The Loop Telecom solutions of Transmission and Networking for Railway - MRT - LRT – Tramway

- TDM/PDH Multiservice access for analog, voice, sync/async data, SCADA
- GSM-R and PMR communication,
- Teleprotection for power distribution commands
- 10GE/GE PTN with MPLS-TP and Carrier Ethernet for Multiservice and Ethernet transport
- SDH/SONET transport
- TDMoE or PseudoWire Emulation transport over IP/Ethernet
- Hardened Ethernet switches for station

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Loop Telecom History
Since 1992, Loop Telecom has developed and produced in Taiwan 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 a new generation Packet Transport Network: 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 solutions according to the requirements of its major customers and compliant to recognized standards and regulations.

Loop Telecom actively pursues the following markets:

- Transportation including: Railway including High-Speed Rails, and Subways, Air traffic Control, Airport Ground Transport, ITS,
- Utilities: Power Companies, Oil, Gas and Water Companies,
- Telco, ISP,
- Military and National infrastructures,
- Industries.
These worldwide deployments are either by direct sales or through partners who also supply local service.

Different Railway’s infrastructures over the world are using the Loop Telecom solutions
We have developed and optimized Multiservice Access for Railway infrastructures with the interfaces particularly to support the Voice conferences and magneto, the PMR for communication with Rolling stock equipment, the SCADA, the RTUs, the power distribution with Teleprotection and the conventional transport of TDM and IP/LAN traffic over SDH/SONET or the packet transport in PseudoWires over IP/Ethernet and mainly over the structured PTN with MPLS-TP or Carrier Ethernet transport protocols which are adapted to this domain.

Loop Telecom has delivered networks solutions for several projects of Long Distance Railway, but also MRT, LRT and Tramway over the 5 the continents of the world.
**Railway infrastructures for long distances or intercity or municipal transports**

request secure telecommunication for:

- Voice communication service between stations, rolling stock material and central, GSM-R and PMR or Trunked Radio for maintenance teams,
- Railway signalization for rolling staff,
- SCADA, hot box detector...using analog, asynchronous or synchronous data interfaces,
- New generation SCADA with Ethernet or IP interfaces,
- Teleprotection for the power grid infrastructure,
- IP Video-surveillance, IP-CCTV,
- Ticketing and customer services as information and Internet distribution
- Physical access control to the sites of the power network
- LAN distribution for railway operator...

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

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

**Short Telecom Glossary**

**Multiservice TDM/PDH** The multiple 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 framed 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 SNCP/MSP/MS-SPRing in ring, bus or Mesh infrastructures, independent synchronization and with an 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 as Ethernet connectivity and multicast video.

**G.8032** This ITU-T protection of PTN, MPLS, CE networks provide a ring protection with a recovery time below 50ms.
Multiservice Access Multiplexer
DS0/T5 Cross-Connect DACS:

AM9900-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, 2Mbps for Voice, VoIP, async and synch serial data, contacts, Ethernet EoPDH.

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

O9400R with multiples STM-1/4/16, E1/T1, E3/T3 and EoS Gigabit Ethernet

O9150S with 2 STM1, 16 E1, EoSDH: 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 DSO Voice and Data multiservice cards

O9170S with 2 STM-1, 16 E1, EoS: 4 FE GE*, E&M, FXS/FXO, RSxxx, Vxx

The Railway, MRT, LRT and Tramway infrastructures are using several type of interfaces for the Signaization, the SCADA, the Voice and Data communication between stations and between rolling stock material and land installation over GSM-R, Radio or rail communication for infrastructure and railway engines.

Multiservice access multiplexers connect in the stations and along the railway lines RTUs, SCADA, hot boxes detectors, counters, analog conference voices, VoIP and multiple dry contacts...

MULTISERVICE DACS cross-connect supports the access of analog and digital customer interfaces, their conversion in TDM (PDH) data which are organized in nx64kbps (DS0) circuits and 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 of power network,
- Trunked Radio or PMR or TETRA which are using E1 links or IP radio over the fully secured EoPDH or EoS.
- Analog Services E&M or conference interfaces for analog RTUs, low speed sensors, Vxx modem based application that are used by SCADA and for remote command,
- Serial Synchronous/Asynchronous services are RS232, RS485, RS422, X21, V35, IEA530, G703 64kbps co-directional and contra-directional interfaces that cover 300bps to 2Mbps rates and provide SCADA services with transport over E1/T1 copper/radio/fiber, SDH/SONET over fiber, IP PseudoWire transport or Analog Radio or over PLC lines.
- Teleprotection for electrical power distribution with TDM interfaces : optical IEEE C37.94, X21, E1, G703 64kbps to teleprotection units or the Digital Lines configurable blocking/permisive/direct tripping toward protection equipment.
- Access control of sites with Dry Contact and Ethernet interfaces
- Weather station, distributed LAN services...

The SDH transport infrastructures are carrying the Multiservice and Ethernet application for CCTV, Passenger Information, physical access... with high level of security, permanent bandwidth availability, low latency and high OAM end-to-end control.

The SDH/SONET Transport provides the interconnection of Multiservice nodes, for high speed train generally two dual independent 2.5G STM-16/OC-48 networks are used, each with dual SNCP rings and Mesh protection over the global infrastructure with:
- High level of the Protection, by redundant CPU, cross-connect, power supplies, aggregate and tributaries interfaces and by WAN protection as Mesh SNCP, MSP 1+1 and dual homing of central chassis.
- Distribution of the Synchronization to all SDH and PDH nodes that insure stability, no-noise and no-missing data transport for key applications.
- Ethernet transport optimized by permanent EoS technology.

The Loop Telecom IMAP devices includes in same chassis the Multiservice Access and the SDH/SONET Transport to provide DACS DSO access function plus synchronous transport with:
- Full SDH/SONET and DSO access functions, multiples 2.5Gbps rings with protection, clock distribution... and a single node to manage,
- Multiservice DSO 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.

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for Signalization, RTUs, SCADA, GSM-R, voice, power distribution...

Loop Telecom Access & Transport with low latency and high security level for all services...

The conventional deployment of Multiservice and Telecom for railway infrastructure, particularly for long distance is facilitated by the Loop Telecom solutions based on TDM and Layer 2 and 3 Ethernet.

At the EDGE of network the AM3440, AM3430, O9550 provide the Multiservice access of all Voices, PMR or GSM-R, Analogs, low rate synchronous, asynchronous or Ethernet RTU/PLC thanks to the multiple modular interfaces. They convert these information to n x 64Kbps, E1/T1, VC12 TDM circuits with the right synchronization. Some dedicated interfaces as C64, TTA take care of the Teleprotection information transport for Railway power distribution.

The O9400R SDH/SONET carry this TDM multiservice circuits from station to station and major railway center with protected optical pipes, secured and low latency transmission. According to the demand we can provide single networks with dual ring that support SNCP+MSP protection, but we can manage dual parallel networks, with Mesh circuits and dual homing in central.

To save the number of nodes we can use the IMAP, or combined Multi-Service and SDH/SONET, with O9500R system.

All Multiservice, SDH/SONET, IMAP devices are managed by INET or iNMS centralized systems with automatic commissioning and a complete information/alarm system of the network.

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

During the last 26 years Loop Telecom has developed and accumulated the knowledge of voices, analogs, low rate data interfaces required by the different domains like the Railway and which are issue from historical manufacturers.

Thanks to these experiences we have developed and reworked because of new technologies the access and transport of key interfaces for narrow technical customers such in Railway domain.

N x 64Kbps interfaces are available in TDM equipment and also in some packets Loop Telecom equipment, see the following pages.
The customer can request a partial migration of application in packet transport or use an existing IP/MPLS transport infrastructures. Loop Telecom proposes Multiservice Access devices with TDM PseudoWire Emulation End to End (PWE3) over IP or Ethernet networks. In these devices analog-voice-async-sync services are supported as TDM PW transport and added with local Ethernet services over GE fiber WANs from station to station or to major railway center. We produce stand-alone, card for DACS multiplexer or concentration devices.

The IP6704A Access Multiservice gateway will connect small sites, with voice/data standards interfaces: E1, E&M, FXS... RS232, Codirectional, C37.94... and IP applications over fiber or wireless Ethernet toward the next station or to major center where a AM3440 DACs as equipped with TDMoEA cards will concentrate up to 64 PseudoWires.

WAN interconnection can use GE link or existing IP/MPLS network. 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 512 PseudoWires traffic from STM-x/OC-x interfaces from small remote sites with few DS0/TS.

INEt EMS and iNMS NMS manage all these PseudoWire and PTN equipment together with TDM and SDH/SONET multiplexer. They manage end-to-end circuits with a mix of TDM and PTN transport. See page 11.
Transport of analog, synchronized low rate and large packet traffic

Full Railway Signalization, SCADA, Voice, GSM-R, Teleprotection ... over PTN with MPLS-TP

As applications are moving to packet communication, the Ethernet demand has grown dramatically, but even reduced, the TDM multiservice require stable bandwidth, low latency with high level of security of transport. Loop Telecom PTN solution run with MPLS-TP or CE protocols and combine in 10GE pipes the stable TDM PseudoWire and the evolutive Ethernet traffics. The G7860A PTN-MPLS-TP, with 10GE, GE and up to 32 E1, STM/OC interfaces, build 10 Gigabit packet transport with frequency and phase synchronisation, OAM, fixed and optimize bandwidth control and LSP protection more flexible than SDH/SONET.

The O9400R-PTN/O9500R-PTN are SDH or IMAP system with integrated 200GB switch with 6 x 10GE and up to 20 GE and support together the PTN MPLS-TP, the SDH/SONET networks and the multiservice access. Deployment for new railway transmission networks can be a combination at EDGE of AM3440, AM3430, O9550 for multiservice access/concentration, IP63xx/IP68xx Layer 2 and 3 industrial switches and G7860A or O9400R-PTN for transport. All multiservice, SDH/SONET, IMAP, PTN MPLS-TP/CE devices, Switches are managed and hybrid circuits are created end-to-end from/to TDM by crossing PseudoWire over MPLS-TP by the iNET or iNMS centralized systems with automatic commissioning.

Migration of Analog Voice, Conference, RTUs over Ethernet fiber, IP or MPLS networks

In case the Railway customer like to migrate only a part of multiservice applications, or use an existing MPLS network or simply fibers, Loop Telecom supplies TDM access multiplexer, combine with PseudoWire gateway and Layer 2 switch for LAN traffic. These solutions with SyncE GE WAN are available as compact device IP6704A or TDMoEA card for AM3440 DACS. They support all voice, low rate data interfaces plus Ethernet traffic with QoS.

IP6704A has redundant power supplies, WAN is secured with RSTP/MSTP protection. Internal L2 switch with VLAN, QoS... and 4 GE ports supports the TDM PW services and additional IP services: IP-voice, IP-Video, access control...

An AM3440 with TDMoEA card in central node concentrate up to 64 PseudoWires.

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The Railway, MRT, LRT and Tramway customer are developing a growing number Ethernet or IP applications for the organization of transport infrastructure as automatic transport, SCADA, power distribution, security, stations without personal, customer services, CCTV with permanent analysis and they request a high level of reliability and security.

Loop Telecom proposes hardened switches conform to railway substation EN50121-4 and electrical substations environment with IEC-61850-3/IEEE-1613 standard.

Layer 2 and Layer 3 switch:
The IP6820, IP6320A and IP6828 switches support highly developed IP stacks of Layer 2 transmission including the IEEE: 802.3x Flow Control, 802.1q VLAN and 802.1ad Q-in-Q, port isolation, 802.1p QoS, 802.3ad Link Aggregation Control Protocol (LACP). Administration is with secured access 802.1X Radius and SSH2, https and SNMP v3 communication.

Router versions of IP6320A and IP6828 support Static and VLAN routing, RIP v1, v2, OSPF and Layer 3 services as VRRP, IGMP v1,v2,v3 and PIM.

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 over 100 per ring 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 own 8 or 4 x 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 fixed to DIN-Rail. Different models are powered by dual inputs or dual power supplies -48v or -24V and built with components for FAN-less in hardened environment up to 70°C.

19” concentrator switch concept:
The IP6320A and IP6828, 19” 1U switch are supplied with dual AC or DC 48v redundant power supplies and they are rated 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 up to 24 POE/POE+ ports. The POE/+ ports and power limits are remotely manageable.

Automatic discovery of ring with NTU and 64/128 RTU:
For deployment of independent rings 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 setting 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 11.

Power supply:
All Loop Telecom switches, are powered with simple or optional dual power supply AC or DC 48volts.
In the infrastructure, hardened and EN50121-4 environment

LRT, Tramway transmission networks for Signalization, SCADA, Voice services, Customer ticketing and services, Power teleprotection ...

CCTV infrastructure and full video solution with analysis for public sites: station, airport...

The telecommunication for the deployment of LRT, Tramway, Buses infrastructure/stations along short or medium distances is more appropriate to use Ethernet solutions. Thanks to the protocols: Layer 2 as the G.8032 ring, or the Layer 3 VRRP or PIM-SM/DM for multicast application, all give the possibility to deploy secured transmission in such configuration. According to environment requirements of these infrastructures, Loop Telecom supply switches with EN50121-4 railway station compliance. Our solution support VLAN and Q-in-Q with QoS with 8 queues and bandwidth control to organize the different services on the same trunk. In case of request from services as analog interfaces, contact or the teleprotection for the tramway power distribution, we can combine with PseudoWire equipment described in the previous pages. iNET and iNMS systems are supporting switch organization and management of Loop equipment and some function of other equipment.

Loop Telecom has supplied several secured switches CCTV infrastructures for large public site airport, railways station, conference center... With partners we also supply full CCTV solution including hardware cameras, video servers for recording, image synchronization, video streaming and software for analysis like: intrusion, gate flow, occupancy rate, left object, stolen object, vehicle license plate.... Such Ethernet G.8032 ring infrastructure run over 60 IP6820 GE industrial switches, which connect up to 8 POE+ cameras. In central video node two IP6320A, layer 3 10GE switches with VRRP protection, can support few hundred cameras in CCTV installation. iNET management system support Loop switches, and third product cameras and access server.
Optimization of fiber
CWDM/DWDM Multiplexing

CWDM and DWDM solution

Modular solution* with colored SFP, direct access or with transponder to support up to 32 wavelengths on the same pair of fiber.

WDM1601 CWDM filter to mux and demux 4 or 8 CWDM lambda plus a standard 1310nm links SDH/SONET and Ethernet up to 10GE per channel over a pair of fiber.

Ethernet, E1/T1 backhaul over fiber and DSL

Standalone or card

O9310 fiber optic 1+1 modem, point to point for 4E1 and Ethernet,

O9340S/R modular 1+1 fiber 1.25G optical multiplexer. Up to 32 E1/T1 or 8 combo GX SFP. Standalone and rack version.

G.SHDSL/Bis modem and multiplexer

H3310 1 or 2 pairs, up to 5.7Mbps
1 or 2 interfaces E1/T1, DTE, Bridge, Router

H3308S 2, 4 or 8 bounded pairs, up to 45Mbps Ethernet

Chassis for Fiber Optic and G.SHDSL/Bis modems multiplexer

C5600 5U Chassis with SNMP management support up to 60 DSLs lines and a mix of fiber and DSL cards.

To optimize the fiber installation particularly in MAN infrastructures particularly for MAN infrastructure < 70km, 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 10Gigabit 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.

Railway operators are deploying GSM-R along their railway lines but they install BTS generally at few km from transmission nodes to cover large radio radius. Loop Telecom supply for these installations E1/Ethernet backhaul over fiber or G.SHDSL/Bis modem or multiplexer. These line extension are also used for 2G/3G/LTE BTS deployment.

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 bounding 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 in Power Companies, Transportation infrastructures...

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 or 60 DSL lines 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.

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Ethernet devices are managed by Web browser or CLI and the TDM, SDH/SONET, TDMoE equipment are managed through local or remote interface by Text menu or by INET-LCT optional Windows local craft interfaces.

**INET-EMS** 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
- Graphical Cross-connection Tool
- File Transfer
- Currently Active Alarm Summary (CAAS)
- North Bound Interface (NBI)
- Trend Grapher
- Threshold
- TDM Circuit Management
- TDM Diagnostics Management

**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 + PW3E + 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

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### Multiservice TDM/PDH DACS

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<th>AM3430</th>
<th>AM3440-A/B/C</th>
<th>AM3440-D</th>
<th>O9550R-A/C</th>
<th>O9550R-D</th>
<th>V4150</th>
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</thead>
<tbody>
<tr>
<td><strong>Multiplexer</strong></td>
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<tr>
<td>SDH/SONET uplink</td>
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<tr>
<td>TDMoE PWE3</td>
<td>-</td>
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<tr>
<td><strong>Modular chassis</strong></td>
<td>1U</td>
<td>A=SU/2/2SU/C=SU</td>
<td>2U</td>
<td>A=SU/C=SU</td>
<td>2U</td>
<td></td>
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<tr>
<td>Aggregate interface</td>
<td>4 E1/FE1, copper or fiber</td>
<td>Any E1 or T1 copper or fiber can set as WAN</td>
<td>4 STM1/4, any E1 or T1</td>
<td>Any E1, T1, STM/DC</td>
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<tr>
<td>TDM/PDH backbone n x 64Kbps</td>
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<td>PDH protection</td>
<td>1+1, SNCP 64K</td>
<td>1+1, SNCP 64K,ULSR</td>
<td>1+1, ULSR</td>
<td>1+1, SNCP 64K,ULSR</td>
<td>E1/T1 1+1</td>
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<tr>
<td>SDH protection</td>
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<tr>
<td><strong>Tributaries cards: slots</strong></td>
<td>4 mini Slots</td>
<td>4 mini + A= 12/B=3/C=5</td>
<td>9 mini Slots</td>
<td>4 mini + A= 12/B=3/C=5</td>
<td>6 slots</td>
<td></td>
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<tr>
<td><strong>FE1/FT1</strong></td>
<td>4 E1/FE1/1 CAS/T1/0</td>
<td>1 or 4 E1/FE1/FT1 or T1, FT1, E1 or T1 fiber</td>
<td>63 E1, 63 T1, 3 E3/T3</td>
<td></td>
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<tr>
<td><strong>Voice</strong></td>
<td>E&amp;M 2w/4w, FXO, FXS, E1-CAS, Magneto*, Conference*, VoIP*, Echo Cancel</td>
<td>(* not for AM3430, AM3440D, O9550D)</td>
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<tr>
<td><strong>Serial sync</strong></td>
<td>X3, X1* - n 64k to 2Mbps</td>
<td>X21, X35, X36, IEEE530, RS322, RS445 64Kbps to 2Mbps and subrate 64k with V110</td>
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</tr>
<tr>
<td><strong>RS232/RS485</strong></td>
<td>Asynchronous</td>
<td>Asynchronous, 64K sub-rate with X50, V110 or V110, or V100 or V100, or V100</td>
<td></td>
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</tr>
<tr>
<td><strong>Teleprotection</strong></td>
<td>Fiber C37.94</td>
<td>Fiber C37.94, TTAT* card: Teleprotection tripping lines direct/blocking/permisive</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Others</strong></td>
<td>G703 64K co-directional, G703 64K co-directional or contra-directional, OC15*, Dry contact Input / Output and Input to TRAP SNMP*, G.SHDSL 2W or G.SHDSL 2W*</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>ETERNET &amp; EPoH</strong></td>
<td>Bridge E-Line</td>
<td>Bridge E-Line, E-LAN - Router</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ports/WANs per card</strong></td>
<td>2 FE,2 WAN, 2Mbps</td>
<td>2 FE,2 WAN, 2Mbps 4 or 8 FE, 64 WAN, 64Kbps to 2Mbps and MUX/PPP * per card (*-support 4Mbps max)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TDMoE PWE3</strong></td>
<td>-</td>
<td>TDMoE card: 2GE WAN and 2GE LAN, 64 PWE3, emulation CESoPSN, SAT, MEF-8</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Environment</strong></td>
<td>Industrial</td>
<td>FANLESS, IEEE1613/ IEC61850-3/5- EN50121-4-FAN</td>
<td></td>
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</tbody>
</table>

### SDH/SONET and PTN with MPLS-TP transport - ADM/TM only or IMAP

<table>
<thead>
<tr>
<th>Models</th>
<th>O9150</th>
<th>O9170</th>
<th>O9400R</th>
<th>O9400RTN</th>
<th>O9500R</th>
<th>O9500RTN</th>
<th>IP6750</th>
<th>G7860A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System</strong></td>
<td>-</td>
<td></td>
<td>SDH</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
<td>SDH/SONET</td>
<td>-</td>
<td>SDH/SONET</td>
</tr>
<tr>
<td><strong>Aggregate interfaces</strong></td>
<td>Fixed 1U</td>
<td>Fixed 1U</td>
<td>Modular 6U</td>
<td>Modular 6U</td>
<td>Modular 6U</td>
<td>Modular 6U</td>
<td>Modular 1U</td>
<td>Modular 1U</td>
</tr>
<tr>
<td><strong>SDH protection</strong></td>
<td>SNP, SNP</td>
<td>SNP, SNP</td>
<td>SNP, MESH, SNAP, MSP, SP*</td>
<td>HOST PROTECTION*</td>
<td>*</td>
<td><strong>PTN MPLS/CE</strong></td>
<td><strong>PTN MPLS/CE</strong></td>
<td><strong>PTN MPLS/CE</strong></td>
</tr>
<tr>
<td><strong>SDH cross-connect</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6 x 10GE, 16 GE</td>
<td>6 x 10GE, 16 GE</td>
<td>2 GE SPF, 8 GE, CB</td>
<td>6 x 10GE, 20 GE</td>
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</tr>
<tr>
<td><strong>EoSDH</strong></td>
<td>4 FE, GE*</td>
<td>4 FE, GE*</td>
<td>4 FE</td>
<td>4 FE, GE*</td>
<td>4 FE, GE*</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Maximum E1/T1</strong></td>
<td>16 E1</td>
<td>8 E1</td>
<td>504 E1/T1, E3/T3</td>
<td>378 E1/T1, E3/T3</td>
<td>252 E1/T1, E3/T3</td>
<td>126 E1/T1, E3/T3</td>
<td>16 E1 T1</td>
<td>32 E1/T1</td>
</tr>
<tr>
<td><strong>PDH services DACS</strong></td>
<td>E1, E1, E703 CD</td>
<td>E1/E1, T1/T1, FT1, FT1, E703 CD</td>
<td></td>
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</tr>
<tr>
<td><strong>PWE3 over IP/Ether.</strong></td>
<td>For E1/E1/E3/T3/VCC</td>
<td>For E1, T1</td>
<td>For E1/E1, ETH</td>
<td>For E1, ETH</td>
<td>For E1/E1, ETH</td>
<td>For E1/E1, ETH</td>
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<tr>
<td><strong>PW2S over MPLS-TP/CE</strong></td>
<td>For E1/E1/E3/T3, VCCx</td>
<td>For E1, T1, ETH</td>
<td>For E1, ETH</td>
<td>For E1, ETH</td>
<td>For E1, ETH, ETHx</td>
<td>For E1, ETH, ETHx</td>
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<tr>
<td><strong>Environment</strong></td>
<td>FANLESS</td>
<td>FANLESS</td>
<td>Version FANLESS : IEC61850, EN50121-4*</td>
<td>Version FANLESS : IEC61850, EN50121-4*</td>
<td>FANLESS</td>
<td>New version</td>
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</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><strong>Switch</strong></td>
<td>-</td>
<td>Layer 2/3</td>
<td>Industrial 19&quot;</td>
<td>Layer 2/3</td>
<td>Industrial 19&quot;</td>
<td>Layer 2/3</td>
</tr>
<tr>
<td><strong>WAN Uplink ports</strong></td>
<td>2 x FE or 2 FX SFP</td>
<td>2 x GX SFP</td>
<td>12 FX/GX SFP</td>
<td>8 x 10GE SPF</td>
<td>4 x GX or 4 x 10GE SPF</td>
<td>4 x GX SFP</td>
</tr>
<tr>
<td><strong>LAN base</strong></td>
<td>3 FE or 3 FE POE</td>
<td>2 GX SFP, 4 FE/GE option</td>
<td>4 FE/GE or 4 FE/GE POE</td>
<td>48 GE</td>
<td>3 slots: for 8 FE/GE, 8 FE/GEO or 8 GX SFP</td>
<td>24 GE</td>
</tr>
<tr>
<td><strong>RS232/RS485</strong></td>
<td>0 or 2</td>
<td>0, 4 or 8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Dry Contact</strong></td>
<td>2 Inp, 2 Out</td>
<td>2 Inp, 2 Out</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Protection</strong></td>
<td>RSTP, MSTP</td>
<td>RSTP, MSTP, G.8032</td>
<td>RSTP, MSTP, G.8032</td>
<td>RSTP, MSTP, G.8032</td>
<td>RSTP, MSTP, G.8032</td>
<td></td>
</tr>
<tr>
<td><strong>L2 protocols</strong></td>
<td>Flow Control, VLAN port, 802.1q and Qin-q, G.9030 803.1p w 8 queues, Link aggregation, 802.1x, Radius, 802.1x Radius, 802.1x radius, 802.1x, SNMP 802.1x, DAM. <strong>please check each datasheet</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>L3 protocols</strong></td>
<td>Static, OSPF, BGP, VRRP, PIM</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Working temperature</strong></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>-20 to 70°C</td>
<td>-20 to 70°C</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td>IEC61850-3/IEC6161</td>
<td>IEE18163/EN601850-3</td>
<td>Industrial grade</td>
<td>FL: IEE1613/EN61850-3.4</td>
<td>EN50121-4</td>
<td>EN50121-4/EN50121-5</td>
</tr>
</tbody>
</table>

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