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 4.3DR.

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 some specific interface slots, provides a total of 16*1Gbps SFP ports and 2*10Gbps XFP ports. Verify the 'Dragon PTN Bandwidth Overview' manual (Ref. [100] in Table 2) to see in which node and IFM slot these IFMs can be used.

In aggregation nodes (see Ref. [3] in Table 1), 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. In core nodes (see Ref. [3b] in Table 1), both IFMs are a one slot IFM.

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 PTN2209 aggregation node and IFM slot S4 or S5 of the PTN2215 core 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

<table>
<thead>
<tr>
<th></th>
<th>Main L3 IFM</th>
<th>Extension L3 IFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usability</td>
<td>Can be used in all nodes according to Ref. [100] in Table 2</td>
<td>Can be used in the PTN2209 node in slot S1(S2) and in PTN2215 node in slot S4 or S5. See also Ref. [100] in Table 2.</td>
</tr>
<tr>
<td>Dependency</td>
<td>Can be used without the extension L3 IFM.</td>
<td>Can only be used together with the main L3 IFM, and this main L3 IFM must be plugged into -(PTN2215) slot S4 or S5 directly below the extension L3 IFM -(aggregation nodes) slot S3(S4) directly next to the extension L3 IFM.</td>
</tr>
<tr>
<td>Hidden Reset Button</td>
<td>Available</td>
<td>Not available, using the reset button on the main L3 IFM also resets the extension L3 IFM.</td>
</tr>
<tr>
<td>LEDs</td>
<td>LED operation according §2.1.1</td>
<td>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.</td>
</tr>
<tr>
<td>Back end ports towards backplane</td>
<td>Available</td>
<td>Not Available. The main and extension L3 IFM together share the same back end ports (towards the backplane) of the main L3 IFM.</td>
</tr>
<tr>
<td>Fans/Cooling</td>
<td>In aggregation nodes: - Yes, via own fans on the L3 IFM itself; in core nodes: - Yes, via node fans</td>
<td>In aggregation nodes: - No; in core nodes: - Yes, via node fans</td>
</tr>
</tbody>
</table>

Main supported features:

- Gigabit Ethernet Ports:
  - 8 x SFP (Fiber, optical): 1000BASE-X;
  - 1 x XFP (Fiber, optical): 10GE;

- (main L3 IFM in aggregation node) Cooling: on-board local active cooling via 3 fans mounted on heatsink;

- Layer2
  - L2 VLAN handling;
  - QoS;
  - MSTP (=Multiple Spanning Tree);
  - IGMP Snooping (IGMP = Internet Group Management Protocol);
  - Link Aggregation/LAG.

- Layer3
  - VRF (=Virtual Router Forwarding);
  - VRRP (=Virtual Router Redundancy Protocol);
  - Static Routing;
  - OSPF (=Open Shortest Path First);
  - PIM (=Protocol Independent Multicast);
  - IGMP;
  - DHCP Relay;
  - VLAN routing (IPv4) / L3VPN;
Port Mirroring;
- Storm Control;
- BPDU Guard via MSTP;
- RGERP (=Redundant Gigabit Ethernet Ring Protocol) Support;
- 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>
<thead>
<tr>
<th>Ref.</th>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
<td>DRA-DRM801-&amp;-*</td>
<td>Dragon PTN Installation and Operation</td>
</tr>
<tr>
<td>[2Mgt]</td>
<td>DRA-DRM830-&amp;-*</td>
<td>HiProvision Management Operation</td>
</tr>
<tr>
<td>[2Eth]</td>
<td>DRA-DRM831-&amp;-*</td>
<td>Dragon PTN Ethernet Services</td>
</tr>
<tr>
<td>[2Leg]</td>
<td>DRA-DRM832-&amp;-*</td>
<td>Dragon PTN Legacy Services</td>
</tr>
<tr>
<td>[2Net]</td>
<td>DRA-DRM833-&amp;-*</td>
<td>Dragon PTN Network Operation</td>
</tr>
<tr>
<td>[3]</td>
<td>DRB-DRM802-&amp;-*</td>
<td>Dragon PTN Aggregation Nodes: PTN2210, PTN2206, PTN1104, PTN2209</td>
</tr>
<tr>
<td>[3b]</td>
<td>DRB-DRM840-&amp;-*</td>
<td>Dragon PTN Core Nodes: PTN2215</td>
</tr>
<tr>
<td>[7]</td>
<td>DRF-DRM811-&amp;-*</td>
<td>Dragon PTN TRMs (Transmit Receive Modules: SFP, XFP, QSFP+)</td>
</tr>
<tr>
<td>[8]</td>
<td>DRA-DRM810-&amp;-*</td>
<td>Dragon PTN General Specifications</td>
</tr>
<tr>
<td>[9]</td>
<td>DRE-DRM817-&amp;-*</td>
<td>Dragon PTN Interface Module: PTN-4-GO-LW</td>
</tr>
<tr>
<td>[10]</td>
<td>DRE-DRM827-&amp;-*</td>
<td>Dragon PTN Interface Module: PTN-6-GE-L</td>
</tr>
<tr>
<td>[100]</td>
<td>DRA-DRM828-&amp;-*</td>
<td>Dragon PTN Bandwidth Overview</td>
</tr>
</tbody>
</table>
2. MODULE DESCRIPTION

2.1 Front Panel

Figure 1 Front Panels: Main L3 IFM / Extension L3 IFM In Aggregation Nodes

Figure 2 Front Panels: Main L3 IFM / Extension L3 IFM in Core Nodes
2.1.1 Insert/Remove Module from Node
See ‘Dragon PTN Installation and Operation Manual’ Ref.[1].

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 position.

Table 3 LED Indications In Boot Operation: Main L3 IFM

<table>
<thead>
<tr>
<th>Cycle</th>
<th>PI</th>
<th>PF</th>
<th>FLT</th>
<th>Spare LED</th>
<th>La[1..9]</th>
<th>Los[1..9]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>✓</td>
<td>---</td>
<td>Slow blinking</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>✓</td>
<td>---</td>
<td>✓</td>
<td>✓</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>✓</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
✓ : 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

<table>
<thead>
<tr>
<th>Cycle</th>
<th>PI</th>
<th>PF</th>
<th>FLT</th>
<th>Spare LED</th>
<th>La[1..9]</th>
<th>Los[1..9]</th>
</tr>
</thead>
</table>
| PLD Version of Extension L3 IFM = OK, no upgrade needed ➔ see also §b
| 1     | ✓  | ---| Slow Blinking (2 seconds) | ---       | ---      | ---       |
| 2     | ✓  | ---| ----             | ---       | ---      | ---       |
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     | ✓  | ---| Fast blinking (7 seconds) | ---       | ---      | ---       |
| 2     | ✓  | ---| ---              | ---       | ---      | ---       |
| 3     | ✓  | ---| Slow blinking (2 seconds) | ---       | ---      | ---       |
| 4     | ✓  | ---| ----             | ---       | ---      | ---       |
✓ : 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)

<table>
<thead>
<tr>
<th>LED</th>
<th>Color</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI (=Power Input)</td>
<td>Not lit, dark</td>
<td>+12V power input to the board not OK</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>+12V power input to the board OK</td>
</tr>
<tr>
<td>PF (=Power Failure)</td>
<td>Not lit, dark</td>
<td>power generation on the board itself is OK</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>power generation on the board itself is erroneous</td>
</tr>
<tr>
<td></td>
<td>Red Blinking</td>
<td>‘Main L3’ IFM is upgrading ‘Extension IFM’ because PLD version of Extension IFM is not in sync with PLD of Main IFM</td>
</tr>
<tr>
<td>FLT (=FauLT)</td>
<td>Not lit, dark</td>
<td>no other fault or error situation, different from PF, is active on the module</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>a fault or error situation, different from PF, is active on the module</td>
</tr>
<tr>
<td>LA&lt;port n°&gt; (=Link Activity)</td>
<td>1G Port (Port 1...8)</td>
<td>The link on port&lt;port n°&gt; is down</td>
</tr>
<tr>
<td></td>
<td>Not lit, dark</td>
<td>The link on port&lt;port n°&gt; is up, no activity</td>
</tr>
<tr>
<td></td>
<td>Yellow lit</td>
<td>The link on port&lt;port n°&gt; is up, with activity</td>
</tr>
<tr>
<td></td>
<td>Yellow blinking</td>
<td>The link on port&lt;port n°&gt; is up, with receive activity (transmit activity is not shown)</td>
</tr>
<tr>
<td></td>
<td>10G Port (Port 9)</td>
<td>The link on the 10G port is down</td>
</tr>
<tr>
<td></td>
<td>Not lit, dark</td>
<td>The link on the 10G port is up, no receive activity (transmit activity is not shown)</td>
</tr>
<tr>
<td></td>
<td>Yellow lit</td>
<td>The link on the 10G port is up, with receive activity (transmit activity is not shown)</td>
</tr>
<tr>
<td>LOS&lt;port n°&gt; (=Loss of Signal)</td>
<td>Not lit, dark</td>
<td>No optical module present or optical module present and received optical signal = ok</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>Loss of optical signal on the port</td>
</tr>
</tbody>
</table>

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 3 PLD Version of Extension L3 No Upgrade Needed
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. When pushing this button, it must be pushed with a fine non-conductive object e.g. a 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 / electrical SFP port 10/100/1000Base-T;
- **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 endpoints for the configured application service, it only forwards MPLS-TP traffic via label switched paths;

VRF (=Virtual Router forwarding): When an optional Virtual Router has been configured on the L3 IFM, the node operates as a router between different IP subnets. The example below shows the VRF in a core node, but it could also be located an aggregation node.

Figure 5 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.
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. An Overview can be found in the figure below. For the L2 IFM, see Ref. [10] in Table 2.
b. Port Based (=Mixed Service)

Use this mode if all the traffic on a port must be transported transparently in one and the same service. Each port based service will consume an entire backend port on the L3 IFM. This means that no other service, either port based or VLAN based, can be configured on the used backend port. Each port based service consumes one VFI in the CSM. This service is a hybrid or mixed service that partially acts as a pure Port based on the WAN side (VLAN unaware) and partially as a VLAN based (single VLAN) service on the LAN side. The single VLAN services will be embedded (= child) in the port based service (=parent).

Figure 7 Ethernet Service Overview on L2/L3 IFM
c. **VLAN Based: Single VLAN**

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’. Each backend port on the L3 IFM can carry multiple VLAN based services. Each Single VLAN based service consumes one VFI in the CSM. If you have many single VLAN based services originating in one node, it’s better to consider Multi VLAN services for a more efficient usage of VFIs in the CSM.

d. **VLAN Based: Multi VLAN / QinQ**

With QinQ, a VLAN based service can carry multiple VLANs instead of just one. QinQ is a feature that operates at the back end ports of the L3 IFM. For incoming traffic (LAN or WAN), this feature adds an outer VLAN (=QinQ VLAN with EtherType 0x8100) around the existing VLANs resulting in double VLAN tagged Ethernet packets. For outgoing traffic (WAN or LAN), the QinQ VLAN is removed. Each backend port on the L3 IFM can carry multiple VLAN based services. Each Multi VLAN based service consumes one VFI in the CSM.

e. **VLAN Based: Single VLAN Local Service**

A Single VLAN 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;
- Requires an external cable if IFMs of different nodes participate in the service.

f. **Configuration**

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

2.2.8 Layer2: Link Aggregation/LAG (=Link Aggregation Group)

Link Aggregation is the bundling (=aggregation) of multiple physical Ethernet links between a source and destination side into one combined logical Ethernet link. A LAG is a combination of multiple Ethernet LAN ports within one logical port group, maximum 8 ports per LAG and 8 LAGs per node. The Link Aggregation is the communication between two LAGs. E.g. one LAG in one Dragon PTN node and the second LAG in a third party switch/application. For 1G ports, all the ports of the source and destination LAG must be in autonegotiation. On the Dragon PTN side, ports with the same speed and linked to the same switch ASIC (CSM, L2 or L3) can be added to the same LAG. Each bullet shows the possible LAG ports per switch ASIC:

- CSM: all Ethernet IFM ports (4-GC-LW, ...) of the same speed in the same node;
L2: all 6-GE-L IFM ports;
L3: all 9-L3A-L / 9-L3EA-L IFM ports of the same speed;

NOTE: Example: Ports in different nodes can not be added to the same LAG because they are linked to different switch ASICs. CSM (4-GC-LW, ...), L2 and L3 ports in a same node can not be added to the same LAG because they are linked to different switch ASICs.

NOTE: LAG on WAN ports and L2/L3 back end ports is not supported.

The resulting combined logical link:
- has at least the bandwidth of one individual link (1 Gbps bandwidth for a 1G port, 10 Gbps for a 10G port), 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 loadshares these streams over different links within the LAG;
- offers loadsharing based on the source and destination MAC addresses;
- offers redundancy in case one of the individual links should fail.

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

![Figure 9 Link Aggregation and LAGs](image)

2.2.9 Layer2: IGMP Snooping (IGMP = Internet Group Management Protocol)

IGMP snooping is designed to prevent hosts on a local network from receiving traffic for a multicast group they have not explicitly joined. Via IFMs that support IGMP snooping (see support matrix in Ref. [2Net] in Table 2), it provides the Dragon PTN nodes with a mechanism to diminish multicast traffic from links that do not contain a multicast listener (an IGMP client). The Dragon PTN node will, by default, flood multicast traffic to all the ports in a broadcast domain (or the VLAN equivalent). Multicast can cause unnecessary load on host devices by requiring them to process packets they have not solicited.

CAUTION: IGMP Snooping is IP based on L3 IFMs.
IGMP snooping allows the Dragon PTN node to only forward multicast traffic to the ports that have solicited them. IGMP snooping is not a protocol but a layer 2 optimization for the layer 3 IGMP protocol (see §2.2.14). IGMP Snooping takes place internally on IFMs that support it.

Snooping is therefore especially useful for bandwidth-intensive IP multicast applications such as IPTV. IGMP Snooping is configured in HiProvision. See Ref. [2Eth] in Table 2 for more configuration information in HiProvision.

![Figure 10 PIM/IGMP/IGMP Snooping Overview](image)

**2.2.10 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. See example figure below. See Ref. [2Eth] in Table 2 for more configuration information in HiProvision.
2.2.11 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. [2Eth] in Table 2 for more configuration information in HiProvision.
## 2.2.12 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. [2Eth] in Table 2 for more configuration information in HiProvision.

## 2.2.13 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. [2Eth] in Table 2 for more configuration information in HiProvision.
2.2.14 Layer3: PIM (=Protocol-Independent Multicast)

PIM is a multicast routing protocol. It is protocol independent because PIM does not have a network topology discovery mechanism like other routing protocols have. PIM uses routing information supplied by other routing protocols. PIM builds up Multicast Distribution Trees for each IP Multicast Group Address. As a result, data packets from senders to a multicast group reach all receivers that have joined the group via IGMP. See Ref. [2Eth] in Table 2 for more configuration information in HiProvision.

MC = Multicast / RP = Rendez-Vous Point / BSR = Bootstrap Router / Q = Querier

Figure 14 PIM/IGMP/IGMP Snooping Overview

2.2.15 Layer3: DHCP Relay (DHCP = Dynamic Host Control Protocol)

DHCP (=Dynamic Host Control Protocol) is a network configuration protocol in IP networks which allows that IP clients at start-up automatically request IP configuration data from a
DHCP Server. This data is necessary for the client to be able to communicate with other IP clients within the IP network.

In HiProvision, a DHCP Relay agent can be configured on the L3 IFMs to forward IP address requests/responses towards external DHCP Servers/DHCP Clients. See Ref. [2Eth] in Table 2 for more configuration information in HiProvision.

![Figure 15 DHCP Overview](image)

### 2.2.16 Layer3: IGMP (=Internet Group Management Protocol)

IGMP is a protocol used between hosts and neighboring local multicast routers. This protocol manages multicast-group memberships. If a host wants to receive a multicast stream, the host must be member of the multicast group. IGMP can be used to manage/distribute multicast streaming video and allows more efficient use of the available bandwidth and resources. See Ref. [2Eth] in Table 2 for more configuration information in HiProvision.

![Figure 16 PIM/IGMP/IGMP Snooping Overview](image)

### 2.2.17 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 services interconnecting them via a virtual router on a L3 IFM. See Figure 6 for a detailed example. See Ref. [2Eth] in Table 2 for more configuration information in HiProvision.

Figure 17 L3VPN Example

2.2.18 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. [2Eth] in Table 2 for more configuration information in HiProvision.

2.2.19 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. [2Eth] in Table 2 for more configuration information in HiProvision.

2.2.20 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. [2Net] in Table 2 for more configuration information in HiProvision.
2.2.21 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. [2Eth] in Table 2 for more configuration information in HiProvision.

2.2.22 MRP (=Media Redundancy Protocol) Support

MRP (IEC 62439-2) is 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. [2Eth] in Table 2 for more configuration information in HiProvision.
2.2.23 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. [2Mgt] in Table 2.

2.3 Onboard Interfaces

2.3.1 In Aggregation Nodes

Figure 20 Main L3 IFM In Aggregation Node: Side View

Figure 21 Main L3 IFM In Aggregation Node: 3D View with Fans
2.3.2 In Core Nodes

Figure 23 Main L3/Extension L3 IFM In Core Node: Top View
2.3.3 Straps
No straps on the board.

2.3.4 Rotary DIP Switches
No rotary DIP switches on board.

2.3.5 Fans (Only on Main L3 IFM in Aggregation Node)
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

<table>
<thead>
<tr>
<th>Measured Temperature (T)</th>
<th>Fan Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &lt;= 10 °C</td>
<td>Minimum speed</td>
</tr>
<tr>
<td>T &lt;= 50 °F</td>
<td></td>
</tr>
<tr>
<td>10 °C &lt; T &lt; 80 °C</td>
<td>Increases stepwise depending on the temperature</td>
</tr>
<tr>
<td>50 °F &lt; T &lt; 176 °F</td>
<td></td>
</tr>
<tr>
<td>80 °C &lt;= T</td>
<td>Maximum speed</td>
</tr>
<tr>
<td>176 °F &lt;= T</td>
<td></td>
</tr>
</tbody>
</table>

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 8 Other Specifications

<table>
<thead>
<tr>
<th>Description</th>
<th>Main L3 IFM</th>
<th>Extension L3 IFM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>942 236-005 (Aggregation Node)</td>
<td>942 236-024 (Core Node)</td>
</tr>
<tr>
<td>Weight</td>
<td>0.629 kg / 1.4 lb</td>
<td>0.819 kg / 1.8 lb</td>
</tr>
<tr>
<td>MTBF</td>
<td>80 years at 25°C/77°F</td>
<td>80 years at 25°C/77°F</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>35.0 W (*)</td>
<td>35.0 W (*)</td>
</tr>
<tr>
<td>Module Size Width:</td>
<td>40.32 mm / 1.6 inches</td>
<td>186 mm / 7.3 inches</td>
</tr>
<tr>
<td></td>
<td>126 mm / 4.96 inches</td>
<td>43.05 mm / 1.69 inches</td>
</tr>
<tr>
<td></td>
<td>195 mm / 7.68 inches</td>
<td>195 mm / 7.68 inches</td>
</tr>
<tr>
<td>Height:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(*): measured at 25°C/77°F, with data transport and fans running
3.3 Ordering Information

- For Aggregation Nodes:
  - 9-L3A-L (Main L3 IFM): 942 236-005;

- For Core Nodes:
  - 9-L3A-L (Main L3 IFM PTN2215): 942 236-024;

4. ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASIC</td>
<td>Application-Specific Integrated Circuit</td>
</tr>
<tr>
<td>BE</td>
<td>Back End Port</td>
</tr>
<tr>
<td>BPDU</td>
<td>Bridge Protocol Data Unit</td>
</tr>
<tr>
<td>CE</td>
<td>Conformité Européenne</td>
</tr>
<tr>
<td>CSM</td>
<td>Central Switching Module</td>
</tr>
<tr>
<td>DHCP</td>
<td>Dynamic Host Control Protocol</td>
</tr>
<tr>
<td>EMI</td>
<td>Electromagnetic Interference</td>
</tr>
<tr>
<td>FLT</td>
<td>Fault</td>
</tr>
<tr>
<td>FP</td>
<td>Front Port</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>IETF</td>
<td>Institute of Electrical and Electronics Engineers</td>
</tr>
<tr>
<td>IFM</td>
<td>InterFace Module</td>
</tr>
<tr>
<td>IGMP</td>
<td>Internet Group Management Protocol</td>
</tr>
<tr>
<td>L3VPN</td>
<td>L3 Virtual Private Network</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>LER</td>
<td>Label Edge Router</td>
</tr>
<tr>
<td>LSA</td>
<td>Link State Advertisement</td>
</tr>
<tr>
<td>LSR</td>
<td>Label Switching Router</td>
</tr>
<tr>
<td>MRC</td>
<td>Media Redundancy Clients</td>
</tr>
<tr>
<td>MRM</td>
<td>Media Redundancy Manager</td>
</tr>
<tr>
<td>MRP</td>
<td>Media Redundancy Protocol</td>
</tr>
<tr>
<td>MSTP</td>
<td>Multiple Spanning Tree</td>
</tr>
<tr>
<td>MTBF</td>
<td>Mean Time Between Failures</td>
</tr>
<tr>
<td>PIM</td>
<td>Protocol-Independent Multicast</td>
</tr>
<tr>
<td>PTN</td>
<td>Packet Transport Network</td>
</tr>
<tr>
<td><strong>OSPF</strong></td>
<td>Open Shortest Path First</td>
</tr>
<tr>
<td><strong>Qos</strong></td>
<td>Quality of Service</td>
</tr>
<tr>
<td><strong>VFI</strong></td>
<td>Virtual Forwarding Interface</td>
</tr>
<tr>
<td><strong>VID</strong></td>
<td>VLAN ID</td>
</tr>
<tr>
<td><strong>VLAN</strong></td>
<td>Virtual LAN</td>
</tr>
<tr>
<td><strong>VRF</strong></td>
<td>Virtual Router Forwarding</td>
</tr>
<tr>
<td><strong>VRRP</strong></td>
<td>Virtual Router Redundancy Protocol</td>
</tr>
<tr>
<td><strong>WAN</strong></td>
<td>Wide Area Network</td>
</tr>
</tbody>
</table>