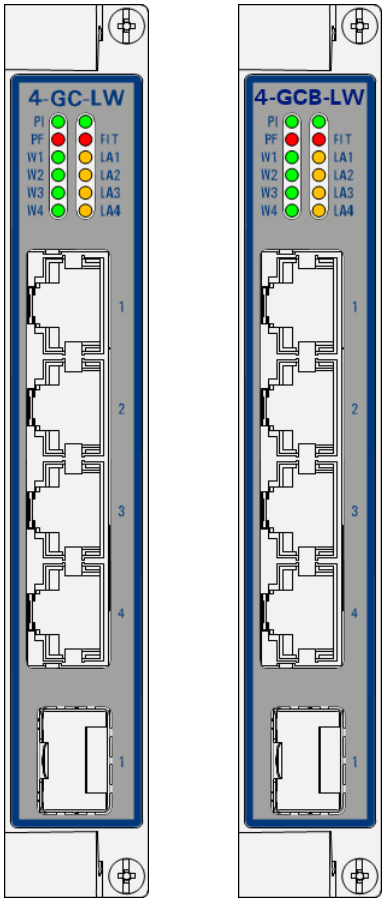
User Manual

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 4.0DR.

This document describes the PTN-4-GC-LW and PTN-4-GCB-LW interface module. The PTN-4-GC-LW supports PoE whereas the PTN-4-GCB-LW not. These Interface Modules 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 PTN-4-GC-LW Interface Module, these RJ45 ports can deliver PoE (=Power Over Ethernet) as well. PTN-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 Interface Module slot this Interface Module can be used.

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.

1.2 Manual References

Table 1 is an overview of the manuals referred to in this manual. All these manuals can be found in the HiProvision (=Dragon PTN Management System) Help function.

Table 1 Manual References

Ref.	Manual	Title
[1]	UM_BasicConfig_Dragon-PTN_and_HiProvision-Operation_Rel_4-0DR_1019_en.pdf	Dragon PTN and HiProvision Operation
[2]	IG_Dragon-PTN_Installation-and-Operation_02_1019_en.pdf	Dragon PTN Installation and Operation
[3]	IG_Dragon-PTN_Nodes_02_1019_en.pdf	Dragon PTN Aggregation Nodes: PTN2210, PTN2209, PTN2206, PTN1104
[4]	IG_Dragon-PTN_PTN-CSM310-A_02_1019_en.pdf	Dragon PTN Switching Module: PTN-CSM310-A
[5]	IG_Dragon-PTN_PTN-1-10G-LW_02_1019_en.pdf	Dragon PTN Interface Module: PTN-1-10G-LW
[6]	IG_Dragon-PTN_PTN-4-GO-LW_01_1019_en.pdf	Dragon PTN Interface Module: PTN-4-GO-LW
[7]	IG_Dragon-PTN_PTN-8-FXS_01_1019_en.pdf	Dragon PTN Interface Module: PTN-8-FXS
[8]	IG_Dragon-PTN_TRMs_SFP_XFP_02_1019_en.pdf	Dragon PTN TRMs (Transmit Receive Modules: SFP, XFP)
[9]	IG_Dragon-PTN_General-Specifications_01_1019_en.pdf	Dragon PTN General Specifications
[100]	UM_Dragon-PTN_Bandwidth-Overview_01_1019_en.pdf	Dragon PTN Bandwidth Overview

2. MODULE DESCRIPTION

2.1 Front Panel

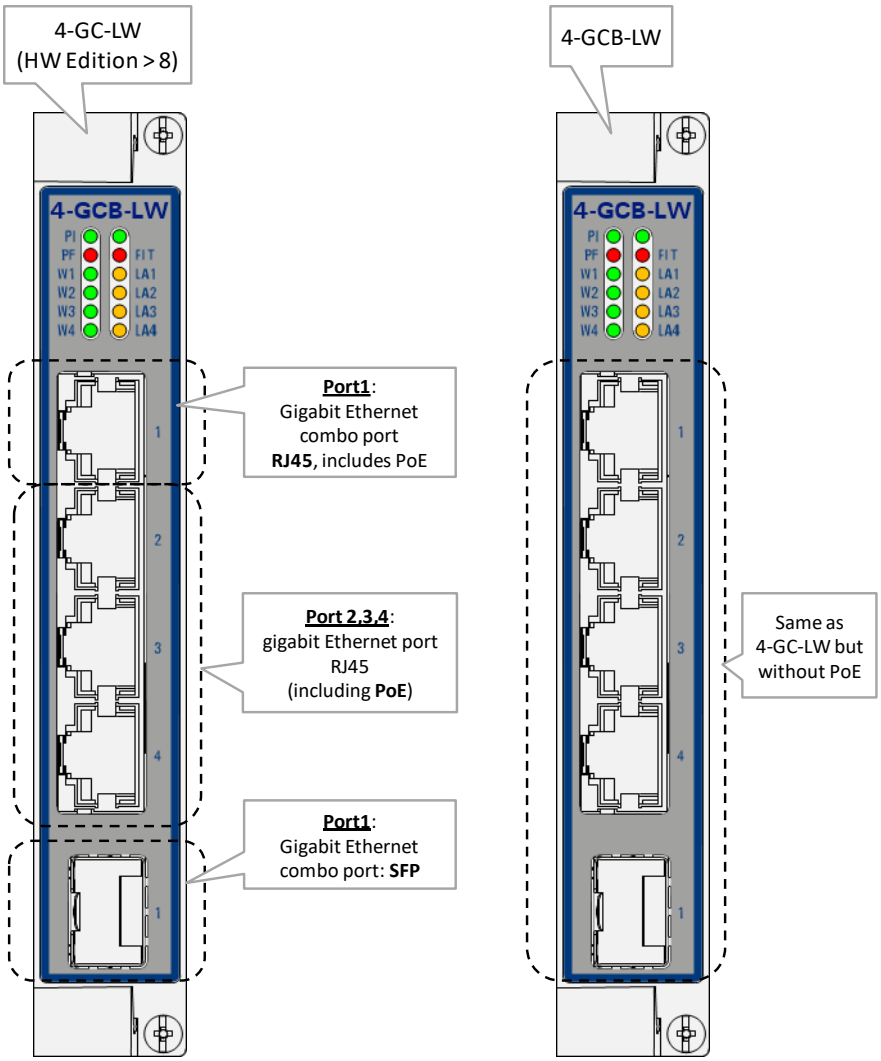

Figure 1 Front Panel

2.1.1 Insert/Remove Module into/from Node

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

2.1.2 LEDs

The meaning of the LEDs depends on the mode of operation (= boot or normal) in which the PTN-4-GC-LW/PTN-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	x	---	Slow blinking	---	---	---

2	x	---	Fast blinking	---	---	---
3	x	---	---	---	---	---
4	x	---	x	---	x	---
5	x	---	---	---	x	---
x : 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.

Table 4 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-

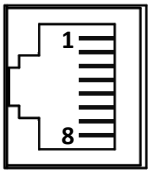

Figure 2 RJ45 Ethernet port

2.2 Functional Operation

The PTN-4-GC-LW/PTN-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;

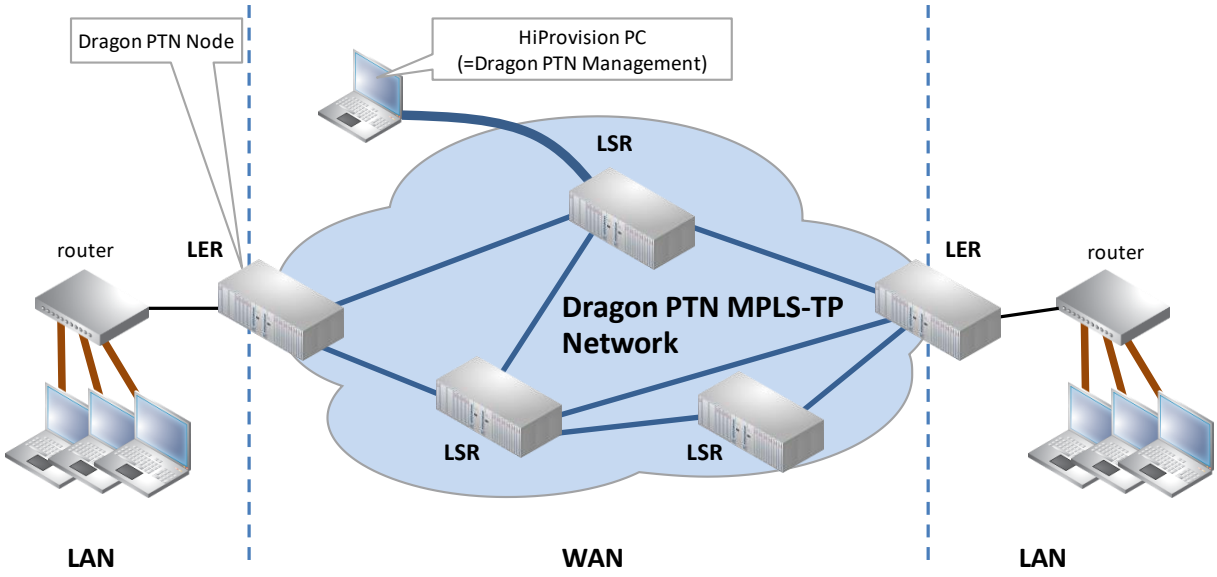

Figure 3 General Example: LAN/WAN

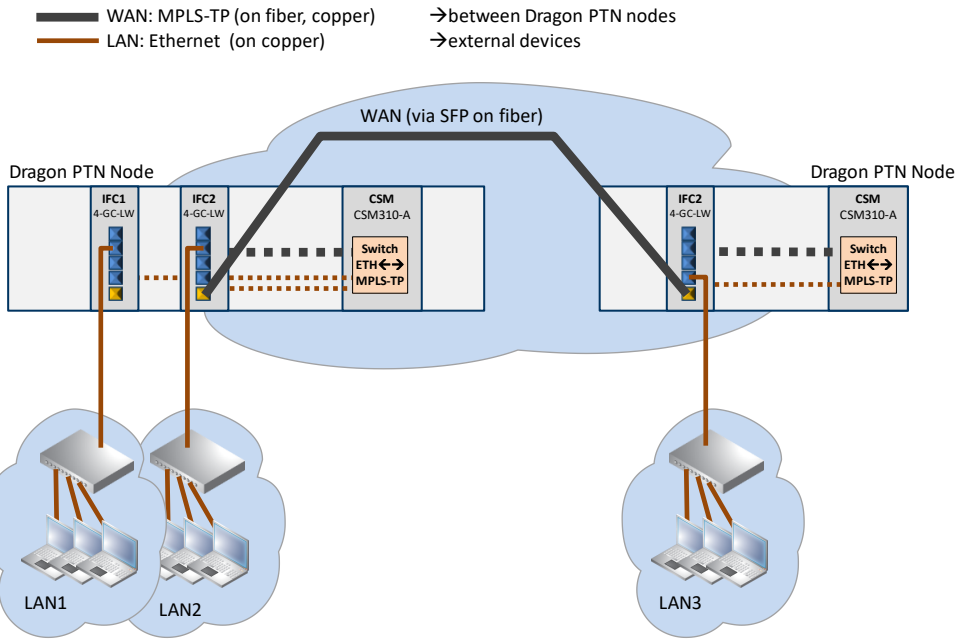

Figure 4 Detailed Example: Interfacing to a LAN or WAN Network

2.2.2 Ethernet Service

a. General

The PTN-4-GC-LW/PTN-4-GCB-LW Interface Module 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/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. 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 PTN-4-GC-LW/PTN-4-GCB-LW Interface Module ports can be configured in the Ethernet part of the Voice service. See Ref. [1] 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 PTN-4-GC-LW/PTN-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 Interface Modules 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 Interface Modules in the node are synchronized. See the table below for an overview of the mechanisms that are supported on the PTN-4-GC-LW/PTN-4-GCB-LW module.

It means that the front ports of the PTN-4-GC-LW/PTN-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 5 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.[1] and Ref.[4], [4b] for more detailed information.

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

See the HiProvision manual in Ref.[1] 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], [4b].

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

NOTE: An PTN-NSM-A and PTN-4-GC-LW are required to deliver PoE. PTN-NSM-B and PTN-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 5.

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 PTN-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.

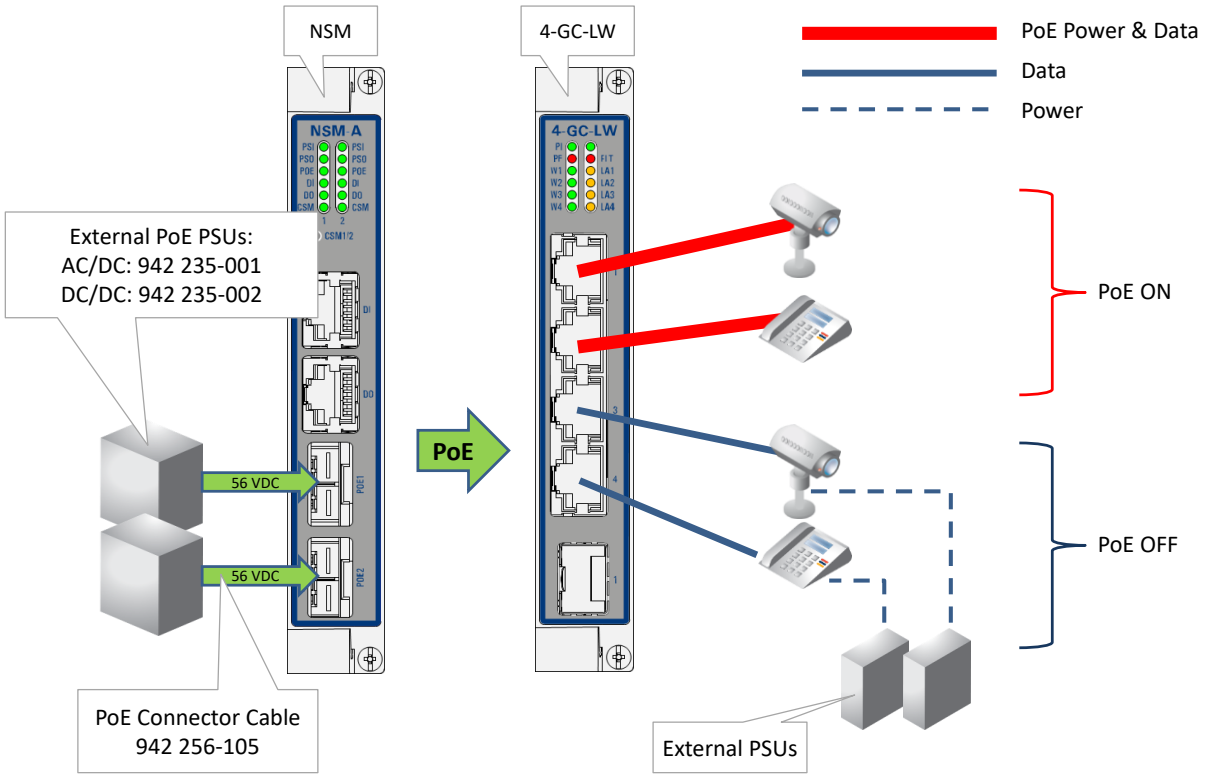

Figure 5 PoE Example

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 PTN-4-GC-LW/PTN-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 PTN-4-GC-LW/PTN-4-GCB-LW Interface Modules.

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. [1] 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.

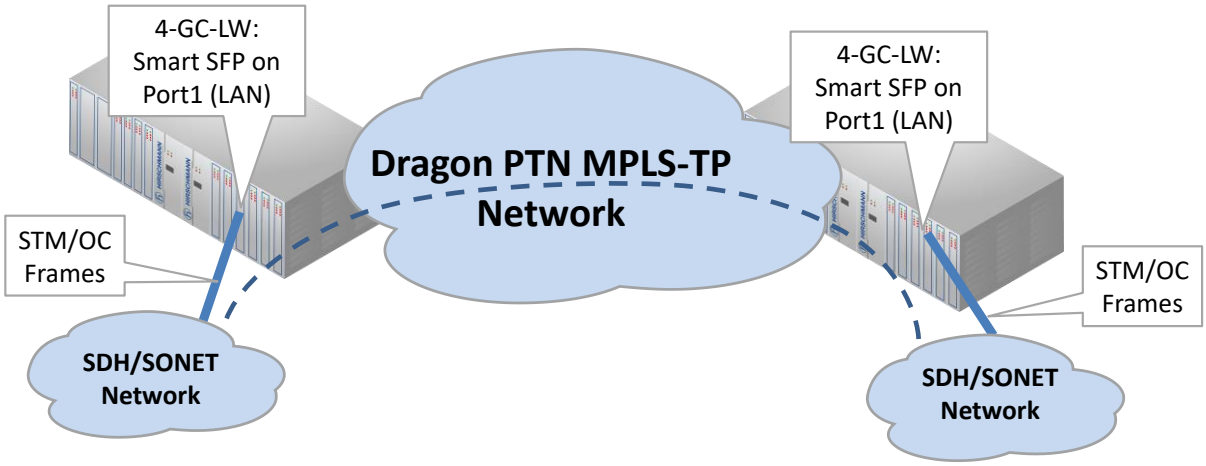

Figure 6 SDH/SONET over Dragon PTN via Smart SFPs

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 Interface Module 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 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 Interface Module:

- protects the network against possible loops created via this Interface Module, although this Interface Module 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. [1] 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. [1] in Table 1 for more configuration information in HiProvision.

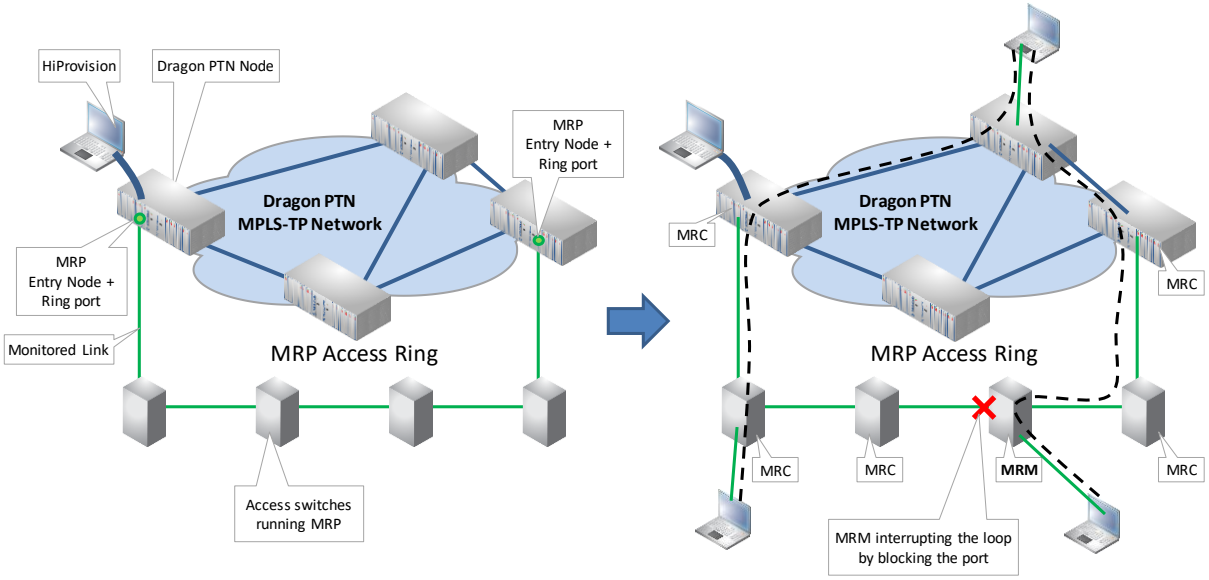

Figure 7 MRP: General Example

2.3 Onboard Interfaces

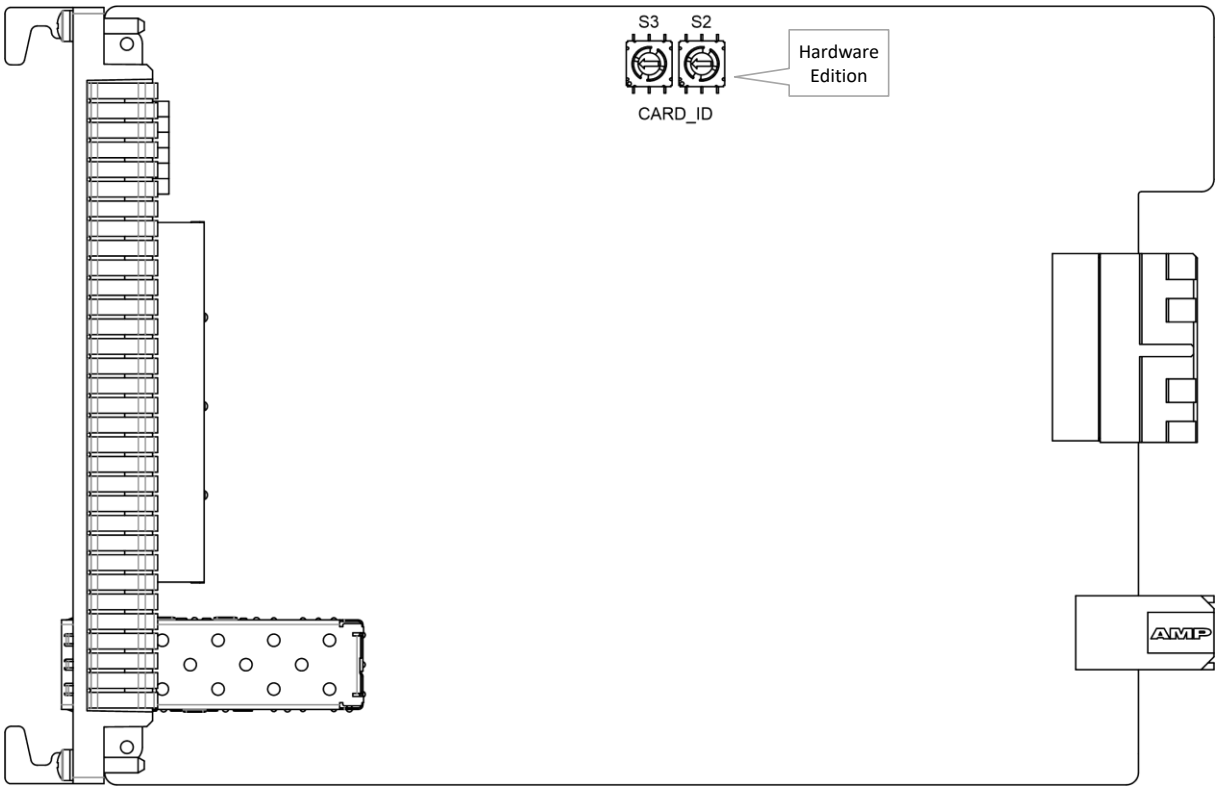

Figure 8 PTN-4-GC-LW/PTN-4-GCB-LW: Side View

2.3.1 Straps

No user relevant straps. The straps J3, J9 and J17 in Figure 8 are straps for service engineers only! These straps MUST NOT BE CHANGED, leave them with the default settings as indicated in Figure 8.

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).

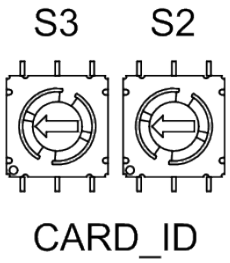

Figure 9 Hardware Edition

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 6 Other Specifications

Description	Value
Weight	PTN-4-GC-LW: 0.25 kg / 0.6 lb PTN-4-GCB-LW: 0.18 kg / 0.4 lb
MTBF	PTN-4-GC-LW: 80 years at 25°C/77°F PTN-4-GCB-LW: pending
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.

4. ABBREVIATIONS

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
ISP	Internet Service Provider
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