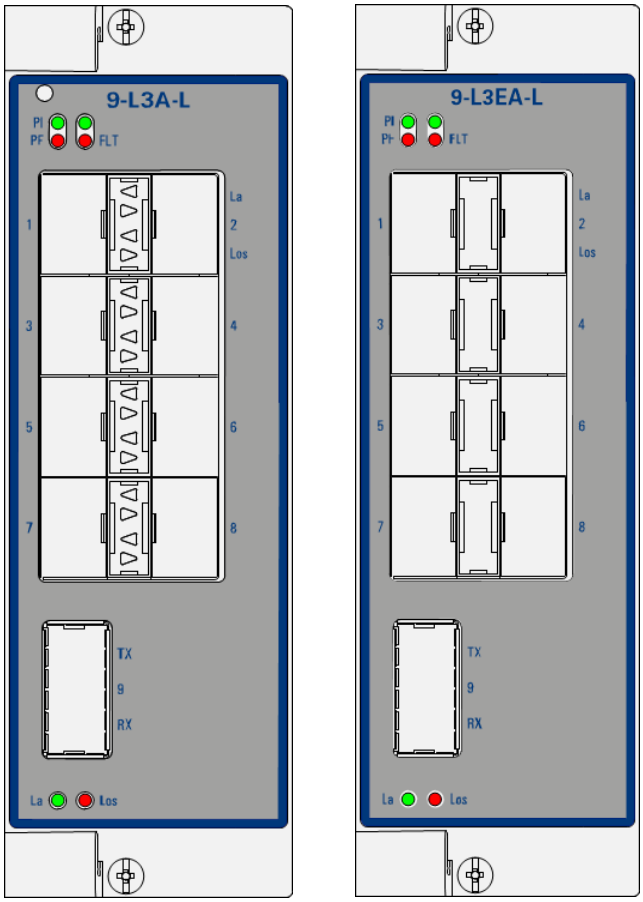
User Manual

Installation
Dragon PTN
Interface Module PTN-9-L3A-L (Main)
Interface Module PTN-9-L3EA-L (Extension)



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1. INTRODUCTION

1.1 General

This document is valid as of Dragon PTN Release 4.0DR.

This document describes the 9-L3A-L (=main) and 9-L3EA-L (=extension) interface modules which provide Layer2/Layer3 functionality. If you want more front ports than available on the main module, use the extension module in addition to double the front ports.

In this manual, following terminology is often used for a better readability:

- 'main L3 IFM' = 9-L3A-L IFM;
- 'extension L3 IFM' = 9-L3EA-L IFM;
- 'L3 IFM' could either mean:
  - 'main L3 IFM' only = 8+1 front ports;
  - The 'main L3 IFM' combined with an 'extension L3 IFM' = 16+2 front ports;

Both IFMs (=interface module) have 9 optical LAN (=Local Area Network) ports on the front panel: 8*1Gbps SFP ports and 1*10Gbps XFP port. Each individual port can be configured via HiProvision (=Dragon PTN Management System). 9-L3A-L refers to '9 ports – Layer3, Variant A IFM – LAN' whereas the 'E' in 9-L3EA-L refers to 'Extension'.

So using the main and extension L3 IFM together in one node, and plugged in in some specific interface slots, provides a total of 16*1Gbps SFP ports and 2*10Gbps XFP ports.

Both IFMs are a dual slot [n, n+1] IFM which means that it is 2 slots wide. Only the left-hand side of the IFM in the left-hand slot will be connected to the node backplane.

Depending on the used slot, the L3 IFM can have up to maximum 5 back end ports to the Central Switching Module (= CSM, see Ref. [4] in Table 2): 1 to 4 (1Gbps) and 1 (10Gbps). The maximum bandwidth availability is 14 Gbps (=4+10) and can be reached when the main L3 IFM is plugged into IFM slots [S3-S4] of the XT-2209-A node.

The L3 IFM bandwidth availability (and back end ports) on the Dragon PTN backbone depends on the used node type and the used slots. Verify the 'Dragon PTN Bandwidth Overview' manual (Ref. [100] in Table 2) to see in which node and IFM slot this IFM can be used.

NOTE: Using the extension L3 IFM does not double the amount of back end ports.

Table 1 Differences Main L3 IFM <-> Extension L3 IFM

	Main L3 IFM	Extension L3 IFM
Usabililty	Can be used in all nodes according to Ref. [100] in Table 2.	Can be used in the XT-2209-A node in slot S1(S2).
Dependency	Can be used without the the extension L3 IFM.	Can only be used together with the main L3 IFM, and this main L3 IFM must be plugged into slot S3(S4) directly next to the extension L3 IFM.
Hidden Reset Button	Available	Not available, using the reset button on the main L3 IFM also resets the extension L3 IFM.
LEDs	LED operation according §2.1.1	Normal LED operation is the same as the main L3 IFM. Boot LED operation is different. Plugging in the extension L3 IFM just flashes the LEDs for a few seconds. Next, the LEDs will be dark for approximately 3 minutes, the time needed for the main L3 IFM to configure its extension L3 IFM.
Back end ports towards backplane	Available	Not Available. The main and extension L3 IFM together share the same back end ports (towards the backplane) of the main L3 IFM.
Fans/Cooling	Yes	No

Main supported features:

- Gigabit Ethernet Ports:
  - 8 x SFP (Fiber, optical): 1000BASE-X;
  - 1 x XFP (Fiber, optical): 10GE;
- (main L3 IFM) Cooling: on-board local active cooling via 3 fans mounted on heatsink;
- Layer2
  - L2 VLAN handling;
  - QoS;
  - MSTP (=Multiple Spanning Tree);
- Layer3
  - VRF (=Virtual Router Forwarding);
  - VRRP (=Virtual Router Redundancy Protocol);
  - Static Routing;
  - OSPF (=Open Shortest Path First);
  - VLAN routing (IPv4) / L3VPN;
- Port Mirroring;
- Storm Control;
- BPDU Guard via MSTP;
- MRP (=Media Redundancy Protocol) Support.

1.2 Manual References

Table 2 is an overview of the manuals referred to in this manual. '&' refers to the language code, '*' refers to the manual issue. All these manuals can be found in the HiProvision (=Dragon PTN Management System) Help function.

Table 2 Manual References

Ref.	Number	Title
[1]	DRA-DRM821-&-*	Dragon PTN and HiProvision Operation
[2]	DRA-DRM801-&-*	Dragon PTN Installation and Operation
[3]	DRB-DRM802-&-*	Dragon PTN Aggregation Nodes: PTN2210, PTN2209, PTN2206, PTN1104
[4]	DRB-DRM803-&-*	Dragon PTN Switching Module: PTN-CSM310-A
[5]	DRE-DRM808-&-*	Dragon PTN Interface Module: PTN-1-10G-LW
[6]	DRE-DRM807-&-*	Dragon PTN Interface Module: PTN-4-GC-LW/PTN-4-GCB-LW
[7]	DRF-DRM811-&-*	Dragon PTN TRMs (Transmit Receive Modules: SFP, XFP)
[8]	DRA-DRM810-&-*	Dragon PTN General Specifications
[9]	DRE-DRM817-&-*	Dragon PTN Interface Module: PTN-4-GO-LW
[100]	DRA-DRM828-&-*	Dragon PTN Bandwidth Overview

2. MODULE DESCRIPTION

2.1 Front Panel

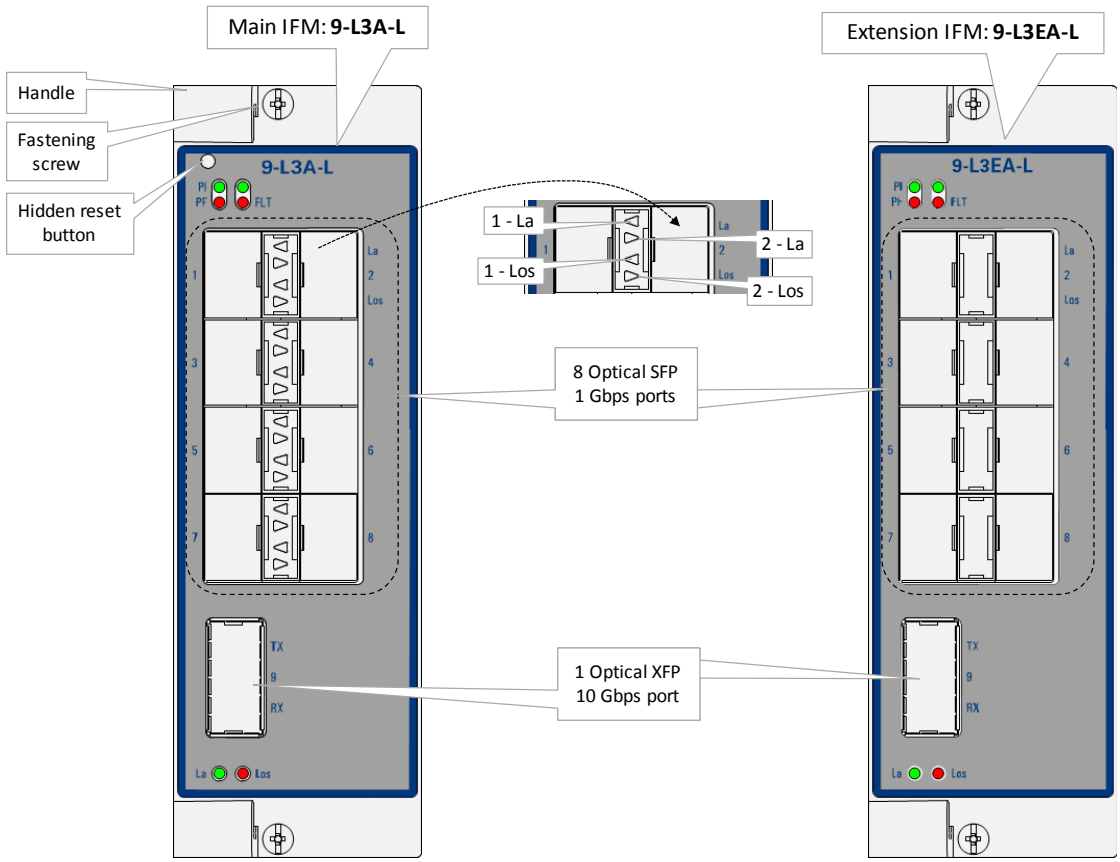

Figure 1 Front Panels: Main L3 IFM / Extension L3 IFM

2.1.1 Insert/Remove Module from Node

See 'Dragon PTN Installation and Operation Manual' Ref.[2].

2.1.2 LEDs

a. General

The meaning of the LEDs depends on the mode of operation (= boot or normal) in which the L3 IFM currently is running. After plugging in the module or rebooting it, the module turns into the boot operation. After the module has gone through all the cycles in the boot table below (=rebooted successfully), the module turns into the normal operation, see LEDs in the normal table.

Prerequisite: When plugging in the Extension L3 IFM, it is expected that the Main L3 IFM is already plugged into the node in the correct slot posittion.

Table 3 LED Indications In Boot Operation: Main L3 IFM

Cycle	PI	PF	FLT	Spare LED	La[1..9]	Los[1..9]
1	x	---	Slow blinking	---	---	---
2	x	---	x	x	---	---
3	x	---	---	---	---	---
x : LED is lit / --- : LED is not lit. The sub cycle times may vary. The entire boot cycle time [1→3] takes less than 1 minute.						

Table 4 LED Indications In Boot Operation: Extension L3 IFM

Cycle	PI	PF	FLT	Spare LED	La[1..9]	Los[1..9]
PLD Version of Extension L3 IFM = OK, no upgrade needed → see also §b						
1	x	---	Slow Blinking (2 seconds)	---	---	---
2	x	---	----		---	---
x : LED is lit / --- : LED is not lit. The entire boot cycle time [1→2] takes just two seconds.						
PLD Version of Extension L3 IFM = NOK, automatic upgrade started at plug in → see also §b						
1	x	---	Fast blinking (7 seconds)	---	---	---
2	x	---	--- (PLD is being upgraded, 3 minutes)	---	---	---
3	x	---	Slow blinking (2 seconds)	---	---	---
4	x	---	----		---	---
x: LED is lit / --- : LED is not lit. The sub cycle times may vary. The entire boot cycle time [1→3] takes approximately 3 minutes.						

Table 5 LED Indications in Normal Operation (Main and Extension L3 IFM)

LED	Color	Status
PI (=Power Input)	Not lit, dark	+12V power input to the board not OK
	Green	+12V power input to the board OK
PF (=Power Failure)	Not lit, dark	power generation on the board itself is OK
	Red	power generation on the board itself is erroneous
	Red Blinking	'Main L3' IFM is upgrading 'Extension IFM' because PLD version of Extension IFM is not in sync with PLD of Main IFM

LED	Color	Status
FLT (=FauLT)	Not lit, dark	no other fault or error situation, different from PF, is active on the module
	Red	a fault or error situation, different from PF, is active on the module
LA<port n°> (=Link Activity)	**1G Port (Port 1..8)**	
	Not lit, dark	The link on port<port n°> is down
	Yellow lit	The link on port<port n°> is up, no activity
	Yellow blinking	The link on port<port n°> is up, with activity
	10G Port (Port 9)	
	Not lit, dark	The link on the 10G port is down
	Yellow lit	The link on the 10G port is up, no receive activity (transmit activity is not shown)
	Yellow blinking	The link on the 10G port is up, with receive activity (transmit activity is not shown)
LOS<port n°> (=Loss of Signal)	Not lit, dark	No optical module present or optical module present and received optical signal = ok
	Red	Loss of optical signal on the port

b. Extension L3 PLD Version Upgrade

When the Extension L3 IFM is plugged in next to the Main L3 IFM, the main L3 IFM will check the PLD version of the Extension L3 IFM immediately. If this version is not expected by the main L3 IFM, the PLD of the Extension L3 IFM will be upgraded automatically by the Main L3 IFM. The PLD upgrade process can be recognized by the fast blinking of the FLT LED on the main L3 IFM. Below, find two figures that clarify this process.

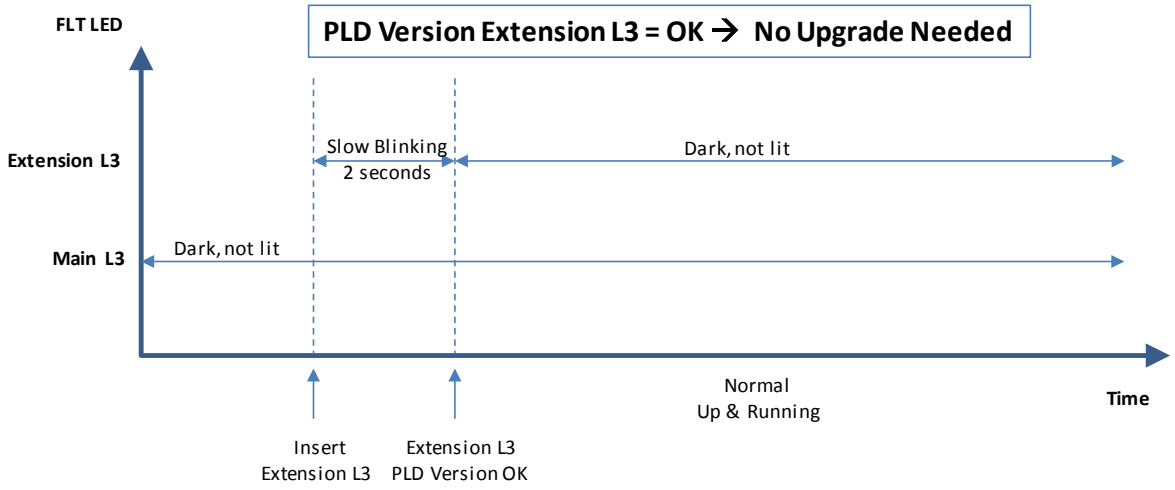

Figure 2 PLD Version of Extension L3 No Upgrade Needed

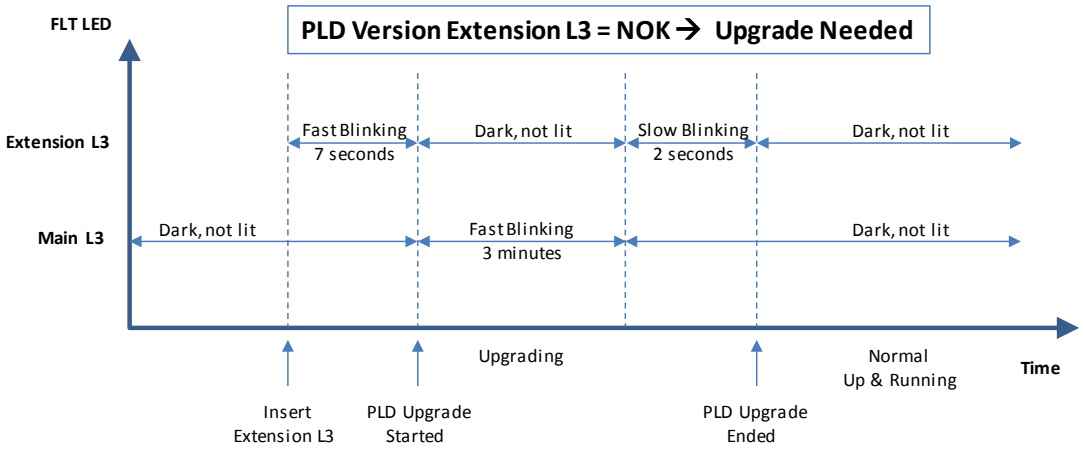

Figure 3 PLD Version of Extension L3 Upgrade Process

2.1.3 Hidden Reset Button (Only on main L3 IFM)

This pushbutton is hidden and accessible through a small hole on the front panel. This button can be pushed with a sharp fine object e.g. a needle, toothpick… Pushing this reset button causes a soft reset i.e. it is not a cold reset (power-off-on-cycle).

If an extension L3 IFM is operational in the node, pushing the reset button on the main L3 IFM also soft resets the extension L3 IFM.

2.1.4 Connectors

This module has following ports:

- SFP: 1000 Mbps Ethernet optical fiber port / Smart SFP;
- XFP: 10 Gigabit Ethernet optical fiber port.

The SFPs/XFPs that can be used for this port can be found in Ref. [7] in Table 2.

2.2 Functional Operation

The L3 IFM performs following major tasks:

2.2.1 Media Module for Ethernet: Interfacing to a LAN Network

WAN ports interconnect nodes within the Dragon PTN network (MPLS-TP) whereas LAN ports interconnect the nodes with their applications. The L3 IFM has LAN ports and as a result can not be used to interconnect nodes. Interconnecting nodes on the WAN side must be done via LAN/WAN Ethernet IFMs (4-GC-LW, ...).

A LAN port talks Ethernet and a WAN port talks MPLS-TP. As a result, the node can serve as an edge node (or LER = Label Edge Router) where traffic is received on a LAN port, mapped into pseudowire and forwarded to the correct label switched path on a WAN port.

For a configured application service, the node can operate as a:

- LER = Label Edge Router or access node: The node is located on the edge between the LAN and WAN. The node converts Ethernet into MPLS-TP and vice versa;
- LSR = Label Switching Router: The node is fully located in the WAN. The node has no end-points for the configured application service, it only forwards MPLS-TP traffic via label switched paths;

- VRF (=Virtural Router forwarding): When an optional Virtual Router has been configured on the L3 IFM, the node operates as a router between different IP subnets.

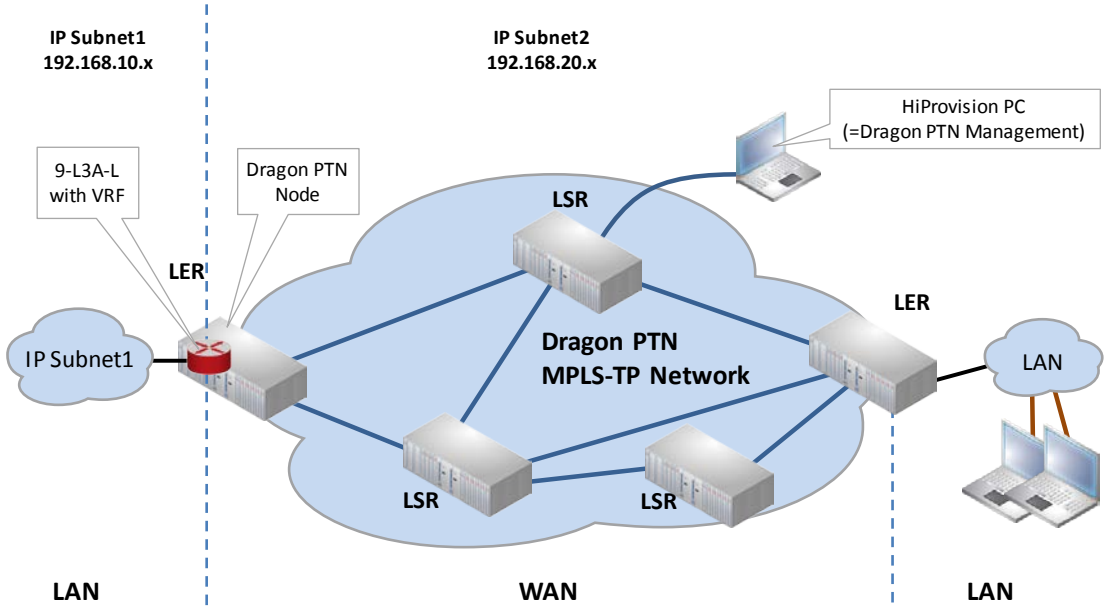

Figure 4 General Example: 2 IP Subnets (Virtual Routing)/LAN/WAN

In the figure below:

- FP = L3 IFM front port;
- BE = L3 IFM back end port to the CSM, the amount depends on the node type and slot;
- VID = VLAN ID, VFI = Virtual Forwarding Interface.

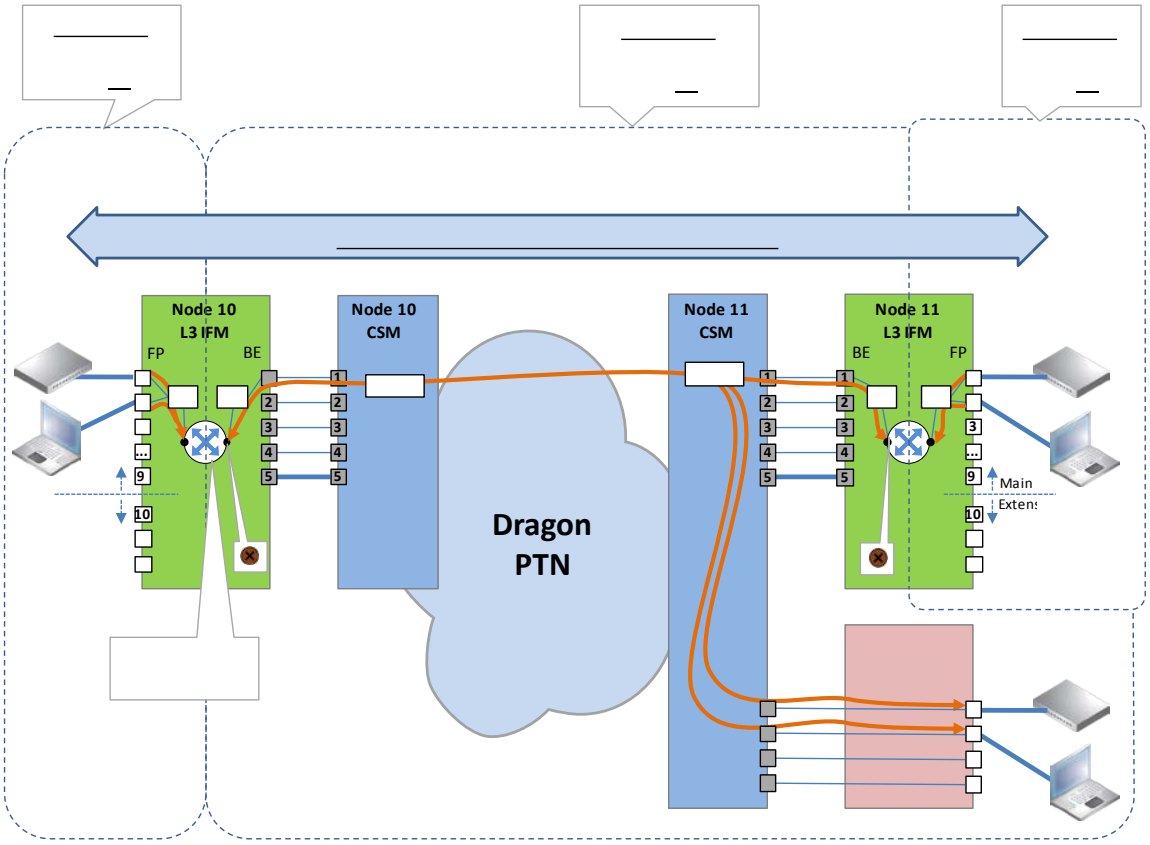

Figure 5 Detailed Example with 3 IP Subnets: L3VPN

2.2.2 I/O with the Central Switching Module (=CSM)

The L3 IFM receives Ethernet traffic via its front panel ports and forward this to the CSM via the main L3 IFM back end ports on the CSM. The CSM does all the processing on this data (synchronization, CRC checks, conversions, switching…). The resulting data will be forwarded via the backplane to one of the IFMs in the node.

2.2.3 Ethernet Service

a. General

The access or end-points of the L3 IFM communicates over the Dragon PTN network via an Ethernet service. This service must be configured via HiProvision. This service can operate port or VLAN based.

b. Port Based / VLAN Based

- Port based: Use this mode if all the traffic on a port must be transported transparently in one and the same service;
- VLAN based/VLAN ID: Use this mode if each VLAN (ID) on a port must have its own service. Ethernet packets with the configured VLAN ID will be forwarded in this service, other VLAN IDs and untagged packets will be dropped. This behavior can be overruled by a more advanced VLAN processing in the 'VLAN Tagging/Untagging' feature in HiProvision. This feature also supports VLAN translation which replaces VLAN ID 'x' into VLAN ID 'y'.

c. VLAN Based Local Service

A VLAN Based Local service:

- Is a VLAN based service between only the front ports on L3 IFMs;
- Does not use back end ports, tunnels, WAN ports or the Dragon PTN network. As a result, this service does not consume network bandwidth.

d. Configuration

See Ref. [1] in Table 2 for more configuration information in HiProvision.

2.2.4 Voice Service

The L3 IFM ports can be used in a Voice service. This service must be configured via HiProvision. See Ref. [1] in Table 2 for more configuration information on a Voice service in HiProvision.

2.2.5 Layer2: VLAN handling

Both port based and VLAN based Ethernet services are supported in which VLANs can be handled (tagging/untagging behavior, Qos, ...). See Ref. [1] in Table 2 for more configuration information in HiProvision.

2.2.6 Layer2: QoS (=Quality of Service)

Each Ethernet service can be assigned its own quality of service (bandwidth, priority, burstsize). See Ref. [1] in Table 2 for more configuration information in HiProvision.

2.2.7 Layer2: MSTP (=Multiple Spanning Tree)

MSTP originally defined in IEEE 802.1s and later merged into IEEE 802.1Q-2003, defines an extension to RSTP to further develop the usefulness of VLANs. This MSTP instance configures a separate Spanning Tree for all VLANs included in this instance and blocks all but one of the possible alternate paths within each Spanning Tree.

If there is only one VLAN in the network, single (traditional) STP works appropriately. If the network contains more than one VLAN, the logical network configured by single STP would work, but it is possible to make better use of the alternate paths available by using an alternate spanning tree for different VLANs or groups of VLANs. More than one VLAN can be assigned to one MST instance. Multiple MST regions can be operational, each having its own MSTP instances. The IST (MSTP) instance monitors the entire Region, the CST (MSTP) instance monitors the links between the regions.

MSTP in a port based service is supported network wide whereas MSTP in a VLAN based service is supported only locally (not over the L3 IFM back end ports). CAUTION: using a VLAN based service with MSTP over the back end ports could cause loops!

MSTP is fully supported on L2 and L3 IFMs. On L2 and L3 IFMs, there is always a default MSTP running even if no MSTP is configured in HiProvision. See Ref. [1] in Table 2 for more configuration information in HiProvision.

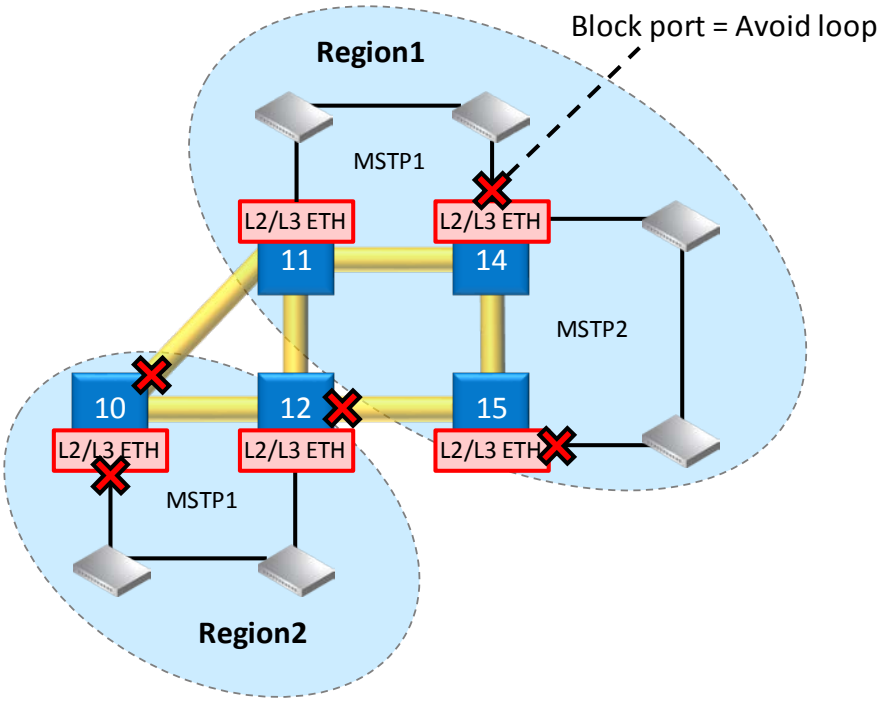

Figure 6 MST Example

2.2.8 Layer2: LAG (=Link Aggregation Group)

Link Aggregation is the bundling (=aggregation) of multiple parallel 1 Gbps links between a source and destination into one logical link. The resulting combined logical link:

- has at least one 1 Gbps bandwidth, but can have more bandwidth if both conditions below are met:
  - multiple streams from different MAC addresses are streamed over the LAG;
  - the LAG algorithm results in loadsharing these streams over different links within the LAG;
- offers loadsharing;
- offers redundancy in case one of the individual links should fail.

LAG is configured in HiProvision. See Ref. [1] in Table 2 for more configuration information in HiProvision.

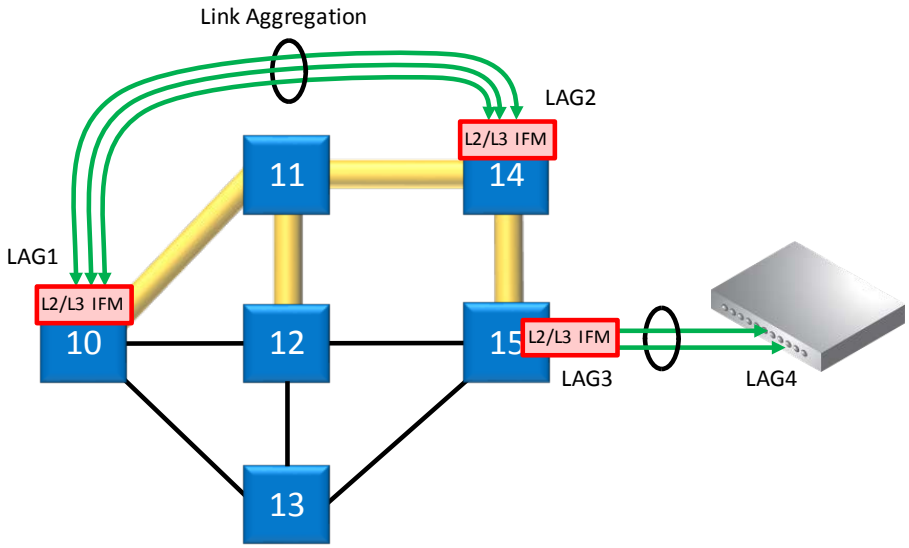

Figure 7 LAG Example

2.2.9 Layer3: VRF (=Virtual Router Forwarding)

Virtual Router is a router (instance) created by HiProvision within an L3 IFM in a Dragon PTN node. 'Virtual' in this context refers to the fact that it is created programmatically and that multiple routers can be created within the same IFM, with each Virtual Router having its own independent routing table. Because the Virtual Routers are independent, the same or overlapping IP addresses can be used without conflicting with each other. These routing tables initially only have IP addresses/masks of directly connected networks. Later on, these routing tables will be extended by using Static Routing, OSPF. Some scalability parameters can be found in §2.2.20. See example figure below. See Ref. [1] in Table 2 for more configuration information in HiProvision.

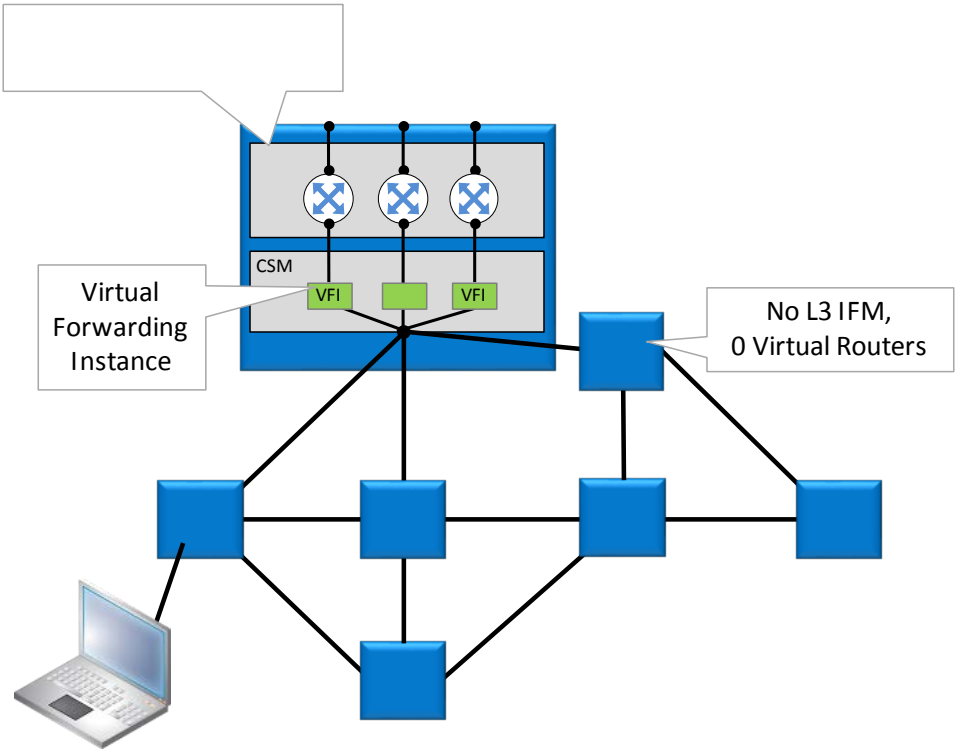

Figure 8 Virtual Router Example

2.2.10 Layer3: VRRP (=Virtual Router Redundancy Protocol)

VRRP (=Virtual Router Redundancy Protocol) is a protocol which increases the availability of the router of a subnet. This redundancy technology is based upon the **sharing** of a **virtual IP Address** amongst all the router interfaces being part of the same VRRP **Group**. This is achieved by combining a master and one or more backup router interfaces into one **Group**. The actual routing within the Group is done by the master (=active) router interface whereas the others act as backup. A router interface becomes master after a master election process.

All the router interfaces within a Group use the same unique virtual IP address, e.g 10.10.10.1. The virtual IP address and router interfaces must be in the same subnet. The virtual IP address will be the default gateway for its associated VLAN e.g. VLAN with VID 150.

The VRRP wizard in HiProvision can create one or more VRRP instances. Each VRRP instance can be configured between two or more routers. As a result, a Group will always have one or more backup router interfaces whenever its active router goes down. See Ref. [1] in Table 2 for more configuration information in HiProvision.

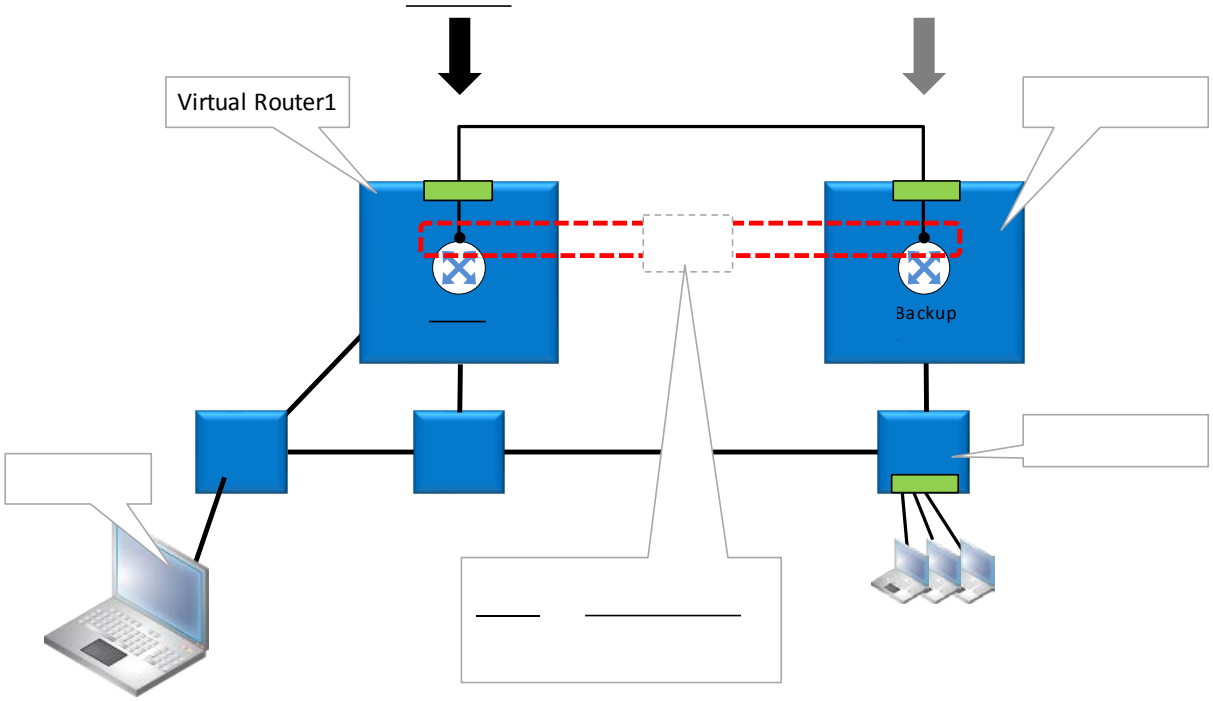

Figure 9 VRRP Example

2.2.11 Layer3: Static Routing

The static routing wizard in HiProvision configures or creates static routes (on the virtual routers) throughout the network. A route is a path from a source towards a destination via which the message has to travel to reach the destination IP network. There can exist multiple paths from source to destination, but only one path will be the most efficient one. Routes (with a same destination) can be favored via a distance parameter. See Ref. [1] in Table 2 for more configuration information in HiProvision.

2.2.12 Layer3: OSPF (=Open Shortest Path First)

OSPF is a dynamic routing protocol for IP networks. A dynamic routing protocol always determines the best possible routing path. For example, determined routes may dynamically change because a specific route becomes less or more preferred than before.

The concept of OSPF is that routers advertise **updates** of their **link states** to neighboring routers. And the neighboring router does the same to its neighboring router and so on…. In other words, each router learns from the other routers based on **link state advertisements** (=LSA). OSPF is a fast protocol because only updates are advertised.

OSPF checks the availability of others routers in the network by sending ‘Hello’ packets. If the other router does not respond then that router is assumed to be down. See Ref. [1] in Table 2 for more configuration information in HiProvision.

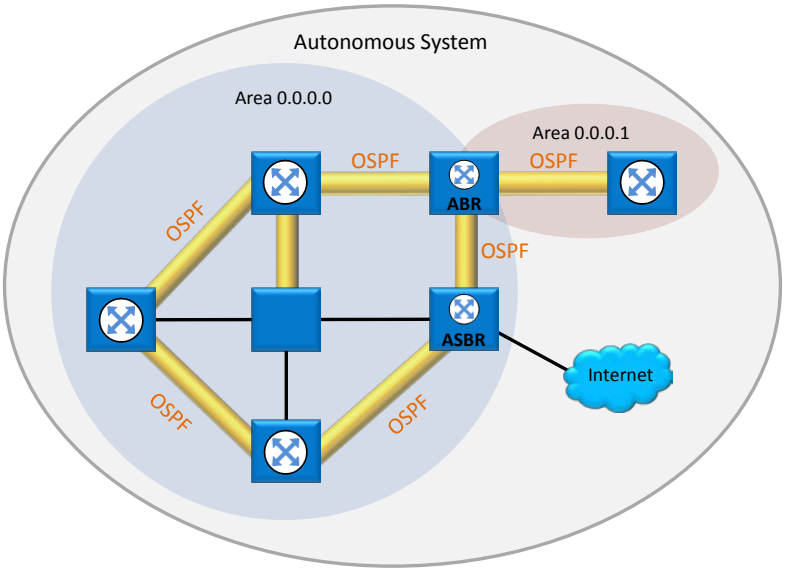

Figure 10 OSPF Example

2.2.13 VLAN routing (IPv4) / L3VPN

A L3VPN (or Layer3 VPN) is a routed network within Dragon PTN that interconnects one or more IP subnets via the MPLS-TP backbone. One or more Ethernet LAN ports from one IP subnet will be able to communicate with one or more Ethernet LAN ports in another IP subnet. The L3VPN is created via configuring an MPLS-TP service and one or more local LAN serivces interconnecting them via a virtual router on a L3 IFM. See §2.2.1 for a detailed example. See Ref. [1] in Table 2 for more configuration information in HiProvision.

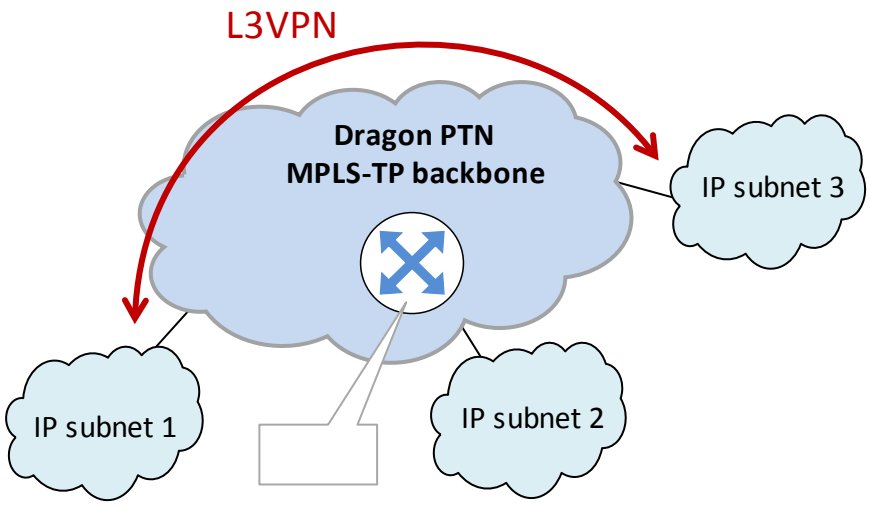

Figure 11 L3VPN Example

2.2.14 Loopback Interface

It is possible to create loopback interfaces or virtual L3 ports on the Virtual Router. The loopback interface is a virtual interface meant for management purposes. See Ref. [1] in Table 2 for more configuration information in HiProvision.

2.2.15 Storm Control on Ethernet LAN Port

A traffic storm is the growing of excessive network traffic due to Ethernet packets flooding the LAN. Such a storm can for example occur because of a data loop in the network due to no or misconfiguration of MSTP. These storms degrade the network performance and must be avoided whenever possible. The storm control feature:

- is an extra protection against these traffic storms;
- can be configured on the IFM ports;
- limits the amount of unlearned received data (Unicast, Broadcast, Multicast) on the LAN port ingress or input side;
- limits the amount of transmitted data (all data) on the LAN port egress or output side;
- Data that exceeds the configured limitations will be dropped. As a result, a possible data storm cannot overload the node processor or the node will limit outgoing data.

See Ref. [1] in Table 2 for more configuration information in HiProvision.

2.2.16 Port Mirroring

Port Mirroring is a network debugging or monitoring feature. It is used in the Dragon PTN node to send a copy of network packets seen on a source port (=mirrored port) to a destination port (=mirroring port). This feature can be used for network appliances that require monitoring of network traffic, such as an intrusion-detection system etc... Port mirroring is supported when source and destination ports are located in the same L3 IFM. See Ref. [1] in Table 2 for more configuration information in HiProvision.

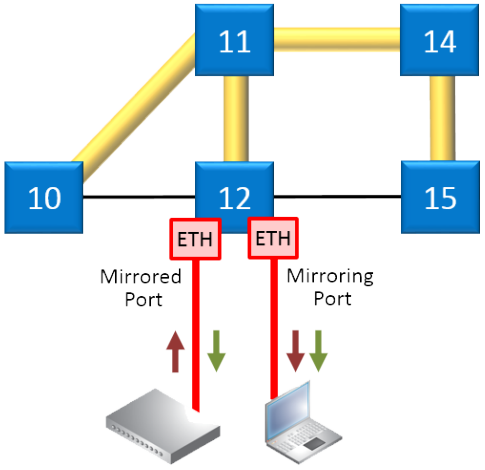

Figure 12 Port Mirroring Example

2.2.17 BPDU Guard via MSTP

BPDU Guard on the L3 IFMs is supported via the MSTP protocol wizard which can be configured in HiProvision. BPDU Guard (=Bridge Protocol Data Unit) is a LAN port property or feature that shuts down the LAN port when a BPDU packet enters this port. As a result, this feature or IFM:

- protects the network against possible loops created via this IFM;
- protects a running MSTP protocol somewhere else in the Dragon PTN network from external MSTP influences via this LAN port, e.g. root bridge protection etc....

See Ref. [1] in Table 2 for more configuration information in HiProvision.

2.2.18 MRP (=Media Redundancy Protocol) Support

The MRP is a protocol (IEC 62439-2) especially designed for industrial applications which need a predictable fail-over time. This protocol can only be used in a ring-topology network and makes sure that the ring network stays loop-free. MRP does in ring networks what spanning tree does in meshed networks but with much faster convergence times. The ring has one selected MR Manager (MRM) and a number of MR Clients (MRC). The two Dragon PTN nodes act as MRC. See Ref. [1] in Table 2 for more configuration information in HiProvision.

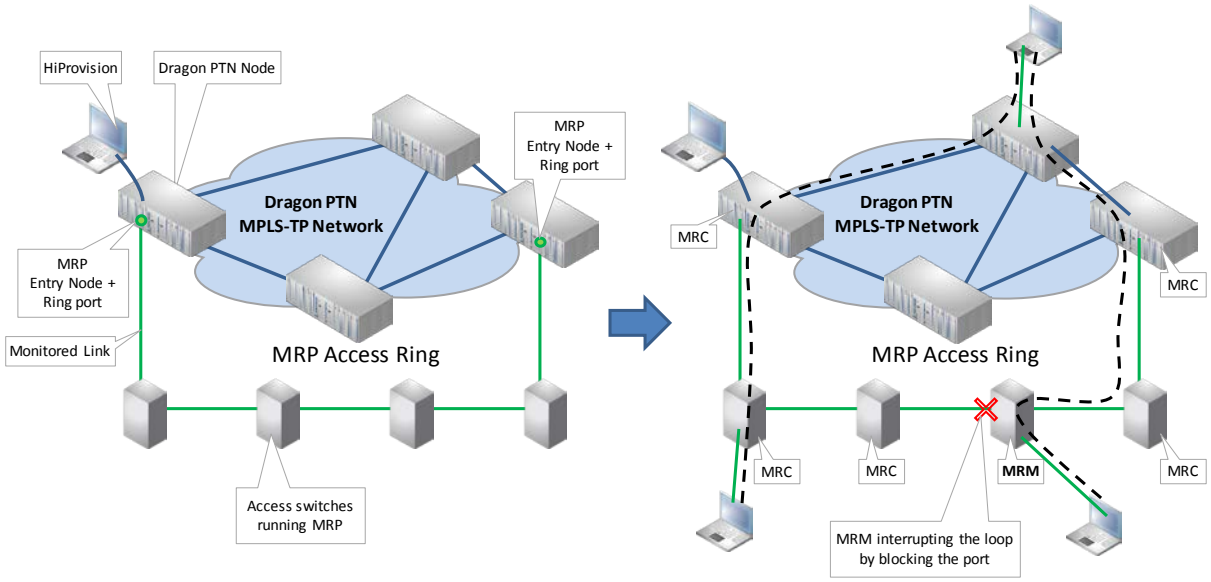

Figure 13 MRP: General Example

2.2.19 Hardware Edition

The hardware edition of this IFM has been factory set and can not be changed! It can be read out via HiProvision, see Ref. [1] in Table 2.

2.2.20 Protocol Scalability Parameters

An overview can be found in Ref. [1] in Table 2 in the Protocols chapter.

2.3 Onboard Interfaces

Figure 14 main L3 IFM: Side View

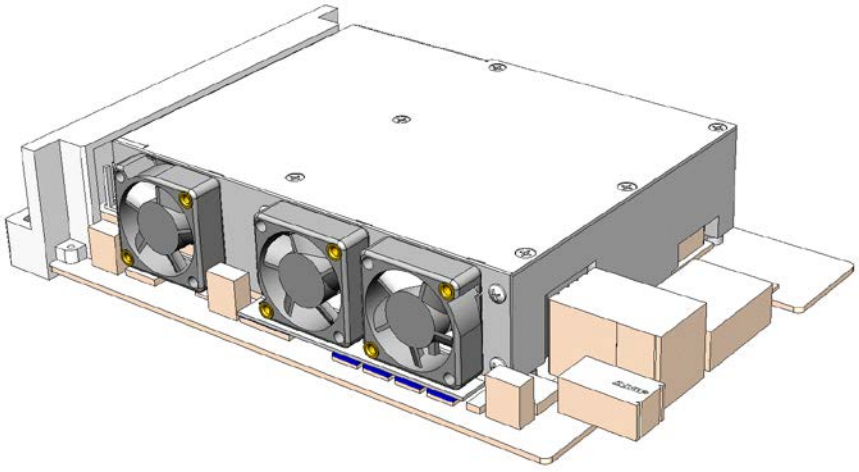

Figure 15 Main L3 IFM: 3D View with Fans

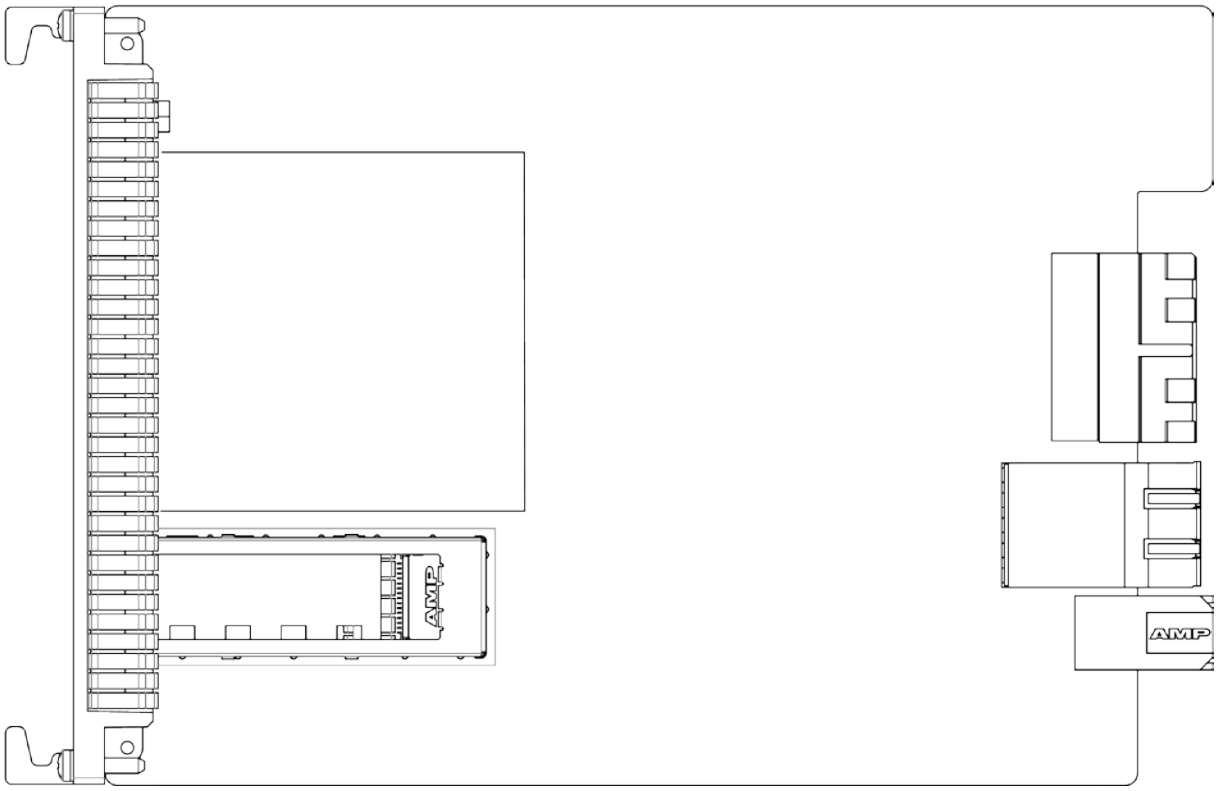

Figure 16 Extension L3 IFM: Side View

2.3.1 Straps

No straps on the board.

2.3.2 Rotary DIP Switches

No rotary DIP switches on board.

2.3.3 Fans (Only on Main L3 IFM)

The three fans are always up and running to cool the L3 IFM. The fan speed is temperature dependent.

Table 6 Fan Speed: Temperature Dependent

Measured Temperature (=T)	Fan Speed
T <= 10 °C T <= 50 °F	Minimum speed
10 °C < T < 80 °C 50 °F < T < 176 °F	Increases stepwise depending on the temperature
80 °C <= T 176 °F <= T	Maximum speed

3. MODULE SPECIFICATIONS

3.1 General Specifications

For general specifications like temperature, humidity, EMI... see Ref.[8] in Table 2.

3.2 Other Specifications

Table 7 Other Specifications

Description	Main L3 IFM	Extension L3 IFM
	Order No.: 942 236-005	**Order No.: 942 236-006**
Weight	0.629 kg / 1.4 lb	0.337 kg / 0.74 lb
MTBF	80 years at 25°C/77°F	Pending
Power Consumption	35.0 W (*)	17.0 W
Module Size Width: Height: Depth	 40.32 mm / 1.6 inches 126 mm / 4.96 inches 195 mm / 7.68 inches	 40.32 mm / 1.6 inches 126 mm / 4.96 inches 195 mm / 7.68 inches
(*): measured at 25°C/77°F, with data transport and fans running		

3.3 Ordering Information

- PTN-9-L3A-L (Main L3 IFM): 942 236-005;
- PTN-9-L3EA-L (Extension L3 IFM): 942 236-006.

4. ABBREVIATIONS

BE	Back End Port
BPDU	Bridge Protocol Data Unit
CE	Conformité Européenne
CSM	Central Switching Module
EMI	Electromagnetic Interference
FLT	Fault
FP	Front Port
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFM	InterFace Module
L3VPN	L3 Virtual Private Network
LAN	Local Area Network
LER	Label Edge Router
LSA	Link State Advertisement

LSR	Label Switching Router
MRC	Media Redundancy Clients
MRM	Media Redundancy Manager
MRP	Media Redundancy Protocol
MSTP	Multiple Spanning Tree
MTBF	Mean Time Between Failures
OSPF	Open Shortest Path First
PTN	Packet Transport Network
Qos	Quality of Service
VFI	Virtual Forwarding Interface
VID	VLAN ID
VLAN	Virtual LAN
VRF	Virtual Router Forwarding
VRRP	Virtual Router Redundancy Protocol
WAN	Wide Area Network