The Loop Telecom solutions of Transmission and Networking for Power Companies

- TDM/PDH Multiservice access for analog, voice, sync/async data, SCADA
- Teleprotection transmission
- SDH/SONET transport
- TDMoE or PseudoWire Emulation transport over IP/Ethernet
- 10GE/GE PTN with MPLS-TP and Carrier Ethernet for Multiservice and Ethernet transport
- Ethernet switches for Substation
- Video surveillance

www.LoopTelecom.com
Loop Telecom a telecom/networking supplier for Power Companies

Loop Telecom history

Since 1992, in Taiwan, Loop Telecom has developed and produced commercial/industrial grade Transmission/Switching equipment conforming to ANSI and ETSI standards. IETF recommendations over copper, fiber, and wireless. Starting with CSU/DSU Loop Telecom has developed TDM Multiservice cross-connect, then SDH/SONET transport multiplexers, and a range of Ethernet devices such as Switch, Router, Demarcation Devices, and PseudoWire Emulation.

Today, Loop Telecom has launched new generation Packet Network Transport: PTN with MPLS-TP or Carrier Ethernet on 10GE and Optical Transport Network OTN. These solutions are tracking from single DS0 Multiservice to high rate IP/Ethernet traffic, and Industrial Ethernet switch router solutions.

Loop Telecom develops high tech-professional equipment and solution according to the requirement of its major customers and compliant to recognized standards et regulations.

Loop Telecom actively pursues the following markets:

- Utilities: Power Companies, Oil, Gas and Water Companies,
- Transportation: Air traffic Control, Airport Ground Transport, ITS, Railway, High-Speed Rails, and Subways,
- Telco, ISP,
- Military and National infrastructures,
- Industries.

These worldwide deployments are either by direct sales or through partners who also supply local service.

Power companies in over 90 countries use equipment manufactured by Loop Telecom around world

Loop Telecom has developed and optimized his Multiservice Access equipment for Power Companies with the interfaces that are used particularly for SCADA, RTUs, Teleprotection, PMR and the conventional transport TDM, SDH, SONET, Ethernet, but also the PseudoWire over IP/Ethernet and PTN with MPLS-TP protocol which are adapted to this domain.

Over 180 power companies are using the Loop Telecom Networking solutions, they are installed over the five continents of the world.
Power transport and distribution companies are requesting telecommunication for:

- Teleprotection for the energy transport over the national, collecting and distribution grids,
- SCADA to control all parameters of relays, breakers, environment using analog, asynchronous or synchronous data interfaces,
- New generation SCADA with Ethernet or IP interfaces,
- Voice communication service between sites,
- Private voice communication network for mobile team as PMR or Trunked Radio or TETRA,
- IP Video-surveillance, IP-CCTV,
- Physical access control to the sites of the power network
- LAN distribution over this private infrastructure with Internet access...

Loop Telecom is pleased to present you along these pages some solutions that has been installed to the Power Companies over the world. This document is giving you some ideas according to general and different demands country per country.

If you do not found the transmission or networking equipment for your needs please contact us.

Page 3 Short glossary
Page 4 & 5 TDM Multiservice for RTUs, SCADA, Teleprotection, voice and PMR communication
Page 6 & 7 SDH/SONET Transport Networks
Page 6 & 7 TDMoE PseudoWire Emulation, point to point transport over IP or Ethernet switched Network
Page 8 & 9 Packet Transport Networks with MPLS-TP or Carrier Ethernet for Multiservice and high packet traffic.
Page 10 Industrial/hardened switches for SCADA, GOOSE IEC61850 teleprotection
Page 11 10GE switches for mixed backbone with Power communication, CCTV, LAN services and Internet
Page 12 Management EMS and NMS
Page 12 Short plan of Loop Telecom ranges

Short Telecom Glossary

- **Multiservice TDM/PDH** The multiples applications as voice, analog data, asynchronous and synchronous low rate, contact relay information like teleprotection are converted in digital information with Time Domain Multiplexing nx64kbps and transport with Time Slots or DS0 framing or unframed with E1, T1 interfaces.

- **SDH/SONET** Synchronous Digital Hierarchy (ETSI) / Synchronous Optical Networking (ANSI) makes the transport over STM-xx/OC-xx fiber of TDM, ATM independent circuits and Ethernet EoS within a hierarchy, mechanism of protection in ring, bus or Mesh infrastructures, independent synchronization and absolute QoS.

- **PWE3 or PW** PseudoWire Emulation End-to-End transport a TDM full service such as E1/T1, SDH, Ethernet over Packet Switched Network IP, Ethernet or MPLS as direct connection.

- **PTN** The New Generation "Packet Transport Network" combines SDH/SONET advantages and high capacity transport of the packet. PTN uses Carrier Ethernet or MPLS as the transport encapsulation running over GE/10GE Synchronous (SyncE) fibers and PTP 1588v2 timing technologies.

- **MPLS-TP** The Multiprotocol Label Switching - Transport Profile is a variant of IP-MPLS protocol. It applies a Label Switching Path (LSP) on packets of multiple protocols, as PW for TDM or SDH/SONET circuits, to accelerate the speed over Mesh infrastructure or over VPN without packet analysis. The MPLS-TP connection-oriented packed switched is implemented like circuits of SDH infrastructure. Therefore, MPLS-TP features the OAM functions for the Alarm Monitoring and Alarm Signaling, Traffic Diagnosis and Circuit Performance Monitoring at every layer (Section, LSP, PW).

- **LSP** The Label Switching Path. The Label pretended to the packet of multiple protocols and to give the information of the Switching Path. Then Multi-Protocol-Routers in MPLS infrastructure will switch the packet very rapidly in the infrastructure.

- **VPLS** The Virtual Private LAN Services over MPLS-TP allows you a Mesh of sites any-point-to-any-point with Layer 2 tunnels for services such Ethernet connectivity and multicast video.
Multiservice Access Multiplexer
DS0/T5 Cross-Connect DACS:

AM3440-A/B/C/D up to 64 E1/ n 64kbps with copper of fiber x E1/T1 WAN
O9550-A/C/D up to 64 E1/ n 64kbps with STM-1/4 or OC3/12 fiber WAN

Multiservice cards for analog to n 64K, 2Mbp for Voice, asynchronous and synchronous Data, contacts, Ethernet EoPDH.

SDH/SONET Transport
ADM/TM modular or fixed multiplexer:

O9300R with multiples STM 1/4/16, E1/T1, E3/T3 and EoS Gigabit Ethernet

O9150S with 2 STM1, up to 16 E1, EoS : 4 FE, GE*

IMAP - Multiservice and SDH/SONET Transport
IMAP include DACS and ADM/TM mux:

O9500R with multiples STM-1/4/16, E1/T1, E3/T3, EoS Gigabit Ethernet and D50 Voice and Data multiservice cards

O9170S with 2 STM-1, 8 E1, EoS 4 FE, GE*, E&M, FXS/FXO, RSxxx, V36/X21*

The Power Companies are using several type of interfaces in the power production plants of nuclear, hydroelectric, fossil energies, geothermal, wind power, solar energy... in power transportation and power distribution.

Multiservice multiplexer connects between sites: RTUs, SCADA, counters, voice communication, access control of site, video surveillance, weather station and the principally the teleprotection command for power lines switch and to protect all energy equipment in production, transport and sub-stations of distribution.

MULTISERVICE DACS cross-connect supports the access of analog and digital customer interfaces, the conversion in TDM (PDH) data which are organized in nx64Kbps (or DS0) circuits and their transport for:

- Voice Services with E1-CAS, FXS, FXO, PLAR, Conference, Magneto and VoIP* interfaces for mandatory and safe communication between sites, NOC and mobile personal over the distribution power network,
- Analog Services E&M or conference interfaces for analog RTUs, low speed sensors, Vxx modem based application use by SCADA and remote command,
- Serial Synchronous/Asynchronous services with RS232, RS485, RS422, X21, V35, IEA530, G703 64Kbps co-directional and contra-directional interfaces covering the rate from 300bps to 2Mbp supporting the SCADA services over E1/T1 copper/radio/fiber, SDH/SONET over fiber, IP PseudoWire transport or over PLC lines or Analog Radio.
- Teleprotection over TDM with optical IEEE C37.94 interface, X21, E1, G703 64Kbps between teleprotection units and Digital Lines configurable blocking, permissive and direct tripping to protection equipment.
- Trunked Radio or PMR or TETRA by using E1 links or IP radio of over fully secure EoPDH or EoS.
- Access control of sites with Dry Contact and Ethernet interfaces
- Weather station, distributed LAN services...

Loop Telecom AM3440 or O9550 Series DACS are secured by redundant CPU, cross-connect matrix, power supply, WAN cards and SNCP DS0 64Kbps protection with recovery time < 50ms or ULSR.

SDH/SONET Transport provides the interconnection of Multiservice nodes up to 2.5G STM-16/OC-48 with:

- High level of Protection with redundant CPU, cross-connect, power supplies, all aggregate and tributaries interfaces and with WAN protection SNCP, MSP 1+1 and dual homing of central chassis.
- Distribution of synchronization to all nodes SDH and PDH that insure stability, no-noise and no-missing data transport for key applications.
- Ethernet transport optimized by EoS technology.

IMAP Multiservice Access and SDH/SONET Transport provides the DACS DS0 node function plus synchronous transport with:

- Single node for dual functions with transport up to 2.5Gb, same level of protection, clock distribution and a single node management,
- Multiservice DS0 section with a single PDH clock independent of SDH clock, using the same voice/data/teleprotection cards of the AM3440,
- Ethernet transport optimized by EoS technology.

www.LoopTelecom.com
Loop Telecom IMAP access & transport with low latency and high security level all services

Teleprotection communication for Power Distribution

The AM3440, O9500R and O9550 provide secured and low latency transmission between teleprotection devices which operate HV power breakers. We provide the digital interfaces C37.94, G703 CD, X21, V24, E1/T1.

The TTA card supports four independent Binary lines, Input and Output up to 280Vdc to connect Protection devices. It supports between protection devices the protection relay commands: blocking, permissive and direct tripping for Point-to-Point or Point-to-Multipoint structures.

Multiservice Voice/Data/SCADA/Teleprotection are converted and multiplexed in TDM

www.LoopTelecom.com
Multiservice Access, PseudoWire Gateway over IP/Ethernet
Remote E1/T1, DS0/TS, Layer2 GE switch

**IP6704A** 4 GE switch optical/copper
PseudoWire CESoPSN, SAToP, MEF-8 for T1, E1 G703/G704/CAS , E&M, FXO, FXS, RS232, X21, V35, C37.94, G703 64K CD

Concentration Gateway to PDH/SDH:
**IP6763A** 2 Combo plus 4 GE switch Concentration 32 E1/T1, 4 STM1, STM4, 512 PseudoWires CESoPSN, SAT, MEF-8, CEP for SDH/SONET link encapsulation

**PTN with MPLS-CE Node**
Multiservice DACS and ADM/TM SDH/SONET multiplexer, 100Gigabit Switch with GE/10GE

**O9500R with PTN**, support GE/10GE PTN MPLS-TP or Carrier Ethernet and STM-1/4/16 or OC3/12/48 transport, of E1/T1, E3/T3, Ethernet and DS0 Voice and Data multiservice access cross-connect SyncE, PTP 1588v2

**PTN MPLS-CE GE/10GE Switches**
with E1/T1, STM-4/OC12 access :

**G7860A** up 6 x 10GE plus 12 GE/GX SFP and 32 E1/T1, 4 STM-1/OC-3 access, SyncE, PTP 1588v2

**IP6750** up 2 GX SFP + 8 FE/ GE or 16 E1, SyncE, PTP 1588v2

The transport infrastructures are changing step by step to large Ethernet pipes over shared fibers, but Power Companies need to carry their principal and sensitive voice/data/Ethernet information for SCADA, RTUs, Teleprotection ...

Loop Telecom proposes the TDM-SDH/SONET line extension with TDM PseudoWire Emulation End to End (PWE3) over IP or Ethernet networks to connect new distant TDM and IP sites or to interconnect TDM networks over Ethernet backhaul.

The **IP6704A** Access Multiservice gateway will connect small power production sites, as wind turbines, with voice/data standards interfaces: E&M, FXS... RS233, Codirectional, C37.94... and IP applications over fiber or wireless Ethernet to central site with DACS concentrator as AM3440 equipped with TDMoEA cards. Then standard central strategy of communication is applied to site remote over economic Ethernet backbone.

Step by step the multiservice conventional information can be migrated to Packet Switched Network with these PW solutions.

Loop Telecom proposes small PW access gateways **IP6702A, IP6704A** but also cards for DACS and SDH/SONET-IMAP AM3440, O9400R, O9500R and a concentration gateway **IP6763A** to groom traffic from STM-x/OC-x interfaces from small remote sites with few DS0/TS.

For large IP/Ethernet traffics deployment together with sensitive Teleprotection, SCADA, RTUs information and Trunked radio, Loop Telecom proposes **PTN Networks with MPLS-TP or Carrier Ethernet GE or 10GE**. They transport the TDM in PseudoWire together or in replacement of SDH/SONET transport.

**O9400R SDH/SONET or O9500R Multiservice SDH/SONET equipped with PTN 10G switch card** running MPLS-TP or Carrier Ethernet protocols transport in packet E1, T1, DS0/TS and STM-x/OC-x, IP circuits. They interconnect TDM/PDH, SDH/SONET and Packet Transport Networks.

With MPLS-TP Layer2 network, we deploy multiple static LSPs to carry sensitive Voice/Data/Ethernet information for SCADA, RTUs, Teleprotection with multiple LSP protection, full OAM control and frequency/timing synchronization. Theses MPLS-TP GE/10GE pipes transport together large IP/Ethernet data all with the same security as SDH, eventually inside an IP-MPLS backbone.

**O9400R PTN/SDH/SONET and O9500R PTN/SDH/SONET-Multiservice** are permanent node of multiple network types. They optimize the transport and share the protection circuits for example from VC12 SDH to LSP MPLS-TP. Multiservice access and transport are managed by the same INMS system.

These modular systems are design to deploy step by step the migration from conventional transport, multiservice to new generation solutions.

**G7860A PTN MPLS-CE switch** are use to create multiple PTN ring GE/10GE with G.8032 protection. It is an access node for E1/T1 and STM-1/OC-3 as PseudoWire gateway over PTN network.

**IP6750 PTN CE switch** is an access node but also use in PTN with CE ring. It is a PseudoWire gateway for 16 E1 and Ethernet.

Thanks to GE/10GE SyncE WAN and PTP 1588v2 support, the G7860A and IP6750 and connected by E1/T1 to AM3440 multiservice DACS are solutions to deploy sensitive Voice/Data/Ethernet information for RTUs, SCADA, Teleprotection and trunked Radio together with high variable Ethernet traffic for video, LAN between sites, and Internet services for power companies.

www.LoopTelecom.com
The PseudoWire gateway transports the central strategy to Edge over IP/Ethernet backhaul.

**Transport of analog, low rate synchronized and large packet traffic**

**O9500 PTN/SDH/SONET/Multiservice supports all communications for Power Companies**

**10GE PTN MPLS-TP G8032 Ring**

**PTN MPLS-TP transports/synchronizes Multiservice TDM and large IP/Ethernet Services**

www.LoopTelecom.com
The Power Companies are using a growing number Ethernet or IP applications for the SCADA and the Teleprotection based on IEC-61850 GOOSE protocol or the transport of Mirrored Bits or MOD-BUS over RS232 and transported in Ethernet.

Loop Telecom proposes hardened switches conform to electrical substations environment standard IEC-61850-3/IEEE-1613.

We supply also 10GE/GE switches for Ethernet WAN infrastructure that can be relayed with Ethernet over SDH/SONET or MPLS-TP infrastructures. These Layer 2 and 3 switch/router are installed to deploy large bandwidth IP/Ethernet applications as CATV and various LAN applications for the power companies with highly secure control by QoS.

Teleprotection with Peer to Peer transmission:
The IP6820 provides Peer to Peer communication with RS232 over Ethernet encapsulation between two teleprotection devices using SEL Mirrored Bits® protocol or other proprietary communications.

The IP6820, IP6320A and IP6828 switches are transporting transparently IEC61850 GOOSE protocols with 802.1p QoS between teleprotection devices.

Ring Protection:
The Layer 2 and 3 are supporting the standard STP, RSTP and MSTP Spanning Tree protocol but also the Ethernet Ring Protection Switching IUT G.8032 for more nodes and a short recovery time better than 50ms.

Dual central node protection:
Based on Layer 3 VRRP protocol two concentration switches are working in parallel but only one is visible at the same time based on a virtual address. This give the possibility to secure WAN Ethernet infrastructures by doubling simple CPU switches, doubling the WAN infrastructure and the independent bridging instances.

High Bandwidth traffic
The IP6320A or IP6828 support over 240 or 120Gbps of switching capacity with maximum throughput of 132 or 95Mpps. They owns 8 or 4 10Gigabit Ethernet uplinks and 48 fixed or 3 x 8 GE tributaries ports. Such configurations satisfy generally traffic demand from Power Companies.

DIN rail devices concept
IP6810 and IP6820 can be fix to DIN-Rail. Different models are powered by dual inputs or dual power supplies -48v or -24V and build with component for FAN-less in hardened environment up to 70°C.

19" concentrator switch concept
The IP6320A and IP6828, 19" 1U switch are supply with dual AC or DC 48v redundant power supplies and they are working over 70°C.

POE/POE+ version
As option, IP6810 supports 3 POE ports, IP6820 supports up to 8 POE/POE+ ports and IP6828 can be used with 3 x 8 POE/POE+ ports. The POE ports and power limits are remotely manageable.

Automatic discovery of ring with NTU and 64/128 RTU
The IP6810, IP6820 support an automatic discovery of 64 units, or 128 for IP6820. After DIP-switches selection of the master unit and others as slave, the master will discover and provides the settling of slaves to avoid the preset of devices and save deployment time.

Management
All Loop Telecom switches, except IP6810, are Web manageable and they are visible and managed by the iNET EMS described in page 10.
Loop Telecom IP6820 Gigabit Ethernet industrial grade switch supports transparent and low latency over fiber the transport of communication between the Teleprotection devices. Thanks to the RS232/RS485 interfaces the IP6820 interconnects with Mirror Bits protocol these teleprotection devices synchronized by local GPS. The IP6820, connected with GE SyncE fiber WAN is supporting transparently the GOOSE communication with IEC61850 protocol for new generation teleprotection devices.

**Teleprotection over Ethernet Transport**

**Ethernet Backbone and Access for SCADA, Security and Voice**

[Diagram showing teleprotection and Ethernet backbone connections]

www.LoopTelecom.com
To optimize the fiber installation particularly in MAN infrastructures of Power Companies, Loop Telecom proposes solutions to share the fibers with independent CWDM or DWDM wavelengths for optical STM1/4/16 or OC3/1/48 together with optical Ethernet, Gigabit or 10 Gigabit Ethernet. Such solution give the possibility to transport on the same fiber, in parallel and independently SDH/SONET, MPLS-TP and GE/10GE links without interferences and security effect.

For simple point-to-point fiber optimization we supply CWDM filters at both-end fiber and colored SFP/SFP+ for the active equipment. The WDM1601 will share an existing or new fiber connection with 1310nm optical wavelength and 4 or 8 new CWDM links, each link can support up to 10 Gigabits. With the right SFP/SFP+ and right fiber this can reach more than 70km.

For longer distances and multiple fibers optimization we supply chassis with CWDM or DWDM filters but also transponder and amplifier for multiple directions. This managed solution can be under iNMS control.

Loop Telecom manufacture Fiber and G.SHDSL modem or multiplexer to install the backhaul of Ethernet and E1/T1 for Telco 2G/3G/LTE but also in many industrial campuses particularly to use the existing wires. These equipment are used as point-to-point links or as CPE to extend the interfaces from the Loop TDM or SDH/SONET or from chassis with multiple link concentration.

The fiber link/backhaul O93xx equipment are using multimode or single mode standard unidirectional fiber, or single bidirectional fiber WDM or CWDM/DWDM colored transmission. They are available with dual 1+1 optical to insure the fiber protection.

The copper G.SHDSL or G.SHDSL-Bis H33xx equipment are using 1 or 2 and 2 to 8 pairs of copper from 0.4 to 1.1 mm of diameter to transport the data up to 5.7Mbps per pair. They carry 1 to 3 interfaces in parallel. The H3308S/R is bundling up to 8 pairs of copper to increase the bandwidth over 40Mbps or it maintain enough traffic at the limit distance of G.SHDSL link.

The adjustment of DSL rate to the quality and length of line is automatic. Loop Telecom is a DSL manufacturer for a long time and we have supply large quantities for Telco and industries like Power Companies.

Central Chassis:
The AM3440, O9550 and O9500R can be equipped with cards having similar fiber or G.SHDSL interfaces and these modem provide the extension of TDM multiservice or Ethernet interfaces to the edge.
The C5600 is a SNMP managed chassis which concentrates several fiber or G.SHDSL links, it support up to 15 cards with multiple interfaces each are independent or Ethernet switched interfaces.

All these remote standalones or central cards are visible and manageable by iNET and iNMS management systems.
Ethernet devices are managed by Web browser or CLI command and the TDM, SDH/SONET, TDMoE equipment are managed through local or remote interface by Text menu or by optional Windows graphical INET-LCT craft.

**INET** based on scalable and modularized architecture, is a 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.

This Web based application is following design of thin client computing with MS Windows server and MySQL RDBMS database. Hot standby server redundancy option provides automatic failover high availability. The system access security is customized per user, per operation, NEs and subnet. This SNMP based management system with NTP supports up to 100,000 Network Elements (NEs) and 3rd-party NEs. Robust and reliable design on distributed system architecture provides flexible and scalable solution for network expansions for:

- Topology Management
- NE GIS View
- NE Auto-Discovery Management
- Configuration Management
- Alarm Management
- User & Security Management

As options:
- System Redundancy and Protection

---

**INMS-NMS** (Integrated/Intelligent Network Management System) is a set of software supporting Loop equipment compliant to TMN. This system manages devices in Multiservice Access Networks (TDM/PDH) and Transport Networks: SDH/SONET, Ethernet with PseudoWire-3E and PTN over MPLS-TP.

This is a GUI, End-to-End automatic commissioning with several services for small to very large infrastructure and NBI interface to access to a head NMS.

The INMS software runs Linux with Oracle Database Server and up to 50 simultaneous MS Windows GUI clients.

INMS supports several thousand of SNMP Loop nodes and 3rd-Party NE.

All servers, database, pollers can build with redundant with High Disaster Recovery option.

INMS provides to administrator:
- GUI of devices and Network view
- End-to-end (A to Z) circuit or LSP and protection services management with automatic node commissioning
- PseudoWire Circuit Management: PWoIP, PWoEth and PWoMPLS
- Hybrid Multi-Segments circuits A to Z with TDM + PWE3 + TDM
- Full SNMP supports functions: commands, alarms, statistics gathering
- Viewing and printing of node statistics, alarms configurable report,
- Topology management with GIS geographic maps, zoom, drag-and-drop
- Views of optical cable, cross-con-nect, panel view and resource trees
- Clock Distribution Map
- System Redundancy and Protection
- Performance monitoring in real-time and history for PM, NE and circuits
- Alarm management with filtering, notification via e-mail and SMS
- Root Cause Analysis diagnoses faults on NEs and managed circuits by status and severity levels
- System Access Security

www.LoopTelecom.com
## Multiservice TDM/PDH DACS

### Models

<table>
<thead>
<tr>
<th>Models</th>
<th>AM3430</th>
<th>AM3440-A/B/C</th>
<th>AM3440-D</th>
<th>O9550-A/C</th>
<th>O9550-D</th>
<th>V4150</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDH/SONET uplink</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TDMoE PWE3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Aggregate interface</td>
<td>2 STM1</td>
<td>2 STM1</td>
<td>4 STM1/2/4 - 4OC/32/48 - 6x64K PWE3 for SDH/SONET ADM/TM</td>
<td>2 STM1</td>
<td>2 STM1</td>
<td>4 STM1/2/4 - 4OC/32/48 - 6x64K PWE3 for SDH/SONET ADM/TM</td>
</tr>
<tr>
<td>SDH/SONET ADM/TM</td>
<td>2 FE, 2 FR, 2.5U</td>
<td>2 FE, 2 FR, 2.5U</td>
<td>4 FE, 4 FR, 4U</td>
<td>2 FE, 2 FR, 2.5U</td>
<td>2 FE, 2 FR, 2.5U</td>
<td>4 FE, 4 FR, 4U</td>
</tr>
<tr>
<td>TDMoE PWE3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TDM/PDH</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
</tr>
<tr>
<td>TDMoE PWE3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### System

<table>
<thead>
<tr>
<th>Models</th>
<th>O9150</th>
<th>O9170</th>
<th>O9400</th>
<th>O9400-PoT</th>
<th>O9500R</th>
<th>O9500R-PoT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDH</td>
<td>SDH</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
</tr>
<tr>
<td>TDM/PDH</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
</tr>
<tr>
<td>TDM/PDH</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
</tr>
<tr>
<td>TDM/PDH</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
</tr>
<tr>
<td>TDM/PDH</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
</tr>
</tbody>
</table>

### Industrial Switch

<table>
<thead>
<tr>
<th>Models</th>
<th>IP6810</th>
<th>IP6820</th>
<th>IP6830</th>
<th>IP6320A/B</th>
<th>IP6828</th>
<th>IP6340</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch</td>
<td>Layer 2 Industrial DIN-Rail</td>
<td>Layer 2/3 Industrial 19&quot;</td>
<td>Layer 2/3 Industrial 19&quot;</td>
<td>Layer 2/3 Industrial 19&quot;</td>
<td>Layer 2/3 Industrial 19&quot;</td>
<td>Layer 2/3 Industrial 19&quot;</td>
</tr>
<tr>
<td>WAN Uplink ports</td>
<td>2 x FE or 2x Fx SFP</td>
<td>2 x GX SFP</td>
<td>12 FX/GX SFP</td>
<td>8 x 10GE SFP+</td>
<td>4 x GX</td>
<td>4 x 10GE SFP+</td>
</tr>
<tr>
<td>Lan base</td>
<td>3 FE or 3 FE POE</td>
<td>2 GX SFP, 4 FE (optional)</td>
<td>4 FE/GE or 4 FE POE</td>
<td>8 FE</td>
<td>48 GE</td>
<td>3 slots for: 4 FE/GE, 4 FE POE or 8GX SFP</td>
</tr>
<tr>
<td>RS232/RS485</td>
<td>0 or 2</td>
<td>0, 4 or 8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dry Contact</td>
<td>2 In, 3 Out</td>
<td>2 In, 3 Out</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Protection</td>
<td>RSTP, MSTP</td>
<td>RSTP, MSTP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L2 protocols</td>
<td>Flow Control, VLAN port, 802.1q and Q-in-Q, QoS 802.1q, IP QoS, Link aggregation, 802.1q, Radius, IGMP Snooping v1-v3, DAM. <strong>Please check each datasheet</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Working temperature</td>
<td>-20 to 70°C</td>
<td>-20 to 70°C</td>
<td>-20 to 70°C</td>
<td>-20 to 70°C</td>
<td>0 to 50°C</td>
<td>0 to 50°C</td>
</tr>
</tbody>
</table>

### SDH/SONET and PTN with MPLS-TP transport - ADM/DM only or IPAM

<table>
<thead>
<tr>
<th>Models</th>
<th>O9150/9170</th>
<th>O9400</th>
<th>O9500</th>
<th>O9500-PoT</th>
<th>IP6750</th>
<th>G7860A</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>SDH</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
</tr>
<tr>
<td>TDM/PDH</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
</tr>
<tr>
<td>TDM/PDH</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
<td>D50/n.64Kbps</td>
</tr>
<tr>
<td>PTM/CE</td>
<td>2 STM1</td>
<td>2 STM1</td>
<td>4 STM1/2/4 - 4OC/32/48 - 6x64K PWE3 for SDH/SONET ADM/TM</td>
<td>2 STM1</td>
<td>2 STM1</td>
<td>4 STM1/2/4 - 4OC/32/48 - 6x64K PWE3 for SDH/SONET ADM/TM</td>
</tr>
<tr>
<td>SDH protection</td>
<td>MSP, SNCP</td>
<td>MSP, SNCP</td>
<td>MSP, SNCP</td>
<td>MSP, SNCP</td>
<td>MSP, SNCP</td>
<td>MSP, SNCP</td>
</tr>
<tr>
<td>SDH cross-connect</td>
<td>Add &amp; Drop VC12/VC3</td>
<td>Add &amp; Drop VC12/VC3</td>
<td>Add &amp; Drop VC12/VC3</td>
<td>Add &amp; Drop VC12/VC3</td>
<td>Add &amp; Drop VC12/VC3</td>
<td>Add &amp; Drop VC12/VC3</td>
</tr>
<tr>
<td>PTM CE/PTN</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SDH</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TDM/PDH DACS</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
</tr>
<tr>
<td>IPAM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>EoSDH</td>
<td>4 FE</td>
<td>4 FE</td>
<td>4 FE</td>
<td>4 FE</td>
<td>4 FE</td>
<td>4 FE</td>
</tr>
<tr>
<td>Maximum E1/T1</td>
<td>504 E1/T1, 120 E1/T1, 120 E1/T1</td>
<td>252 E1/T1, 120 E1/T1, 120 E1/T1</td>
<td>120 E1/T1, 120 E1/T1, 120 E1/T1</td>
<td>120 E1/T1, 120 E1/T1, 120 E1/T1</td>
<td>120 E1/T1, 120 E1/T1, 120 E1/T1</td>
<td>120 E1/T1, 120 E1/T1, 120 E1/T1</td>
</tr>
<tr>
<td>PDH services DACS</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
<td>E1, E1, E1/T1, 7070</td>
</tr>
<tr>
<td>Voice, Serial, utilities interfaces</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SDH</td>
<td>PseudoWire Emulation End to End over IP/Ethernet with TDMoEA card</td>
<td>PseudoWire Emulation End to End over IP/Ethernet with TDMoEA card</td>
<td>PseudoWire Emulation End to End over IP/Ethernet with TDMoEA card</td>
<td>PseudoWire Emulation End to End over IP/Ethernet with TDMoEA card</td>
<td>PseudoWire Emulation End to End over IP/Ethernet with TDMoEA card</td>
<td>PseudoWire Emulation End to End over IP/Ethernet with TDMoEA card</td>
</tr>
<tr>
<td>Others</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Loop Telecommunications

- **Worldwide**
  - **Europe**
    - **Americas**
      - **Australia & New Zealand**

- **Commercial grade**

---

**Contact Information**

sales@looptelecom.com | eu_sales@looptelecom.com | ncsa_sales@looptelecom.com | aus_sales@looptelecom.com

**Reach Us**

- **Americas**
  - 3.1 Imperial Ave, Mount Waverley, Victoria 3149
  - +61-413-382-931

**Website**

www.LoopTelecom.com

**V 1.2 May 2019 © 2018 Loop Telecommunication International, Inc. All Rights Reserved**

Priced pictures licensed to EPA-Technologies • Subject to change without notice

---

**LOOP TELECOMMUNICATION INTERNATIONAL, INC.**

an ISO 9001 and ISO 14001 Company