

AM3440/CCPB-8GEHSWa*

G7820

G7860A

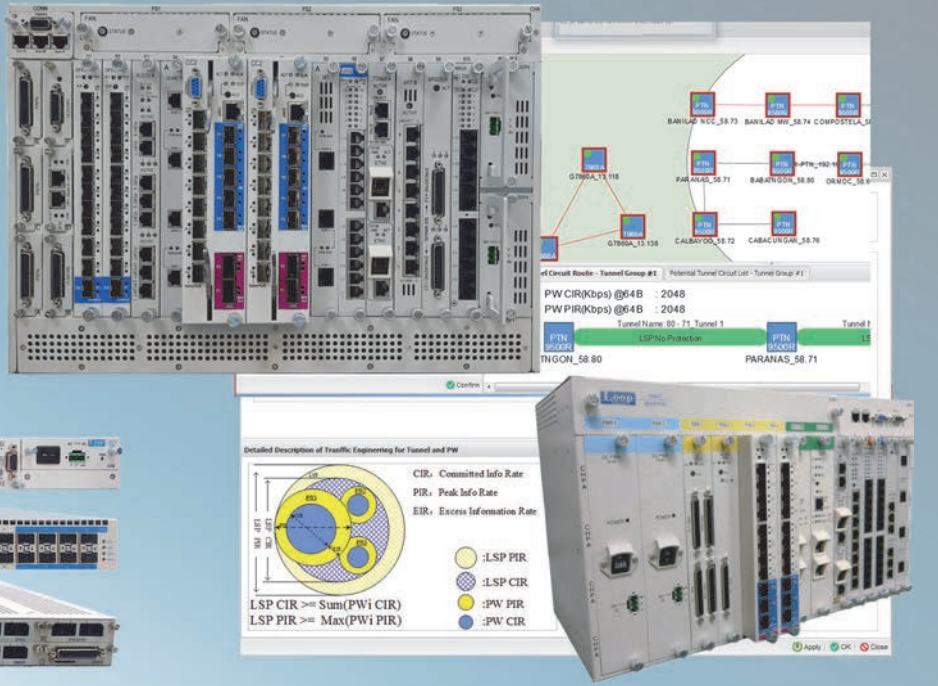
G7800*

O9400R-PTN/PTN10G

O9500R-PTN/PTN10G

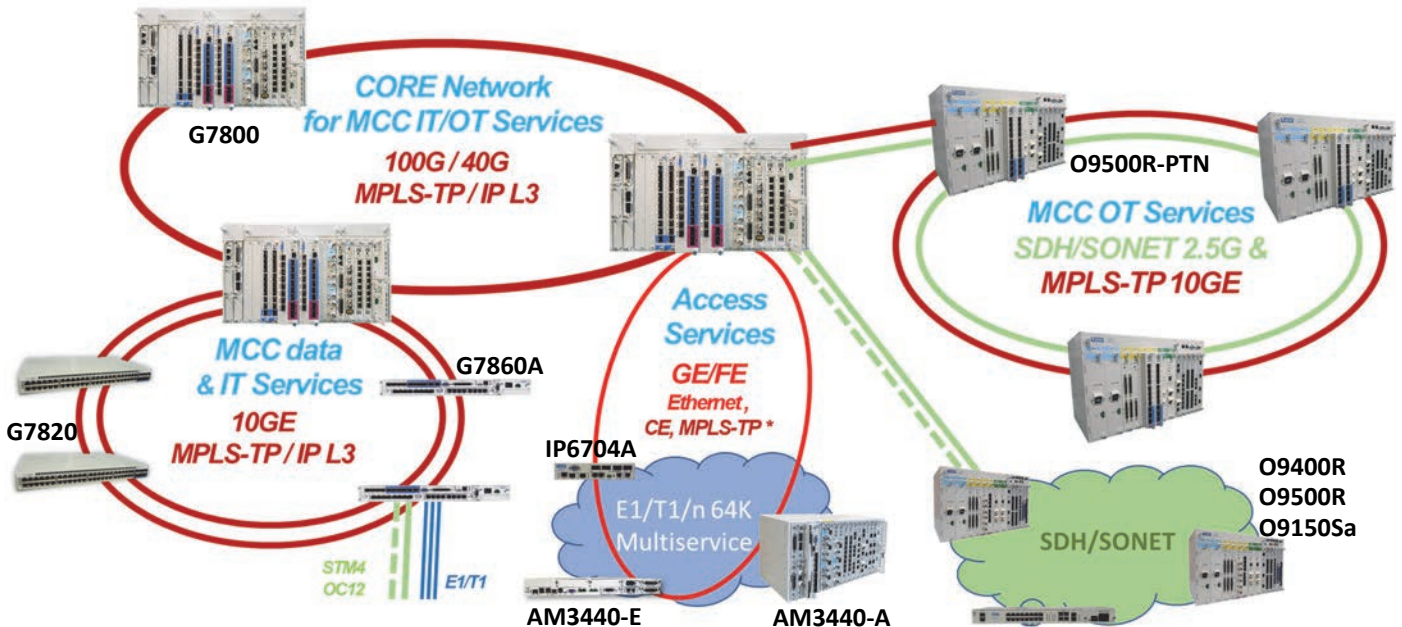
iNET EMS

iNMS NMS



Loop Telecom owns a large expertise of Multiservice Access and Telecommunication Transport for Industries and large infrastructures. We provide Mission Critical Communication (MCC) over TDM/PDH links, SDH/SONET and now primarily over Packet with PseudoWire emulation. We produce Packet Network Transport (PTN) equipment using MPLS-Transport Profile, Carrier Ethernet and IP L3 transport protocols.

Our MPLS-TP solutions support Mission Critical Communication for Power Utilities, Air Traffic Control, Railway-Mobility, Oil & Gas, Defense and Carriers for customers who require high level of bandwidth stability, latency and security to transport voice communication, SCADA, signalization, power control, etc.



Loop Telecom supports solutions for

- Packet Core Network and Aggregation Network for OT/MCC and IT transport,
- Hybrid Network TDM SDH/SONET and packet MPLS-TP for MCC and easier migrations,
- Access network Multiservice TDM and IP/Ethernet with packet transport,
- High rate MPLS-TP/Carrier Ethernet data networks.

MPLS-TP is a natural evolution for TDM/SDH/SONET infrastructures to carry low-rate multiservice together with a high volume of packets. Its features also include deterministic/static and bidirectional LSP paths, low latency, precise QoS with CIR/PIR and OAM.

Loop Telecom has extensive expertise to access, transport and encapsulation of voice, analog signal, synchronous, asynchronous, legacy interfaces, teleprotection, dry contacts...and low rate SCADA Ethernet over TDM or Packet networks. Starting from E1/T1 and then gradually for all multiservice interfaces, we have naturally developed SDH/SONET transport solutions, PseudoWire Emulation over PSN IP/Ethernet, and then finally large organized Packet Transmission Network (PTN) with MPLS-TP.

Our products act as gateways and bridges for all of these technologies to save CAPEX and OPEX.

Definitions

IT Information technologies: describe all hardware, OS, software, communication protocols, and today must focus on Cybersecurity.

OT Operational technologies: initially was using independent, non compatible hardware transmission, proprietary OS and protocols that provide a default protection for industrial processes. But new industrial systems use standard IP/Ethernet/Wireless transmission, Open sources, standard OS and rapidly standard IT transmission solution but with hardware constraints and same Cybersecurity obligations.

MCC Mission Critical Communication, this definition has been applied to the transport of highly secured applications for Power-Utilities, Transportation, Oil & Gas, Military... when dedicated or legacy transport have migrated to standard packet IP/Ethernet/Wireless transport that originally cannot respect these constraints. New protocols as SyncE, PTP, MPLS-TP... give the possibility to respect these constraints.

Multiservice This includes the technical/industrial applications as voice, analogue data, asynchronous and synchronous low rate, contact relay information, teleprotection... using standard or old (legacy) interfaces, which generally does not exceed a rate of 2Mbps.

TDM (PDH) The Time Domain Multiplexing makes the conversion of multiservice applications in digital information nx64kbps Time Slots or DS0 framing or unframed with E1, T1, E3, T3 interfaces. They are cross-connected by DCS/DACS and transported over copper, fiber, microwave point to point or multiplexed by a SDH/SONET device. PDH, Plesiochronous Digital Hierarchy was the first technology between TDM nodes. Today PDH name is used to talk about TDM DS0 circuits and equipment. The TDM/PDH nodes/multiplexer use the same clock.

SDH Synchronous Digital Hierarchy (ETSI) makes the transport over fiber STM1/4/16/64/256 links of the TDM or ATM circuits and Ethernet EoS within a hierarchy of transport using VCxx containers. The SDH carry independent circuits with independent synchronization, absolute QoS because bandwidth is permanently reserved in fiber, with protection in ring, bus or Mesh fiber infrastructures, and OAM end-to-end management of transmission quality.

SONET Synchronous Optical Networking (ANSI) is the same technology than SDH with ANSI definitions and OC3/12/48/192/768 hierarchy.

PW (or PWE3) The PseudoWire Emulation End-to-End is used to transport a service such as TDM (E1/T1/E3/DS3), SDH, Ethernet with VLAN, Q-in-Q, SAN...over Packet Switched Network (PSN): IP, Ethernet or MPLS. Different emulations are used like SAToP for unframed E1/T1/E3/T3, CESoPSN for framed TDM DS0 and CEP for channelized SDH/SONET at VCx/VTx level.

PTN "Packet Transport Network" optimizes the transport of variable IP/Ethernet data together with low rate, low latency PW and make possible high protection based on OAM and synchronization as well SDH/SONET synchronous transmission. PTN technology is Layer 2 packet switching Core of transport. The hardware use Ethernet Synchronous (SyncE) on optical GE/10GE/40GE/100GE interfaces and generally support PTP 1588v2 timing. PTN Ethernet switch uses Carrier Ethernet or MPLS-TP Layer 2.5 protocols to organize End-to-end transport.

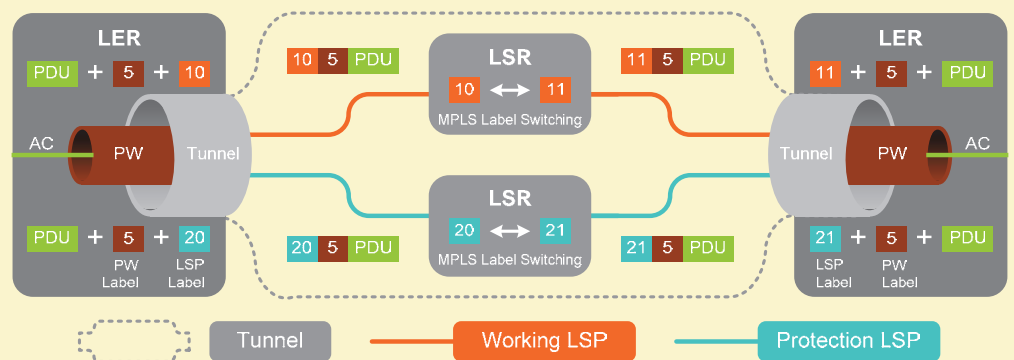
MPLS-TP The Multiprotocol Label Switching - Transport Profile is a variant of IP-MPLS protocol issue from Internet Engineering Task Force (IETF) together with International Telecommunication Union Telecommunication Standardization (ITU-T). MPLS/MPLS-TP applies a Label Switching Path (LSP) on packet to accelerate the switch distribution speed in Mesh infrastructure or VPN without packet analysis.

MPLS-TP is a **connection-oriented packed switched profile** that the administrator will implement like TDM/SDH circuits. Therefore, MPLS-TP features the OAM functions for Alarm Monitoring and Signaling, Traffic Diagnosis and Circuit Performance Monitoring at every layer (section, LSP, PW). This layer 2.5 protocol optimizes the transport over PTN infrastructure with enhanced protection switching, OAM and clock/timing synchronization by using SyncE and PTP 1588v2. TDM are carried in PWE3 and switched Ethernet is connected over VPWS point-to-point or VPLS to support EPV-LAN multipoint.

LER/LSR The Label Edge Router (LER) is referring to both end Edge Routers of a circuit while the Label Switch Router is referring to the intermediate nodes performing Label Switching along the LSP. The MPLS label added to the packets leads to LER/LSR a high switching speed.

LSP The Label Switching Path is one of the label switching path that the Tunnel traffic actually rides on. The LSP is used to carry several PW/VPWS/VPLS between two ends. The bidirectional LSP generally takes the same path for both forward and backward direction to guarantee the same delay back and forth. The LSP is attached to the both-end LERs and to the crossed LSRs in between. Loop support RFC7271.

MPLS-TP Tunnel A tunnel basically consists of one or two LSP (working and protection) between two LERs. Several TDM-PW, VPWS, VPLS will be attached to this virtual link or Tunnel.



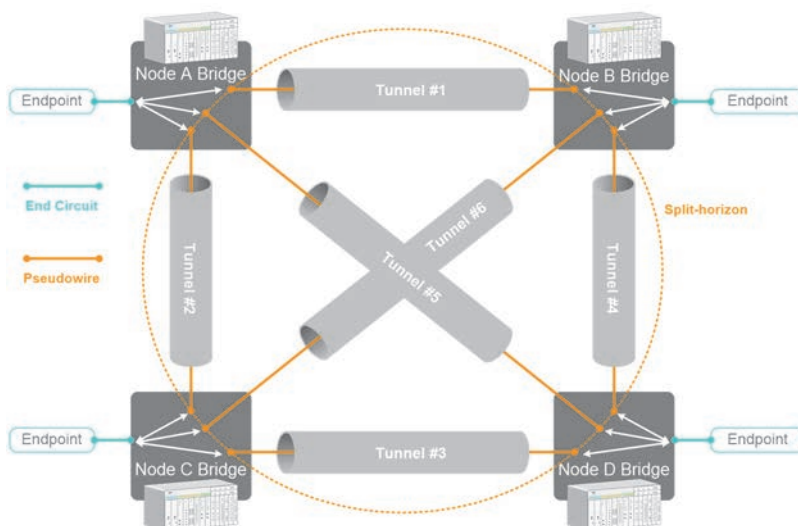
IP/Ethernet transport over MPLS-TP Networks Layer 2.5 in Loop-OS equipment

MPLS-TP protocol also carry large volumes of IP/Ethernet over PseudoWire in bridged and switched MPLS-TP LSP. We will distinguish the PW point to point VPWS and multipoint VPLS. One of the great advantages of MPLS-TP, with respect to SDH/SONET, is that intermediary nodes (LSR) of the network are not gullets throttling as SDH/SONET nodes hardware. The Traffic Engineering Engine optimize the use of total bandwidth with CIR (Committed Information rate) and PIR (Peak Information Rate) per PW and a QoS with Two-Rate Three-Color Marker.

VPWS The VPWS is a point-to-point Ethernet Layer2 bridging service providing an E-line service over MPLS-TP. This can carry VLAN with simple or double tagging.

VPLS A VPLS is a multipoint-to-multipoint Ethernet Layer2 bridging service using fully meshed topo-logy. VPLS supports Virtual Private LAN, EVP-LAN, or EVP-Tree Services over MPLS-TP. For this service each node is connected to each other by a single PW over MPLS-TP tunnels. Each nodes of these VPLS are connected to LAN ports by a per PW or WAN, this does not limit the speed of transfer over MPLS-TP unlike the E-LAN over EoS switches.

H-VPLS When too many VPLS instances are required with a large number of meshed PW and tunnels, the Hierarchical-VPLS (H-VPLS) can be an alternate solution. It can be used to divide the flooding into separate VPLS domains, also known as multi-domain VPLS, by splitting the load of a single domain into smaller ones.



The End-to-end PseudoWires attached with TDM, Ethernet, or IP payloads are transported inside the LSP/VPLS over MPLS-TP Tunnels from node to node with simple labelling. MPLS-TP is a cost-efficient packet transportation technology with standardized QoS, OAM, and protection. MPLS-TP services transports customer traffic via dedicated tunnels.

IP Routing transport Layer 3 in Loop Telecom equipment with Loop-OS.

This IP routing can use independent GE/10GE/100GE ports or VLAN virtual ports as VLAN routing. It can also use Virtual Routing and Forwarding (VRF) instances with IP overflow MPLS-TP Pseudowire/LSP with all services including MPLS-TP as OAM, protection, QoS, etc.

The IP routing can be use for access to split the data services in different domains or, as a WAN protocol of transport using Static Route, RIP v1/v2 of OSPF v2/v3 routing. The VRRP provides an easy redundancy of uplink particularly for the access of a large number of industrial devices RTU. The Protocol Independent Multicasting-Sparse Mode (PIM-SM) is a multicast routing protocol operating across WAN with sparsely distributed groups. It maintains bandwidth for geographically dispersed nodes network and reduces traffic by simultaneously delivering of single stream information to multiple node.

Loop Telecom PTN devices provide a flexibility with simultaneously support of Ethernet or IP access application and MPLS-TP, Carriere Ethernet L2.5 and IP L3 transport from/to the same nodes.

Rapid comparison of transport for industrial application and Mission Critical Communication

This comparison is based on Loop SDH, MPLS-TP devices and the general deployment of IP-MPLS solutions.

@@ But different hybrid IP/MPLS devices can provide better specifications for some lines.

	SDH/SONET	MPLS-TP	IP/MPLS @@
Determinist and predicable concept	Basic principle of transport	Yes thanks to Traffic Engineering Engine and Static selection of paths	Not possible because no static selection of paths
Strictly Connection Oriented	Yes: Circuit deployment A to Z	Yes : PW, LSP and Tunnel are deployed A to Z	Not easy to deploy
End to End Synchronization	SDH synchronise the transmission and carry independant PDH clocks	Networks synchronized by SyncE and PTP1588 timing Remote Synchronized over PW(TDM)	Centralized synchronisation PTP1588. No synchronization over PW
Equal bidirectional transit time	Yes by using SNCP or MSP	Yes over bidirectionnal LSP, with reduced time	No . Unidirectionnal LSP. No warranty on the difference of transit time
Static Circuit PDH and SDH	Yes PDH circuit over E1/T1 over SDH/SONET by NMS	Yes static L2 by NMS	No because IP forwarding or routing with unpredictable transport
Determinist protection	Yes selection of SDH nodes of the working and protection paths	Yes selection of LSR nodes of the working and protection paths	Automatic deployment w/o control
Transport of SCADA TDM and Packet based	Yes fully	Yes, with right mechanism of PW emulations of services	No control of mechanism
Protection recovery	< 50ms	<< 50ms	Cannot guarantee 50ms
High rate Ethernet E-Line	EoS fix rate limited by SDH frame	VPWS or VPLS limited by fixed CIR/PIR for each WAN	Dynamic optimisation of the BW available
High rate Ethernet E-LAN	EoS fix rate limited by node HW		
OAM	In-Band based on EOC channel for fiber section and mux/ demux	In-Band on PW, LSP or Tunnel end-to-end and per PHY section	Out-band

These PTN switches provide for OT and IT applications GE/10GE transport infrastructures using MPLS-TP, CE or IP routing over ring or mesh networks with determinist path, high level QoS.

Loop G7820 and G7860A are powerful 10GE Ethernet switches using MPLS-TP, Carrier Ethernet, or IP routing transport for deployment of many industrial and secured applications together with transport of video and IT applications. Additionally, the G7860A supports E1/T1, STM1-4/OC3-12 tributaries and make gateway these TDM circuit in PseudoWire Emulation End-to-End over MPLS network.



G7820: 10GE PTN Core, Aggregation Switch, 120Gbps MPLS-TP/Carrier Ethernet/IP Layer 3 Transport

G7820

Core, Aggregation switch, Metro, Enterprise, Data Center MPLS-TP / C.E. / IP L3

G7820-48T

- 8 GE/10GE SFP+, 48 FE/GE copper

G7820-24T

- 8 GE/10GE SFP+, 24 FE/GE SFP, 8 FE/GE copper with 4 POE+ ports

Layer 2, 2.5 switch, L3 router

- 120Gbps wire-speed bidir. switch
- Dual AC or DC redundant power
- See other Common Specification

The **G7820** is powerful switch available in two versions with 8 GE/10GE SFP+ and 48 FE/GE copper for model **G7820-48T** or 24 FE/GE SFP plus 8 copper 10/100/1000BaseT including 4 POE+ optional ports for model **G7820-24S**.

This device with up to 120Gbps Wire-Speed bi-directional switching capacity is used by the industries for OT, video and IT applications, or by data centers, enterprises and carriers for IT application. Thanks to its eight 10GE ports, the G7820 is used to build core and aggregation infrastructure, particularly in industries; it simultaneously supports MPLS-TP in Core and Carrier Ethernet (EPL, EVPL, ELAN, EVC, E-Tree, and EP-Tree defined in MEF) for access network organizations. Customers can deploy together IP L3 routing in access or transport using different GE/10GE port or over Virtual routing and forwarding (VRF) through VPWS/VPLS MPLS-TP with all his advantage of QoS and protection. A pair of G7820 with VRRP provides a solution, simple to deploy, to groom large number of Ethernet RTUs with uplink protection.



G7860A: 10GE PTN Concentration switch MPLS-TP/CE/IP TDM PseudoWire gateway for E1/T1, DS3, STM-n/OC-n

G7860A

Concentrator switch, Service Aggregation Device, Industries MPLS-TP / C.E./ IP L3

- 6 GE/10GE SFP+, 4 GE SFP, 0 or 16 E1/T1
- 2 modules for
- 8 GE SFP or 8 FE/GE RJ45 or
- 4 STM1 or 1 STM4 SFP
- 32 E1/T1 with SCSI or 6 DS3

PseudoWires Emulation PW

- E1, T1, FE1, FT1, DS3 VC11/12/4, TUn, VT-n/STS-n
- ACR or DCR
- CESoPSN, SAToP, MEF-8, CEP

Layer 2, 2.5 switch, L3 Prouter

- 85 GBps wire-speed bidir. switch
- Dual AC or DC redundant power
- Dual unit redundant stacking
- See other Common Specification

Common Specifications

Layer 2, 2.5 switch, L3 router

- VLAN, Q-in-Q, QoS
- SyncE GE/10GE ports,
- Option: IEEE1588v2, PTP slave, boundary, transparent clock,
- TOD and 1PPS interfaces
- OAM 802.1ag, Y.1731, 802.3ah

MPLS-TP

- Ethernet PW:VPWS, VPLS, H-VPLS,
- 1000 PW/LSP,

Carrier Ethernet

- E-Line/E-LAN/E-Tree/E-Access

IP L3 router, option

- Over port, VLAN or over VPLS/VPWS MPLS-TP with VRF
- Router: Static, RIPv1/2, OSPFv3
- VRRP, Multicast PIM-SM

Protection

- LSP 1+1/1:1 <50ms
- ELPS G.8031, ERPS G.8032
- RTSP/MPSP, IEEE 802.1w/1s

The **G7860A** is a 85Gbps Layer 2/2.5/3 switch. The mother board supports 6 GE/10GE SFP+, 4 GE SFP and 16 E1/T1 built-in ports. Two hot-swap plug-in slots scale up the capacity with additional 32 E1/T1, 1 or 4 STM-n/OC-n, 8 GE to support up 20 GE SFP or copper, 80 E1/T1, 12 DS3 or 2 STM4.

The chassis FAN or FANLESS can be powered with redundant AC or -48Vdc swap modules. Two chassis can be stacked to support four 10GE with redundant CPU and services.

The G7860A is use by industrial operator or industries, it supports simultaneously transporting MPLS-TP, C.E. and optional IP routing Layer 3 for access or transport over port/VLAN or MPLS-TP VPLS/VPWS.

The G7860A is also gateway for PDH and SDH/SONET circuits over PSN, with Circuit Emulation SAT/CES/CEP and Encapsulation technologies TDMoE, TDMoIP, and TDMoMPLS. The G7860A can groom FE1/FT1 in E1/T1 with CAS support and avoids the use of a DS0/n.64K DACS in TDM side. E1/T1 can be drop to PTN or to incoming STM/OC3 interfaces.

PseudoWire Emulation for transport TDM/PDH and SDH/SONET circuit.

TDM circuit PseudoWire Emulation End-to-End (PW or PWE3) as TDMoIP, TDMoE, TDMoMPLS-TP across Packet-Switched Networks include: Unframed or Framed TDM, bit streams for the CAS with Multi-frame, CRC control and CCS for ISDN E1/T1, and clock synchronization.

Packet networks are elastic but TDM links require high stability and low latency. PW emulation request the selection of an emulation protocol, size of packets and buffer size to limit jitter delay. Loop provides tools and OAM to control these parameters. PW latency is longer than SDH/SONET circuit, but thanks to new designs is reduced and PW over MPLS-TP can be shorter when crossing many nodes.

TDM PseudoWire emulation Protocols

SAToP (RFC 4553). emulation only for unframed interfaces E1, T1, E3, DS3; is simple to deploy.

CESoPSN (RFC 5086). emulation for framed n.64kbps service E1/T1 circuits only; is used by industry, SCADA, teleprotection, multiples applications to dispatch to different server or NTU.

MEF-8 or TDMoE design by MEF for framed service n.64kbps, E1, T1, DS1, E3 and DS3 over Ethernet.

CEP (RFC4842). This emulation transports only SDH/SONET VCn/TU-n/VT-n/STS-n interfaces.

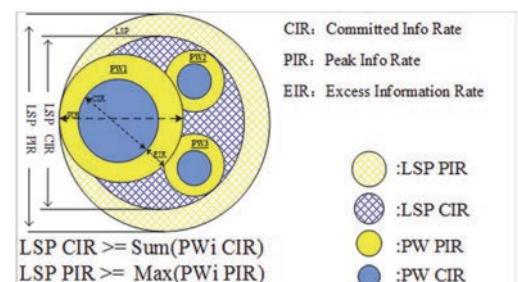
Traffic Engineering: Algorithms guarantee and optimize bandwidth per service

Traffic Engineering causes the QoS to control bandwidth of data flow with metering algorithms to re-shape rate fluctuations. This is achieved by applying buffers to accommodate burst traffic metering algorithms using Token Bucket, Single Rate/Two Rate Three Color (SRTC/TRTC) and Hierarchical QoS (H-QoS).

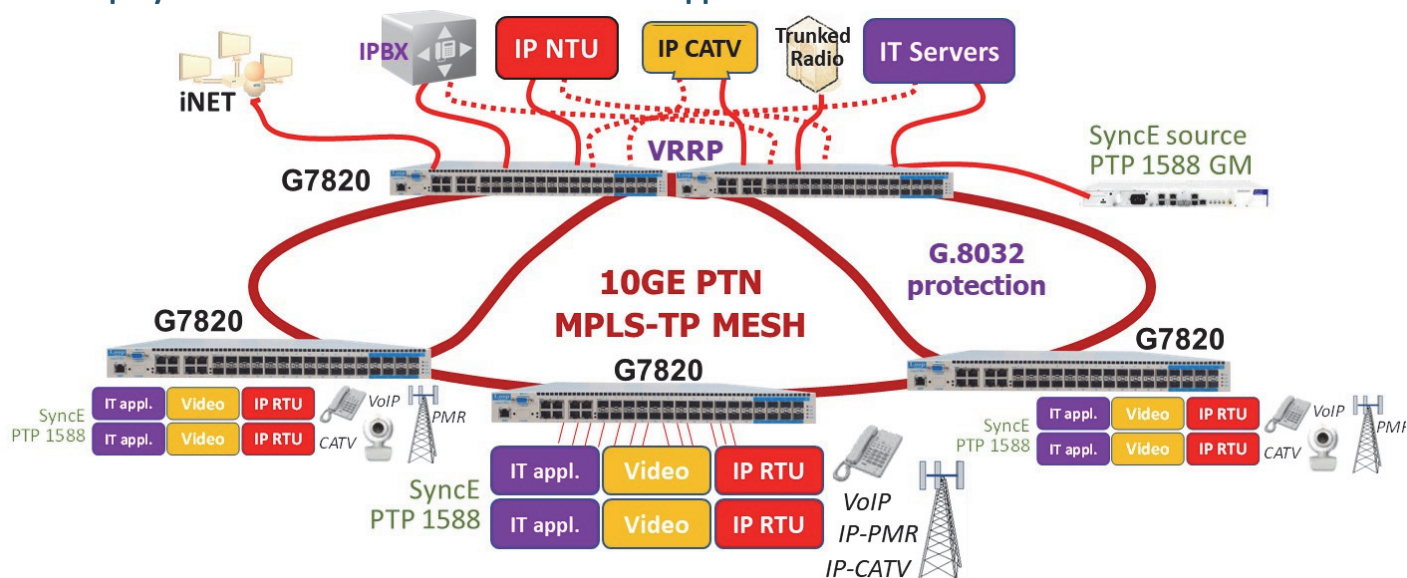
The administrator can define per PW Service, per LSP :

Traffic rate **CIR** (Committed Info. Rate Kbps/Mbps), **PIR** (Peak Info. Rate), moderate the traffic with **CBS** (Committed Burst Size) and **PBS** (Peak Burst). Ingress packets are marked with three colors according to whether and how much they exceed configured burst sizes. The algorithms regulate the LSP's traffic.

OAM PW, TDM PW and SDADA Ethernet PW transmission are guaranteed by CIR and the Tunnel BW is shared according PIR and Traffic Engineering algorithms .



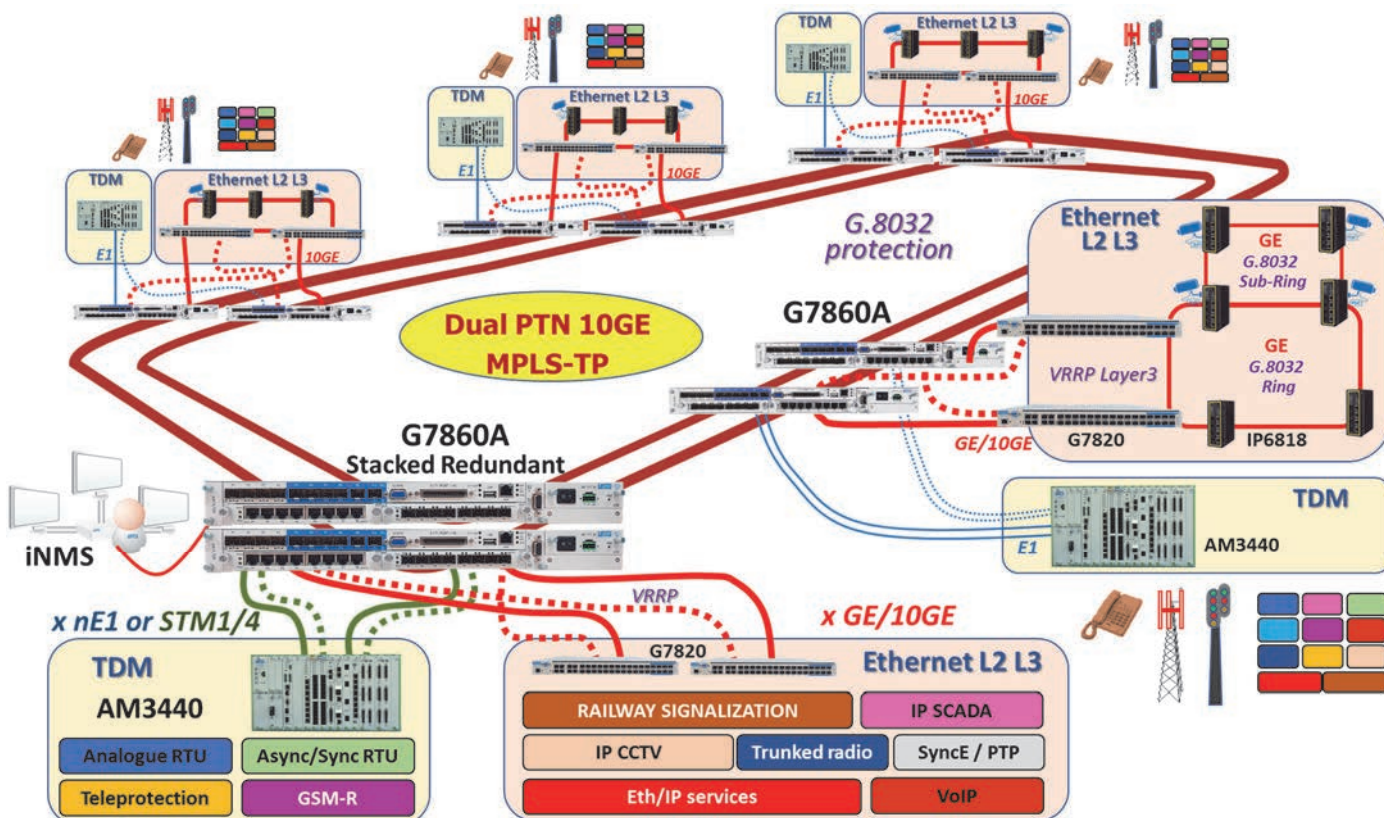
Core deployment in MPLS-TP for Industrial and IT applications



The deployment of G7820 for industrial network can save some CAPEX and OPEX cost. First, G7820 will be used to deploy a MPLS-TP Core transport network ring or Mesh with 10GE or aggregate $n \times 10GE$ pipe. Thanks to the number of FE/GE ports (copper or fiber depending on 24S or 48T model), G7820 can be used as an access switch supporting multiple ERPS v2 Ethernet rings, including sub-rings and with Carrier Ethernet structure of many devices. The IT applications can be routed at the access with VFR over MPLS-TP PW and the MPLS-TP will optimize the maximum bandwidth in the Core. Frequency synchronization is provided by SyncE with ESMC on Core and, the timing synchronization with the option PTP-1588v2 Ordinary/Boundary/Transparent with ToD and 1-pps outputs.

The deployment of these G7820 and Tunnel/LSP can be assisted by the iNET management system.

Network infrastructure for long distance Railway infrastructure



Railway companies are moving MCC applications from SDH to packet transport and IP/Ethernet applications are growing very fast. The G7860A MPLS-TP switch with E1/T1, STM1/4 access is a powerful economic solution to deploy telecom for Railway. Thanks to Traffic Engineering engine mechanisms it supports the low-rate SCADA and signalization together with highly variable data as video and IT applications.

Two G7860A can be stacked to support full redundancy of CPU, interfaces and provides two parallel 10GE rings networks along the railway line. It can perform the multiplexing and grooming of DSO and it can cross-connect local E1/T1 in STM-n/OC-n interfaces.

O9400R & O9500R SDH/SONET systems with PTN10G switch card support the PTN MPLS-TP transport networks together with TDM transport and the Multiservice DS0/n.64k Access.

PTN10G

PTN Switch card for backbone MPLS-TP, Carrier Ethernet 2.0*
With 2 redundant cards:

- 6 GE/10GE SFP+, 16 GE SFP
- 2.5G TDM/SDH backplane
- PseudoWires Emulation**
- E1, T1, FE1, FT1, VCxx, TUn, VT-n/STS-n
- ACR or DCR
- PW/LSP, SAToP, CESoPSN, MEF-8 (CESoEth), CEP
- VPWS, VPLS, H-VPLS for Ethernet services
- Layer 2 switch, L3 router**
- 100GB switch
- E-Line/E-LAN/E-Tree
- VLAN, Q-in-Q, QoS
- SyncE GE/10GE ports,
- IEEE1588v2 slave, boundary transparent clock, Stratum 3
- OAM 802.1ag, Y.1731, 802.3ah
- IP Router over GE/10GE or VLAN or over MPLS-TP VPLS/VPWS
- Router: Static, RIP v1/2, OSPF v1/2, VRRP, PIM-SM

Protection

- LSP 1+1/1:1 <50ms, and LSP replacement
- ELPS G.8031, ERPS G.8032
- RTSP/MPSP, IEEE 802.1w/1s



O9400R SDH/SONET ADM/TM / Cross-Connect

2 STM16/OC48 rings and 8 slots for PTN10G, STM1/4/16, OC3/12/48, E1/T1, E3/T3, FE/GE EoS
Circuit Protection MSP, SNCP, SNCP-MESH, MS-SPRing



O9500R SDH/SONET/PDH ADM/TM/Cross-Connect/DACS

2 STM16/OC48 ring, 2 sl. for PTN10G, STM1/4/16, OC3/12/48, E1/T1, E3/DS3 with MSP, SNCP-MESH protection and
6 sl. for Multiservice PDH: voice FXO, FXS, E&M..., data RSxxx, V35, X21...
Teleprotection, contact...

The O9400R and O9500R are powerful SDH/SONET Multiplexers with multiple STM16/OC48 rings. Thanks to PTN10G switch cards they support together TDM networks and PTN with MPLS-TP or Carrier Ethernet networks. They run together and bridge both architectures, permit a smooth migration of circuits over packet with high determinism and mix transport protection.

They guarantee conventional TDM deployment and 10GE dynamic bandwidth.

Protection of TDM services, of Packet traffic and infrastructure:

The PTN10G, G7860A, G7820 use multiple process to guarantee the protection of transport:

- The OAM at the level of Ethernet interfaces, LSP and PW track the availability of network and its bandwidth by section and End-to-end over different tunnels.
 - The LSP protection of the tunnel guarantees the end to end transport of PW, VPWS and VPLS.
 - The PW protection guaranty the emulation end-to-end of the service/application.
- Globally, for the deployment of MPLS-TP, the OAM provides monitoring of infrastructure. In order to serve mandatory/standard services, the protection is applied to the PW(TDM) and/or to the LSP, by tunnels implementation with automatic protection schemes.

Operation Administration Maintenance can be set from simple to sophisticated

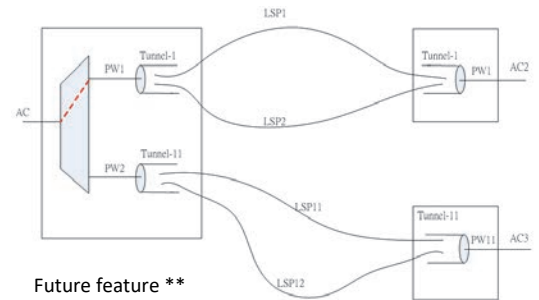
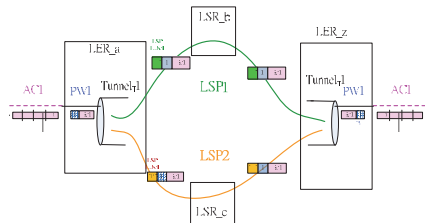
The OAM on PTN Ethernet structure is covered by the section (EFM) IEEE 802.1af, on their connectivity (CFM) IEEE 802.1ag and end-to-end with ITU-T Y.1731 with Fault and Performance Management over simple or multiple provider domain.

The MPLS-TP OAM ITU G.8113.2 enables service continuity and performance monitoring per LSP and PW by addition of OAM-LSP, OAM-PW with Bidirectional Forwarding Detection, AIS, Link Down Indication, Route Trace, Packet Loss Measurement and Delay Measurement... all are available for statistics or for iNET/iNMS system.

Protection: Hardware, MPLS LSP and PW

With two PTN10G, internal PTN switches are redundant independently of GE, 10GE ports and 2.5 SDH PW access. The full system O9400R/O9500R are redundant with CPU, Power supply and tributaries.

The MPLS-TP protection 1+1 or 1:1 for LSP in Tunnel recover in less than 50ms. The PW and VPLS protection can support AC to AC1/AC2 services over 4 LSP.



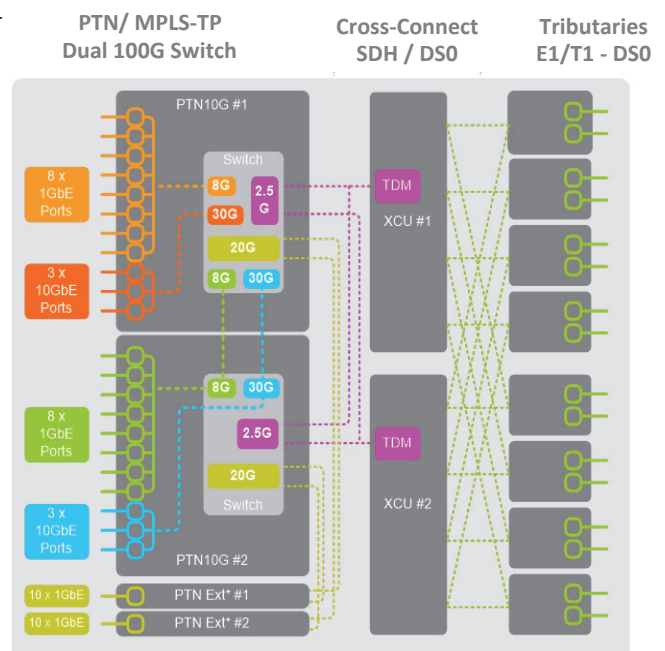
The O9500R-PTN, a powerful hybrid node with Multiservice PDH, SDH/SONET transport and 100GB MPLS-TP/CE switch

The O9500R full redundant node with multiple functions running in this node:

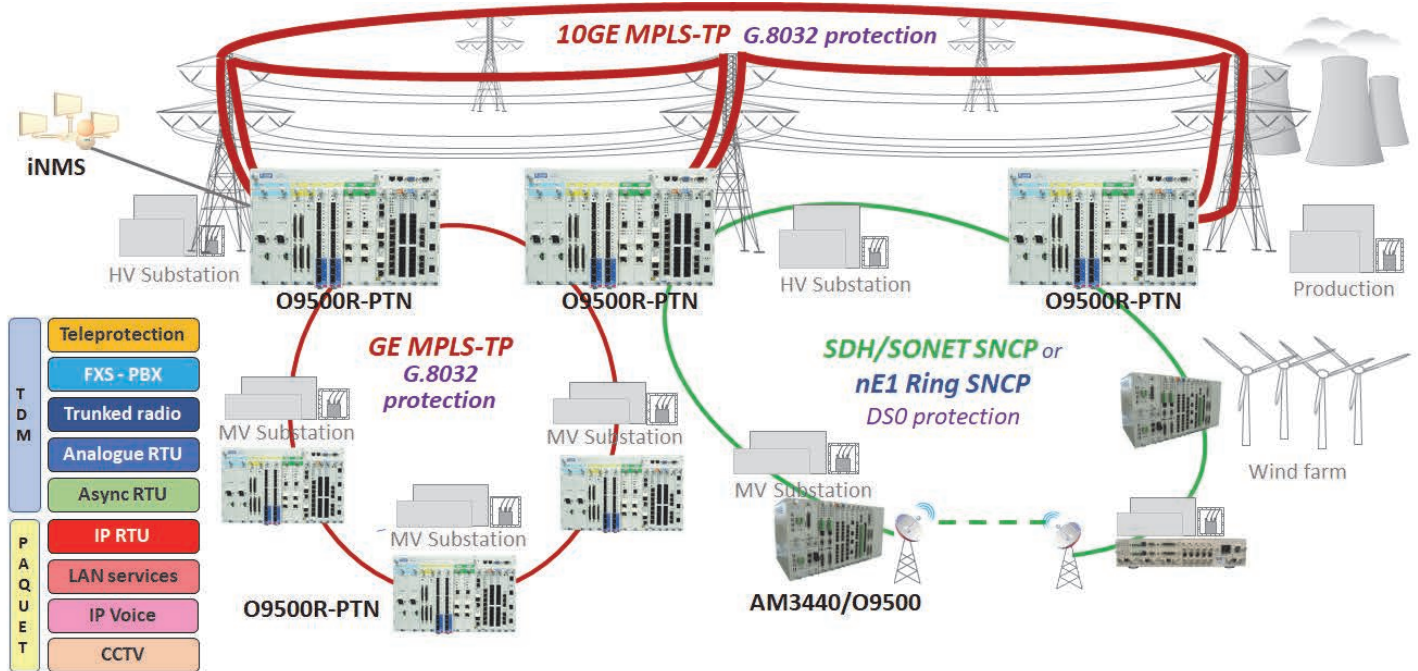
- **SDH/SONET ADM/TM** multiplexer with dual STM16/OC48 SNCP aggregate rings, multiple STM1/4, E1/T1, E3/T3, EoS tributaries
- **TDM/PDH Multiservice** multiplexer with 6 PDH DS0/n64K cards for voice, serial, contact, teleprotection, EoPDH...
- **PseudoWire Gateway** for TDM and SDH/SONET circuits to MPLS-TP or CE
- **100GB PTN switch**, up 6x10GE, 16xGE, optional 2x10XGE under MPLS-TP or Carrier Ethernet.

O9500R-PTN simultaneously processes MPLS-TP backbone, CE access, SDH infrastructure, multiservice access/ADM, and network interconnections over PW.

O9500R-PTN is also a key equipment to organize an easy migration from the conventional PDH/SDH/SONET to Packet for applications and transport.



MPLS-TP Loop Telecom solutions for Critical Communication in Power transport



New power grid infrastructures require large amounts of packet communication transport. But even if reduced, TDM multiservice will continue existing for a long time to carry conventional SCADA and teleprotection for power distribution management. In addition, SCADA is shifting towards low-rate Ethernet compliant to IEC61850 protocols.

All these technical applications require a very stable bandwidth, low latency with high level of security of transport.

Loop Telecom PTN MPLS-TP hybrid systems are the key solution of those Power National and Distribution grid telecom infrastructures.

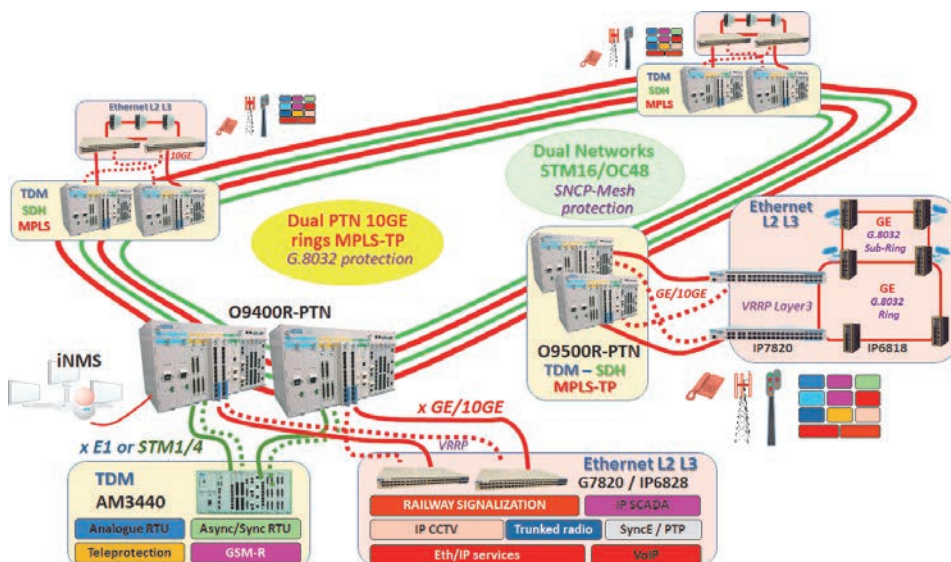
- We use GE or 10GE fiber to carry the mix traffics in Mesh infrastructure with large bandwidth and high security transport
- We provide Multiservice Access for SCADA, teleprotection, voice RTU/analog/VoIP, data sync/async... as integrated in the MPLS-TP machine with O9500R-PTN or as two chassis with O9400R-PTN and AM3440 DACS,
- We guarantee for TDM/Legacy and IP/Ethernet low rate SCADA... with fixed bandwidth and lower latency when connecting many nodes,
- We support together MPLS-TP backbone and SDH/SONET or E1/T1 ring network for smooth migration.
- iNET-EMS or iNMS-NMS manage and create end to end TDM circuit over TDM, MPLS-TP together with VPWS/VPLS Ethernet distribution.

Critical communications for Transportation/Mobility, Power, Oil and Gas, Chemical complex, sometimes request to work in parallel TDM/SDH/SONET and MPLS-TP

O9400R-PTN/O9500R-PTN run together 10GE networks and STM16/OC48 networks

Different users look to maintain conventional transport infrastructure together with the deployment of large Packet backbones because of maintaining zones without migration or existing engineering rule or certainly the need of time to migrate special applications.

Thanks to their dual processors (one for TDM/SDH/SONET/PDH and one for PTN MPLS-TP switch), each with a redundant CPU and matrix, we can simultaneously provide both transport infrastructures and also Multiservice and IP/Ethernet access.



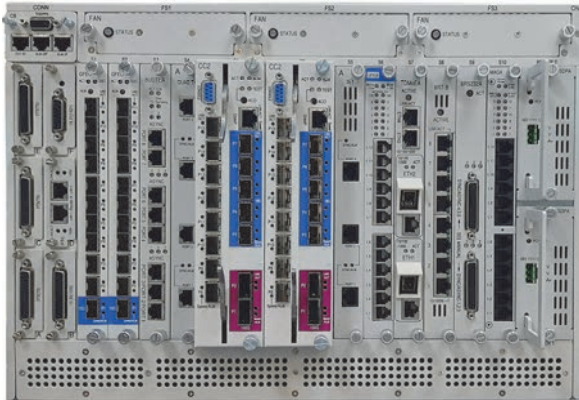
O9400R-PTN and O9500R-PTN support:

- SDH/SONET ADM/TM STM16/OC48,
- MPLS-TP/CE/IP L3 100MB Switch,
- Multiservice PDH DCS DSO/DACS,
- Full Redundant components,
- A-to-Z circuits over TDM and PVoMPLS-TP,
- Ethernet over CE then MPLS-TP VPWS/VPLS,
- MPLS-TP/CE ERPS G.8032 protection and
- SDH/SONET MSP, SNCP, MS-Spring, dual homing protection,
- Migration per circuit from TDM transport to
- Packet PW or to native Packet applications,
- Circuit over VCxx protected by PVoMPLS,
- Single NMS for all functions of TDM and Packet networks by iNET or iNMS with the conception of network as TDM organization,
- Single system for multiple function nodes to reduce OPEX cost,
- and more

Loop Telecom G7800 is a new evolutive platform MPLS-TP, CE and IP L3, Switch/Router. The first version is based on redundant 400Gbps Switch and supports Multiservice PDH, SDH access and IT transport.

Loop Telecom adds to existing PTN solutions for MCC a Core Network deployment for IT/OT requested by industrial customers, one with a high volume of data transport capacity. The new G7800 switch supports 40GE/100GE with up to thirty 10GE interfaces with MacSec encryption which can:

- build a secure Core Network MPLS-TP or IP L3,
- deploy Access nodes with SDH/SONET interfaces and Multiservice DCS/DACS.



Powerful Switch and evolutive PTN/TDM Node

The **G7800** is a fully modular and fully redundant system. The first version (available end of 2023) is equipped with 2 CC2 cards. Each card includes the CPU of the system and 400Gbps Ethernet switch with redundancy. The **G7800** will support in the future CCx switch over Tbps switching capacity.

The system includes a tributary backplane of four GE/10GE slots, six GE slots and six 4 E1 mini-slots. All slots support low rate PDH AM3440 interfaces. GE and 10G slot can support Ethernet and SDH/SONET interfaces.

The system includes the PseudoWire emulation/encapsulation over MPLS of E1/T1/DS3, n 64K and SDH/SONET interfaces. The **G7800** carries this TDM traffic in PW over Packet protocol (MPLS-TP) and guarantees short and stable latency, as well as protection and determinist paths thanks to its Traffic Engineering engine and OAM at PW, LSP, and PHY levels.

G7800*

MPLS-TP/CE/IP L3 Switch
TDM/PDH Multiplexer DACS
SDH/SONET Access TM

- 7U 19" modular system
- CC2 400Mbps switch
- -20 to +55°C

Interfaces up to :

- 2 x 100/40GE
- 30 x 10GE/GE
- 56 x GE/FE
- 100 x FE Copper or POE+
- 320 x E1/T1
- 160 x DS3
- 68 x STM1/OC3
- 34 x STM4/OC12
- 8 x STM16/OC48

PDH cross connect with

- FXO, FXS, E&M, Magneto, Conf.
- RS232/422/485, V35, X21, C37.94, G703 CD, contact, TTA,
- EoPDH, Terminal server

TDM PseudoWire gateway

- 4096 PW TDMoMPLS, TDMoE
- SAToP, CESoP, MEF-8, CEP
- ACR/DCR Clock Recovery

L2.5 MPLS-TP

- Bidirectional LSP, static prov.
- Ethernet : VPWS, VPLS, H-VPLS
- Protection LSP 1+1/1:1, PW
- MPLS-TP OAM & QoS

L2.5 Carrier Ethernet CE2.0*

- EPL, EVPL, EP-LAN, EPV-Lan, EP-Tree, E-Access, EPVL-Access
- ERPS G.8032, ELPS G.8031

L3 IP routing for IT

- Over physical port, VLAN or over MPLS-TP LSP with VFR
- Static Route, RIPv1/v2, OSPFv3
- VRRP, IGMP v2/v3, PIM-SM
- EPL, EVPL, EP-LAN, EPV-Lan, EP-Tree, E-Access, EPVL-Access

Encryption

- Management SNMPv3, IPsec
- Data ports: MacSec 256

*/** in development or qualification, please contact us

G7800 Core MPLS-TP System of Mission Critical communication

The full redundant PTN **G7800** system can be used as 100GE Core system Network used for Mission Critical Communication to carry highly secure low-rate information and a high volume of data.

High number of interfaces:

With two Switch/CPU CC2 the G7800 supports 2 x 40/100GE NNI and multiple NNI/UNI interfaces. These two 400Gbps non-blocking redundant CC2 switches support 12 x GE/10GE and 16 x FE/GE and with extension cards the system supports up to 30 x 10GE, 50 x GE/FE and 100FE Copper or POE+. All interfaces MPLS-TP, CE or L3 IP routing, together but in different interfaces.

Encrypted communication:

The management communication to iNET/iNMS is encrypted by SNMP v3, and over management port or VLAN the communication in Bridge mode or OSPF is encrypted with IPsec EAS-256 protocol.

The G7800 will encrypt each 100GE/10GE/GE interfaces per Link Security MacSec AES-256 according to IEEE802.1AE, per Service Security LSPsec** and per Domain Security: IPsec**. Node-to-node MacSec will encrypt data of all interfaces, will not request additional bandwidth, and will not add latency for MCC.

G7800 Evolutive node MPLS-TP/CE, Multiservice DACS/DCS and SDH Access

Industrial infrastructures change more rapidly than access applications. The industries can run simultaneously with old and new infrastructures to secure and spread migration time.

Multiservice TDM/PDH node, native TDM cross-connect of 128 E1/T1 at DS0 level:

All tributaries slots can support the AM3440 analogue voice, VoIP, serial, FOM, synchronous, contact, teleprotection, Ethernet-over-E1 cards with local interconnection and emulation to the network in TDMoMPLS with CES or SAT emulation. The network provides a transport C37.94 to C37.94 lower than 1ms over MPLS-TP.

Access SDH/SONET STM1/4/16 - OC3/12/48:

The G7800 supports the connection to SDH/SONET synchronous networks over up to 8 STM16, 34 STM4 and 68 STM1 with MSP protection. The G7800 MPLS-TP can interconnect two SDH/SONET networks and transport the VCxx over PseudoWire with CEP emulation, or can convert the SDH/SONET traffic to MPLS-TP/CE by conversion of TDM in SDH/SONET VC11/VC12 to TDM PseudoWire with CES

G7800 Transport of Ethernet

Different Ethernet transport are used in industrial networks because of hardware and applications:

Ethernet over MPLS-TP:

According to page 3 definition, Ethernet traffic transport over MPLS-TP is done over PW point to point VPWS, multipoint VPLS or when there are too many VPLS instances with H-VPLS (Hierarchical-VPLS).

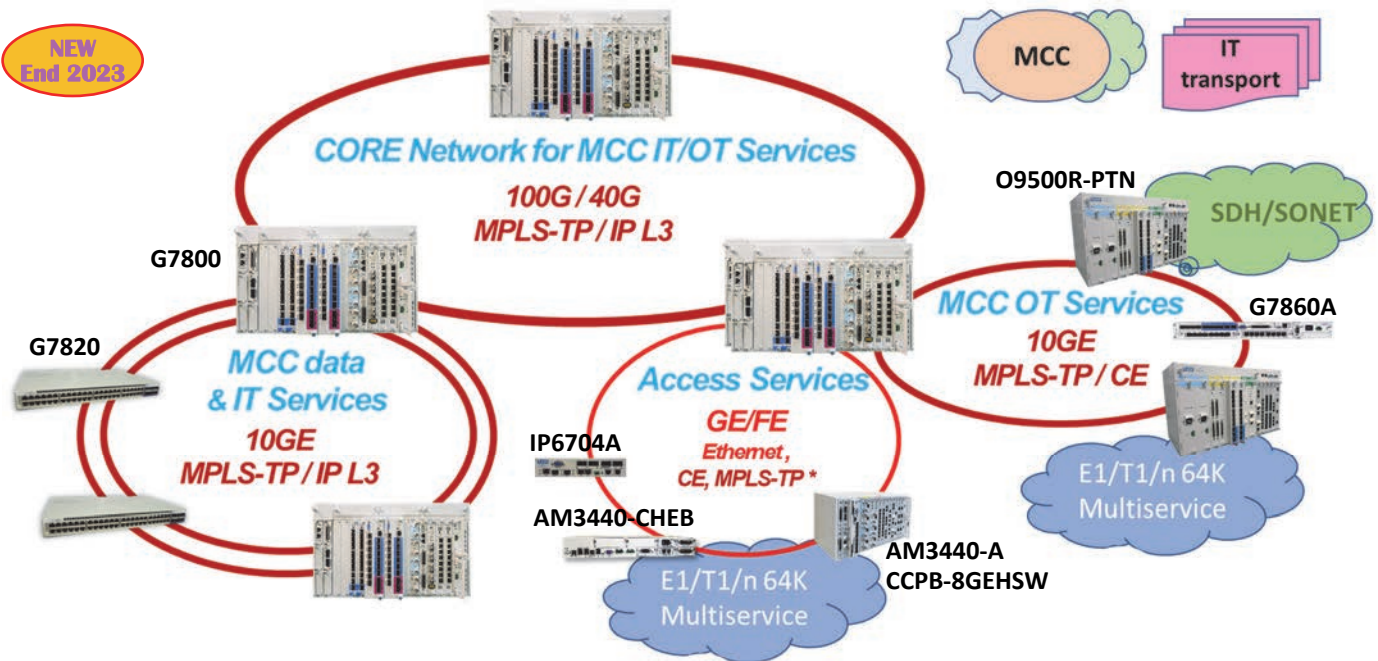
Ethernet over EoSDH/SONET:

The EoS traffic coming from SDH/SONET interfaces can be carried to other SDH/SONET interfaces as CEP VCxx PseudoWire or converted by the G7800-EOS-G card from EoS to Ethernet and over MLS-TP.

Ethernet over E1/T1/PDH:

This Ethernet traffic n x 64K, E1/T1 or n x E1 use for low rate stable application in PDH network can be created by RTA/RTB to other PDH nodes or transported over TDMoMPLS PW CES or SAT.

Loop-G7800: a modular system for Core Network MCC and IT services or for dedicated services OT or IT

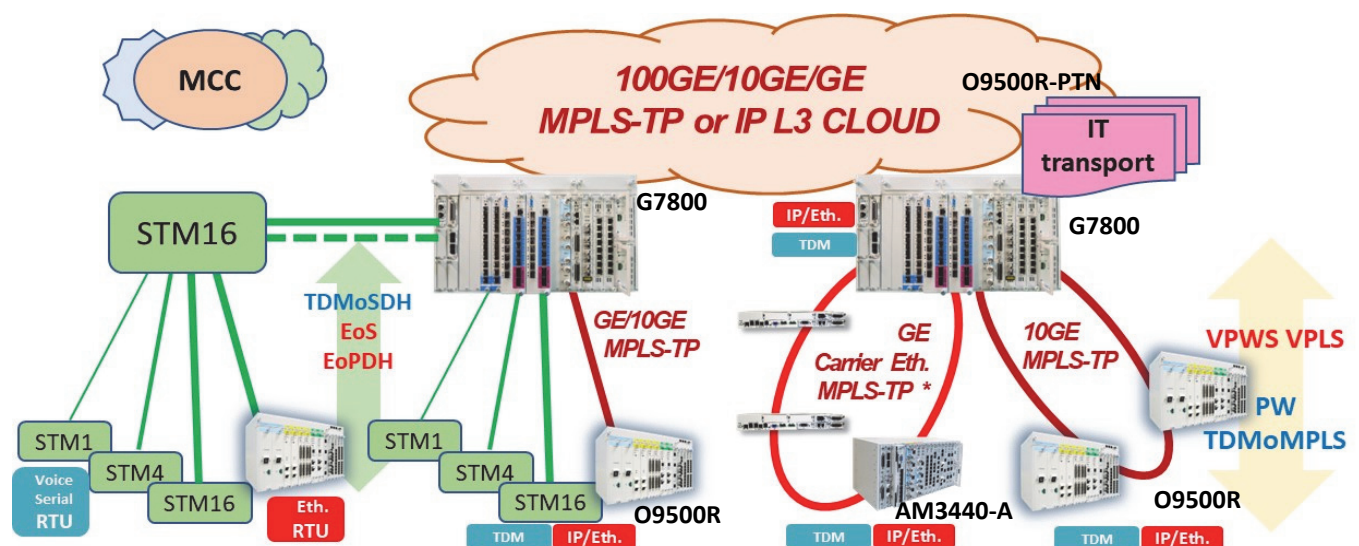


Thanks to the modularity of the **Loop-G7800** and the 400Gbps switch CC2, this equipment can be configured for many applications together or per network application. The 40/100GE interfaces, up to 30 x 10GE interfaces with MacSec encryption make this device as node of Core transport infrastructure for MCC IT/OT. To increase the IT performances the IP L3 routing over MPLS-TP PW with his protections and OAM or over dedicate ports integrate the G7800 network in the global IP Network.

Such a solution makes simple the deployment of pure IT/Data/Video network and MCC or precise Access networks over an unique Core Network.

The **Loop-iNET EMS** or **Loop-iNMS NMS** assists operator in the deployment of OT and IT applications over Tunnel/LSP and VPWS, VPLS or H-VPLS with Traffic Engineering Engine. This makes simple to operate and easy to monitor the full network for multiple missions.

Loop-G7800: Migration of SDH/SONET infrastructure to large MPLS-TP for OT MCC and add IT transport



Because of the capability to use each slot for n x 64K Multiservice, with a 128 E1/T1 cross-connect for TDM and TDM-PseudoWire interfaces, and high number of SDH/SONET tributaries with VCxx conversion to direct TDMoMPLS-TP or to CEP(VCxx)oMPLS-TP make the G7800 as a powerful reconfigurable Multiservice access and migration node.

The system will give to customer the possibility to migrate all OT services TDM/Synchronous/Voice over packet, and the legacy interfaces to Ethernet with high QoS, latency control, low bidirectional transit time difference... At the same time customer can add high Ethernet or IP volume for pure IT application without disturbing the OT services.

The **Loop-iNET EMS** or **Loop-iNMS NMS** assists operator in the deployment of all services OT with Multiservice interfaces (voice, serial...) and Ethernet and all the transport over E1/T1, SDH/SONET, their packet conversion and MPLS-TP or CE or IP L3 transport.

Multiservice TDM multiplexer are now build with Ethernet uplink and support MPLS-TP* CE or IPL3 transport in small network or to access Core.



AM3440-E-CHEB Multiservice TDM Multiplexer

- Cross-connect 6 slots 4 E1/T1 + 64 PW(E1/T1), n x 64K, DSO
 - 6 hot swap. modules: E1/T1, X21, RS232/V24, V35, C37.94, G703 CD, E&M, FXO, FXS, contact
 - 1U, 2 redundant power s. AC or DC
- PseudoWire Gateway**
- 64 PWE3 n.64kbp or 2Mbps
 - SAToP, CESoPSN, MEF-8
 - ACR Clock Recovery
- Layer 2/2.5/3 Switch 10Gbps**
- 4 GE SFP, 4 FE/GE SFP
 - Protocols same CCPB-8GEHSW



AM3440-A-CHPA w. CCPB-8GEHSW Multiservice TDM Multiplexer

- Cross-connect 16 slots 4 E1/T1 + 64 PW(E1/T1), n x 64K, DSO
 - Hot swap. modules: E1/T1, G704 CAS, copper/fiber, FXO, FXS, E&M, Magneto, RS232/422/485, V35, X21, EIA530, C37.94, G703 CD, contact...
 - EoPDH, Terminal server
- PseudoWire gateway**
- 64 PWE3 n.64kbp or 2Mbps
 - SAToP, CESoPSN, MEF-8
 - ACR Clock Recovery,
- Layer 2/3* Switch 32Gbps**
- CCPB-8GEHSW 2 cards redundant switch/CPU, per chassis:
 - 2 x 4 GE SFP, 4 FE/GE SFP SyncE
 - 2 cards 8 FE/GE copper or SFP
- Carrier Ethernet*:**
- VLAN, Q-in-Q
 - EPL, EVPL, EPLAN, EVPLAN, E-Tree services by MEF 9 & 14
- MPLS-TP*:**
- Eth. PW VPWS, VPLS, H-VPLS
 - LSP 1+1/1:1, dual-homing PW protection <50ms
- IP L3 routing**:**
- Over GE or VPWS/VPLS
 - Static, RIP v1/v2, OSPF v2/v3



IP6704A Multiservice TDMoE Gateway, L2 switch

- 2 x FE/GE SFP, 2 x FE/GE copper
- 2 x E1/T1, 2 modules 4 E1/T1, serial, C37.94, G703, E&M, FXO/FXS
- 16 PW, 4 with ACR
- SAToP, CESoPSN, MEF-8

Loop Telecom produces popular Access Devices for E1/T1, Multiservice applications. Now these multiplexers integrate Gateway to TDM PseudoWire over Ethernet, IP or MPLS-TP* and can replace STM-1/4 - OC3/12 interconnection or network by GE network with same level of Latency, QoS, protection plus more IP/Ethernet traffic. These devices facilitate the migration of legacy, old interfaces to packet transport over existing aggregation/core networks CE, MPLS-TP or IP/MPLS from Loop or other vendor. The deployment of these access gateway can be managed by iNET or iNMS system which provide TDM to PWOEthernet, PWO MPLS-TP to TDM setting independently of core network management.

Multiservice TDM and Gateway to Ethernet, IP and MPLS-TP

The challenge of TDM migration to Packet transport is to track independently each application because of the constraints generate by each voice/serial data/teleprotection end-terminals as the interfaces, the latency, burst... the but also to keep a solution easy to manage and to optimize the PW, Tunnel and to minimize the bandwidth.

Our gateways include a full access TDM multiplexer device with full electrical, timing, noise control, E1/T1, FXS, E&M... RS232...C37.94, with DACS cross-connect and grooming of interfaces in FE1/E1-CAS per destination before the conversion to packet.

The IP6704A or AM3440-CHPA/CCPB emulate these circuit in PW toward up to 16 or 64 directions over IP/Ethernet network or linked to MPLS-TP cloud.

Then the circuit will be established from analog/serial/... interface to TDM to PWOEth to PWO MPLS-TP and back to same interface at the other end. They are using the Emulation CEsoPSN or MEF-8 (TDMoE) for framed application circuits and SAToP for unframe E1/T1 circuits.

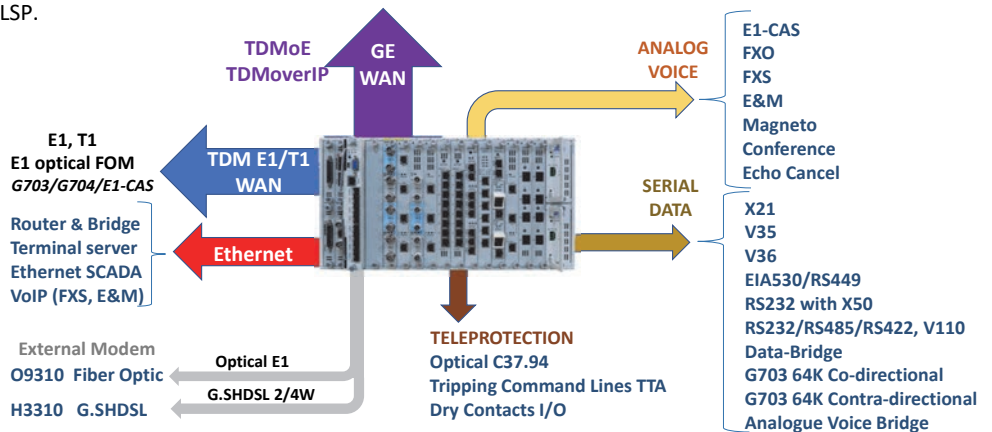
TDM frequency synchronization can be transfer from one node with ACR mechanism or by using SyncE from concentration level.

AM3440-E or AM3440-A/C/D with CHPA high density multiservice gateway

The AM3440-series are a very complete range of DCS DSO/DACS multiservice multiplexer. It can be used as PDH node of a E1/T1 network or terminal access for analog, serial and Ethernet applications. This modular system is available with 3 models AM3440-A/C/D using 2 CPUs, up to 64 E1/FE1 backplane/tributaries, and the AM3440-E is a 1U compact system.

CPUs are available in version CCPB-DCS as pure cross-connect multiplexer, version CCPB-2GE add a TDMoE gateway with 2 GE combo and version CCPB-8GEHSW add a switch to support 16 GE plus 2 8GE* future card with support of PTN Carrier Ethernet, in future MPLS-TP and IP L3 router.

CCPB-2GE/8GHSW are PseudoWire gateway which supports 64 PW with PW protection over Ethernet or over LSP.



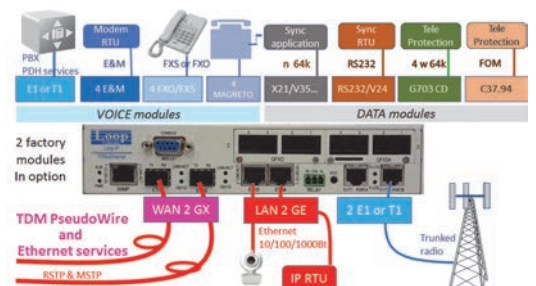
IP6704A compact gateway from Multiservice to PseudoWire for substation

This modular device includes :

A **Multiservice access multiplexer** with optional cross-connect for voice band E1, T1, E&M, FXS, FXO, Magneto interfaces and synchronous data n x 64K/2Mbps, codirectional, C37.94...

A **PseudoWire gateway** that emulates TDM services to PWE3 over Ethernet or IP networks,

A **Layer2 switch** with 4 FE/GE, 2 SFP and 2 copper as WAN or LAN. Thanks to support of VLAN, Q-in-Q, OoS and CoS and flow control of Ethernet traffic its optimize the PWE3 over the WAN.



*/**in development or qualification, please contact us

Power industry : Replacement of infrastructure STM1/4 by GE and deployment of IEC61850 substations

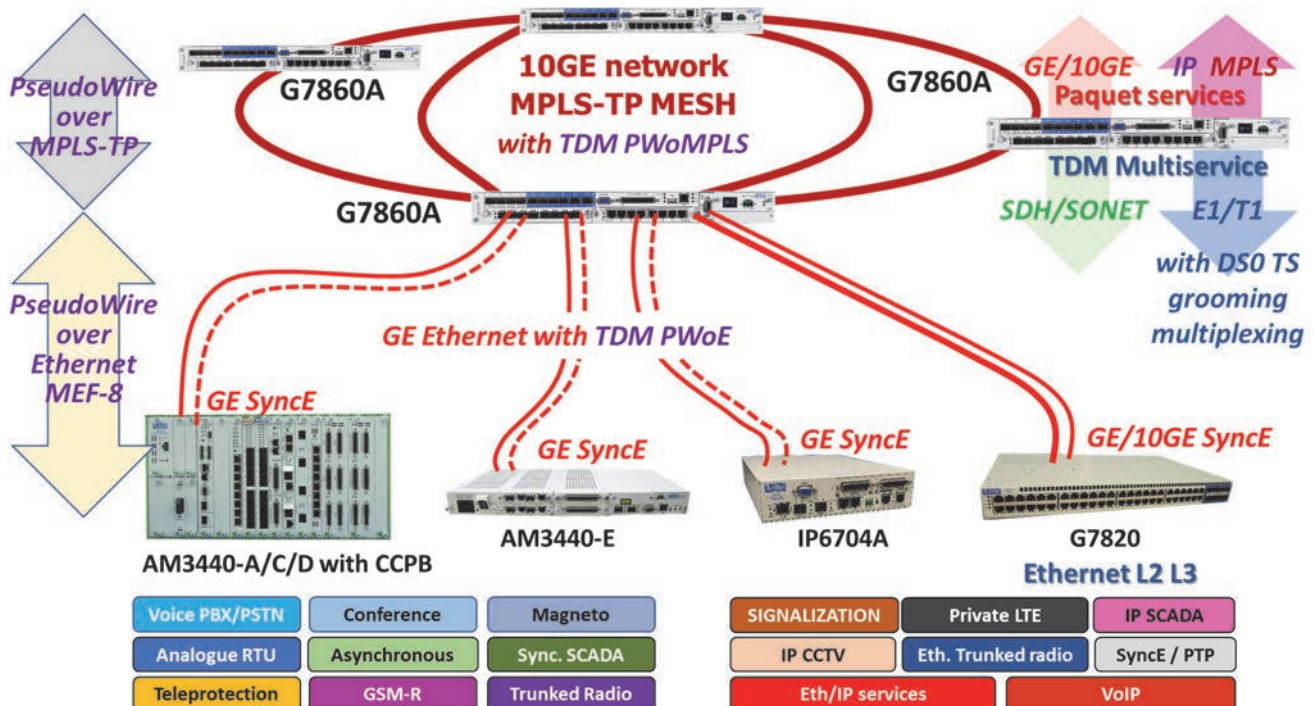


The Power Industry is very cautious on the critical communication particularly for the communication between Teleprotection devices and Phase Measurement Units. The long distance legacy communication between power substation was based on SDH/SONET that generally warranty less than 1.5ms of transit time between two nearest substation. Thanks to the AM3440 series installation with TDMoE PseudoWire emulation this transit time can be 1ms or less and cross many nodes with few ns increase and satisfy to the life of teleprotection. This industry is changing all elements of substation as measuring, relay, telecommand... from serial, analogue to pure Layer 2 Ethernet devices with a small messages exchange as GOOSE and a real strategy of deployment and protection named IEC61850.

The **AM3440-E-CHEB** (1U) or **AM3440-A-CHPA** (5U) with **CCPB-8GEHSW** switch are Multiservice cross-connect to support local TDM network, with Gateway to encapsulate/emulate these service in packet and with performant Gigabit Ethernet switches of 8 or up to 32 GE with SyncE WAN and Carrier Ethernet transport protocol, in the future MPLS-TP, to organize the transport of mandatory stable PW for TDM/ SCADA Ethernet and to optimize the IP/Ethernet traffic with CIR/PIR and TRTC (2 Rates 3 colors) QoS.

Such Gigabit Ethernet solution can replace with success STM1/4 SDH transport and provide an efficient communication between substation with SyncE frequency synchronization and PTP 1588v2 timing support.

Migration of Multi-Services TDM applications to packet transport



For large infrastructure with many existing TDM/PDH nodes it could be easier or more cost effective to deploy a mixed infrastructure with a PseudoWire Emulation from the edge device over Ethernet or IP using the existing links toward the MLPS-TP concentrator and then carry the PseudoWire over MPLS-TP. The existing AM3440 multiplexer can be upgraded by the exchange of standard CPU CCA/CCB by the combined CPU + PW Gateway CHPA. For small nodes use IP6704A or AM3440-E.

In future, the AM3440-E/CCPA will be upgradable with GE MPLS-TP switch to build MPLS-TP tunnels from TDM EDGE.

Models	AM3440-CHEB	AM3440-CHPA + 8GEHSW	O9400R-CHPA + PTN10G	O9500R-CHPA+ PTN10G
Functions	GE Ethernet Switch MPLS-TP*/CE/L3 IP*	GE Ethernet Switch MPLS-TP*/CE/L3 IP*	GE/10GE Ethernet Switch card MPLS-TP/CE/L3 IP	
	-	-	SDH/SONET ADM/TM with Cross-connect VC-xx	
	PDH DCS/DACS multiplexer	PDH DCS/DACS multiplexer		PDH DCS/DACS multiplexer
System	Fix 1U 19"	Modular 5U 19"	Modular 6U 19"	Modular 6U 19"
		Main fix + 2 slots	4 Slots MPLS-TP + 6 sl. SDH trib	4sl MPLS-TP + 2 sl. SDH + 6 sl. PDH DS0
	1 CPU	2 redundant CPU (CCPB-8GEHSW)	2 redundant CPUs (CCPA) and 2 redundant PTN MPLS-TP (PTN10G) switch cards	
	1 or 2 AC or 2 DC 48v	2 DC48v redundant	2 AC or 2 DC48v redundant power	2 DC48v redundant power supplies
	Loop-OS		Loop-OS on PTN10G	
PTN Packet Transport Network	Switch support MPLS-TP, Carrier Ethernet CE2.0*, IP L3 Routing			
Fix GE/10GE SFP+	-	-	2 x 3 GE/10GE NNI/UNI	
Fix or modules Ethernet	Fix 4 GE SFP and 4 FE/GE SFP	2 x (4 GE SFP + 4 FE/GE) SFP	2 x 8 GE SFP NNI/UNI	
		2 Modules= 8 FE/GE or 8 FE/ GE SFP	Cards = PTNExt : 10 GE NNI/UNI MPLS-TP/CE SFP EoS cards: 8 FE/GE (4 SFP+ 4 copper RJ45) in SDH/SONET side	
Switching capacity	10 Gbps	32 Gbps	100 Gbps	
MPLS-TP L2.5				
TDM Emulation	PseudoWire Emulation End-to-End PWE3 in CESoPS and SAToP over LSP PseudoWire Emulation End-to-End PWE3 in CESoPS and SAToP over LSP			
MPLS-TP transport	VPWS, VPLS or H-VPLS Bridging, 2K VPLS instance per node *		WPWS, VPLS or H-VPLS Bridging, 2K VPLS instance per node	
OAM	Section/LSP/PW TP-OAM using BFD (Per IEEE 8113.2)			
Protection	ITU: ERPS (G.8032) - RFP : RSTP (802.3) , MSTP (802.3) all <50ms. MPLS-TP: LSP 1+1 and 1:1 (RFC6378)			
L3 IP Routing	Over Ethernet GE/10GE or VLAN ports or over MPLS-TP PW : VPWS/VPLS			
Ethernet L3 transport	L3 Router*: Static, RIP, OSPF v2/v3, VRRP, PIM-DM		L3 Router: Static, RIP, OSPF v2/v3, VRRP, PIM-DM	
SDH/SONET	-		ADM, TM, cross-connect node : STM1/4/16 or OC3/12/48	
Capacity			2 ring SNCP STM16/OC48, maxi 16 STM1 or 12 STM4	2 ring SNCP STM16/OC48, maxi 12 STM1 or 8 STM4
Protection			MSP 1+1, SNCP, MESH SNCP and	
Cross-connect			Cross-connect VC11/VC12/VC3/V4/VC4-4c	
EoS			EoS from SDH/SONET network convert to local ports 8GE ports	
TDM	With n64K/DS0 cross-connect		Unframed only	Cross-connect n 64k/DS0
E1/T1 G703, E3/T3	6 x 4 E1/T1	16 x 4 E1/T1	378 E1/T1 or 18 E3/DS3	126 E1/T1 or 6 E3/DS3
PDH DS0 services	6 Mini-slots	12 Slots+ 4 Mini-slots	-	6 slots 4 x n 64Kbps
Cross-connect: TDM+PW	96 E1/T1	128 E1/T1	-	56 E1/T1
Voice, serial and Utilities cards	FXS,FXO,E&M, Conference, Magneto, RS232, RS485, RS422, X21,V35.. , C37.94, Teleprotection	FXS,FXO,E&M, Conference, Magneto, VoIP, RS232, RS485, RS422, X21,V35, C37.94, TTA	-	FXS,FXO,E&M, Conference, Magneto, VoIP, RS232, RS485, RS422, X21,V35.. , C37.94, TTA
TDM PseudoWire PW	PW Emulation End to End : fractional E1/T1= CES, CES-CAS, Unframe =SAToP		PW Emulation End to End : fractional E1/T1= CES for O9500R Unframe =SAToP, SDH/SONET: CEP =VCn/TU-n/VT-n/STS-n	
TDM Encapsulation	PW/LSP (TDM over MPLS-TP), "Dry Martini", MEF-8 (TDMoE), TDMoverIP			
ETHERNET	Any GE/10GE interface can be use as NNI Network or UNI local LAN interface			
Services	E-Line, E-LAN, E-Tree according to MEF 9 & 14 over VPWS/WPLS, Native Ethernet, VLAN simple/double tagging Q-in-Q			
Over MPLS-TP	VPLS and H-VPLS bridging, 32K MAC addresses, 2K VPLS instance, Split horizon to prevent forwarding loops			
EoS/SDH/SONET & EoPDH	EoPDH with RTA	EoPDH with RTA/RTB -	EoS	EoS & EoPDH
Encryption				
Management	IPSec over Bridge and OSPF*, SNMPv3		IPSec over Bridge and OSPF**, SNMPv3	
Synchronization	SyncE on all GE/10GE ports with ESMC Message Channel			
IEEE 1588 v2	Option CLKc Minicard	Option CLKc Minicard	PTP clocks : Ordinary/Boundary/Transparent, ToD, 1 PPS output	
TDM clock	Option CLKa Minicard	Option CLKa Minicard	Clock Input/Output: 2Mbps/2Mbps, SSM, on E1/T1 an STM-xx/Ocxx ports	
Environment	Versions Fanless	Versions Fanless and Fan	Version Fan	Version Fan
Temperature w FAN	-	Over 50°C add AM3440-FAN	-10 to +50°C	-10 to +50°C
Temperature FANLESS	-20 to +55°c (DC only)	-20 to 55°C	NC	NC
Standard compliances	FCC Part 15 Subpart B, Class A - CE - Safety IEC60950-1			
Other compliances (NC)	IEC61850-3*,EN50121-4*,IEEE1613*	IEC61850-3*, EN50121-4*	IEC61850-3, EN50121-4	IEC61850-3, EN50121-4
Management	SNMP v1, v2c, v3, in CLI over Telnet, SSH via Ethernet or Console port , IPV4, IPV6* (AM3440)			
LCT Interface	Node administration, Windows GUI			
iNET (EMS)	Yes	Windows GUI , Graphic cross-connect, vision of programed circuit		
iNMS (NMS)	Support Transport, Access, PW3R or MPLS-TP circuits, automatic nodes commissioning, synchronization,			

*/** in development or qualification, please contact us

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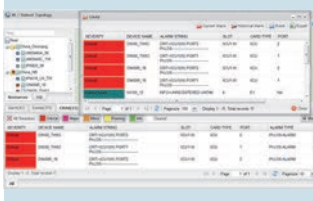
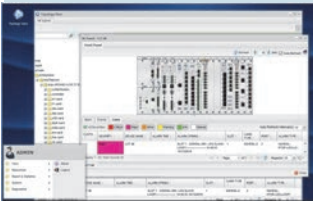
Models	G7820 48T/24S	G7860A	G7800 + CC2 * Sept 2023
Functions	GE/10GE Ethernet Switch PTN MPLS-TP/CE/L3 IP	GE/10GE Ethernet Switch PTN MPLS-TP/CE/L3 IP	GE/10GE/40GE/100GE Ethernet Switch PTN MPLS-TP/CE/L3 IP
	-	SDH/SONET Access -TM	SDH/SONET Access - TM
	-	PDH E1/T1, DS3 access	PDH DCS/DACS multiplexer
System	Fix 1U 19"	Modular 1U 19"	Modular 7U 19"
		Main fix card + 2 slots	4 slots 10G/PDH + 6 sl. 1G/PDH + 6 mini sl. PDH
	1 CPU and switch	1 CPU and switch, redundant chassis stacking	2 redundant CPUs and switch (CC2)
	1 or 2 AC or 2 DC 48v	1 AC or 2 DC48v redundant	2 AC or 2 DC48v redundant power supplies
	Loop-OS		
Packet Transport Netw.	MPLS-TP and Carrier Ethernet CE2.0* with 2 CC2		
40GE/100GE			2 x 40GE/100GE QSFP28
GE/10GE SFP+	8 GE/10GE NNI/UNI	6 GE/10GE NNI/UNI	In 2 CC2: 2 x 5 GE/10GE NNI/UNI 2 x 8 GE/FE NNI/UNI with 2 XGE0 *: 2 x 9 x 10GE NNI/UNI
Fix or modules Ethernet	Version 48T= 48 FE/GE RJ45 Version 24S = 24 FE/GE SFP + 8 FE/GE RJ45 (4 POE/+ in option)	4 GE SFP NNI/UNI 2 modules = 8 FE/GE SFP or 8 FE/GE RJ45 or 8 FE/GE POE/+*	with 4 GFE-10S*: 4 x 10 x GE/FE SFP with 4 GFE-8T* : 4 x 8 x 10/100/1000BaseT with 4 GFE-8POE*: 4 x 8 x 10/100/1000BaseT POE/+/**
Switching capacity	120 Gbps	85 Gbps	400 Gbps - (future switch version over 1Tbps**)
L2.5 MPLS-TP/CE	Over Ethernet GE/10GE/40GE/100GE ports		
TDM Emulation	With external AM3440	PseudoWire Emulation End-to-End in CESoPS (n64k), SAToP (E1/T1/DS3), CEP (SDH) over MPLS/CE/IP tunnel	
MPLS-TP transport	VPWS, VPLS or H-VPLS Bridging, 2K VPLS instance per node		
Carrier Ethernet 2.0*	EPL, EVPL, EP-LAN, EPV-LAN, EP-Tree, E-Access, EPL-Access, EPVL-Access		
OAM	MPLS-TP: Section/LSP/PW TP-OAM using BFD (Per IEEE 8113.2) - CE: CFM (IEEE802.1ag/Y1731), EFM (IEEE802.3ah)		
Protection	LSP 1+1 and 1:1 (RFC6378) ITU: ELPS (G.8031), ERPS (G.8032) - RFP : RSTP (802.3), MSTP (802.3) all <50ms		
L3 IP Routing	Over Ethernet GE/10GE/40GE/100GE or VLAN ports or over MPLS-TP PW : VPWS/VPLS		
Router	Static Route, RIP v1/v2, OSPF v3	Option: Static Route, RIP v1/v2, OSPF v3	Static Route, RIP v1/v2, OSPF v3
Protocol	ARP, Ping, Trace Route, VRRP, VRF w/o Multicast protocol, VLAN routing, 32 sub-interfaces, IGMP v2/v3, PIM-SM,		
SDH/SONET	-	Access TM only STM1/4	Access TM of STM1/4/16 or OC3/12/48
Capacity		1 STM4 MSP or 4 STM1 MSP	Maxi 8 STM16/OC48 or 34 STM4/OC12 or 68 STM1/OC3
Protection		MSP 1+1	4 STM16 MSP, 17 STM4 MSP, 34 STM1 MSP
Cross-connect		Access only VC11/VC12/VC3/VC4	Cross-connect VC11/VC12/VC3/V4 to PW PW-emulated Cross-Con. between any two SDH/PDH ports
EoS	-	EoS convert PW(VTx) in MPLS-TP	EoS convert to PW(VTx) or EoS convert to Ethernet/VPLS/VPWS with EOS card
TDM	With external AM3440	Access G703	128 E1/T1 & n64K/DS0 Cross-connect
Maximum E1/T1 G703, T3	-	16 E1/T1 to 80 E1/T1 , 6 DS3	320 E1/T1 or 160 DS3
PDH DS0 services	-	PW(DS0/TS) grooming in E1/T1	10 slots+ 6 mini-sl. of 4 x n 64Kbps
E1/T1, G703 64k cards	-	32 E1/T1 cards (maxi 2)	16-32 E1/T1, 4 E1/FE1, 4 T1/FT1, 8 G703 CD cards
Voice, serial and Utilities cards	-	-	FXS,FXO,E&M, Conference, Magneto, VoIP, RS232, RS485, RS422, X21,V35.. , C37.94, Teleprotection
TDM PseudoWire PW	-	PW Emulation EDGE to EDGE : fractional E1/T1= CES & CES-CAS*, Unframe =SAToP, SDH/SONET CEP: VCn/TU-n/VT-n/STS-n	
TDM Encapsulation	-	PW/LSP (TDM over MPLS-TP), "Dry Martini", MEF-8 (TDMoE), TDMoverIP	
ETHERNET	Any GE/10GE/40GE/100GE interface can be use as NNI Network or UNI local LAN interface		
Services	E-Line, E-LAN, E-Tree according to MEF 9 & 14 over VPWS/WPLS, Native Ethernet, VLAN simple/double tagging Q-in-Q		
VPLS	VPLS and H-VPLS bridging, 32K MAC addresses, 2K VPLS instance, Split horizon to prevent forwarding loops		
EoS/SDH/SONET & EoPDH	-	From SDH Network	EoS from Network or EOS card, EoPDH with RTA/RTB card
Encryption			
Management	IPSec, SNMPv3		
MPLS-TP data	-	-	MacSec AES-256, IEEE802.1AE, on all GE/10GE/100GE ports, per Service Security: LSPsec*, per Domain Security: IPsec**
Synchronization	SyncE on all GE/10GE ports with ESMC Message Channel		
IEEE 1588 v2	Option	PTP clocks : Ordinary/Boundary/Transparent, ToD, 1 PPS output	
TDM clock	-	Clock Input/Output: 2Mbps/2Mbps, SSM, on E1/T1 an STM-xx/Ocxx ports	
Environment	Versions Fan and Fanless	Versions Fan and Fanless*	Versions Fan and Future Fanless**
Temperature w FAN	-20 to +60°C	-20 to +65°C	-20 to +65°C
Temperature FANLESS	-20 to +55°C (DC only)	-20 to 65°C	ND
Standard compliances	FCC Part 15 Subpart B, Class A - CE - Safety IEC60950-1		
Other compliances (NC)	FL version IEC61850-3, EN50121-4	IEC61850-3*, EN50121-4*, IEEE1613*	IEC61850-3*, EN50121-4*
Management	SNMP v1/v2/v3 in Bridge or over OSPF, in CLI over Telnet, SSH via Ethernet or Console port , IPv4, IPV6 (G7800)		
LCT Interface	Node administration, Windows GUI		
iNET (EMS)	Yes	Windows GUI , Graphic cross-connect, vision of programed circuit	
iNMS (NMS)	Support Transport, Access, PW3R or MPLS-TP circuits, automatic nodes commissioning, synchronization,		

*/**in development or qualification, please contact us

PLEASE CONSULT THE DEDICATE BROCHURE OF THE EQUIPMENT FOR REAL AVAILABILITY OF SPECIFICATIONS

iNET-LCT

This light Windows software is a Local Craft Interfaces. This basic version of the iNET NMS is permitting to set-up node per node locally or over the network and gives the vision of all setting and cross-connects of the device.



iNET Loop-iNET, based on scalable and modularized architecture, is an intelligent network management software for Element Management Layer (EML) and Network Management Layer (NML) based on Telecommunications Management Network (TMN) model. It provides a GUI (graphical user interface) for the management of a communications network containing Loop Telecom products and 3rd-parties NE .

Loop-iNET management system is a Web based application supported by MS Windows server platform and MySQL RDBMS database server. This solution in option with hot standby server redundancy with automatic switchover provides high availability (HA). The system access security is based on users with privilege access that are customized through combination of operation functions and managed NEs, user access log with single or multiple GUI.

Multi-hierarchical subnet structure allows users to provide multi-level network topology display. This SNMP v2/v3 based management system supports functions including commands, alarms, and statistics gathering.

iNET can support up to 100,000 Network Elements (NEs) of TDM, Ethernet and PseudoWire Loop Telecom devices and generic 3rd-party NE. The robust and reliable design provides flexible and scalable solution for network expansions.

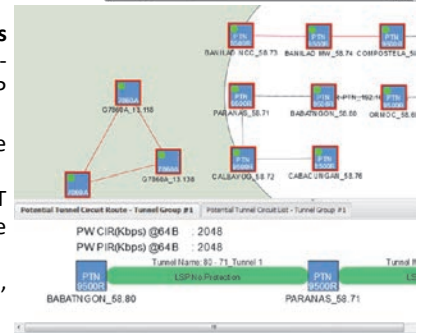
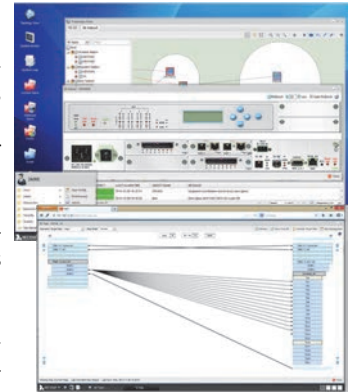
For MPLS-TP deployment and management iNET supports some extended functions. The system is permitting a pre-configuration with the network vision and detail per PW, LSP and Tunnel and the synchronization per NE.

The operator will give per NE the Global ID and Node ID to be visible and create assisted Topology .

The operator will create both end Tunnel and PW. Then iNET will propose Tunnel and LSP paths and will show the PW route MAP. The system is assisted for Traffic Engineering setting.

iNET provides PW OAM, Tunnel OAM, Circuit rate verification, port rate utilization statistics and circuit maintenance.

iNET supports all Loop Telecom devices.



Loop Telecom propose a modular solution CWDM, DWDM and OTN to multiplex and extend the distance of GE/10GE/25GE and STM1/4/16/64 over fiber.



WDM1800 WDM Multi Service Platform

15 and 5 modules chassis support 2 CPU, 2 PS, 1 FAN and modules:

- Transponders
- CWDM and DWDM filter 4/8 ch over single fiber
- Optical link protection
- EDFA-Booster
- EDFA-Preamplifier
- DCM for 10/25G
- Raman amplifier*
- MuxPonder OTN over 10G

* In development

WDM1800 Wavelength Multiservice platform.

To optimize the fiber utilization, particularly for MAN infrastructure < 60km, we propose CWDM multiplexing of 8 wavelengths GE/10GE and STM1/4/16/64 over a single fiber.

To extend four 10GE links over 80km the WDM1800 Loop Telecom system provide DWDM extension up to 33,4dB around 180km with EDFA and DCM.

The management systems iNET and iNMS associate the management of links between active optical equipment L2/L3... and the WDM1800 optical solution.

The WDM1800 system has been also develop to support the C-RAN for 3G/4G/LTE and for 5G RAN/O-RAN with eCPRI 10GE/25GE.

WDM1800 Modular system support CWDM, DWDM and OTN with amplification.

This system support CWDM and a-thermal DWDM in C-Band passive filter and different managed modules with a redundant controller that can be daisy chained in large center.

The **WDM1800-CHAA** and **WDM1800-CHBA** are 5U and 2U 19" chassis for the support of 15 and 5 slots for optical modules plus one or two redundant CPU and two DC or AC power supply.

Transponder modules are available for 1G/10GE, 4 or 8 ports module use 850/1310/1550nm SFP/SFP+ standard in customer side and colored CWDM/DWDM in filter side. This transponder support per optical signal 3R functions: Re-amplification, digital Reshaping and clock Recovery/Retiming automatically or with manual selection for particular rate.

10G Transponder supports 3R for GE/10GE/OBSAI/CPRI and 2R for STM-n/OC-n interfaces

25G Transponder supports 3R for eCPRI/10GE/25GE fronthaul RAN

40G/100G Transponder supports 3R for Ethernet, use repeater. *

CDWM filter modules multiplex 8 or 16 lambdas for 4 or 8 Rx/Tx pairs over a single bidirectional fiber.

DWDM filter modules multiplex 8 or 16 lambdas in C-Band for 4 or 8 Rx/Tx pairs over single bidirectional fiber. It support 10G and 25G lambdas and amplification EDFA/RAMAN/DCM

OLP optional optical link protection is included in the filters

EDFA-Booster to amplify the DWDM signal over 60km with a gain of 20dB.

EDFA-Preamplifier for recondition of optical DWDM multiplexed signal over 100km.

DCM Dispersion Compensation Module correct the dispersion impairment for long haul transmission

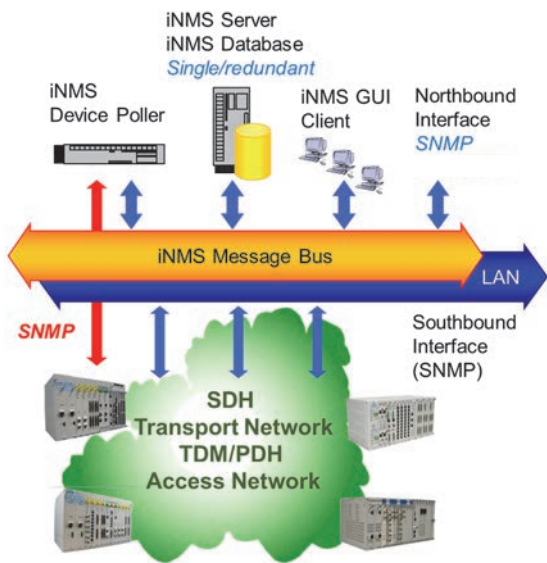
MuxPonder Optical Transport Networking over a single 10Gbps OTU2 based on ITU-T G.709 TDM multiplexing of 7 optical circuits FE/GE/STM1/STM4/STM16.

OTDR module to control links.

The WDM1800 is managed by iNET and iNMS system which integrate together with the management of active optical equipment L2/L3/SDH/SONET for the same links.

iNMS-NMS Loop-iNMS (Integrated/Intelligent Network Management System) is a set of software programs supporting the Loop equipment compliant to TMN. This system manage the device of Transport Network (SDH), Access Network (PDH), Ethernet with PseudoWire-Emulation and PTN over MPLS-TP. This includes the support of multiple GUI, End-to-End commissioning with several services for small to very large infrastructure with an optional NBI to communicate with to an umbrella NMS.

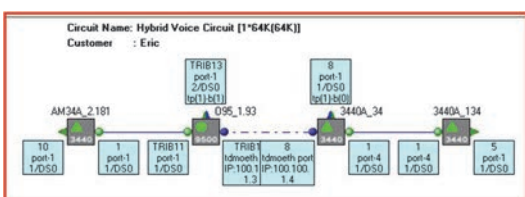
The **iNMS** system is a Software package running under Linux with Oracle 19c Database Server with up to 50 simultaneous GUI on MS Windows platform. iNMS support several thousand SNMP Loop nodes and 3rd-Party NE and all service can work on Virtual server for easy evolution of resources. All servers, database, pollers can be build with redundancy, in option with High Disaster Recovery and High Availability Real-Time Cluster (HARC) with Real-Time Data Replication and system redundancy. The **iNMS** provides his administrators and High Level NMS with GUI of devices and Network views. Its performs the **End-to-end service management of Access Multiservice plus TDM/SDH/SONET and PTN MPLS-TP transport with planning proposition and the automatic commissioning of the nodes.**



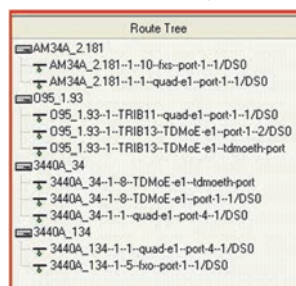
- Full SNMP supports functions including commands, alarms, and statistics gathering,
- Viewing and printing of all node statistics, alarm reports, configurable report design,
- Enriched topology management with GIS geographic maps, zoom and drag-and-drop,
- Views of optical cable connection, cross-connection, panel view, and resource trees,
- Clock Distribution Map,
- System Redundancy and Protection,
- Efficient performance monitoring in real-time and history for PM, NE and circuits,
- Alarm management with notification via email, GSM message (SMS), with filtering,
- Root Cause Analysis accurately diagnoses faults on NEs and managed circuits by status and severity levels,
- System Access Security and many options to customize your requirement.

iNMS creates/monitors TDM Circuits and PseudoWire over IP/Ethernet, MPLS-TP and multi-segment transport, multiple protections and OAM at different levels: iNMS provides the proposition, allocation and commissioning of

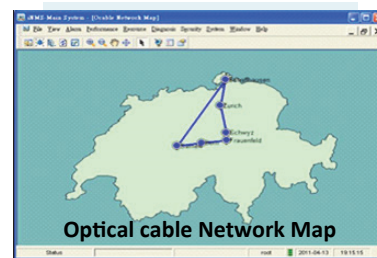
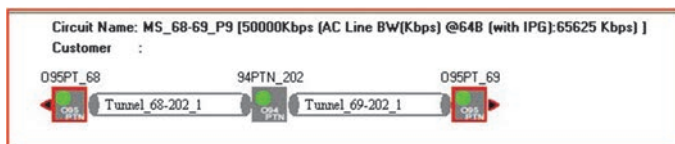
- PseudoWire End-to-end Circuits TDM, TDM PVoIP, TDM PVoEth, TDM PVoMPLS for Ethernet the VPWS and VPLS over MPLS-TP,
- Hybrid Multi-Segments Circuit : Access TDM + PWE3 transport (over IP/Ethernet/MPLS-TP) + TDM,



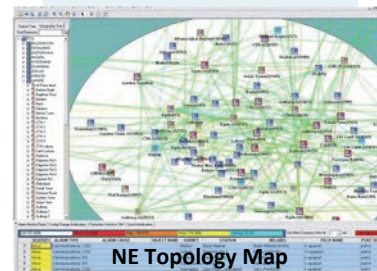
Multi-Segment Circuit



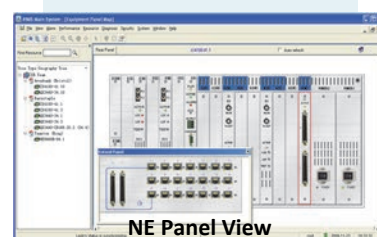
- For the **G7820, G7860A, PTN10G** and future **G7800 MPLS-TP** devices and these infrastructure, **iNMS** supports with allocation and commissioning the PVoEth and PVoMPLS, the Ethernet VPWS/VPSL with Tunnel, LSP their protection and the monitoring,
- OAM for End to End are available for the PW and LSP, at both ends for bidirectional transmission,
- PWs and Tunnels are created with Traffic Engineering setting of CIR, PIR, PBS and the Color Metering policy per default or adapted to the particular item.



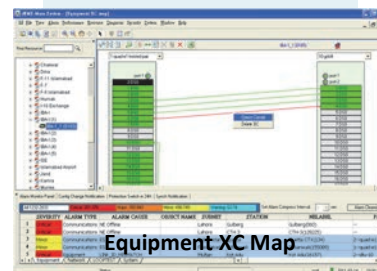
Optical cable Network Map



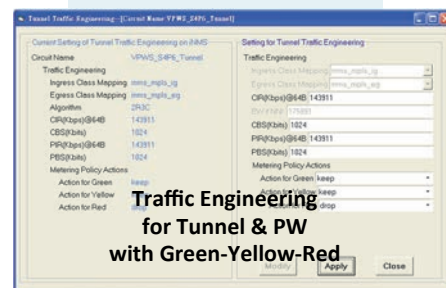
NE Topology Map



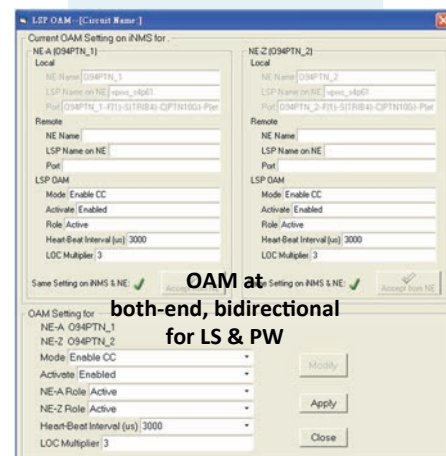
NE Panel View



Equipment XC Map



Traffic Engineering for Tunnel & PW with Green-Yellow-Red



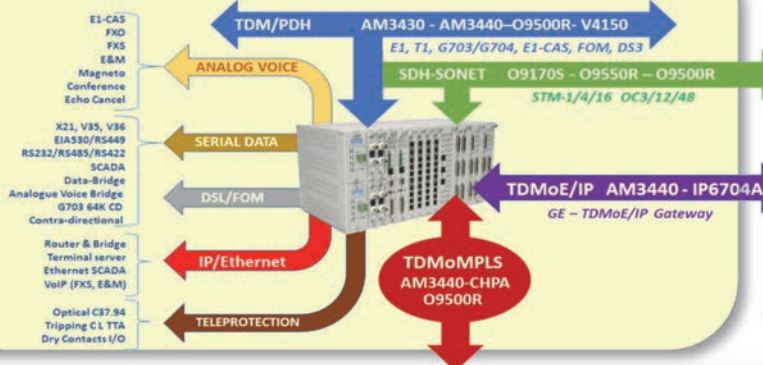
OAM at both-end, bidirectional for LS & PW



Loop Telecom supplies Analog to 100 Gigabit Ethernet solutions

Multiservice analogue/digital TDM/PDH Multiplexing

Cross-Connect TDM/PDH from 2 to 504 E1/T1



SDH/SONET Transport

Versions STM1/4/16 or OC3/12/48
Tributaries E1/T1, E3, EoS, STMxx
Versions with TDM DACS

O9150S / O9400R
O9170S / O9500R



PseudoWire over IP/Ethernet

Packet transport of TDM E1/T1, n 64K, Voice,
Serial data Emulation and Synchronization, over

IP6702A /IP6704A
G7860A

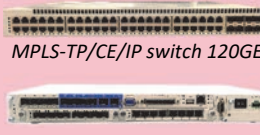


Packet Network Transport: MPLS-TP, Carrier Ethernet switch, IP router up 100GE



MPLS-TP/CE/IP switch 32GE,
PDH Multiservice DACS—PW gateway

AM3440-CHEB/ 8GEHSW
FE/GE & PDH Access Mux



MPLS-TP/CE/IP switch 120GE

MPLS-TP/CE switch 85GE,
Access E1 /T1 & STM1/4

G7820 GE/10GE
G7860A GE/10GE + E1 + SDH



Full SDH/SONET ADM 2.5G
MPLS-TP/CE/IP switch 100GE

O9x00R +PTN10G
GE/10GE, SDH ADM, PDH



MPLS-TP/CE switch 400G
Access E1/T1, DACS, STM1/4/16

G7800
GE/10GE/40GE/100GE, SDH, PDH

Railway EN50121-4

DIN-Rail to concentration Ethernet Switches/Router for

Power, IEC61850



SFP+, copper, POE+, MACsec, Protection
RSTP, MSTP, ERPS v2, no single point of
failure, SyncE, PTP 1588 BC & TC

IP6818 / IP6828 / G7820



FE/GE/10GE

wide temperature



For Power, IEC61850-3, IEEE1613
Protection PRP/HSR, RSTP, MSTP,
ERPS v2, SyncE, PTP 1588 BC & TC

IP6820 / IP6838* / G7820 / G7860A

CWDM/DWDM/OTN multiplexing



WDM1800

- 4 or 8 links 10GE or 25G over 1 fiber
- 3G/LTE/5G RAN deployment
- 10GE network extension to 200km
- Transponder 40/100GE
- Multiplexing for Ethernet & SDH

Environnemental Monitoring

- Data Center env. security
- Industrial control
- Rail track, transportation

IoT-0510

EMS - NMS system

- Local Craft Interface or Web
- Element Network Management
- Intelligent Network Management with automatic commissioning

LCT / iNET / iNMS

LOOP TELECOMMUNICATION INTERNATIONAL, Inc.

ISO 9001, ISO 14001 and ISO 27001

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