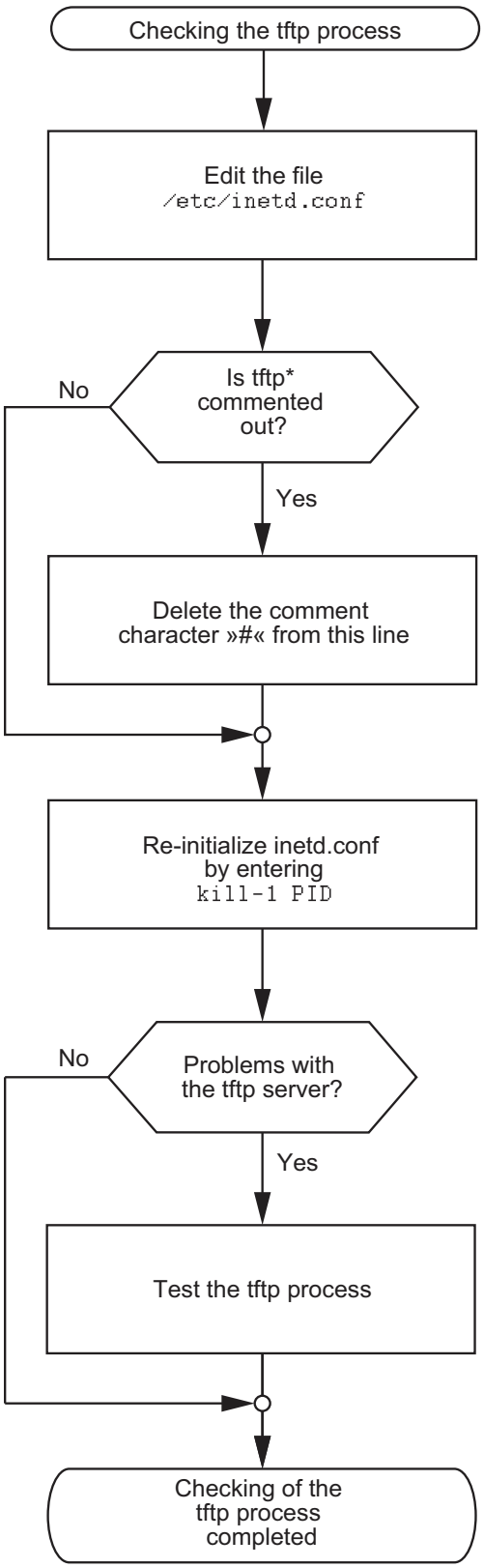
☐ During installation on an HP workstation, enter the user tftp in the /etc/passwd file.

For example:

```
tftp:*:510:20:tftp server:/usr/tftpdir:/bin/false
```

`tftp`user ID,
`*` is in the password field,
`510` sample user number,
`20` sample group number.,
`tftp server` any meaningful name ,
`/bin/false` mandatory entry (login shell)

☐ Test the tftp process with, for example:
```
cd /tftpboot/device
tftp <tftp-Servername>
get device/device.bin
rm device.bin
```



e.g
`cd /tftpboot/device`
`tftp <tftp-Servername>`
`get device/device.bin`

Response if the process is running: `Received ...`

`rm device.bin`

* `tftp dgram udp wait root/usr/etc/in.tftpd in.tftpd /tftpboot`

Figure 72: Flow chart for setting up TFTP server with SunOS and HP

A.3.2 Software Access Rights

The agent needs read permission for the TFTP directory on which the device software is stored.

Example of a UNIX tftp Server

Once the device software has been installed, the TFTP server should have the following directory structure with the stated access rights:

File name	Access
device.bin	-rw-r--r--

Table 29: Directory structure of the software

l = link; d = directory; r = read; w = write; x = execute
1st position denotes the file type (- = normal file),
2nd to 4th positions designate user access rights,
5th to 7th positions designate access rights for users from other groups,
8th to 10th positions designate access rights of every other user.

A.4 Preparing access via SSH

To be able to access the device via SSH, perform the following steps:

- Generate a key (SSH host key).
- Install the key on the device.
- Enable access via SSH on the device.
- Install a program for executing the SSH protocol (SSH client) on your computer.

A.4.1 Generating a key

The device gives you the option to use your own self-generated keys for the SSH server. If there is no SSH key on the device, the device generates the required keys automatically when the SSH server is switched on for the first time.

The PuTTYgen program allows you to generate the key. This program is located on the product CD.

☐ Start the program by double-clicking on it.
☐ In the “Parameters” frame you select the type of key to be generated.
  ☐ To generate a key for SSH version 2, you select "SSH-2 (RSA)" or "SSH-2 (DSA)".
  ☐ To generate a key for SSH version 1, you select "SSH-1 (RSA)".
☐ Make sure that the field "Number of bits in a generated key" in the "Parameters" frame is showing the value `1024`.
☐ In the "Actions" box, click on "Generate". Move the mouse pointer over the PuTTYgen-window, so that PuTTYgen can create the key using random numbers.
☐ Leave the "Key passphrase" and "Confirm passphrase" input boxes empty.

- ☐ Save the key:
  - ☐ To save a key for SSH version 2, click the `Conversions:Export OpenSSH key` menu.
  - ☐ To save a key for SSH version 1, click the "Save private key" button in the "Actions" frame.
- ☐ Answer the question about saving the key without a passphrase with "Yes".
- ☐ Select the Save location and enter a file name for the key file.
- ☐ Note down the key fingerprint, so that you can check it when establishing a connection.
- ☐ You should also store the key in a location separate from the device so that, if the device is being replaced, the key can be transferred to the new device.

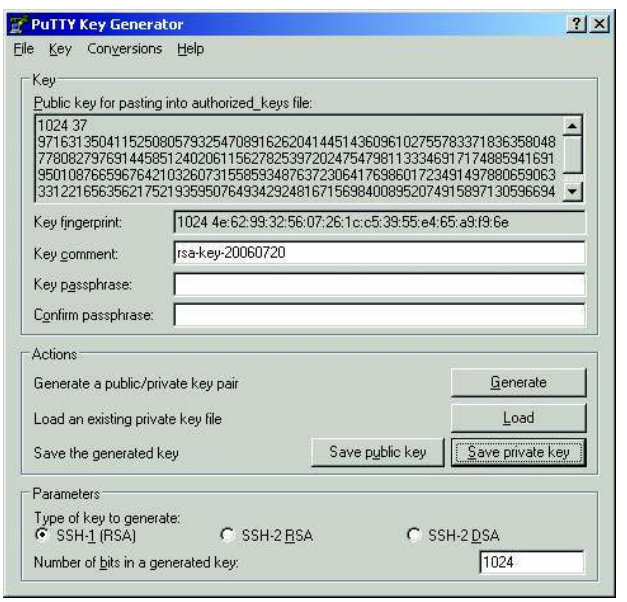


Figure 73: PuTTY key generator

For experienced network administrators, another way of creating the key is with the OpenSSH Suite. To generate the key, enter the following command:

```
ssh-keygen(.exe) -q -t rsa1 -f rsa1.key -C '' -N ''
```

A.4.2 Loading a key onto the device

You load the SSH key onto the device with the Command Line Interface via TFTP.

SSH version 1 works with an RSA key. However, SSH version 2 works with an RSA key and a DSA key. For SSH version 2, you always load both keys to the device.

☐ Store the keys on your tftp server.

☐ Load the keys from the tftp server onto the device.

`enable`	Switch to the privileged EXEC mode.
`no ip ssh`	Deactivates the SSH server.
`copy tftp://ip/filepath/key nvram:sshkey-rsa2`	Loads the key to the non-volatile memory of the device. ▶ `nvram:sshkey-rsa2` is the storage location of the RSA key for SSH version 2. ▶ `nvram:sshkey-dsa` is the storage location of the DSA key for SSH version 2. ▶ `nvram:sshkey-rsa1` is the storage location of the RSA key for SSH version 1.
`copy tftp://ip/filepath/key nvram:sshkey-dsa`	
`copy tftp://ip/filepath/key nvram:sshkey-rsa1`	
`ip ssh`	Activates the SSH server.

A.4.3 Access through an SSH

One way of accessing your device through an SSH is by using the PuTTY program. This program is provided on the product-CD.

☐ Start the program by double-clicking on it.
☐ Enter the IP address of your device.
☐ Select "SSH".

☐ Click on "Open" to set up the connection to your device.

Depending on the device and the time at which SSH was configured, it can take up to a minute to set up the connection.

Just before the connection is established, the PuTTY program displays a security alarm message and gives you the option of checking the key fingerprint.

Figure 74: Security alert prompt for the fingerprint

☐ Check the fingerprint of the key to ensure that you have actually connected to the desired device. You will find the fingerprint of your key in the "Key fingerprint" field of the PuTTY key generator.
☐ If the fingerprint matches your key, click on "Yes".

PuTTY also displays another security alarm message at the defined warning threshold.

Figure 75: Security query at the defined warning threshold

☐ Click on "Yes" in the security alarm message.

To suppress this message when establishing subsequent connections, select "SSH" in the "Category" box in the PuTTY program before opening the connection. In the "Encryption options" box, select "DES" and click on "Up" until "DES" comes above the line "-- warn below here --". In the "Category" box, switch back to "Session" and establish the connection as usual.

For experienced network administrators, another way of accessing your device through an SSH is by using the OpenSSH Suite. To open the connection, enter the following command:

```
ssh admin@10.0.112.53 -cdes
```

- `admin` for the user name.
- `10.0.112.53` is the IP address of your device.
- `-cdes` sets the encryption type for SSHv1.

A.5 HTTPS Certificate

The encryption of HTTPS connections requires an X.509 certificate. The device allows you to use your own X.509 certificate. If there is no X.509 certificate on the device, the device generates this automatically when the HTTPS server is switched on for the first time.

You load your own X.509 certificate onto the device with the Command Line Interface via TFTP.

☐ Store the certificate on your tftp server.

☐ Load the certificate from the tftp server onto the device.

`enable`	Change to the privileged EXEC mode.
`no ip https`	Deactivates the HTTPS function before transferring the certificate to the device.
`copy tftp://ip/filepath/cert nvram:httpscert`	Loads the certificate to the non-volatile memory of the device. `nvram:httpscert` is the storage location of the X.509 certificate.
`ip https`	Activates the HTTPS function after transferring the certificate to the device.

A.6 Service Shell

When you need assistance with your device, then the service personnel use the Service Shell function to monitor internal conditions, for example switch or CPU registers.

The CLI Reference Manual contains a description of deactivating the Service Shell.

Note: When you deactivate the Service Shell, then you are still able to configure the device, but you limit the service personnel to system diagnostics. In order to reactivate the Service Shell function, the device requires disassembly by the manufacturer.

B General Information

B.1 Management Information Base (MIB)

The Management Information Base (MIB) is designed in the form of an abstract tree structure.
The branching points are the object classes. The "leaves" of the MIB are called generic object classes.
If this is required for unique identification, the generic object classes are instantiated, i.e. the abstract structure is mapped onto reality, by specifying the port or the source address.
Values (integers, time ticks, counters or octet strings) are assigned to these instances; these values can be read and, in some cases, modified. The object description or object ID (OID) identifies the object class. The subidentifier (SID) is used to instantiate them.

Example:
The generic object class
`hmPSState (OID = 1.3.6.1.4.1.248.14.1.2.1.3)`
is the description of the abstract information "power supply status". However, it is not possible to read any information from this, as the system does not know which power supply is meant.
Specifying the subidentifier (2) maps this abstract information onto reality (instantiates it), thus indicating the operating status of power supply 2. A value is assigned to this instance and can then be read. The instance "get `1.3.6.1.4.1.248.14.1.2.1.3.2`" returns the response "1", which means that the power supply is ready for operation.

The following abbreviations are used in the MIB:	
Comm	Group access rights
con	Configuration
Descr	Description
Fan	Fan
ID	Identifier
Lwr	Lower (e.g. threshold value)
PS	Power supply
Pwr	Power supply
sys	System

The following abbreviations are used in the MIB:	
UI	User interface
Upr	Upper (e.g. threshold value)
ven	Vendor = manufacturer (Hirschmann)

Definition of the syntax terms used:	
Integer	An integer in the range -2^{31} - 2^{31}-1
IP Address	xxx.xxx.xxx.xxx (xxx = integer in the range 0-255)
MAC Address	12-digit hexadecimal number in accordance with ISO/IEC 8802-3
Object identifier	x.x.x.x… (e.g. 1.3.6.1.1.4.1.248...)
Octet string	ASCII character string
PSID	Power supply identifier (number of the power supply unit)
TimeTicks	Stopwatch, Elapsed time (in seconds) = numerical value / 100 Numerical value = integer in range 0-2^{32}-1
Timeout	Time value in hundredths of a second Time value = integer in range 0-2^{32}-1
Type field	4-digit hexadecimal number in accordance with ISO/IEC 8802-3
Counter	Integer (0-2^{32-1}), whose value is increased by 1 when certain events occur.

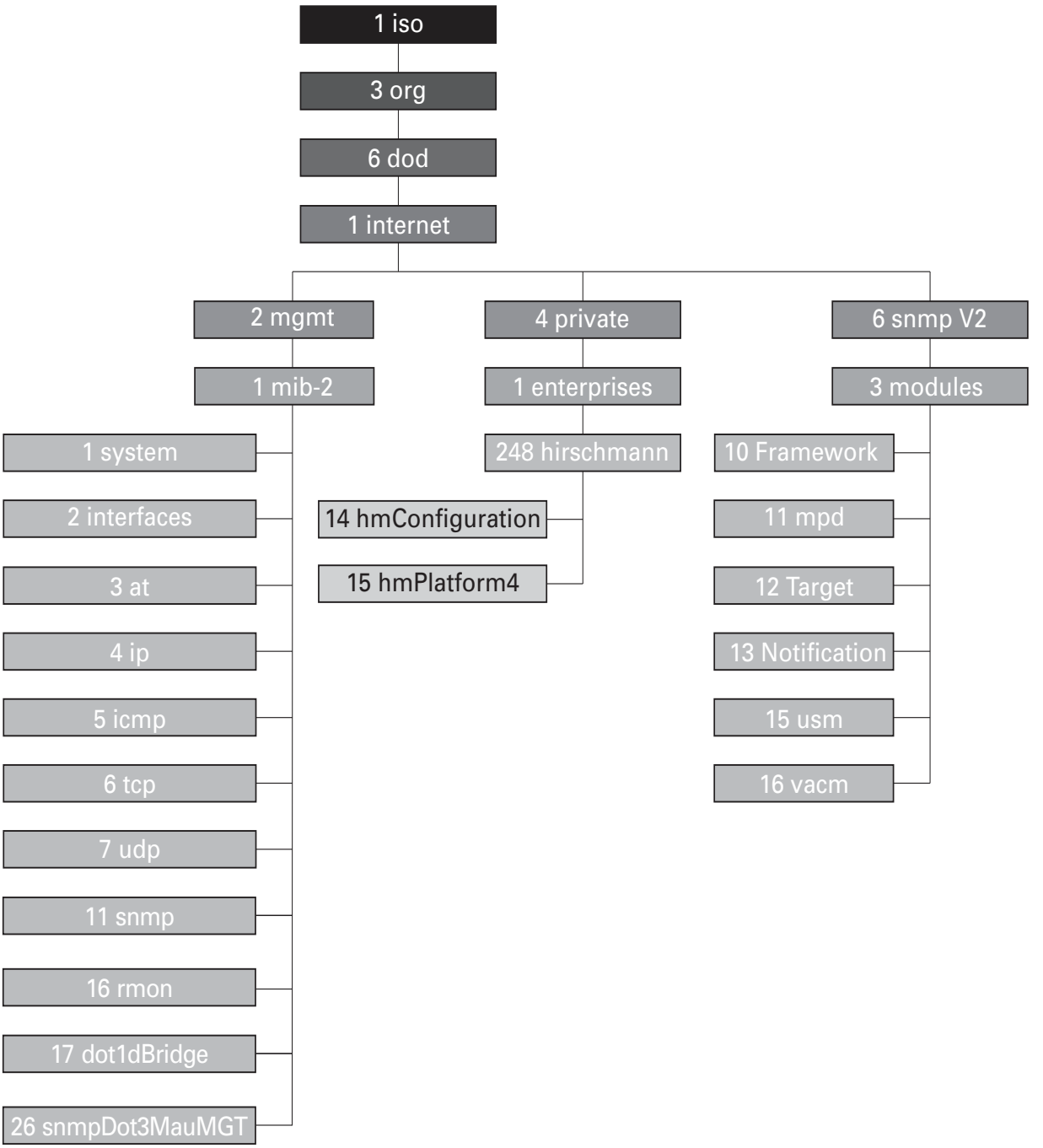


Figure 76: Tree structure of the Hirschmann MIB

A complete description of the MIB can be found on the product CD provided with the device.

B.2 Abbreviations used

ACA	AutoConfiguration Adapter
ACL	Access Control List
BOOTP	Bootstrap Protocol
CLI	Command Line Interface
DHCP	Dynamic Host Configuration Protocol
FDB	Forwarding Database
GARP	General Attribute Registration Protocol
GMRP	GARP Multicast Registration Protocol
HTTP	Hypertext Transfer Protocol
ICMP	Internet Control Message Protocol
IGMP	Internet Group Management Protocol
IP	Internet Protocol
LED	Light Emitting Diode
LLDP	Link Layer Discovery Protocol
F/O	Optical Fiber
MAC	Media Access Control
MSTP	Multiple Spanning Tree Protocol
NTP	Network Time Protocol
PC	Personal Computer
PTP	Precision Time Protocol
QoS	Quality of Service
RFC	Request For Comment
RM	Redundancy Manager
RS	Rail Switch
RSTP	Rapid Spanning Tree Protocol
SFP	Small Form-factor Pluggable
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
TCP	Transmission Control Protocol
TFTP	Trivial File Transfer Protocol
TP	Twisted Pair
UDP	User Datagram Protocol
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
VLAN	Virtual Local Area Network

B.3 Technical Data

You will find the technical data in the document “GUI Reference Manual”.

B.4 Readers' Comments

What is your opinion of this manual? We are constantly striving to provide as comprehensive a description of our product as possible, as well as important information to assist you in the operation of this product. Your comments and suggestions help us to further improve the quality of our documentation.

Your assessment of this manual:

	Very Good	Good	Satisfactory	Mediocre	Poor
Precise description	O	O	O	O	O
Readability	O	O	O	O	O
Understandability	O	O	O	O	O
Examples	O	O	O	O	O
Structure	O	O	O	O	O
Comprehensive	O	O	O	O	O
Graphics	O	O	O	O	O
Drawings	O	O	O	O	O
Tables	O	O	O	O	O

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If so, on what page?

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  Hirschmann Automation and Control GmbH
  Department 01RD-NT
  Stuttgarter Str. 45-51
  72654 Neckartenzlingen

C Index

D Further Support

Technical Questions

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You will find the addresses of our partners on the Internet at http://www.hirschmann.com

Contact our support at https://hirschmann-support.belden.eu.com

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in the EMEA region at
- Tel.: +49 (0)1805 14-1538
- E-mail: hac.support@belden.com

in the America region at
- Tel.: +1 (717) 217-2270
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User Manual

Industrial Protocols
Industrial ETHERNET (Gigabit-)Switch
MACH 100, MACH 1000, MACH 4000, MS20/MS30, OCTOPUS, PowerMICE, RS20/RS30/RS40, RSR20/RSR30

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Hirschmann can accept no responsibility for damages, resulting from the use of the network components or the associated operating software. In addition, we refer to the conditions of use specified in the license contract.

You can get the latest version of this manual on the Internet at the Hirschmann product site (www.hirschmann.com).

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Rel. 9.0 - 02/2015 – 25.03.2015

Contents

Safety Information

⚠ WARNING

UNCONTROLLED MACHINE ACTIONS
To avoid uncontrolled machine actions caused by data loss, configure all the data transmission devices individually.
Before you start any machine which is controlled via data transmission, be sure to complete the configuration of all data transmission devices.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

About this Manual

The “Industry Protocols” user manual describes how the device is connected by means of a communication protocol commonly used in the industry, such as EtherNet/IP and PROFINET IO.

The following thematic sequence has proven itself in practice:

- Device configuration in line with the “Basic Configuration” user manual
- Check on the connection Switch <–> PLC
- Program the PLC

The “Installation” user manual contains a device description, safety instructions, a description of the display, and the other information that you need to install the device.

The “Redundancy Configuration” user manual document contains the information you require to select the suitable redundancy procedure and configure it.

You will find detailed descriptions of how to operate the individual functions in the “Web-based Interface” and “Command Line Interface” reference manuals.

The Industrial HiVision Network Management Software provides you with additional options for smooth configuration and monitoring:

- Simultaneous configuration of multiple devices
- Graphical user interface with network layout
- Auto-topology discovery
- Event log
- Event handling
- Client/server structure
- Browser interface
- ActiveX control for SCADA integration
- SNMP/OPC gateway.

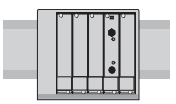
Key

The designations used in this manual have the following meanings:

▶	List
☐	Work step
■	Subheading
Link	Cross-reference with link
Note:	A note emphasizes an important fact or draws your attention to a dependency.
`Courier`	ASCII representation in user interface

Symbols used:

	WLAN access point
	Router with firewall
	Switch with firewall
	Router
	Switch
	Bridge

	Hub
	A random computer
	Configuration Computer
	Server
	PLC - Programmable logic controller
	I/O - Robot

1 Industry Protocols

For a long time, automation communication and office communication were on different paths. The requirements and the communication properties were too different.

Office communication moves large quantities of data with low demands with respect to the transfer time. Automation communication moves small quantities of data with high demands with respect to the transfer time and availability.

While the transmission devices in the office are usually kept in temperature-controlled, relatively clean rooms, the transmission devices used in automation are exposed to wider temperature ranges. Dirty, dusty and damp ambient conditions make additional demands on the quality of the transmission devices.

With the continued development of communication technology, the demands and the communication properties have moved closer together. The high bandwidths now available in Ethernet technology and the protocols they support enable large quantities to be transferred and exact transfer times to be defined.

With the creation of the first optical LAN to be active worldwide, at the University of Stuttgart in 1984, Hirschmann laid the foundation for industry-compatible office communication devices. Thanks to Hirschmann's initiative with the world's first rail hub in the 1990s, Ethernet transmission devices such as switches, routers and firewalls are now available for the toughest automation conditions.

The desire for uniform, continuous communication structures encouraged many manufacturers of automation devices to come together and use standards to aid the progress of communication technology in the automation sector. This is why we now have protocols that enable us to communicate via Ethernet from the office right down to the field level.

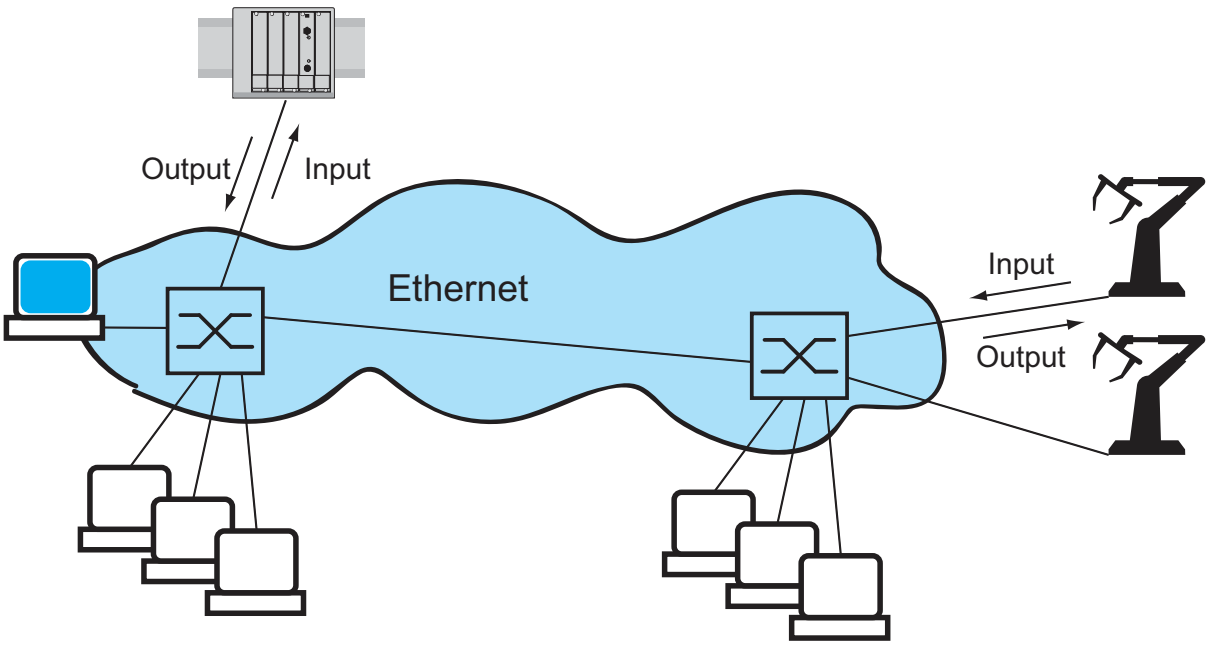


Figure 1: Example of communication.

Hirschmann switches support the following industry protocols and systems

- EtherNet/IP
- PROFINET IO

Depending on the ordered Industrial Protocol variant the Switch offers the suitable default settings:

Settings / Variant	Standard	EtherNet/IP	PROFINET IO
Order code	H	E	P
EtherNet/IP	0	1	0
IGMP Snooping	0	1	0
IGMP Querier	0	1	0
Unknown Multicast	Send To All Ports	Discard	Discard
Address Conflict Detection	0	1	0
RSTP	1	0	1
DIP switch	SW-Konfig	SW-Konfig	SW-Konfig
100 Mbit/s TP ringports	Autoneg	Autoneg	Autoneg

Settings / Variant	Standard	EtherNet/IP	PROFINET IO
Static Query Port	Disable	Automatic	Automatic
PROFINET IO	0	0	1
Boot-Modus	DHCP	DHCP	Lokal
VLAN 0 Transparent Modus	0	0	1
HiDiscovery	Read/Write	Read/Write	ReadOnly
sysName	Product name + 3 Byte MAC	Product name + 3 Byte MAC	empty

If you want to configure a device with the standard configuration for PROFINET IO, you will find the corresponding dialogs of the Web-basedInterface in the following table.

Parameter	Dialog	Action
PROFINET IO	`Advanced:Industrial Protcols`	Activate PROFINET IO.
Boot Mode	`Basic Settings:Network/Mode`	Select “Local”.
IP Address	`Basic Settings:Network/Local`	Enter the “IP address” `0.0.0.0`.
Netmask	`Basic Settings:Network/Local`	Enter the “netmask” `0.0.0.0`.
Gateway Address	`Basic Settings:Network/Local`	Enter the “gateway address” `0.0.0.0`.
VLAN 0 Transparent	`Switching:VLAN:Global`	Activate the “VLAN 0 transparent mode”.
HiDiscovery	`Basic Settings:Network/HiDiscovery Protocol`	Activate the function and select “Read only” access.
System Name	`Basic Settings: System/System data`	Delete the field content.

Table 1: Web-based interface dialogs for setting the PROFINET IO parameters

2 EtherNet/IP

EtherNet/IP, which is accepted worldwide, is an industrial communication protocol standardized by the Open DeviceNet Vendor Association (ODVA) on the basis of Ethernet. It is based on the widely used transport protocols TCP/IP and UDP/IP (standard). EtherNet/IP thus provides a wide basis, supported by leading manufacturers, for effective data communication in the industry sector.

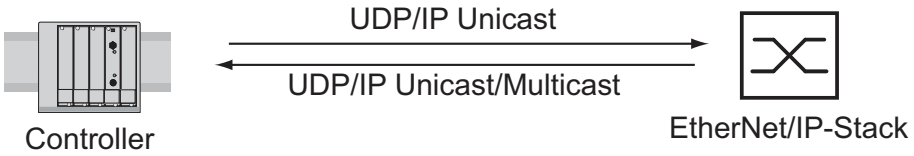


Figure 2: Communication between the controller (PLC) and the Switch

EtherNet/IP adds the industry protocol CIP (Common Industrial Protocol) to the Ethernet as an application level for automation applications. Ethernet is thus ideally suited to the industrial control technology sector.

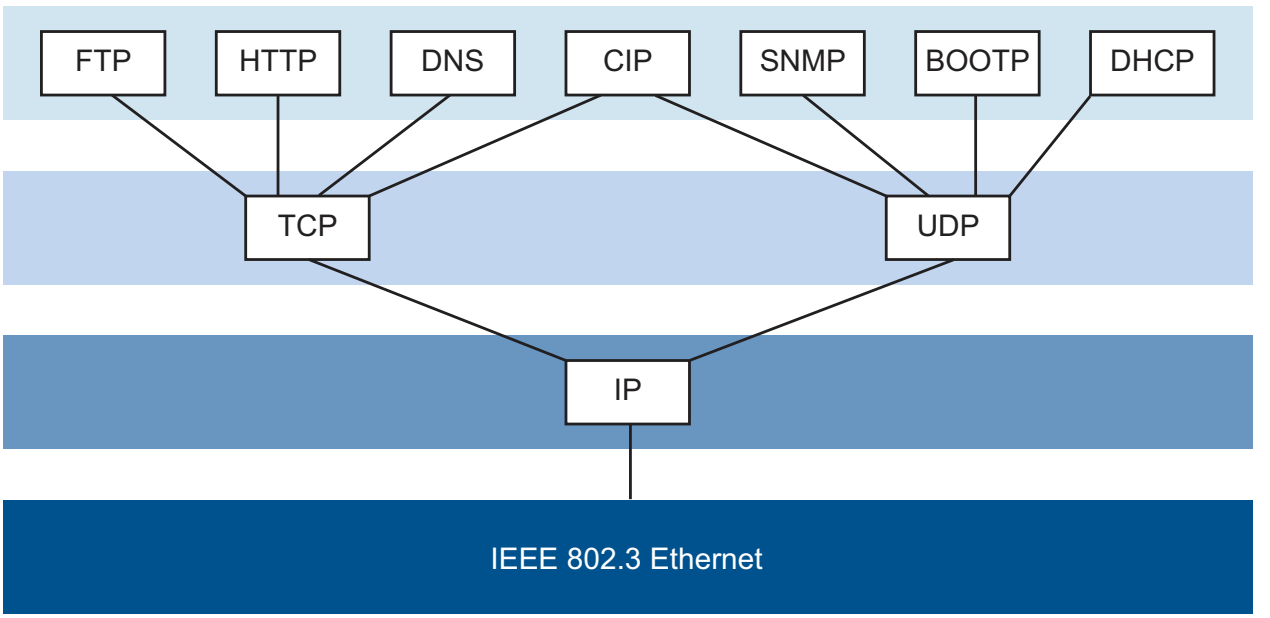


Figure 3: EtherNet/IP (CIP) in the ISO/OSI reference model

In particular, you will find EtherNet/IP in the USA and in conjunction with Rockwell controllers.

For detailed information on EtherNet/IP, see the Internet site of ODVA at www.ethernetip.de.

2.1 Integration into a Control System

After installing and connecting the Switch, you configure it according to the “Basic Configuration” user manual. Then:

☐ Use the Web-based interface in the `Switching:Multicasts:IGMP` dialog to check whether the IGMP Snooping is activated.

☐ Use the Web-based interface in the `Advanced:Industry Protocols` dialog to check whether EtherNet/IP is activated.

☐ Use the Web-based interface in the `Advanced:Industry Protocols` dialog to download the EDS (EtherNet/IP configuration file) and the icon to your local computer.

Note: If EtherNet/IP and the router function are switched on at the same time, malfunctions could occur with EtherNet/IP, for example, in connection with “RS Who”. Therefore, you should switch off the router function of the device.

- Switch off the router function in the Web-based interface: `Routing:Global` dialog.
- Switch off the router function in the Command Line interface: in the configuration mode (prompt “`..(Config)#`”) with the command `no ip routing`.

Configuration of a PLC using the example of Rockwell software

- ☐ Open the “EDS Hardware Installation Tool” of RSLinx.
- ☐ Use the “EDS Hardware Installation Tool” to add the EDS file.
- ☐ Restart the “RSLinx” service so that RSLinx takes over the EDS file of the Switch.
- ☐ Use RSLinx to check whether RSLinx has detected the Switch.
- ☐ Open your Logix 5000 project.
- ☐ Integrate the Switch into the Ethernet port of the controller as a new module (Generic Ethernet Module).

Setting	I/O connection	Input only	Listen only
Comm Format:	Data - DINT	Data - DINT	Input data - DINT - Run/Program
IP Address	IP address of the Switch	IP address of the Switch	IP address of the Switch
Input Assembly Instance	2	2	2
Input Size	7 (MACH 4000: 11)	7 (MACH 4000: 11)	7 (MACH 4000: 11)
Output Assembly Instance	1	254	255
Output Size	1 (MACH 4000: 2)	0	0
Configuration Assembly Instance	3	3	3
Configuration Size	0	0	0

Table 2: Settings for integrating a Generic Ethernet Module

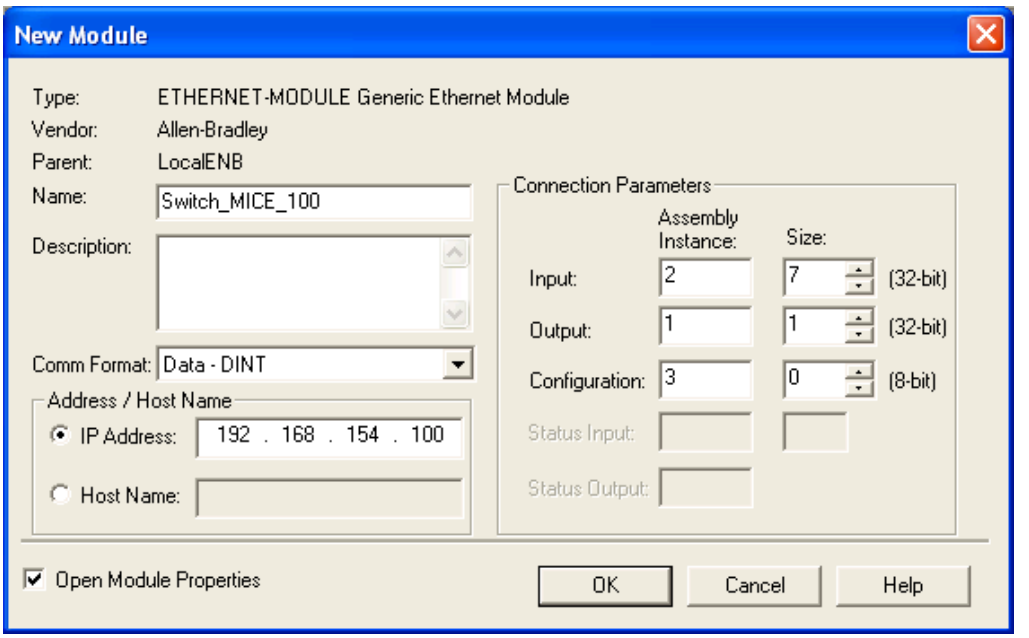


Figure 4: Integrating a new module into Logix 5000

☐ In the module properties, enter a value of at least 100 ms for the Request Packet Interval (RPI).

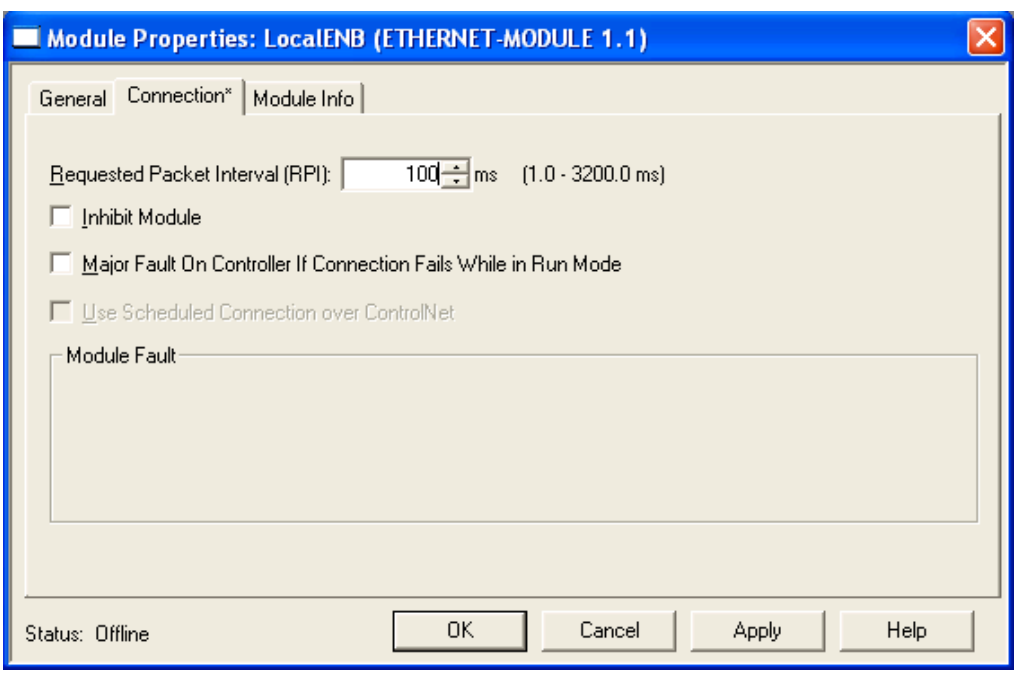


Figure 5: Module properties for the Request Packet Interval (RPI)

Note: If for example, a management program is occupying the Switch CPU with SNMP requests, the I/O connection between the programmable logic controller (PLC) and the Switch can be interrupted for a time. As the Switch can still transmit data packages in this case, the system can also still be ready for operation.
The monitoring of the I/O connection to the Switch CPU as a failure criterion can result in system failure and is therefore less suitable as a failure criterion.

Example of integration from the Sample Code Library

The Sample Code Library is a website from Rockwell. The object of the website is to provide users with a place where they can exchange their best architecture integration applications.
On the website http://samplecode.rockwellautomation.com, search for catalog number 9701. This is the catalog number of an example for integrating HirschmannSwitches into RS Logix 5000 rel. 16, PLC firmware release 16.

2.2 EtherNet/IP Parameters

2.2.1 Identity Object

The Switch supports the identity object (class code 01) of EtherNet/IP. The Hirschmann manufacturer ID is 634. Hirschmann uses the manufacturer-specific ID 149 (95_H) to indicate the product type “Managed Ethernet Switch”.

ID	Attribute	Access Rule	Data Type	Description
1	Vendor ID	Get	UINT	Hirschmann 634
2	Device Type	Get	UINT	Vendor-specific Definition 149 (95H) “Managed Ethernet Switch”.
3	Product Code	Get	UINT	Product Code: mapping is defined for every device type, e.g. RS20-0400T1T1SDAPHH is 16650.
4	Revision	Get	STRUCT USINT Major USINT Minor	Revision of the Ethernet/IP implementation, currently 1.1, Major Revision and Minor Revision
5	Status	Get	WORD	Not used
6	Serial Number	Get	UDINT	Serial number of the device (contains last 3 bytes of MAC address).
7	Product Name	Get	Short String (max. 32 bytes)	Displayed as "Hirschmann" + order code, e.g. Hirschmann RSxxxxx.

Table 3: Identity Object

2.2.2 TCP/IP Interface Object

The Switch supports an instance (instance 1) of the TCP/IP Interface Object (Class Code $F5_H$, 245) of EtherNet/IP.
In the case of write access, the Switch stores the complete configuration in its flash memory. Saving can take 10 seconds. If the save process is interrupted, for example, by a power cut, the Switch may become inoperable.

Note: The Switch replies to the configuration change "Set Request" with a "Response" although saving of the configuration has not yet been completed.

Id	Attribute	Access rule	Data type	Description
1	Status	Get	DWORD	Interface Status (0: Interface not configured, 1: Interface contains valid config).
2	Interface Capability flags	Get	DWORD	Bit 0: BOOTP Client, Bit 1: DNS Client, Bit 2: DHCP Client, Bit 3: DHCP-DNS Update, Bit 4: Configuration settable (within CIP). Other bits reserved (0).
3	Config Control	Set/Get	DWORD	Bits 0 through 3: Value 0: using stored config, Value 1: using BOOTP, Value 2: using DHCP. Bit 4: 1 device uses DNS for name lookup (always 0 because not supported) Other bits reserved (0).
4	Physical Link Object	Get	Structure: UINT Path size EPATH Path	Path to the Physical Link Objekt, always {20H, F6H, 24H, 01H} describing instance 1 of the Ethernet Link Object.

Table 4: TCP/IP Interface Object

Id	Attribute	Access rule	Data type	Description
5	Interface Configuration	Set/Get	Structure: UDINT IP address UDINT Netmask UDINT Gateway address UDINT Name server 1 UDINT Name server 2 STRING Domain name	IP Stack Configuration (IP-Address, Netmask, Gateway, 2 Nameservers (DNS, not supported) and the domain name).
6	Host name	Set/Get	STRING	Host name (for DHCP DNS Update).
8	TTL Value	Set/Get	USINT	TTL value for EtherNet/IP multicast packets
9	Mcast Config	Set/Get	STRUCT of:	IP multicast address configuration
	Alloc Control		USINT	Multicast address allocation control word. Determines how addresses are allocated.
	Reserved		USINT	Reserved for future use
	Num Mcast		UINT	Number of IP multicast addresses to allocate for EtherNet/IP
	Mcast Start Addr		UDINT	Starting multicast address from which to begin allocation.
100	Quick Connect	Set/Get	DWORD	Bitmask of 1 bit per port to enable/disable Quick Connect.

Table 4: TCP/IP Interface Object

2.2.3 Ethernet Link Object

The Switch supports at least one instance (Instance 1; the instance of the CPU Ethernet interface) of the Ethernet Link Object (Class Code $F6_H$, 246) of EtherNet/IP.

Id	Attribute	Access rule	Data type	Description
1	Interface Speed	Get	UDINT	Used interface speed in MBits/s (10, 100, 1000, …). 0 is used when the speed has not been determined or is invalid because of detected problems.
2	Interface Flags	Get	DWORD	Interface Status Flags: Bit 0: Link State (1: Link up), Bit 1: 0: Half-Duplex, 1: FullDuplex1, Bits 2 through 4: Autoneg Status (0: Autoneg in Progress, 1: Autoneg unsuccessful, 2: unsuccessful but Speed detected, 3: Autoneg success, 4: No Autoneg), Bit 5: manual configuration requires reset (always 0 because not needed), Bit 6: detected hardware error.
3	Physical Address	Get	ARRAY of 6 USINTs	MAC address of physical interface.
4	Interface Counters	Get	Struct MIB II Counters Jeweils UDINT	InOctets, InUcastPackets, InNUcastPackets, InDiscards, InErrors, InUnknownProtos, OutOctets, OutUcastPackets, OutNUcastPackets, OutDiscards, OutErrors.
5	Media Counters	Get	Struct Ethernet MIB Counters Jeweils UDINT	Alignment Errors, FCS Errors, Single Collision, Multiple Collision, SQE Test Errors, Deferred Transmissions, Late Collisions, Excessive Collisions, MAC TX Errors, Carrier Sense Errors, Frame Too Long, MAC RX Errors.
6	Interface Control	Get/Set	Struct Control Bits WORD Forced Iface Speed UINT	Control Bits: Bit 0: Autoneg enable/disable (1: enable), Bit 1: Duplex mode (1: full duplex, if Autoneg is disabled). Interface speed in MBits/s: 10, 100,…, if Autoneg is disabled.
7	Interface Type	Get	USINT	Value 0: Unknown interface type, Value 1: The interface is internal, Value 2: Twisted-pair, Value 3: Optical fiber.

Table 5: Ethernet Link-Objekt

Id	Attribute	Access rule	Data type	Description
8	Interface State	Get	USINT	Value 0: Unknown interface state, Value 1: The interface is enabled, Value 2: The interface is disabled, Value 3: The interface is testing,
9	Admin State	Set	USINT	Value 1: Enable the interface, Value 2: Disable the interface.
10	Interface Label	Get	SHORT_ STRING	Interface name. The content of the string is vendor-specific.

Table 5: Ethernet Link-Objekt

The Switch supports additional vendor specific attributes.

Id	Attribute	Access rule	Data type	Description
100 (64 H)	Ethernet Interface Index	Get	UDINT	Interface/Port Index (ifIndex from MIB II)
101 (65 H)	Port Control	Get/Set	DWORD	Bit 0 (RO): Link state (0: link down, 1: link up) Bit 1 (R/W): Link admin state (0: disabled, 1: enabled) Bit 8 (RO:) Access violation alarm Bit 9 (RO): Utilization alarm
102 (66 H)	Interface Utilization	Get	UDINT	The existing Counter from the private MIB hmIfaceUtilization is used. Utilization in percentage[a]. RX Interface Utilization.
103 (67 H)	Interface Utilization Alarm Upper Threshold	Get/Set	UDINT	Within this parameter the variable hmIfaceUtilizationAlarmUpperThreshold can be accessed. Utilization in percentage[a]. RX Interface Utilization Upper Limit.
104 (68 H)	Interface Utilization Alarm Lower Threshold	Get/Set	UDINT	Within this parameter the variable hmIfaceUtilizationAlarmLowerThreshold can be accessed. Utilization in percentage[a]. RX Interface Utilization Lower Limit.

Table 6: Hirschmann-Erweiterungen des Ethernet Link-Objekts

Id	Attribute	Access rule	Data type	Description
105 (69 H)	Broadcast Limit	Get/Set	UDINT	Broadcast limiter Service (Egress BC-Frames limitation, 0: disabled), Frames/second
106 (6A H)	Ethernet Interface Description	Get	STRING [max. 64 Bytes] even number of Bytes	Interface/Port Description (from MIB II ifDescr), e.g. "Unit: 1 Slot: 2 Port: 1 - 10/100 Mbit TX", or "unavailable", max. 64 Bytes.

Table 6: Hirschmann-Erweiterungen des Ethernet Link-Objekts

a. Einheit: 1 Hundertstel von 1%, d.h., 100 entspricht 1%

2.2.4 Ethernet Switch Agent Object

The Switch supports the Hirschmann vendor specific Ethernet Switch Agent Object (Class Code $95_{H,}$ 149) for the Switch configuration and information parameters with one instance (Instance 1).
For further information on these parameters and how to adjust them refer to the Reference Manual „GUI“ (Graphical User Interface / Web-based Interface).

Attribute	ID/Bit No.	Description
Switch Status	ID 01	DWORD (32 bit) RO
	Bit 0	Overall state (0: ok, 1: failed) Like the signal contact.
	Bit 1	Power Supply 1 (0: ok, 1: failed or does not exist)
	Bit 2	Power Supply 2 (0: ok, 1: failed or does not exist)
	Bit 3	Power Supply 3 (0: ok or not possible on this platform, 1: failed or does not exist)
	Bit 4	Power Supply 4 (0: ok or not possible on this platform, 1: failed or does not exist)
	Bit 5	Power Supply 5 (0: ok or not possible on this platform, 1: failed or does not exist)
	Bit 6	Power Supply 6 (0: ok or not possible on this platform, 1: failed or does not exist)
	Bit 7	Power Supply 7 (0: ok or not possible on this platform, 1: failed or does not exist)
	Bit 8	Power Supply 8 (0: ok or not possible on this platform, 1: failed or does not exist)
	Bit 9	DIP RM (ON: 1, OFF: 0)
	Bit 10	DIP Standby (ON: 1, OFF: 0)
	Bit 11	Signal Contact 1 (0: closed, 1: open)
	Bit 12	Signal Contact 2 (0: closed, 1: open)
	Bit 13	Quick Connect (1: ON, 0: OFF)
	Bit 16	Temperature (0: ok, 1: threshold exceeded)
	Bit 17	Fan (0: ok or no fan, 1: inoperable)
	Bit 21	DIP Ring ports, 0: module 1 ports 1&2, 1: module 2, ports 1&2
	Bit 22	DIP Configuration (1: enabled, 0: disabled)
	Bit 23	DIP HIPER-Ring state (1: ON, 0: OFF)
	Bit 24	Module removed (1: removed)
	Bit 25	ACA removed (1: removed)
	Bit 28	Hiper-Ring (1: loss of redundancy reserve)
	Bit 29	Ring-/Netcoupling (1: loss of redundancy reserve)

Table 7: Hirschmann Ethernet Switch Agent Object

Attribute	ID/Bit No.	Description
	Bit 30	Connection Error (1: link inoperable)
Switch Temperature	ID 02	Struct{INT RO Temperature °F, INT RO Temperature °C}
Reserved	ID 03	Always 0, attribute is reserved for future use.
Switch Max Ports	ID 04	UINT (16 bit) RO Maximum number of Ethernet Switch Ports
Multicast Settings (IGMP Snooping)	ID 05	WORD (16 bit) RW
	Bit 0 RW	IGMP Snooping (1: enabled, 0: disabled)
	Bit 1 RW	IGMP Querier (1: enabled, 0: disabled)
	Bit 2 RO	IGMP Querier Mode (1: Querier, 0: Non-Querier)
	Bit 4-6 RW	IGMP Querier Packet Version 1: V1, 2: V2, 3: V3, 0: Off (IGMP Querier disabled)
	Bit 8-10 RW	Treatment of Unknown Multicasts (Railswitch only): 0: Send To All Ports, 1: Send To Query Ports, 2: Discard
Switch Existing Ports	ID 06	ARRAY OF DWORD[a] RO Bitmask of existing Switch Ports
	Per Bit starting with Bit 0 (means Port 1)	1: Port existing, 0: Port not available. Array (bit mask) size is adjusted to the size of maximum number of Switch ports (e.g. a max. no of 28 ports means that 1 DWORD is used (32 bit)).
Switch Port Control	ID 07	ARRAY OF DWORD[a] RW Bitmask Link Admin Status Switch Ports
	Per Bit starting with Bit 0 (means Port 1)	0: Port enabled, 1: Port disabled. Array (bit mask) size is adjusted to the size of maximum number of Switch ports (e.g. a max. no of 28 ports means that 1 DWORD is used (32 bit)).
Switch Ports Mapping	ID 08	ARRAY OF USINT (BYTE, 8 bit) RO Instance number of the Ethernet Link Object
	Starting with Index 0 (means Port 1)	All Ethernet Link Object Instances for the existing Ethernet Switch Ports (1..N (maximum number of ports)). When the entry is 0, the Ethernet Link Object for this port does not exist.
Switch Action Status	ID 09	DWORD (32 bit) RO
	Bit 0	Flash write in progress
	Bit 1	Unable to write to flash or write incomplete

Table 7: Hirschmann Ethernet Switch Agent Object

a. RS20/RS30/RS40, MS20/MS30, OCTOPUS, PowerMICE, RSR20/RSR30, MACH 100 and MACH 1000: 32 bit;
MACH 4000: 64 bit

The Hirschmann specific Ethernet Switch Agent Object provides you with the additional vendor specific service, with the Service-Code 35_H for saving the Switch configuration. The Switch replies to the request for saving the configuration, as soon as it saved the configuration in the flash memory.

2.2.5 I/O Data

You will find the exact meaning of the individual bits of the device status in the I/O data in “Ethernet Switch Agent Object” on page 27.

I/O Data	Value (data types and sizes to be defined)	Direction
Device Status	Bitmask (see Switch Agent Attribute 1)	Input, DWORD 32 Bit
Link Status	Bitmask, 1 Bit per port 0: No link, 1: Link up	Input, DWORD[a]
Output Links Admin State applied	Bitmask (1 Bit per port) to acknowledge output. Link state change can be denied, e.g. for controller access port. 0: Port enabled, 1: Port disabled.	Input DWORD[a]
Utilization Alarm	Bitmask, 1 Bit per port 0: No alarm, 1: Alarm on port	Input, DWORD[a]
Access Violation Alarm	Bitmask, 1 Bit per port 0: No alarm, 1: Alarm on port	Input, DWORD[a]
Multicast Connections	Integer, number of connections	Input, 1 DINT 32 bit
TCP/IP Connections	Integer, number of connections	Input, 1 DINT 32 bit
Link Admin State	Bitmask, one bit per port 0: Port enabled, 1: Port disabled	Output, DWORD[a]

Table 8: I/O Data

a. RS20/RS30/RS40, MS20/MS30, OCTOPUS, PowerMICE, RSR20/RSR30, MACH 100 and MACH 1000: 32 Bit;
MACH 4000: 64 Bit

2.2.6 Assignment of the Ethernet Link Object Instances

The table shows the assignment of the Switch ports to the Ethernet Link Object Instances.

Ethernet Link Object Instance	RS20/RS30/RS40 RSR20/RSR30, OCTOPUS, MACH 1000	MS20/MS30, PowerMICE, MACH 100	MACH 4000
1	CPU	CPU	CPU
2	1	Module 1 / port 1	Module 1 / port 1
3	2	Module 1 / port 2	Module 1 / port 2
4	3	Module 1 / port 3	Module 1 / port 3
5	4	Module 1 / port 4	Module 1 / port 4
6	5	Module 2 / port 1	Module 1 / port 5
7	6	Module 2 / port 2	Module 1 / port 6
8	7	Module 2 / port 3	Module 1 / port 7
9	8	Module 2 / port 4	Module 1 / port 8
10	9	Module 3 / port 1	Module 2 / port 1
11	10	Module 3 / port 2	Module 2 / port 2
12	11	Module 3 / port 3	Module 2 / port 3
13	12	Module 3 / port 4	Module 2 / port 4
14	13	Module 4 / port 1	Module 2 / port 5
..	..	..	..

Table 9: Assignment of the Switch ports to the Ethernet Link Object Instances

2.2.7 Supported Services

The table gives you an overview of the services for the object instances supported by the EtherNet/IP implementation.

Service code	Identity Object	TCP/IP Interface Object	Ethernet Link Object	Switch Agent Object
Get Attribute All (01H)	All Attributes	All Attributes	All Attributes	All Attributes
Set Attribute All (02H)	-	Settable Attributes (3, 5, 6)	-	-
Get Attribute Single (0EH)	All Attributes	All Attributes	All Attributes	All Attributes
Set Attribute Single (10H)	-	Settable Attributes (3, 5, 6)	Settable Attributes (6, 65H, 67H, 68H, 69H)	Settable Attributes (7)
Reset (05H)	Parameter (0.1)	-	-	-
Save Configuration (35H) Vendor-specific	Parameter (0.1)	-	-	Save Switch Configuration

Table 10: Supported Services

3 PROFINET IO

PROFINET IO is an industrial communication network based on Ethernet that is accepted worldwide. It is based on the widely used transport protocols TCP/IP and UDP/IP (standard). This is an important aspect for fulfilling the requirements for consistency from the management level down to the field level.

PROFINET IO enhances the existing Profibus technology for such applications that require fast data communication and the use of industrial IT functions.

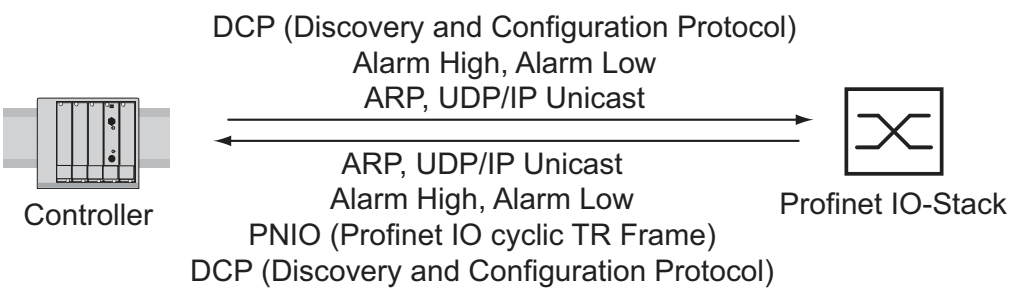


Figure 6: Communication between the Controller and the Switch

In particular, you will find PROFINET IO in Europe and in conjunction with Siemens controllers.
PROFINET IO uses the device description language GSDML (Generic Station Description Markup Language) to describe devices and their properties so that they can be processed automatically. You will find the device description in the GSD(ML) file of the device.

You will find detailed information on PROFINET on the Internet site of the PROFIBUS Organization at http://www.profibus.com.
The devices conform to class B for PROFINET IO.

Switch Models for PROFINET IO GSDML Version 2.3

The device creates GSDML files in the GSDML V.2.3 format. Within the GSDML file, the device is modeled according to GSDML standard V.2.2.

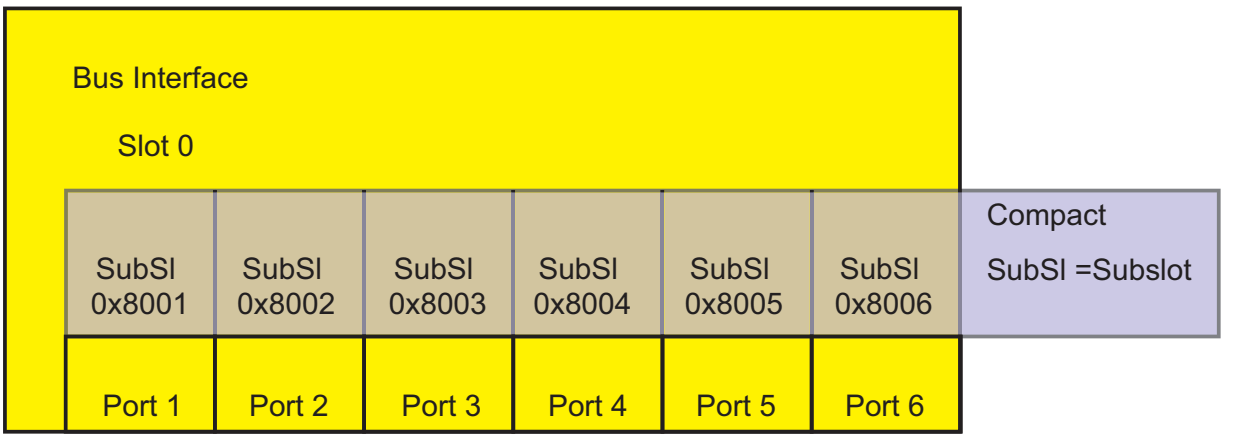


Figure 7: Compact Switch

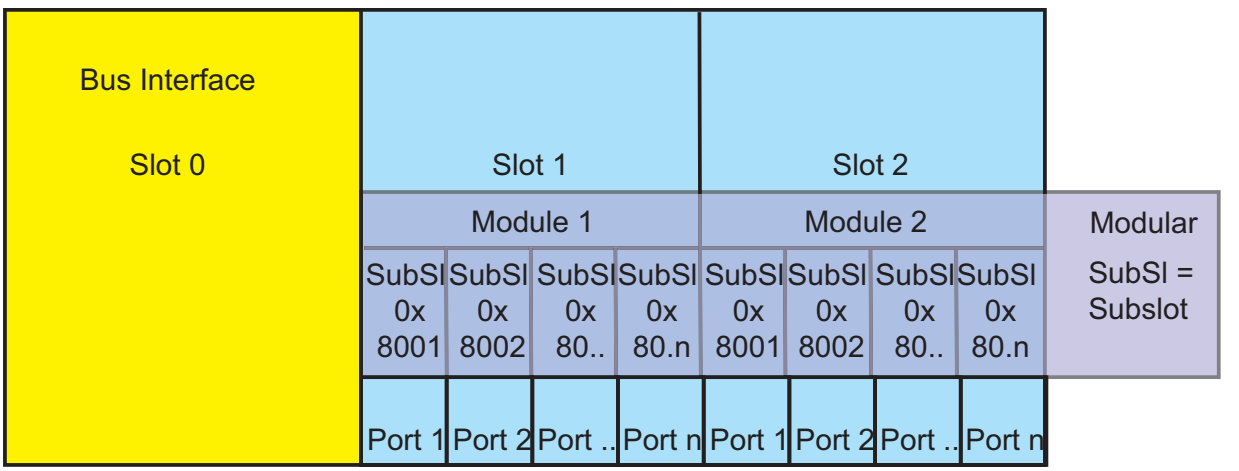


Figure 8: Modular Switch

Graphical user interface and CLI

In Profinet environments, the automation process establishes an application relation (AR) to the device when the device is set up successfully. As long as the application relation is established, certain device settings can not be changed by other users.

The following parameters are unchangeable via the graphical user interface, CLI, and SNMP when the application relation is established:

- IP address
- MRP
- Hiper-Ring
- DCP configuration
- HiDiscovery configuration
- Cable test
- LLDP configuration
- Port configuration

After the login of a user, the device displays a corresponding message via the graphical user interface and CLI.

3.1 Integration into a Control System

3.1.1 Preparing the Switch

After installing and connecting the Switch, you configure it according to the “Basic Configuration” user manual:

☐ In the `Basic Settings:System` dialog, check if a valid system name for the device is specified in the "Name" field.
The system name can only contain alphanumeric characters, hyphens, and periods.

☐ Use the Web-based interface in the `Basic Settings:Network` dialog to check whether `Local` is selected in the “Mode” frame.

☐ Use the Web-based interface in the `Switching:VLAN:Global` dialog to check whether “VLAN 0 Transparent Mode” is selected.

☐ Use the Web-based interface in the `Advanced:Industry Protocols:PROFINET IO` dialog to check whether Profinet IO is activated.

☐ Load the GSD(ML) file and the icon onto your local computer.
You get the GSD(ML) file and the icon
– by using the Web-based interface in the `Advanced:Industry Protocols` dialog or
– by using the software (Stand Alone GSDML File Generator) for creating the GSD(ML) file, which is included in the delivery.

☐ Configure the alarm setting and the threshold value for the alarms you want to monitor.

3.1.2 Configuration of the PLC

The following illustrates the configuration of the PLC using the example of the Simatic S7 software from Siemens, and assumes that you are familiar with operating the software.
The device also supports engineering stations from other manufacturers, such as PC Worx from Phönix.

Note: If for example, a management program is occupying the Switch CPU with SNMP requests, the I/O connection between the programmable logic controller (PLC) and the Switch can be interrupted for a time. As the Switch can still transmit data packages in this case, the system can also still be ready for operation.
The monitoring of the I/O connection to the Switch CPU as a failure criterion can result in system failure and is therefore less suitable as a failure criterion.

In the PLC default setting, the PLC sees the interruption of the I/O connection to the Switch as a failure criterion. According to the default setting, this leads to a system failure. To change this default setting, you employ Step7 programming measures.

Providing the GDSML file

The Hirschmann provides you with the following options for generating GDSML files and icons:

- you can use the Web-based interface in the `Advanced:Industry Protocols:PROFINET IO` dialog to select `PROFINET IO` and download the GSDML file and the icon of the device.
- you can use the Web-based interface in the `Advanced:Industry Protocols:PROFINET IO` dialog to select `Other device` and download the GSDML file and the icon of another device, for which you enter the order description.
- you can use the software included in the delivery (Stand Alone GSDML File Generator) to create the GSDML file.

Incorporating the Switch in the configuration

- ☐ Open the “Simatic Manager” from Simatic S7.
- ☐ Open your project.
- ☐ Go to the hardware configuration.
- ☐ Install the GSD(ML) file using `Extras:Install GSD File`.
  Select the GSD file previously saved on your PC.
  Simatic S7 installs the file together with the icon.
  You will find the new Switch under `Profinet IO:Other Field Devices:Switching Devices:Hirschmann..` or under `Profinet IO:Other Field Devices:Network Components:Hirschmann...`
- ☐ Use Drag & Drop to pull the Switch onto the bus cable.

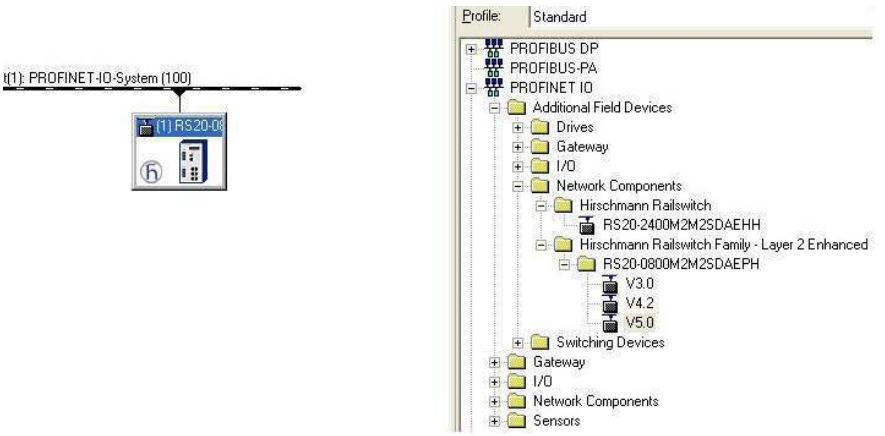


Figure 9: Adding a Switch from the Simatic S7 library

☐ To give the Switch its name, select the Switch and in the menu bar choose `Target System:Ethernet:Edit Ethernet Participants...`

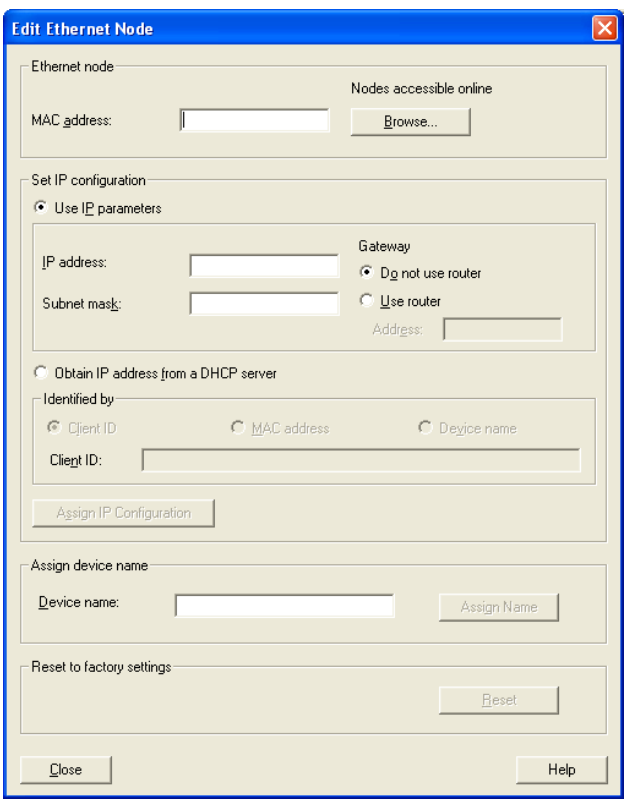


Figure 10: Dialog for entering the Switch name

☐ Click on “Browse”.
Select your Switch.
Click on “OK”.

☐ Give the Switch its name.
Click on “Assign Name”.
☐ Click on “Close”.

☐ In the hardware configuration, right-click on the Switch and select `Object properties`.

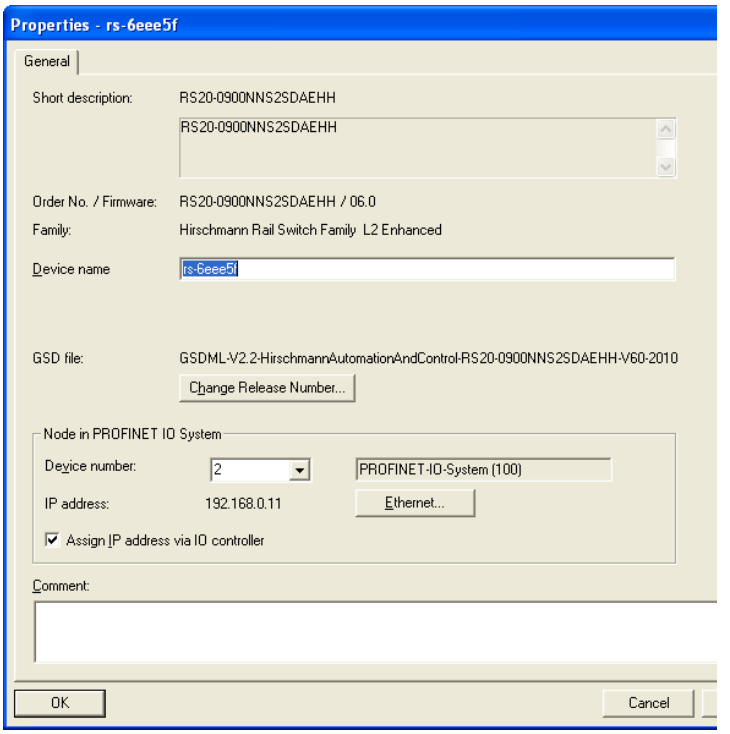


Figure 11: Dialog for entering the object name (= name of the Switch) and the IP parameter

☐ Enter the same device name here.
☐ Click on “Ethernet”.
Enter the IP parameters.
Close the Ethernet input window.
☐ Click on “OK” to close the properties window.

The Switch is now included in the configuration.

Configuring IO Cycle

☐ In the hardware configuration, right-click on the Switch and select `Object properties`.

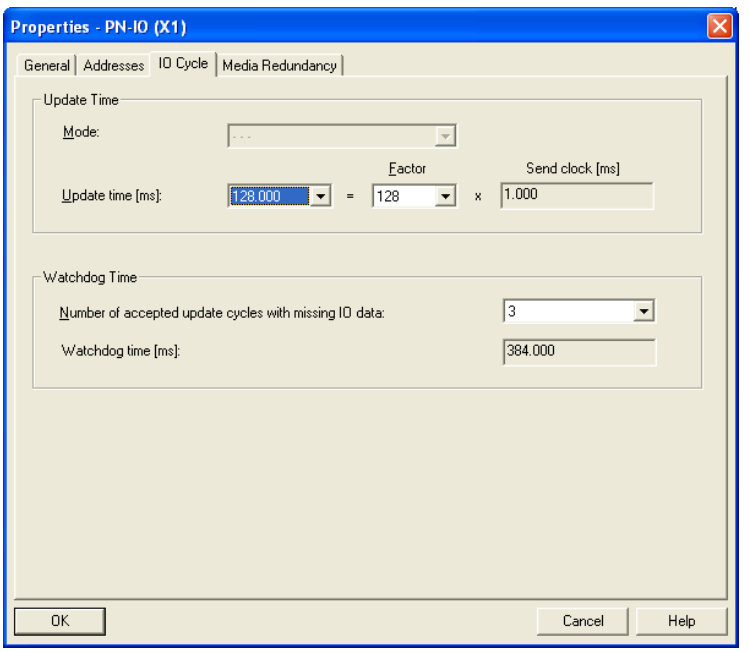


Figure 12: Dialog for entering the IO Cycle

☐ In the Properties window, select the “IO Cycle” tab.
☐ Under `Update Time/Update time[ms]:`, select the required update time (in ms) for the IO Cycle (see figure 12).
☐ Under `Watchdog Time/Number of accepted update cycles with missing IO data`, select the required number for the IO Cycle (see figure 12).
☐ Click on “OK” to close the properties window.

Configuring Media Redundancy

☐ In the hardware configuration, right-click on the Switch and select `Object properties`.

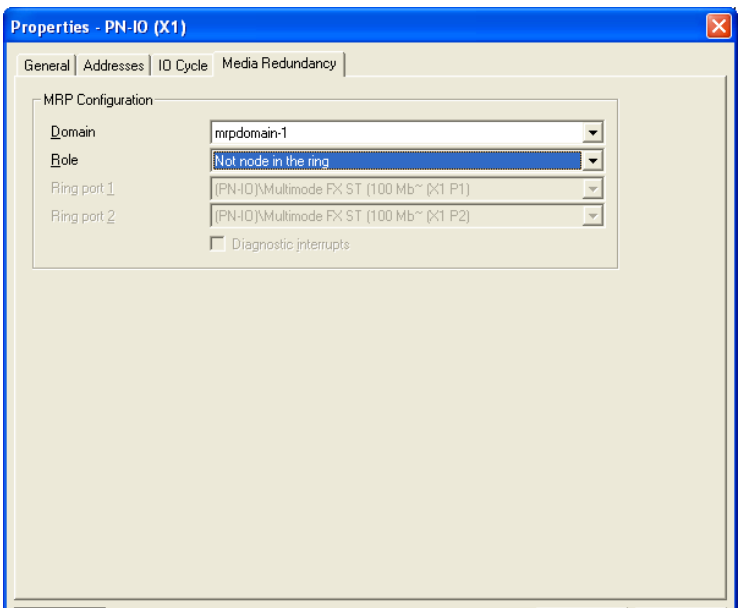


Figure 13: Dialog for entering the Media redundancy

☐ In the Properties window, select the “Media Redundancy” tab.
☐ Under `MRP Configuration/Domain` , select the required MRP domain for the node (see figure 13).
☐ Under `MRP Configuration/Role` , select the required role of the node in the ring (see figure 13).
☐ Under `Ring Port 1/2` , select the actice MRP Ring Ports.
☐ Click on “OK” to close the properties window.

Adding modules for modular devices

☐ Use Drag & Drop to pull a module from the library into a slot. Simatic S7 adds the ports using the Module properties.

Configuring device property

On slot 0 you enter the settings for the entire Switch.

☐ Select the Switch.

☐ Right-click on slot 0.
To configure the entire device, select `Object properties`.

☐ In the Properties window, select the “Parameters” tab.

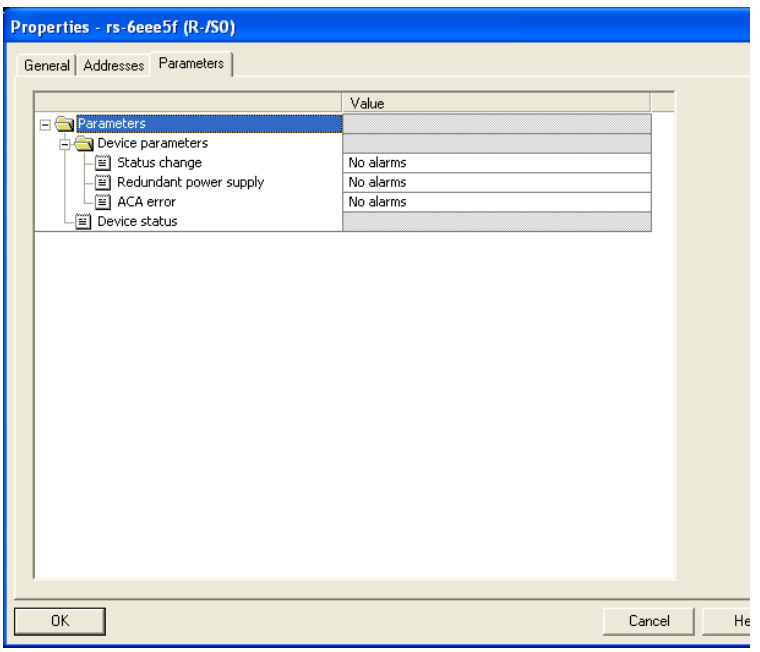


Figure 14: Configuring device alarms for e.g. RS20/RS30.

Configuring the port properties

For modular devices, slots 1 to n represent the modules. Within the slots, the ports are shown as records.
For non-modular devices, the slots 1 to n represent the ports.

Configuring Alarms

☐ Right-click on one of the slots 1 to n and select `Object properties`.
☐ In the Properties window, select the “Parameters” tab.
☐ Select the desired alarms and close the window (see figure 15).

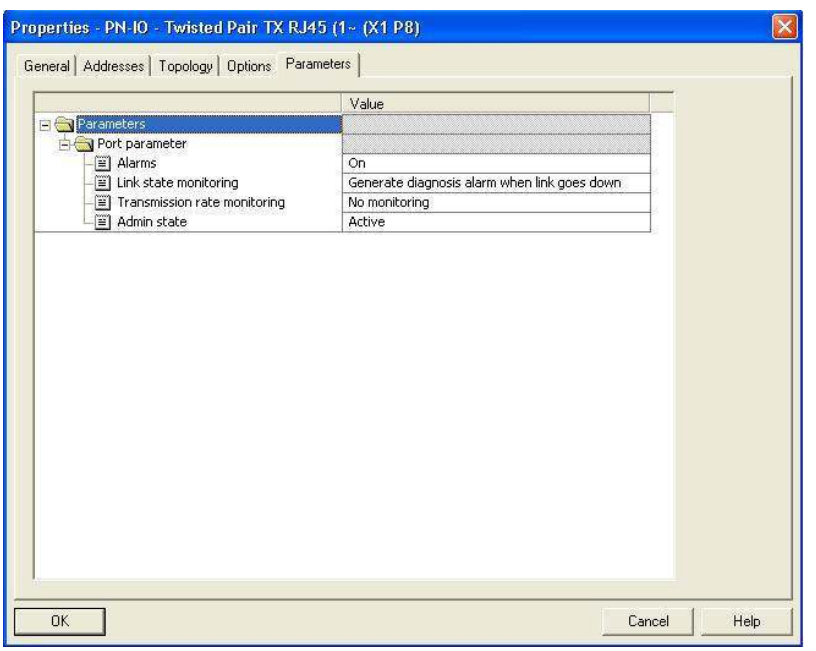


Figure 15: Port properties

Special case: “LinkDown” alarm:
The LinkDown alarm is made up of the AND-link
– of the Hirschmann-specific status for connection errors and
– of the Simatic S7-specific option for the connection.
Activating the LinkDown alarm:
☐ Under `Object properties`, select the `Parameter` tab (Hirschmann-specific).
Activate “Alarms” and select the option `Generate diagnosis alarm when link goes down` under “Link state monitoring”.
☐ Under `Object properties`, select the `Options` tab (Simatic S7-specific).
To activate the link monitoring, select a fixed setting for the port under `Connection/Transmission medium/Duplex`.

Configuring Connection Options

☐ Right-click on one of the slots 1 to n and select `Object properties`.

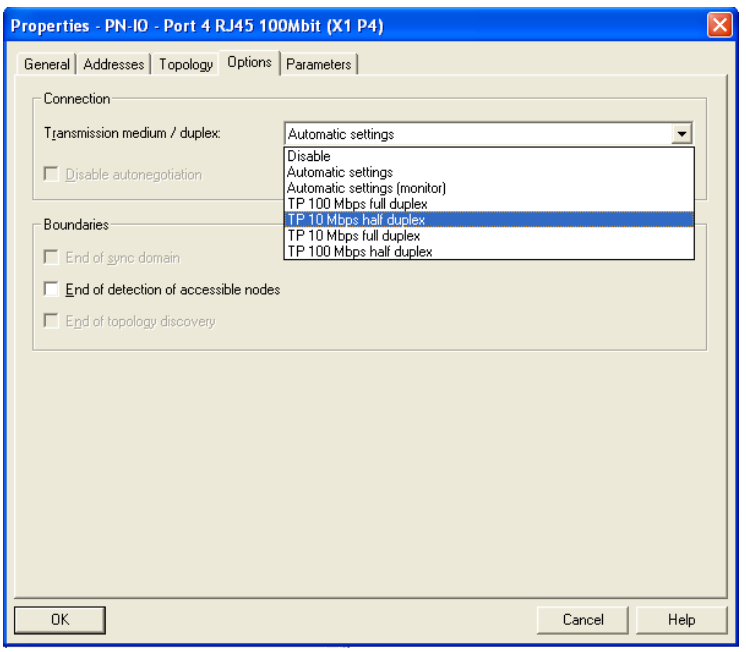


Figure 16: Dialog for entering the connection options

☐ In the Properties window, select the "Options" tab.
☐ Under "Connection/Transmission medium/duplex", select the desired setting for the port (see figure 16).

When you change the port setting to a value other than `Automatic settings`, the device disables the port for a short time. When the port is situated on the path between the I/O controller and the I/O device, the interruption possibly leads to a failure in establishing the Application Relation. Make the following provisions before changing the port setting:

▶ Beware of Loops! Deactivate RSTP on the ports between the I/O controller and the I/O device.
  ☐ Open the "Redundancy:Spanning Tree:Port" dialog.
  ☐ Unmark the "Stp active" checkbox for the relevant port.
  ☐ Save the settings.

▶ Activate "Fast Start Up" on the ports between the I/O controller and the I/O device.
  ☐ Open the "Advanced:Industrial Protocols:PROFINET" dialog.
  ☐ For the relevant port, specify in the "Fast Start Up" field the value `enable`.

☐ Save the settings.

☐ Click "OK" to close the Properties window.

Configuring Topology

☐ Right-click on one of the slots 1 to n and select `Object properties`.

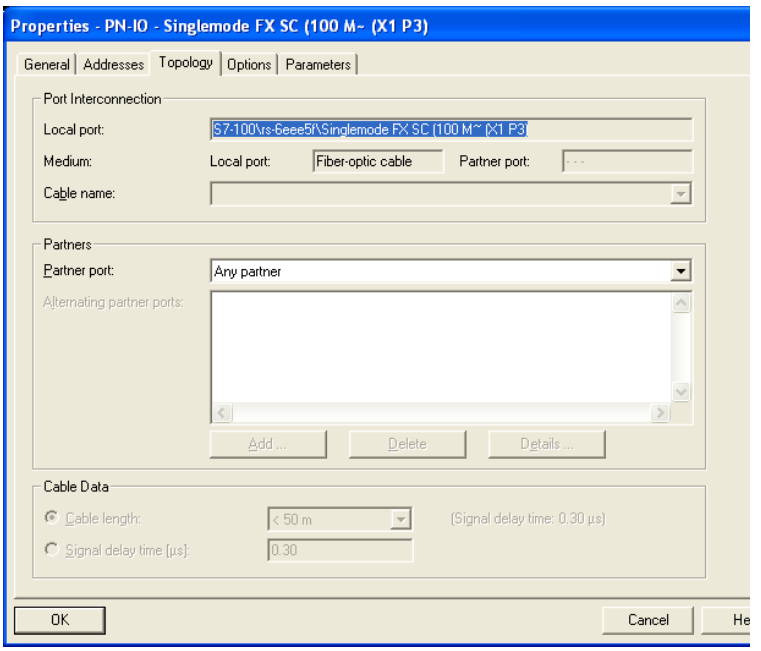


Figure 17: Dialog for entering the topology

☐ In the Properties window, select the "Topology" tab.

☐ Under `Port Interconnection/Local port`, select the required setting for the port (see figure 17).

☐ Under `Partner/Partner port`, select the required setting for the partner port (see figure 17).

☐ Click on “OK” to close the properties window.

3.1.3 Configuring the device

Included with the device is the program “Hirschmann Tool Calling Interface”, which you can install with the installation program `HirschmannToolCallingInterfaceXXXXXSetup.exe` (`XXXXX` = software version, e.g. 01000).
After installing the program “Hirschmann Tool Calling Interface”, you have the option of starting two Hirschmann operating programs in Simatic S7 in order to perform more detailed device configurations.

☐ In Simatic S7, right-click on a device and select Web-based Interface (WWW) or Telnet in the drop-down menu.

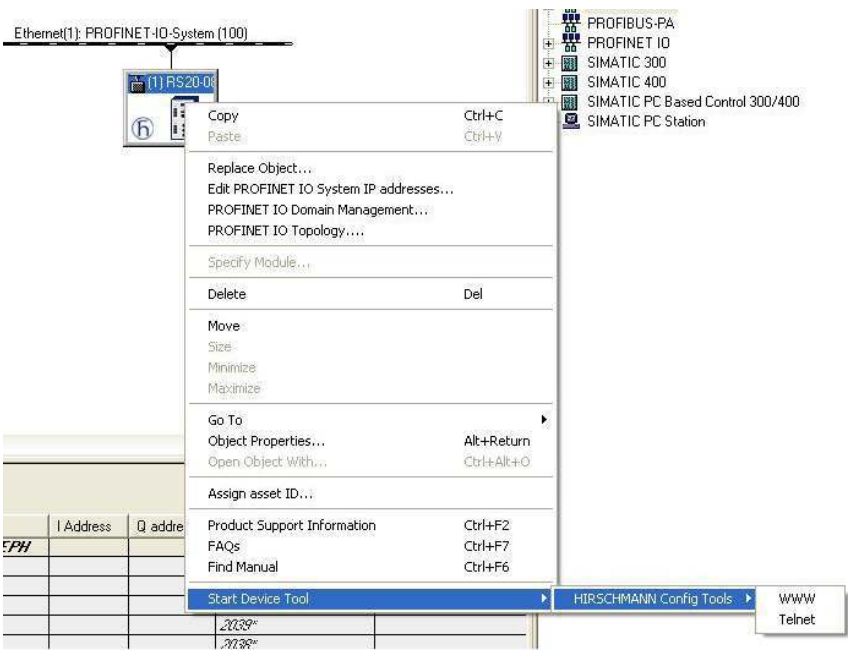


Figure 18: Call up the Hirschmann operating program

3.1.4 Swapping devices

Hirschmann devices support the device swapping function with an engineering station.
If identical devices are being swapped, the engineering station assigns the parameters of the original device to the new device.

The device swapping function with Simatic S7 requires the following prerequisites:
- S7 300 with SW release from V2.7 (currently available for CPU 319) or S7 400 with SW release from V5.2
- Hirschmann device SW release from 05.0.00
- Neighboring device(s) support(s) LLDP
- Topology (=neighborhood relationships) is configured and loaded onto SPS

Device swapping requires the following conditions:
- the replacement device is of exactly the same type as the device to be replaced.
- the replacement device is connected to exactly the same place in the network (same ports and neighboring devices).
- the replacement device has a Profinet default configuration. Set the device name to "" (null string).

If all these conditions are fulfilled, the engineering station automatically assigns the parameters of the original device (device name, IP parameters and configuration data) to the replacement device.

Procedure for swapping devices:
☐ Reset the replacement device to the state on delivery:
  - System name "" (= null string)
  - IP address = 0.0.0.0 or DHCP
  - PROFINET IO activated
☐ Make a note of the port assignment of the original device and remove the original device from the system.
  The PLC now detects an error.
☐ Now insert the replacement device at the same position in the network. Make sure the port assignments are the same as for the original device.

The PLC finds the replacement device and configures it like the original device.
The PLC detects normal operation again.
If necessary, reset the PLC to “Run”.

3.1.5 Swapping modules

The PROFINET IO stack in the device detects a change in the modules connected and reports the change to the engineering station. If a previously configured module is removed from the device, the engineering station reports an error. If a configured module that was missing is connected, the engineering station removes the error message.

3.1.6 Monitoring the network

Topology Discovery

After the user initializes the Topology Discovery, the engineering station looks for connected devices.

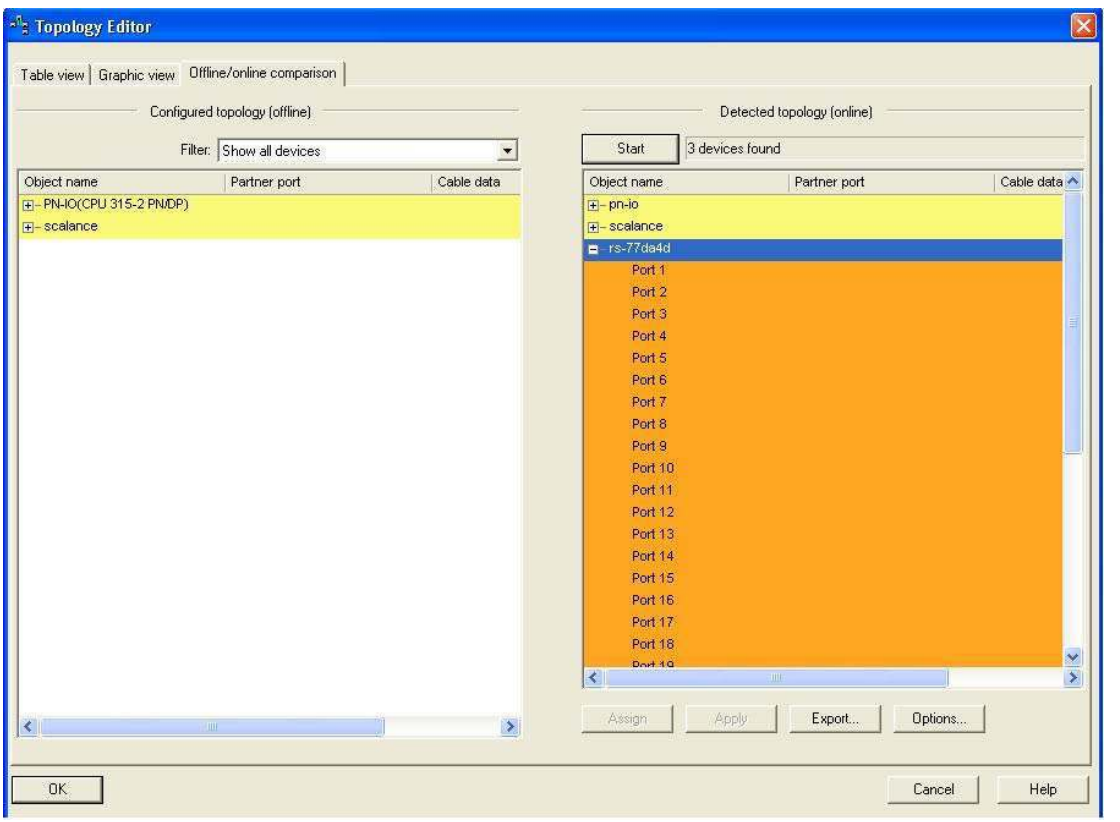


Figure 19: Topology Discovery

Configuring the topology

Simatic S7 gives the user the option to configure the topology and monitor it accordingly.
Simatic S7 displays the connection parameters (quality and settings) in a colored graphic.

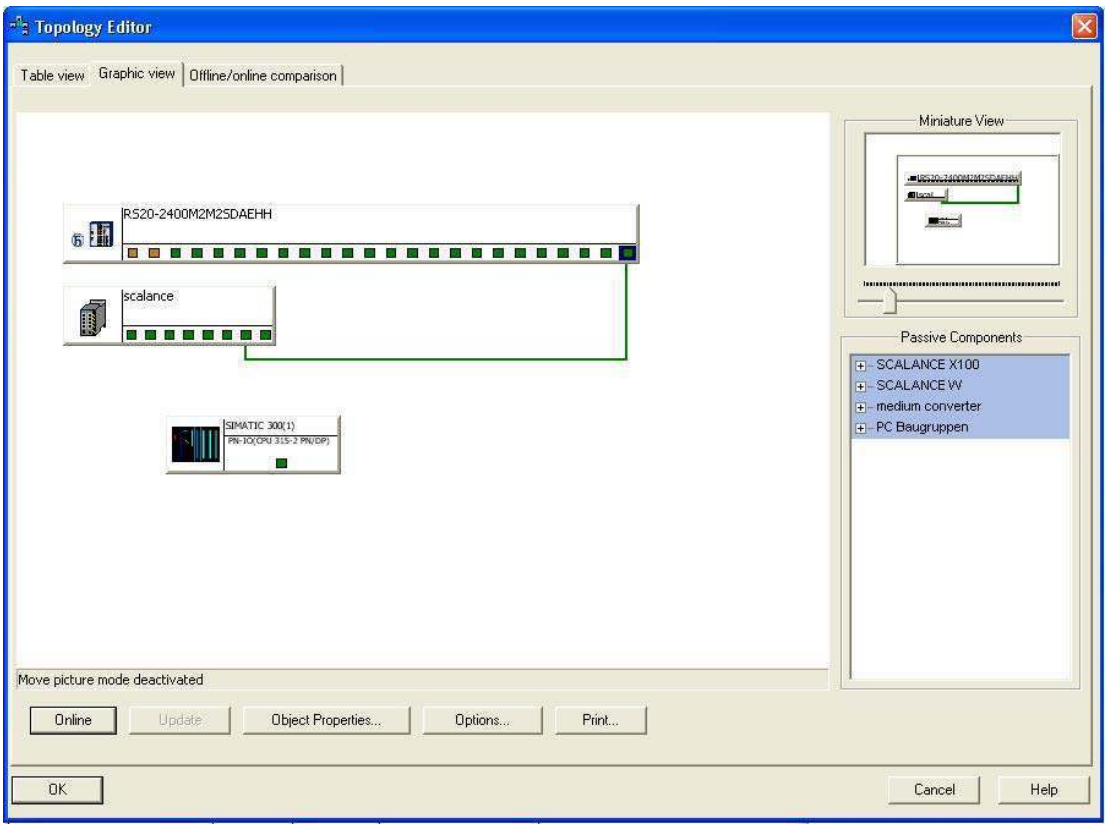


Figure 20: Configuring the topology

Communication diagnosis

Simatic S7 monitors the communication quality and outputs messages relating to communication problems.

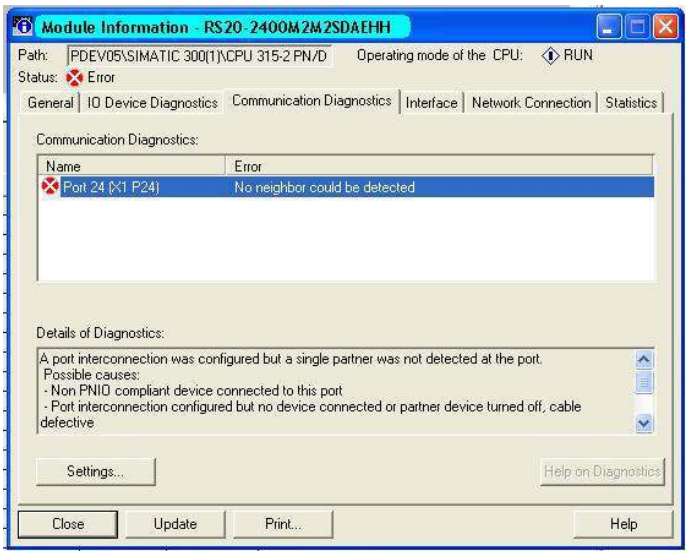


Figure 21: Diagnosis messages for the communication between the Switches and IO devices

Outputting port statistics

Simatic S7 counts for each port the number of data packets received and sent, the collisions, etc. You can view these figures in the form of statistic tables in Simatic S7.

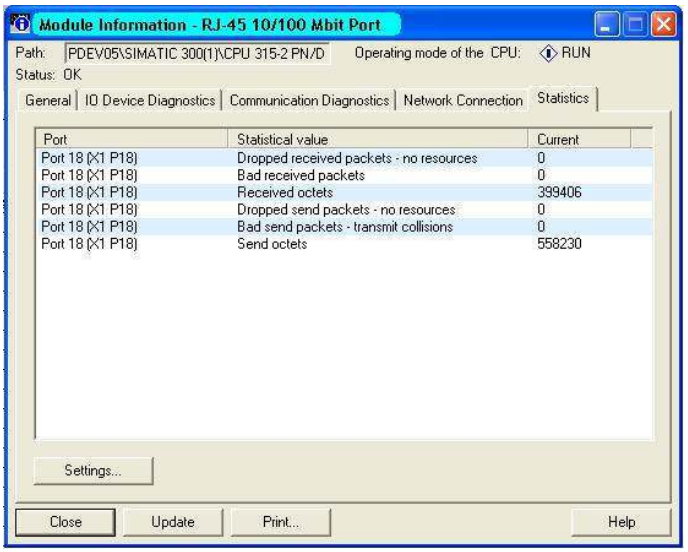


Figure 22: Example of a port statistic table

3.2 PROFINET IO Parameters

3.2.1 Alarms

The Switch supports alarms on the device and port levels (see „Device State“ in the Basic Configuration User Manual or the Web-based Interface Reference Manual.

Alarms on device level	Change in device status - Failure of redundant power supply - Failure/removal of ACA
Alarms on port level	- Change in link status - Specified transfer rate exceeded.

Table 11: Alarms supported

3.2.2 Record parameters

The Switch provides records for:
- Device parameters
- Device status
- Port status/parameters

Byte	Content	Access	Value	Meaning
0	Send alarm if status changes	rw	0	Do not send alarms
			1	Send alarm if one of the following alarm reasons occurs.
1	Power Alarm	rw	0	Do not send alarm
			1	Send alarm if a power supply fails.
2	ACA Alarm	rw	0	Do not send alarm
			1	Send alarm if the ACA is removed.
3	Module Alarm	rw	0	Do not send alarm
			1	Send alarm if the module connections are changed.

Table 12: Device parameters

Byte	Content	Access	Value	Meaning
0	Device Status	ro	0	Unavailable
			1	OK
			2	Error
1	Power supply unit 1	ro	0	Unavailable
			1	OK
			2	Error
2	Power supply unit 2	ro	0	Unavailable
			1	OK
			2	Error
3	Power supply unit 3	ro	0	Unavailable
			1	OK
			2	Error
4	Power supply unit 4	ro	0	Unavailable
			1	OK
			2	Error
5	Power supply unit 5	ro	0	Unavailable
			1	OK
			2	Error
6	Power supply unit 6	ro	0	Unavailable
			1	OK
			2	Error
7	Power supply unit 7	ro	0	Unavailable
			1	OK
			2	Error

Table 13: Device status

Byte	Content	Access	Value	Meaning
8	Power supply unit 8	ro	0	Unavailable
			1	OK
			2	Error
9	Signal contact 1	ro	0	Unavailable
			1	Closed
			2	Open
10	Signal contact 2	ro	0	Unavailable
			1	Closed
			2	Open
11	Temperature	ro	0	Unavailable
			1	OK
			2	Threshold value for temperature exceeded or not reached
12	Fan	ro	0	Unavailable
			1	OK
			2	Fan failure
13	Module removal	ro	0	Unavailable
			1	OK
			2	A module has been removed.
14	ACA removal	ro	0	Unavailable
			1	OK
			2	The ACA has been removed.
15	HIPER_Ring	ro	0	Unavailable
			1	OK
			2	Redundancy failure.
16	Ring/Network coupling	ro	0	Unavailable
			1	OK
			2	Redundancy failure.
17	Connection	ro	0	Unavailable
			1	OK
			2	Connection failure.

Table 13: Device status

Byte	Content	Access	Value	Meaning
0	Report port error	rw	0	Do not send alarms
			1	Send alarm if one of the following alarm reasons occurs.

Table 14: Port status/parameters

Byte	Content	Access	Value	Meaning
1	Report connection error	rw	0	Do not send alarm
			1	Send alarm if the connection has failed.
2	Transmission rate too high	rw	0	Do not send alarm
			1	Send alarm if the threshold value for the temperature has been exceeded.
3	Port on	rw	0	Unavailable
			1	Switched on
			2	Switched off
4	Link status	ro	0	Unavailable
			1	Connection exists
			2	Connection interrupted
5	Bit rate	ro	0	Unavailable
			1	Unknown
			2	10 MBit/s
			2	100 MBit/s
			2	1000 MBit/s
6	Duplex	ro	0	Unavailable
		1	Half duplex	
		2	Full duplex	
7	Autonegotiation	ro	0	Unavailable
			1	Off
			2	On

Table 14: Port status/parameters

3.2.3 I/O Data

You will find the bit assignment for the transferred I/O data in the following table.

Direction	Byte	Bit	Meaning
Input	0		General
		0	Device status
		1	Signal contact 1
		2	Signal contact 2
		3	Temperature
		4	Fan
		5	Module removal
		6	ACA removal
		7	Not used
Input	1		Power supply status
		0	Power supply unit 1
		1	Power supply unit 2
		2	Power supply unit 3
		3	Power supply unit 4
		4	Power supply unit 5
		5	Power supply unit 6
		6	Power supply unit 7
		7	Power supply unit 8
Input	2		Supply voltage status
		0	HIPER-Ring
		1	Ring/Network coupling
		2	Connection error
		3	Not used
		4	Not used
		5	Not used
		6	Not used
		7	Not used
Output			Not defined
Meaning of the bit content: - 0: OK or unavailable - 1: Reason for report exists			

Table 15: Device I/O data

Direction	Byte	Bit	Meaning
Input	0		Connection status for ports 1 to 8
		0	Port 1
		1	Port 2
		2	Port 3
		3	Port 4
		4	Port 5
		5	Port 6
		6	Port 7
		7	Port 8
Input	1		Connection status for ports 9 to 16
		0	Port 9
		1	Port 10
		2	Port 11
		3	Port 12
		4	Port 13
		5	Port 14
		6	Port 15
		7	Port 16
Input	n		Connection for port (n * 8) + 1 to port (n * 8) + 8
		0	Port (n * 8) + 1
		1	Port (n * 8) + 2
		2	Port (n * 8) + 3
		3	Port (n * 8) + 4
		4	Port (n * 8) + 5
		5	Port (n * 8) + 6
		6	Port (n * 8) + 7
		7	Port (n * 8) + 8
Meaning of the bit content: - 0: no connection - 1: connection active			
Output	0		“Port activated” for ports 1 to 8
		0	Port 1 activated
		1	Port 2 activated
		2	Port 3 activated
		3	Port 4 activated
		4	Port 5 activated
		5	Port 6 activated
		6	Port 7 activated
		7	Port 8 activated

Table 16: Port I/O data

Direction	Byte	Bit	Meaning
Output	1		“Port activated” for ports 9 to 16
		0	Port 9 activated
		1	Port 10 activated
		2	Port 11 activated
		3	Port 12 activated
		4	Port 13 activated
		5	Port 14 activated
		6	Port 15 activated
		7	Port 16 activated
Output	n		“Port activated” for port (n * 8) + 1 to port (n * 8) + 8
		0	Port (n * 8) + 1 activated
		1	Port (n * 8) + 2 activated
		2	Port (n * 8) + 3 activated
		3	Port (n * 8) + 4 activated
		4	Port (n * 8) + 5 activated
		5	Port (n * 8) + 6 activated
		6	Port (n * 8) + 7 activated
		7	Port (n * 8) + 8 activated
Meaning of the output bit content: - 0: Port activated - 1: Port deactivated			

Table 16: Port I/O data

4 IEC 61850/MMS (RSR20/RSR30/MACH1000)

IEC 61850/MMS is an industrial communication protocol standardized by the International Electrotechnical Commission (IEC). The protocol is to be found in substation automation, e.g. in the control technology of energy suppliers.

This protocol, which works in a packet-oriented way, is based on the TCP/IP transport protocol and uses the Manufacturing Messaging Specification (MMS) for the client-server communication. The protocol is object-oriented and defines a standardized configuration language that comprises, among other things, functions for SCADA, Intelligent Electronic Devices (IED) and for the network control technology.

Part 6 of the IEC 61850 standard defines the configuration language SCL (Substation Configuration Language). SCL describes the properties of the device and the system structure in an automatically processable form. The properties of the device described with SCL are stored in the ICD file on the device.

4.1 Switch model for IEC 61850

Technical Report IEC 61850 90-4 specifies a bridge model. The bridge model represents the functions of a switch as objects of an Intelligent Electronic Device (IED). An MMS client (e.g. the control room software) uses these objects to monitor and configure the device.

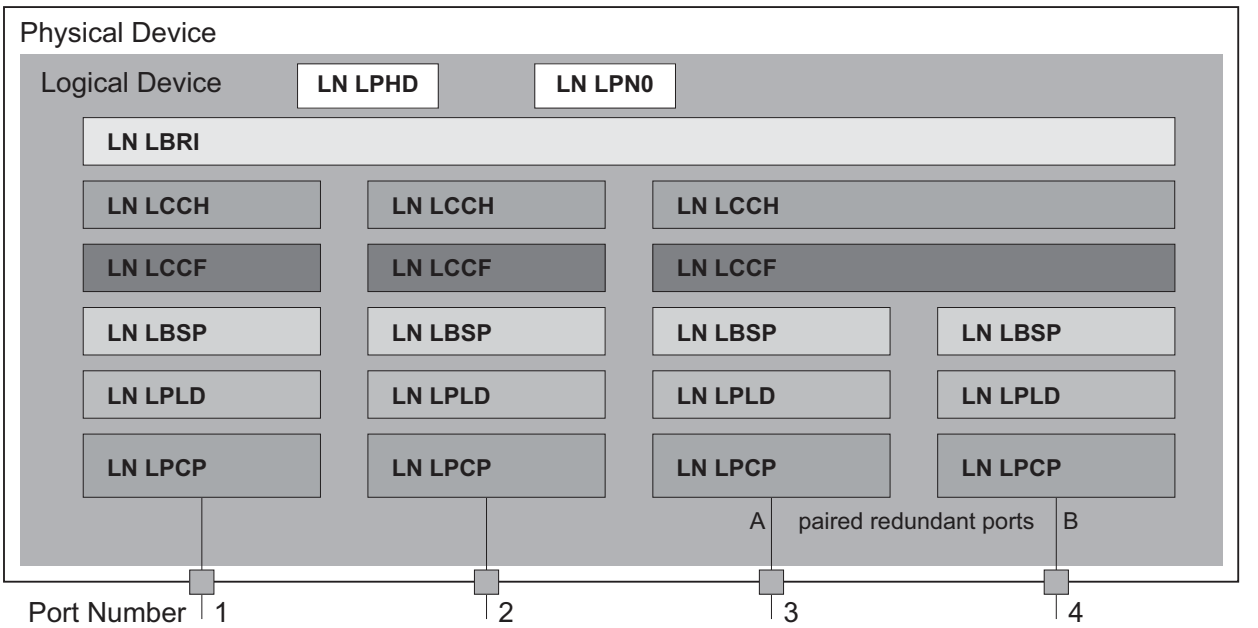


Figure 23: Bridge model based on Technical Report IEC 61850 90-4

Class	Description
LN LLN0	“Zero” logical node of the “Bridge” IED: Defines the logical properties of the device.
LN LPHD	“Physical Device” logical node of the “Bridge” IED: Defines the physical properties of the device.
LN LBRI	“Bridge” logical node: Represents general settings of the bridge functions of the device.
LN LCCH	“Communication Channel” logical node: Defines the logical “Communication Channel” that consists of one or more physical device ports.

Table 17: Classes of the bridge model based on TR IEC61850 90-4

Class	Description
LN LCCF	“Channel Communication Filtering” logical node: Defines the VLAN and Multicast settings for the higher-level “Communication Channel”.
LN LBSP	“Port Spanning Tree Protocol” logical node: Defines the Spanning Tree statuses and settings for the respective physical device port.
LN LPLD	“Port Layer Discovery” logical node: Defines the LLDP statuses and settings for the respective physical device port.
LN LPCP	“Physical Communication Port” logical node: Represents the respective physical device port.

Table 17: Classes of the bridge model based on TR IEC61850 90-4 (cont.)

4.2 Integration into a Control System

4.2.1 Preparing the Switch

After installing and connecting the Switch, you configure it according to the “Basic Configuration” user manual:

☐ Check that an IP address is assigned to the device.

☐ To start the MMS server, activate the function in the graphical user interface, in the `Advanced:Industry Protocols:IEC61850` dialog. Afterwards, an MMS client is able to connect to the device and to read and monitor the objects defined in the bridge model.

⚠ WARNING

RISK OF UNAUTHORIZED ACCESS TO THE DEVICE

IEC61850/MMS does not provide any authentication mechanisms. If the write access for IEC61850/MMS is activated, every client that can access the device using TCP/IP is capable of changing the settings of the device. This in turn can result in an incorrect configuration of the device and to failures in the network.
Only activate the write access if you have taken additional measures (e.g. Firewall, VPN, etc.) to eliminate the risk of unauthorized access.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

☐ To enable the MMS client to configure the objects defined in the bridge model, you select the "Write Access" checkbox.

4.2.2 Offline configuration

The device enables you to download the ICD file using the graphical user interface. This file contains the properties of the device described with SCL and enables the substation to be configured without a direct connection to the device.

☐ You download the ICD file by clicking the "Download ICD File" button in the `Advanced:Industry Protocols:IEC61850` dialog.

4.2.3 Monitoring the device

The IEC61850/MMS server integrated into the device allows you to monitor multiple statuses of the device by means of the Report Control Block (RCB). Up to 5 MMS clients can register for a Report Control Block at the same time.

The device allows the following statuses to be monitored:

Class	RCB object	Description
LN LPHD	PwrSupAlm	Changes when one of the redundant power supplies fails or starts operating again.
	TmpAlm	Changes when the temperature measured in the device exceeds or falls below the set temperature thresholds.
	PhyHealth	Changes when the status of the “LPHD.PwrSupAlm” or “LPHD.TmpAlm” RCB object changes.
LN LBRI	Health	Changes when the status of the “LPHD.PwrSupAlm” or “LPHD.TmpAlm” RCB object changes.
	RstpRoot	Changes when the device takes over or relinquishes the role of the root bridge.
	RstpTopoCnt	Changes when the topology changes due to a change of the root bridge.
LN LCCH	ChLiv	Changes when the link status of the physical port changes.
LN LPCP	PhyHealth	Changes when the link status of the physical port changes.

Table 18: Statuses of the device that can be monitored with IEC 61850/MMS

A GSD File Generator

The program “Stand-alone GSD File Generator” is located on the product CD. The program allows you to generate a GSD file (PROFINET IO) and/or an EDS file (Ethernet/IP, EDS file from a later release onward) with icon from a non-existent device. You can use these files to configure devices in your engineering station that are not installed in the network yet.

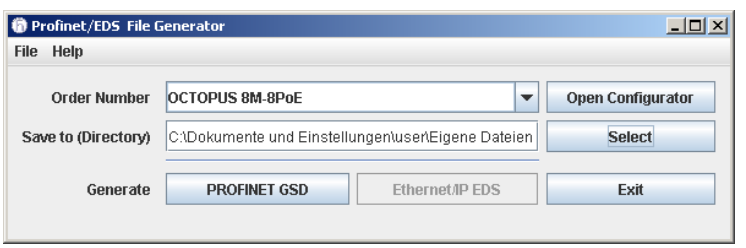


Figure 24: Stand-alone GSD file generator

B Readers' Comments

What is your opinion of this manual? We are constantly striving to provide as comprehensive a description of our product as possible, as well as important information to assist you in the operation of this product. Your comments and suggestions help us to further improve the quality of our documentation.

Your assessment of this manual:

	Very Good	Good	Satisfactory	Mediocre	Poor
Precise description	O	O	O	O	O
Readability	O	O	O	O	O
Understandability	O	O	O	O	O
Examples	O	O	O	O	O
Structure	O	O	O	O	O
Comprehensive	O	O	O	O	O
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Drawings	O	O	O	O	O
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User Manual

Redundancy Configuration
Industrial ETHERNET (Gigabit-)Switch
PowerMICE, MACH 4000

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Contents

Safety Information

⚠ WARNING
UNCONTROLLED MACHINE ACTIONS To avoid uncontrolled machine actions caused by data loss, configure all the data transmission devices individually. Before you start any machine which is controlled via data transmission, be sure to complete the configuration of all data transmission devices. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

About this Manual

The “Redundancy Configuration” user manual document contains the information you require to select the suitable redundancy procedure and configure it.

The “Basic Configuration” user manual contains the information you need to start operating the device. It takes you step by step from the first startup operation through to the basic settings for operation in your environment.

The “Installation” user manual contains a device description, safety instructions, a description of the display, and the other information that you need to install the device.

The “Industry Protocols” user manual describes how the device is connected by means of a communication protocol commonly used in the industry, such as EtherNet/IP and PROFINET IO.

The “Routing Configuration User Manual” document contains the information you need to start operating the routing function. The manual enables you to configure your router by following the examples.

The “Graphical User Interface” reference manual contains detailed information on using the graphical user interface to operate the individual functions of the device.

The “Command Line Interface” reference manual contains detailed information on using the Command Line Interface to operate the individual functions of the device.

The Industrial HiVision network management software provides you with additional options for smooth configuration and monitoring:

- ActiveX control for SCADA integration
- Auto-topology discovery
- Browser interface
- Client/server structure
- Event handling
- Event log
- Simultaneous configuration of multiple devices
- Graphical user interface with network layout
- SNMP/OPC gateway

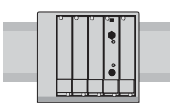
Key

The designations used in this manual have the following meanings:

▶	List
☐	Work step
■	Subheading
Link	Cross-reference with link
Note:	A note emphasizes an important fact or draws your attention to a dependency.
`Courier`	ASCII representation in the graphical user interface
	Execution in the Graphical User Interface
	Execution in the Command Line Interface

Symbols used:

	WLAN access point
	Router with firewall
	Switch with firewall
	Router
	Switch

	Bridge
	Hub
	A random computer
	Configuration Computer
	Server
	PLC - Programmable logic controller
	I/O - Robot

1 Introduction

The device contains a range of redundancy functions:

- Link Aggregation
- HIPER-Ring
- MRP-Ring
- Sub-Ring (RSR20, RSR30 and MACH 1000)
- Ring/Network coupling
- Rapid Spanning Tree Algorithm (RSTP)
- VRRP/HiVRRP

1.1 Overview of Redundancy Topologies

To introduce redundancy onto layer 2 of a network, you first define which network topology you require. Depending on the network topology selected, you then choose from the redundancy protocols that can be used with this network topology.

The following topologies are possible:

Network topology	Possible redundancy procedures	Comments
Tree structure without loops (cycle-free)	Only possible in connection with physical loops	-
Topology with 1 loop	RSTP Ring Redundancy	Ring Redundancy procedures (HIPER-Ring, Fast HIPER-Ring or MRP) provide shorter switching times than RSTP.
Topology with 2 loops	RSTP Ring Redundancy Sub-Ring (RSR20, RSR30, PowerMICE, MACH 1000 and MACH 4000)	Ring redundancy: a Basis-Ring with a Sub-Ring or an MRP-Ring with an RSTP-Ring.
Topology with 3 non-nested loops	RSTP Ring Redundancy Sub-Ring (RSR20, RSR30, PowerMICE, MACH 1000 and MACH 4000) Ring coupling	The ring coupling provides particular support when redundantly coupling a redundant ring to another redundant ring, or to any structure that only works with Hirschmann devices
Topology with nested loops	RSTP Sub-Ring (RSR20, RSR30, PowerMICE, MACH 1000 and MACH 4000) Ring coupling	Ring coupling only couples non-nested rings, though these can couple local Sub-Rings.

Table 1: Overview of Redundancy Topologies

The Ring Redundancy Protocol MRP has particular properties to offer:

- You have the option of nesting MRP-Rings. A coupled ring is known as a Sub-Ring (see on page 44 “Sub-Ring”).
- You have the option of coupling to MRP-Rings other ring structures that work with RSTP (see on page 112 “Combining RSTP and MRP”).

1.2 Overview of Redundancy Protocols

Redundancy procedure	Network topology	Switch-over time
RSTP	Random structure	typically < 1 s (STP < 30 s), up to < 30 s - depends heavily on the number of devices
	Note: Up to 79 devices possible, depending on topology and configuration. If the default values (factory settings) are used, up to 39 devices are possible, depending on the topology (see on page 83 “Spanning Tree”).	
HIPER-Ring	Ring	typically 80 ms, up to < 500 ms or < 300 ms (selectable) - the number of switches has a minimal effect on the switch-over time
MRP-Ring	Ring	typically 80 ms, up to < 500 ms or < 200 ms (selectable) - the number of switches has a minimal effect on the switch over time
	Note: In combination with RSTP in MRP compatibility mode, up to 39 devices are possible, depending on the configuration. If the default values (factory settings) for RSTP are being used, up to 19 devices are possible (see on page 83 “Spanning Tree”).	
Sub-Ring (RSR20, RSR30, PowerMICE, MACH 1000 and MACH 4000)	Ring segment coupled to a primary ring	typically 80 ms, up to < 500 ms or < 200 ms (selectable) - the number of switches has a minimal effect on the switch over time
Link Aggregation	Coupling of network segments via parallel active lines with dynamic load distribution and line redundancy	
VRRP/HiVRRP	Any structure; provides terminal devices with redundancy for default gateway	< 400 ms with HiVRRP

Table 2: Comparison of the redundancy procedures

Note: When you are using a redundancy function, you deactivate the flow control on the participating device ports. If the flow control and the redundancy function are active at the same time, there is a risk that the redundancy function will not operate as intended.

2 Link Aggregation

The LACP (Link Aggregation Control Protocol based on IEEE 802.3ad) is a network protocol for dynamically bundling physical network connections. The added bandwidth of all connection lines is available for data transmission. In the case of a connection breaking down, the remaining connections take over the entire data transmission (redundancy). The load distribution between the connection lines is performed automatically.
You configure a link aggregation by combining at least 2 existing parallel redundant connection lines (known as a trunk) between two devices into one logical connection. You can use link aggregation to combine up to 8 (optimally up to 4) connection lines between devices into a trunk.
Any combination of twisted pair and F/O cables can be used as the connection lines of a trunk. Configure the connections so that the data rates and the duplex settings of the related ports are matching.
The maximum that can exit a device are

– 2 trunks for rail devices with 4 ports,
– 4 trunks for rail and MICE devices with 8-10 ports,
– 7 trunks for all other devices.

2.1 Example of link aggregation

In a network consisting of seven devices in a line topology, there are two segments with a particularly large amount of data traffic. You therefore decide to set up link aggregations in these segments. As well as dividing the load over several lines, you also get increased reliability in these segments through the redundant lines.
The link aggregation LATP (Link Aggregation Twisted Pair) consists of 3 twisted pair lines, and the link aggregation LAFO (Link Aggregation Fiber Optic) consists of 2 glass fiber lines.

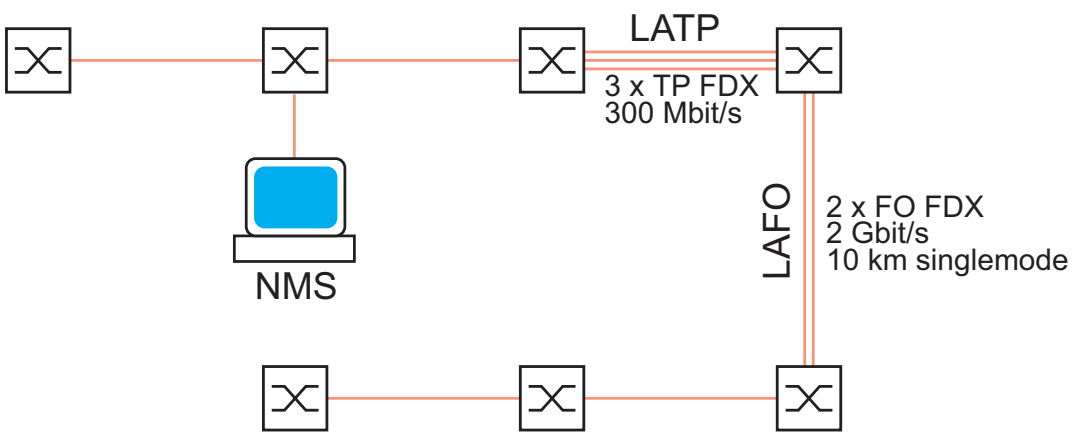


Figure 1: Example of link aggregation
NMS = Network Management Station
LATP = Link Aggregation Twisted Pair
LAFO = Link Aggregation Fiber Optic

The following example describes the configuration of the LATP link aggregation. For this link aggregation, you provide three free twisted pair ports at each of the two participating devices. (Connection: Module1 Port1 to Port3).

2.1.1 Creating and configuring the link aggregation

Note: A link aggregation connects exactly 2 devices.
You configure the link aggregation on each of the 2 devices involved. During the configuration phase, you connect only one single connection line between the devices. This is to avoid loops.

- ☐ Under `Basic Settings:Port Configuration`, you configure all three connections so that the transmission rate and the duplex settings of the participating ports on both devices are matching.
- ☐ Among the devices involved in a link aggregation, you define that device that has the most devices between itself and the device to which the configuration PC/(NMS network management station) is connected. You begin the configuration at this device, otherwise the Link Aggregation Control Protocol (LACP) can block ports and disconnect devices from the network, so that they cannot be configured any more.
- ☐ In the example below (see figure 2), you configure the link aggregation first on device 3, then on device 2. If you accidentally disconnect device 3 from the network, you can access it again by selecting “Allow static link aggregation” in the `Redundancy: Link Aggregation` dialog, or by activating this option via the CLI.

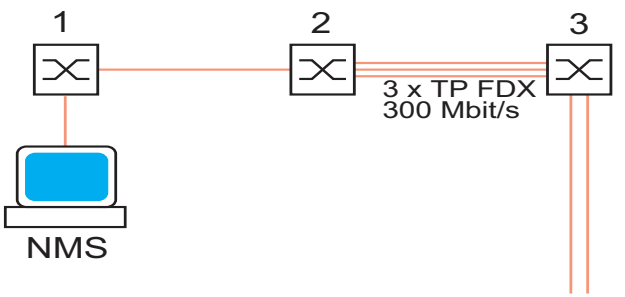


Figure 2: Example: “Defining the first device”
NMS = Network Management Station

☐ Proceed as follows to configure a link aggregation from 3 twisted pair lines on device 3:

☐ Select the `Redundancy:Link Aggregation` (see figure 3) dialog.

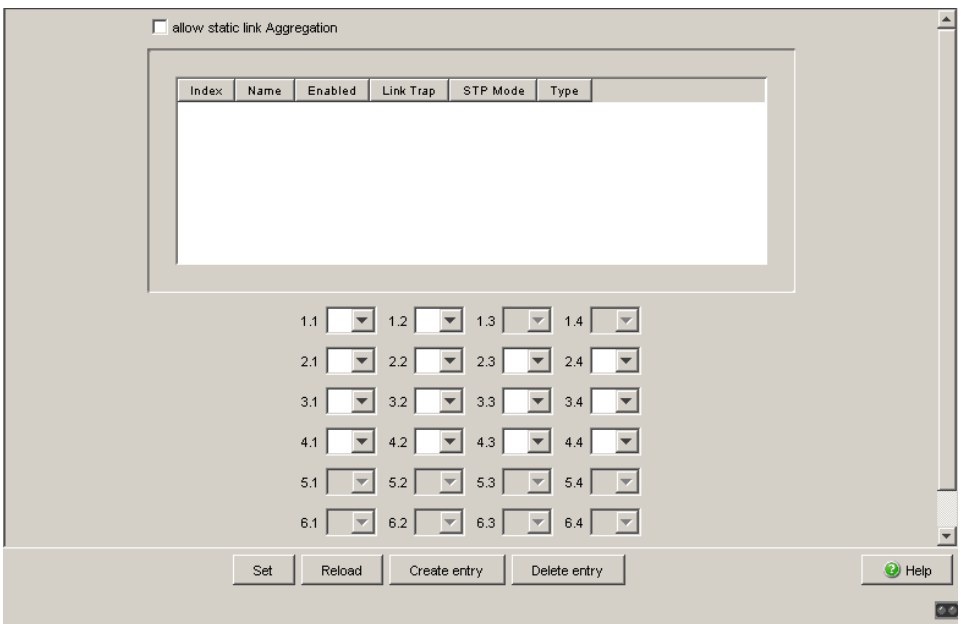


Figure 3: Creating the link aggregation

☐ Select `Allow static link aggregation` if the partner device does not support the Link Aggregation Control Protocol (LACP) (e.g. MACH 3000).

☐ Click “Create entry” to create a new link aggregation.

☐ The `Index` column shows you the ID under which the device uses a link aggregation (a trunk) as a virtual port. The device creates the port in module 8, which does not physically exist, and the first link aggregation then has the ID 8.1.

☐ The `Name` column allows you to give this connection any name you want. In this example, you give the new link aggregation the name “LAPT”.

☐ The `Enabled` column allows you to enable/disable a link aggregation that has been set up. Leave the checkmark in the “Enabled” column while you are using the link aggregation.

- ☐ Leave the checkmark in the `Link Trap` column if you want the device to generate an alarm if all the connections of the link aggregation are interrupted.
- ☐ In the “STP Mode” column, you select
  `on` if the link aggregation connection is connected to a Spanning Tree,
  `off` if no Spanning Tree is active, or if the link aggregation is a segment of a HIPER-Ring.
- ☐ “Type” shows whether you created this link aggregation manually (`Allow static link aggregation` is selected), or whether it was created dynamically using LACP (`Allow static link aggregation` is not selected).
  Note: If there are multiple connections between devices that support LACP, and if `Allow static link aggregation` is nevertheless selected, `dynamic` is still displayed, because in this case the devices automatically switch to dynamic.

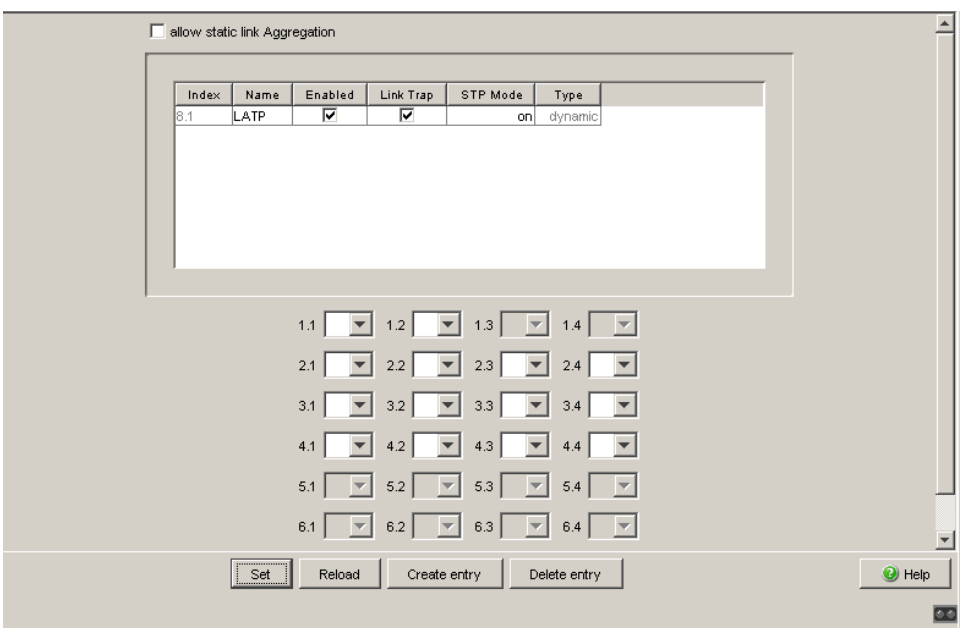


Figure 4: Link aggregation created and named.

- ☐ Now assign to the ports participating in the link aggregation (ports 1.1, 1.2 and 1.3) the index of the link aggregation connection LAPT (8.1). (see figure 5).

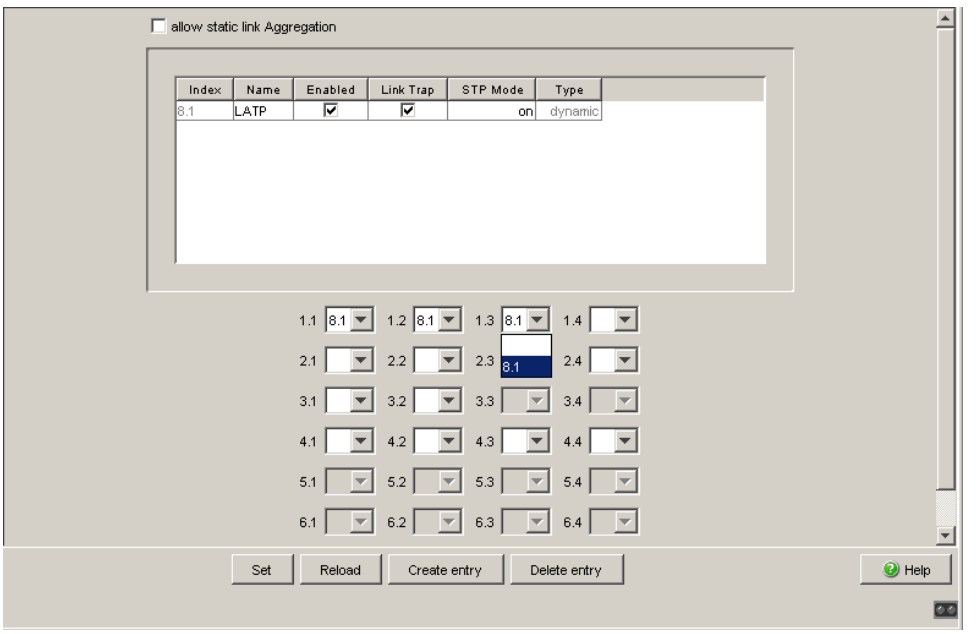


Figure 5: Assigning ports to link aggregation

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`link-aggregation LATP`	Create a new link aggregation with the name LATP.

```
New link aggregation created. Slot/port is 8.1.
```

`Interface 1/1`	Configuration for port 1.1
`addport 8/1`	Assign port 1.1 to link aggregation 8.1.
`Interface 1/2`	Configuration for port 1.2
`addport 8/1`	Assign port 1.2 to link aggregation 8.1.
`Interface 1/3`	Configuration for port 1.3
`addport 8/1`	Assign port 1.3 to link aggregation 8.1.
`exit`	Change to the privileged EXEC mode.
`show link-aggregation brief`	Show the parameters of all the link aggregations created on the device.

```
Max. num. of LAGs: 7
Slot no. for LAGs: 8
Static Capability: Disabled
Logical    Link-Aggr.
Interface  Name       Link State   Mbr Ports Active Ports
---------- ---------- ------------ --------- ------------------
8/1        LATP       Down         1/1,1/2,  1/3
```

☐ Now you configure the partner device (device 2) in the same way.
☐ After the configuration, you connect the other connection line(s) between the devices.

Note: Exclude the combination of a link aggregation with the following redundancy procedures:

- Network/Ring coupling
- MRP-Ring
- Sub-Ring

2.2 HIPER-Ring and Link Aggregation

To increase the availability on particularly important connections, you can combine the HIPER-Ring (see on page 29 “Ring Redundancy”) and link aggregation redundancy functions.

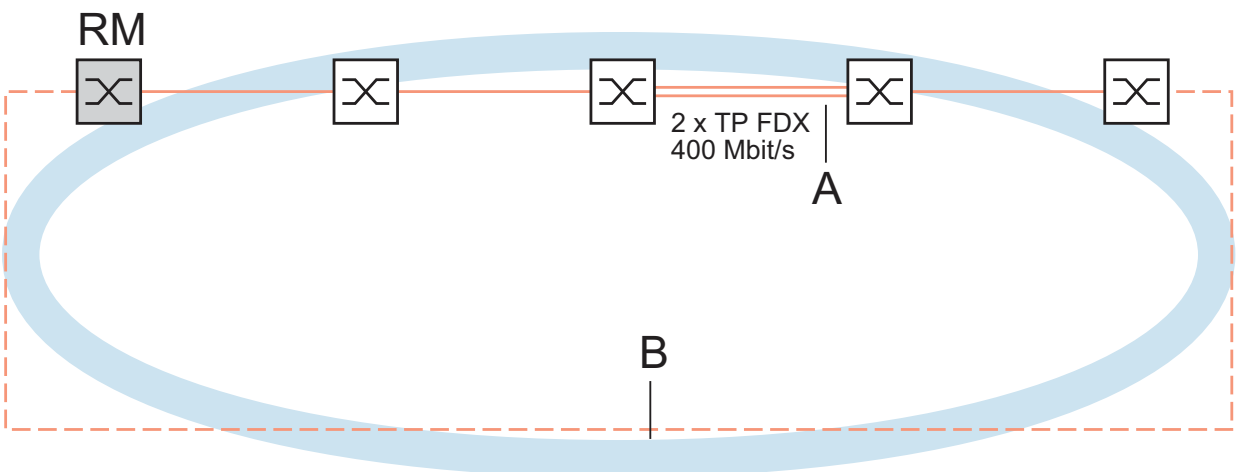


Figure 6: Example of a HIPER-Ring / link aggregation combination
RM = Ring Manager
A = link aggregation
B = HIPER-Ring

The above example shows a HIPER-Ring. One link aggregation forms a segment of the ring. When all the connection lines of the link aggregation are interrupted, the HIPER-Ring function activates the redundant line of the ring.

Note: If you want to use a link aggregation in a HIPER-Ring, you first configure the link aggregation, then the HIPER-Ring. In the HIPER-Ring dialog, you enter the index of the desired link aggregation as the value for the module and the port (8.x). Ascertain that the respective ring port belongs to the selected link aggregation.

Note: Deactivate RSTP when link aggregations are segments of a HIPER-Ring.

3 Ring Redundancy

The concept of ring redundancy allows the construction of high-availability, ring-shaped network structures.
With the help of the RM (**R**ing **M**anager) function, the two ends of a backbone in a line structure can be closed to a redundant ring. The ring manager keeps the redundant line open as long as the line structure is intact. If a segment becomes inoperable, the ring manager immediately closes the redundant line, and line structure is intact again.

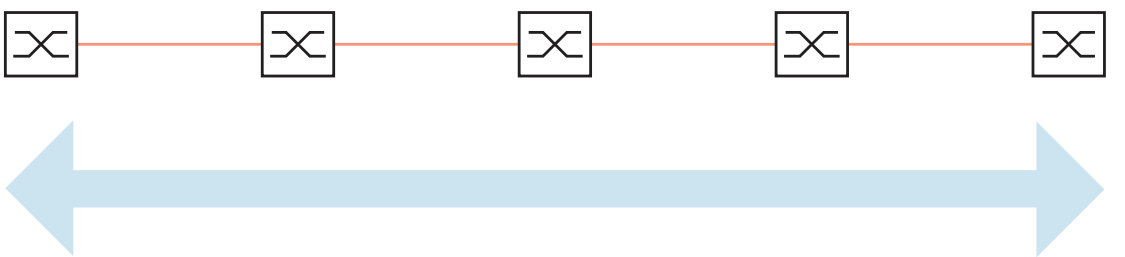


Figure 7: Line structure

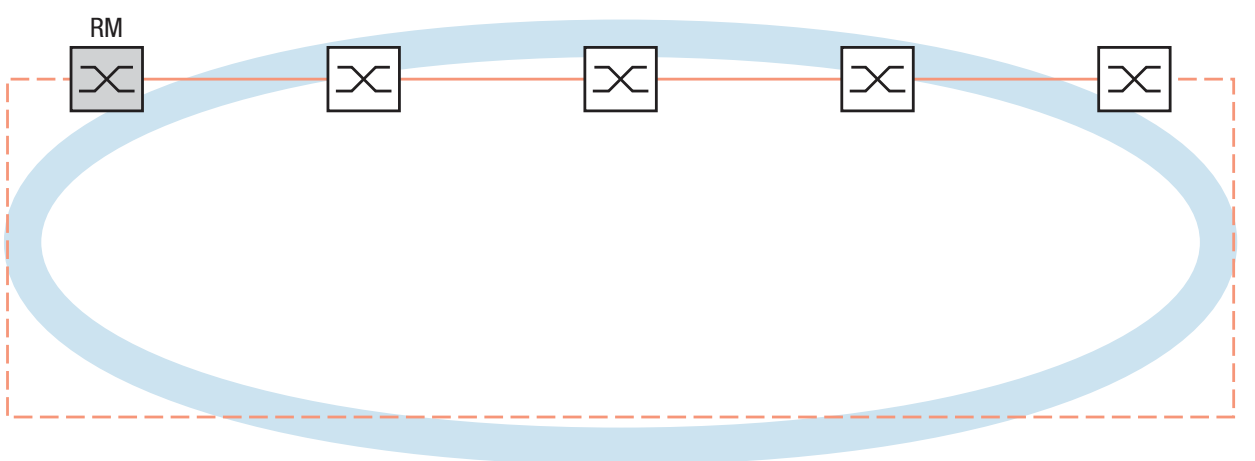


Figure 8: Redundant ring structure
RM = Ring Manager
—— main line
- - - redundant line

If a section is down, the ring structure of a

- HIPER-(**HI**GH **PE**RFORMANCE **R**EDUNDANCY) Ring with up to 50 devices typically transforms back to a line structure within 80 ms (possible settings: standard/accelerated).
- MRP (**M**edia **R**edundancy **P**rotocol) Ring (IEC 62439) of up to 50 devices typically transforms back to a line structure within 80 ms (adjustable to max. 200 ms/500 ms).

Devices with HIPER-Ring function capability:

- Within a HIPER-Ring, you can use any combination of the following devices:
  - RS1
  - RS2-./.
  - RS2-16M
  - RS2-4R
  - RS20, RS30, RS40
  - RSR20, RSR30
  - OCTOPUS
  - MICE
  - MS20, MS30
  - PowerMICE
  - MACH 100
  - MACH 1000
  - MACH 1040
  - MACH 3000
  - MACH 4000
- Within an MRP-Ring, you can use devices that support the MRP protocol based on IEC62439.

Note: Only one Ring Redundancy method can be enabled on one device at any one time. When changing to another Ring Redundancy method, deactivate the function for the time being.

Note: The following usage of the term “ring manager” instead of “redundancy manager” makes the function easier to understand.

3.1 Example of a HIPER-Ring

A network contains a backbone in a line structure with 3 devices. To increase the redundancy reliability of the backbone, you have decided to convert the line structure to a HIPER-Ring. You use ports 1.1 and 1.2 of the devices to connect the lines[1].

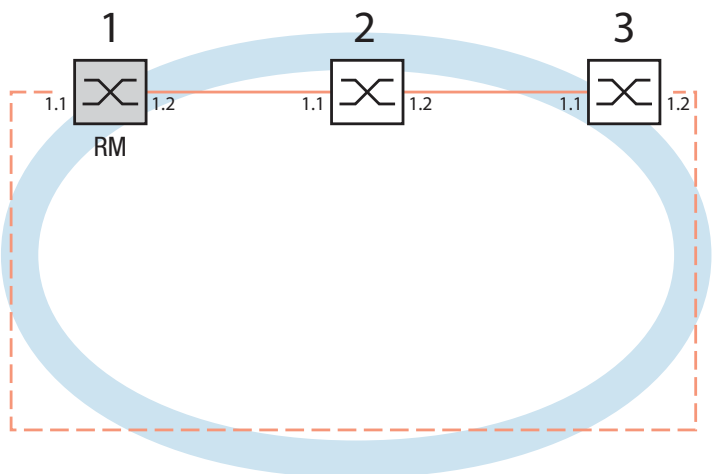


Figure 9: Example of HIPER-Ring
RM = Ring Manager
—— main line
- - - redundant line

The following example configuration describes the configuration of the ring manager device (1). The two other devices (2 to 3) are configured in the same way, but without activating the ring manager function. Select the “Standard” value for the ring recovery, or leave the field empty.

1. On modular devices the 1st number of the port designation specifies the module. The 2nd number specifies the port on the module. The specification pattern 1.x is also used on non-modular devices for consistency.

Note: As an alternative to using software to configure the HIPER-Ring, with the RS20/30/40, MS20/30 and PowerMICE Switches, you can also use DIP switches to enter a number of settings on the devices. You can also use a DIP switch to enter a setting for whether the configuration via DIP switch or the configuration via software has priority. The state on delivery is “Software Configuration”. You will find details on the DIP switches in the “Installation” user manual.

Note: Configure all the devices of the HIPER-Ring individually. Before you connect the redundant line, you must complete the configuration of all the devices of the HIPER-Ring. You thus avoid loops during the configuration phase.

3.1.1 Setting up and configuring the HIPER-Ring

☐ Set up the network to meet your demands.
☐ Configure all ports so that the transmission speed and the duplex settings of the lines correspond to the following table:

Port type	Bit rate	Autonegotiation (automatic configuration)	Port setting	Duplex
TX	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
TX	1 Gbit/s	on	on	-
Optical	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
Optical	1 Gbit/s	on	on	-
Optical	10 Gbit/s	-	on	10 Gbit/s full duplex (FDX)

Table 3: Port settings for ring ports

Note: When activating the HIPER-Ring function via software or DIP switches, the device sets the corresponding settings for the pre-defined ring ports in the configuration table (transmission rate and mode). If you switch off the HIPER-Ring function, the ports, which are changed back into normal ports, keep the ring port settings. Independently of the DIP switch setting, you can still change the port settings via the software.

☐ Select the `Redundancy:Ring Redundancy` dialog.
☐ Under “Version”, select `HIPER-Ring`.
☐ Define the desired ring ports 1 and 2 by making the corresponding entries in the module and port fields. If it is not possible to enter a module, then there is only one module in the device that is taken over as a default.

Display in “Operation” field:
– `active`: This port is switched on and has a link.
– `inactive`: This port is switched off or it has no link.

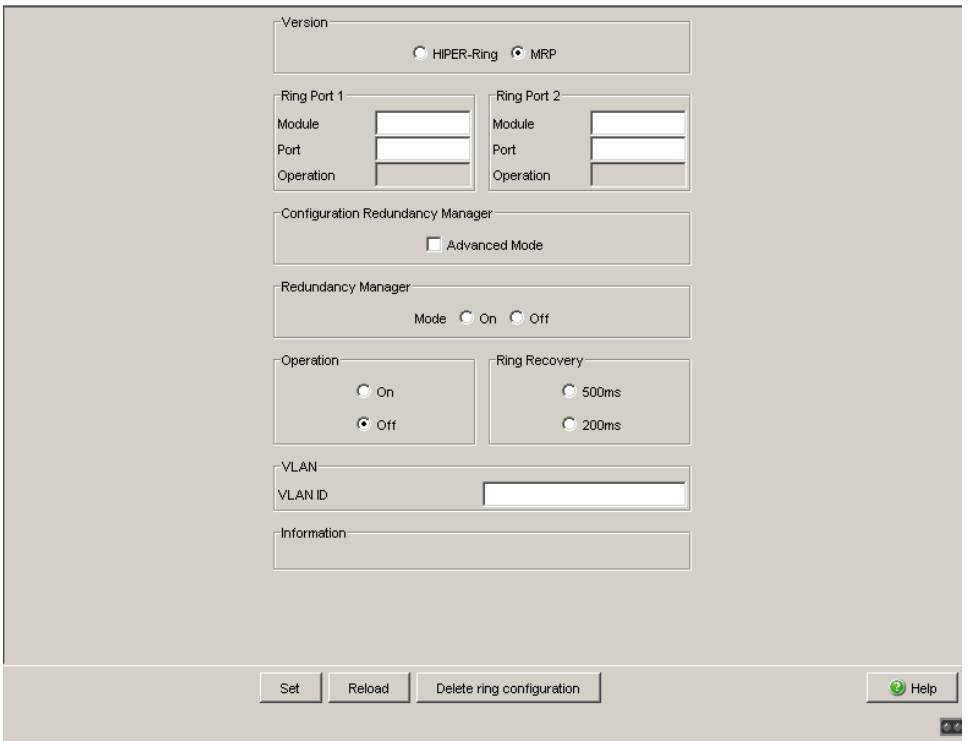


Figure 10: Ring Redundancy dialog

☐ Activate the ring manager for this device. Do not activate the ring manager for any other device in the HIPER-Ring.

☐ In the “Ring Recovery” frame, select the value “Standard” (default).

Note: Settings in the “Ring Recovery” frame are only effective for devices that you have configured as ring managers.

☐ Click "Set" to save the changes temporarily.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`hiper-ring mode ring-manager`	Select the HIPER-Ring ring redundancy and define the device as ring manager.
`Switch's HIPER Ring mode set to ring-manager`	
`hiper-ring port primary 1/1`	Define port 1 in module 1 as ring port 1.
`HIPER Ring primary port set to 1/1`	
`hiper-ring port secondary 1/2`	Define port 2 in module 1 as ring port 2.
`HIPER Ring secondary port set to 1/2`	
`exit`	Change to the privileged EXEC mode.

```
show hiper-ring                    Display the HIPER-Ring parameters.
HIPER Ring Mode of the Switch..................... ring-manager
  configuration determined by..................... management
HIPER Ring Primary Port of the Switch.......... 1/1, state active
HIPER Ring Secondary Port of the Switch........ 1/2, state active
HIPER Ring Redundancy Manager State............ active
HIPER Ring Redundancy State (red. exists).. no (rm is active)
HIPER Ring Setup Info (Config. failure)........ no error
HIPER Ring Recovery Delay...................... 500ms
```

☐ Now proceed in the same way for the other two devices.

Note: If you have configured VLANS, note the VLAN configuration of the ring ports.
In the configuration of the HIPER-Ring, you select for the ring ports
– VLAN ID 1 and "`Ingress Filtering`" disabled in the port table and
– VLAN membership `U` or `T` in the static VLAN table.

Note: Deactivate the Spanning Tree protocol for the ports connected to the HIPER-Ring, because Spanning Tree and Ring Redundancy affect each other.
If you used the DIP switch to activate the function of HIPER-Ring, RSTP is automatically switched off.

☐ Now you connect the line to the ring. To do this, you connect the 2 devices to the ends of the line using their ring ports.

The displays in the "Redundancy Manager Status" frame mean:
– "Active (redundant line)": The ring is open, which means that a data line or a network component within the ring is down.
– "Inactive": The ring is closed, which means that the data lines and network components are working.

The displays in the “Information” frame mean
– “Redundancy existing”: One of the lines affected by the function may be interrupted, with the redundant line then taking over the function of the interrupted line.
– "Configuration failure”: The function is incorrectly configured or the cable connections at the ring ports are improperly configured (e.g., not plugged into the ring ports).

Note: If you want to use link aggregation connections in the HIPER-Ring (PowerMICE and MACH 4000), you enter the index of the desired link aggregation entry for the module and the port.

3.2 Example of a MRP-Ring

A network contains a backbone in a line structure with 3 devices. To increase the availability of the backbone, you decide to convert the line structure to a redundant ring. In contrast to the previous example, devices from different manufacturers are used which do not all support the HIPER-Ring protocol. However, all devices support MRP as the ring redundancy protocol, so you decide to deploy MRP. You use ports 1.1 and 2.2 of the devices to connect the lines.

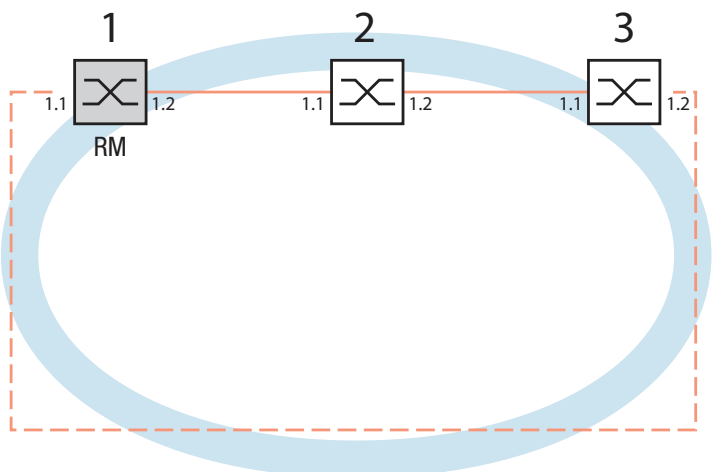


Figure 11: Example of MRP-Ring
RM = Ring Manager
—— main line
- - - redundant line

The following example configuration describes the configuration of the ring manager device (1). You configure the 2 other devices (2 to 3) in the same way, but without activating the ring manager function. This example does not use a VLAN. You have entered 200 ms as the ring recovery time, and all the devices support the advanced mode of the ring manager.

Note: For devices with DIP switches, put all DIP switches to “On”. The effect of this is that you can use the software configuration to configure the redundancy function without any restrictions. You thus avoid the possibility of the software configuration being hindered by the DIP switches.

Note: Configure all the devices of the MRP-Ring individually. Before you connect the redundant line, you must have completed the configuration of all the devices of the MRP-Ring. You thus avoid loops during the configuration phase.

☐ Set up the network to meet your demands.
☐ Configure all ports so that the transmission speed and the duplex settings of the lines correspond to the following table:

Port type	Bit rate	Autonegotiation (automatic configuration)	Port setting	Duplex
TX	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
TX	1 Gbit/s	on	on	-
Optical	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
Optical	1 Gbit/s	on	on	-
Optical	10 Gbit/s	-	on	10 Gbit/s full duplex (FDX)

Table 4: Port settings for ring ports

☐ Select the `Redundancy:Ring Redundancy` dialog.
☐ Under “Version”, select `MRP`.
☐ Define the desired ring ports 1 and 2 by making the corresponding entries in the module and port fields. If it is not possible to enter a module, then there is only one module in the device that is taken over as a default.

Display in “Operation” field:

- `forwarding`: this port is switched on and has a link.
- `blocked`: this port is blocked and has a link
- `disabled`: this port is disabled
- `not-connected`: this port has no link

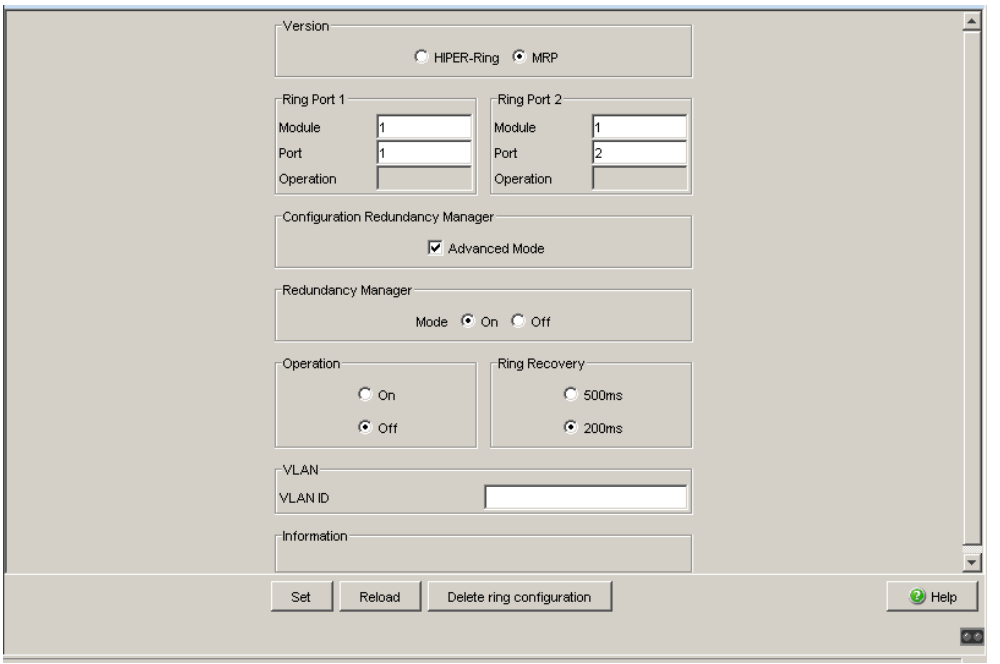


Figure 12: Ring Redundancy dialog

☐ In the “Ring Recovery” frame, select 200 ms.

Note: If selecting 200 ms for the ring recovery does not provide the ring stability necessary to meet the requirements of your network, you select 500 ms.

Note: Settings in the “Ring Recovery” frame are only effective for devices that you have configured as ring managers.

☐ Under “Configuration Redundancy Manager”, activate the advanced mode.

☐ Activate the ring manager for this device. Do not activate the ring manager for any other device in the MRP-Ring.

☐ Leave the VLAN ID as 0 in the VLAN field.

☐ Switch the operation of the MRP-Ring on.

☐ Click "Set" to save the changes temporarily.

The displays in the “Information” frame mean
– “Redundancy existing”: One of the lines affected by the function may be interrupted, with the redundant line then taking over the function of the interrupted line.
– "Configuration failure”: The function is incorrectly configured or the cable connections at the ring ports are improperly configured (e.g., not plugged into the ring ports).

The “VLAN” frame enables you to assign the MRP-Ring to a VLAN:

☐ If VLANs are configured, you make the following selections in the "VLAN" frame:
  – VLAN ID 0, if the MRP-Ring configuration is not to be assigned to a VLAN, as in this example.
    Select VLAN ID 1 and VLAN membership `U` (Untagged) in the static VLAN table for the ring ports.
  – A VLAN ID > 0, if the MRP-Ring configuration is to be assigned to this VLAN.
    For all devices in this MRP-Ring, enter this VLAN ID in the MRP-Ring configuration, and then choose this VLAN ID and the VLAN membership Tagged (`T`) in the static VLAN table for all ring ports in this MRP-Ring.

Note: If you want to use the RSTP (see on page 83 “Spanning Tree”) redundancy protocol in an MRP-Ring, switch on the MRP compatibility on all devices in the MRP-Ring in the `Rapid Spanning Tree:Global` dialog as the RSTP (Spanning-Tree) and ring redundancy affect each other.
If this is not possible, perhaps because individual devices do not support the MRP compatibility, you deactivate RSTP at the ports connected to the MRP-Ring.

Note: When you are configuring an MRP-Ring using the Command Line Interface, you define an additional parameter. When configured using CLI, an MRP-Ring is addressed via its MRP domain ID. The MRP domain ID is a sequence of 16 number blocks (8-bit values). Use the default domain of 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 for the MRP domain ID.
This default domain is also used internally for a configuration via the Web-based interface.
Configure all the devices within an MRP-Ring with the same MRP domain ID.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`mrp new-domain default-domain`	Creates a new MRP-Ring with the default domain ID 255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.

```
MRP domain created:
Domain ID:
255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255
  (Default MRP domain)
```

`mrp current-domain port primary 1/1`	Define port 1 in module 1 as ring port 1 (primary).

```
Primary Port set to 1/1
```

`mrp current-domain port secondary 1/2`	Define port 2 in module 1 as ring port 2 (secondary)

```
Secondary Port set to 1/2
```

`mrp current-domain mode manager`	Define this device as the ring manager.

```
Mode of Switch set to manager
```

`mrp current-domain recovery-delay 200ms`	Define 200ms as the value for the “Ring Recovery”.

```
Recovery delay set to 200ms
```

`mrp current-domain advanced-mode enable`	Activate the “MRP Advanced Mode”.

```
Advanced Mode (react on link change) set to Enabled
```

`mrp current-domain operation enable`	Activate the MRP-Ring.

```
Operation set to Enabled
```

`exit`	Go back one level.
`show mrp`	Show the current parameters of the MRP-Ring (abbreviated display).

```
Domain ID:
255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255
(Default MRP domain)

Configuration Settings:
Advanced Mode (react on link change).... Enabled
Manager Priority....................... 32768
Mode of Switch (administrative setting). Manager
Mode of Switch (real operating state)... Manager
Domain Name............................ <empty>
Recovery delay......................... 200ms
Port Number, Primary................... 1/1, State: Not Connected
Port Number, Secondary................. 1/2, State: Not Connected
VLAN ID................................ 0 (No VLAN)
Operation.............................. Enabled
```

☐ Now you connect the line to the ring. To do this, you connect the 2 devices to the ends of the line using their ring ports.

4 Multiple Rings

The device allows you to set up multiple rings with different redundancy protocols:

- You have the option of nesting MRP-Rings. A coupled ring is known as a Sub-Ring (see on page 44 “Sub-Ring”).
- You have the option of coupling to MRP-Rings other ring structures that work with RSTP (see on page 112 “Combining RSTP and MRP”).

4.1 Sub-Ring

4.1.1 Sub-Ring description

For the devices PowerMICE und MACH 4000.
The Sub-Ring concept enables you to easily couple new network segments to suitable devices in existing redundancy rings (primary rings). The devices of the primary ring to which the new Sub-Ring is being coupled are referred to as Sub-Ring Managers (SRMs).

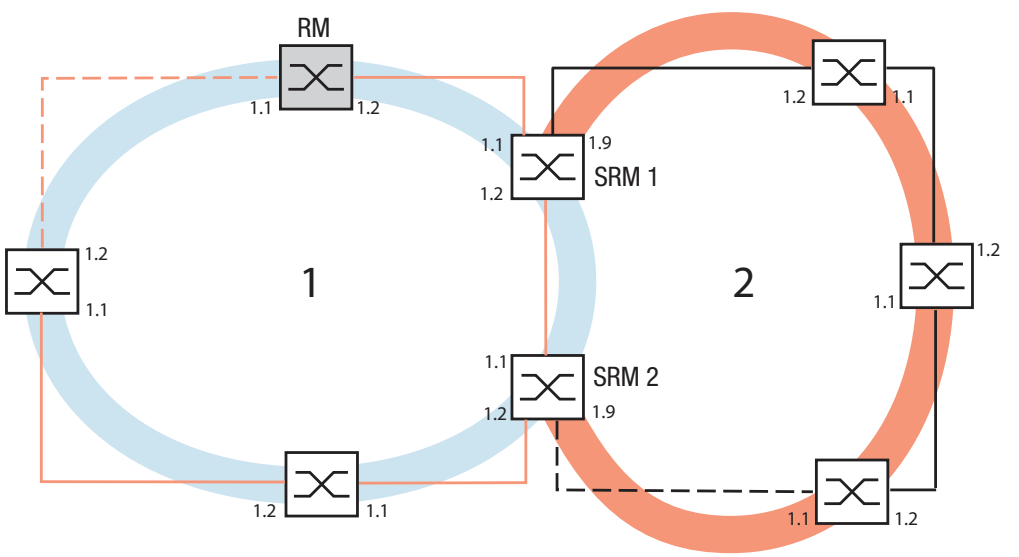


Figure 13: Example of a Sub-Ring structure
1 blue ring = basis ring
2 orange ring = Sub-Ring
SRM = Sub-Ring Manager
RM = Ring Manager

Note: The following devices support the Sub-Ring Manager function:
– MACH 4000
– PowerMICE

The SRM-capable devices support up to 4 SRM instances and can thus be the Sub-Ring manager for up to 4 Sub-Rings at the same time.

In a Sub-Ring, you can integrate as participants the devices that support MRP - the Sub-Ring Manager function is not required.

Each Sub Ring may consist of up to 200 participants. The SRMs themselves and the switches placed in the Base Ring between the SRMs do not count. here.
Setting up Sub-Rings has the following advantages:
- Through the coupling process, you include the new network segment in the redundancy concept.
- You can easily integrate new company areas into existing networks.
- You easily map the organizational structure of a company in the network topology.
- As an MRP-Ring, the switching times of the Sub-Ring in redundancy cases are typically < 100 ms.

The following graphics show examples of possible Sub-Ring topologies:

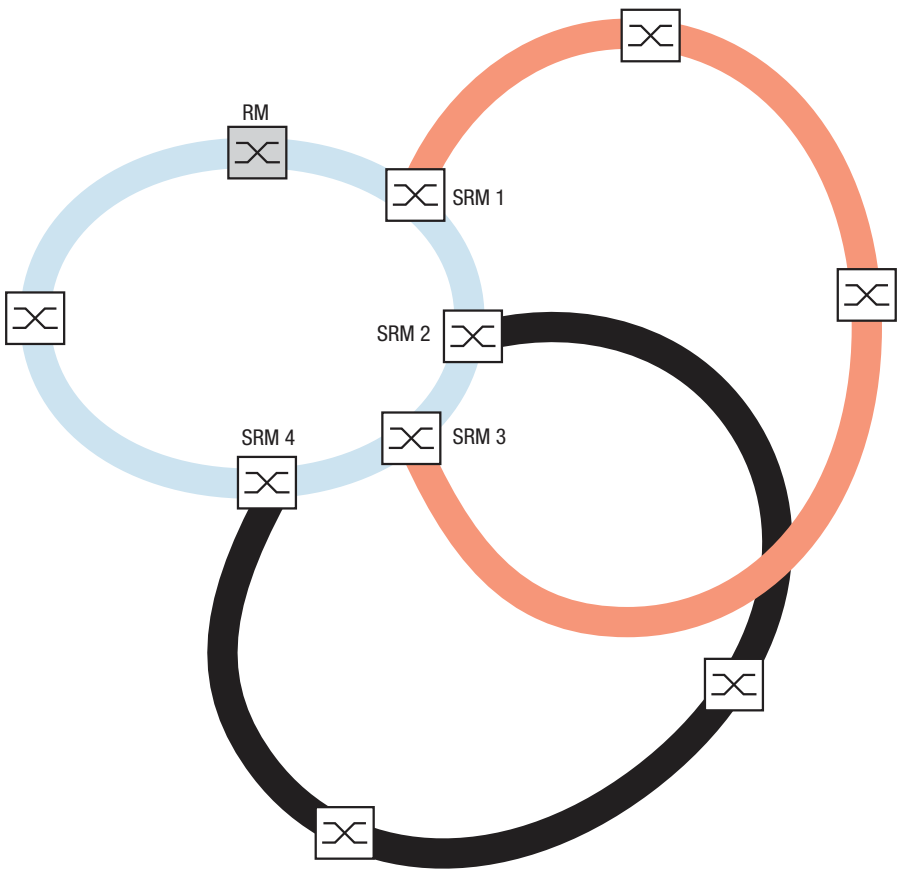


Figure 14: Example of an overlapping Sub-Ring structure

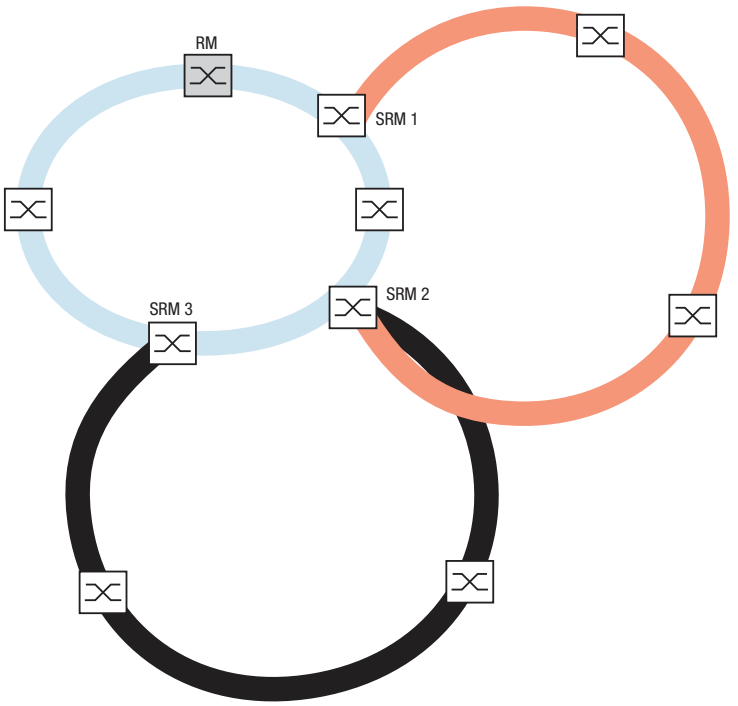


Figure 15: Special case: a Sub-Ring Manager manages 2 Sub-Rings (2 instances). Depending on the device type, you can configure additional instances.

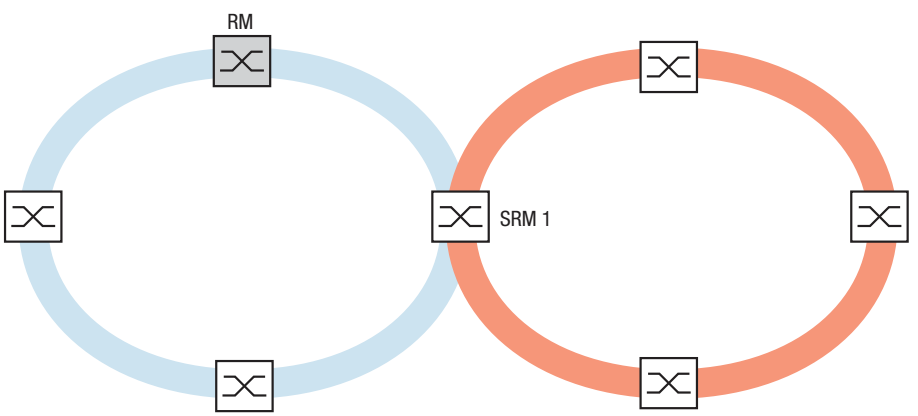


Figure 16: Special case: a Sub-Ring Manager manages both ends of a Sub-Ring at different ports (Single Sub-Ring Manger).

Note: Connect Sub-Rings only to existing primary rings. Do not cascade Sub-Rings (i.e., a new Sub-Ring must not be connected to an existing Sub-Ring).

Note: Sub-Rings use MRP. You can couple Sub-Rings to existing primary rings with the HIPER-Ring protocol, the Fast HIPER-Ring protocol and MRP. If you couple a Sub-Ring to a primary ring under MRP, configure both rings in different VLANs. You configure

- either the Sub-Ring Managers' Sub-Ring ports and the devices of the Sub-Ring in a separate VLAN. Here multiple Sub-Rings can use the same VLAN.
- or the devices of the primary ring including the Sub-Ring Managers' primary ring ports in a separate VLAN. This reduces the configuration effort when coupling multiple Sub-Rings to a primary ring.

4.1.2 Sub-Ring example

You want to couple a new network segment with 3 devices to an existing redundant ring with the HIPER-Ring protocol. If you couple the network at both ends instead of only one end, this provides increased availability with the corresponding configuration.

The new network segment is connected as a Sub-Ring. The connection is made to existing devices of the basis ring with the following types:

– MACH 4000
– PowerMICE

Configure these devices as Sub-Ring Managers.

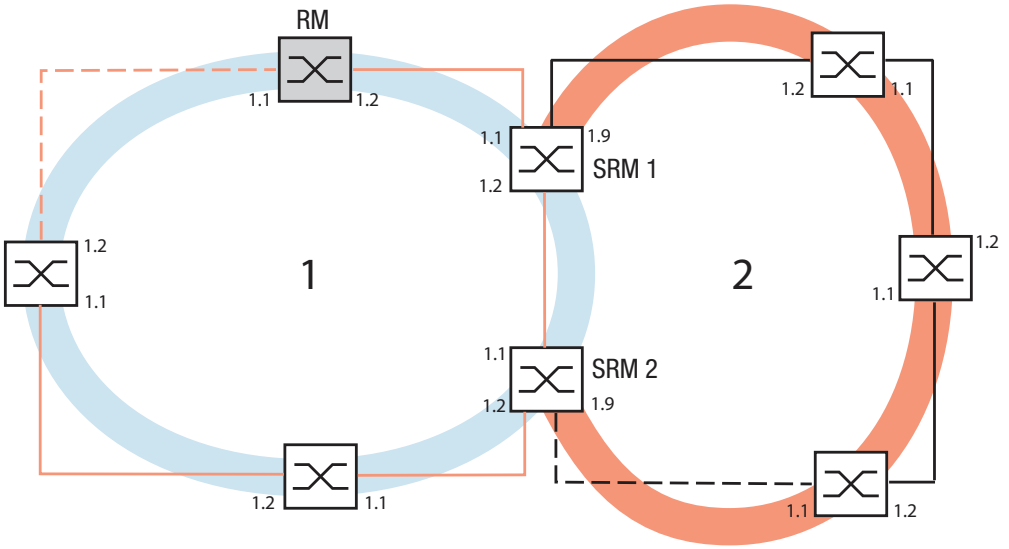


Figure 17: Example of a Sub-Ring structure
1 blue ring = basis ring
2 orange ring = Sub-Ring
SRM = Sub-Ring Manager
RM = Ring Manager

Proceed as follows to configure a Sub-Ring:

☐ Configure the three devices of the new network segment as participants in an MRP-Ring. This means:
  – Configure the transmission rate and the duplex mode for all the ring ports in accordance with the following table:

Port type	Bit rate	Autonegotiation (automatic configuration)	Port setting	Duplex
TX	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
TX	1 Gbit/s	on	on	-
Optical	100 Mbit/s	off	on	100 Mbit/s full duplex (FDX)
Optical	1 Gbit/s	on	on	-
Optical	10 Gbit/s	-	on	10 Gbit/s full duplex (FDX)

Table 5: Port settings for ring ports

☐ Other settings:
- Define a different VLAN membership for the Primary Ring and the Sub-Ring even if the basis ring is using the MRP protocol, e.g. VLAN ID 1 for the Primary Ring and VLAN ID 2 for the Sub-Ring.
- For all ring ports in the Sub-Ring, select this VLAN ID and the VLAN membership Tagged (T) in the static VLAN table.
- Switch the MRP-Ring function on for all devices.
- In the Ring Redundancy dialog, under MRP-Ring, configure for all devices the two ring ports used in the Sub-Ring.
- Switch the Ring Manager function off for all devices.
- Do not configure link aggregation.
- Switch RSTP off for the MRP Ring ports used in the Sub-Ring.

Note: The MRP domain ID is a sequence of 16 numbers (range 0 to 255). The default domain (in the CLI: “default-domain“) is the MRP domain ID of 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255. A MRP domain ID consisting entirely of zeroes is invalid.

If you need to adjust the MRP domain ID, open the Command Line Interface (CLI) and proceed as follows:

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`mrp delete-domain current-domain`	Deletes the current MRP domain. If no MRP domain exists, the device outputs an error message.

```
MRP current domain deleted:
Domain ID:
  255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255
  (Default MRP domain)
```

`mrp new-domain 0.0.1.1.2.2.3.4.4.111.222.123.0.0.66.99`	Creates a new MRP domain with the specified MRP domain ID. You can subsequently access this domain with “current-domain”.

```
MRP domain created:
Domain ID: 0.0.1.1.2.2.3.4.5.111.222.123.0.0.66.99
```

4.1.3 Sub-Ring example configuration

Proceed as follows to configure the 2 Sub-Ring Managers in the example:

☐ Select the `Redundancy:Sub-Ring` dialog.
☐ Click the button "New“.

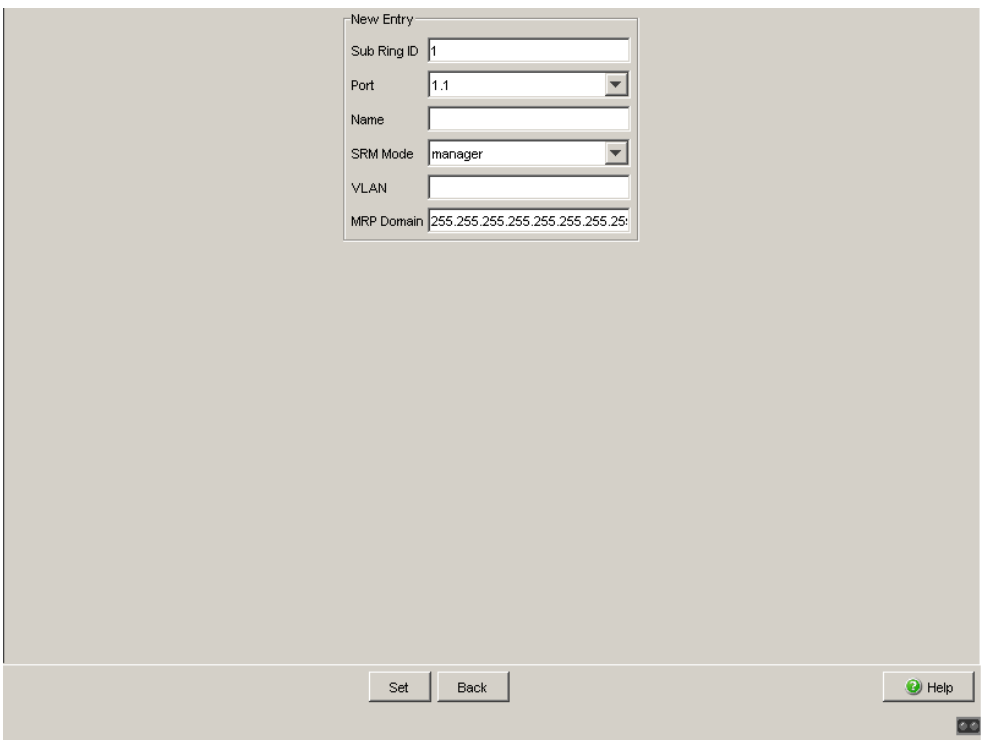


Figure 18: Sub-Ring – New Entry dialog

☐ Enter the value “1” as the ring ID of this Sub-Ring.
☐ In the Module.Port field, enter the ID of the port (in the form X.X) that connects the device to the Sub-Ring (in the example, 1.9). For the connection port, you can use all the available ports that you have not already configured as ring ports of the basis ring.
☐ You have the option of entering a name for the Sub-Ring (in the example, “Test”).

- ☐ Select the Sub-Ring Manager mode (SRM mode). You thus specify which connection between the primary ring and the Sub-Ring becomes the redundant line.
  The options for the connection are:
  - Both Sub-Ring Managers have the same setting (default `manager`): - the device with the higher MAC address manages the redundant line.
  - In the SRM Mode field, a device is selected to be the `redundant manager`: - this device manages the redundancy line as long as you have configured the other Sub-Ring Manager as a `manager`, otherwise the higher MAC address applies.

  Configure Sub-Ring Manager 1 as the “manager” and Sub-Ring Manager 2 as the manager of the redundant line with “redundant manager”, in accordance with the overview drawing for this example.
- ☐ Leave the fields VLAN ID (default 0) and MRP Domain (default 255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255) as they are. The example configuration does not require any change here.
- ☐ Click "Set" to save the changes temporarily.
- ☐ Click “Back” to return to the Sub-Ring dialog.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`sub-ring new-ring 1`	Creates a new Sub-Ring with the Sub-Ring ID 1.
`Sub-Ring ID created:ID: 1`	
`sub-ring 1 port 1/9`	Defines port 9 in module 1 as the Sub-Ring port.
`Port set to 1/9`	
`sub-ring 1 ring-name Test`	Assigns the name “Test” to Sub-Ring 1
`Sub-Ring Ring name set to "Test"`	
`sub-ring 1 mode manager`	Configures the mode of this Sub-Ring Manager as “manager”.
`Mode of Switch set to manager`	

- ☐ Click “Reload” to update the Sub-Ring overview and check all the entries.

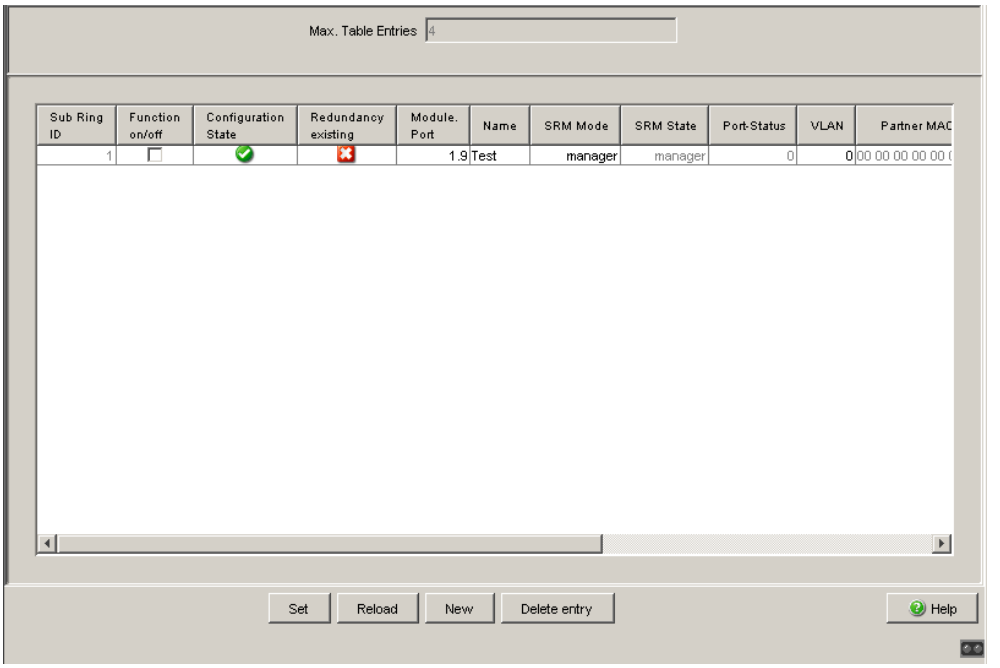


Figure 19: Completely configured Sub-Ring Manager

- ☐ Configure the 2nd Sub-Ring Manager in the same way. If you have explicitly assigned SRM 1 the SRM mode `manager`, you configure SRM 2 as `redundant manager`. Otherwise, the assignment is performed automatically via the higher MAC address (see above)
- ☐ Switch the two Sub-Ring Managers on under “Function on/off” in the overview of the Sub-Ring dialog.
- ☐ Click "Set" to save the changes temporarily.
- ☐ Select the dialog `Basic Settings:Load/Save`.
- ☐ In the “Save” frame, select “To Device” for the location and click “Save” to permanently save the configuration in the active configuration.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`sub-ring 1 operation enable`	Switches on the Sub-Ring with the Sub-Ring ID 1.
`Operation set to Enabled`	
`exit`	Change to the privileged EXEC mode.
`show sub-ring`	Displays the state for all Sub-Rings on this device.

```
Ring ID: 1
Mode of Switch (administrative setting)... manager
Mode of Switch (real operating state)..... manager
Port Number.............................. 1/9,  State: Forwarding
Protocol................................. Standard MRP
MRP Domain ID.............................
255.255.255.255.255.255.255.255.255.255.255.255.255.255.255.255Ri
ng Name.................................. Test
Partner MAC.............................. 02:E3:00:1B:00:09
VLAN ID.................................. 0 (No VLAN)
Operation................................ Enabled

General Operating States:
SRM Setup Info (Config. Failure)......... No Error

Manager-related Operating States:
Ring State............................... Open
Redundancy Guaranteed.................... No
copy system:running-config
  nvram:startup-config
```

Save the current configuration to the non-volatile memory.

☐ When you have configured both SRMs and, if applicable, the devices included in the Sub-Ring, close the Sub-Ring's redundant line.

5 Ring/Network Coupling

Based on a ring, Ring/Network Coupling allows the redundant coupling of redundant rings or network segments. Ring/Network Coupling connects 2 rings/network segments via 2 separate paths.

The ring/network coupling supports the coupling of a ring (HIPER-Ring, Fast HIPER-Ring or MRP) to a second ring (also HIPER-Ring, Fast HIPER-Ring or MRP) or to a network segment of any structure, when all the devices in the coupled network are Hirschmann devices.

Note: Depending on the model, the devices have a DIP switch, with which you can select between the software configuration and the DIP switch configuration. Starting with software version 8.x, the device allows you to deactivate the DIP switch settings or overwrite them with the software settings. This allows you to freely specify the port settings.

The ring/network coupling supports the following devices:

- RS2-./.
- RS2-16M
- RS20, RS30, RS40
- OCTOPUS
- MICE (from rel. 3.0)
- PowerMICE
- MS20, MS30
- RSR20, RSR30
- MACH 100
- MACH 1000
- MACH 1040
- MACH 3000 (from Rel. 3.3),
- MACH 4000

5.1 Variants of the ring/network coupling

The redundant coupling is effected by the **one-Switch coupling** of two ports of **one** device in the first ring/network segment to one port each of two devices in the second ring/network segment (see figure 21). One of the two connections – the redundant one – is blocked for normal data traffic in normal operation.
If the main line no longer functions, the device opens the redundant line immediately. If the main line functions again, the redundant line is again blocked for normal data traffic and the main line is used again.
The ring coupling detects and handles an error within 500 ms (typically 150 ms).

The redundant coupling is effected by the **two-switch coupling** of one port each from **two** devices in the first ring/network segment to one port each of two devices in the second ring/network segment (see figure 27).
The device in the redundant line and the device in the main line use control packets to inform each other about their operating states, via the Ethernet or the control line.
If the main line no longer functions, the redundant device (slave) opens the redundant line immediately. As soon as the main line is working again, the device in the main line informs the redundant device of this. The redundant line is again blocked for normal data traffic and the main line is used again.
The ring coupling detects and handles an error within 500 ms (typically 150 ms).

The type of coupling configuration is primarily determined by the topological conditions and the desired level of availability (see table 6).

	One-Switch coupling	Two-Switch coupling	Two-Switch coupling with control line
Application	The 2 devices are in impractical topological positions. Therefore, putting a line between them would involve a lot of effort for two-Switch coupling.	The 2 devices are in practical topological positions. Installing a control line would involve a lot of effort.	The 2 devices are in practical topological positions. Installing a control line would not involve much effort.
Disadvantage	If the Switch configured for the redundant coupling becomes inoperable, no connection remains between the networks.	More effort for connecting the 2 devices to the network (compared with one-Switch coupling).	More effort for connecting the two devices to the network (compared with one-Switch and two-Switch coupling).
Advantage	Less effort involved in connecting the 2 devices to the network (compared with two-Switch coupling).	If one of the devices configured for the redundant coupling becomes inoperable, the coupled networks are still connected.	If one of the devices configured for the redundant coupling becomes inoperable, the coupled networks are still connected. The partner determination between the coupling devices occurs more secure and faster than without the control line.

Table 6: Selection criteria for the configuration types for redundant coupling

Note: Choose a configuration based on topological conditions and the level of availability you require (see table 6).

5.2 Preparing a Ring/Network Coupling

5.2.1 STAND-BY switch

All devices have a STAND-BY switch, with which you can define the role of the device within a Ring/Network coupling.
Depending on the device type, this switch is a DIP switch on the devices, or else it is exclusively a software setting (`Redundancy:Ring/Network Coupling` dialog). By setting this switch, you define whether the device has the main coupling or the redundant coupling role within a Ring/Network coupling. You will find details on the DIP switches in the “Installation” user manual.

Device type	STAND-BY switch type
RS2-./.	DIP switch
RS2-16M	DIP switch
RS20/RS30/RS40	Selectable: DIP switch and software setting
MICE/Power MICE	Selectable: DIP switch and software setting
MS20/MS30	Selectable: DIP switch and software setting
OCTOPUS	Software switch
RSR20/RSR30	Software switch
MACH 100	Software switch
MACH 1000	Software switch
MACH 3000/MACH 4000	Software switch

Table 7: Overview of the STAND-BY switch types

Depending on the device and model, set the STAND-BY switch in accordance with the following table:

Device with	Choice of main coupling or redundant coupling
DIP switch	On “STAND-BY” DIP switch
DIP switch/software switch option	According to the option selected - on “STAND-BY” DIP switch or in the - `Redundancy:Ring/Network Coupling` dialog, by making selection in “Select configuration”. **Note:** These devices have a DIP switch, with which you can choose between the software configuration and the DIP switch configuration. You can find details on the DIP switches in the User Manual Installation.
Software switch	In the `Redundancy:Ring/Network Coupling` dialog

Table 8: Setting the STAND-BY switch

Note: In the following screenshots and diagrams, the following conventions are used:

- Blue indicates devices or connections of the items currently being described
- Black indicates devices or connections that connect to the items currently being described
- Thick lines indicate connections of the items currently being described
- This lines indicate connections which connect to the items currently being described
- Lines of dashes indicate a redundant connection
- Dotted lines indicate the control line.

- ☐ Select the `Redundancy:Ring/Network Coupling` dialog.
- ☐ You first select the configuration you want: One-Switch coupling (“1”), two-Switch coupling (“2”) or two-Switch coupling with control line (“3”), (see figure 20).

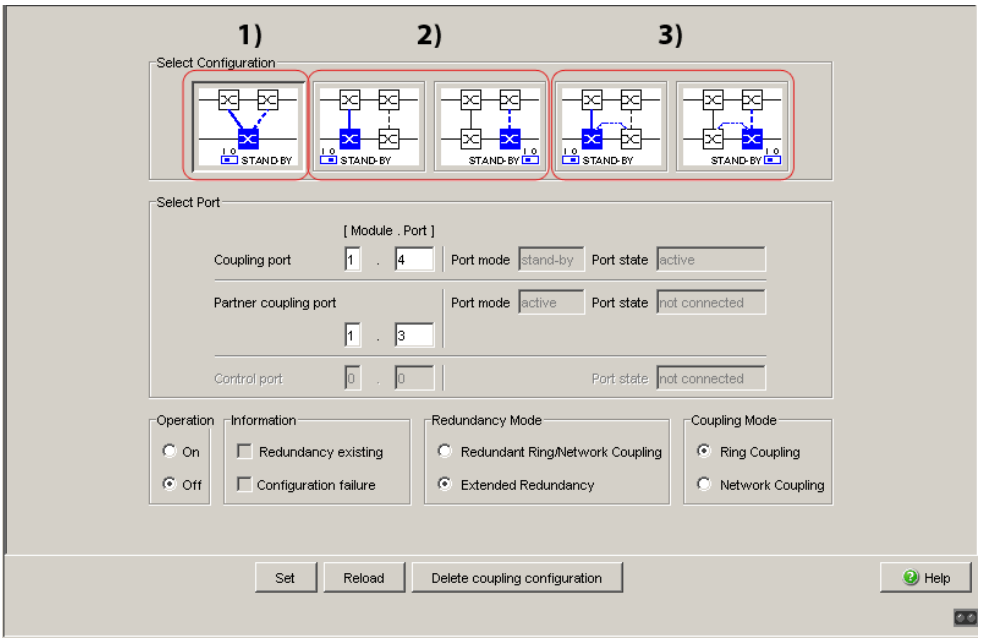


Figure 20: Choosing the ring coupling configuration (when the DIP switch is off, or for devices without a DIP switch)

For devices without DIP switches, the software settings are not restricted.
For devices **with** DIP switches, depending on the DIP switch position, the dialog displays the possible configurations in color, while those configurations that are not possible appear in gray.
The possible configurations are:

- DIP switch RM: ON or OFF, STAND-BY: OFF:
  Two-Switch coupling as master (with or without control line)
- DIP switch RM: OFF, STAND-BY: ON:
  One-Switch coupling and two-Switch coupling as slave (with or without control line)
- DIP switch RM: ON, STAND-BY: ON:
  DIP switches are deactivated, and the software settings are possible without any restrictions

If the DIP switches are activated and you want to use the software to select one of the configurations that are not possible (grayed-out), you put the DIP switches on the device into another position and reload the dialog.

Note: Refrain from combining Rapid Spanning Tree and Ring/Network Coupling. Competing redundancy functions are ineligible.

5.2.2 One-Switch coupling

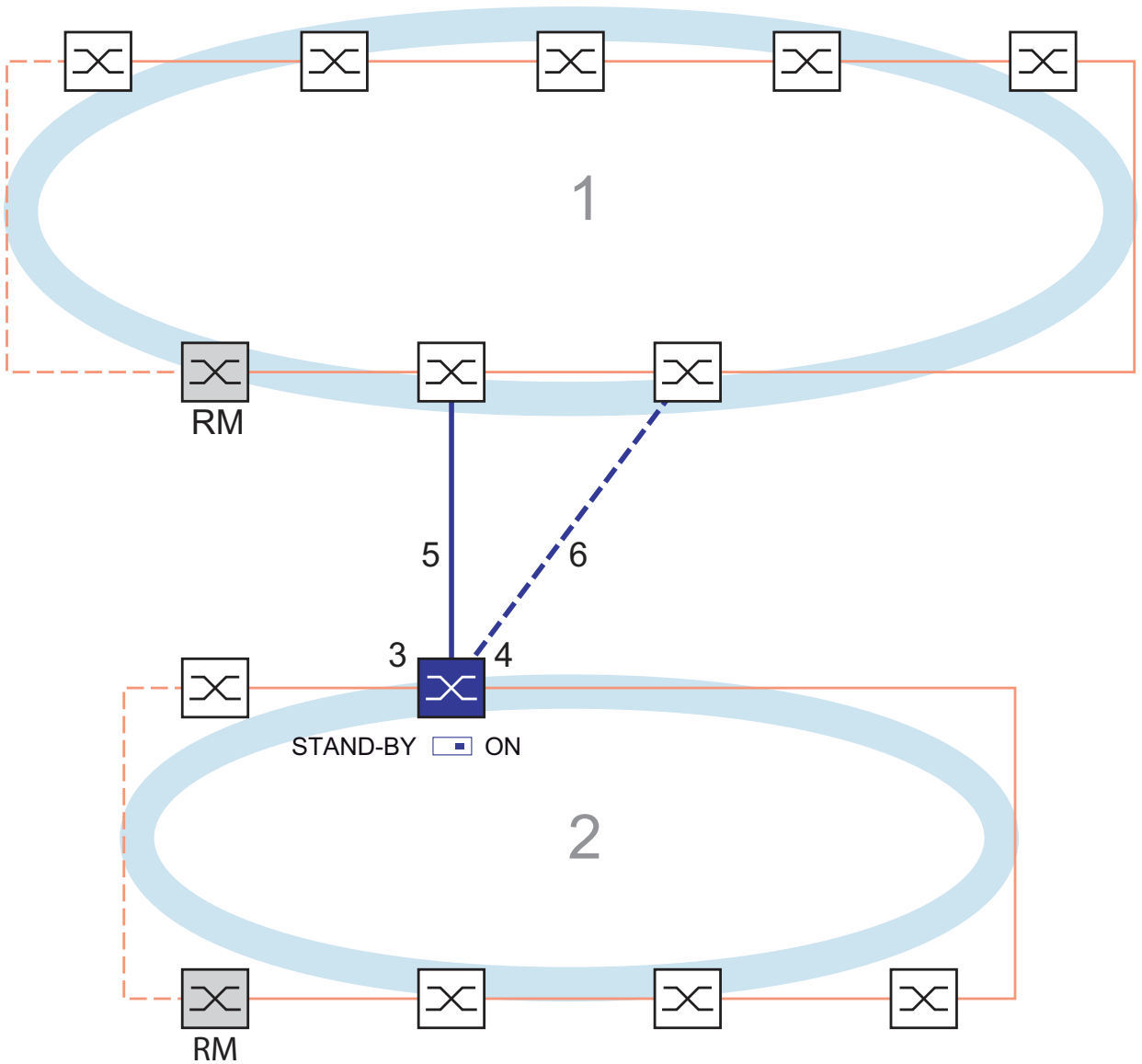


Figure 21: Example of one-Switch coupling
1: Backbone
2: Ring
3: Partner coupling port
4: Coupling port
5: Main Line
6: Redundant Line

The coupling between two networks is performed by the main line (solid blue line) in the normal mode of operation, which is connected to the partner coupling port. If the main line becomes inoperable, the redundant line (dashed blue line), which is connected to the coupling port, takes over the ring/network coupling. The coupling switch-over is performed by **one** Switch.

☐ Select the `Redundancy:Ring/Network Coupling` dialog.
☐ Select "One-Switch coupling" by means of the dialog button with the same graphic as below (see figure 22).

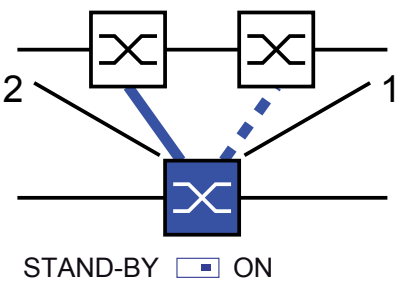


Figure 22: One-Switch-coupling
1: Coupling port
2: Partner coupling port

The following settings apply to the Switch displayed in blue in the selected graphic.

☐ Select the partner coupling port (see figure 23).
.With “Partner coupling port” you specify at which port you are connecting the control line.
You will find the port assignment for the redundant coupling in table 9.

The following tables show the selection options and default settings for the ports used in the Ring/Network coupling.

Device	Partner coupling port	Coupling port
RS2-./.	Not possible	Not possible
RS2-16M	All ports (default setting: port 2)	All ports (default setting: port 1)

Table 9: Port assignment for one-Switch coupling

Device	Partner coupling port	Coupling port
RS20, RS30, RS40	All ports (default setting: port 1.3)	All ports (default setting: port 1.4)
OCTOPUS	All ports (default setting: port 1.3)	All ports (default setting: port 1.4)
MICE	All ports (default setting: port 1.3)	All ports (default setting: port 1.4)
PowerMICE	All ports (default setting: port 1.3)	All ports (default setting: port 1.4)
MS20	All ports (default setting: port 1.3)	All ports (default setting: port 1.4)
MS30	All ports (default setting: port 2.3)	All ports (default setting: port 2.4)
RSR20/30	All ports (default setting: port 1.3)	All ports (default setting: port 1.4)
MACH 100	All ports (default setting: port 2.3)	All ports (default setting: port 2.4)
MACH 1000	All ports (default setting: port 1.3)	All ports (default setting: port 1.4)
MACH 3000	All ports	All ports
MACH 4000	All ports (default setting: port 1.3)	All ports (default setting: port 1.4)

Table 9: Port assignment for one-Switch coupling

Note: Configure the partner coupling port and the ring redundancy ports on different ports.

☐ Select the coupling port (see figure 23).
With “Coupling port” you specify at which port you are connecting the network segments:
You will find the port assignment for the redundant coupling in table 9.

Note: Configure the coupling port and the redundancy ring ports on different ports.

☐ Activate the function in the “Operation” frame (see figure 23)

☐ Now connect the redundant line.

The displays in the “Select port” frame mean:

– “Port mode”: The port is either active or in stand-by mode.
– “Port state”: The port is either active, in stand-by mode or not connected.

The displays in the “Information” frame mean:

– “Redundancy guaranteed”: The redundancy function is active.
  – The Link LED on the partner coupling port to which the main line is connected lights up permanently.
  – The Link LED on the coupling port to which the redundant line is connected blinks evenly.

  If the main line no longer functions, the redundant line takes over the function of the main line.
– “Configuration failure”: The function is incomplete or incorrectly configured.

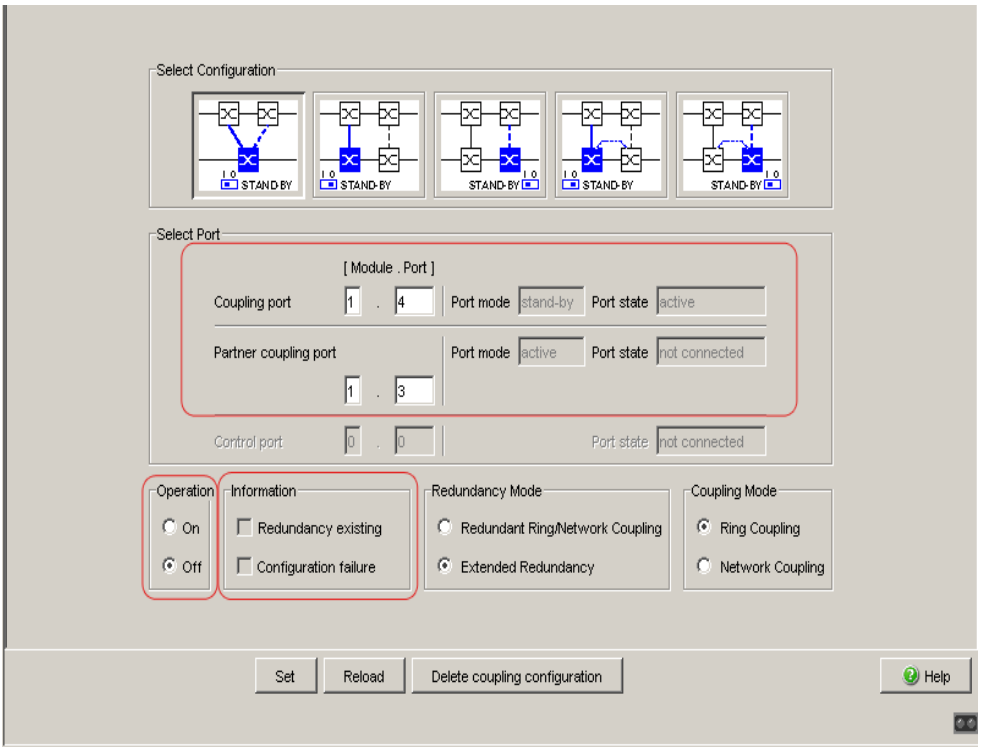


Figure 23: One-Switch coupling: Selecting the port and enabling/disabling operation

Note: The following settings are required for the coupling ports (you select the `Basic Settings:Port Configuration`dialog):
See table 3 on page 33.

Note: If VLANs are configured, set the coupling and partner coupling ports’ VLAN configuration as follows:

– in the `Switching:VLAN:Port` dialog, Port VLAN ID 1 and “Ingress Filtering” deactivated
– in the `Switching:VLAN:Statisch` dialog , for all redundant connections VLAN 1 and VLAN Membership `T` (Tagged)
  The device sends the redundancy packets with the highest priority in VLAN 1.

Redundancy mode

☐ In the “Redundancy Mode” frame, select (see figure 24)

– “Redundant Ring/Network Coupling” or

– “Extended Redundancy”.

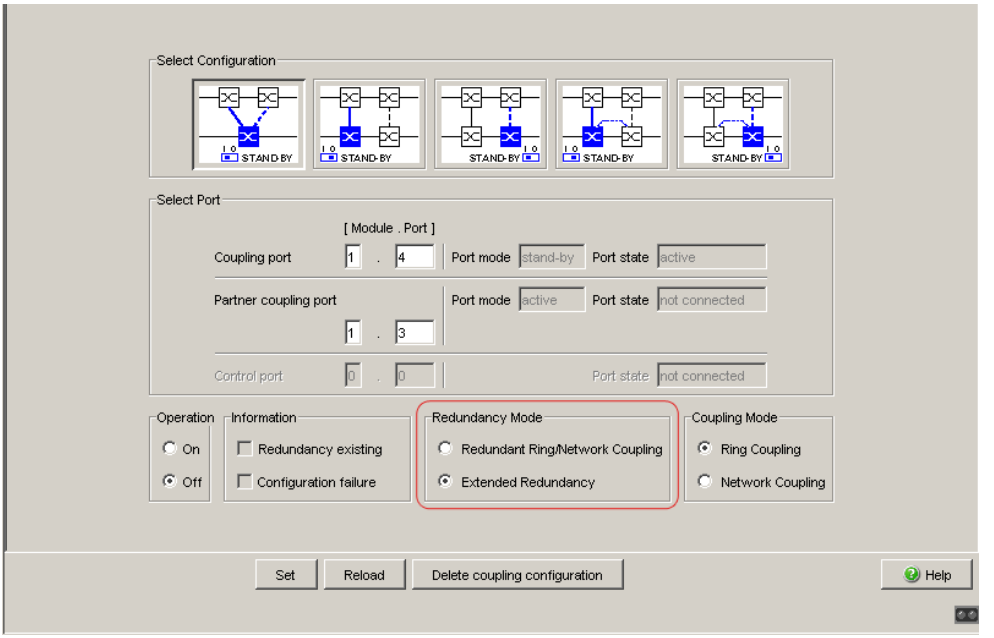


Figure 24: One-Switch coupling: Selecting the redundancy mode

With the “`Redundant Ring/Network Coupling`” setting, either the main line or the redundant line is active. The lines are never both active at the same time.

With the “`Extended Redundancy`” setting, the main line and the redundant line are simultaneously active if the connection line between the devices in the connected (i.e., remote) network becomes inoperable (see figure 25). During the reconfiguration period, packet duplications may occur. Therefore, select this setting only if your application detects package duplications.

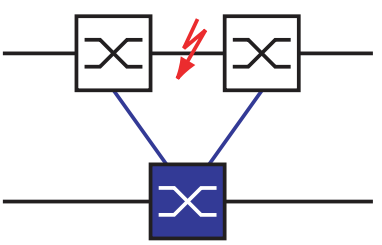


Figure 25: Extended redundancy

Coupling mode

The coupling mode indicates the type of the connected network.

☐ In the “Coupling Mode” frame, select (see figure 26)

– “Ring Coupling” or

– “Network Coupling”

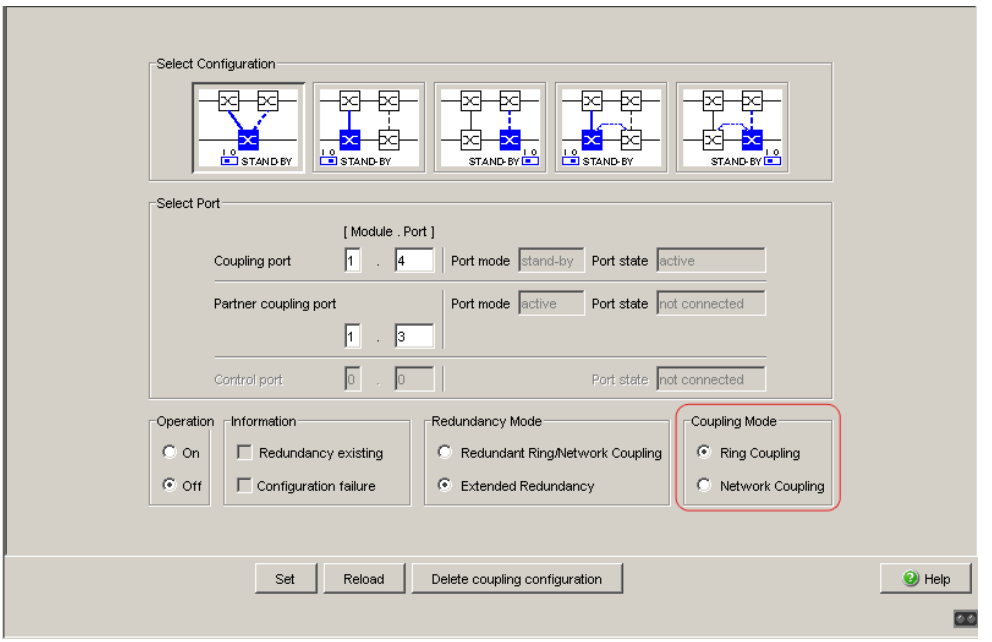


Figure 26: One-Switch coupling: Selecting the coupling mode

☐ Select **"Ring coupling"** if you are connecting to a redundancy ring.

☐ Select **"Network Coupling"** if you are connecting to a line or tree structure.

Delete coupling configuration

☐ The “Delete coupling configuration” button in the dialog allows you to reset all the coupling settings of the device to the state on delivery.

5.2.3 Two-Switch coupling

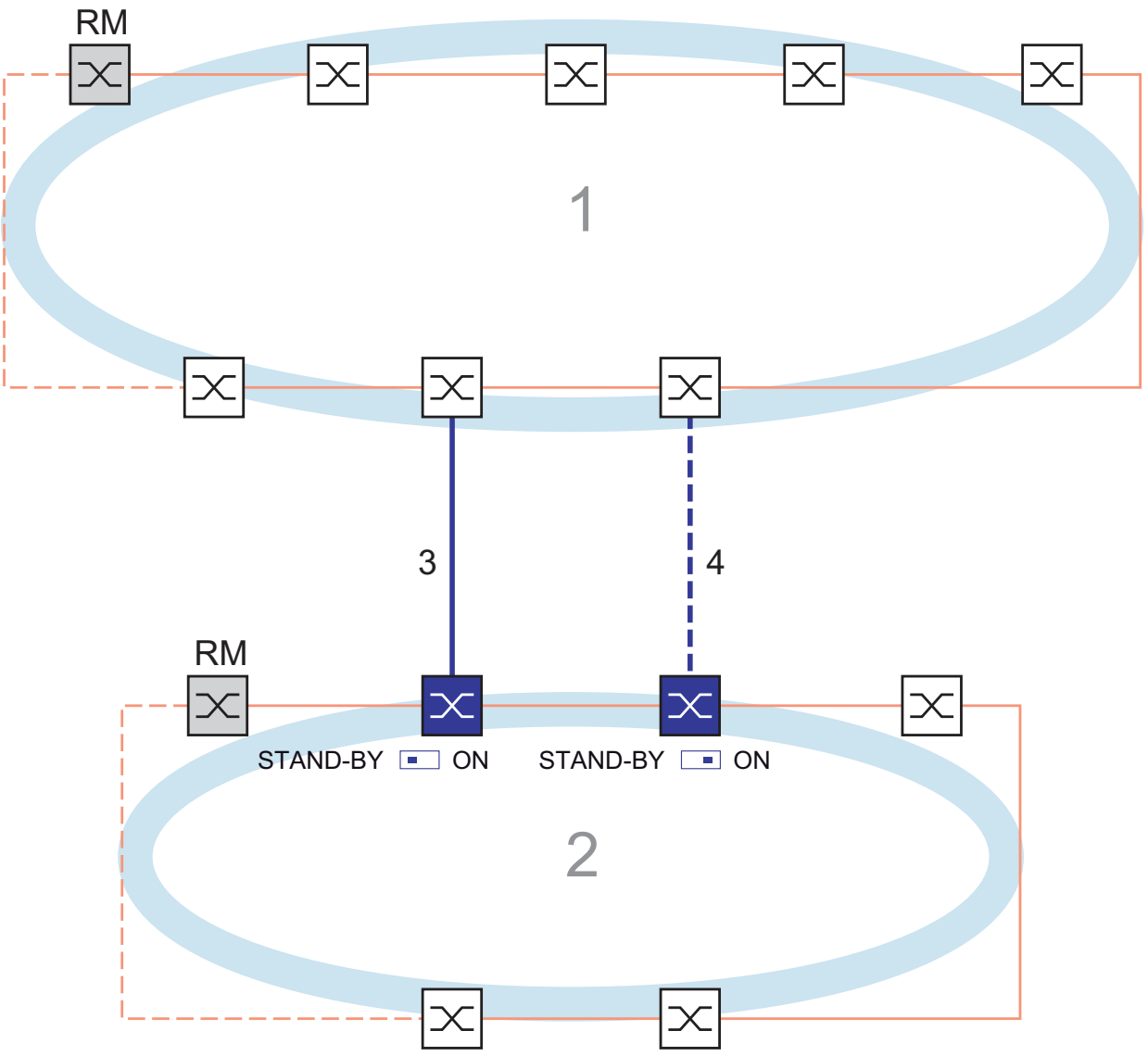


Figure 27: Example of two-Switch coupling
1: Backbone
2: Ring
3: Main line
4: Redundant line

The coupling between 2 networks is performed by the main line (solid blue line). If the main line or one of the adjacent Switches becomes inoperable, the redundant line (dashed black line) takes over coupling the 2 networks.
The coupling is performed by two Switches.
The switches send their control packages over the Ethernet.
The Switch connected to the main line, and the Switch connected to the redundant line are partners with regard to the coupling.

☐ Connect the two partners via their ring ports.

☐ Select the `Redundancy:Ring/Network Coupling` dialog.
☐ Select "Two-Switch coupling“ by means of the dialog button with the same graphic as below (see figure 28).

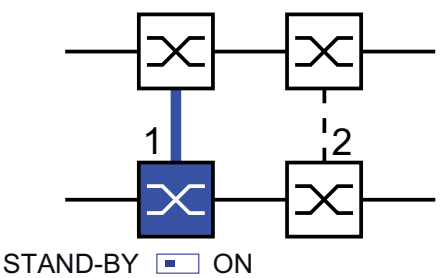


Figure 28: Two-Switch coupling
1: Coupling port
2: Partner coupling port

The following settings apply to the Switch displayed in blue in the selected graphic.
☐ Select the coupling port (see figure 29).
With “Coupling port” you specify at which port you are connecting the network segments:
You will find the port assignment for the redundant coupling in table 10.
☐ For a device with DIP switches, you switch the STAND-BY switch to OFF or deactivate the DIP switches. Connect the main line to the coupling port.

Device	Coupling port
RS2-./.	Not possible
RS2-16M	Adjustable for all ports (default setting: port 1)
RS20, RS30, RS40	Adjustable for all ports (default setting: port 1.4)
OCTOPUS	Adjustable for all ports (default setting: port 1.4)
MICE	Adjustable for all ports (default setting: port 1.4)
PowerMICE	Adjustable for all ports (default setting: port 1.4)
MS20	Adjustable for all ports (default setting: port 1.4)
MS30	Adjustable for all ports (default setting: port 2.4)
RSR20/30	Adjustable for all ports (default setting: port 1.4)
MACH 100	Adjustable for all ports (default setting: port 2.4)
MACH 1000	Adjustable for all ports (default setting: port 1.4)
MACH 3000	Adjustable for all ports
MACH 4000	Adjustable for all ports (default setting: port 1.4)

Table 10: Port assignment for the redundant coupling (two-Switch coupling)

Note: Configure the coupling port and the redundancy ring ports on different ports.

☐ Activate the function in the “Operation” frame (see figure 29)

☐ Now connect the redundant line.

The displays in the “Select port” frame mean:

– “Port mode”: The port is either active or in stand-by mode.

– “Port state”: The port is either active, in stand-by mode or not connected.

– “IP Address”: The IP address of the partner, if the partner is already operating in the network.

The displays in the “Information” frame mean:

– “Redundancy guaranteed”: The redundancy function is active.

  – The Link LED on the partner coupling port to which the main line is connected lights up permanently.

  – The Link LED on the coupling port to which the redundant line is connected blinks evenly.

  If the main line no longer functions, the redundant line takes over the function of the main line.

– “Configuration failure”: The function is incomplete or incorrectly configured.

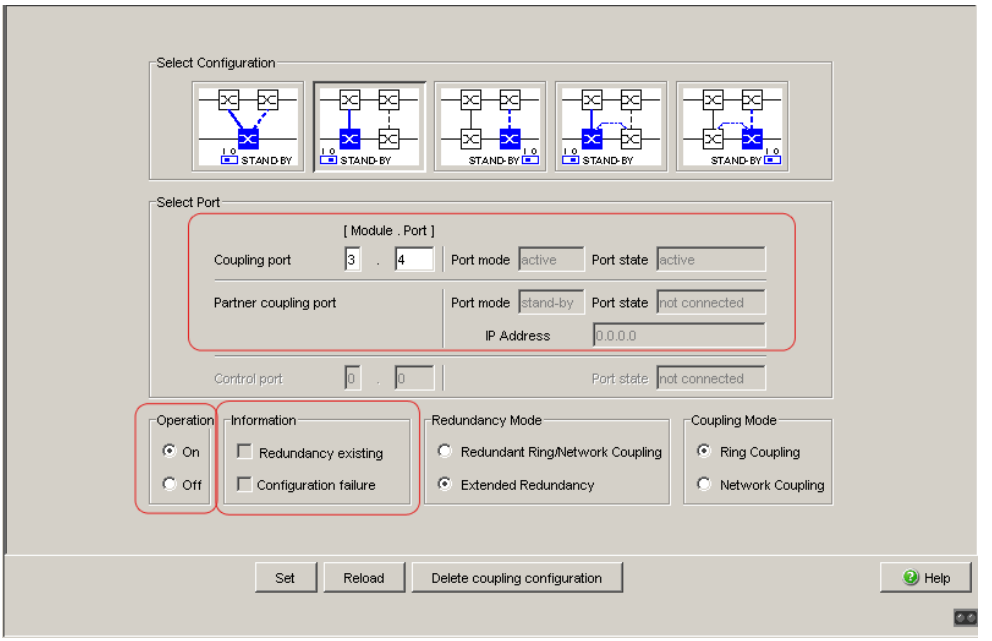


Figure 29: Two-Switch coupling: Selecting the port and enabling/disabling operation

To avoid continuous loops, the Switch sets the port state of the coupling port to “off” if you:

– switch off the operation setting or
– change the configuration

while the connections are in operation at these ports.

Note: The following settings are required for the coupling ports (you select the `Basic Settings:Port Configuration`dialog):
See table 3 on page 33.

Note: If VLANs are configured, set the coupling and partner coupling ports’ VLAN configuration as follows:

– in the `Switching:VLAN:Port` dialog, Port VLAN ID 1 and “Ingress Filtering” deactivated
– in the `Switching:VLAN:Statisch` dialog , for all redundant connections VLAN 1 and VLAN Membership `T` (Tagged)
  The device sends the redundancy packets with the highest priority in VLAN 1.

Note: If you operate the Ring Manager and Two-Switch coupling functions at the same device, there is the possibility of creating a loop.

☐ Select "Two-Switch coupling“ by means of the dialog button with the same graphic as below (see figure 30).

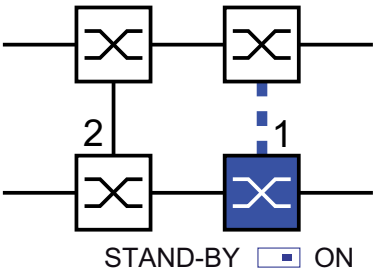


Figure 30: Two-Switch coupling
1: Coupling port
2: Partner coupling port

The following settings apply to the Switch displayed in blue in the selected graphic.

☐ Select the coupling port (see figure 29).
With “Coupling port” you specify at which port you are connecting the network segments:
You will find the port assignment for the redundant coupling in table 10.

☐ For a device with DIP switches, you switch the STAND-BY switch to ON or deactivate the DIP switches. You connect the redundant line to the coupling port.

Note: Configure the coupling port and the redundancy ring ports on different ports.

☐ Activate the function in the “Operation” frame (see figure 29)

The displays in the “Select port” frame mean:

– “Port mode”: The port is either active or in stand-by mode.
– “Port state”: The port is either active, in stand-by mode or not connected.
– “IP Address”: The IP address of the partner, if the partner is already operating in the network.

The displays in the “Information” frame mean:
– “Redundancy guaranteed”: The redundancy function is active.
  – The Link LED on the partner coupling port to which the main line is connected lights up permanently.
  – The Link LED on the coupling port to which the redundant line is connected blinks evenly.

  If the main line no longer functions, the redundant line takes over the function of the main line.
– “Configuration failure”: The function is incomplete or incorrectly configured.

To avoid continuous loops, the Switch sets the port state of the coupling port to "off” if you::
– switch off operation or
– change the configuration

while the connections are in operation at these ports.

Note: The following settings are required for the coupling ports (you select the `Basic Settings:Port Configuration`dialog):
See table 3 on page 33.

Note: If VLANs are configured, set the coupling and partner coupling ports’ VLAN configuration as follows:
– in the `Switching:VLAN:Port` dialog, Port VLAN ID 1 and “Ingress Filtering” deactivated
– in the `Switching:VLAN:Statisch` dialog , for all redundant connections VLAN 1 and VLAN Membership `T` (Tagged)
  The device sends the redundancy packets with the highest priority in VLAN 1.

Note: If you operate the Ring Manager and Two-Switch coupling functions at the same device, there is the possibility of creating a loop.

Redundancy mode

☐ In the “Redundancy Mode” frame, select (see figure 31)
– “Redundant Ring/Network Coupling” or
– “Extended Redundancy”.

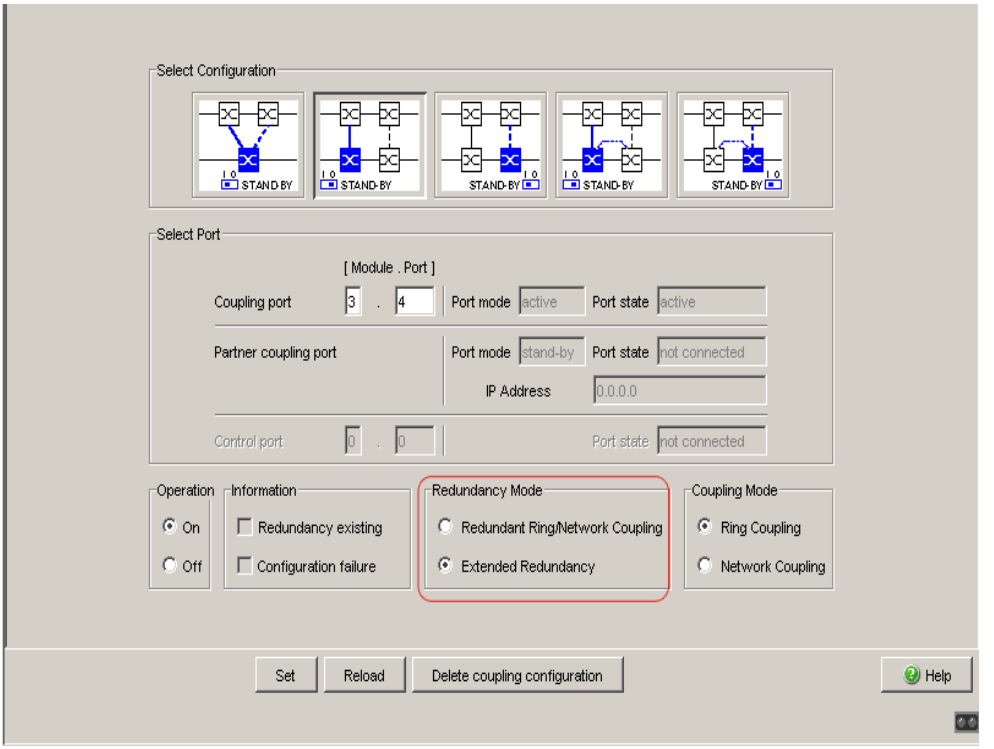


Figure 31: Two-Switch coupling: Selecting the redundancy mode

With the "`Redundant Ring/Network Coupling`" setting, either the main line or the redundant line is active. The lines are never both active at the same time.

With the "`Extended Redundancy`" setting, the main line and the redundant line are simultaneously active if the connection line between the devices in the connected (i.e. remote) network fails (see figure 25). During the reconfiguration period, package duplications may occur. Therefore, only select this setting if your application detects package duplications.

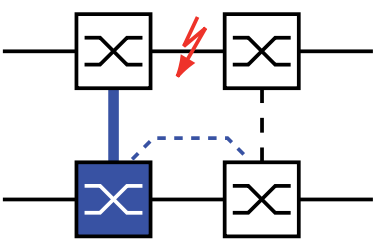


Figure 32: Extended redundancy

Coupling mode

The coupling mode indicates the type of the connected network.

☐ In the “Coupling Mode” frame, select (see figure 33)

– “Ring Coupling” or

– “Network Coupling”

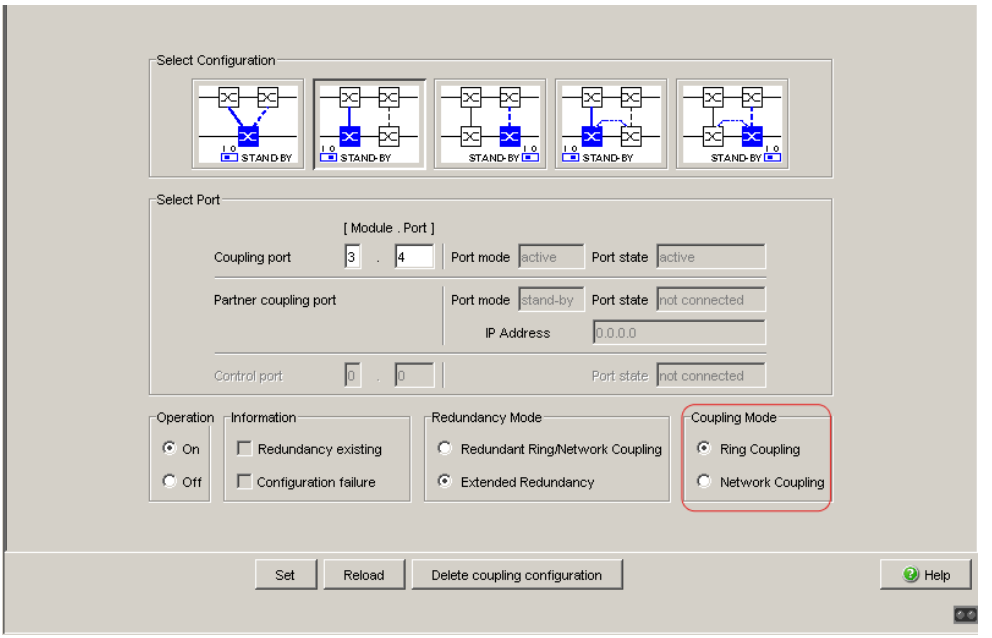


Figure 33: Two-Switch coupling: Selecting the coupling mode

☐ Select **"Ring coupling"** if you are connecting to a redundancy ring.

☐ Select **"Network Coupling"** if you are connecting to a line or tree structure.

Delete coupling configuration

☐ The “Delete coupling configuration” button in the dialog allows you to reset all the coupling settings of the device to the state on delivery.

5.2.4 Two-Switch Coupling with Control Line

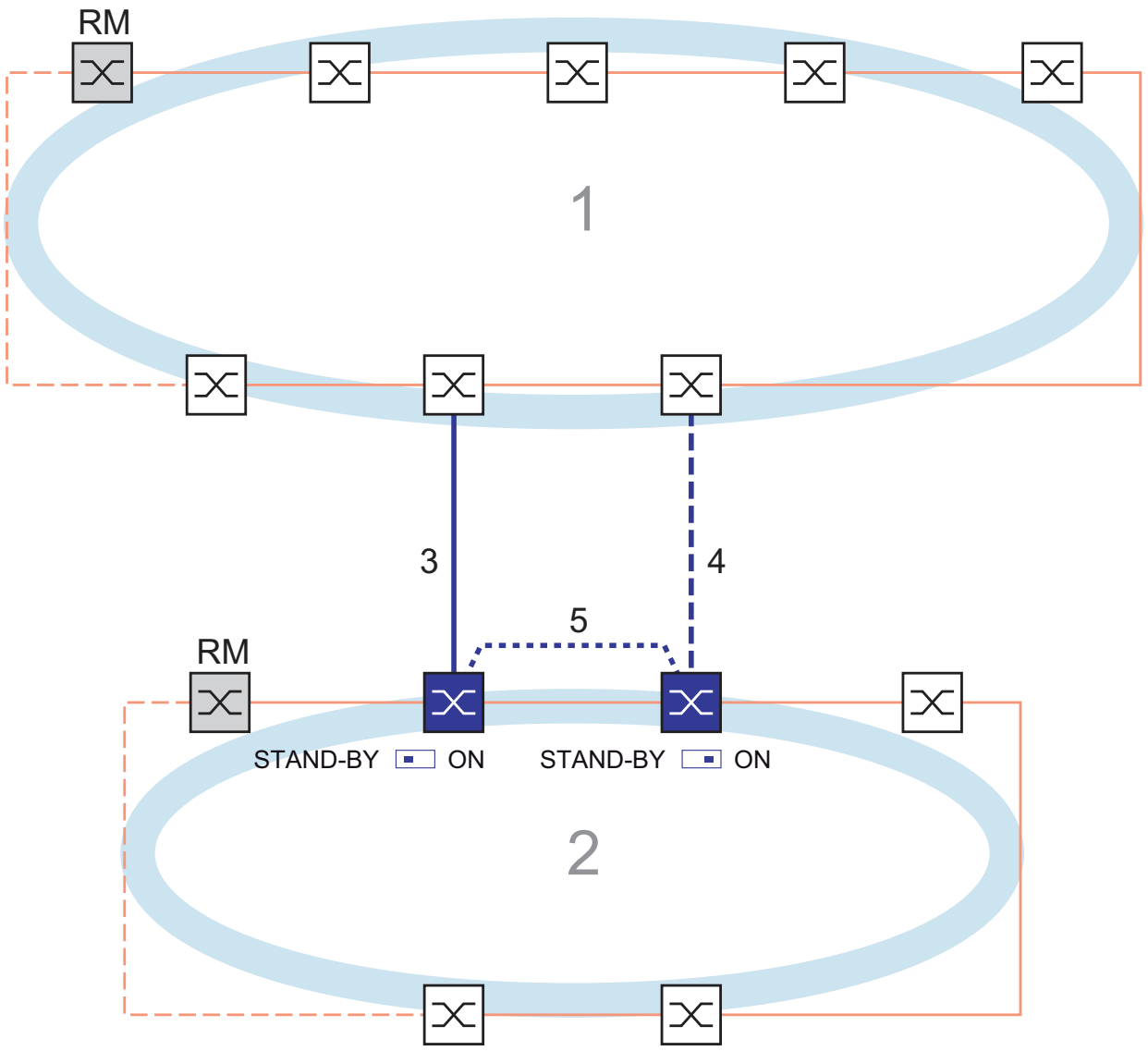


Figure 34: Example of Two-Switch coupling with control line
1: Backbone
2: Ring
3: Main line
4: Redundant line
5: Control line

The coupling between 2 networks is performed by the main line (solid blue line). If the main line or one of the adjacent Switches becomes inoperable, the redundant line (dashed black line) takes over coupling the 2 networks. The coupling is performed by two Switches.
The Switches send their control packets over a control line (dotted line). The Switch connected to the main line, and the Switch connected to the redundant line are partners with regard to the coupling.

☐ Connect the two partners via their ring ports.

☐ Select the `Redundancy:Ring/Network Coupling` dialog.
☐ Select „Two-Switch coupling with control line“ by means of the dialog button with the same graphic as below (see figure 35).

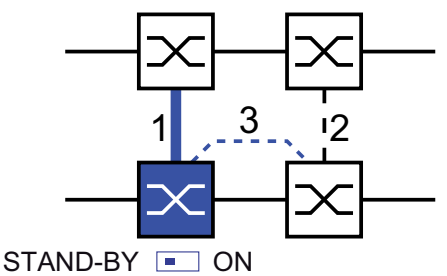


Figure 35: Two-Switch coupling with control line
1: Coupling port
2: Partner coupling port
3: Control line

The following settings apply to the Switch displayed in blue in the selected graphic.
☐ Select the coupling port (see figure 36).
With “Coupling port” you specify at which port you are connecting the network segments:
You will find the port assignment for the redundant coupling in table 11.
☐ For a device with DIP switches, you switch the STAND-BY switch to OFF or deactivate the DIP switches. Connect the main line to the coupling port.

☐ Select the control port (see figure 36)
With “Control port” you specify at which port you are connecting the control line.
You will find the port assignment for the redundant coupling in table 11.

Device	Coupling port	Control port
RS2-./.	Port 1	Stand-by port (can only be combined with RS2-../..)
RS2-16M	Adjustable for all ports (default setting: port 1)	Adjustable for all ports (default setting: port 2)
RS20, RS30, RS40	Adjustable for all ports (default setting: port 1.4)	Adjustable for all ports (default setting: port 1.3)
OCTOPUS	Adjustable for all ports (default setting: port 1.4)	Adjustable for all ports (default setting: port 1.3)
MICE	Adjustable for all ports (default setting: port 1.4)	Adjustable for all ports (default setting: port 1.3)
PowerMICE	Adjustable for all ports (default setting: port 1.4)	Adjustable for all ports (default setting: port 1.3)
MS20	Adjustable for all ports (default setting: port 1.4)	Adjustable for all ports (default setting: port 1.3)
MS30	Adjustable for all ports (default setting: port 2.4)	Adjustable for all ports (default setting: port 2.3)
RSR20/RSR30	Adjustable for all ports (default setting: port 1.4)	Adjustable for all ports (default setting: port 1.3)
MACH 100	Adjustable for all ports (default setting: port 2.4)	Adjustable for all ports (default setting: port 2.3)
MACH 1000	Adjustable for all ports (default setting: port 1.4)	Adjustable for all ports (default setting: port 1.3)
MACH 3000	Adjustable for all ports	Adjustable for all ports
MACH 4000	Adjustable for all ports (default setting: port 1.4)	Adjustable for all ports (default setting: port 1.3)

Table 11: Port assignment for the redundant coupling (two-Switch coupling with control line)

Note: Configure the coupling port and the redundancy ring ports on different ports.

☐ Activate the function in the “Operation” frame (see figure 36)

☐ Now connect the redundant line and the control line.

The displays in the “Select port” frame mean:

– “Port mode”: The port is either active or in stand-by mode.
– “Port state”: The port is either active, in stand-by mode or not connected.
– “IP Address”: The IP address of the partner, if the partner is already operating in the network.

The displays in the “Information” frame mean:

– “Redundancy guaranteed”: The redundancy function is active.
  – The Link LED on the partner coupling port to which the main line is connected lights up permanently.
  – The Link LED on the coupling port to which the redundant line is connected blinks evenly.

  If the main line no longer functions, the redundant line takes over the function of the main line.
– “Configuration failure”: The function is incomplete or incorrectly configured.

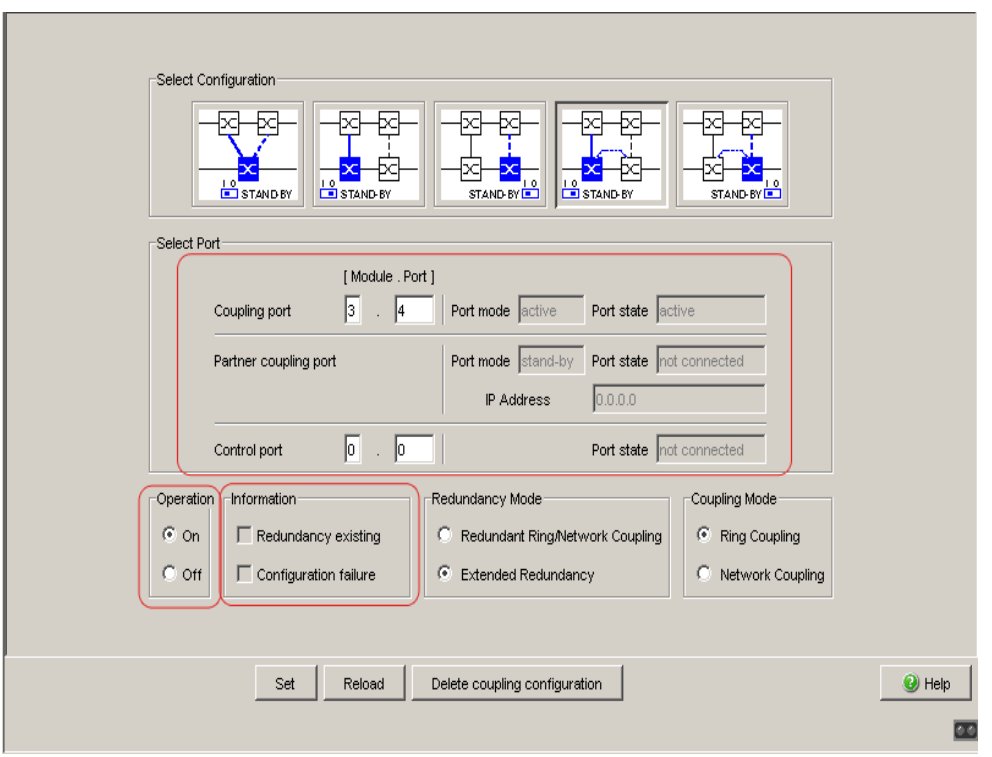


Figure 36: Two-Switch coupling with control line: Selecting the port and enabling/disabling operation

To avoid continuous loops, the Switch sets the port state of the coupling port to “off” if you:
– switch off the operation setting or
– change the configuration
while the connections are in operation at these ports.

Note: The following settings are required for the coupling ports (you select the `Basic Settings:Port Configuration`dialog):
See table 3 on page 33.

Note: If VLANs are configured, set the coupling and partner coupling ports’ VLAN configuration as follows:
– in the `Switching:VLAN:Port` dialog, Port VLAN ID 1 and “Ingress Filtering” deactivated
– in the `Switching:VLAN:Statisch` dialog , for all redundant connections VLAN 1 and VLAN Membership `T` (Tagged)
The device sends the redundancy packets with the highest priority in VLAN 1.

☐ Select "Two-Switch coupling with control line“ by means of the dialog button with the same graphic as below (see figure 37).

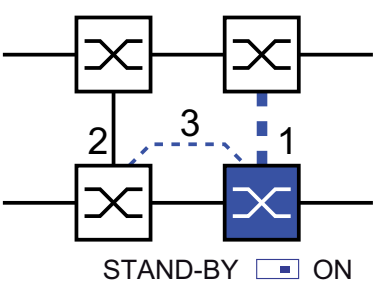


Figure 37: Two-Switch coupling with control line
1: Coupling port
2: Partner coupling port
3: Control line

The following settings apply to the Switch displayed in blue in the selected graphic.

☐ Select the coupling port (see figure 36).
With “Coupling port” you specify at which port you are connecting the network segments:
You will find the port assignment for the redundant coupling in table 11.

☐ For a device with DIP switches, you switch the STAND-BY switch to ON or deactivate the DIP switches. You connect the redundant line to the coupling port.

☐ Select the control port (see figure 36)
With “Control port” you specify at which port you are connecting the control line.

Note: Configure the coupling port and the redundancy ring ports on different ports.

☐ Activate the function in the “Operation” frame (see figure 36)
☐ Now connect the redundant line and the control line.
The displays in the “Select port” frame mean:
– “Port mode”: The port is either active or in stand-by mode.
– “Port state”: The port is either active, in stand-by mode or not connected.
– “IP Address”: The IP address of the partner, if the partner is already operating in the network.

The displays in the “Information” frame mean:
– “Redundancy guaranteed”: The redundancy function is active.
  – The Link LED on the partner coupling port to which the main line is connected lights up permanently.
  – The Link LED on the coupling port to which the redundant line is connected blinks evenly.

  If the main line no longer functions, the redundant line takes over the function of the main line.
– “Configuration failure”: The function is incomplete or incorrectly configured.

To avoid continuous loops, the Switch sets the port state of the coupling port to “off” if you:
– switch off the operation setting or
– change the configuration

while the connections are in operation at these ports.

Note: If VLANs are configured, set the coupling and partner coupling ports’ VLAN configuration as follows:
– in the `Switching:VLAN:Port` dialog, Port VLAN ID 1 and “Ingress Filtering” deactivated
– in the `Switching:VLAN:Statisch` dialog , for all redundant connections VLAN 1 and VLAN Membership `T` (Tagged)
  The device sends the redundancy packets with the highest priority in VLAN 1.

Redundancy mode

☐ In the “Redundancy Mode” frame, select:

– “Redundant Ring/Network Coupling”
or
– “Extended Redundancy”.

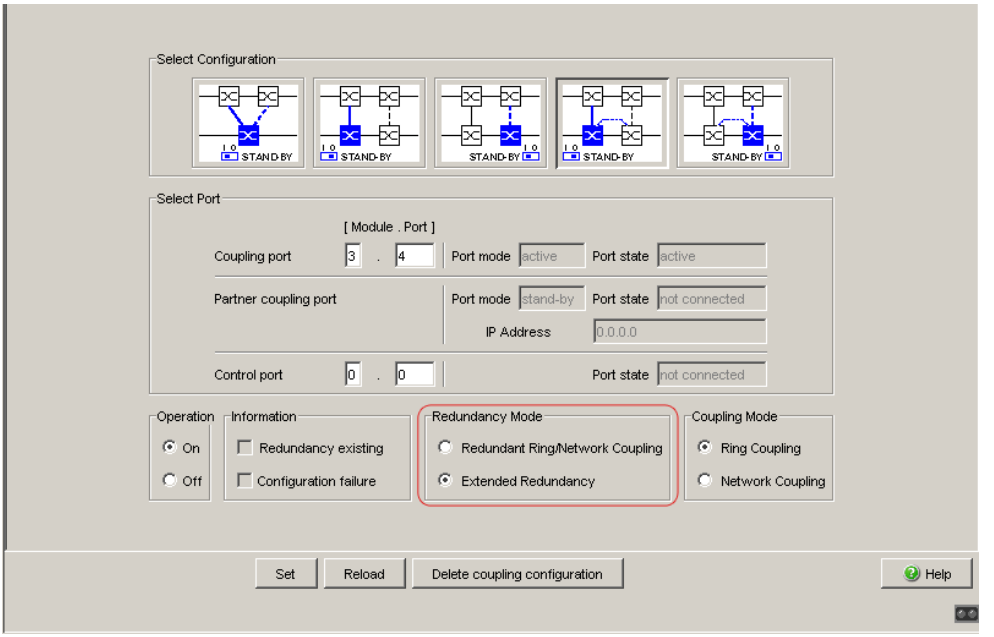


Figure 38: Two-Switch coupling with control line: Selecting the redundancy mode

With the “`Redundant Ring/Network Coupling`” setting, either the main line or the redundant line is active. The lines are never both active at the same time.

With the “`Extended Redundancy`” setting, the main line and the redundant line are simultaneously active if the connection line between the devices in the connected (i.e. remote) network fails (see figure 25). During the reconfiguration period, package duplications may occur. Therefore, only select this setting if your application detects package duplications.

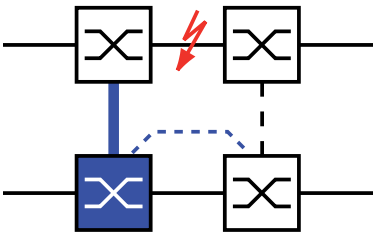


Figure 39: Extended redundancy

Coupling mode

The coupling mode indicates the type of the connected network.

☐ In the “Coupling Mode” frame, select:

– “Ring coupling”

or

– “Network Coupling”

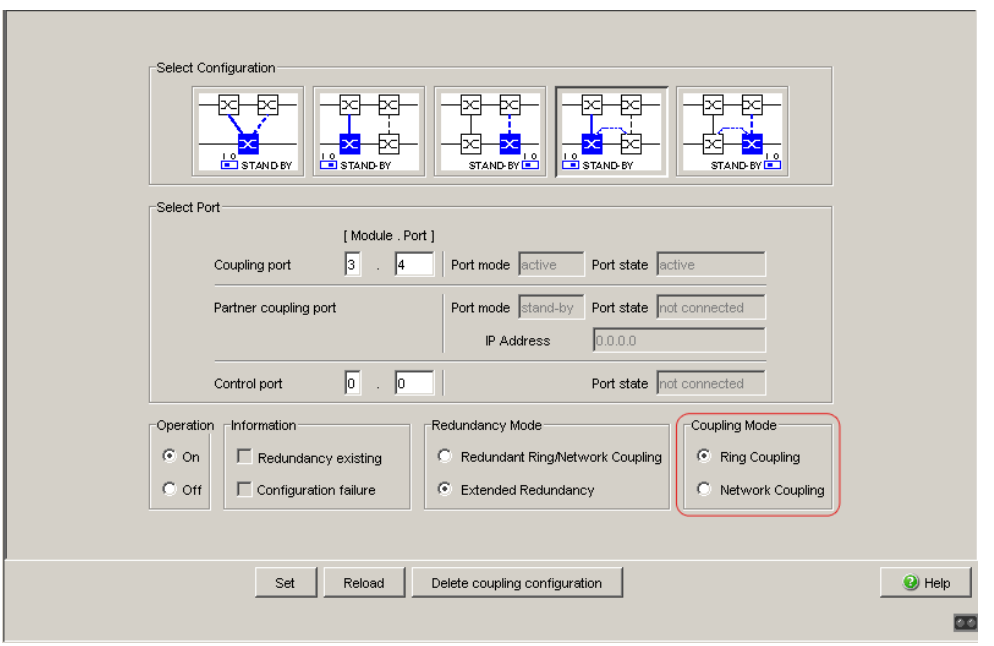


Figure 40: Two-Switch coupling with control line: Selecting the coupling mode

☐ Select **"Ring coupling"** if you are connecting to a redundancy ring.

☐ Select **"Network Coupling"** if you are connecting to a line or tree structure.

Delete coupling configuration

☐ The “Delete coupling configuration” button in the dialog allows you to reset all the coupling settings of the device to the state on delivery.

6 Spanning Tree

Note: The Spanning Tree Protocol is a protocol for MAC bridges. For this reason, the following description uses the term bridge for Switch.

Local networks are getting bigger and bigger. This applies to both the geographical expansion and the number of network participants. Therefore, it is advantageous to use multiple bridges, for example:

- to reduce the network load in sub-areas,
- to set up redundant connections and
- to overcome distance limitations.

However, using multiple bridges with multiple redundant connections between the subnetworks can lead to loops and thus loss of communication across of the network. In order to help avoid this, you can use Spanning Tree. Spanning Tree enables loop-free switching through the systematic deactivation of redundant connections. Redundancy enables the systematic reactivation of individual connections as needed.

RSTP is a further development of the Spanning Tree Protocol (STP) and is compatible with it. If a connection or a bridge becomes inoperable, the STP required a maximum of 30 seconds to reconfigure. This is no longer acceptable in time-sensitive applications. RSTP achieves average reconfiguration times of less than a second. When you use RSTP in a ring topology with 10 to 20 devices, you can even achieve reconfiguration times in the order of milliseconds.

Note: RSTP reduces a layer 2 network topology with redundant paths into a tree structure (Spanning Tree) that does not contain any more redundant paths. One of the Switches takes over the role of the root bridge here. The maximum number of devices permitted in an active branch (from the root bridge to the tip of the branch) is specified by the variable `Max Age` for the current root bridge. The preset value for `Max Age` is 20, which can be increased up to 40.

If the device working as the root is inoperable and another device takes over its function, the `Max Age` setting of the new root bridge determines the maximum number of devices allowed in a branch.

Note: The RSTP standard dictates that all the devices within a network work with the (Rapid) Spanning Tree Algorithm. If STP and RSTP are used at the same time, the advantages of faster reconfiguration with RSTP are lost in the network segments that are operated in combination.
A device that only supports RSTP works together with MSTP devices by not assigning an MST region to itself, but rather the CST (Common Spanning Tree).

Note: By changing the IEEE 802.1D-2004 standard for RSTP, the Standards Commission reduced the maximum value for the “Hello Time” from 10 s to 2 s. When you update the Switch software from a release before 5.0 to release 5.0 or higher, the new software release automatically reduces the locally entered “Hello Time” values that are greater than 2 s to 2 s.
If the device is not the RSTP root, “Hello Time” values greater than 2 s can remain valid, depending on the software release of the root device.

6.1 The Spanning Tree Protocol

Because RSTP is a further development of the STP, all the following descriptions of the STP also apply to the RSTP.

6.1.1 The tasks of the STP

The Spanning Tree Algorithm reduces network topologies built with bridges and containing ring structures due to redundant links to a tree structure. In doing so, STP opens ring structures according to preset rules by deactivating redundant paths. If a path is interrupted because a network component becomes inoperable, STP reactivates the previously deactivated path again. This allows redundant links to increase the availabiliy of communication. STP determines a bridge that represents the STP tree structure‘s base. This bridge is called root bridge.

Features of the STP algorithm:

- automatic reconfiguration of the tree structure in the case of a bridge becoming inoperable or the interruption of a data path
- the tree structure is stabilized up to the maximum network size (up to 39 hops, depending on the setting for `Max Age`, (see table 14)
- stabilization of the topology within a short time period
- topology can be specified and reproduced by the administrator
- transparency for the end devices
- low network load relative to the available transmission capacity due to the tree structure created

6.1.2 Bridge parameters

In the context of Spanning Tree, each bridge and its connections are uniquely described by the following parameters:

- Bridge Identifier
- Root Path Cost for the bridge ports,
- Port Identifier

6.1.3 Bridge Identifier

The Bridge Identifier consists of 8 bytes. The 2 highest-value bytes are the priority. The default setting for the priority number is 32,768, but the Management Administrator can change this when configuring the network. The 6 lowest-value bytes of the bridge identifier are the bridge's MAC address. The MAC address allows each bridge to have unique bridge identifiers.
The bridge with the smallest number for the bridge identifier has the highest priority.

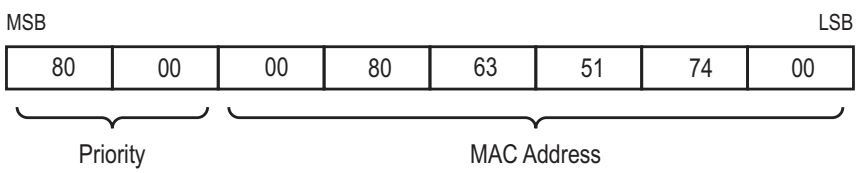


Figure 41: Bridge Identifier, Example (values in hexadecimal notation)

6.1.4 Root Path Cost

Each path that connects 2 bridges is assigned a cost for the transmission (path cost). The Switch determines this value based on the transmission speed (see table 12). It assigns a higher path cost to paths with lower transmission speeds.

Alternatively, the Administrator can set the path cost. Like the Switch, the Administrator assigns a higher path cost to paths with lower transmission speeds. However, since the Administrator can choose this value freely, he has a tool with which he can give a certain path an advantage among redundant paths.

The root path cost is the sum of all individual costs of those paths that a data packet has to traverse from a connected bridge‘s port to the root bridge.

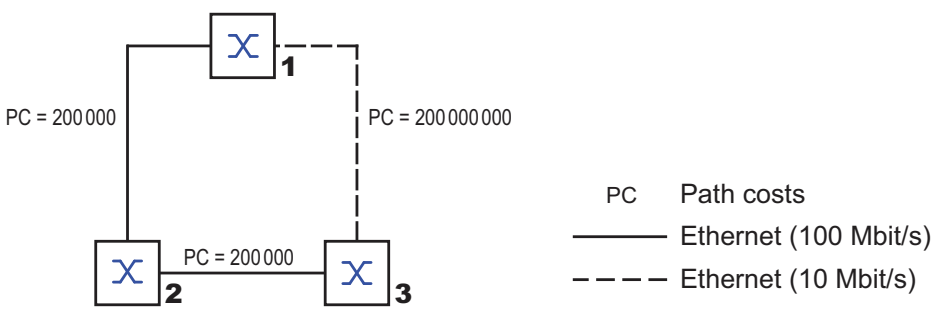


Figure 42: Path costs

Data rate	Recommended value	Recommended range	Possible range
≤100 Kbit/s	200,000,000[a]	20,000,000-200,000,000	1-200,000,000
1 Mbit/s	20,000,000[a]	2,000,000-200,000,000	1-200,000,000
10 Mbit/s	2,000,000[a]	200,000-20,000,000	1-200,000,000
100 Mbit/s	200,000[a]	20,000-2,000,000	1-200,000,000
1 Gbit/s	20,000	2,000-200,000	1-200,000,000
10 Gbit/s	2,000	200-20,000	1-200,000,000
100 Gbit/s	200	20-2,000	1-200,000,000
1 TBit/s	20	2-200	1-200,000,000
10 TBit/s	2	1-20	1-200,000,000

Table 12: Recommended path costs for RSTP based on the data rate.

a. Bridges that conform with IEEE 802.1D 1998 and only support 16-bit values for the path costs should use the value 65,535 (FFFFH) for path costs when they are used in conjunction with bridges that support 32-bit values for the path costs.

Note: If link aggregation (see on page 19 “Link Aggregation”) is used to combine the connection lines between devices into a trunk, then the automatically specified path costs are reduced by half.

6.1.5 Port Identifier

The port identifier consists of 2 bytes. One part, the lower-value byte, contains the physical port number. This provides a unique identifier for the port of this bridge. The second, higher-value part is the port priority, which is specified by the Administrator (default value: 128). It also applies here that the port with the smallest number for the port identifier has the highest priority.

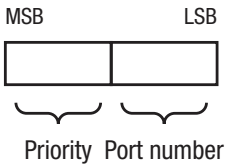


Figure 43: Port Identifier

6.2 Rules for Creating the Tree Structure

6.2.1 Bridge information

To determine the tree structure, the bridges need more detailed information about the other bridges located in the network.
To obtain this information, each bridge sends a BPDU (Bridge Protocol Data Unit) to the other bridges.

The contents of a BPDU include

- bridge identifier,
- root path costs and
- port identifier

(see IEEE 802.1D).

6.2.2 Setting up the tree structure

- The bridge with the smallest number for the bridge identifier is called the root bridge. It is (or will become) the root of the tree structure.
- The structure of the tree depends on the root path costs. Spanning Tree selects the structure so that the path costs between each individual bridge and the root bridge become as small as possible.

- If there are multiple paths with the same root path costs, the bridge further away from the root decides which port it blocks. For this purpose, it uses the bridge identifiers of the bridge closer to the root. The bridge blocks the port that leads to the bridge with the numerically higher ID (a numerically higher ID is the logically worse one). If 2 bridges have the same priority, the bridge with the numerically larger MAC address has the numerically higher ID, which is logically the worse one.
- If multiple paths with the same root path costs lead from one bridge to the same bridge, the bridge further away from the root uses the port identifier of the other bridge as the last criterion (see figure 43). In the process, the bridge blocks the port that leads to the port with the numerically higher ID (a numerically higher ID is the logically worse one). If 2 ports have the same priority, the port with the higher port number has the numerically higher ID, which is logically the worse one.

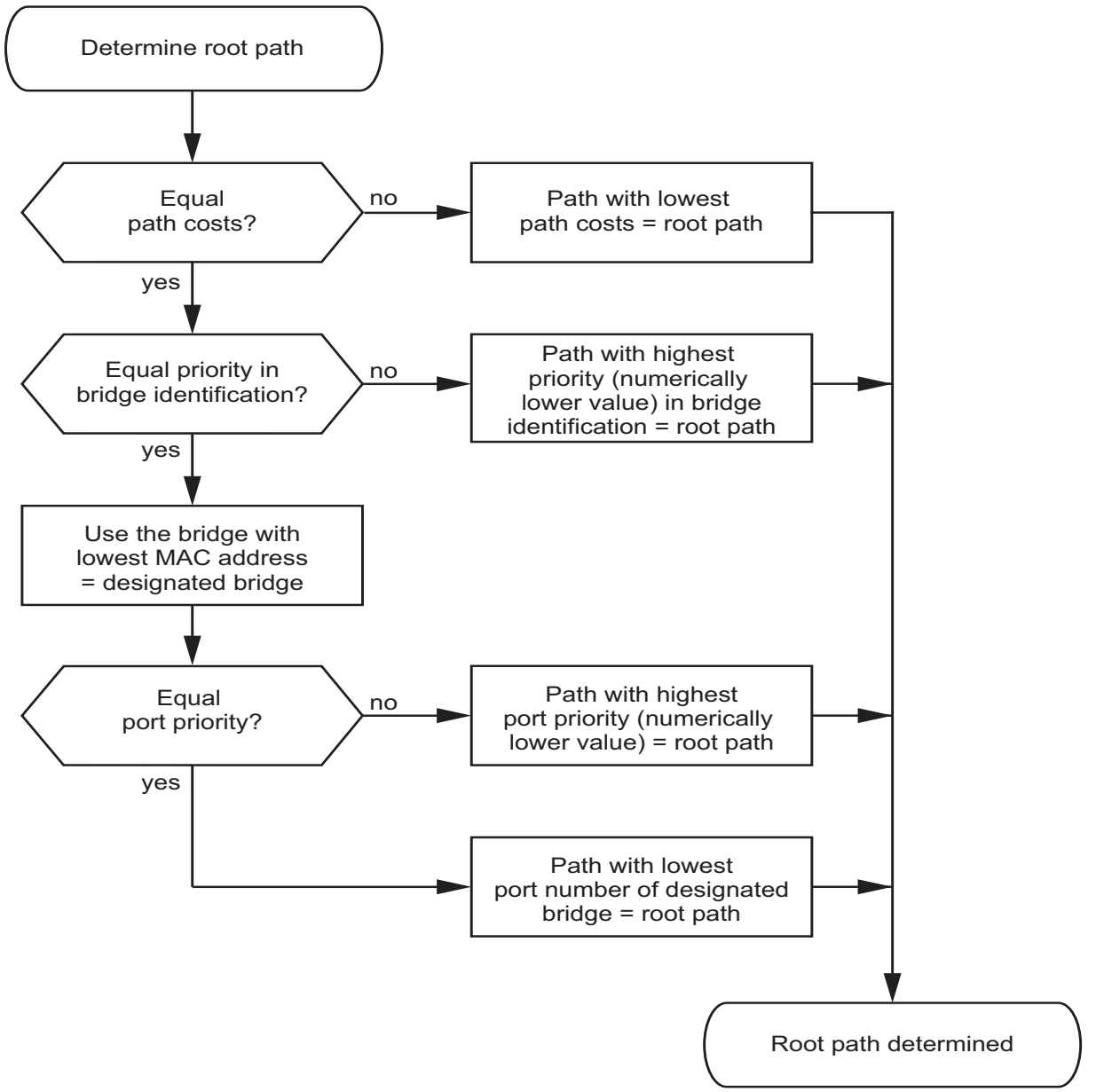


Figure 44: Flow diagram for specifying the root path

6.3 Example of determining the root path

You can use the network plan (see figure 45) to follow the flow chart (see figure 44) for determining the root path. The administrator has specified a priority in the bridge identification for each bridge. The bridge with the smallest numerical value for the bridge identification takes on the role of the root bridge, in this case, bridge 1. In the example all the sub-paths have the same path costs. The protocol blocks the path between bridge 2 and bridge 3 as a connection from bridge 3 via bridge 2 to the root bridge would result in higher path costs.

The path from bridge 6 to the root bridge is interesting:

- The path via bridge 5 and bridge 3 creates the same root path costs as the path via bridge 4 and bridge 2.
- The bridges select the path via bridge 5 because the value 28,672 for the priority in the bridge identifier is smaller than value 32,768.
- There are also 2 paths between bridge 6 and bridge 4. The port identifier is decisive here (Port 1 < Port 3).

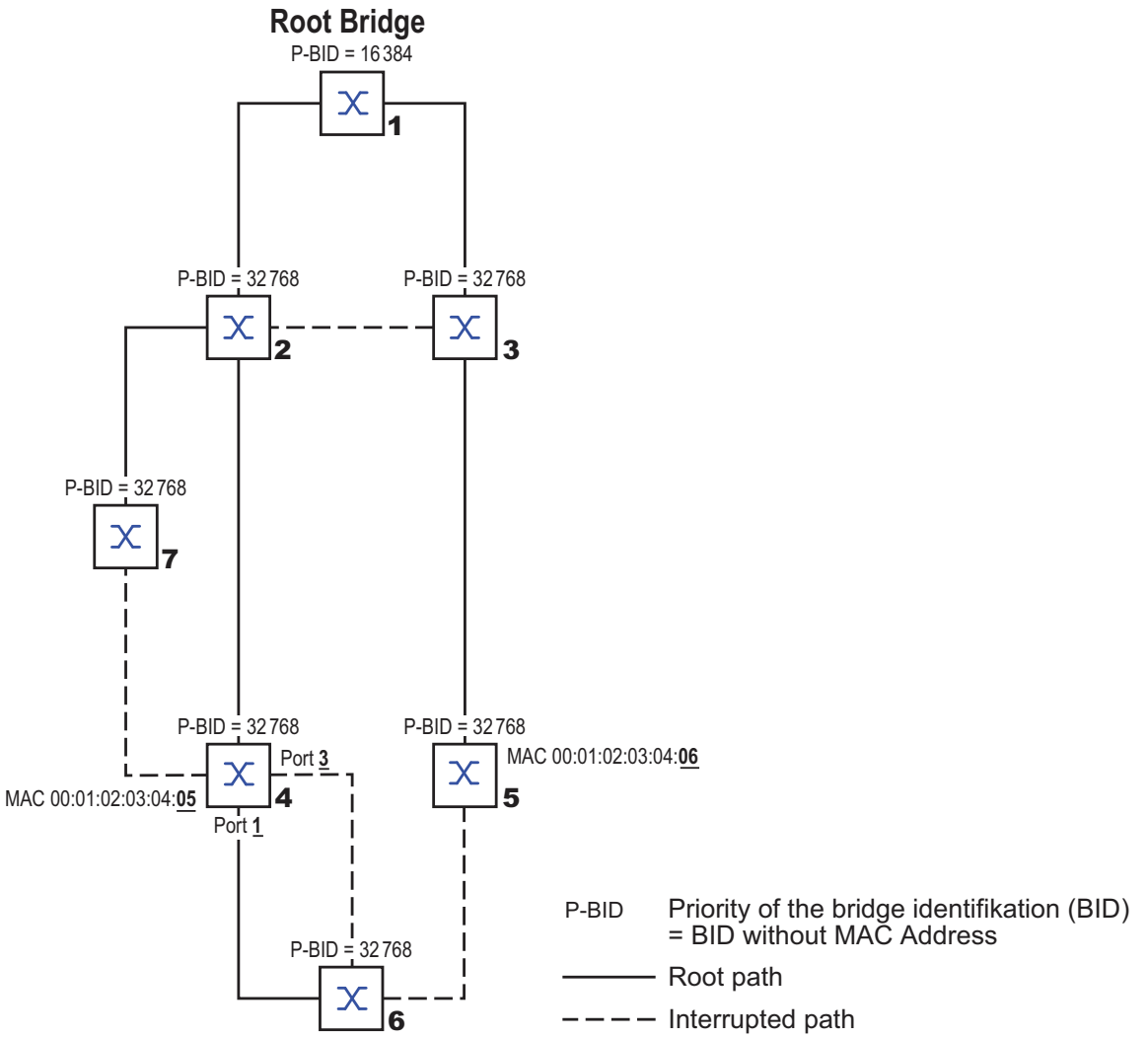


Figure 45: Example of determining the root path

6.4 Example of manipulating the root path

You can use the network plan (see figure 45) to follow the flow chart (see figure 44) for determining the root path. The Administrator has performed the following:

– Left the default value of 32,768 (8000H) for every bridge apart from bridge 1 and bridge 5, and
– assigned to bridge 1 the value 16,384 (4000H), thus making it the root bridge.

The protocol blocks the path between bridge 2 and bridge 3 as a connection from bridge 3 via bridge 2 to the root bridge would mean higher path costs.

The path from bridge 6 to the root bridge is interesting:

- The path via bridge 5 and bridge 3 creates the same root path costs as the path via bridge 4 and bridge 2.
- STP selects the path using the bridge that has the lowest MAC address in the bridge identification (bridge 4 in the illustration).
- There are also 2 paths between bridge 6 and bridge 4. The port identifier is decisive here.

Note: Because the Administrator does not change the default values for the priorities of the bridges in the bridge identifier, apart from the value for the root bridge, the MAC address in the bridge identifier alone determines which bridge becomes the new root bridge if the current root bridge goes down.

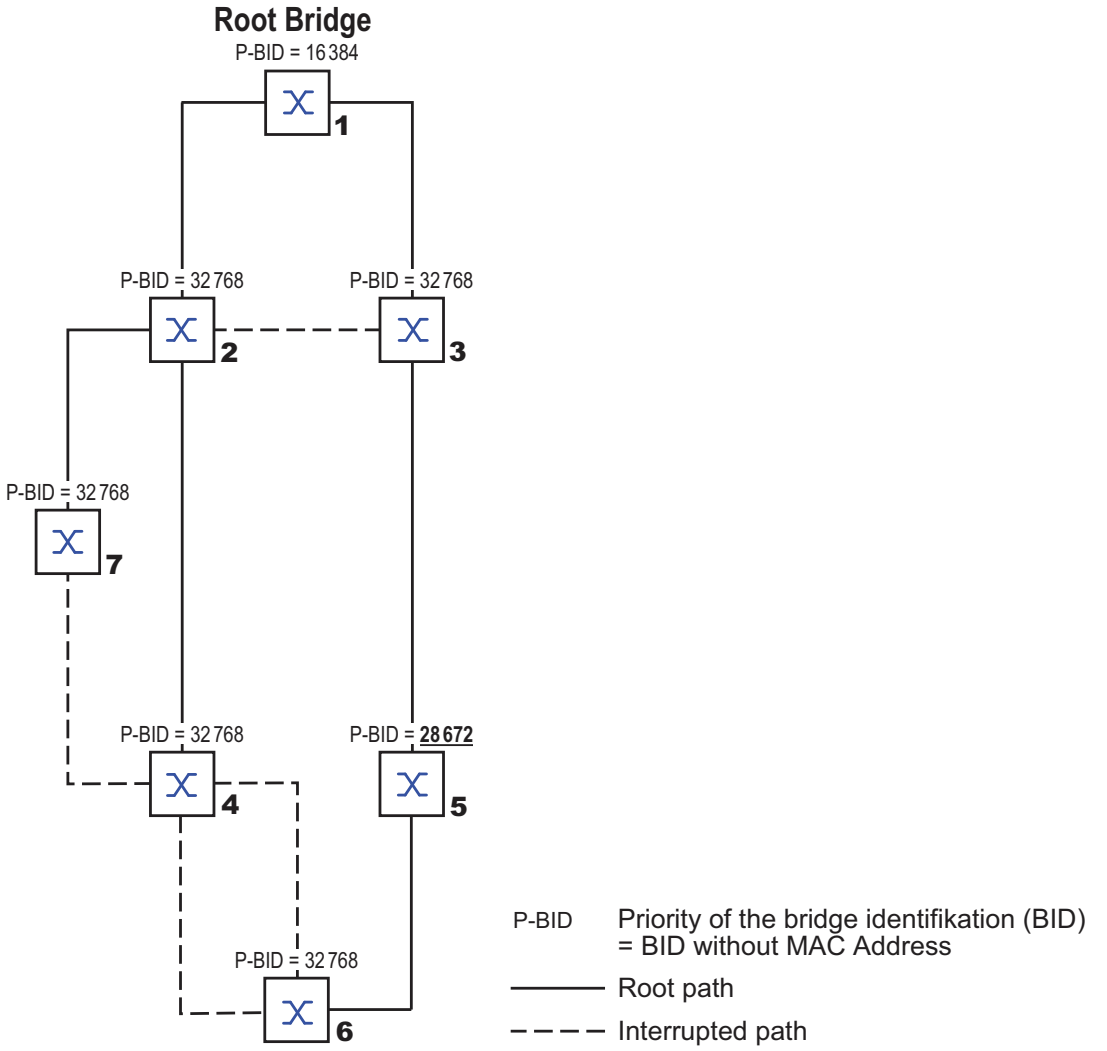


Figure 46: Example of manipulating the root path

6.5 Example of manipulating the tree structure

The Management Administrator soon discovers that this configuration with bridge 1 as the root bridge (see on page 93 “Example of determining the root path”) is invalid. On the paths from bridge 1 to bridge 2 and bridge 1 to bridge 3, the control packets which the root bridge sends to all other bridges add up. If the Management Administrator configures bridge 2 as the root bridge, the burden of the control packets on the subnetworks is distributed much more evenly. The result is the configuration shown here (see figure 47). The path costs for most of the bridges to the root bridge have decreased.

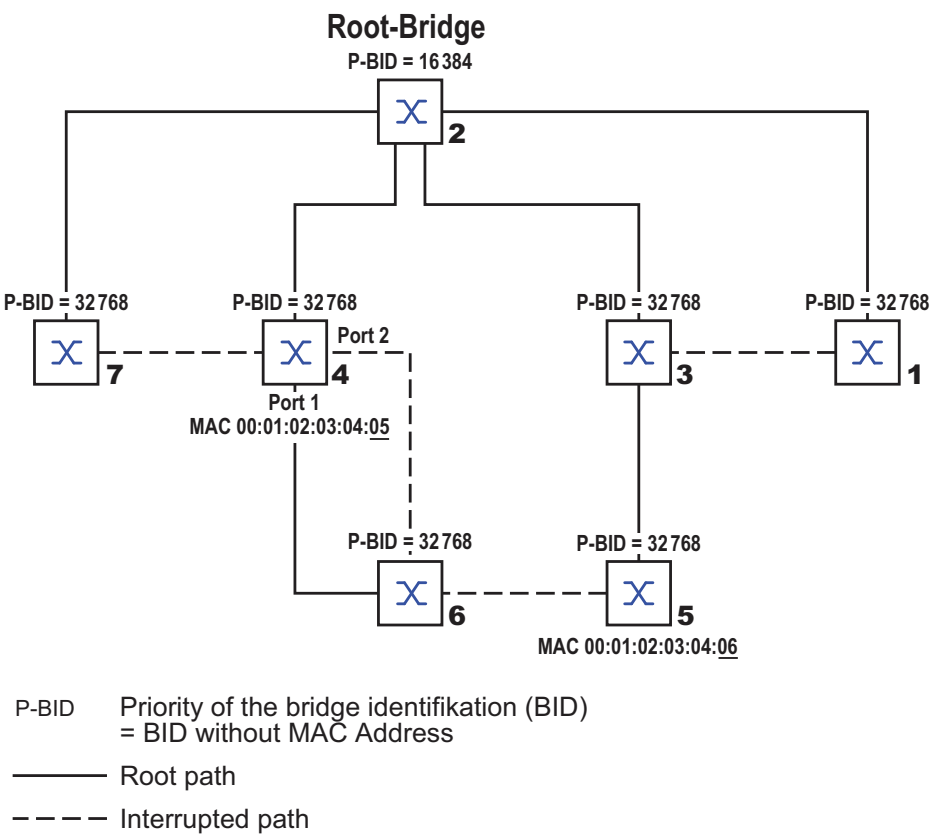


Figure 47: Example of manipulating the tree structure

6.6 The Rapid Spanning Tree Protocol

The RSTP uses the same algorithm for determining the tree structure as STP. RSTP merely changes parameters, and adds new parameters and mechanisms that speed up the reconfiguration if a link or bridge becomes inoperable.
The ports play a significant role in this context.

6.6.1 Port roles

RSTP assigns each bridge port one of the following roles (see figure 48):

- Root Port:
  This is the port at which a bridge receives data packets with the lowest path costs from the root bridge.
  If there are multiple ports with equally low path costs, the bridge ID of the bridge that leads to the root (designated bridge) decides which of its ports is given the role of the root port by the bridge further away from the root.
  If a bridge has multiple ports with equally low path costs to the same bridge, the bridge uses the port ID of the bridge leading to the root (designated bridge) to decide which port it selects locally as the root port (see figure 44).
  The root bridge itself does not have a root port.
- Designated port:
  The bridge in a network segment that has the lowest root path costs is the designated bridge.
  If more than 1 bridge has the same root path costs, the bridge with the smallest value bridge identifier becomes the designated bridge. The designated port on this bridge is the port that connects a network segment leading away from the root bridge. If a bridge is connected to a network segment with more than one port (via a hub, for example), the bridge gives the role of the designated port to the port with the better port ID.

- Edge port
  Every network segment with no additional RSTP bridges is connected with exactly one designated port. In this case, this designated port is also an edge port. The distinction of an edge port is the fact that it does not receive any RST BPDUs (Rapid Spanning Tree Bridge Protocol Data Units).
- Alternate port
  This is a blocked port that takes over the task of the root port if the connection to the root bridge is lost. The alternate port provides a backup connection to the root bridge.
- Backup port
  This is a blocked port that serves as a backup in case the connection to the designated port of this network segment (without any RSTP bridges) is lost
- Disabled port
  This is a port that does not participate in the Spanning Tree Operation, i.e., the port is switched off or does not have any connection.

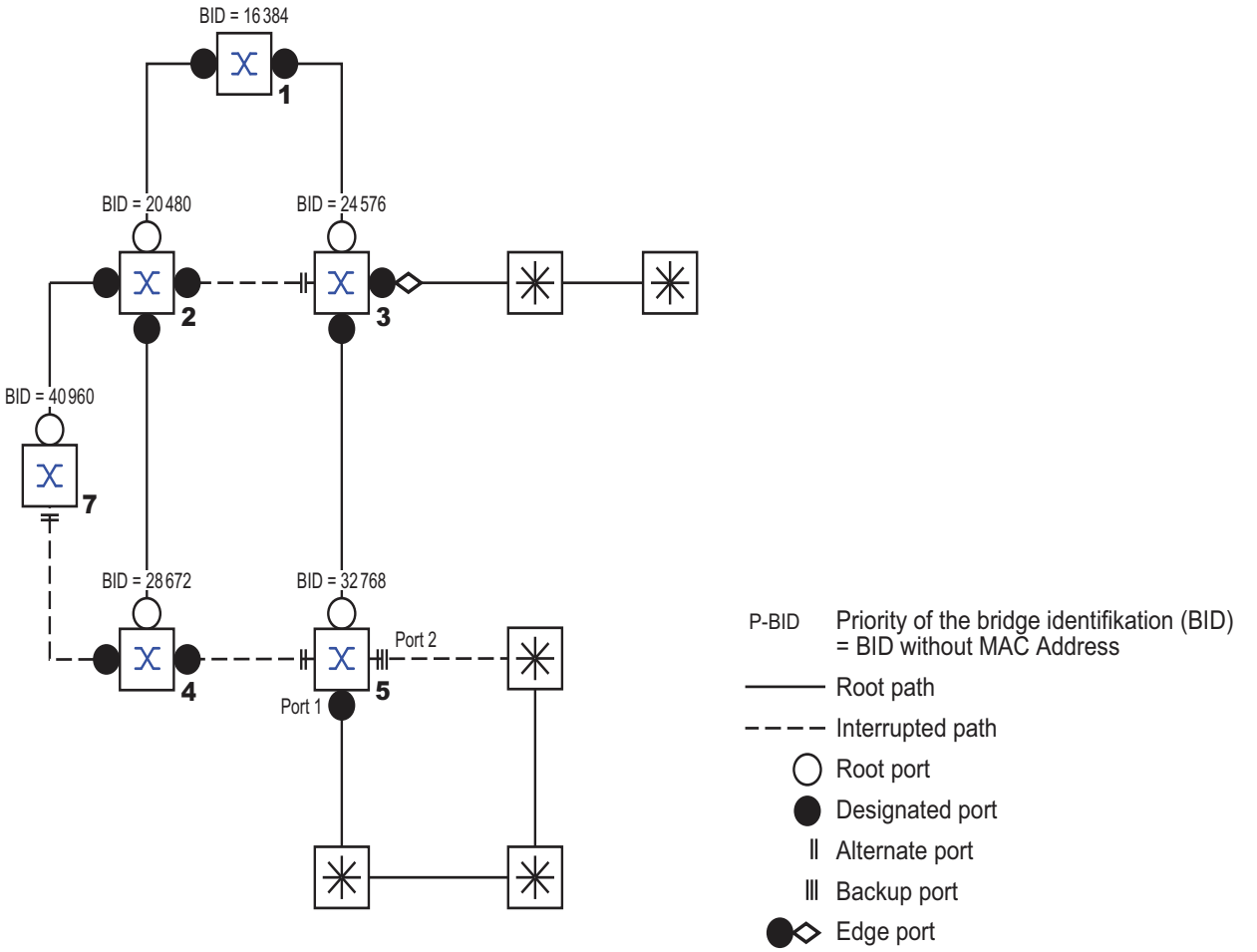


Figure 48: Port role assignment

6.6.2 Port states

Depending on the tree structure and the state of the selected connection paths, the RSTP assigns the ports their states.

STP port state	Administrative bridge port state	MAC operational	RSTP Port state	Active topology (port role)
DISABLED	Disabled	FALSE	Discarding[a]	Excluded (disabled)
DISABLED	Enabled	FALSE	Discarding[a]	Excluded (disabled)
BLOCKING	Enabled	TRUE	Discarding[b]	Excluded (alternate, backup)
LISTENING	Enabled	TRUE	Discarding[b]	Included (root, designated)
LEARNING	Enabled	TRUE	Learning	Included (root, designated)
FORWARDING	Enabled	TRUE	Forwarding	Included (root, designated)

Table 13: Relationship between port state values for STP and RSTP.

a. The dot1d-MIB displays “Disabled”
b. The dot1d-MIB displays “Blocked”

Meaning of the RSTP port states:

- Disabled: Port does not belong to the active topology
- Discarding: No address learning in FDB, no data traffic except for STP BPDUs
- Learning: Address learning active (FDB) and no data traffic except for STP BPDUs
- Forwarding: Address learning is active (FDB), sending and receipt of all frame types (not only STP BPDUs)

6.6.3 Spanning Tree Priority Vector

To assign roles to the ports, the RSTP bridges exchange configuration information with each other. This information is known as the Spanning Tree Priority Vector. It is part of the RSTP BPDUs and contains the following information:

- Bridge identification of the root bridge
- Root path costs of the sending bridge
- Bridge identification of the sending bridge
- Port identifiers of the ports through which the message was sent
- Port identifiers of the ports through which the message was received

Based on this information, the bridges participating in RSTP are able to determine port roles themselves and define the port states of their own ports.

6.6.4 Fast reconfiguration

Why can RSTP react faster than STP to an interruption of the root path?

- Introduction of edge-ports:
  During a reconfiguration, RSTP switches an edge port into the transmission mode after three seconds and then waits for the “Hello Time” (see table 14) to elapse, to be sure that no bridge sending BPDUs is connected.
  When the user determines that a terminal device is connected at this port and will remain connected, he can switch off RSTP at this port. Thus no waiting times occur at this port in the case of a reconfiguration.
- Introduction of alternate ports:
  As the port roles are already distributed in normal operation, a bridge can immediately switch from the root port to the alternative port after the connection to the root bridge is lost.
- Communication with neighboring bridges (point-to-point connections):
  Decentralized, direct communication between neighboring bridges enables reaction without wait periods to status changes in the spanning tree topology.

- Address table:
  With STP, the age of the entries in the FDB determines the updating of communication. RSTP immediately deletes the entries in those ports affected by a reconfiguration.
- Reaction to events:
  Without having to adhere to any time specifications, RSTP immediately reacts to events such as connection interruptions, connection reinstatements, etc.

Note: The downside of this fast reconfiguration is the possibility that data packages could be duplicated and/or arrive at the recipient in the wrong order during the reconfiguration phase of the RSTP topology. If this is unacceptable for your application, use the slower Spanning Tree Protocol or select one of the other, faster redundancy procedures described in this manual.

6.6.5 Configuring the Rapid Spanning Tree

☐ Set up the network to meet your demands.

Note: Before you connect the redundant lines, you must complete the configuration of the RSTP.
You thus avoid loops during the configuration phase.

☐ For devices with DIP switches, you switch these to “deactivated” (both to ON), so that the software configuration is not restricted.
☐ Select the `Redundancy:Rapid Spanning Tree:Global` dialog.
☐ Switch on RSTP on each device

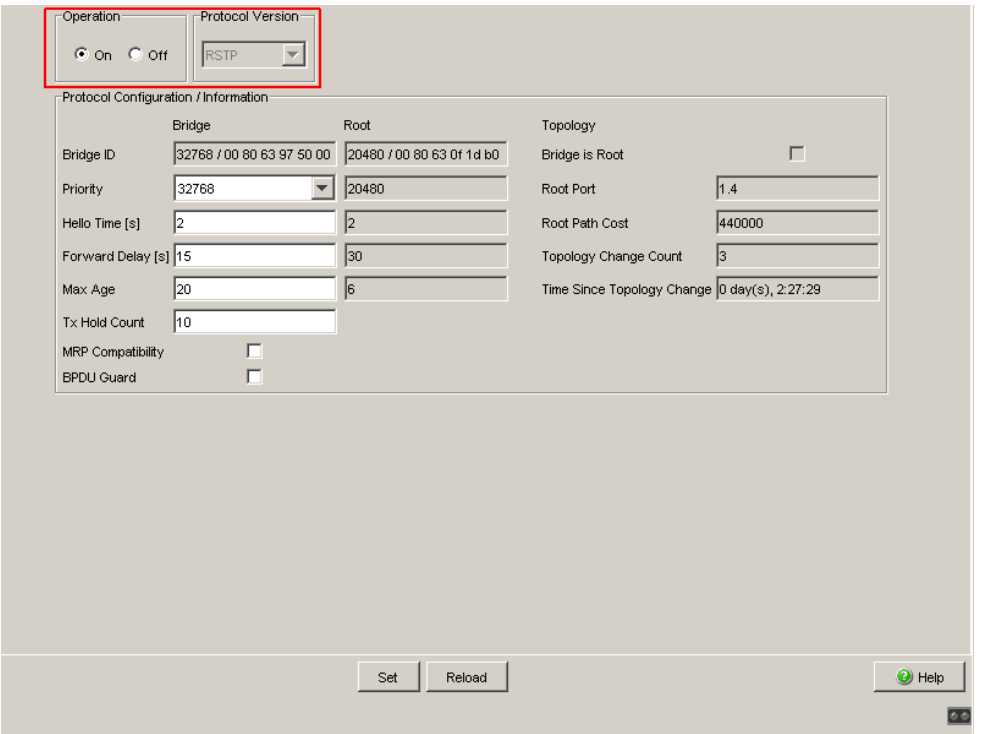


Figure 49: Operation on/off

☐ Define the desired Switch as the root bridge by assigning it the lowest priority in the bridge information among all the bridges in the network, in the “Protocol Configuration/Information” frame. Note that only multiples of 4,096 can be entered for this value (see table 14). In the “Root Information” frame, the dialog shows this device as the root.
A root switch has no root port and a root cost of 0.

☐ If necessary, change the default priority value of 32,768 in other bridges in the network in the same way to the value you want (multiples of 4,096).
For each of these bridges, check the display
in the “Root Information” frame:
– Root-ID: Displays the root bridge’s bridge identifier
– Root Port: Displays the port leading to the root bridge
– Root Cost: Displays the root cost to the root bridge
in the “Protocol Configuration/Information” frame:
– Priority: Displays the priority in the bridge identifier for this bridge
– MAC Address: Displays the MAC address of this Switch
– Topology Changes: Displays the number of changes since the start of RSTP
– Time since last change: Displays the time that has elapsed since the last network reconfiguration

☐ If necessary, change the values for “Hello Time”, “Forward Delay” and “Max. Age” on the rootbridge. The root bridge then transfers this data to the other bridges. The dialog displays the data received from the root bridge in the left column. In the right column you enter the values which shall apply when this bridge becomes the root bridge. For the configuration, take note of table 14.

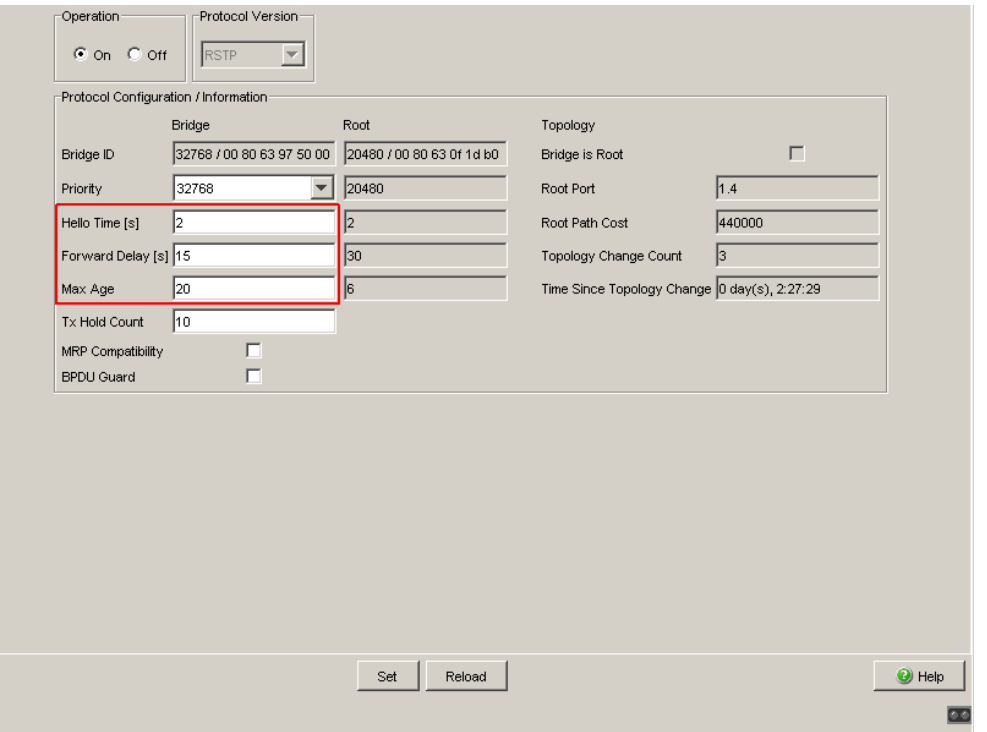


Figure 50: Assigning Hello Time, Forward Delay and Max. Age

The times entered in the RSTP dialog are in units of 1 s
Example: a Hello Time of 2 corresponds to 2 seconds.

☐ Now connect the redundant lines.

Parameter	Meaning	Possible Values	Default Setting
Priority	The priority and the MAC address go together to make up the bridge identification.	0 < n*4,096 (1000H) < 61,440 (F000H)	32,768 (8000H)
Hello Time	Sets the Hello Time. The local `Hello Time` is the time in seconds between the sending of two configuration messages (Hello packets). If the local device has the root function, the other devices in the entire network take over this value. Otherwise the local device uses the value of the root bridge in the “Root” column on the right.	1 - 2	2
Forward Delay	Sets the Forward Delay parameter. In the previous STP protocol, the Forward Delay parameter was used to delay the status change between the statuses `disabled`, `discarding`, `learning`, `forwarding`. Since the introduction of RSTP, this parameter has a subordinate role, because the RSTP bridges negotiate the status change without any specified delay. If the local device is the root, the other devices in the entire network take over this value. Otherwise the local device uses the value of the root bridge in the “Root” column on the right.	4 - 30 s See the note following this table.	15 s
Max Age	Sets the Max Age parameter. In the previous STP protocol, the Max Age parameter was used to specify the validity of STP BPDUs in seconds. For RSTP, Max Age signifies the maximum permissible branch length (number of devices to the root bridge). If the local device is the root, the other devices in the entire network take over this value. Otherwise the local device uses the value of the root bridge in the “Root” column on the right.	6 - 40 s See the note following this table.	20 s

Table 14: Global RSTP settings

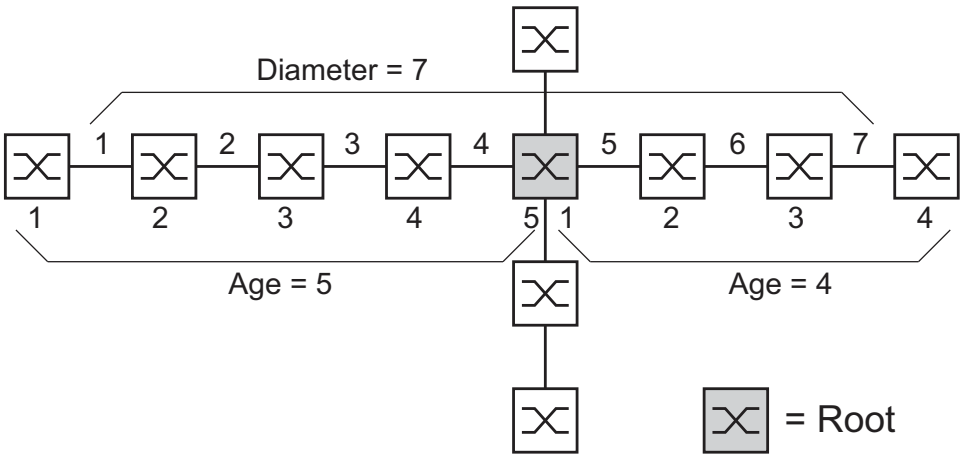


Figure 51: Definition of diameter and age

The network diameter is the number of connections between the two devices furthest away from the root bridge.

Note: The parameters
– Forward Delay and
– Max Age
have a relationship to each other:

Forward Delay ≥ (Max Age/2) + 1

If you enter values that contradict this relationship, the device then replaces these values with a default value or with the last valid values.

☐ When necessary, change and verify the settings and displays that relate to each individual port (dialog: `Rapid Spanning Tree:Port`).

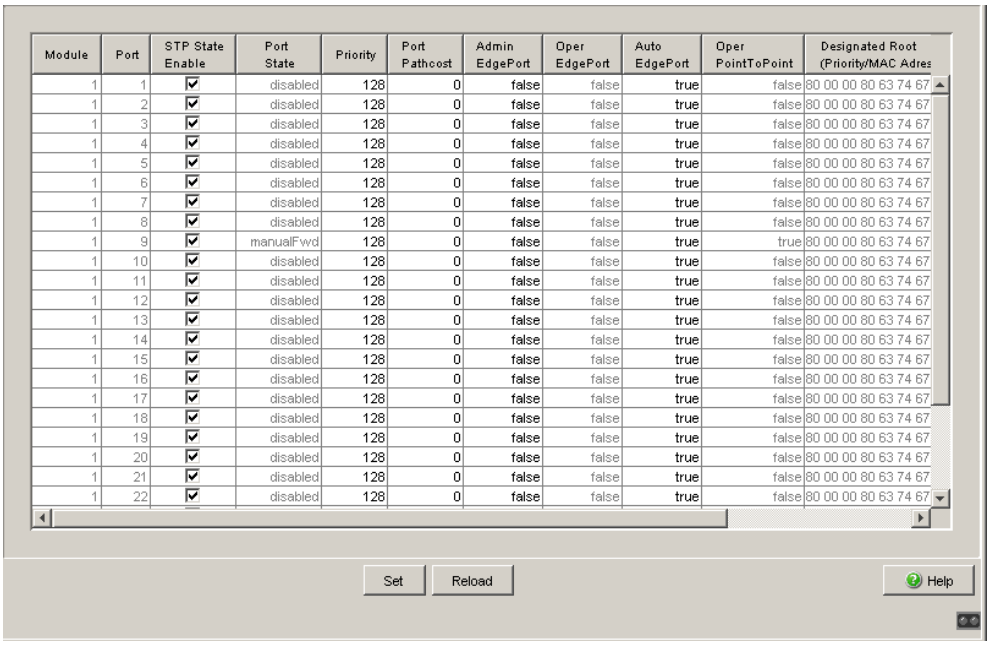


Figure 52: Configuring RSTP for each port

Note: Deactivate the Spanning Tree Protocol on the ports connected to a redundant ring, because Spanning Tree and Ring Redundancy work with different reaction times.

If you are using the device in a Multiple Spanning Tree (MSTP) environment, the device only participates in the Common Spanning Tree (CST) instance. This chapter of the manual also uses the term Global MST instance to describe this general case.

Parameter	Meaning	Possible Values	Default Setting
STP active	Here you can switch Spanning Tree on or off for this port. If Spanning Tree is activated globally and switched off at one port, this port does not send STP-BPDUs and drops any STP-BPDUs received. **Note:** If you want to use other layer 2 redundancy protocols such as HIPER-Ring or Ring/Network coupling in parallel with Spanning Tree, make sure you switch off the ports participating in these protocols in this dialog for Spanning Tree. Otherwise the redundancy may not operate as intended or loops can result.	`On`, `Off`	`On`
Port status (read only)	Displays the STP port status with regard to the global MSTI (IST).	`discarding`, `learning`, `forwarding`, `disabled`, `manualForwarding`, `notParticipate`	-
Port priority	Here you enter the port priority (the four highest bits of the port ID) with regard to the global MSTI (IST) as a decimal number of the highest byte of the port ID.	16 ≤ n·16 ≤ 240	128
Port path costs	Enter the path costs with regard to the global MSTI (IST) to indicate preference for redundant paths. If the value is 0, the Switch automatically calculates the path costs for the global MSTI (IST) depending on the transmission rate.	0 - 200000000	0 (automatically)

Table 15: Port-related RSTP settings and displays

Parameter	Meaning	Possible Values	Default Setting
Admin Edge Port	Only activate this setting when a terminal device is connected to the port (administrative: default setting). Then the port immediately has the forwarding status after a link is set up, without first going through the STP statuses. If the port still receives an STP-BPDU, the device blocks the port and clarifies its STP port role. In the process, the port can switch to a different status, e.g. `forwarding`, `discarding`, `learning`. Deactivate the setting when the port is connected to a bridge. After a link is set up, the port then goes through the STP statuses first before taking on the `forwarding` status, if applicable. This setting applies to all MSTIs.	`active` (box selected), `inactive` (box empty)	`inactive`
Oper Edge Port	The device sets the “Oper Edge Port” condition to `true` if it has not received any STP-BPDUs, i.e. a terminal device is connected. It sets the condition to `false` if it has received STP-BPDUs, i.e. a bridge is connected. This condition applies to all MSTIs.	`true`, `false`	-
Auto Edge Port	The device only considers the Auto Edge Port setting when the Admin Edge Port parameter is deactivated. If Auto Edge Port is active, after a link is set up the device sets the port to the forwarding status after 1.5 · `Hello Time` (in the default setting 3 s). If Auto Edge Port is deactivated, the device waits for the `Max Age` instead (in the default setting 20 s). This setting applies to all MSTIs.	`active` (box selected), `inactive` (box empty)	`active`

Table 15: Port-related RSTP settings and displays

Parameter	Meaning	Possible Values	Default Setting
Oper PointToPoint	The device sets the “Oper point-to-point” condition to `true` if this port has a full duplex condition to an STP device. Otherwise it sets the condition to `false` (e.g. if a hub is connected). The point-to-point connection makes a direct connection between 2 RSTP devices. The direct, decentralized communication between the two bridges results in a short reconfiguration time. This condition applies to all MSTIs.	`true`, `false` The device determines this condition from the duplex mode: FDX: `true` HDX: `false`	
Received bridge ID (read only)	Displays the remote bridge ID from which this port last received an STP-BPDU.[a]	Bridge identification (format ppppp / mm mm mm mm mm mm)	-
Received path costs (read only)	Displays the path costs of the remote bridge from its root port to the CIST root bridge.[a]	0-200000000	-
Received port ID (read only)	Displays the port ID at the remote bridge from which this port last received an STP-BPDU.[a]	Port ID, format pn nn, with p: port priority / 16, nnn: port No., (both hexadecimal)	-

Table 15: Port-related RSTP settings and displays

– [a] These columns show you more detailed information than that available up to now:
For designated ports, the device displays the information for the STP-BPDU last received by the port. This helps with the diagnosis of possible STP problems in the network.
For the port roles alternative, back-up, master and root, in the stationary condition (static topology), this information is identically to the designated information.
If a port has no link, or if it has not received any STP-BDPUs for the current MSTI, the device displays the values that the port would send as a designated port.

6.7 Combining RSTP and MRP

In the MRP compatibility mode, the device allows you to combine RSTP with MRP.
With the combination of RSTP and MRP, the fast switching times of MRP are maintained.
The RSTP diameter (see figure 51) depends on the “Max Age”. It applies to the devices outside the MRP-Ring.

Note: The combination of RSTP and MRP presumes that both the root bridge and the backup root bridge are located within the MRP-Ring.

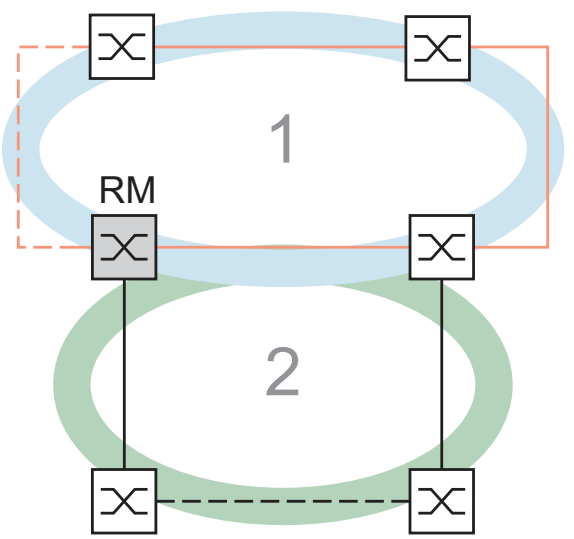


Figure 53: Combination of RSTP and MRP
1: MRP-Ring
2: RSTP-Ring
RM: Ring Manager

To combine RSTP with MRP, you perform the following steps in sequence:

- Configure MRP on all devices in the MRP-Ring.
- Close the redundant line in the MRP-Ring.
- Activate RSTP at the RSTP ports and also at the MRP-Ring ports.
- Configure the RSTP root bridge and the RSTP backup root bridge in the MRP-Ring:
  - Set their priority.
  - If you exceed the RSTP diameter specified by the preset value of `Max Age` = 20, modify Max Age and Forward Delay accordingly.
- Switch on RSTP globally.
- Switch on the MRP compatibility mode.
- After configuring all the participating devices, connect the redundant RSTP connection.

6.7.1 Application example for the combination of RSTP and MRP

The figure (see figure 54) shows an example for the combination of RSTP and MRP.

Parameters	S1	S2	S3	S4	S5	S6
MRP settings						
Ring redundancy: MRP version	MRP	MRP			MRP	MRP
Ring port 1	1.1	1.1			1.1	1.1
Ring port 2	1.2	1.2			1.2	1.2
Port from MRP-Ring to the RSTP network	1.3	1.3	-	-	-	-
Redundancy Manager mode	On	Off	–	–	Off	Off
MRP operation	On	On	Off	Off	On	On
RSTP settings						
For each RSTP port: STP State Enable	On	On	On	On	On	On
Protocol Configuration: priority (S2<S1<S3 and S2<S1<S4)	4,096	0	32,768	32,768	32,768	32,768
RSTP:Global: Operation	On	On	On	On	On	On
RSTP:Global: MRP compatibility	On	On	–	–	On	On

Table 16: Values for the configuration of the switches of the MRP/RSTP example

Prerequisites for further configuration:

- You have configured the MRP settings for the devices in accordance with the above table.
- The redundant line in the MRP-Ring is closed.

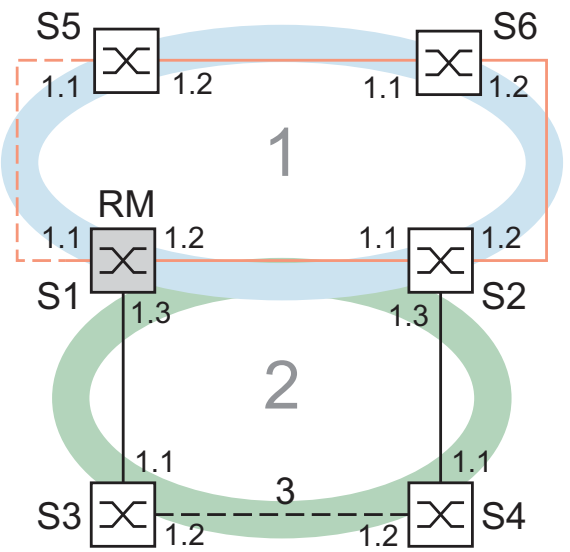


Figure 54: Application example for the combination of RSTP and MRP
1: MRP-Ring, 2: RSTP-Ring, 3: Redundant RSTP connection
RM: Ring Manager
S2 is RSTP Root Bridge
S1 is RSTP Backup Root Bridge

☐ Activate RSTP at the ports, using S1 as an example (see table 16).

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`interface 1/1`	Change to the Interface Configuration mode of port 1/1.
`spanning-tree port mode`	Activate RSTP on the port.
`exit`	Change to the Configuration mode.
`interface 1/2`	Change to the interface configuration mode for interface 1/2.
`spanning-tree port mode`	Activate RSTP on the port.

`exit`	Change to the Configuration mode.
`interface 1/3`	Change to the interface configuration mode for interface 1/3.
`spanning-tree port mode`	Activate RSTP on the port.
`exit`	Change to the Configuration mode.

☐ Configure the global settings, using S1 as an example:
- the RSTP priority
- global operation
- the MRP compatibility mode

`spanning-tree mst priority 0 4096`	Set the RSTP priority for the MST instance 0 to the value 4,096. the MST instance 0 is the default instance.
`spanning-tree`	Activate RSTP operation globally.
`spanning-tree stp-mrp-mode`	Activate MRP compatibility.

☐ Configure the other switches S2 though S6 with their respective values (see table 16).

☐ Connect the redundant RSTP connection.

7 VRRP/HiVRRP

The Virtual Router Redundancy Protocol (VRRP) is a procedure that enables the system to react to the failure of a router.
VRRP is used in networks with terminal devices that only support one entry for the default gateway. If the default gateway fails, VRRP ensures that the terminal devices find a redundant gateway.
The Hirschmann company has further developed the VRRP into the Hirschmann Virtual Router Redundancy Protocol (HiVRRP). With the appropriate configuration, HiVRRP provides switching times of less than 400 ms.

Note: You will find detailed information on VRRP and HiVRRP in the "Routing Configuration“ user manual.

7.1 VRRP/HiVRRP Configuration

With this dialog you can enter general settings and settings for each port for the VRRP.
You can configure
– up to 8 virtual routers per port and
– up to 16 entries with HiVRRP per router.

7.1.1 General settings

- Operation: Switch the VRRP function on and off.
- Version: Display the VRRP version.
- Send VRRP Master Trap: As soon as the router takes over the VRRP master function, it sends a master trap.
- Send VRRP Authentication Error Trap: As soon as the router receives a VRRP message with an incorrect authentication, it sends a VRRP authentication error trap.

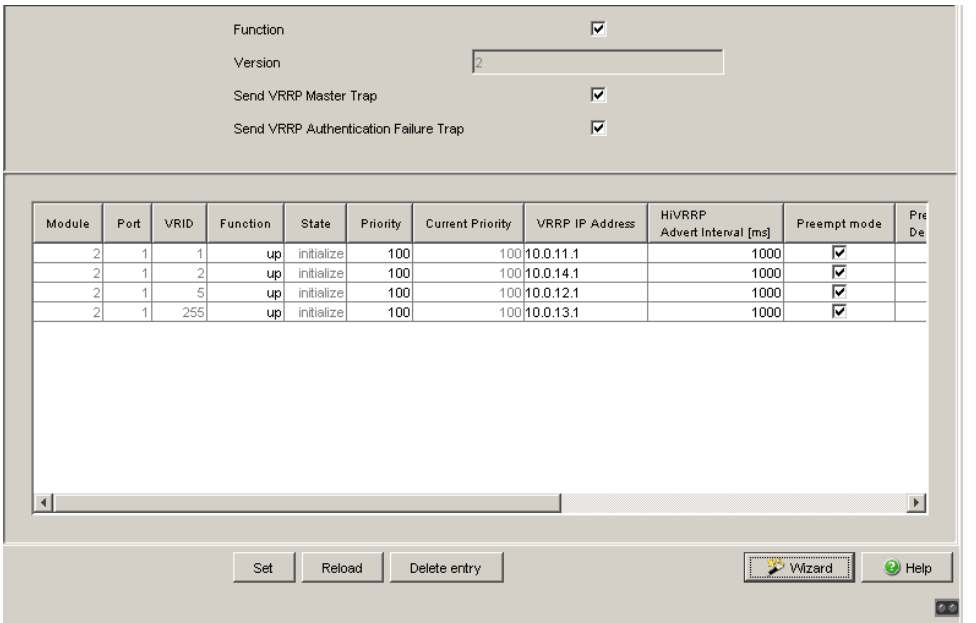


Figure 55: VRRP/HiVRRP Configuration dialog

7.1.2 VRRP instance settings

- Module: Module of the device
- Port: Port to which this entry applies
- VRID: Virtual router ID (value 1-255)
- Operation: Switch the VRRP instances on and off
- Status: VRRP state
  - `initialize`: VRRP is in the initialization phase. No master has been named yet.
  - `backup`: the Switch sees the possibility of becoming master.
  - `master`: the Switch is master.
- Priority: VRRP priority set (range: 1 to 255; default: 100).
  The router with the highest value is the master. If the virtual router IP address is the same as the IP address of the router interface, then this router is the “owner”. If an owner exists, then VRRP assigns the owner the VRRP priority 255 and thus declares it the master.

- Current Priority: VRRP priority actually used (range: 1 to 255). This value is usually the same as the VRRP priority set but can be smaller if tracking objects monitored have the status “down”.
- VRRP IP address: Primary virtual router IP address.
- HiVRRP advertisement Interval: Interval for sending out messages (advertisements) as the master
  (range for VRRP: 1 to 255 s,
  range for HiVRRP: 100 to 255.000 ms,
  default setting: 1 s).
- Preempt mode: This setting specifies whether this router, as a backup router, will take over the master role from a master router with a lower VRRP priority. If the preempt mode is switched off, this router only takes on the master role if the IP Multicast message from the existing master does not appear.
- Preempt delay: The preempt mode, in collaboration with VRRPtracking, can enable a switch to a better router. However, dynamicrouting procedures take a certain amount of time to react to changedroutes and refill their routing table. To avoid the loss of packetsduring this time, delayed switching (preempt delay) from the masterrouter to the backup router enables the dynamic routing procedureto fill the routing tables (value: 0-65535 s, default setting 0 s).
- Domain ID: The domain ID is a number identifying the domain (see on page 123 “HiVRRP Domains”).
  Range: 0 to 8, default setting 0: no domain.
- Domain role:
  none: not a member of a domain
  member: copies the behavior of the supervisor
  supervisor: determines the behavior of the domains
- Authentication: Type of authentication used:
  - `noAuthentication`: VRRP information is exchanged without authentication.
  - `simpleTextPassword`: VRRP information is exchanged with plain text password authentication.
- Key: Password for authentication.
  In order to communicate, the routers with the same virtual router IP address must have the same authentication setting.
- Master IP Address: Actual router interface IP address of the master.

7.1.3 Setting up the VRRP router instance

- ☐ In the `Redundancy:VRRP/HiVRRP:Configuration` dialog, click “Wizard” at the bottom right.
- ☐ In the table in the Wizard dialog, select a port row and enter the virtual router ID in the VRID row. You can configure up to 8 virtual routers per interface.
- ☐ Click “Continue”.
- ☐ Under “Edit entry” in the “Basic configuration” frame, enter:
  - the IP address of the virtual router
  - the VRRP priority
  - the type of authentication
  - the key for the authentication
  - the preempt delay
  - the advertisement interval.

  If necessary, select the preempt mode
  Switch on the operation of VRRP.
  If you want
  - switching times of less than 3 s,
  - the routers to use Unicasts to communicate with each other,
  - to set up domains or
  - to send link-down notifications,

  you activate the “HiVRRP” field.
  In the “HiVRRP” frame, enter:
  - the “Advertisement Interval”
  - the “Destination Address”. The HiVRRP destination address is the IP address of the partner HiVRRP router.
  - the IP address of the second router to which the link-down notifications are sent. This function can be used when the virtual router consists of two VRRP routers.
  - the domain ID
  - the domain role
- ☐ Click “Finish” to transfer the VRRP router interface to the VRRP router interface table
  or
- ☐ Click “Next” to assign tracking objects to the virtual router under “Tracking”. If a tracking object’s status changes to “down”, the VRRP priority is decremented.
  Select an existing tracking entry and click “Add”. You can add up to 8 tracking objects. Ascertain that the sum of the decrements of all the assigned tracking entries is less than the VRRP priority of this VRRP interface.

Note: As the IP address owner has the fixed VRRP priority 255 by definition, the VRRP tracking function requires the IP addresses of the VRRP router interfaces to differ from the virtual router IP address.

Note: Activate the preempt mode so that, the backup router can take over the master role after the decrementation of the master's VRRP priority via the tracking function.

- ☐ Click "Finish" to transfer the VRRP router interface to the VRRP router interface table
  or
- ☐ Click "Next" if you want to enter additional IP addresses under "Associated IP Addresses" (Multinetting).
- ☐ Click "Finish" to transfer the VRRP router interface to the VRRP router interface table.

7.1.4 Configuring the VRRP router instance

- ☐ In the `Redundancy:VRRP/HiVRRP:Configuration` dialog, double-click a cell of the table and edit the entry or right-click a cell and select a value.
- ☐ As an alternative to editing directly in the table, you can mark a row in the table and use the Wizard to edit it.

7.1.5 Deleting a VRRP router instance

- ☐ In the `Redundancy:VRRP/HiVRRP:Configuration` dialog, select a row and click "Remove". You thus delete the row.

7.2 HiVRRP Domains

A HiVRRP instance is a router instance configured as HiVRRP with functions that HiVRRP contains. In a HiVRRP domain you combine multiple HiVRRP instances of a router into one administrative unit. You nominate one HiVRRP instance as the supervisor of the HiVRRP domain. This supervisor regulates the behavior of all HiVRRP instances in its domain.
The router supports up to 8 domains.

7.2.1 Displaying HiVRRP domains

- Domain ID: identification of the domains
- Status: status of the supervisor of the domains
  `Supervisor`: supervisor is active
  `SupervisorDown`: supervisor is not active
  `noSupervisor`: no supervisor defined
- Supervisor Port: HiVRRP instance (module and port, written as <Slot>.<Port>) that was defined as the supervisor
- Supervisor VRID: VRID of the supervisor
- Supervisor Status: status of the supervisor
  - `initialize`: VRRP is in the initialization phase. No master has been named yet.
  - `backup`: the Switch sees the possibility of becoming master.
  - `master`: the Switch is master
  - `unknown`: no supervisor
- Current Priority: the current VRRP priority

7.2.2 HiVRRP domain instances at different ports

If domain instances (members) are divided among different physical ports, the router monitors by default only the supervisor's connection for line interruptions (“Redundancy Check per Member” deactivated).
You have the option of activating the monitoring of the other connections for line interruptions within the domain. Monitoring means that the router sends HiVRRP messages when it detects a line interruption. If there is a low probability of a line interruption, you select a long HiVRRP message interval (see on page 119 “VRRP instance settings”) in order to minimize the network load.

☐ In the “Redundancy check per member” column, you can activate the function for a chosen domain as required.

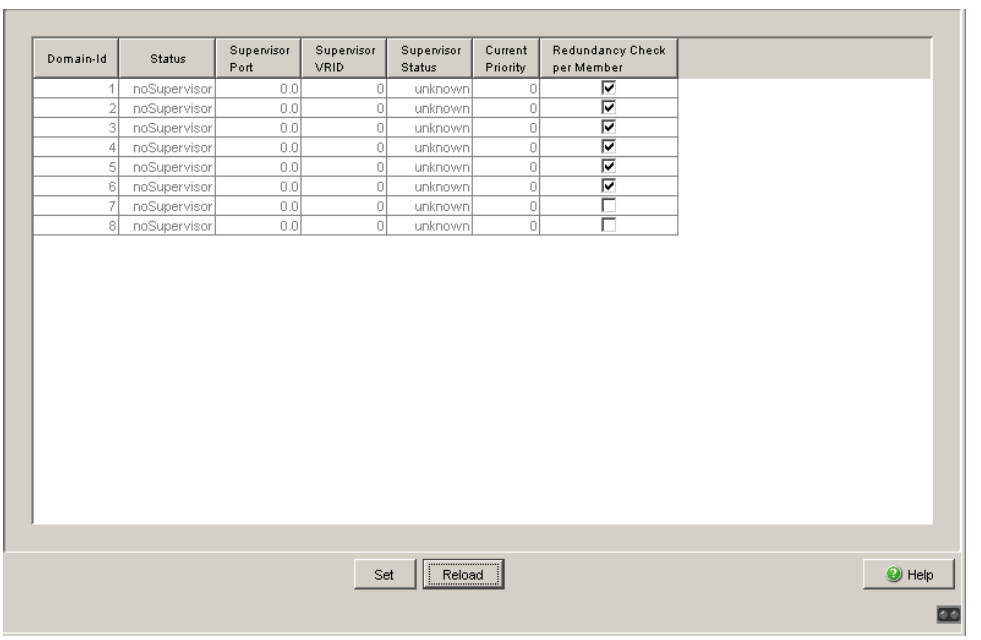


Figure 56: HiVRRP domain dialog

7.3 Statistics

The VRRP statistics window displays the numbers on counters that count events relevant to VRRP.

7.3.1 VRRP statistic for all ports

- Checksum errors: Number of VRRP advertisements received with the wrong checksum.
- Version errors: Number of VRRP advertisements received with an unknown or unsupported version number.
- VRID errors: Number of VRRP advertisements received with an invalid VRID for this virtual router.

7.3.2 VRRP statistics per port

- Module: Module of the device
- Port: Port to which this entry applies
- VRID: Virtual router ID.
- Become Master: Number of times the Switch has become the master.
- Advertise receives: Number of VRRP advertisements received.
- Advertise interval errors: Number of VRRP advertisements received by the router outside the advertisement interval.
- Authentication failures: Number of VRRP messages received with authentication errors.

- IP TTL errors: Number of VRRP advertisements received with an IP-TTL not equal to 255.
- Priority Zero packets received: Number of VRRP advertisements via a VRRP participant with a priority of 0.
- Priority Zero packets sent: Number of VRRP messages that the device has sent with a priority of 0.
- Received Bad Packets: Number of VRRP advertisements received with an invalid type.
- Address errors: Number of VRRP messages received for which the address list does not match the address list configured locally for the virtual router.
- Invalid authentication type: Number of VRRP advertisements received with an invalid authentication type.
- Authentication type mismatch: Number of VRRP messages received with an incorrect authentication type.
- Packet length errors:Number of VRRP messages received with an incorrect packet length.

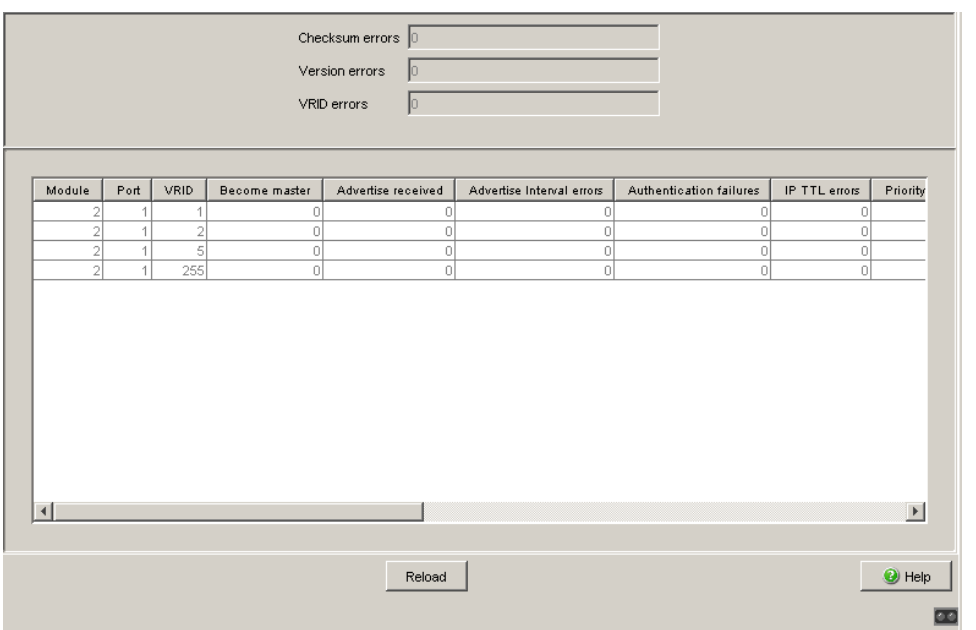


Figure 57: VRRP statistics dialog

7.4 Tracking

The VRRP Tracking window displays the status of all the tracking objects assigned to VRRP objects.

- Port: Port to which this entry applies, in the form <Slot>.<Port>
- VRID: Virtual router ID of the assigned virtual router.
- TrackID: the tracking object's ID number.
- Decrement: Change value by which the current VRRP priority of the assigned VRRP priority is reduced when the tracking object gets the status "down".
- Status: Current status of the tracking object:
  "up" or "down".
- Active: Entry is displayed as "active" if the tracking object is completely set up and is activated.
  If the entry is active, you can find more information about it in the "Tracking dialog" (see on page NOT DEFINED).
  If the entry is not active, its status is always "up".

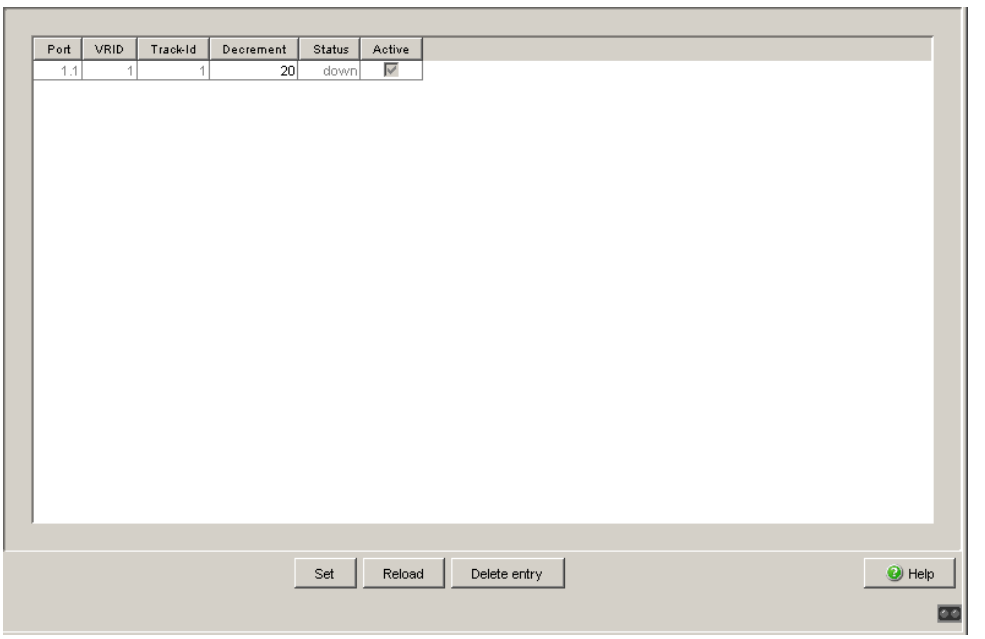


Figure 58: Tracking dialog

7.4.1 Deleting a tracking object

☐ In the `Redundancy:VRRP:Tracking` dialog, select a row and click “Remove”. You thus delete the row.

A Readers' Comments

What is your opinion of this manual? We are always striving to provide as comprehensive a description of our product as possible, as well as important information that will ensure trouble-free operation. Your comments and suggestions help us to further improve the quality of our documentation.

Your assessment of this manual:

	Very good	Good	Satisfactory	Mediocre	Poor
Precise description	O	O	O	O	O
Readability	O	O	O	O	O
Understandability	O	O	O	O	O
Examples	O	O	O	O	O
Structure	O	O	O	O	O
Completeness	O	O	O	O	O
Graphics	O	O	O	O	O
Drawings	O	O	O	O	O
Tables	O	O	O	O	O

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C Further Support

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User Manual

Routing Configuration
Industrial ETHERNET (Gigabit-)Switch
PowerMICE, MACH 4000

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Rel. 9.0 - 02/2015 – 09.01.2015

Contents

Safety Information

⚠ WARNING

UNCONTROLLED MACHINE ACTIONS
To avoid uncontrolled machine actions caused by data loss, configure all the data transmission devices individually.
Before you start any machine which is controlled via data transmission, be sure to complete the configuration of all data transmission devices.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

About this Manual

The “Routing Configuration User Manual” document contains the information you need to start operating the routing function. It takes you step-by-step from a small router application through to the router configuration of a complex network.
The manual enables you to configure your router by following the examples.

The “Routing Configuration” user manual requires you to be familiar with the content of the “Basic Configuration” user manual.

You can use this manual to configure simple networks without any special knowledge. The configuration of complex networks requires well-founded knowledge on the subject of routing and of the protocols IP, RIP, OSPF, IGMP and VRRP.

The “Installation” user manual contains a device description, safety instructions, a description of the display, and the other information that you need to install the device.

The “Basic Configuration” user manual contains the information you need to start operating the device. It takes you step by step from the first startup operation through to the basic settings for operation in your environment.

The “Redundancy Configuration” user manual document contains the information you require to select the suitable redundancy procedure and configure it.

The “Industry Protocols” user manual describes how the device is connected by means of a communication protocol commonly used in the industry, such as EtherNet/IP and PROFINET IO.

You will find detailed descriptions of how to operate the individual functions in the “Web-based Interface” and “Command Line Interface” reference manuals.

The Industrial HiVision network management software provides you with additional options for smooth configuration and monitoring:

- ActiveX control for SCADA integration
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- Client/server structure
- Event handling
- Event log
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Maintenance

Hirschmann are continually working on improving and developing their software. Check regularly whether there is an updated version of the software that provides you with additional benefits. You find information and software downloads on the Hirschmann product pages on the Internet (www.hirschmann.com).

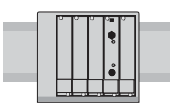
Key

The designations used in this manual have the following meanings:

▶	List
☐	Work step
■	Subheading
Link	Cross-reference with link
Note:	A note emphasizes an important fact or draws your attention to a dependency.
`Courier`	ASCII representation in the graphical user interface
	Execution in the Graphical User Interface
	Execution in the Command Line Interface

Symbols used:

	WLAN access point
	Router with firewall
	Switch with firewall
	Router
	Switch

	Bridge
	Hub
	A random computer
	Configuration Computer
	Server
	PLC - Programmable logic controller
	I/O - Robot

1 Configuration

Because the configuration of a router is very dependent on the conditions in your network, you are first provided with a general list of the individual configuration steps. To optimally cover the large number of options, this list is followed by examples of networks that usually occur in the industry sector. The examples are selected so that the configurations for other applications can be easily derived from them.

The configuration of the routing function usually contains the following steps:

☐ Drawing a network plan
Create a picture of your network so that you can clearly see the division into subnetworks and the related distribution of the IP addresses.
This step is very important. Good planning of the subnetworks with the corresponding network masks makes the router configuration much easier.

☐ Router basic settings
Along with the global switching on of the routing function, the router basic settings also contain the assignment of IP addresses and network masks to the router interfaces.

Note: Adhere to the sequence of the individual configuration steps so that the configuration computer has access to all the layer 3 Switches throughout the entire configuration phase.

Note: When you assign an IP address from the subnetwork of the management IP address to a router interface, the Switch deletes the management IP address. You access the Switch via the IP address of the router interface.
Activate the routing globally before you assign an IP address from the subnetwork of the management IP address to a router interface.

Note: When you assign the VLAN ID of the management VLAN to a router interface, the Switch deactivates the management IP address. You access the Switch via the IP address of the router interface. The management VLAN is the VLAN by means of which you access the management of all the Switches.

Note: Depending on your configuration steps, it may be necessary to change the IP parameters of your configuration computer to enable access to the layer 3 Switches.

☐ Selecting a routing procedure
On the basis of the network plan and the communication requirements of the connected devices, you select the optimal routing procedure (static routes, RIP, OSPF) for your situation. In doing so, consider which routing procedures the routers can use along a route.

☐ Configuring a routing procedure
Configure the selected routing procedure.

2 Routing - Basics

A router is a node for exchanging data on the layer 3 of the ISO/OSI layer model.
This ISO/OSI reference model had the following goals:

- To define a standard for information exchange between open systems;
- To provide a common basis for developing additional standards for open systems;
- To provide international teams of experts with functional framework as the basis for independent development of every layer of the model;
- To include in the model developing or already existing protocols for communications between heterogeneous systems;
- To leave sufficient room and flexibility for the inclusion of future developments.

The reference model consists of 7 layers, ranging from the application layer to the physical layer.

7	Application	Access to communication services from an application program
6	Presentation	Definition of the syntax for data communication
5	Session	Set up and breakdown of connections by synchronization and organization of the dialog
4	Transport	Specification of the terminal connection, with the necessary transport quality
3	Network	Transparent data exchange between two transport entities
2	Data-Link	Access to physical media and detection of transmission errors
1	Physical	Transmission of bit strings via physical media

Table 1: OSI Reference Model

What does the data exchange on the layer 3 mean in comparison with the data exchange on the layer 2?

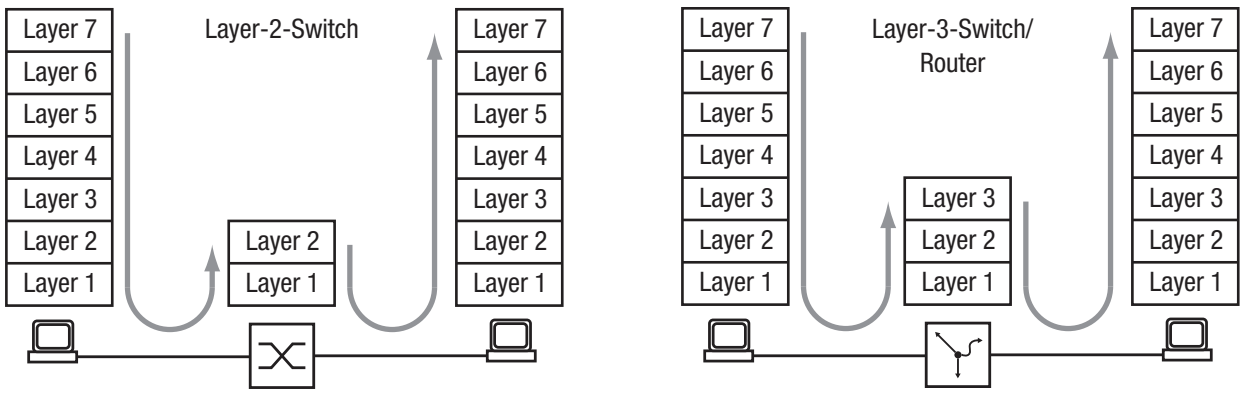


Figure 1: Data Transport by a Switch and a Router in the OSI Reference Model‘s Layers

On the layer 2, the MAC address signifies the destination of a data packet. The MAC address is an address tied to the hardware of a device. The layer 2 expects the receiver in the connected network. The data exchange to another network is the task of layer 3. Layer 2 data traffic is spread over the entire network. Every subscriber filters the data relevant for him from the data stream. Layer 2 switches are capable of steering the data traffic that is intended for a specific MAC address. It thus relieves some of the load on the network. Broadcast and multicast data packets are forwarded by the layer 2 switches at all ports.

IP is a protocol on the layer 3. IP provides the IP address for addressing data packets. The IP address is assigned by the network administrator.
By systematically assigning IP addresses, he can thus structure his network, breaking it down into subnets (see on page 19 “CIDR”). The bigger a network gets, the greater the data volume. Because the available bandwidth has physical limitations, the size of a network is also limited. Dividing large networks into subnets limits the data volume on these subnets. Routers divide the subnets from each other and only transmit the data that is intended for another subnet.

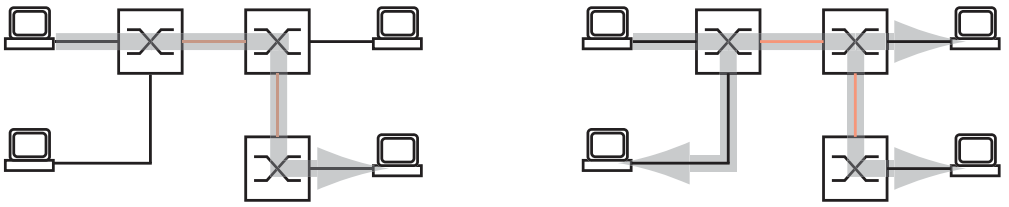


Figure 2: MAC Data Transmission: Unicast Data Packet (left) and Broadcast Data Packet (right)

This illustration clearly shows that broadcast data packets can generate a considerable load on larger networks. You also make your network easier to understand by forming subnets, which you connect with each other using routers and, strange as it sounds, also separate securely from each other.

A Switch uses the MAC destination address to transmit, and thus uses layer 2.
A router uses the IP destination address to transmit, and thus uses layer 3.
The subscribers associate the MAC and IP addresses using the Address Resolution Protocol (ARP).

2.1 ARP

The Address Resolution Protocol (ARP) determines the MAC address that belongs to an IP address. What is the benefit of this?

Let's suppose that you want to configure your Switch using the Web-based interface. You enter the IP address of your Switch in the address line of your browser. But which MAC address will your PC now use to display the information in the Switch in your browser window?

If the IP address of the Switch is in the same subnet as your PC, then your PC sends what is known as an ARP request. This is a MAC broadcast data packet that requests the owner of the IP address to send back his MAC address. The Switch replies with a unicast data packet containing his MAC address. This unicast data packet is called an ARP reply.

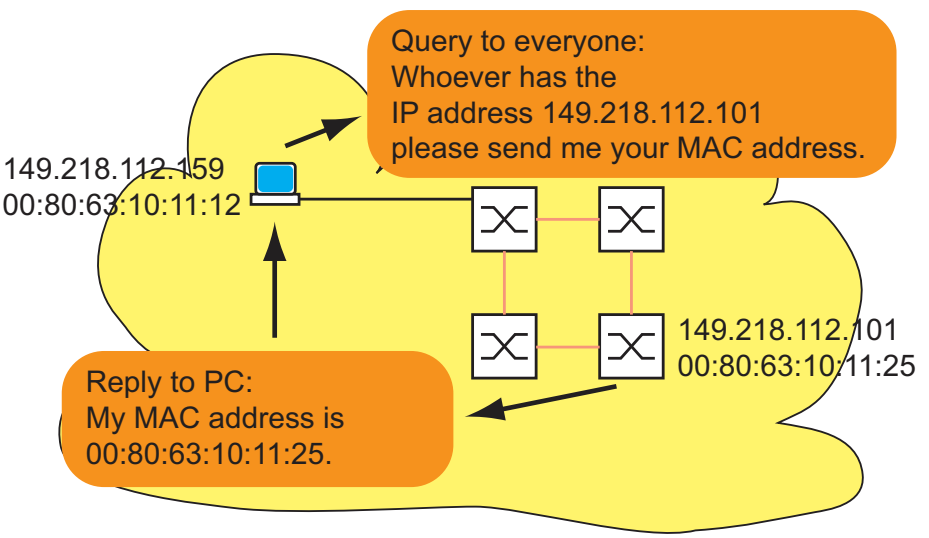


Figure 3: ARP request and reply

If the IP address of the Switch is in a different subnet, then the PC asks for the MAC address of the gateway entered in the PC. The gateway/router replies with its MAC address.
Now the PC packs the IP data packet with the IP address of the switch, the final destination, into a MAC frame with the MAC destination address of the gateway/router and sends the data.
The router receives the data and releases the IP data packet from the MAC frame, so that it can then forward it in accordance with its transmission rules.

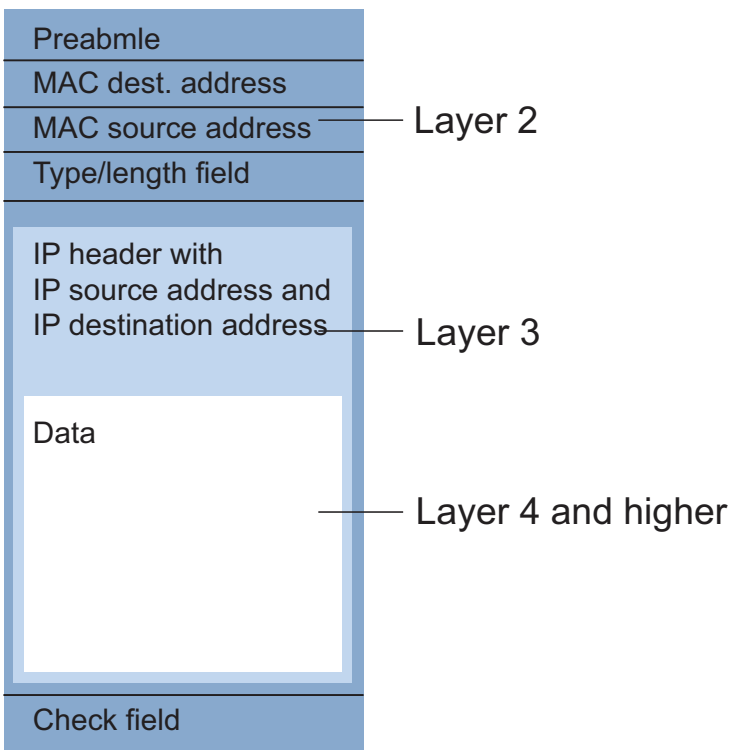


Figure 4: Structure of a data packet from the ISO/OSI layer model perspective

All terminal devices still working with IPs of the first generation, for example, are not yet familiar with the term 'subnet'. They also send an ARP request when they are looking for the MAC address for an IP address in a different subnet. They neither have a network mask with which they could recognize that the subnet is a different one, nor do they have a gateway entry. In the example below, the left PC is looking for the MAC address of the right PC, which is in a different subnet. In this example, it would normally not get a reply.

Because the router knows the route to the right PC, the proxy ARP function replies to this router interface on behalf of the right PC with its own MAC address. Thus the left PC can address its data to the MAC address of the router, which then forwards the data to the right PC.

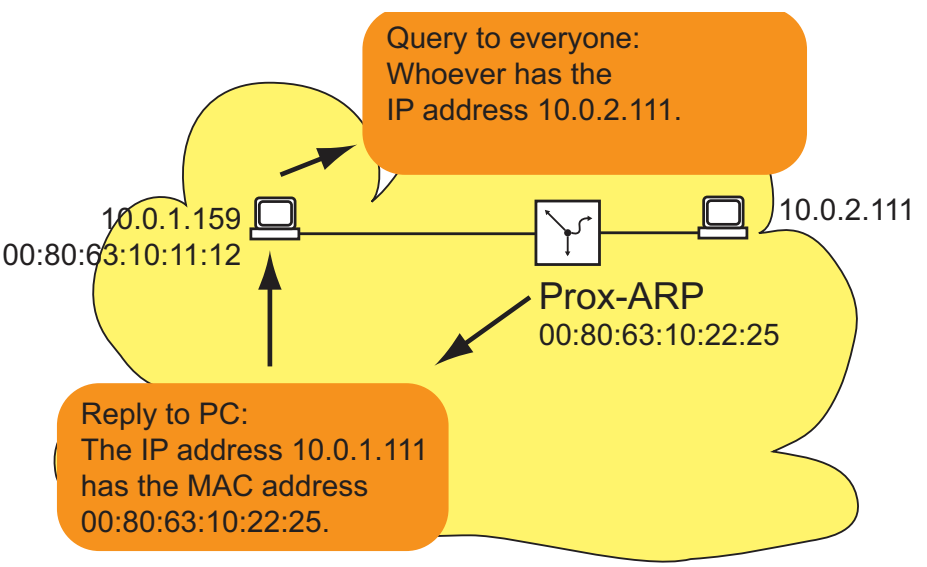


Figure 5: ARP proxy funktion

The proxy ARP function is available on the router interfaces on which you switch on the proxy ARP.

2.2 CIDR

The original class allocation of the IP addresses only planned for three address classes to be used by the users (see “Basics of IP Parameters” in the basic configuration of the user manual).

Since 1992, five classes of IP address have been defined in the RFC 1340.

Class	Network part	Host part	Address range
A	1 byte	3 bytes	1.0.0.0 to 126.255.255.255
B	2 bytes	2 bytes	128.0.0.0 to 191.255.255.255
C	3 bytes	1 byte	192.0.0.0 to 223.255.255.255
D			224.0.0.0 to 239.255.255.255
E			240.0.0.0 to 255.255.255.255

Table 2: IP address classes

Class C with a maximum of 254 addresses was too small, and class B with a maximum of 65534 addresses was too large for most users, as they would never require so many addresses. This resulted in ineffective usage of the class B addresses available.
Class D contains reserved multicast addresses. Class E is reserved for experimental purposes. A gateway not participating in these experiments ignores datagrams with this destination address.
The Classless Inter-Domain Routing (CIDR) provides a solution to these problems. The CIDR overcomes these class boundaries and supports classless address ranges.

With CIDR, you enter the number of bits that designate the IP address range. You represent the IP address range in binary form and count the mask bits that designate the network mask. The network mask indicates the number of bits that are identical for all IP addresses, the network part, in a given address range. Example:

IP address, decimal	Network mask, decimal	IP address, binary
149.218.112.1	255.255.255.128	10010101 11011010 01110000 00000001
149.218.112.127		10010101 11011010 01110000 01111111

25 mask bits

CIDR notation: 149.218.112.0/25

Mask bits

The combination of a number of class C address ranges is known as “supernetting”. This enables you to subdivide class B address ranges to a very fine degree.

Using mask bits simplifies the routing table. The router determines in that direction in which most of the mask bits match (longest prefix match).

2.3 Net-directed Broadcasts

A net-directed Broadcast is an IP data packet that a device sends to the network Broadcast address[1] of a network to contact all the receivers of the network. A net-directed Broadcast is sent as a MAC Unicast frame in a transfer network. If the router locally responsible for this network supports net-directed Broadcasts, then it transmits this data packet as a MAC Broadcast frame into its local network. With VLAN-based router interfaces it transmits the frame to all the ports that are members in the VLAN of the Router interface.

Thus net-directed Broadcasts can relieve your transfer network of the multiple IP Unicasts that would be necessary to replace a net-directed Broadcast.

If the router does not support net-directed Broadcasts or if you switch off this function for a router interface, the router discards IP data packets received at the network Broadcast address of the router interface. With multinetting, this also applies to the secondary IP addresses of the router interface.

1. The network Broadcast address is the highest IP address of an IP network for which a router interface is responsible. The device determines the Broadcast address from its interface IP address and the related netmask. For example, if a router interface has the IP address 192.168.1.1 and the netmask 255.255.255.0, it is responsible for network 192.168.1.0/24. The network Broadcast address here is 192.168.1.255.

2.4 Multinetting

Multinetting allows you to connect a number of subnets to one router port. Multinetting provides a solution for when you want to connect existing subnets to a router within a physical medium. In this case you can use multinetting to assign a number of IP addresses for the different subnets to the routing port to which you are connecting the physical medium.

For a long-term solution, other network design strategies provide more advantages with regard to problem solving and bandwidth management.

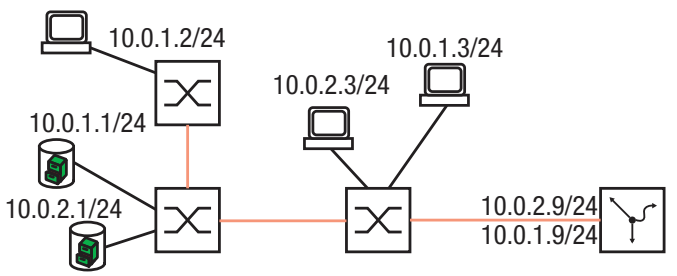


Figure 6: Example of multinetting

3 Static Routing

Static routes are user-defined routes which the Switch uses to transmit data from one subnet to another.
The user specifies to which router (next hop) the Switch forwards data for a particular subnet. Static routes are kept in a table which is permanently stored in the Switch.

Compared to dynamic routing, the advantage of this transparent route selection is offset by the increased workload involved in configuring the static routes. Static routing is therefore suited to very small networks or to selected areas of larger networks. Static routing makes the routes transparent for the administrator and can be easily configured in small networks.
If, for example, a line interruption causes the topology to change, the dynamic routing can react automatically to this, in contrast to the static routing. If you combine static and dynamic routing, you can configure the static routes in such a way that they have a higher priority than a route selected by a dynamic routing procedure.

The first step in configuring the router is to globally switch on the router function and configure the router interfaces.
The Switch allows you to define port-based and VLAN-based router interfaces (see figure 7).

Example: Connecting two production cells

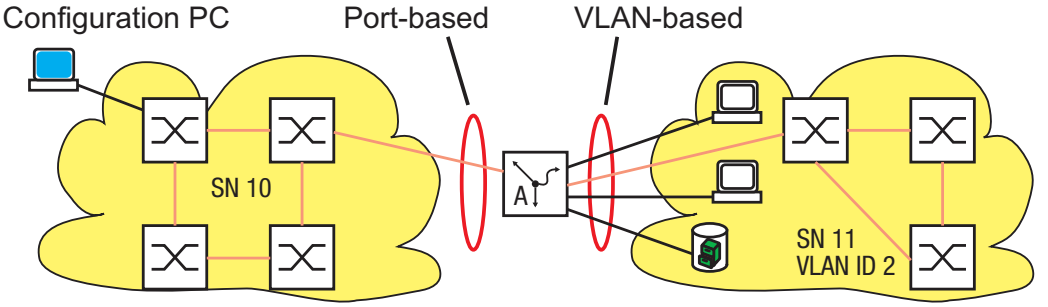


Figure 7: Static routes

3.1 Port-based Router Interface

A characteristic of the port-based router interface is that a subnet is connected to a port (see figure 7).

Special features of port-based router interfaces:

- If there is no active connection, then the entry from the routing table is omitted, because the router transmits exclusively to those ports for which the data transfer is likely to be successful.
  The entry in the interface configuration table remains.
- A port-based router interface does not recognize VLANs, which means that the router rejects tagged frames which it receives at a port-based router interface.
- A port-based router interface rejects all the non-routable packets.

Below (see figure 8) you will find an example of the simplest case of a routing application with port-based router interfaces.

3.1.1 Configuration of the router interfaces

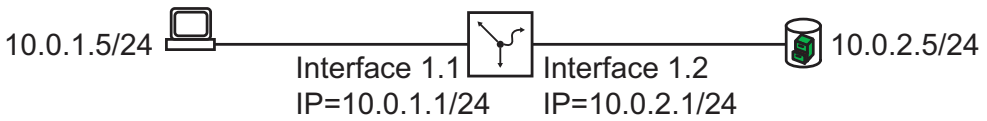


Figure 8: Simplest case of a route

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`ip routing`	Switch on the router function globally.
`interface 2/1`	Select the first port for entering the router interface IP address.
`ip address 10.0.1.1 255.255.255.0`	Assign the port its IP parameters.
`routing`	Switch on the router function at this port.
`exit`	Change to the Configuration mode.
`interface 2/2`	Select the second port for entering the router interface IP address.
`ip address 10.0.2.1 255.255.255.0`	Assign the port its IP parameters.
`routing`	Switch on the router function at this port.
`ip netdirbcast`	Einschalten der Vermittlung von Netdirected Broadcasts an diesem Port.
`exit`	Change to the Configuration mode.
`exit`	Change to the privileged EXEC mode.
`show ip interface brief`	Check the entries.

```
                                                Netdir   Multi
Interface IP Address      IP Mask               Bcast    CastFwd
--------- --------------- --------------- -------- --------
2/1       10.0.1.1        255.255.255.0   Disable  Disable
2/2       10.0.2.1        255.255.255.0   Enable   Disable
```

`show ip interface 2/1`	Check the remaining settings for interface 2/1.

```
Primary IP Address..... ..... 10.0.1.1/255.255.255.0
Routing Mode.............................  Enable
Administrative Mode..... Enable
Forward Net Directed Broadcasts..... Enable
Proxy ARP..... Disable
Active State..... Active
Link Speed Data Rate..... 100 Full
MAC Address..... 00:80:63:51:74:0C
Encapsulation Type..... Ethernet
IP MTU..... 1500
```

`show ip route` Verify the routing table:

```
Total Number of Routes..... 2
   Network          Subnet                    Next Hop    Next Hop
   Address           Mask         Protocol     Intf     IP Address
--------------- --------------- ------------  ------  ------------
10.0.1.0        255.255.255.0   Local          2/1       10.0.1.1
10.0.2.0        255.255.255.0   Local          2/2       10.0.2.1
```

`show ip route bestroutes` Check which routes the router actually uses for the transmission.

```
   Network          Subnet                    Next Hop    Next Hop
   Address           Mask         Protocol     Intf     IP Address
--------------- --------------- ------------  ------  ------------
10.0.1.0        255.255.255.0   Local          2/1       10.0.1.1
10.0.2.0        255.255.255.0   Local          2/2       10.0.2.1

Total Number of Routes..... 2
```

Note: To be able to see these entries in the routing table, you need an active connection at the ports.

3.2 VLAN-based Router-Interface

A characteristic of the VLAN-based router interface is that a number of devices in a VLAN are connected to different ports. The devices within a subnet belong to one VLAN (see figure 7).

Within a VLAN, the Switch exchanges data packets on layer 2.
Terminal devices address data packets with a destination address in another subnet to the router as a gateway. The router then exchanges the data packets layer 3.

Below you will find an example of the simplest case of a routing application with VLAN-based router interfaces. For the VLAN 2, the router combines ports 3.1 and 3.2 into the VLAN router interface 9.1. A VLAN router interface remains in the routing table until at least one port of the VLAN has a connection.

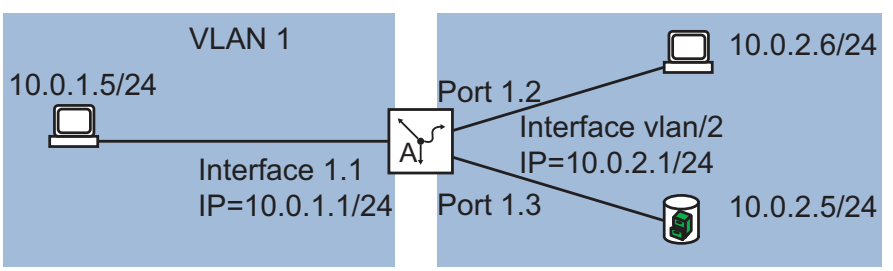


Figure 9: VLAN-based router interface

Configuring a VLAN router interface:

`enable`	Switch to the privileged EXEC mode.
`vlan database`	Switch to the VLAN mode.
`vlan 2`	Create a VLAN by entering the VLAN ID. The VLAN ID is between 1 and 4,042 (MACH 4000: 3,966).
`vlan name 2 Gerhard`	Assign the name “Gerhard” to VLAN 2.
`vlan routing 2`	Create a virtual router interface and activate the router function at this interface.
`exit`	Switch to the privileged EXEC mode.

```
show ip vlan
```
Display the virtual router interface that the router has set up for the VLAN.

```
show ip vlan
        Logical
VLAN ID Interface  IP Address  Subnet Mask   MAC Address
------- ---------- ----------- ------------- -----------------
2       9/1        0.0.0.0     0.0.0.0       00:80:63:51:74:2C
```

```
show ip interface brief
```
Check the entry for the virtual router interface.

```
                                          Netdir   Multi
Interface IP Address      IP Mask         Bcast    CastFwd
--------- --------------- --------------- -------- --------
9/1       0.0.0.0         0.0.0.0         Disable  Disable
```

```
configure
```
Switch to the Configuration mode.

```
interface 9/1
```
Change to the interface configuration mode of interface 9/1.

```
ip address 10.0.2.1
255.255.255.0
```
Assign the IP parameters to the router interface.

```
routing
```
Activate the router function at this interface.

```
ip netdirbcast
```
Enable the transmission of net-directed broadcasts for this interface.

```
exit
```
Switch to the Configuration mode.

```
interface 3/1
```
Switch to the interface configuration mode of interface 3/1.

```
vlan participation include 2
```
Declare port 3.1 a member of VLAN 2.

```
vlan participation exclude 1
```
Remove port 3.1 from VLAN 1. In the state on delivery, every port is assigned to VLAN 1.

```
vlan pvid 2
```
Set the port VLAN-ID to 2, which means that data packets that are received without a tag at that port are assigned to VLAN 2 by the Switch.

```
exit
```
Switch to the Configuration mode.

```
interface 3/2
```
Switch to the interface configuration mode of interface 3/2.

```
vlan participation include 2
```
Declare port 3.2 a member of VLAN 2.

```
vlan participation exclude 1
```
Remove port 3.2 from VLAN 1. In the state on delivery, every port is assigned to VLAN 1.

```
vlan pvid 2
```
Set the port VLAN-ID to 2, which means that data packets that are received without a tag at that port are assigned to VLAN 2 by the Switch.

```
exit
```
Switch to the Configuration mode.

```
exit
```
Switch to the privileged EXEC mode.

Check your entries in the static VLAN table.

```
show vlan 2

VLAN ID: 2
VLAN Name: Gerhard
VLAN Type: Static

Interface   Current   Configured   Tagging
----------  --------  -----------  --------
1/1         Exclude   Autodetect   Untagged
1/2         Exclude   Autodetect   Untagged
1/3         Exclude   Autodetect   Untagged
1/4         Exclude   Autodetect   Untagged
2/1         Exclude   Autodetect   Untagged
2/2         Exclude   Autodetect   Untagged
2/3         Exclude   Autodetect   Untagged
2/4         Exclude   Autodetect   Untagged
3/1         Include   Include      Untagged
3/2         Include   Include      Untagged
3/3         Exclude   Autodetect   Untagged
3/4         Exclude   Autodetect   Untagged
4/1         Exclude   Autodetect   Untagged
4/2         Exclude   Autodetect   Untagged
4/3         Exclude   Autodetect   Untagged
4/4         Exclude   Autodetect   Untagged
8/1         Exclude   Autodetect   Untagged
```

Check the VLAN-specific port settings.

```
show vlan port all

           Port    Acceptable   Ingress     Default
Interface  VLAN ID Frame Types  Filtering   Priority
---------- ------- ------------ ----------- --------
1/1        1       Admit All    Disable       0
1/2        1       Admit All    Disable       0
1/3        1       Admit All    Disable       0
1/4        1       Admit All    Disable       0
2/1        1       Admit All    Disable       0
2/2        1       Admit All    Disable       0
2/3        1       Admit All    Disable       0
2/4        1       Admit All    Disable       0
3/1        2       Admit All    Disable       0
3/2        2       Admit All    Disable       0
3/3        1       Admit All    Disable       0
3/4        1       Admit All    Disable       0
4/1        1       Admit All    Disable       0
4/2        1       Admit All    Disable       0
4/3        1       Admit All    Disable       0
4/4        1       Admit All    Disable       0
8/1        1       Admit All    Disable       0
```

☐ Select the dialog `Routing:Interfaces:Configuration`.
☐ Click on “Assistant” at the bottom right to configure the VLAN router interface.

☐ Enter a number between 1 and 4,042 (MACH 4000: 3,966) as the VLAN-ID, in this example: 2.
☐ Click on “Next” at the bottom.

☐ n the “VLAN Name” line above, enter a name with which you want to identify the VLAN.
☐ In the “Member” column of the table, you select the ports which will belong to this VLAN.
☐ Click on “Next” at the bottom.

☐ In the “IP Address” line of the “Primary Address” frame, you enter the IP address for the VLAN.
☐ Enter the related network mask in the “Network mask” line.
☐ Click on “Close” to end the configuration of the VLAN-based router interface.

In the router interface table, the router interface 9.1 appears.In the static VLAN table, the VLAN appears.

☐ Tick the box in the column „net-directed broadcasts“ for the router interface 9.1.

With “Delete“, you have the opportunity to delete a selected virtual router interface from the table or to reset a physical router interface‘s entry.

Note: When you delete a VLAN router interface, the entry for the VLAN will remain in the VLAN table.
Deleting a VLAN deletes the VLAN router interface‘s entry in the router interface table.

3.3 Configuration of a Static Route

In the example below, router A requires the information that it can reach the subnet 10.0.3.0/24 via the router B (next hop). It can obtain this information via a dynamic routing protocol or via a static routing entry. With this information, router A can transmit data from subnet 10.0.1.0/24 via router B into subnet 10.0.3.0/24.

Vice versa to be able to forward data of subnet 10.0.1.0/24 router B also needs an equivalent route.

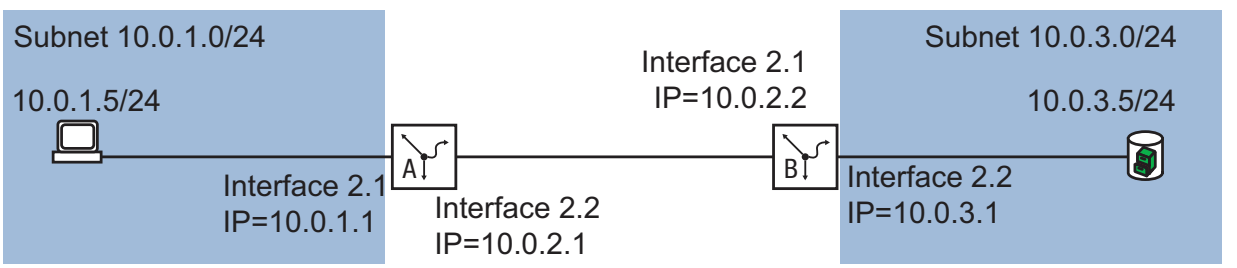


Figure 10: Static Routing

You can enter static routing for port-based and VLAN-based router interfaces.

3.3.1 Configuration of a simple static route

Enter a static route for router A based on the configuration of the router interface in the previous example (see figure 8):

```
enable                              Switch to the privileged EXEC mode.
configure                           Switch to the Configuration mode.
ip routing                          Switch on the router function globally.
ip route 10.0.3.0                   Create the static routing entry
  255.255.255.0 10.0.2.2
exit                                Switch to the privileged EXEC mode.

show ip route                       Verify the routing table:

Total Number of Routes..... 3

   Network          Subnet                    Next Hop    Next Hop
   Address           Mask         Protocol      Intf     IP Address
--------------- --------------- ------------  ------  -------------
10.0.1.0        255.255.255.0   Local          2/1       10.0.1.1
10.0.2.0        255.255.255.0   Local          2/2       10.0.2.1
10.0.3.0        255.255.255.0   Static         2/2       10.0.2.2
```

☐ Configure router B in the same way.

3.3.2 Configuration of a redundant static route

To ensure a reliable connection between the two routers, you can connect the two routers with two or more lines.

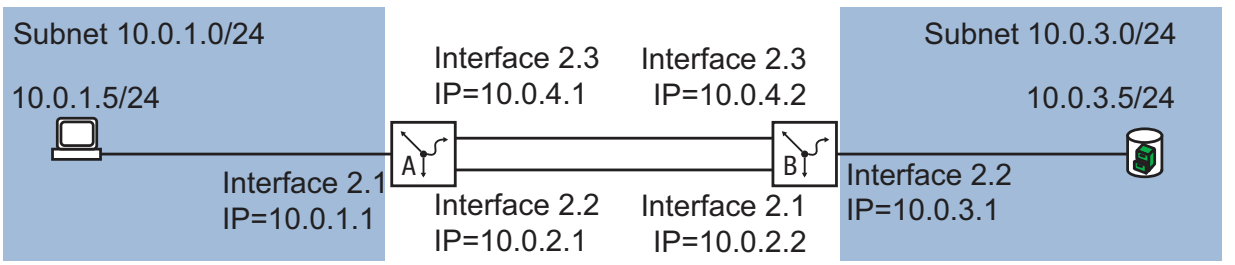


Figure 11: Redundant static route

You have the option of assigning importance (distance) to a route. If there are a number of routes to a destination, then the router chooses the route with the highest importance. If you do not assign a value for the importance during the configuration, the router takes the default value “1” for the importance. This is the highest importance.

☐ Configure router A.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`interface 2/3`	Select the port at which you want to connect the redundant route.
`ip address 10.0.4.1 255.255.255.0`	Assign the port its IP parameters.
`routing`	Switch on the router function at this port.
`exit`	Switch to the Configuration mode.
`ip route 10.0.3.0 255.255.255.0 10.0.4.2` **`2`**	Create the static routing entry for the redundant route. The “2” at the end of the command is the importance value. When both routes are available, the router uses the route via subnetwork 10.0.2.0/24, because this route has the higher importance (default value = 1) (see on page 32 “Configuration of a simple static route”).

```
show ip route
```

Verify the routing table:

```
Total Number of Routes..... 5

   Network          Subnet                    Next Hop    Next Hop
   Address           Mask         Protocol     Intf     IP Address
--------------- --------------- ------------ ------ -------------
10.0.1.0        255.255.255.0   Local         2/1       10.0.1.1
10.0.2.0        255.255.255.0   Local         2/2       10.0.2.1
10.0.3.0        255.255.255.0   Static        2/2       10.0.2.2
10.0.3.0        255.255.255.0   Static        2/3       10.0.4.2
10.0.4.0        255.255.255.0   Local         2/3       10.0.4.1
```

```
show ip route bestroutes
```

Check which routes the router actually uses for the transmission.

```
   Network          Subnet                    Next Hop    Next Hop
   Address           Mask         Protocol     Intf     IP Address
--------------- --------------- ------------ ------ -------------
10.0.1.0        255.255.255.0   Local         2/1       10.0.1.1
10.0.2.0        255.255.255.0   Local         2/2       10.0.2.1
10.0.3.0        255.255.255.0   Static        2/2       10.0.2.2
10.0.4.0        255.255.255.0   Local         2/3       10.0.4.1

Total Number of Routes..... 4
```

☐ Configure router B in the same way.

3.3.3 Configuration of a redundant static route with load sharing

The router shares the load between the two routes (load sharing), when the routes have the same importance (distance).

```
ip route 10.0.3.0
255.255.255.0 10.0.2.2 2
```

assign the importance “2” to the existing static routing entry (see on page 32 “Configuration of a simple static route”).
When both routes are available, the router uses both routes for the data transmission.

```
show ip route
```

Verify the routing table:

```
Total Number of Routes..... 4

   Network          Subnet                    Next Hop    Next Hop
   Address           Mask         Protocol     Intf     IP Address
--------------- --------------- ------------  ------  -------------
10.0.1.0        255.255.255.0   Local          2/1       10.0.1.1
10.0.2.0        255.255.255.0   Local          2/2       10.0.2.1
10.0.3.0        255.255.255.0   Static         2/2       10.0.2.2
                                               2/3       10.0.4.2
10.0.4.0        255.255.255.0   Local          2/3       10.0.4.1
```

```
show ip route bestroutes
```

Check which routes the router actually uses for the transmission.

```
   Network          Subnet                    Next Hop    Next Hop
   Address           Mask         Protocol     Intf     IP Address
--------------- --------------- ------------  ------  -------------
10.0.1.0        255.255.255.0   Local          2/1       10.0.1.1
10.0.2.0        255.255.255.0   Local          2/2       10.0.2.1
10.0.3.0        255.255.255.0   Static         2/2       10.0.2.2
                                               2/3       10.0.4.2
10.0.4.0        255.255.255.0   Local          2/3       10.0.4.1

Total Number of Routes..... 4
```

3.4 Static route tracking

3.4.1 Description of the static route tracking function

With static routing, if there are a number of routes to a destination, the router chooses the route with the highest importance. The router detects an existing route by the state of the router interface. While connection L 1 (see table 3) on the router interface may be fine, the connection to remote router B at location L 2 may be interrupted. In this case, the router continues transmitting via the interrupted route.

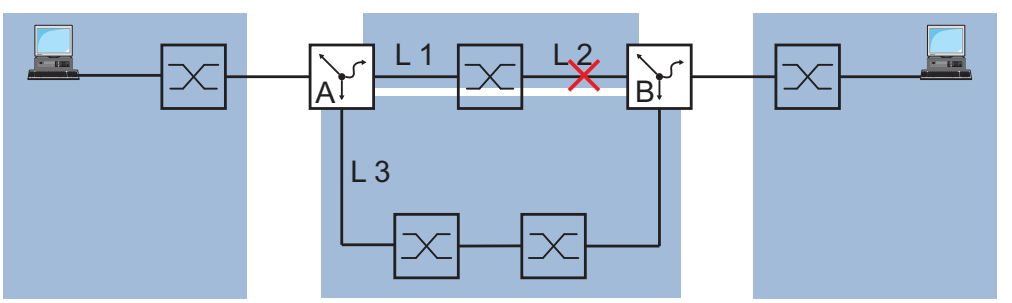


Figure 12: Example of static route tracking

With the static route tracking function, the router uses a tracking object such as a ping tracking object (see on page 46 “Ping tracking”) to detect the connection interruption. The active static route tracking function then deletes the interrupted route from the current routing table. If the tracking object returns to the “up” state, the router enters the static route in the current routing table again.

3.4.2 Application example for the static route tracking function

The figure (see figure 13) shows an example of the static route tracking function:
Router A monitors the best route via L 1 with ping tracking. If there is a connection interruption, router A transmits via redundant connection L 3.
The following is known:

Parameter	Router A	Router B
IP address interface (IF) 1.1	10.0.4.1	
IP address interface (IF) 1.2	10.0.2.1	10.0.4.2
IP address interface (IF) 1.3		10.0.2.53
IP address interface (IF) 1.4	10.0.1.112	
IP address interface (IF) 2.2		10.0.5.1
Netmask	255.255.255.0	255.255.255.0

Prerequisites for further configuration:

- The IP parameters of the router interface are configured. (see on page 25 “Configuration of the router interfaces”)
- The router function is activated globally and at the ports/router interface.
- Ping tracking at interface 1.2 of router A is configured (see on page 51 “Application example for ping tracking”).

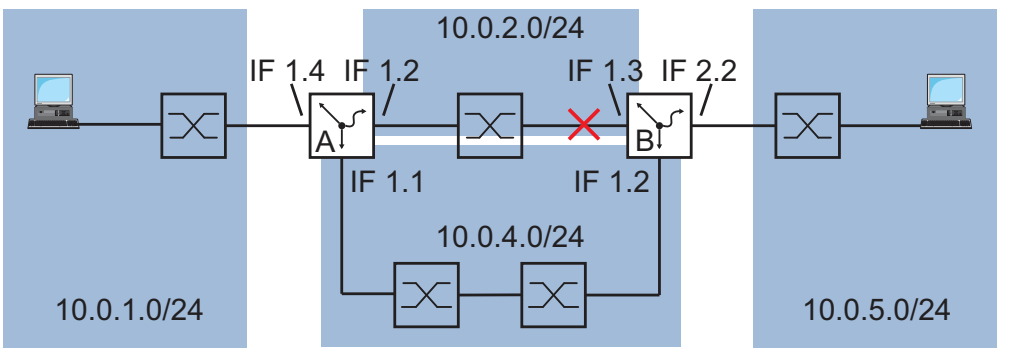


Figure 13: Configuring static route tracking

☐ Enter the two routes to destination network 10.0.5.0/24 in the static routing table of router A.

☐ Select the dialog `Routing:Routing Table:Static`.

☐ Click on “Create Entry”.
You thus open the input window for a new entry.

☐ Enter the data for the first static route:

“Destination Network”	`10.0.5.0`
“Destination Netmask”	`255.255.255.0`
“Next Hop”	`10.0.2.53`
“Track ID”	`21`

☐ Click "OK".

☐ Click on “Create Entry”.
You thus open the input window for a new entry.

☐ Enter the data for the first static route:
“Destination Network” 10.0.5.0
“Destination Netmask” 255.255.255.0
“Next Hop” 10.0.4.2
“Track ID” 0
☐ Click "OK".

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`ip route 10.0.5.0 255.255.255.0 10.0.2.53 1 track 21`	Create the static routing entry with preference 1 and track ID 21.
`ip route 10.0.5.0 255.255.255.0 10.0.4.2 2`	Create the static routing entry with preference 2.
`exit`	Switch to the privileged EXEC mode.
`show ip route`	Verify the routing table:

```
Total Number of Routes..... 3

   Network          Subnet                      Next Hop     Next Hop
   Address           Mask          Protocol      Intf      IP Address
-------------- --------------- ------------  ------  -------------
10.0.1.0       255.255.255.0   Local          1/4       10.0.1.112
10.0.2.0       255.255.255.0   Local          1/2       10.0.2.1
10.0.5.0       255.255.255.0   Static         1/2       10.0.2.53
```

☐ On router B, create a ping tracking object with the track ID, for example 22, for IP address 10.0.2.1.
☐ Enter the two routes to destination network 10.0.1.0/24 in the static routing table of router B.

Destination Network	Destination Netmask	Next Hop	Preference	Track ID
10.0.1.0	255.255.255.0	10.0.2.1	1	22
10.0.1.0	255.255.255.0	10.0.4.1	2	

Table 3: Static routing entries for router B

3.5 Adaptation for non-IP-compliant devices

Some devices use a simplified IP stack that does not correspond to the IP standard. Without an ARP request, these devices send their responses to the MAC address contained as the source address in the requesting packet (see figure below, no MAC/IP address resolution). These devices exhibit this behavior with ping requests in particular (ICMP echo request). Some of these devices also exhibit this behavior with other data packets.
As long as the router interface of the router to which such a device is connected is itself connected to the MAC address of the physical port, the router can receive and transmit the packet.
However, if the physical port belongs to a VLAN, the VLAN router interface then has its own MAC address. Thus the router rejects packets that are being sent to the port's MAC address.

A terminal device that performs the MAC/IP address resolution according to the IP standard starts an ARP request to determine the correct MAC address before sending the reply to the determined VLAN MAC address (see figure below: MAC/IP standard address resolution using ARP).

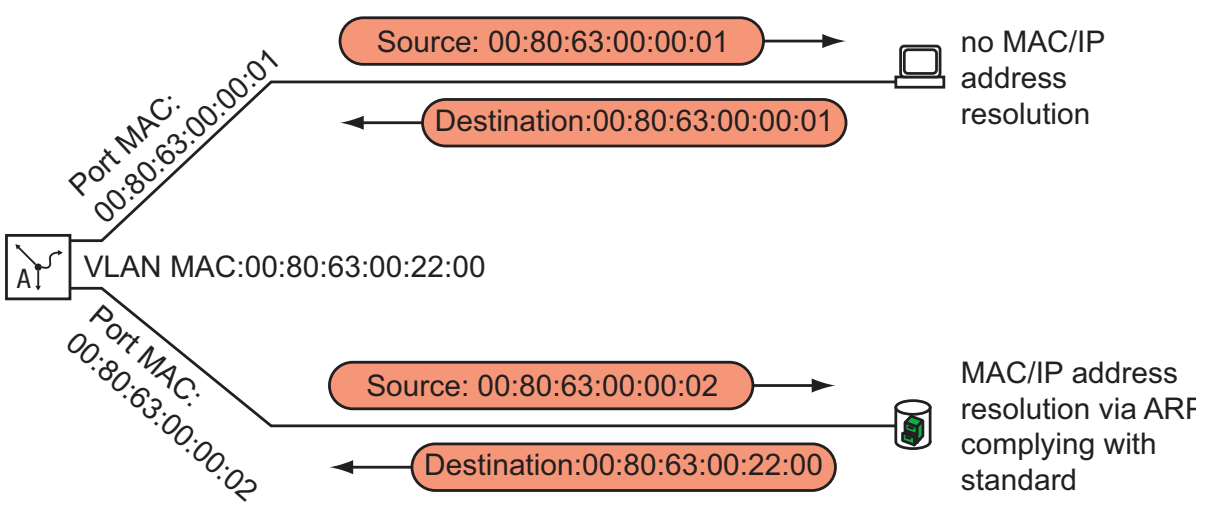


Figure 14: Addressing with simplified IP stack and compliant with the standard

For you also to be able to connect devices with a simplified IP stack to a VLAN-based router interface, the router provides you with the VLAN single MAC mode.
In the VLAN single MAC mode, all VLAN interfaces and all physical ports use the same MAC address, with the exception of the port-based router interface.

4 Tracking

The tracking function gives you the option of monitoring certain objects, such as the availability of an interface.
A special feature of this function is that it forwards an object status change to an application, e.g. VRRP, which previously registered as an interested party for this information.

Tracking can monitor the following objects:

- Link status of an interface (interface tracking)
- Accessibility of a device (ping tracking)
- Result of logical connections of tracking entries (logic tracking)

An object can have the following statuses:

- up (OK)
- down (not OK)

The definition of "up" and "down" depends on the type of the tracking object (e.g. interface tracking).

Tracking can forward the state changes of an object to the following applications:

- VRRP (see on page 70 “VRRP tracking”)
- Static routing (see on page 36 “Static route tracking”)

4.1 Interface tracking

With interface tracking the Switch monitors the link status of:

- physical ports
- link aggregation interfaces (interfaces 8.x)
- VLAN router interfaces (interfaces 9.x)

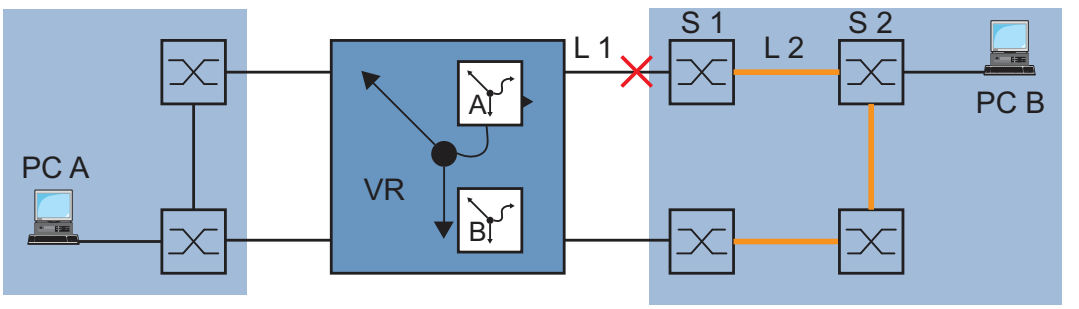


Figure 15: Monitoring a line with interface tracking

Ports/interfaces can have the following link statuses:

- interrupted physical link (link down) and
- existing physical link (link up).

A link aggregation interface has link status “down” if the link to all the participating ports is interrupted.

A VLAN router interface has link status “down” if the link is interrupted from all the physical ports/link aggregation interfaces that are members of the corresponding VLAN.

Setting a delay time enables you to insert a delay before informing the application about an object status change.

An interface tracking object is given the “down” status if the physical link interruption remains for longer than the “link down delay” delay time.

An interface tracking object is given the “up” status if the physical link holds for longer than the “link up delay” delay time.

State on delivery: delay times = 0 seconds.
This means that if a status changes, the registered application is informed immediately.
You can set the “link down delay” and “link up delay” delay times independently of each other in the range from 0 to 255 seconds.
You can define an interface tracking object for each interface.

4.2 Ping tracking

With ping tracking, the device uses ping requests to monitor the link status to other devices.

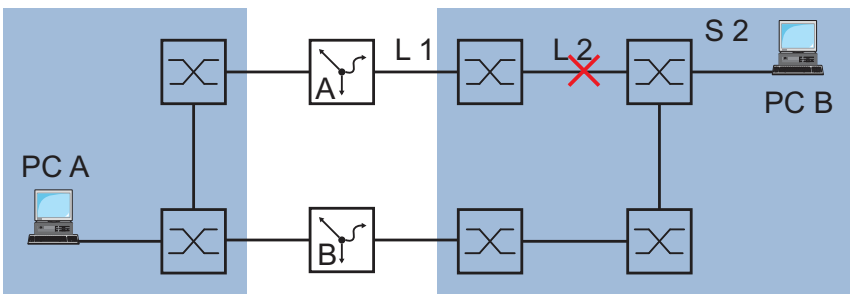


Figure 16: Monitoring a line with ping tracking

The device sends ping requests to the device with the IP address that you entered in the “IP Address” column.
The “Ping Interval” column allows you to define the frequency for sending ping requests, and thus the additional network load.
If the response comes back within the time entered in the “Ping Timeout” column, this response is a valid “Ping response received”.
If the response comes back after the time entered in the “Ping Timeout” column, or not at all, this response is evaluated as “No ping response”.

Ping tracking objects can have the following statuses:

- the number of “No ping responses” is greater than the number entered (down) and
- the number of “Ping responses received” is greater than the number entered (up).

Entering a number for unreceived or received ping responses enables you to set the sensitivity of the ping behavior of the device. The device informs the application about an object status change.

Ping tracking enables you to monitor the accessibility of defined devices. As soon as a monitored device can no longer be accessed, the device can choose to use an alternative path.

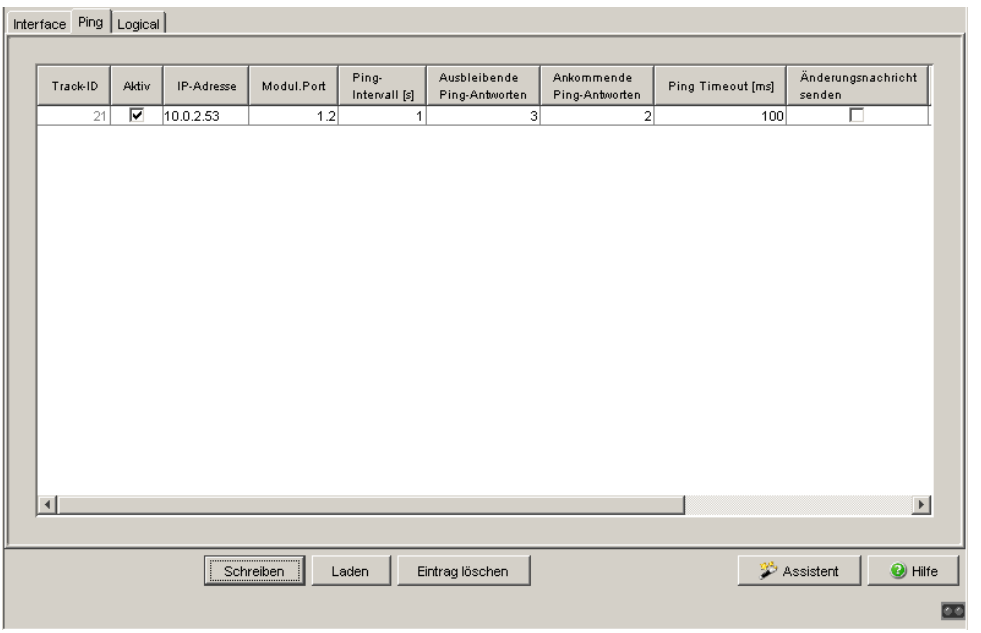


Figure 17: Ping Tracking dialog

4.3 Logical tracking

Logical tracking enables you to logically link multiple tracking objects with each other and thus perform relatively complex monitoring tasks.
You can use logical tracking, for example, to monitor the link status for a network node to which redundant paths lead (see on page 52 “Application example for logical tracking”).

The device provides the following options for a logical link:
- AND
- OR

For a logical link, you can combine up to 8 operands with one operator.

Logical tracking objects can have the following statuses:
- The result of the logical link is incorrect (down).
- The result of the logical link is correct (up).

When a logical link delivers the result “incorrect”, the device can choose to use an alternative path.

4.4 Configuring the tracking

You configure the tracking by setting up tracking objects. The following steps are required to set up a tracking object:

- Enter the tracking object ID number (track ID).
- Select a tracking type, e.g. interface.
- Depending on the track type, enter additional options such as “port” or “link up delay” in the interface tracking.

Note: The registration of applications (e.g. VRRP) to which the tracking function reports status changes is performed in the application itself (see on page 70 “VRRP tracking”).

4.4.1 Configuring interface tracking

☐ Set up interface tracking at port 1.1 with a link down delay of 0 seconds and a link up delay of 3 seconds.

☐ In the `Routing:Tracking:Configuration` dialog, click on “Wizard” at the bottom right.

Select type:

☐ Enter the values you desire:

Track ID:	`1`
Type:	`interface`

☐ Click on “Continue”.

Properties:

☐ Enter the values you desire:

Module.Port:	1.1
Link up delay:	3
Link down delay:	0

☐ Click on “Finish” to leave the Wizard and save the entry temporarily in the configuration.

```
enable                                  Change to the privileged EXEC mode.
configure                               Change to the Configuration mode.
track 1 interface 1/1                   Enter the tracking parameters and activate this
  link-down-delay 0                     tracking object.
  link-up-delay 3
Tracking ID 1 created
  Tracking type set to Interface
  Target interface set to 1/1
  Link Down Delay for target interface set to 0 sec
  Link Up Delay for target interface set to 3 sec
Tracking ID 1 activated
exit                                    Change to the privileged EXEC mode.
show track                              Display the configured tracks
             Link Delay                       No. of
ID Type  Intf Down  Up   Status  Mode  Changes Time since last change
-- ----  ---- ---- ----- ------ ------ ------- --------------------
1 Intf  1/1    0s    3s  DOWN  Enable      0   0 day(s), 00:00:29
Unconfigured Track-IDs with registered applications:
-------------------------------------------------
```

4.4.2 Application example for ping tracking

While the interface tracking monitors the directly connected link (see figure 15), the ping tracking monitors the entire link to Switch S2 (see figure 16).

☐ Set up ping tracking at port 1.2 for IP address 10.0.2.53 with the preset parameters.

☐ In the `Routing:Tracking:Configuration` dialog, click on “Wizard” at the bottom right.

Select type:

☐ Enter the values you desire:

Track ID:	`21`
Type:	`ping`

☐ Click on “Continue”.

Properties:

☐ Enter the values you desire:

IP address:	`10.0.2.53`
Module.Port:	`1.2`
Ping interval [s]:	`1`
No ping response:	`3`
Ping responses received:	`2`
Ping timeout [ms]:	`100`

☐ Click on “Finish” to leave the Wizard and save the entry temporarily in the configuration.

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`track 21 ping 10.0.2.53 interface 1/2 interval 1 miss 3 success 2 timeout 100`	Enter the tracking parameters and activate this tracking object.

```
Tracking ID 21 created
  Tracking type set to Ping
  Target IP address set to 10.0.2.53
  Interface used for sending pings to target set to 1/2
  Ping Interval for target set to 1 sec
  Max. no. of missed ping replies from target set to 3
  Min. no. of received ping replies from target set to 2
  Timeout for ping replies from target set to 100 ms
Tracking ID 21 activated
exit                              Change to the privileged EXEC mode.
show track                        Display the configured tracks
Ping Tracking
                                                 No. of   Time since
  ID Type IP Address  Intvl Status Mode Changes  last change
 --- ---- ---------- ----- ------ ------ ------- -----------------
  21 Ping  10.0.2.53    1s  DOWN   Enable   1    0 day(s), 00:13:39
```

4.4.3 Application example for logical tracking

The figure (see figure 15) shows an example of monitoring the connection to a redundant ring.
By monitoring lines L 2 and L 4, you can detect a line interruption from router A to the redundant ring.
With a ping tracking object at port 1.1 of router A, you monitor the connection to Switch S2.
With an additional ping tracking object at port 1.1 of router A, you monitor the connection to Switch S4.
Only the OR link of both ping tracking objects delivers the precise result that router A has no connection to the ring.
One ping tracking object for Switch S3 could indicate an interrupted connection to the redundant ring, but in this case there could be another reason for the lack of a ping response from Switch S3. For example, there could be a power failure at Switch S3.

The following is known:

Parameter	Value
Operand No. 1 (track ID)	21
Operand No. 2 (track ID)	22

Prerequisites for further configuration:

- The ping tracking objects for operands 1 and 2 are configured (see on page 51 “Application example for ping tracking”).

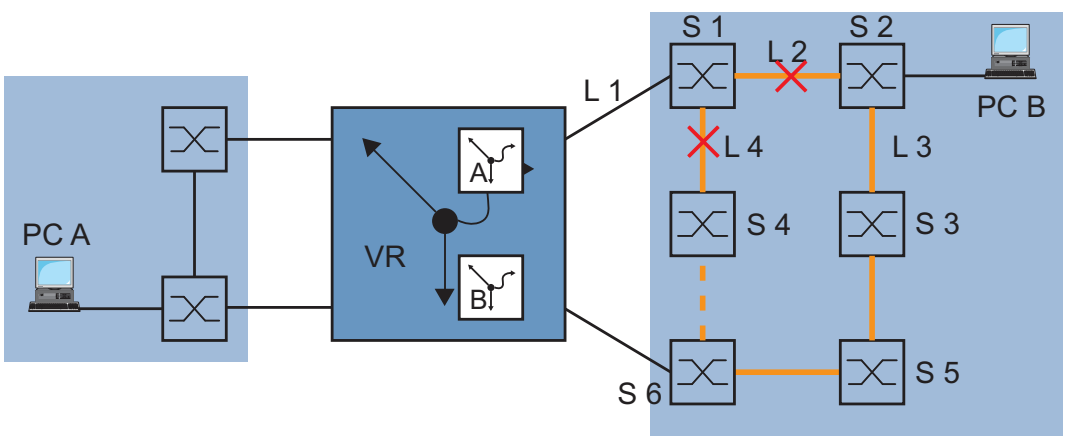


Figure 18: Monitoring the accessibility of a device in a redundant ring

☐ Set up a logical tracking object as an OR link.

☐ In the `Routing:Tracking:Configuration` dialog, click on “Wizard” at the bottom right.

Select type:

☐ Enter the values you desire:

Track ID:	`31`
Type:	`Logical`

☐ Click on “Continue”.

Properties:

☐ Enter the values you desire:

Operator:	or
Operand 1 (track ID):	21
Operand 2 (track ID):	22

☐ Click on “Finish” to leave the Wizard and save the entry temporarily in the configuration.

```
enable                          Change to the privileged EXEC mode.
configure                       Change to the Configuration mode.
track 31 logical or 21 22       Enter the tracking parameters and activate this
                                tracking object.

Tracking ID 31 created
  Tracking type set to Logical
  Logical Operator set to or
  Logical Instance 21 included
  Logical Instance 1 included
Tracking ID 31 activated
exit                            Change to the privileged EXEC mode.
show track                      Display the configured tracks
Ping Tracking
                                                 No. of   Time since
  ID Type IP Address  Intvl Status Mode Changes  last change
 --- ---- ----------- ----- ------ ------ ------- -----------------
  21 Ping  10.0.2.53    1s  DOWN   Enable   1    0 day(s), 00:13:39

Ping Tracking
                                                 No. of   Time since
  ID Type IP Address  Intvl Status Mode Changes  last change
 --- ---- ----------- ----- ------ ------ ------- -----------------
  22 Ping  10.0.2.54    1s  DOWN   Enable   1    0 day(s), 00:14:39

Logical Tracking
                                      No. of
 ID Type  Instances  Status  Mode    Changes Time since last change
--- ---- ----------- ------ ------- ------- ---------------------
 31  OR  21,22       DOWN   Enable        0   0 day(s), 00:04:58
```

5 VRRP/HiVRRP

Terminal devices usually give you the option of entering a default gateway for transmitting data packets in external subnetworks. Here the term “Gateway” applies to a router by means of which the terminal device can communicate in other subnetworks.

If this router fails, the terminal device cannot send any more data to external subnetworks.
In this case, the Virtual Router Redundancy Protocol (VRRP) provides assistance.
VRRP is a type of “gateway redundancy”. VRRP describes a process that groups multiple routers into one virtual router. Terminal devices always address the virtual router, and VRRP ensures that a physical router belonging to the virtual router takes over the data transmission.
Even if a physical router fails, VRRP ensures that another physical router takes over the distribution tasks as part of the virtual router.

VRRP has typical switching times of 3 to 4 seconds when a physical router fails.
In many cases, such as Voice over IP, Video over IP, industrial controllers, etc., these long switching times are not acceptable.

The Hirschmann company has further developed the VRRP into the Hirschmann Virtual Router Redundancy Protocol (HiVRRP).
With the appropriate configuration, HiVRRP guarantees maximum switching times of 400 milliseconds.
Thanks to this guaranteed switching time, HiVRRP enables the use of “gateway redundancy” in time-critical applications. Even in tunnel controllers that require switching times of less than one second, the user can improve the network availability with this form of “gateway redundancy”.

5.1 VRRP

All the routers within a network on which VRRP is active specify among themselves which router is to be the master. This router contains the IP and MAC address of the virtual router. All the devices in the network that have entered this virtual IP address as the default gateway use the master as the default gateway.

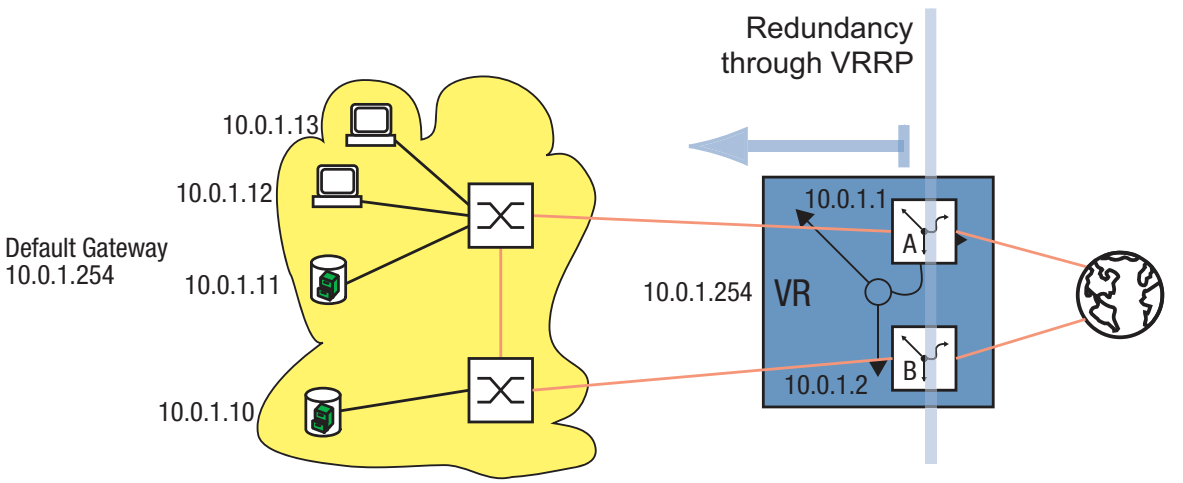


Figure 19: Illustration of the virtual router

If the master fails, then the remaining routers use the VRRP to specify a new master. This router then takes over the IP and MAC address of the virtual router. Thus the devices find their route via their default gateway, as before. The devices always only see the master with the virtual MAC and IP addresses, regardless of which router is actually behind this virtual address. The virtual router IP address is assigned by the administrator.
The VRRP specifies the virtual MAC address with:
00:00:5e:00:01:<VRID>.
The first 5 octets form the fixed part in accordance with RFC 2338.
The last octet is the virtual router ID (VRID). It is a number between 1 and 255. On the basis of this, the administrator can define 255 virtual routers within a network.

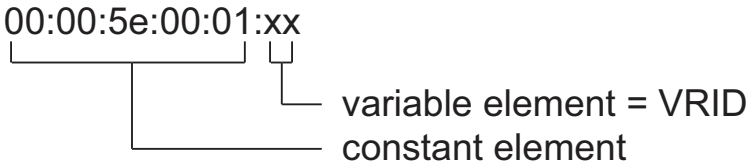


Figure 20: Virtual MAC address

The VRRP router sends IP Multicast messages to the IP Multicast address 224.0.0.18 in order to determine the master. The router with the highest VRRP priority becomes the master. The VRRP priority is specified by the administrator. If the VRRP priorities are the same, then the highest IP interface address of the VRRP routers is decisive. If the virtual IP address is the same as the IP address of a router interface, then this router is the IP address owner. VRRP sets the VRRP priority of an IP address owner to the value 255 and thus declares it the master. If there is no IP address owner, then VRRP declares the router with the highest VRRP priority the master.

The master regularly sends IP Multicast messages (default: 1 s) to the other VRRP routers in order to signal that it is ready for operation. If this message does not appear three times in a row, then the VRRP router with the highest remaining VRRP priority declares itself the new master.

1.	The IP address owner as it has the highest VRRP priority (255) by definition.
2.	The VRRP router with the highest VRRP priority.
3.	If the priorities are the same, the VRRP router with the highest IP address.

Table 4: Who shall be the master?

VRRP terms:

- Virtual router
  A virtual router is a router or group of routers that act as the default gateway in a network and use the Virtual Router Redandancy Protocol.
- VRRP router
  A VRRP router is a router that uses VRRP. It can be part of one or more virtual routers.

- Master router
  The master router is the router within the virtual router that is currently responsible for forwarding data packets and responding to ARP queries. The master router periodically sends messages (advertisements) to the other VRRP routers (backup routers) to inform them about its existence.
- Ip address owner
  The IP address owner is the VRRP router whose IP address is identical to the IP address of the virtual router. By definition, it has the highest VRRP priority (255) and is thus automatically the master router.
- Backup router
  The backup router is a VRRP router that is not the master router. The backup router is ready to take over the master role, should the master fail.
- VRRP priority
  The VRRP priority is a number between 1 and 255. It is used to determine the master router. The value 255 is reserved for the IP address owner.
- VRID
  The VRID (virtual router ID) uniquely identifies a virtual router.
- Virtual router MAC address
  The virtual router MAC address is the MAC address of the virtual router (see figure 4).
- Virtual router IP address
  The virtual router IP address is the IP address of the virtual router.
- Advertisement interval
  The advertisement interval describes the frequency with which the master router sends its existence message (advertisement) to all the VRRP routers of its virtual router. The values for the advertisement interval are between 1 and 255 seconds. The default value is 1 second.
- Skew time
  The skew time is the time, dependent on the VRRP priority, that specifies the time when the backup router names itself the master router.
  Skew time = ((256 - VRRP priority) / 256) · 1 second
- Master down interval
  The master down interval specifies the time when the backup router names itself the master router.
  Master down interval = 3 · advertisement interval + skew time

5.1.1 Configuration of VRRP

The configuration of VRRP requires the following steps:

- Switch on routing globally (if this has not already been done).
- Switch on VRRP globally.
- Configure port - assign IP address and network mask.
- Switch on VRRP at the port.
- Create virtual router ID (VRID), because you have the option of activating a multiple virtual routers for each port.
- Assign virtual router IP address.
- Switch on virtual router.
- Assign VRRP priority.

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`ip routing`	Switch on the router function globally.
`ip vrrp`	Switch on VRRP globally.
`interface 2/3`	Select the port for setting up VRRP.
`ip address 10.0.1.1 255.255.255.0`	Assign the port its IP parameters.
`routing`	Activate the router function at this interface.
`ip vrrp 1`	Create the VRID for the first virtual router at this port.
`ip vrrp 1 mode`	Switch on the first virtual router at this port.
`ip vrrp 1 ip 10.0.1.100`	Assign virtual router 1 its IP address.
`ip vrrp 1 priority 200`	Assign virtual router 1 the router priority 200.

☐ You configure every port at which VRRP will be active in the same way.

☐ You also perform the same configuration on the redundant router.

5.2 HiVRRP

HiVRRP provides a number of mechanisms for shortening the switching times or reducing the number of Multicasts:

- shorter advertisement intervals
- link-down notification
- preempt delay
- Unicast advertisement
- domains

In compliance with RFC 2338, the master sends IP Multicast messages (advertisements) at intervals of one second to the other VRRP routers. Only if this message does not appear three times do the remaining routers select a new master.
VRRP has typical switching times of 3 to 4 seconds.

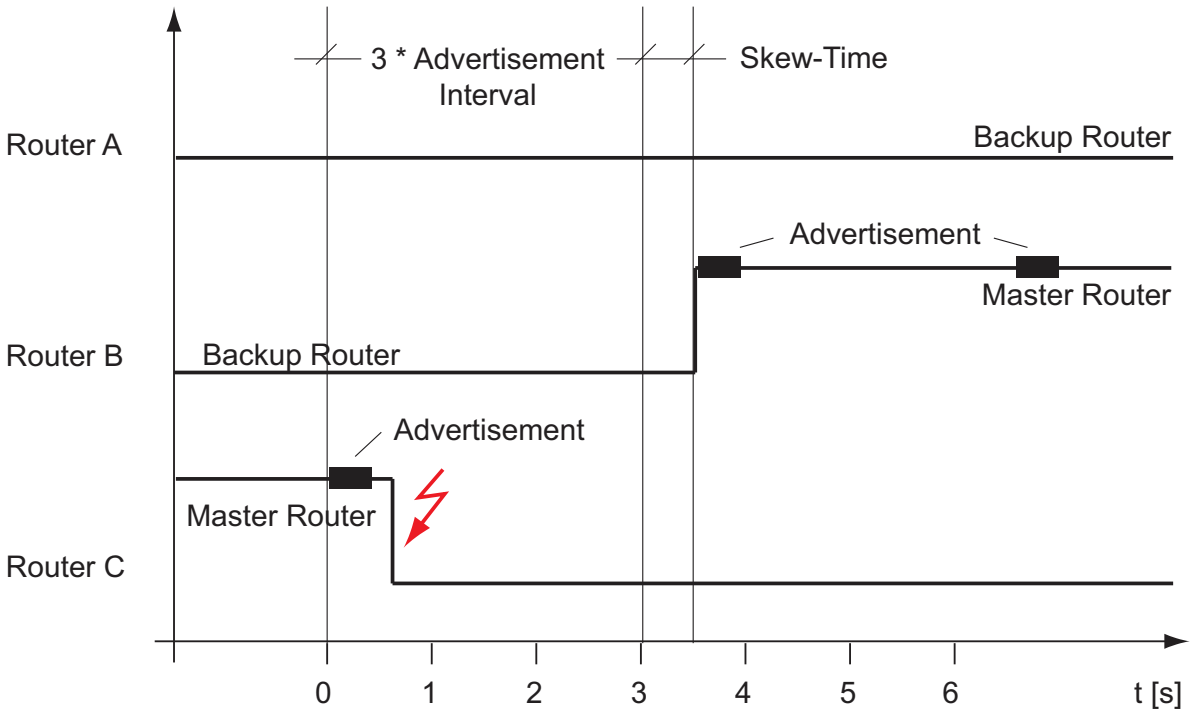


Figure 21: Master router <-> backup router switching times according to RFC 2338
VRRP priority router A = 64
VRRP priority router B = 128
VRRP priority router C = 254

To be able to achieve faster switching times, Hirschmann provides HiVRRP so that the cycle for sending the IP Multicast message can be shortened to as little as 0.1 seconds. You can thus achieve switching times that are up to 10 times as fast.

The router supports up to 16 VRRP router interfaces with this shortened sending cycle.

- HiVRRP skew time
  The HiVRRP skew time is the time, dependent on the VRRP priority, that specifies the time when the HiVRRP backup router names itself the HiVRRP master router.
  HiVRRP skew time =
  (256 - VRRP priority) / 256 · advertisement interval
  Times shown in milliseconds
- HiVRRP master down interval
  The HiVRRP master down interval specifies the time when the HiVRRP backup router names itself the HiVRRP master router.
  HiVRRP master down interval =
  3 · advertisement interval + HiVRRP skew time
  Times shown in milliseconds

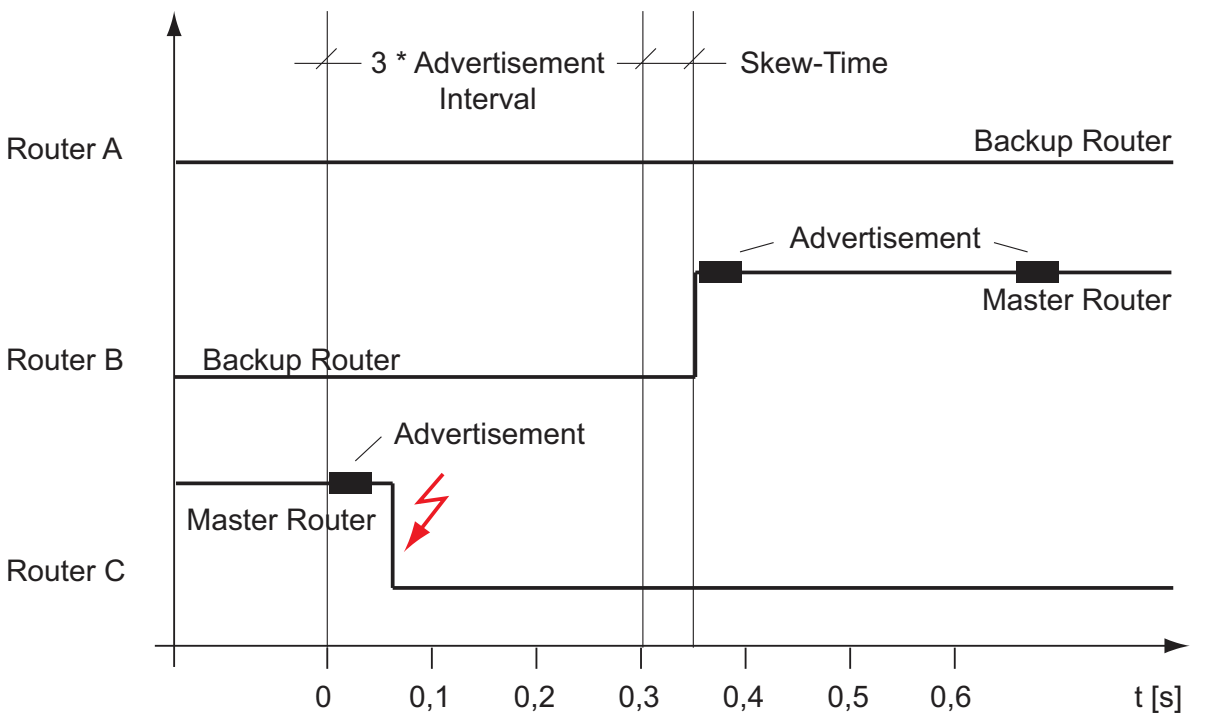


Figure 22: Master router <-> backup router switching times according to HiVRRP
VRRP priority router A = 64
VRRP priority router B = 128
VRRP priority router C = 254

Another option provided by HiVRRP for shortening the switching times dramatically is the link-down notification. You can use this function when the virtual router consists of two VRRP routers. As two VRRP routers are participating, it is sufficient to send the link-down notification in the form of a Unicast message. In contrast to the Multicast message, the Unicast message travels beyond the boundaries of the subnetwork. This means that if the link is down to your own subnetwork, the link-down notification can also travel via another subnetwork to reach the second router of the virtual router.
As soon as HiVRRP detects that the link is down, it sends the link-down notification to the second router via a different route. The second router takes over the master function immediately after receiving the link-down notification.

In the preempt mode, the backup router can take over the master function from the master router as soon as the backup router receives an advertisement from the master router for which the VRRP priority is lower than its own.
Thus the preempt mode, in collaboration with VRRP tracking (see on page 70 “VRRP tracking”) , can enable a switch to a better router. However, dynamic routing procedures take a certain amount of time to react to changed routes and refill their routing table.
To avoid the loss of packets during this time, delayed switching (preempt delay) from the master router to the backup router enables the dynamic routing procedure to fill the routing tables.

HiVRRP provides an additional advantage for networks with devices that have problems with higher volumes of Multicasts. Instead of sending advertisements in the form of Multicasts, HiVRRP can send the advertisements in the form of Unicast data packets (VRRP destination address) when using up to two HiVRRP routers.

Note: If you want to avail of the advantages of HiVRRP, then only use VRRP routers equipped with the HiVRRP function from Hirschmann as the virtual router.

5.3 HiVRRP Domains

In large, flat network structures, HiVRRP domains enable you to

- switch over all HiVRRP routers very quickly in the case of redundancy
- use the available bandwidth more effectively
- configure more than 16 VRRP router interfaces for each router using HiVRRP
- operate Multicast-sensitive terminal devices in large HiVRRP networks

A HiVRRP instance is a router interface configured as HiVRRP with functions that HiVRRP contains. In a HiVRRP domain you combine multiple HiVRRP instances of a router into one administrative unit. You nominate one HiVRRP instance as the supervisor of the HiVRRP domain. This supervisor regulates the behavior of all HiVRRP instances in its domain.

- The supervisor sends its advertisements on behalf of all HiVRRP instances in its domain.
- The supervisor puts itself and the other HiVRRP instances together into the master role or the backup role.

See figure 23 for an example of a flat network structure. All cross-VLAN data streams pass through the ring.

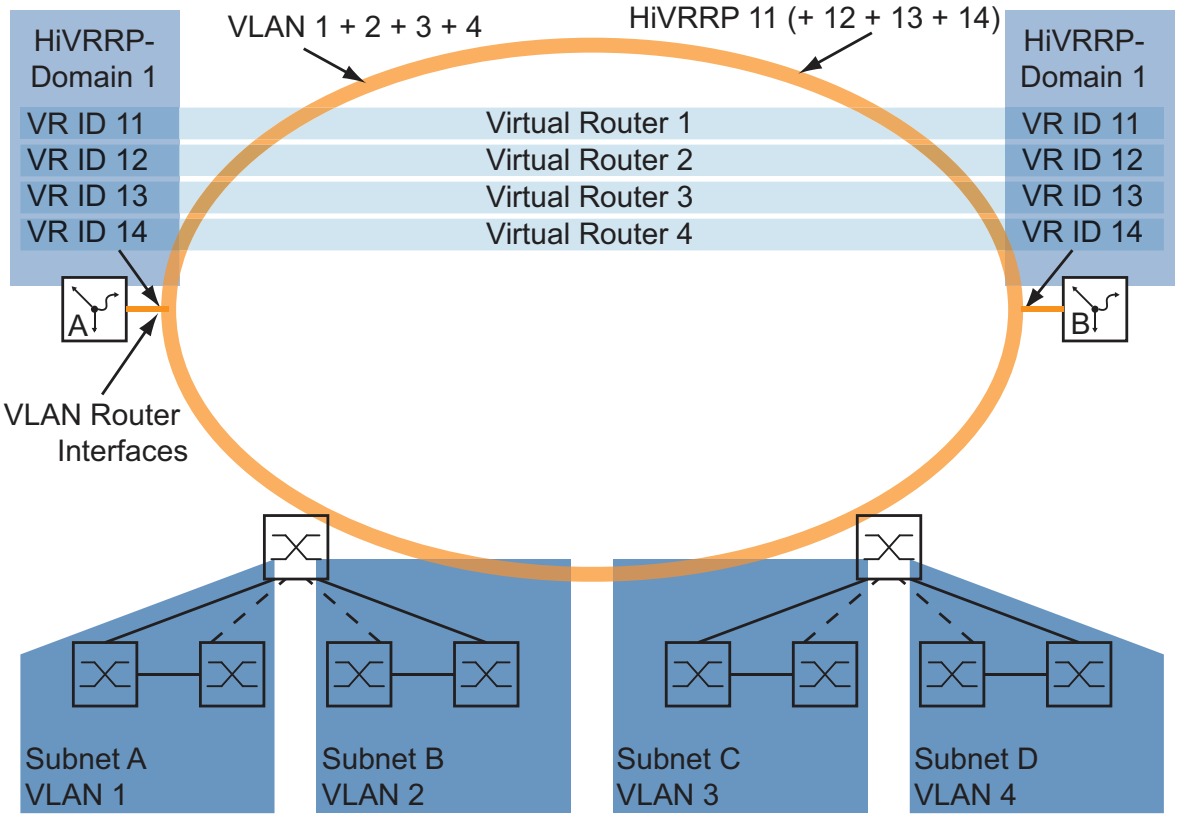


Figure 23: Example of how a HiVRRP domain is used

5.3.1 Configuration of HiVRRP domains

The configuration of HiVRRP domains consists of the following steps:

- Create VLANs
- Configure VLAN router interfaces
- Assign the IP addresses to the router interfaces
- Configure HiVRRP instances
  - Activate VRRP instance (all instances)
  - Assign IP address (all instances)
    Within a router, you either configure all instances as IP address owners, or no instance as an IP address owner.
  - Assign priority (supervisor)
    Assign the supervisors different priorities so that the VRRP routers can agree on a master router.

  - Switch on HiVRRP (all instances)
  - Assign to the domain (all instances)
  - Specify sending interval (supervisor)

- Configure HIPER-Ring (in applications as in the above example)
- Define the (Ring) ports as members of the VLANs
- Switch on routing and VRRP globally

5.3.2 Example of configuration of HiVRRP domains

Example of possible settings for the application in figure 23:

Subnetwork	IP address range	VLAN	VLAN ID
A	10.0.11.0/24	1	11
B	10.0.12.0/24	2	12
C	10.0.13.0/24	3	13
D	10.0.14.0/24	4	14

Table 5: Configuration of the Switches in the subnetwork

Virtual router	VR ID	IP address of the virtual router	Router interface of router A: IP address	Router interface of router B: IP address	VLAN ID
1	11	10.0.11.1/24	10.0.11.2/24	10.0.11.3/24	11
2	12	10.0.12.1/24	10.0.12.2/24	10.0.12.3/24	12
3	13	10.0.13.1/24	10.0.13.2/24	10.0.13.3/24	13
4	14	10.0.14.1/24	10.0.14.2/24	10.0.14.3/24	14

Table 6: Configuration of the two routers

☐ Configure VLAN router interface and assign IP address:

```
enable                                  Switch to the privileged EXEC mode.
vlan database                           Switch to the VLAN mode.
vlan 11                                 Create a VLAN by entering the VLAN ID.
vlan name 11 VLAN1                      Assign the name “VLAN1” to VLAN 11.
vlan routing 11                         Create a virtual router interface and activate the
                                        router function at this interface.
exit                                    Switch to the privileged EXEC mode.

show ip vlan                            Display the virtual router interface that the router
                                        has set up for the VLAN.
show ip vlan          Logical
VLAN ID  Interface    IP Address    Subnet Mask     MAC Address
-------  ----------   -----------   -------------   ------------
11       9/1          0.0.0.0      0.0.0.0          00:80:63:51:74:2C

show ip interface brief                 Check the entry for the virtual router interface.

                                                    Netdir    Multi
Interface IP Address       IP Mask                  Bcast     CastFwd
--------- ---------------  ---------------  --------  --------
9/1       0.0.0.0          0.0.0.0          Disable   Disable

configure                               Switch to the Configuration mode.
interface 9/1                           Change to the interface configuration mode of
                                        interface 9/1.
ip address 10.0.11.2                    Assign the interface its IP parameters.
255.255.255.0
routing                                 Activate the router function at this interface.
```

☐ Set up virtual router and configure port

```
ip vrrp 1                               Create the VRID for the first virtual router at this
                                        port.
ip vrrp 1 priority 200                  Assign virtual router 1 the router priority 200.
ip vrrp 1 mode                          Switch on the first virtual router at this port.
ip vrrp 1 ip 10.0.11.1                  Assign virtual router 1 its IP address.
ip vrrp 1 domain 1 supervisor           Assign the HiVRRP domain and the domain role
                                        to the interface.
```

`ip vrrp 1 timers advertise milliseconds 100`	Assign the HiVRRP notification interval to the interface.
`exit`	Switch to the Configuration mode.
`exit`	Switch to the privileged EXEC mode.
`show ip vrrp interface 9/1 1`	Display the configuration of VLAN 11

```
Primary IP Address.............................. 10.0.11.1
VMAC Address.................................... 00:00:5e:00:01:01
Authentication Type............................. None
Base Priority................................... 200
Advertisement Interval (milliseconds)..... 100
Pre-empt Mode................................... Enable
Administrative Mode............................. Enable
State........................................... Initialized
Current Priority................................ 200
Preeption Delay (seconds)....................... 0
Link Down Notification.......................... Disabled
VRRP Domain..................................... 1
VRRP Domain Role................................ Supervisor
VRRP Domain State.............................. Supervisor is down
Advertisement Address........................... 224.0.0.18
```

☐ Define the (Ring) port as a member of the VLAN

`interface 2/1`	Switch to the Interface Configuration mode of interface 2/1.
`vlan participation include 11`	Assign the interface to the VLAN.
`exit`	Change to the Configuration mode.
`exit`	Change to the privileged EXEC mode.
`show vlan 11`	Display the configuration of VLAN 11

```
VLAN ID           : 11
VLAN Name         : VLAN1
VLAN Type         : Static
VLAN Creation Time: 0 days, 00:00:06 (System Uptime)

Interface   Current   Configured   Tagging
----------  --------  -----------  --------
1/1         Exclude   Autodetect   Untagged
1/2         Exclude   Autodetect   Untagged
1/3         Exclude   Autodetect   Untagged
1/4         Exclude   Autodetect   Untagged
2/1         Include   Include      Untagged
2/2         Exclude   Autodetect   Untagged
2/3         Exclude   Autodetect   Untagged
2/4         Exclude   Autodetect   Untagged
3/1         Exclude   Autodetect   Untagged
3/2         Exclude   Autodetect   Untagged
9/1         Exclude   Autodetect   Untagged
```

Switch on routing and VRRP globally

`enable`	Switch to the privileged EXEC mode.
`configure`	Switch to the Configuration mode.
`ip routing`	Switch on the router function globally.
`ip vrrp`	Switch on VRRP globally.

5.4 VRRP tracking

By monitoring certain router statuses (e.g. line interruption), VRRP tracking makes it possible to switch to a better router when a link goes down.

If there is a line interruption between Switch S1 and router A (see figure 25), router B takes over the master function for virtual router 10.0.1.254.
Router A remains the master for virtual router 10.0.2.254. However, router A no longer has a link to subnetwork 10.0.1.0.
The virtual router interfaces are independent of each other.

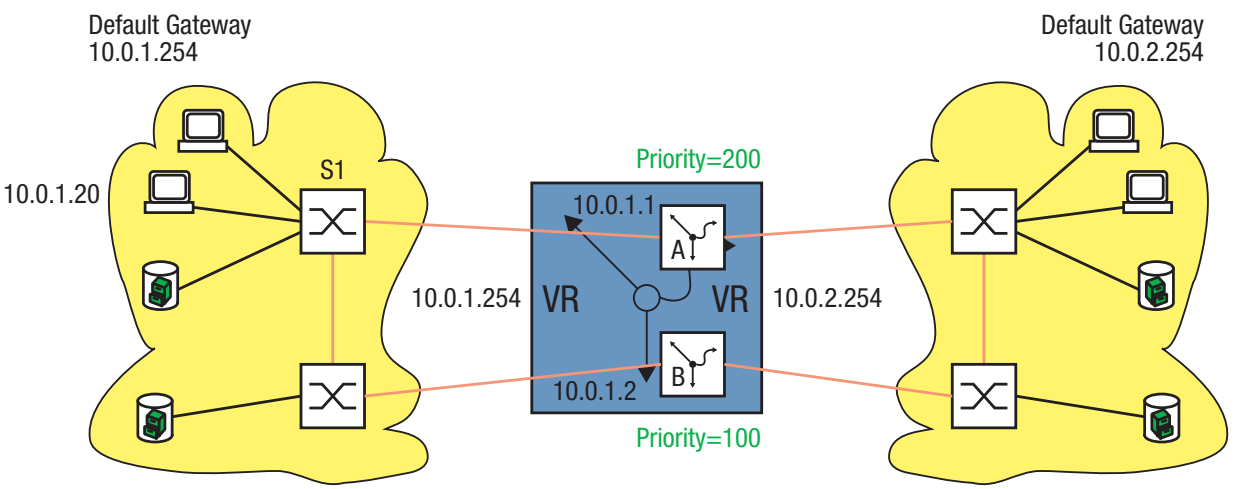


Figure 24: Typical VRRP application

As soon as the VRRP master router with the VRRP tracking function active detects the interruption of one of its links, it lowers its VRRP priority and informs the other VRRP routers of this.
Then another VRRP router, which now has the highest priority due to this change in the situation, can take over the master function within the skew time.

Solution without tracking:
Configure router A with a static route to router B or with a dynamic routing procedure, so that router A finds a route into subnetwork 10.0.1.0.

A direct link with preference 0 is the best route.
The static route with preference 1 is the second-best route. Then comes the dynamic route.

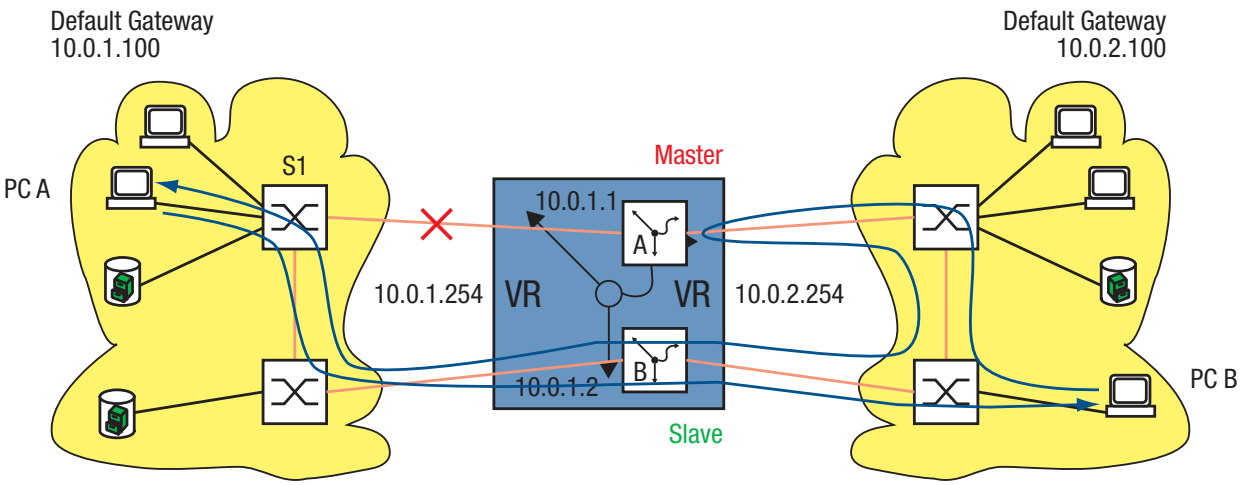


Figure 25: Transmission path from PC B to PC A in the case of a line interruption without tracking

The data from PC B is then transferred to PC A via router A and router B.

Solution with tracking:
For an optimal route, you can now use the tracking function to also make router B the master for virtual router 10.0.2.254.
By "tracking" the interrupted link and registering the virtual routers for this tracking object (see on page 43 “Tracking”), router A decrements its VRRP priority. Thus when router B receives the next advertisement from router A, router B detects that its own VRRP priority is higher than that of router A and takes over the master function (see figure 26).

Note: As the IP address owner has the fixed VRRP priority 255 by definition, the VRRP tracking function requires the IP addresses of the VRRP router interfaces to differ from the virtual router IP address.

Note: For the backup router to be able to take over the master function from the master router with the lower priority, the VRRP tracking function requires that the preempt mode is activated.

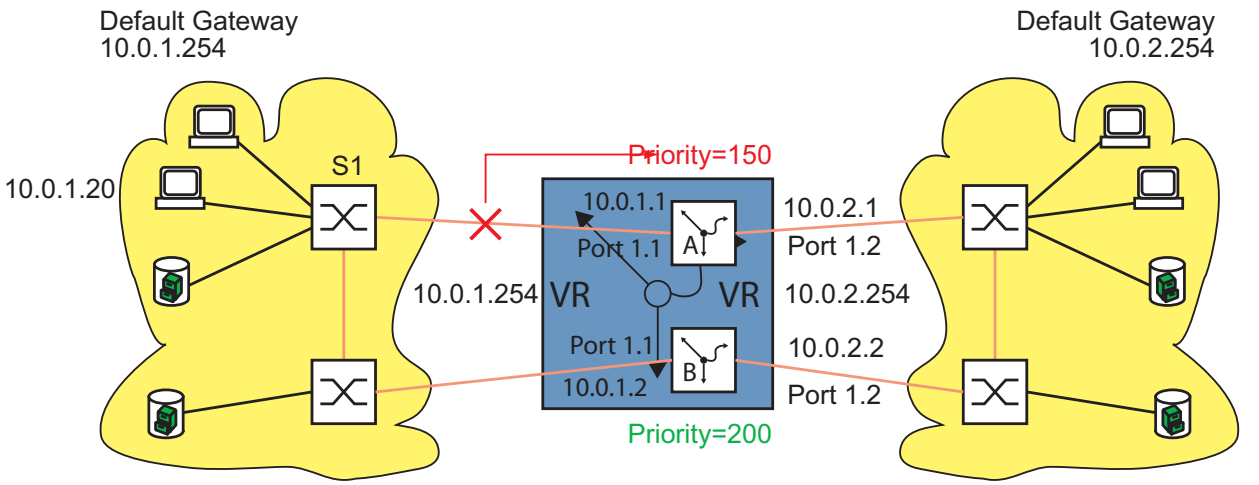


Figure 26: VRRP tracking after a line interruption

	Router A	Router A	Router B	Router B
Interface	1.1	1.2	1.2	1.1
IP address	10.0.1.1/24	10.0.2.1/24	10.0.2.2/24	10.0.1.2/24
VRID	1	2	2	1
VRRP IP address	10.0.1.254	10.0.2.254	10.0.2.254	10.0.1.254
VRRP priority	250	250	200	200
VRRP preemption	Enabled	Enabled	Enabled	Enabled
Track ID	2	1	-	-
Track decrement	100	100	-	-

Table 7: VRRP tracking configuration for the example above

	Router A	Router A	Router B	Router B
Track ID	1	2	-	-
Type	Interface	Interface	-	-
Interface	1.1	1.2	-	-

Table 8: Tracking configuration for the example above

The configuration of VRRP tracking requires the following steps:

- Configure the tracking object
  (see on page 49 “Configuring the tracking”).
- Configure the VRRP.
- Add the track ID to the VRRP entry (= register the VRRP entry for the tracking object).

☐ Set up interface tracking at port 1.1 with a link down delay of 0 seconds and a link up delay of 3 seconds.

☐ In the `Routing:Tracking:Configuration` dialog, click on “Wizard” at the bottom right.

Select type:

☐ Enter the values you desire:

Track ID:	`1`
Type:	`interface`

☐ Click on “Continue”.

Properties:

☐ Enter the values you desire:

Module.Port:	`1.1`
Link up delay:	`3`
Link down delay:	`0`

☐ Click on “Finish” to leave the Wizard and save the entry temporarily in the configuration.

```
enable
configure
track 1 interface 1/1
  link-down-delay 0
  link-up-delay 3
```

Switch to the privileged EXEC mode.
Switch to the Configuration mode.
Enter the tracking parameters and activate this tracking object.

☐ Switch on routing and VRRP globally.

☐ Select the `Routing:Global` dialog.
☐ Select “Routing”.
☐ Click "Set" to save the changes temporarily.
☐ Select the dialog `Redundancy:VRRP/HiVRRP:Configuration`.
☐ Select “Operation”.
☐ Click "Set" to save the changes temporarily.

`ip routing`	Switch on the router function globally.
`ip vrrp`	Switch on VRRP globally.

☐ Configure the IP address and VRRP at port 1.2.

☐ In the `Redundancy:VRRP/HiVRRP:Configuration` dialog, click “Wizard” at the bottom right.

Create entry:

☐ Enter the values you desire:

“Module”:	`1`
“Port”:	`2`
“VRID”:	`2`

☐ Click on “Continue”.

Edit entry:

☐ Enter the values you desire:

“VRRP IP address”:	`10.0.2.254`
“Priority”:	`250`
“Preempt mode”:	`1`

☐ Click on “Continue”.

`interface 1/2`	Select the port for setting up VRRP.
`ip address 10.0.2.1 255.255.255.0`	Assign the port its IP parameters.
`routing`	Switch on the router function at this port.
`ip vrrp 2`	Create the VRID for the first virtual router at this port.
`ip vrrp 2 mode`	Switch on the first virtual router at this port.
`ip vrrp 2 ip 10.0.2.254`	Assign virtual router 1 its IP address.
`ip vrrp 2 priority 250`	Assign virtual router 1 the router priority 250.

☐ Register VRRP for the tracking object.

Tracking

☐ Enter the values you desire:
“Track ID”: `1`
“Decrement”: `100`

☐ Click on “Add”.

☐ Click on “Continue”.

☐ Click on “Finish” to leave the Wizard and save the entry temporarily in the configuration.

`ip vrrp 2 track 1 decrement 100`	Register the first VRRP entry for the tracking object.
`exit`	Switch to the Configuration mode.
`exit`	Switch to the privileged EXEC mode.
`show track applications`	Display the registered applications.

```
TrackId  Application              Changes  Time since last change
-------  ----------------------  -------  ----------------------
1        VRRP 1/2 VRID: 2          0      0 day(s), 00:38:24
```

☐ You also perform the same configuration on the redundant router.

5.5 VRRP with load sharing

With the simple configuration, a router performs the gateway function for all terminal devices. The capacity of the redundant router lies idle. VRRP allows you to also use the capacity of the redundant router. By setting up a number of virtual routers, you can enter different default gateways on the connected terminal devices and thus steer the data flow.
When both routers are active, the data flows via the router on which the IP address of the default gateway has the higher VRRP priority. If a router fails, then all the data flows via the remaining routers.

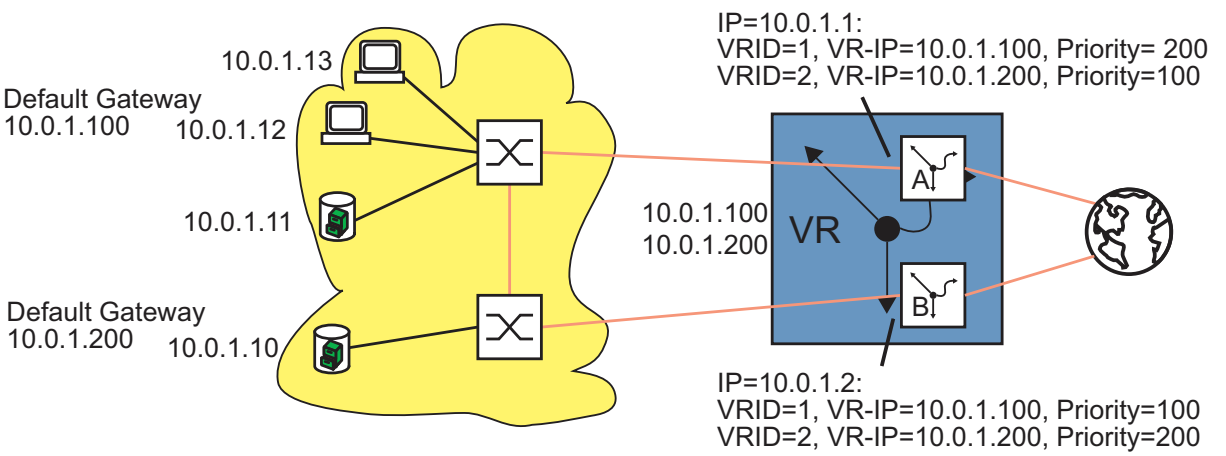


Figure 27: Virtual router with load sharing

To use load sharing, you perform the following configuration steps:

- ☐ Define a second VRID for the same router interface.
- ☐ Assign the router interface its own IP address for the second VRID.
- ☐ Assign the second virtual router a lower priority than the first virtual router.
- ☐ When configuring the redundant router, make sure that you assign the second virtual router a higher priority than the first.
- ☐ Give the terminal devices one of the virtual router IP addresses as a default gateway.

5.6 VRRP mit Multinetting

The router allows you to combine VRRP with Multinetting.

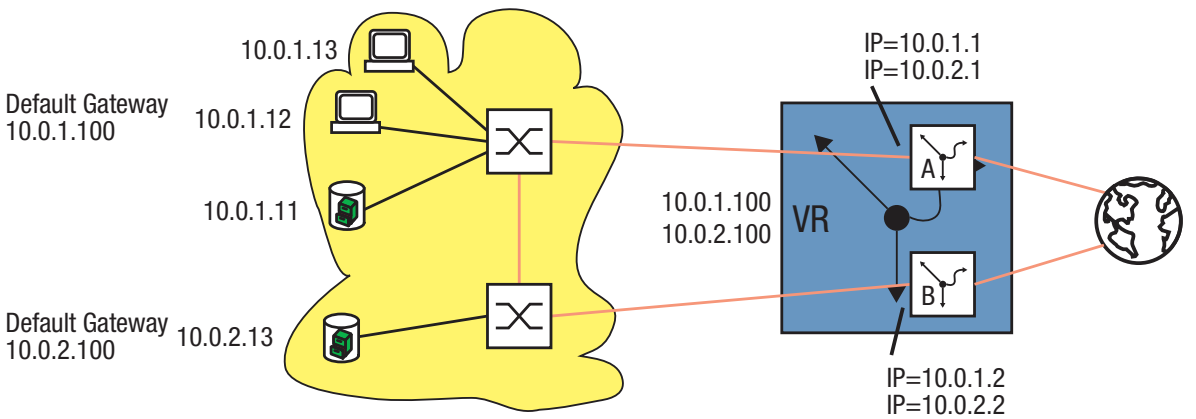


Figure 28: Virtual router with multinetting

To use VRRP with multinetting, you perform the following configuration steps on the basis of an existing VRRP configuration (see figure 19):

☐ Assign a second (secondary) IP address to the port.

☐ Assign a second (secondary) IP address to the virtual router.

```
interface 2/3

ip address 10.0.2.1
255.255.255.0 secondary
ip vrrp 1 ip 10.0.2.100
secondary
```

Select the port at which you want to configure multinetting.

Assign the second IP address to the port.

Assign the second IP address to the virtual router with the VR-ID 1.

☐ Perform the same configuration on the redundant router also.

6 RIP

The Routing Information Protocol (RIP) is a routing protocol based on the distance vector algorithm. It is used for the dynamic creation of the routing table for routers.

When you start a router, the router only knows the networks directly connected to it, and it sends this routing table to the neighboring routers. At the same time, it requests the routing tables of its neighboring routers. The router adds this information to its routing table and thus learns which networks can be accessed via which routers, and how much effort is involved in this. In order to detect changes in the network (when a router fails or starts), the routers regularly repeat the exchange of all the routing tables, usually every 30 seconds. This involves a considerable bandwidth requirement in large networks.

The costs, also known as the metric, refer to the work involved in reaching a particular network. RIP uses the hop count for this, which describes the number of routers that are traversed along the path to the destination network. The name 'distance vector' is derived from the fact that the distance (metric) is the criterion for determining the route, and the direction is specified by the next hop (vector). The next hop refers to the neighboring router along the path to the destination address.

An entry in the routing table consists of the address of the next hop, the destination address and the metric. The RIP routing table always contains the most efficient route to the destination. This is the route with the smallest metric and the longest suitable network mask prefix.

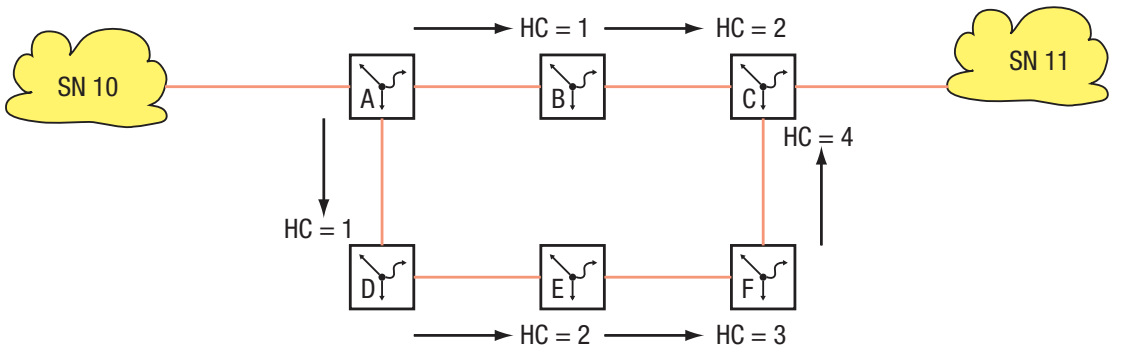


Figure 29: Counting Hops

Router A			**Router B**			**Router D**		
Destination	Next Hop	Metric	Destination	Next Hop	Metric	Destination	Next Hop	Metric
SN 10	lokal	0	SN 10	Router A	1	SN 10	Router A	1
SN 11	Router B	2	SN 11	Router C	1	SN 11	Router E	3

Table 9: Routing table to the figure above

In contrast to OSPF, a RIP router regularly exchanges the content of its entire routing table with its direct neighbor. Every router knows only its own routes and the routes of its direct neighbor. Thus it only has a local perspective.

When changes are made in the network, it takes a while until all the routers have the same uniform view of the network. The process of achieving this condition is known as convergence.

6.1 Convergence

How does RIP react to changes in the topography?
In the following example of a line interruption between router B and router C, you can see the resulting changes in the address table:

Assumptions:
- The interruption occurs 5 seconds after B sent its routing table.
- The routers send their routing table every 30 seconds (= factory setting).
- There is an interval of 15 seconds between when router A sends its routing table and when router B sends its routing table.

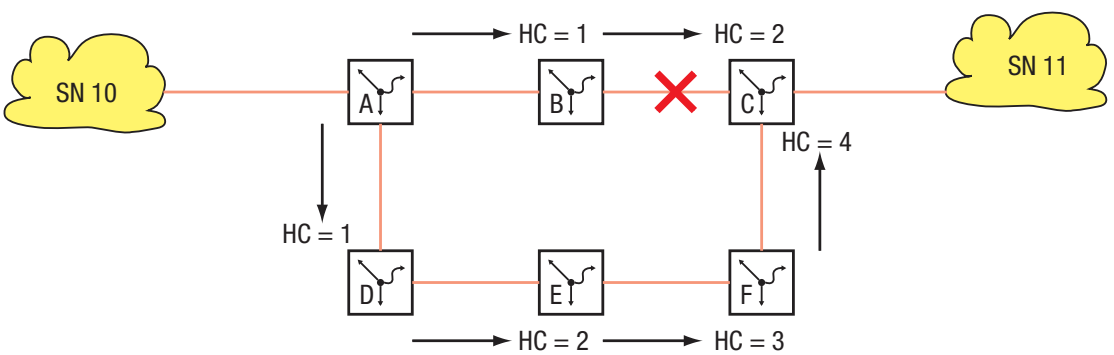


Figure 30: Hop Count

Time elapsing before convergence:

0 seconds:
Interruption

10 seconds
Router A sends its routing table:

Router A		
Destination	Next hop	Metric
SN 10	local	0
SN 11	Router B	2

Using the routing table from router A, router B sees that router A knows a connection to destination SN 11 with a metric of 2. Because it does not have its own connection to router C as the next hop to SN 11, router B changes its entry to destination SN 11. It enters router A as the next hop and increases the metric from router A by 1 to 3 (distance = learned distance + 1).

25 secondsRouter B sends its routing table:

Router B		
Destination	Nex- Hop	Metrik
SN 10	Router A	1
SN 11	Router A	3

Using the routing table from router B, router A sees that router B knows a connection to SN 11 with a metric of 3. So router A increases its metric for SN 11 by 1 to 4.

40 secondsRouter A sends its routing table:

Router A		
Destination	Next hop	Metric
SN 10	local	1
SN 11	Router B	4

Using the routing table from router A, router B sees that router A knows a connection to destination SN 11 with a metric of 4. So router B increases its metric for SN 11 by 1 to 5.

55 secondsRouter B sends its routing table

Router B		
Destination	Next hop	Metric
SN 10	Router A	1
SN 11	Router A	5

Using the routing table from router B, router A sees that router B knows a connection to SN 11 with a metric of 5. So router A increases its metric for SN 11 by 1 to 6. Because router A can see in the routing table from router D that router D has a connection to SN 11 with the smaller metric of 3, router A changes its entry for SN 11.

70 secondsRouter A sends its routing table:

Router A		
Destination	Next hop	Metric

Router A		
SN 10	Router A	1
SN 11	Router D	4

After 70 seconds, convergence has been achieved again.

6.2 Maximum Network Size

The biggest problem with RIP is that routers only know their neighbors directly. This results in long convergence times and the count-to-infinity problem. Infinity refers to the inaccessibility of a destination, and it is designated by hop count 16 in RIP. If the above example did not contain the parallel path via routers D, E and F, then routers A and B would keep sending their routing tables until the metric reached a value of 16. Then the routers recognize that the destination is inaccessible.
Using the “split horizon” approach eliminates this looping problem between two neighboring routers. Split horizon has two operating modes.

Simple split horizon	Omits the entries known by a neighbor when sending the routing table to this neighbor.
Simple split horizon with poison reverse	Sends the routing table to a neighbor with the entries known by this neighbor, but denotes these entries with the infinity metric (=16).

Thus the hop count 16 specifies the maximum size of a network with RIP as the routing procedure. The longest paths may use up to 15 routers.

6.3 General Properties of RIP

The RFC 1058 from June 1988 specifies RIP version 1. Version 1 has the following restrictions:

- Use of broadcasts for protocol messages.
- Does not support subnetworks/CIDR.
- No authentification.

The standardization of RIP version 2 in the RFC 2453 in 1998 eliminates the above restrictions.
RIP V2 sends its protocol messages as a multicast with the destination address 224.0.0.9, and supports subnetwork masks and authentication. However, the restrictions relating to the size of the network remain.

Advantages	Disadvantages
Easy to implement	Routing tables in large networks very comprehensive
Easy to administrate	Routing information is distributed slowly, because there are fixed sending intervals. This applies in particular to connections that have elapsed, since the routing table only contains existing paths.
	Count-to-infinity

Table 10: Advantages and disadvantages of Vector Distance Routing

6.4 Configuring the RIP

The advantage of RIP is the simple configuration. After the router interface is defined and the RIP is switched on, RIP automatically enters the required routes in the routing table.

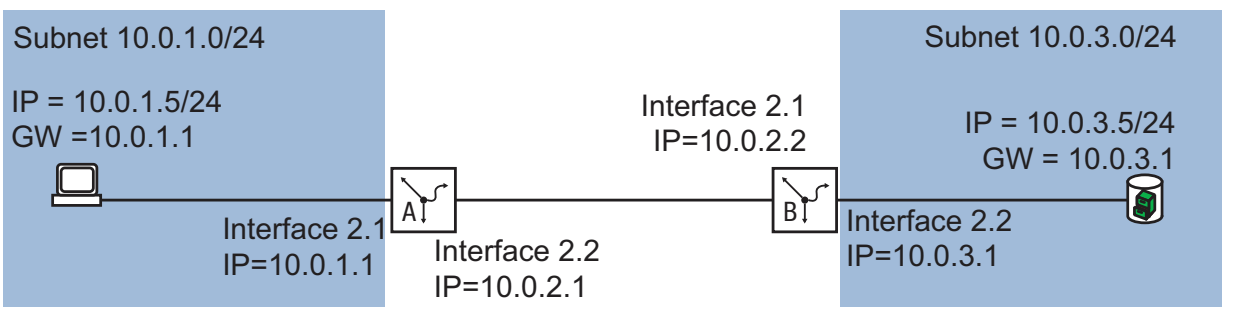


Figure 31: Example of the configuration of RIP

The configuration of RIP requires the following steps:

- Configure router interfaces - assign IP address and network mask.
- Switch on RIP on port.
- Switch on RIP globally.
- Switch on routing globally (if this has not already been done).

Configuration for router B

`enable`	Change to the privileged EXEC mode.
`configure`	Change to the Configuration mode.
`interface 2/2`	Change to the interface configuration mode of interface 2/2.
`ip address 10.0.3.1 255.255.255.0`	Assign the IP parameters to the port.
`routing`	Switch on the router function at this port.
`exit`	Change to the Configuration mode.

`interface 2/1`	Switch to the Interface Configuration mode of interface 2/1.
`ip address 10.0.2.2 255.255.255.0`	Assign the IP parameters to the port.
`routing`	Switch on the router function at this port.
`ip rip`	Switch on RIP at this port.
`exit`	Change to the Configuration mode.
`show ip rip interface brief`	Verify the settings for the RIP configuration.

```
                          Send       Receive      RIP        Link
Interface  IP Address     Version     Version     Mode       State
---------  -------------  ----------  ---------  ---------  -----
2/1        0.0.0.0         RIP-2       Both        Enable     Down
```

The IP address entries remain at 0.0.0.0 as long as the routing function is switched off globally.

router rip	Switch to the router configuration mode
redistribute connected	Tell RIP to send the routes of the locally connected interfaces along with the learned routes in the RIP information
`enable`	Switch on RIP globally.
`exit`	Change to the Configuration mode.
`ip routing`	Switch on the router function globally.
`show ip rip interface brief`	Verify the settings for the RIP configuration.

```
                          Send       Receive      RIP        Link
Interface  IP Address     Version     Version     Mode       State
---------  -------------  ----------  ---------  ---------  -----
2/1        10.0.2.2         RIP-2       Both        Enable     Up
```

`show ip route` Verify the routing table:

```
Total Number of Routes..... 3

   Network          Subnet                    Next Hop    Next Hop
   Address           Mask         Protocol     Intf     IP Address
--------------- --------------- ------------  ------  ------------
10.0.1.0        255.255.255.0   RIP            2/1       10.0.2.1
10.0.2.0        255.255.255.0   Local          2/1       10.0.2.2
10.0.3.0        255.255.255.0   Local          2/2       10.0.3.1
```

☐ Also perform the corresponding configuration on the other RIP routers.

A Appendix

A.1 Abbreviations used

ABR	Area Border Router
ACA	AutoConfiguration Adapter
AS	Autonomous System
ASBR	Autonomous System Border Router
BC	Broadcast
BDR	Backup designated Router
BGP	Border Gateway Protocol
BOOTP	Bootstrap Protocol
CIDR	Classless Inter Domain Routing
CLI	Command Line Interface
DHCP	Dynamic Host Configuration Protocol)
DR	Designated Router
DVMRP	Distance Vector Multicast Routing Protocol
EUI	Extended Unique Identifier
FDB	Forwarding Database
GARP	General Attribute Registration Protocol
GMRP	GARP Multicast Registration Protocol
http	Hypertext Transfer Protocol
HiVRRP	Hirschmann Virtual Router Redundancy Protocol
IANA	Internet Assigned Numbers Authority
ICMP	Internet Control Message Protocol
IGMP	Internet Group Management Protocol
IGP	Interior Gateway Protocol
IP	Internet Protocoll
LED	Light Emitting Diode
LLDP	Link Layer Discovery Protocol
LSA	Link Status Advertisement
LSD	Link State Database
F/O	Optical Fiber
MAC	Media Access Control
MC	Multicast
MICE	Modular Industrial Communication Equipment
NSSA	Not So Stubby Area
NTP	Network Time Protocol
OSPF	Open Shortest Path First
OUI	Organizationally Unique Identifier
PC	Personal Computer
PIM-DM	Protocol Independent Multicast-Dense Mode

PIM-SM	Protocol Independent Multicast-Sparse Mode
PTP	Precision Time Protocol
RFC	Request For Comment
RM	Redundancy Manager
RS	Rail Switch
RSTP	Rapid Spanning Tree Protocol
RIP	Routing Information Protocol
RPF	Reverse Path Forwarding
SFP	Small Form-factor Pluggable
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
SPT	Shortest Path Tree
TCP	Transfer Control Protocol
tftp	Trivial File Transfer Protocol
TP	Twisted Pair
TTL	Time-to-live
UDP	User Datagramm Protocol
URL	Uniform Resourve Locator
UTC	Coordinated Universal Time
VL	Virtual Link
VLAN	Virtual Local Area Network
VLSM	Variable Length Subnet Mask
VRID	Virtual Router Identification
VRRP	Virtual Router Redundancy Protocol

A.2 Underlying IEEE Standards

- IEEE 802.1AB
  Topology Discovery (LLDP)
- IEEE 802.1D
  Switching, GARP, GMRP, Spanning Tree (Supported via 802.1S implementation)
- IEEE 802.1D-1998
  Media Access Control (MAC) Bridges (includes IEEE 802.1p Priority and Dynamic Multicast Filtering, GARP, GMRP)
- IEEE 802.1Q-1998
  Virtual Bridged Local Area Networks (VLAN Tagging, Port Based VLANs, GVRP)
- IEEE 802.1S
  Multiple Spanning Tree
- IEEE 802.1 w.2001
  Rapid Reconfiguration, Supported via 802.1S implementation
- IEEE 802.1 X
  Port Authentication
- IEEE 802.3 - 2002
  Ethernet
- IEEE 802.3 ac
  VLAN Tagging
- IEEE 802.3 ad
  Link Aggregation with Static LAG and LACP support
- IEEE 802.3 x
  Flow Control

A.3 List of RFCs

- RFC 768 (UDP)
- RFC 783 (TFTP)
- RFC 791 (IP)
- RFC 792 (ICMP)
- RFC 793 (TCP)
- RFC 826 (ARP)
- RFC 854 (Telnet)
- RFC 855 (Telnet Option)
- RFC 951 (BOOTP)
- RFC 1112 (Host Extensions for IP Multicasting)
- RFC 1155 (SMIv1)
- RFC 1157 (SNMPv1)
- RFC 1212 (Concise MIB Definitions)
- RFC 1213 (MIB2)
- RFC 1493 (Dot1d)
- RFC 1542 (BOOTP-Extensions)
- RFC 1643 (Ethernet-like -MIB)
- RFC 1757 (RMON)
- RFC 1867 (HTML/2.0 Forms w/ file upload extensions)
- RFC 1901 (Community based SNMP v2)
- RFC 1905 (Protocol Operations for SNMP v2)
- RFC 1906 (Transport Mappings for SNMP v2)
- RFC 1907 (Management Information Base for SNMP v2)
- RFC 1908 (Coexistence between SNMP v1 and SNMP v2)
- RFC 1945 (HTTP/1.0)
- RFC 2068 (HTTP/1.1 protocol as updated by draft-ietf-http-v11-spec-rev-03)
- RFC 2131 (DHCP)
- RFC 2132 (DHCP-Options)
- RFC 2233 The Interfaces Group MIB using SMI v2
- RFC 2236 (IGMPv2)
- RFC 2246 (The TLS Protocol, Version 1.0)
- RFC 2271 (SNMP Framework MIB)
- RFC 2346 (AES Ciphersuites for Transport Layer Security)
- RFC 2570 (Introduction to SNMP v3)
- RFC 2571 (Architecture for Describing SNMP Management Frameworks)
- RFC 2572 (Message Processing and Dispatching for SNMP)
- RFC 2573 (SNMP v3 Applications)

- RFC 2574 (User Based Security Model for SNMP v3)
- RFC 2575 (View Based Access Control Model for SNMP)
- RFC 2576 (Coexistence between SNMP v1,v2 & v3)
- RFC 2578 (SMI v2)
- RFC 2579 (Textual Conventions for SMI v2)
- RFC 2580 (Conformance statements for SMI v2)
- RFC 2613 (SMON)
- RFC 2618 (RADIUS Authentication Client MIB)
- RFC 2620 (RADIUS Accounting MIB)
- RFC 2674 (Dot1p/Q)
- RFC 2818 (HTTP over TLS)
- RFC 2851 (Internet Addresses MIB)
- RFC 2865 (RADIUS Client)
- RFC 2866 (RADIUS Accounting)
- RFC 2868 (RADIUS Attributes for Tunnel Protocol Support)
- RFC 2869 (RADIUS Extensions)
- RFC 2869bis (RADIUS support for EAP)
- RFC 2933 (IGMP MIB)
- RFC 3164 (The BSD Syslig Protocol)
- RFC 3376 (IGMPv3)
- RFC 3580 (802.1X RADIUS Usage Guidelines)
- RFC 4330 (SNTP, obsoletes RFCs 1769 and 2330)

Routing

- RFC 826 Ethernet ARP
- RFC 894 Transmission of IP Datagrams over Ethernet Networks
- RFC 896 Congestion Control in IP/TCP Networks
- RFC 919 IP Broadcast
- RFC 922 IP Broadcast in the presence of subnets
- RFC 950 IP Subnetting
- RFC 1027 Using ARP to implement Transparent Subnet Gateways (Proxy ARP)
- RFC 1256 ICMP Router Discovery Messages
- RFC 1321 Message Digest Algorithm
- RFC 1519 CIDR
- RFC 1724 RIP v2 MIB Extension
- RFC 1812 Requirements for IP Version 4 Routers
- RFC 2082 RIP-2 MD5 Authentication
- RFC 2131 DHCP Relay
- RFC 2453 RIP v2

- RFC 2787 VRRP MIB
- RFC 2863 The Interfaces Group MIB
- RFC 3046 DHCP/BootP Relay

A.4 Entering the IP Parameters

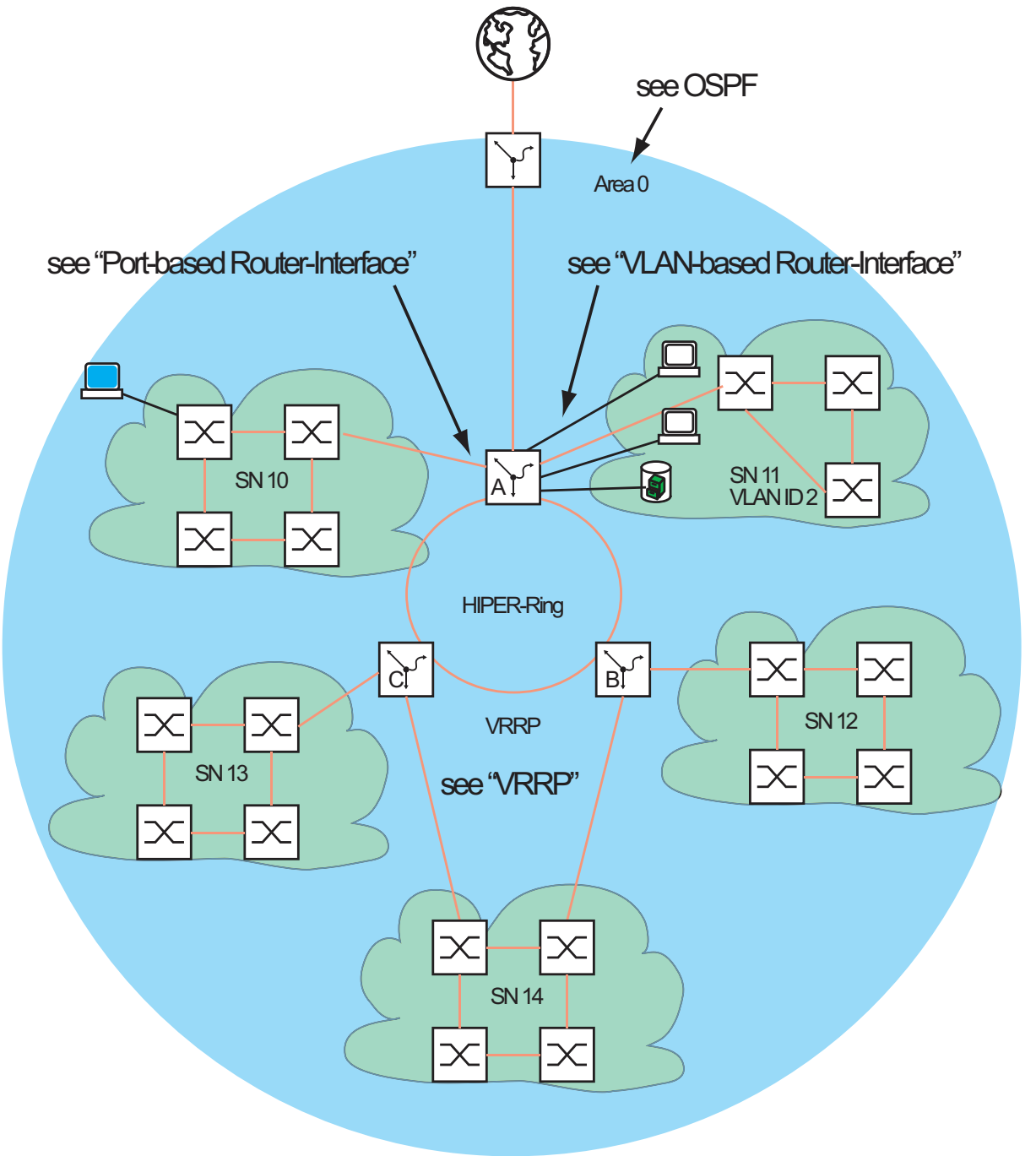


Figure 32: Network plan

To configure the layer 3 function, you require access to the management of the Switch, as described in the “Basic Configuration” user manual. Depending on your own application, you will find many options for assigning IP addresses to the devices. The following example describes one option that often arises in practice. Even if you have other prerequisites, this example shows the general method for entering the IP parameters and points out important things that you should note.

The prerequisites for the following example are:

- All layer 2 and layer 3 switches have the IP address 0.0.0.0 (= state on delivery)
- The IP addresses of the switches and router interfaces and the gateway IP addresses are defined in the network plan.
- The devices and their connections are installed.
- Redundant connections are open (see VRRP and HIPER-Ring). To avoid loops in the configuration phase, close the redundant connections only after the configuration phase.

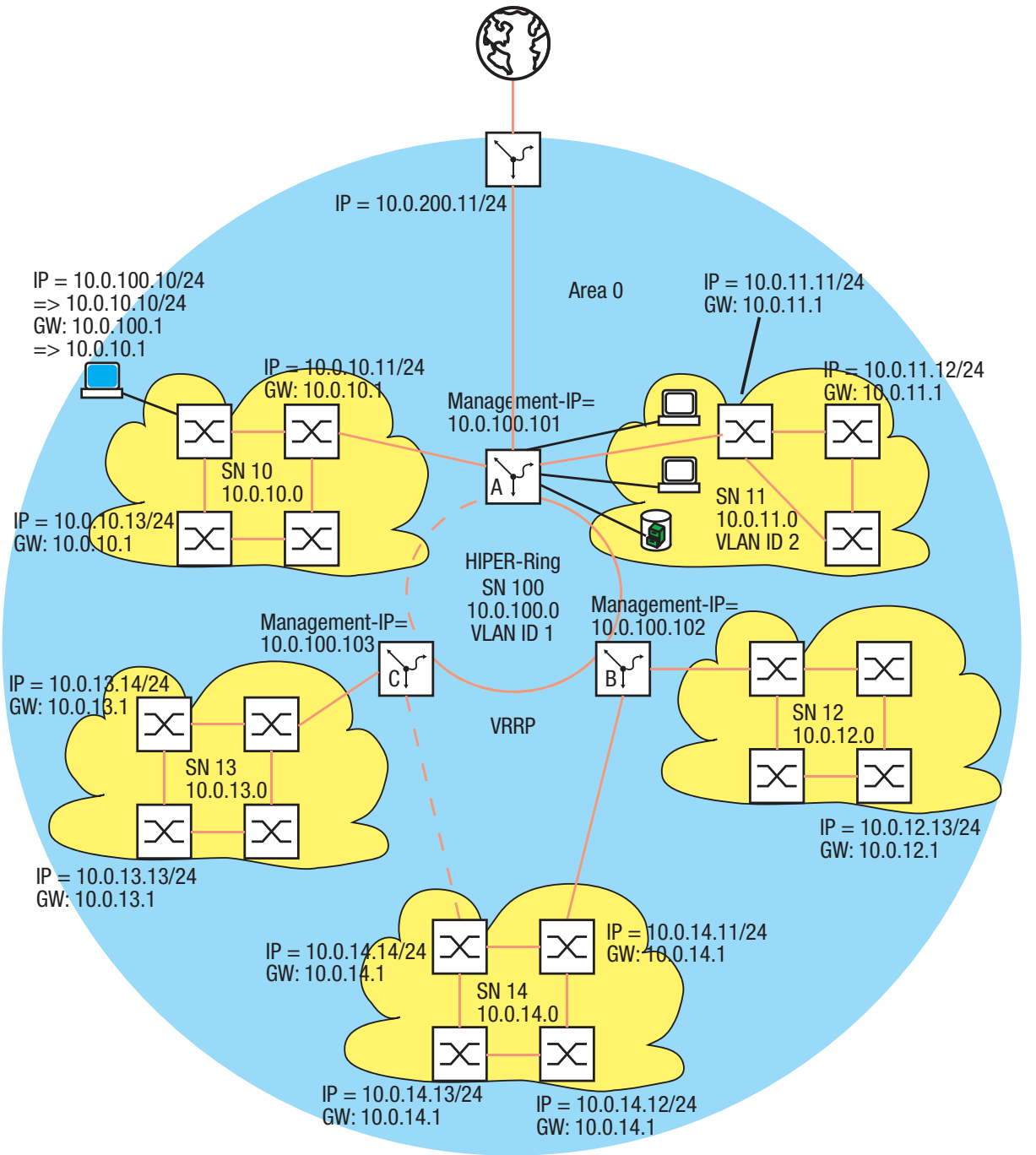


Figure 33: Network plan with management IP addresses

☐ Assign the IP parameters to your configuration computer. During the configuration phase, the configuration computer is located in subnet 100. This is necessary, so that the configuration computer has access to the layer 3 switches throughout the entire configuration phase.

☐ Start HiDiscovery on your configuration computer.

☐ Give all the layer 2 and layer 3 switches their IP parameters in accordance with the network plan.
You can access the devices in subnets 10 to 14 again when you have completed the following router configuration.

☐ Configure the router function for the layer 3 switches.
Note the sequence:
1. Layer 3 switch C
2. Layer 3 switch B
The sequence is important; you thus retain access to the devices.
As soon as you assign an IP address from the subnet of the management IP address (= SN 100) to a router interface, the Switch deletes the management IP address. You access the Switch via the IP address of the router interface.

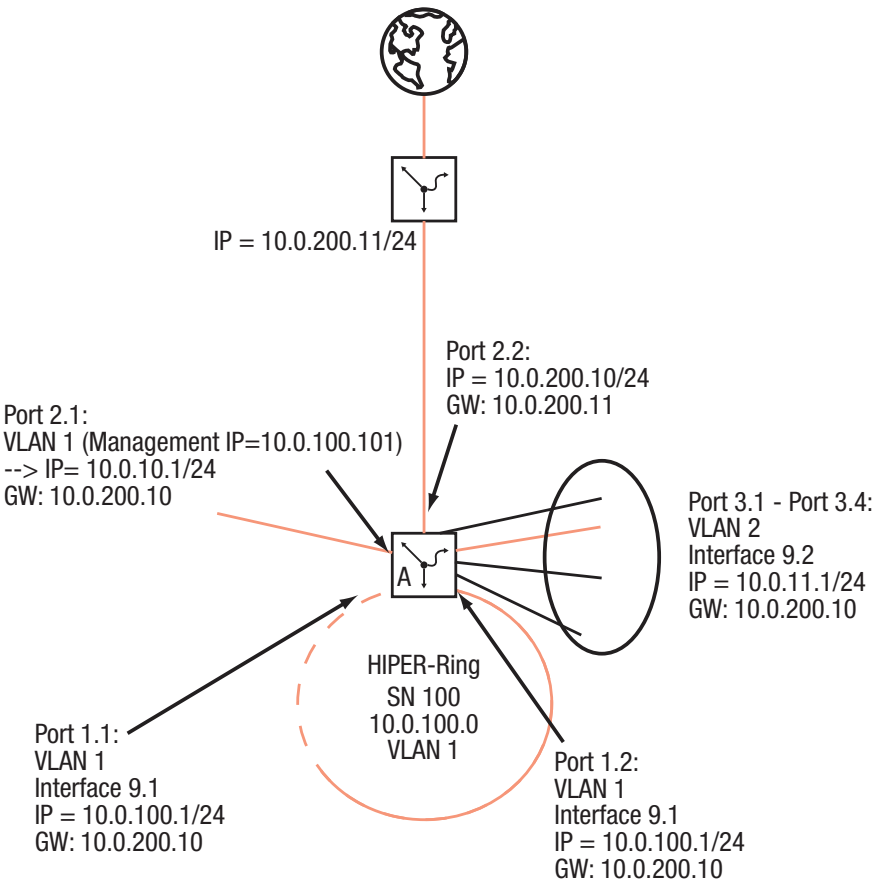


Figure 34: IP parameters for layer 3 switch A

☐ Configure the router function for layer 3 switch A.
You first configure the router interface at a port to which the configuration computer is connected. The result of this is that in future you will access the layer 3 switch via subnet 10.
☐ Change the IP parameters of your configuration computer to the values for subnet 10. You thus access layer 3 switch A again, namely via the IP address of the router interface set up beforehand.
☐ Finish the router configuration for layer 3 switch A (see figure 34).

After the configuration of the router function on all layer 3 switches, you have access to all the devices.

A.5 Copyright of Integrated Software

A.5.1 Bouncy Castle Crypto APIs (Java)

A.5.2 Broadcom Corporation

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