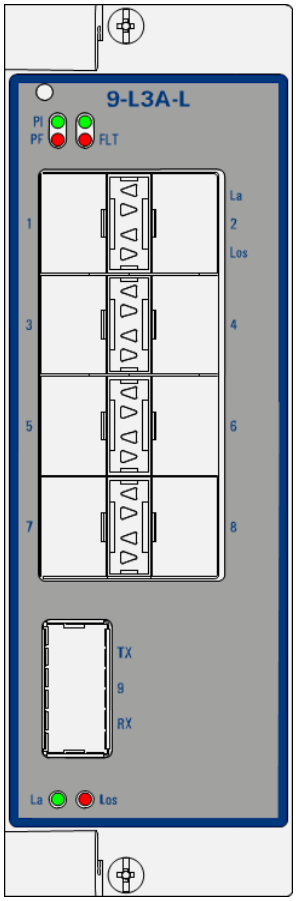
User Manual

Installation
Dragon PTN Interface Module
PTN-9-L3A-L



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1. INTRODUCTION

1.1 General

This document is valid as of Dragon PTN Release 3.0.

This document describes the 9-L3A-L interface module (=IFM) which provides Layer2 and Layer3 functionality. This IFM has 9 optical LAN (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 – LAN'.

The 9-L3A-L is 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.

The 9-L3A-L IFM bandwidth availability on the Dragon PTN backbone depends on the used node type and the used slots. Depending on the used slot, the IFM can have up to maximum 5 back end ports to the CSM: 1 to 4 (1Gbps) and 1 (10Gbps). The maximum bandwidth availability is 14 Gbps (=4+10) and can be reached when the IFM is plugged into IFM slots [S3-S4] of the XT-2209-A node. The available bandwidth per slot overview where the 9-L3A-L IFM can be used/not used can be found in the table below.

Table 1 Maximum Bandwidth of the 9-L3A-L IFM on the Dragon PTN Backbone

Node Type	Slots								
	S1(S2)	S2(S3)	S3(S4)	S4(S5)	S5(S6)	S6(S7)	S7(S8)	S8(S9)	S9(S10)
XT-2210-A	4*1G	4*1G	4*1G	---	1*1G	1*1G	1*1G	1*1G	4*1G
XT-2209-A (optimized for 9-L3A-L)	---(*)	---(*)	4*1G (=BE1-BE4) **1*10G** (=BE5)	---	1*1G	1*1G	1*1G	4*1G	4*1G
XT-2206-A	4*1G	4*1G	4*1G	---	1*1G				
XT-1104-A	4*1G	4*1G	4*1G	---					

Example: The XT-2209-A node has in slot S3-S4, 5 back end ports: 4 * 1Gbps + 1 * 10Gbps
BEn = Back End Port 'n'
--- = 9-L3A-L can not be used in this slot.
(*): These slots have 4*1G bandwidth available but 9-L3A-L cannot be plugged into these slots because of a mechanical polarisation key next to S1 backplane connector. All other IFMs can be plugged into S1, S2 and S3.

IFM slot overviews for nodes can be found in the Dragon PTN Nodes manual Ref. [3] in Table 2.

Main supported features:

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

- Cooling: on-board local active cooling via 3 small 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;

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 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

2. MODULE DESCRIPTION

2.1 Front Panel

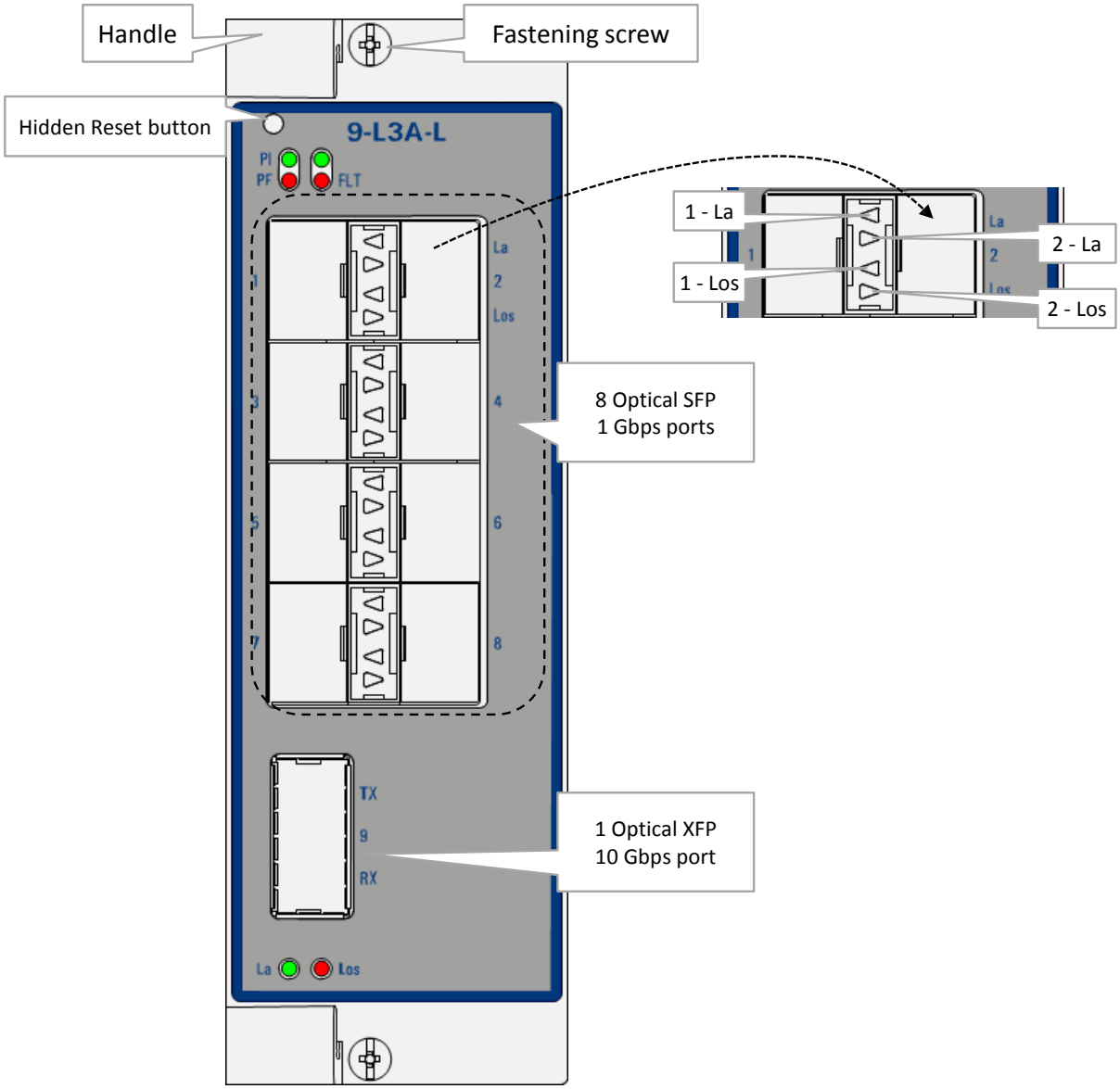

Figure 1 Front Panel

2.1.1 Handle

a. Insert the Module into the Node

Take the front panel handles to insert or slide the module into the Dragon PTN node. Push the module thoroughly into the node's backplane. Next, tighten the two fastening screws in the front panel.

b. Remove the Module from the Node

Untighten the two fastening screws in the front panel. Take the front panel handles to pull out and finally remove the module from the Dragon PTN node.

2.1.2 LEDs

The meaning of the LEDs depends on the mode of operation (= boot or normal) in which the 9-L3A-L module currently is running. After plugging in the module or rebooting it, the module turns into the boot operation, see Table 3. After the module has gone through all the cycles in the table below (=rebooted successfully), the module turns into the normal operation, see LEDs in Table 4.

Table 3 LED Indications In Boot Operation

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 Normal Operation

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
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

2.1.3 Hidden Reset button

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).

2.1.4 Connectors

This module has following ports:

- SFP: 100/1000 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 9-L3A-L 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 9-L3A-L 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 9-L3A-L IFM, the node operates as a router between different IP subnets.

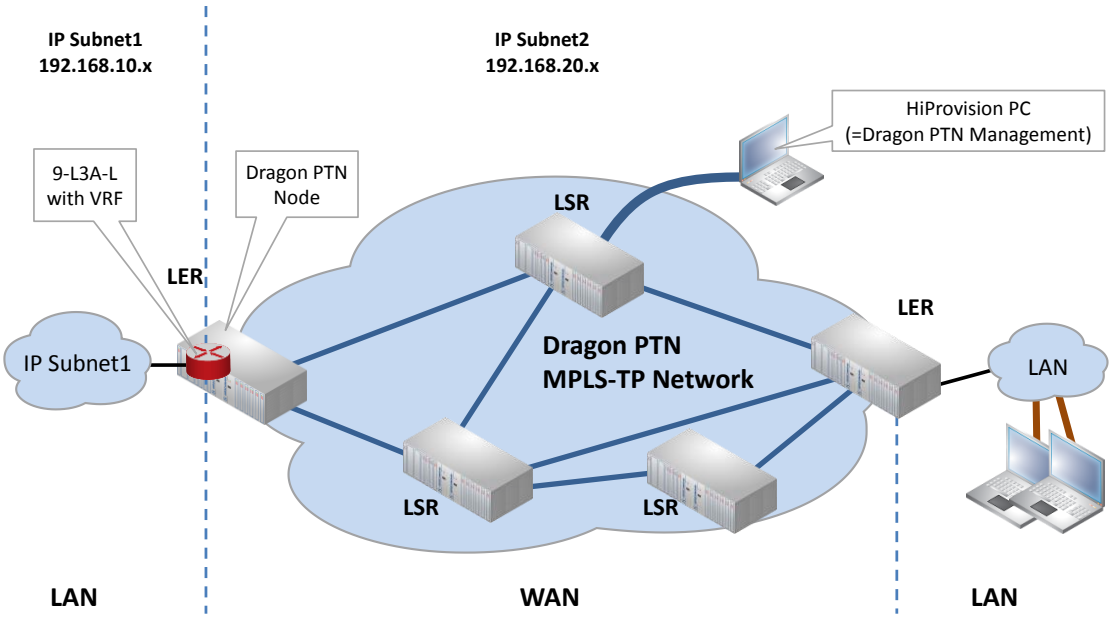

Figure 2 General Example: 2 IP Subnets (Virtual Routing)/LAN/WAN

In the figure below:

- FP = 9-L3A-L front port;
- BE = 9-L3A-L back end port to the CSM, the amount depends on the node type and slot;
- VID = VLAN ID, VFI = Virtual Forwarding Interface.

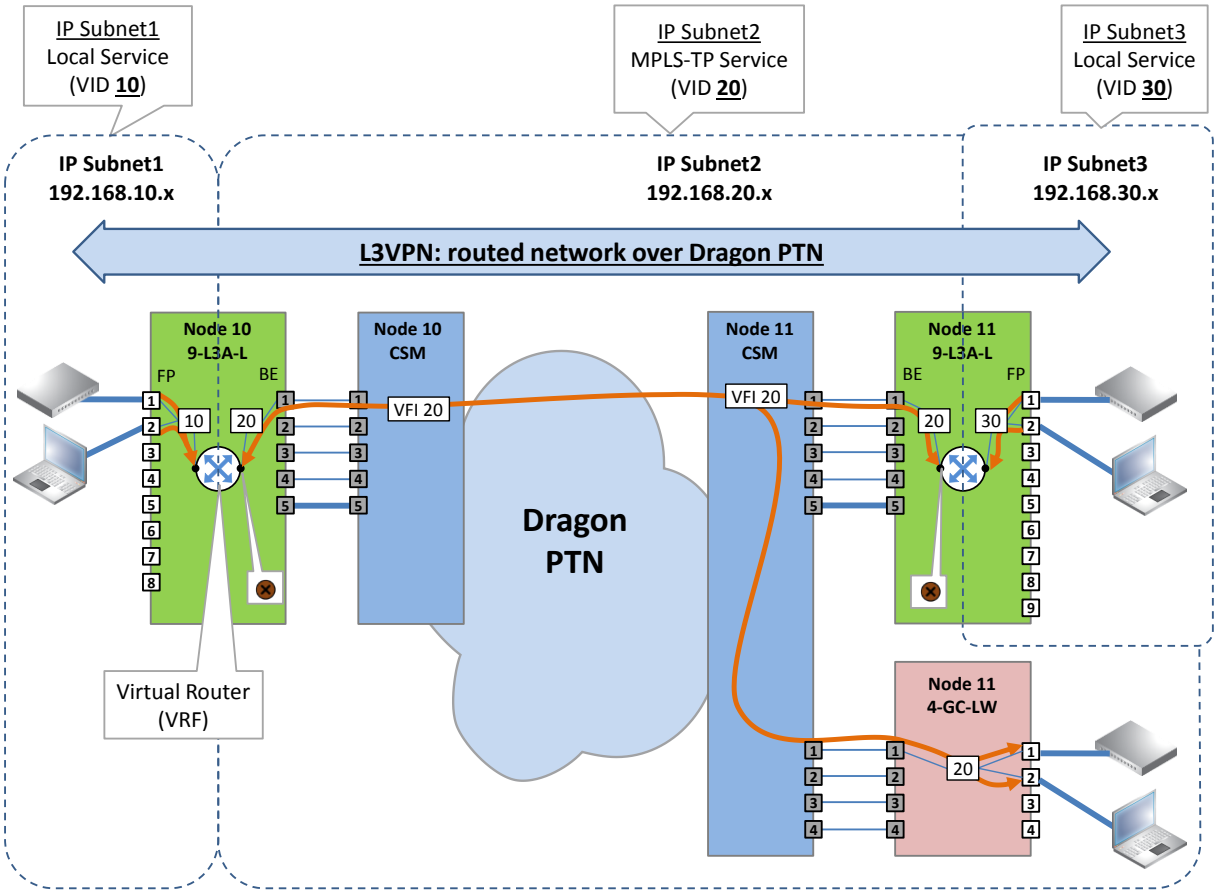

Figure 3 Detailed Example with 3 IP Subnets: L3VPN

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

The 9-L3A-L module receives Ethernet traffic via its front panel ports and forwards this to the CSM via the back end ports 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 9-L3A-L IFM access or end-points communicate 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 LAN front ports on 9-L3A-L IFMs. Does not use back end ports, tunnels, WAN ports, the Dragon PTN network and 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 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.

2.2.5 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.

2.2.6 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 9-L3A-L back end ports). CAUTION: using a VLAN based service with MSTP over the back end ports could cause loops!

MSTP is fully supported on 9-L3A-L IFMs. On 9-L3A-L 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.

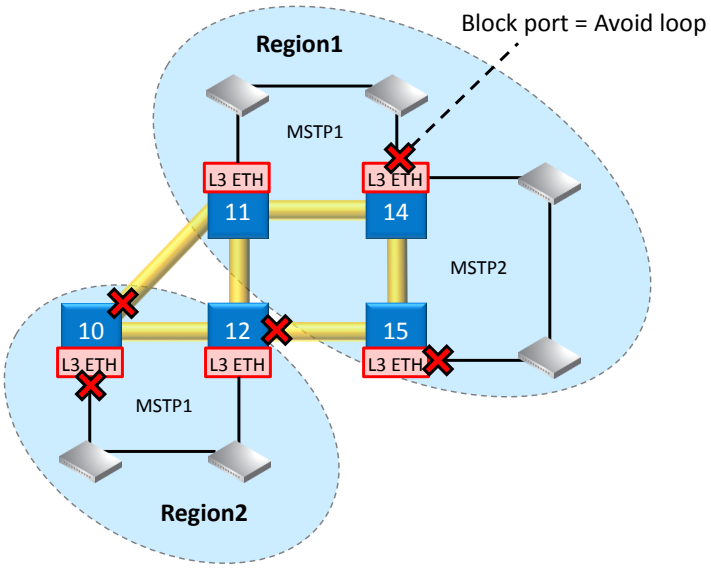

Figure 4 MST Example

2.2.7 Layer3: VRF (=Virtual Router Forwarding)

Virtual Router is a router (instance) created by HiProvision within an 9-L3A-L IFM in an 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 §2.2.15. See example figure below. See Ref. [1] in Table 2 for more configuration information in HiProvision.

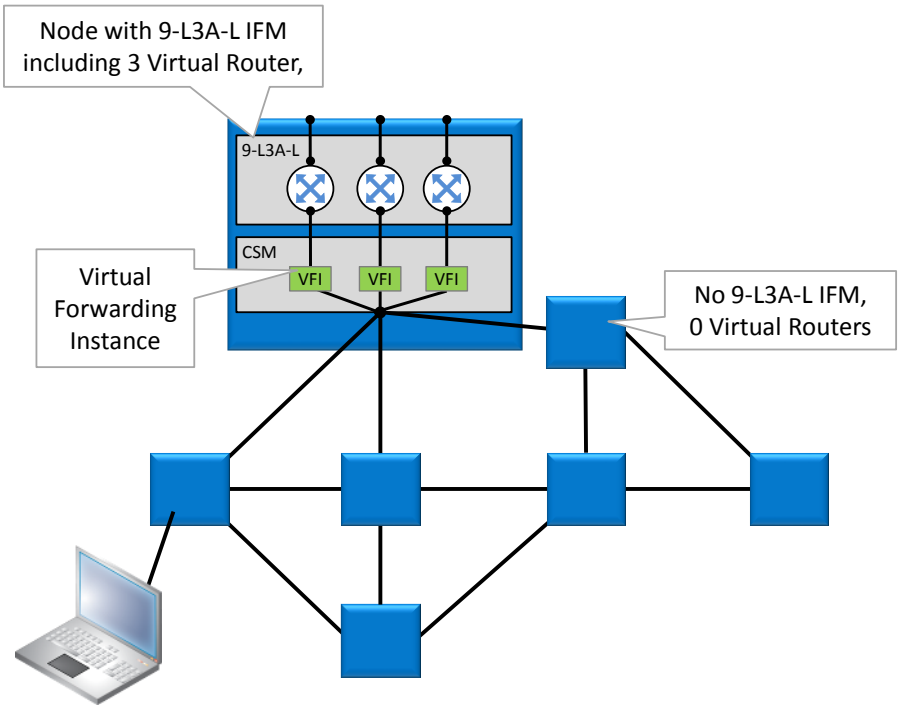

Figure 5 Virtual Router Example

2.2.8 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.

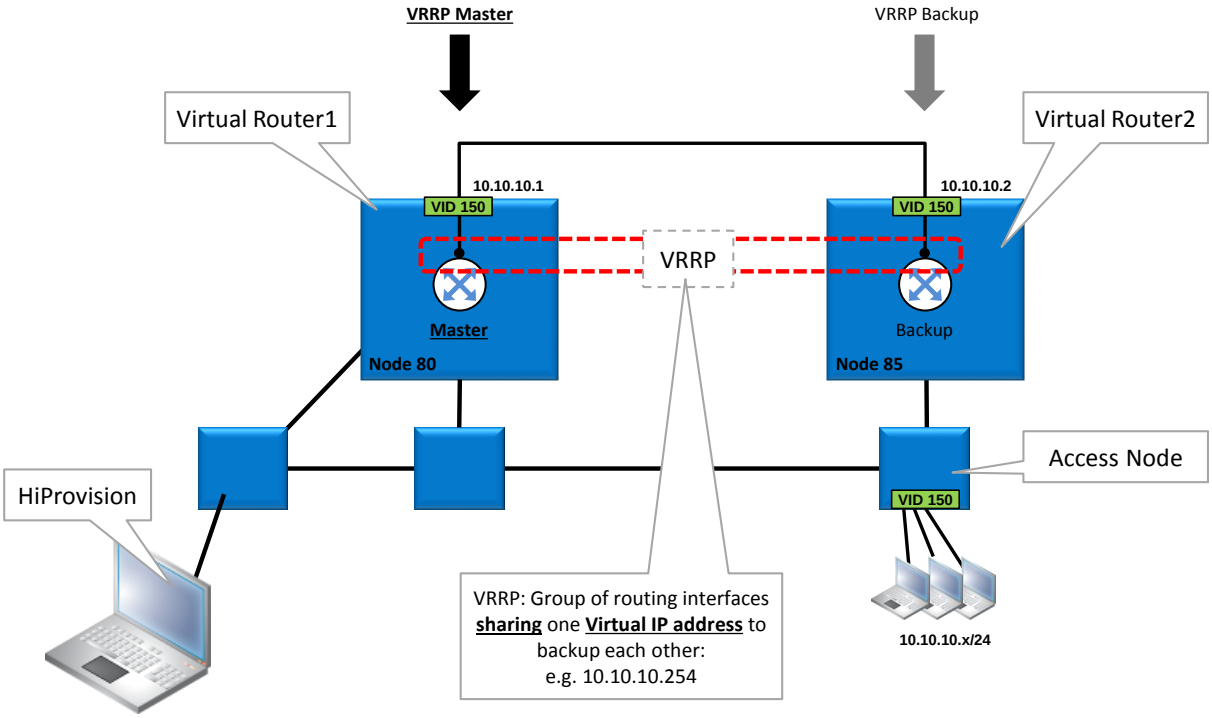

Figure 6 VRRP Example

2.2.9 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.

2.2.10 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.

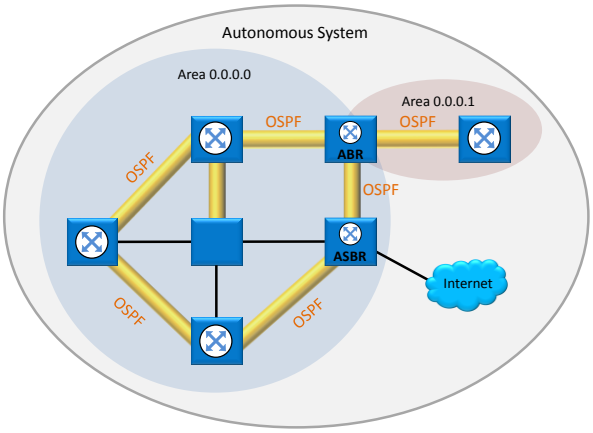

Figure 7 OSPF Example

2.2.11 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 9-L3A-L IFM. See Figure 3 for a detailed example. See Ref. [1] in Table 2 for more configuration information in HiProvision.

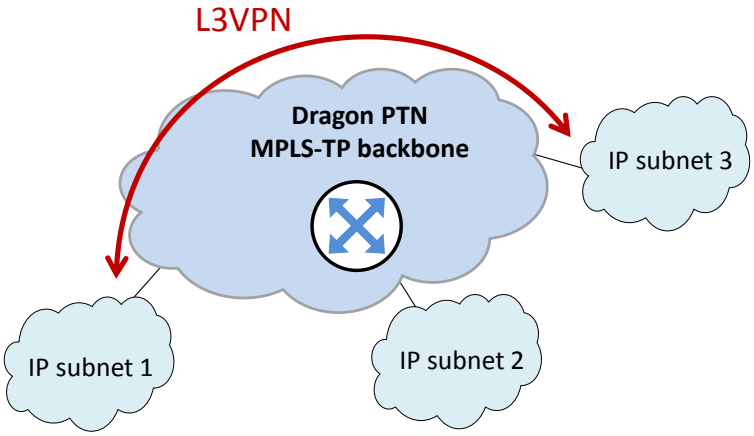

Figure 8 L3VPN Example

2.2.12 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.

2.2.13 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 9-L3A-L IFM. See Ref. [1] in Table 2 for more configuration information in HiProvision.

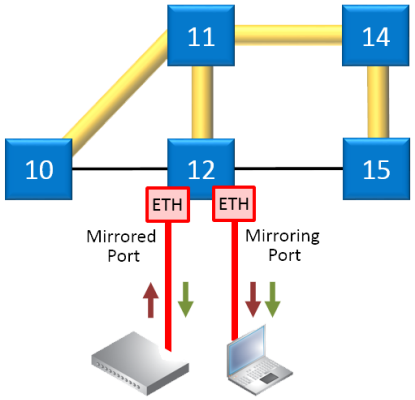

Figure 9 Port Mirroring Example

2.2.14 BPDU Guard via MSTP

BPDU Guard on 9-L3A-L 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.

2.2.15 Protocol Scalability Parameters

Find below some protocol scalability parameters.

Table 5 Protocol Scalability Parameters

Scalability Parameter	Per VRF in 9-L3A-L IFM	Total per 9-L3A-L IFM
VLAN IDs		4K
VRFs	1	64
L3-VLANs / IP Interfaces	256	256
MAC addresses		16k
ARP entries	2K	4K
Unicast routes	3K	12K
Multicast routes	1K	1K
VRRP instance	64	64
OSPF Neighbors	32	128
ACL L2 and L3		798

2.3 Onboard Interfaces

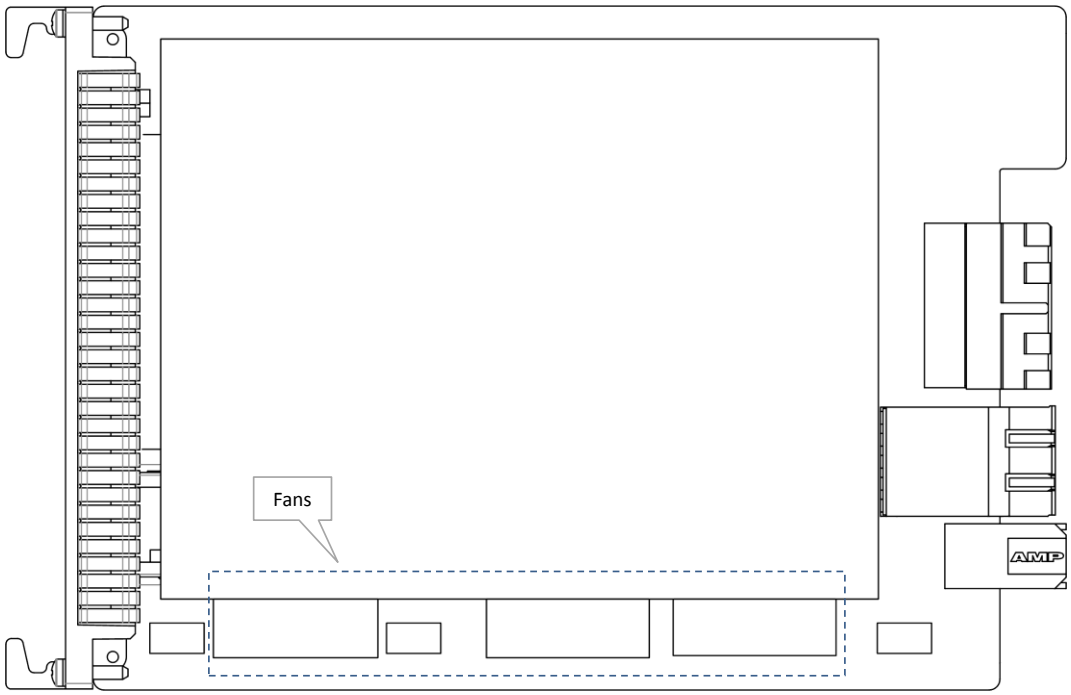

Figure 10 9-L3A-L: Side View

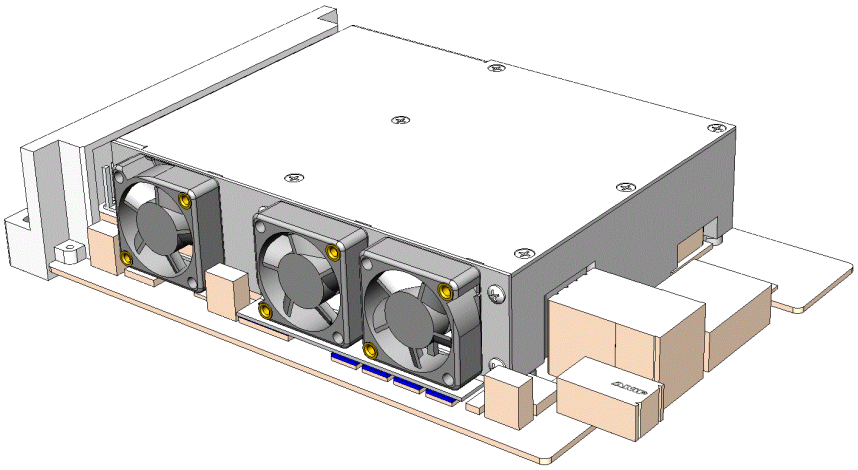

Figure 11 9-L3A-L: 3D View with Fans

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

The three fans are always on and running at the same speed for cooling the 9-L3A-L IFM. Future support: temperature dependent fan-speed control.

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 6 Other Specifications

Description	Value
Weight	0.629 kg / 1.4 lb
MTBF	80 years at 25°C/77°F
Power Consumption	35.0 W (measured at 25°C/77°F, with data transport and fans running)
Module Size	width: 40.32 mm / 1.6 inches height: 126 mm / 4.96 inches depth: 195 mm / 7.68 inches

3.3 Ordering Information

- PTN-9-L3A-L: 942 236-005.

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