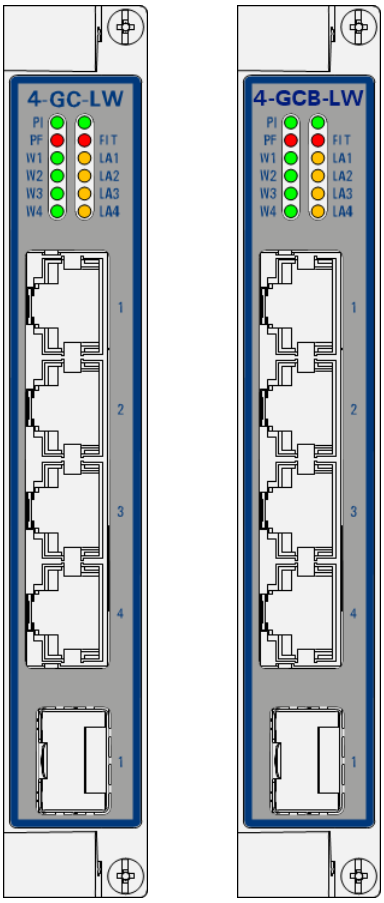
User Manual

Installation
Dragon PTN
Interface Module PTN-4-GC-LW/PTN-4-GCB-LW



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1. INTRODUCTION

1.1 General

This document is valid as of Dragon PTN Release 4.3DR.

This document describes the 4-GC-LW and 4-GCB-LW interface module (=IFM). The 4-GC-LW supports PoE whereas the 4-GCB-LW not. These IFMs provide four 1Gbps LAN/WAN ports on the front panel (LAN = Local Area Network; WAN = Wide Area Network). Port 1 is a gigabit combo port (SFP/RJ45) whereas ports 2, 3 and 4 are 1 gigabit RJ45 ports. Each individual port can be configured as either LAN or WAN port via HiProvision (=Dragon PTN Management System). By default, each port is configured as WAN port. On the 4-GC-LW IFM, these RJ45 ports can deliver PoE (=Power Over Ethernet) as well. 4-GC-LW refers to '4 ports – Gigabit Combo port – LAN WAN'.

Verify the 'Dragon PTN Bandwidth Overview' manual (Ref. [100] in Table 1) to see in which node and IFM slot this IFM can be used. This IFM requires an interface adapter kit in core nodes which is not needed in aggregation nodes (see §2.1, Nodes: see Ref. [3], [3b] in Table 1).

Main supported features:

- Gigabit Ethernet Ports:
  - 1 x Combo (one of the two options below):
    - 1 x RJ45 (Cu, electrical): 10/100/1000BASE-T;
    - 1 x SFP (Fiber, optical): 1000BASE-X / Smart SFP;
  - 3 x RJ45 (Cu, electrical): 10/100/1000BASE-T;
- Synchronization
  - SyncE;
  - PTP IEEE 1588v2 (=Precision Time Protocol);
- on 4-GC-LW: PoE IEEE 802.3at ;
- Smart SFP;
- LAN or WAN function selectable per port;
- (future) EFM-F IEEE 802.3ah (=Ethernet in the first Mile – Fiber);
- E-Tree in an Ethernet Service;
- MRP (=Media Redundancy Protocol) Support;
- Ethernet Layer2: Link Aggregation/LAG.

1.2 Manual References

Table 1 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 1 Manual References

Ref.	Number	Title
[1]	XA-M801-&-*	Dragon PTN Installation and Operation
[2Mgt]	XA-M830-&-*	HiProvision Management Operation
[2Eth]	XA-M831-&-*	Dragon PTN Ethernet Services
[2Leg]	XA-M832-&-*	Dragon PTN Legacy Services
[2Net]	XA-M833-&-*	Dragon PTN Network Operation
[3]	XB-M802-&-*	Dragon PTN Aggregation Nodes: PTN2210, PTN2206, PTN1104, PTN2209
[3b]	XB-M840-&-*	Dragon PTN Core Nodes: PTN2215
[4]	XB-M803-&-*	Dragon PTN Switching Module: PTN-CSM310-A/PTN-CSM540-A
[7]	XE-M819-&-*	Dragon PTN Interface Module: PTN-8-FXS
[8]	XF-M811-&-*	Dragon PTN TRMs (Transmit Receive Modules: SFP, XFP, QSFP+)
[9]	XA-M810-&-*	Dragon PTN General Specifications
[100]	XA-M828-&-*	Dragon PTN Bandwidth Overview

2. MODULE DESCRIPTION

2.1 Front Panel

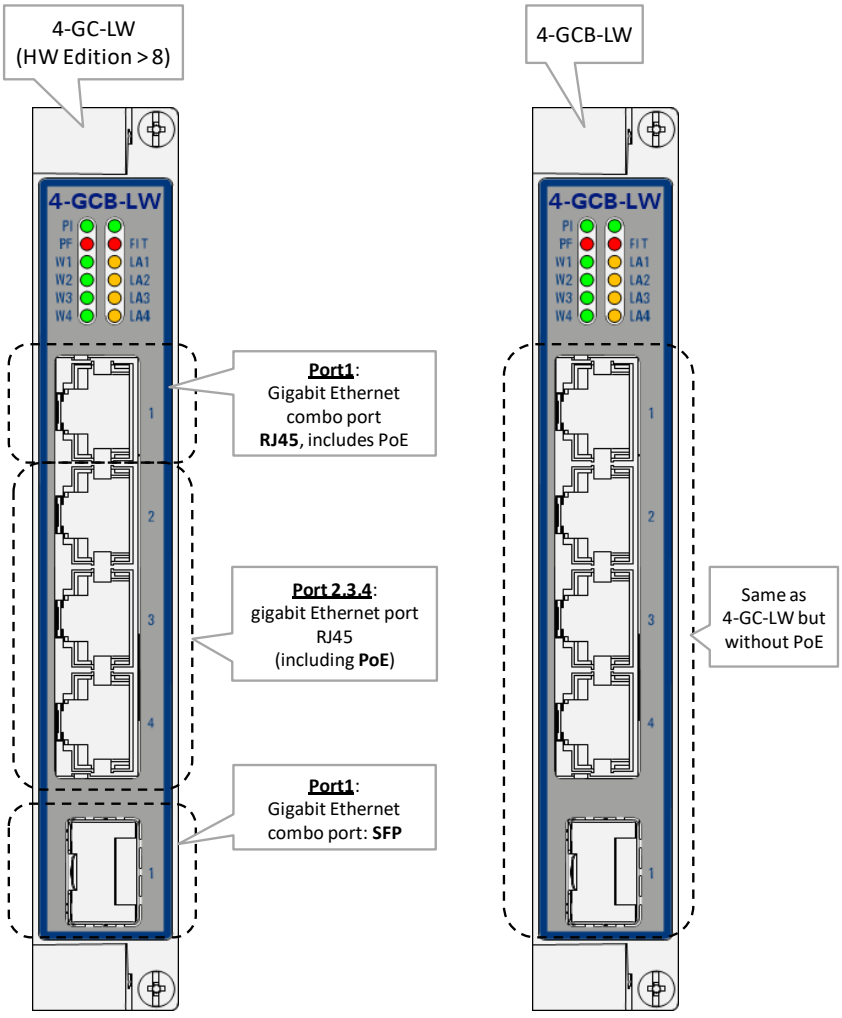

Figure 1 IFM In Aggregation Nodes

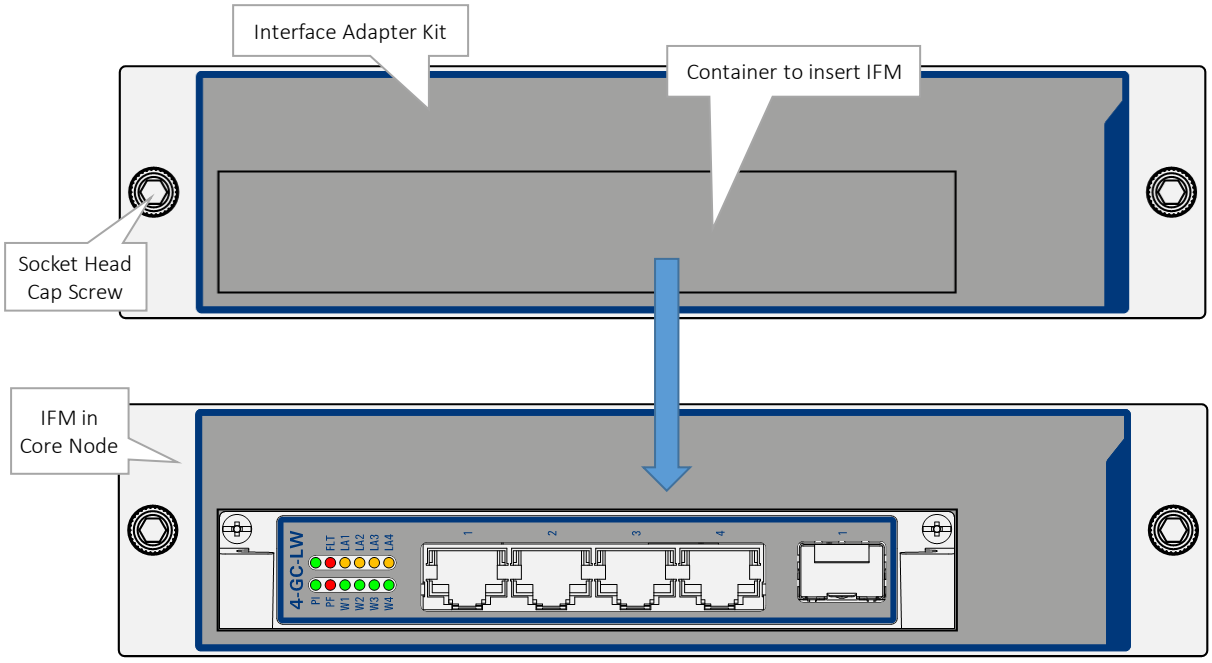

Figure 2 IFM In Core Nodes

2.1.1 Insert/Remove Module into/from Node

See 'Dragon PTN Installation and Operation Manual' Ref.[1].

2.1.2 LEDs

The meaning of the LEDs depends on the mode of operation (= boot or normal) in which the 4-GC-LW/4-GCB-LW module currently is running. After plugging in the module or rebooting it, the module turns into the boot operation, see Table 2. 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 3.

Table 2 LED Indications In Boot Operation

Cycle	PI	PF	FLT	Spare LED	W[1..4]	LA[1..4]
1	✓	---	Slow blinking	---	---	---
2	✓	---	Fast blinking	---	---	---
3	✓	---	---	---	---	---
4	✓	---	✓	---	✓	---
5	✓	---	---	---	✓	---

✓ : LED is lit / --- : LED is not lit
The sub cycle times may vary. The entire boot cycle time [1→5] takes approximately 3 minutes.

Table 3 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
W<port n°>	Not lit, dark	The link on port<port n°> is a LAN link
	Green	The link on port<port n°> is a WAN link
LA<port n°>	**Normal SFP or RJ45**	
	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
	Smart SFP (see §2.2.9)	
	Not lit, dark	The port is administratively down or no service programmed on this port
	Yellow blinking	A service is programmed on this port. CAUTION: The link status and link activity to the SDH/SONET network cannot be derived from this LA LED, instead it must be derived from the Smart SFP status/alarms information in HiProvision.

2.1.3 Connectors

This module has following ports:

- **Port1 = Combo Ethernet port**: A 'Combo' port is a double Ethernet port with an electrical (RJ45) and optical (SFP) port. Only one of the two ports can be active at the same time, either the RJ45 or the SFP port. If an SFP link comes up on the SFP, the SFP link has always priority over a possible RJ45 link. An RJ45 link on this port can only become active if no link comes up on the SFP. If for example no SFP link is up, and the RJ45 brings up the link first, the RJ45 port will become active. If an SFP link comes up later on, the SFP port will become the active one and the RJ45 port will be deactivated. The SFPs that can be used for this port can be found in Ref. [8] in Table 1.
  - RJ45: 10/100/1000 Gigabit Ethernet copper port, see figure and table below;
  - SFP: 100/1000 Gigabit Ethernet fiber port / Smart SFP;

NOTE: The behavior described above counts for both SFP and Smart SFPs;

- **Port2, 3, 4 = RJ45 Ethernet port:** 10/100/1000Base-T Gigabit Ethernet copper port. Use CAT5E shielded cables for 10/100Base-T and CAT6 shielded cables for 1000Base-T to connect these ports.

CAUTION: Port speed settings in 10G slots in aggregation nodes have limited support, see table below.

Table 4 Port Speed Support in 10G Slots in Aggregation Nodes

Speed	Port1 (RJ45)	Port1 (SFP, Fiber)	Port2,3,4
10M/100M	---	---	cannot be used in 10G slots
1G Fixed	---	✓	
1G Autonegotiation	✓	✓	
Note: ✓= supported; --- = not supported			

Table 5 RJ45 Ethernet port: Pin Assignments

Pin No.	Signal 100/100Base-T	Signal 1000Base-T
1	Transmit output (+)	DA+
2	Transmit output (-)	DA-
3	Receive input (+)	DB+
4	---	DC+
5	---	DC-
6	Receive input (-)	DB-
7	---	DD+
8	---	DD-

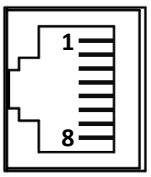

Figure 3 RJ45 Ethernet port

2.2 Functional Operation

The 4-GC-LW/4-GCB-LW performs following major tasks:

2.2.1 Media Module for Ethernet: Interfacing to a LAN or WAN Network

WAN ports interconnect nodes within the Dragon PTN network (MPLS-TP) whereas LAN ports interconnect the nodes with their applications.

Each Ethernet front port can be configured individually as LAN or a WAN port in HiProvision. By default, each port is configured as WAN port. 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.

When the module needs a WAN port configuration, typically combo port 1 will be used for this because this port offers an SFP port which can be used to cover larger distances over

fiber within the WAN. The other ports can also be configured as WAN port, but these ports must be hooked up to a copper cable via RJ45, which leads to shorter distances.

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;

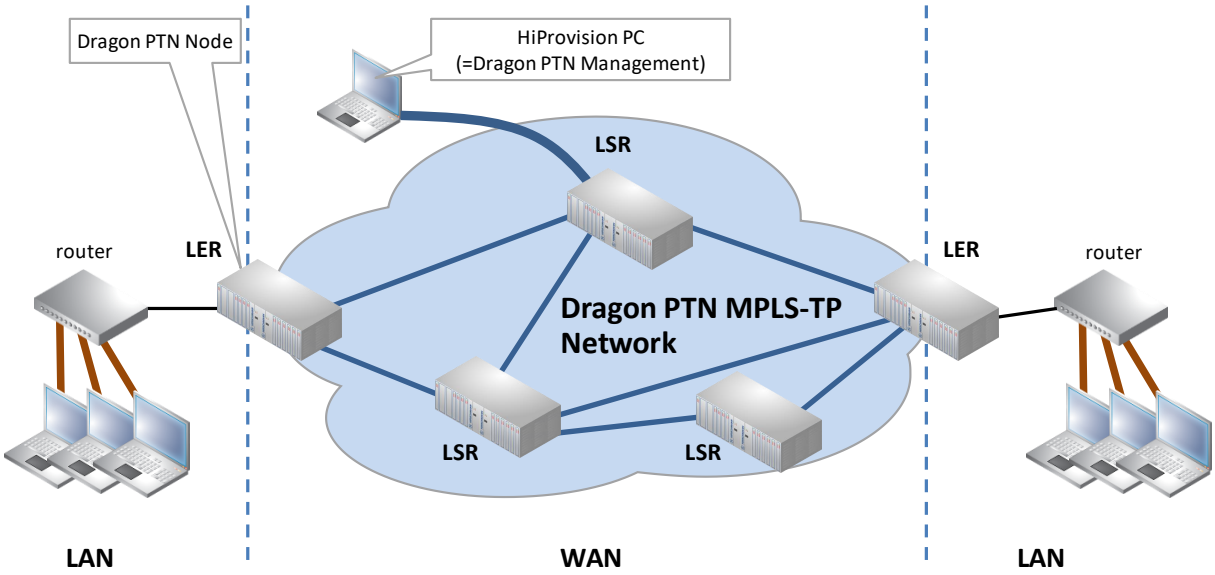

Figure 4 General Example: LAN/WAN

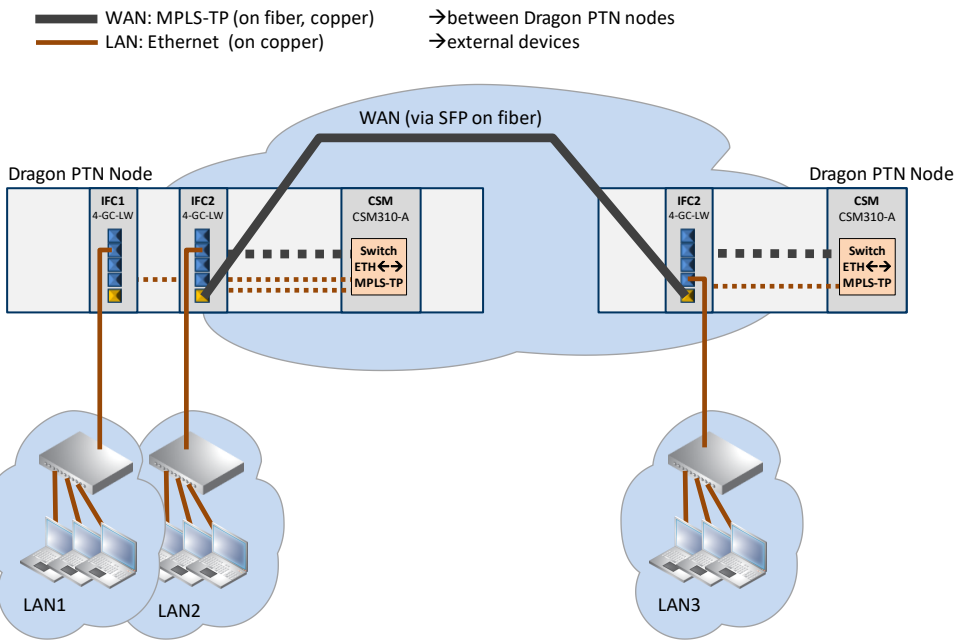

Figure 5 Detailed Example: Interfacing to a LAN or WAN Network

2.2.2 Ethernet Service

a. General

The 4-GC-LW/4-GCB-LW 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. An optional E-Tree can be configured as well on this Ethernet service.

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 (single VLAN)/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'.
- VLAN based (Multi VLAN)/QinQ VLAN ID (can only be used when L2/L3 IFM ports are included in the service): 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 L2/L3 IFMs. For incoming traffic on the L2/L3 IFM backend ports (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 on the L2/L3 IFM backend ports (WAN or LAN), the QinQ VLAN is removed. The 4-GC-LW/4-GCB-LW IFM itself is not able to add/remove the double VLAN tags. It will process incoming double VLAN tagged packets as if it was a single VLAN tagged packet meaning that only the outer VLAN will be processed. Detailed examples with a mix of all these IFMs can be found in Ref. [2Eth] in Table 1. A switch that supports QinQ should be connected to the 4-GC-LW/4-GCB-LW ports to process double VLAN tagged packets.

c. E-Tree

An E-Tree is a rooted (not routed) point-to-multipoint partial service within a programmed Ethernet service. E-Tree can be used as a security precaution to separate different customers (=leafs) using the same Ethernet service while accessing one or more ISPs (=roots).

When an E-Tree is used, each service endpoint is designated as either **leaf** or **root**. A leaf can only communicate with a root. A root can communicate with all the roots and leafs.

2.2.3 Voice Service

The 4-GC-LW/4-GCB-LW IFM ports can be configured in the Ethernet part of the Voice service. See Ref. [2Leg] and Ref.[7] in Table 1 for more information on the Voice service.

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

The 4-GC-LW/4-GCB-LW module receives traffic (Ethernet or MPLS-TP) via its front panel ports and forwards this to the CSM via the backplane. 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.

2.2.5 Synchronization / Clock Distribution / Network Timing

The Dragon PTN network provides a number of mechanisms to perform synchronization / clock distribution / network timing. The CSM makes sure that all the included IFMs in the node are synchronized. See the table below for an overview of the mechanisms that are supported on the 4-GC-LW/4-GCB-LW module.

It means that the front ports of the 4-GC-LW/4-GCB-LW module can be used to recover a clock from an incoming data stream and redistribute this clock via an outgoing data stream;

Table 6 Synchronization / Clock Distribution / Network Timing Overview

Mechanism	Domain	What is Synchronized?	Purpose
SyncE	Network wide	Clock Frequency	Distribute a synchronous clock, based on a PRC (=Primary Reference Clock), network wide over all the nodes that need it.
PTP IEEE 1588v2	Network wide	Timestamping	A protocol to synchronize real-time clocks (timestamping) in Dragon PTN network elements and/or connected devices.

a. SyncE (=Synchronous Ethernet)

See the manuals in Ref.[2Net] and Ref.[4] for more detailed information.

b. PTP IEEE 1588v2 (=Precision Time Protocol)

See the HiProvision manual in Ref.[2Net] for more detailed information.

2.2.6 EFM-F IEEE 802.3ah (=Ethernet in the First Mile – Fiber) (future)

Future planned.

2.2.7 MPLS-TP Compliancy

See the CSM manual in Ref.[4].

2.2.8 PoE (=Power Over Ethernet) on 4-GC-LW

NOTE: An NSM-A and 4-GC-LW are required to deliver PoE. NSM-B and 4-GCB-LW do not support PoE.

PoE is a technology that allows a Powered Device (=PD, e.g. IP telephones, IP cameras etc.) to receive power from 'Power Sourcing Equipment' (=PSE, e.g. the Dragon PTN node). An example with PoE on/off can be found in Figure 6.

Dragon PTN nodes are able to deliver PoE when one (or two) external PoE PSU(s) is (are) connected to the NSM via the PoE connectors. A possible external PoE PSU and how to connect it can be found in the manual Ref.[3], [3b] see Table 1.

The PD receives power in parallel to data, over the existing CAT-5 Ethernet infrastructure. PoE integrates data and power on the same cable, it keeps the structured cabling safe and does not interfere with concurrent network operation.

PoE delivers a minimum of 48V of DC power over shielded/unshielded twisted-pair wiring for terminals consuming less than 25.5 Watts of power.

Before the power is delivered to a connected device, a protocol measures whether that device is a PoE device and how much power it needs (power classification). If required, the necessary power will be delivered by the PSE with a maximum of 32 Watts per port.

PoE is supported on all the electrical RJ45 ports of the 4-GC-LW module. All these ports can deliver power according to the 802.3af (PoE) and 802.3at (PoE+) standard.

Via HiProvision it is possible to enable/disable PoE per port and to verify which ports in each node are PoE enabled;

Power management is supported, i.e. the Dragon PTN node decides in an intelligent way which PoE ports will get power and which ones will not. There are a lot of possible scenarios in which power management must tune its delivered power on each port. Some configuration/status parameters in HiProvision used by power management are:

- External PoE PSU power;
- Available power budget;
- Power Priority / Port Priority;
- Power Class (class 0, 1, 2, 3, 4 configured and detected);
- Power management also offers PoE diagnostics in HiProvision.

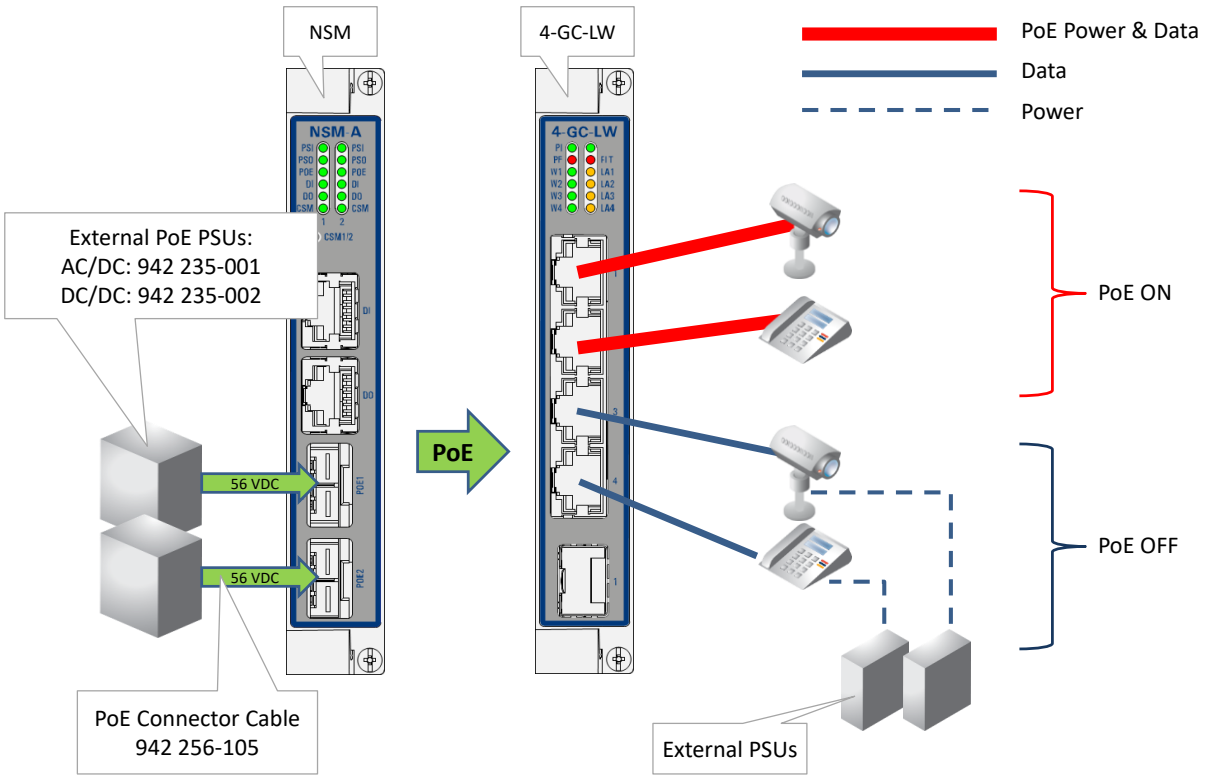

Figure 6 PoE Example

2.2.9 Smart SFP

Smart SFP is a hot-pluggable optical transceiver that converts incoming STM/OC frames from a fiber-optic SDH/SONET network into Ethernet frames at the 4-GC-LW/4-GCB-LW front port 1 or vice versa for outgoing frames. As a result, Dragon PTN allows to transparently transport synchronous digital bit streams from an SDH/SONET network via the 4-GC-LW/4-GCB-LW IFMs.

Smart SFPs must be used in a point-to-point port based Ethernet service over Dragon PTN.

The Smart SFP has an optional security feature onboard which allows to secure the point-to-point connection to only two dedicated MAC addresses. This can be done via setting the Destination MAC Address in HiProvision for the Smart SFPs. Furthermore, the Smart SFPs need some extra Quality of Service settings in HiProvision, see Ref. [2Leg] in Table 1.

For clocking/synchronization, SyncE must be configured in the nodes that have Smart SFPs plugged in.

Smart SFPs also generate appropriate alarms, e.g. Loss of Signal, Loss of Frame etc.

NOTE: Smart SFP is also called TSoP (Transparent Sonet/SDH over Packet).

NOTE: The supported Smart SFPs and speeds can be found in Ref. [8] in Table 1.

NOTE: SFPs are typically used on WAN ports whereas Smart SFPs are used on LAN ports.

CAUTION: When using this IFM with Smart SFP in aggregation nodes (see Ref. [3] in Table 1) limit the ambient node temperature to 50°C/122°F.

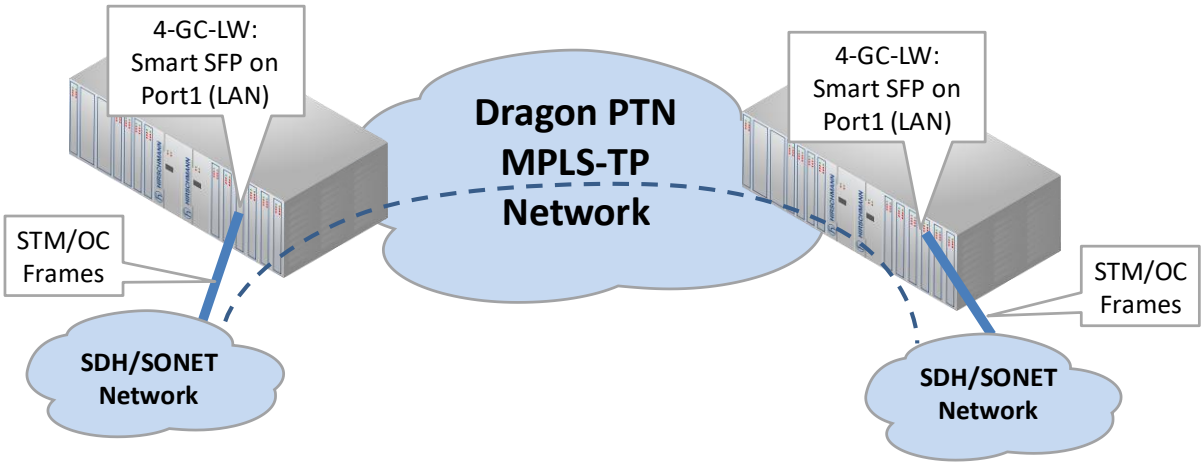

Figure 7 SDH/SONET over Dragon PTN via Smart SFPs

2.2.10 Storm Control on Ethernet LAN Port

NOTE: Storm Control is not relevant/supported on WAN Ports;

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 1 for more configuration information in HiProvision.

2.2.11 BPDU Guard on Ethernet LAN Port

NOTE: BPDU Guard is not relevant/supported on WAN Ports;

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;
- sends out dummy BPDU packets.

As a result, this feature or IFM:

- protects the network against possible loops created via this IFM, although this IFM does not support MSTP;
- 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 1 for more configuration information in HiProvision.

2.2.12 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. [2Eth] in Table 1 for more configuration information in HiProvision.

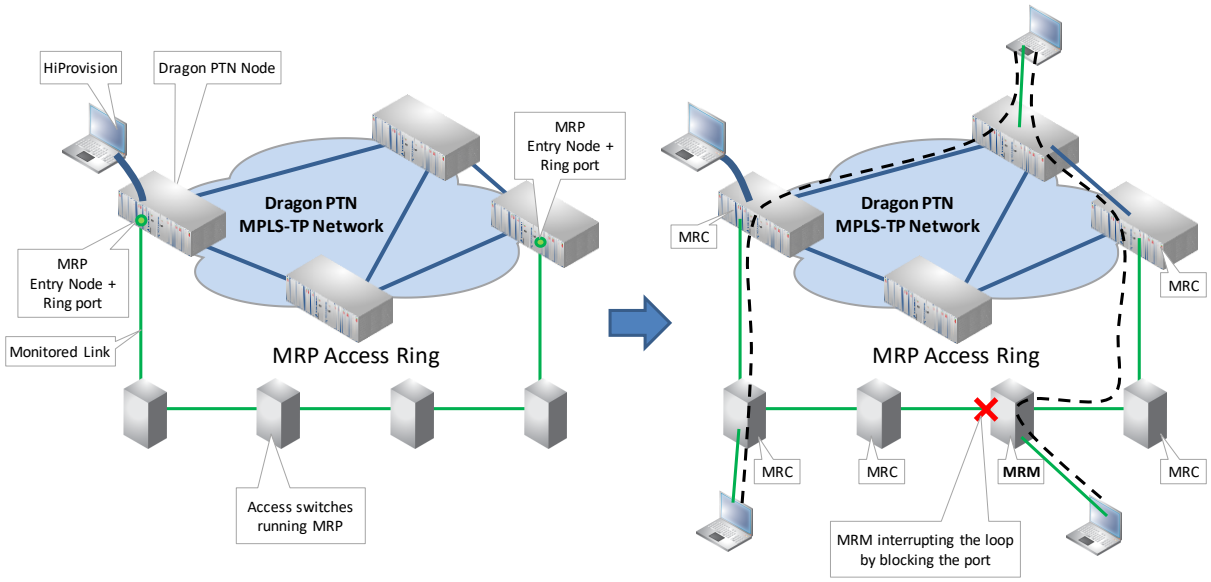

Figure 8 MRP: General Example

2.2.13 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 1 for more configuration information in HiProvision.

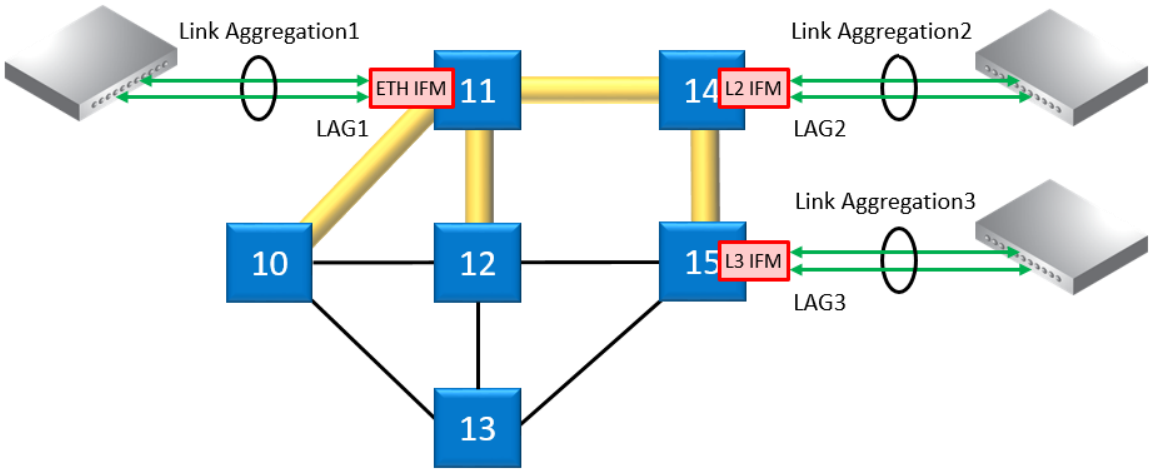

Figure 9 Link Aggregation and LAGs

2.3 Onboard Interfaces

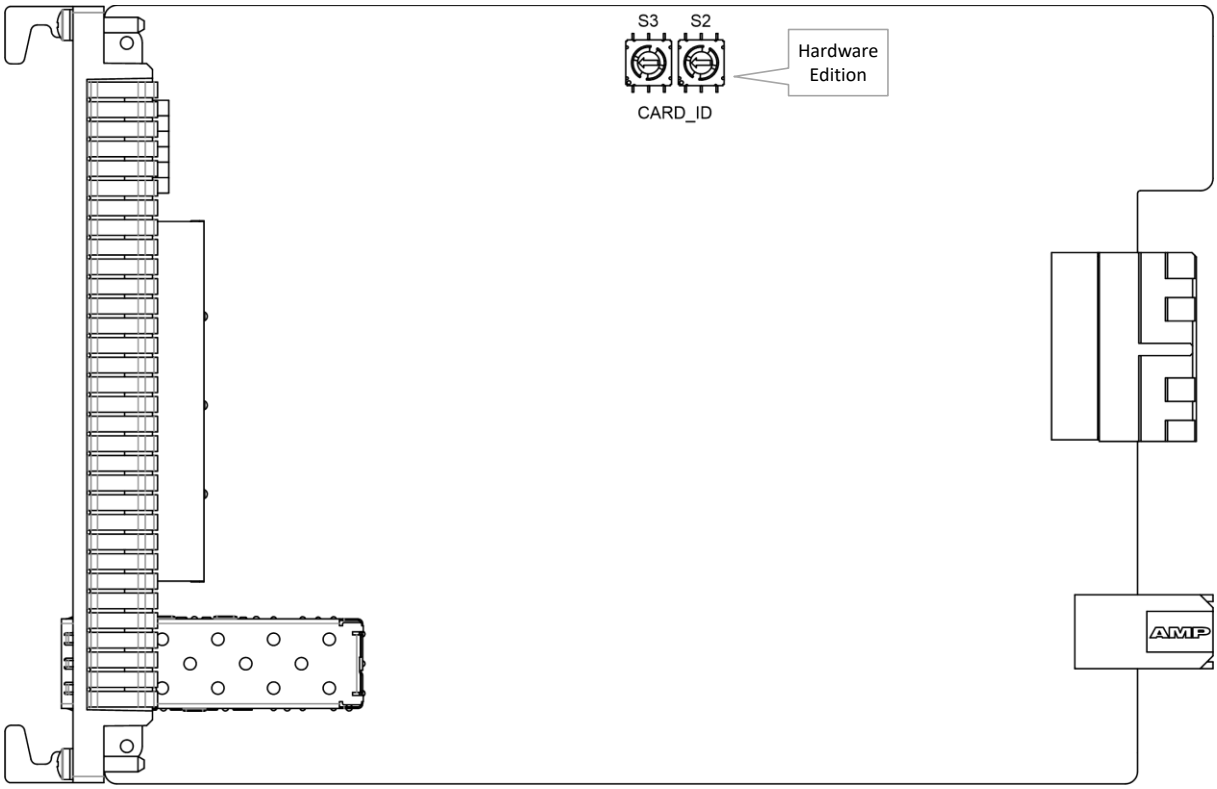

Figure 10 4-GC-LW/4-GCB-LW: Side View

2.3.1 Straps

No user relevant straps. The straps J3, J9 and J17 in Figure 10 are straps for service engineers only! These straps MUST NOT BE CHANGED, leave them with the default settings as indicated in Figure 10.

2.3.2 Rotary DIP Switches

a. Hardware Edition

The Hardware Edition (labeled as CARD_ID) is set in decimal code using rotary switches S2 to S3 (S3 = most significant). It can be read out as well via HiProvision. This edition has been factory set and MUST NOT BE CHANGED!

Example: Setting S3='0' and S2='5' indicates Hardware Edition '5' (dec).

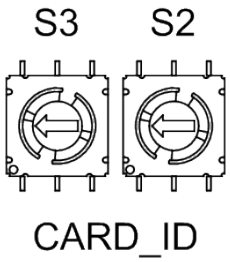

Figure 11 Hardware Edition

3. MODULE SPECIFICATIONS

3.1 General Specifications

For general specifications like temperature, humidity, EMI ... see Ref.[9] in Table 1.

3.2 Other Specificiations

Table 7 Other Specifications

Description	Value
Weight	4-GC-LW: 0.25 kg / 0.6 lb 4-GCB-LW: 0.18 kg / 0.4 lb
MTBF	4-GC-LW: 109 years at 25°C/77°F 4-GCB-LW: 147 years at 25°C/77°F
Power Consumption	6W (measured at 25°C/77°F, with data transport)
Module Size	width: 20.32 mm / 0.8 inches height: 126 mm / 4.96 inches depth: 195 mm / 7.68 inches

3.3 Ordering Information

- PTN-4-GC-LW: 942 236-001;
- PTN-4-GCB-LW: 942 236-008;
- Interface Adapter Kit for Core Nodes: 942 237-007.

4. ABBREVIATIONS

ASIC	Application-Specific Integrated Circuit
BPDU	Bridge Protocol Data Unit
CE	Conformité Européenne

CSM	Central Switching Module
EFM-F	Ethernet in the First Mile Over Point-to-Point Fiber
EMI	Electromagnetic Interference
FLT	Fault
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFM	InterFace Module
ISP	Internet Service Provider
LAG	Link Aggregation Group
LAN	Local Area Network
LER	Label Edge Router
LSR	Label Switching Router
LVD	Low Voltage Directive
MIB	Management Information Base
MRC	Media Redundancy Clients
MRM	Media Redundancy Manager
MRP	Media Redundancy Protocol
MSTP	Multiple Spanning Tree
MTBF	Mean Time Between Failures
PD	Powered Device
PF	Power Failure
PI	Power Input
PoE	Power Over Ethernet
PSC	Protection State Coordination
PSE	Power Source Equipment
PSU	Power Supply Unit
PTN	Packet Transport Network
PTP	Precision Time Protocol
SNMP	Simple Network Management Protocol
SyncE	Synchronous Ethernet
TSoP	Transparent Sonet/SDH over Packet
WAN	Wide Area Network