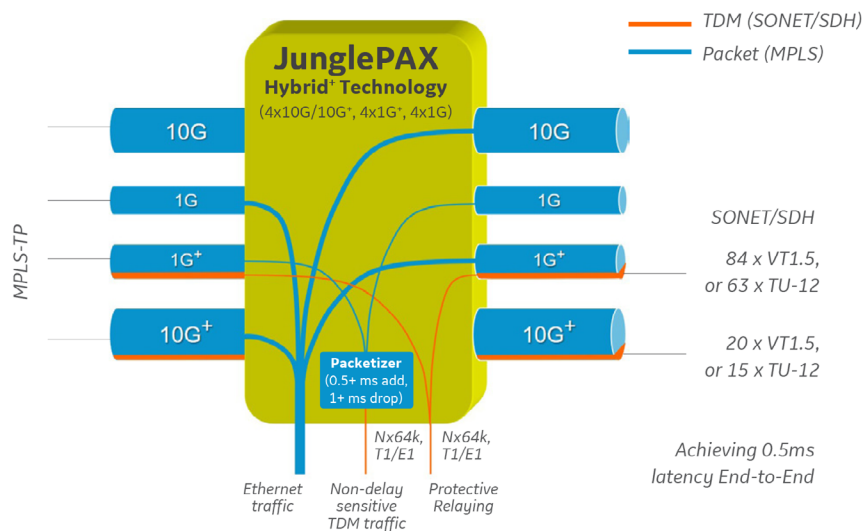# Grid Solutions

LENTRONICS JUNGLEPAX

Packet Switched Networking Solution for Teleprotection with Hybrid[+] Transport Capabilities

GE Vernova's Lentronics™ JunglePAX™ is an ideal communications solution specifically designed for utility operations, providing the required security and dependability through layers of redundancy. The platform is based on MPLS-TP (Multi-protocol Label Switching - Transport Profile) technology that maintains deterministic performance through packet based communications to provide utilities with increased efficiency and ease of integration.

The JunglePAX (JPAX) platform employs an optimized version of MPLS-TP, which offers a converged communications platform to reliably add/drop and transport 64 kbps, T1/E1 and Ethernet services across an optical Wide-Area Network (WAN). With a flexible mix of WAN connectivity, access options, and hardware redundancy on critical modules and control functions, the JunglePAX provides utilities a cost-effective, streamlined solution to protect utility assets and improve system reliability.

Hybrid[+] Transport Mode

To minimize latencies and asymmetric delays for teleprotection services, the JPAX platform implements an innovative Hybrid[+] technology that allows for optionally carrying TDM services over the SONET/SDH transport layer established alongside the MPLS-TP transport layer (without impacting its capacity) over the same fiber. This innovative transport concept offers the best of both worlds by preserving SONET/SDH performance in a packet-switched network without a need for additional fibers or advanced traffic engineering.

JunglePAX Hybrid[+] Technology (4x10G/10G[+], 4x1G[+], 4x1G)

TDM (SONET/SDH)
Packet (MPLS)

MPLS-TP: 10G, 1G, 1G[+], 10G[+]

SONET/SDH: 84 x VT1.5, or 63 x TU-12 / 20 x VT1.5, or 15 x TU-12

Achieving 0.5ms latency End-to-End

Packetizer (0.5+ ms add, 1+ ms drop)

Ethernet traffic / Non-delay sensitive TDM traffic (Nx64k, T1/E1) / Protective Relaying (Nx64k, T1/E1)

Purpose-built for Teleprotection and Superior Performance

- High speed protection switching within 3ms
- Low end-to-end service latency within 4 ms for MPLS-TP transport layer and within 0.6 ms for SONET/SDH transport layer (excluding propagation delay)
- Designed with layers of redundancy for improved security and dependability
- 'AAA' secured for improved reliability

Single Solution Converging and Simplifying Operations

- Flexible design for deployment across backhaul, aggregation and access networks
- One box solution for mission critical OT and IT networks, capable of connecting multiple and diverse applications
- Integrated and application-driven software simplifies network management
- Network-wide summary and status information dashboard for simplified health and integrity validation

Ruggedized and Modular Design Lowering Total Cost of Ownership

- Industrially hardened with no cooling fans for longer life in harsh environments
- IEEE 1613 and IEC 61850-3 compliant
- Processes 24 Gb/s of traffic across the extended -20°C to + 60°C operating temperature
- Flexible redistribution of service ports
- 10x the capacity of many traditionally designed SONET/SDH networks

GE VERNOVA

Key Benefits

- Supports packet-over-packet, TDM-over-packet (TDMoP), and TDM-over-SONET/SDH (TDMoS) transport over the same fiber

- Improves service quality with a secure and dependable platform that provides reliable communications for utility applications within harsh industrial environments

- Maximizes service uptime using robust hardware to ensure utility-grade performance through layers of redundancy.

- Addresses emerging applications by implementing a flexible and scalable solution to assist with network convergence where traffic and application mix change

- Improves system-wide manageability with integrated and application-driven software that simplifies network management.

- Increases control and promote information assurance with an advanced cyber-security platform that employs defense-in-depth strategies

- Protects the electronics from pests, liquid, dust, and industrial contaminants thanks to patented shelf mechanics with convection cooling chimneys
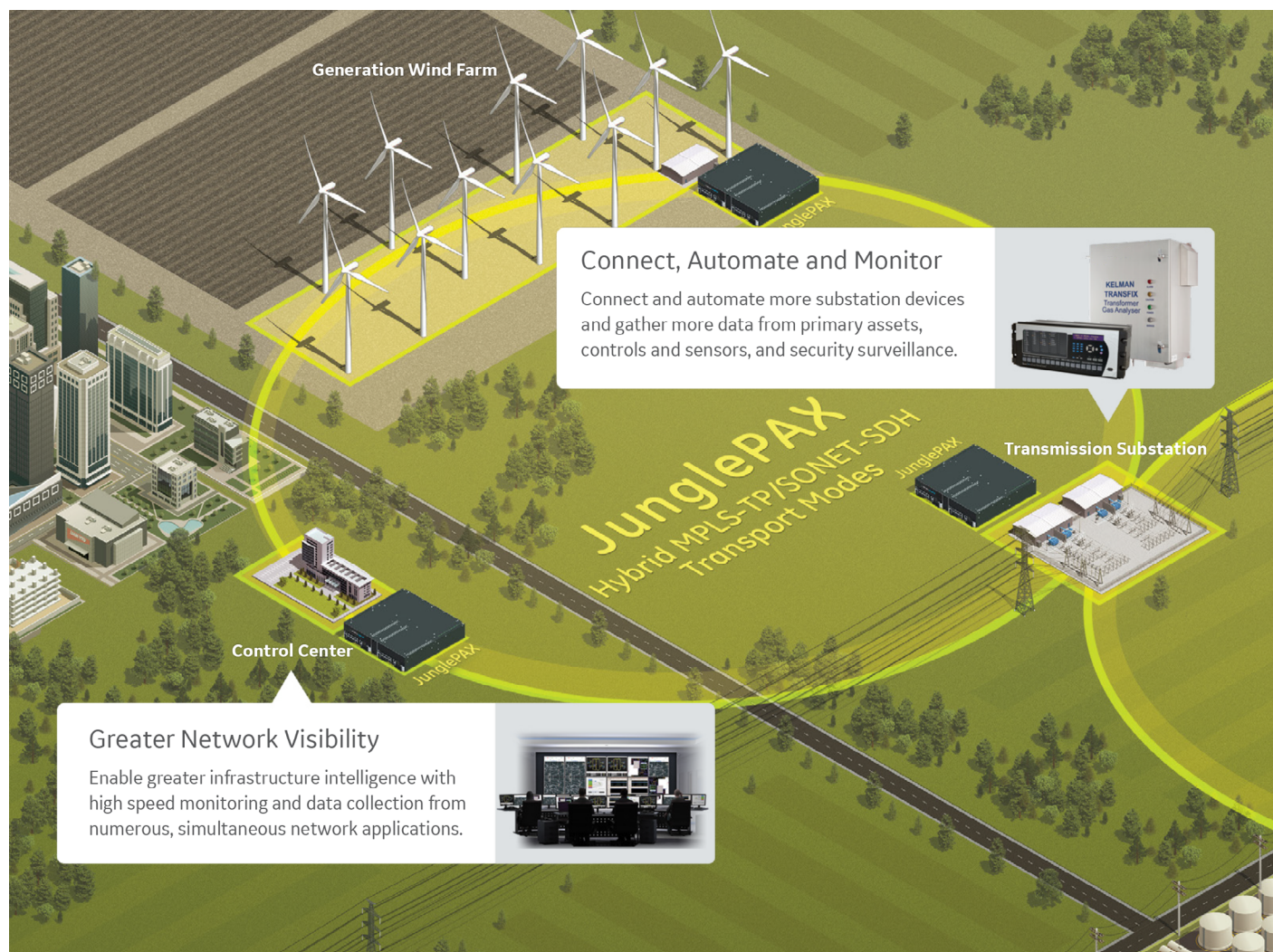
Customer Challenges

Power Utility Environment

A utilities' communication network is critical to their business operations as they interconnect an array of intelligent electronic devices that enable the reliable and safe delivery of electricity from generation to power consumers. In addition to protecting people and energy assets, utilities are concerned with improving operational efficiency, service quality, maximizing service uptime and mitigating risks associated with cyber-threats.

Power Utility Applications

Critical operational traffic includes applications such as transmission line protection. Essential OT/IT applications are vast and include SCADA, metering, surveillance, maintenance and emergency voice trunking, business service backhaul, remedial actions schemes, real-time fault analysis and intrusion detection.

Lentronics JunglePAX Application Overview

Generation Wind Farm

Connect, Automate and Monitor
Connect and automate more substation devices and gather more data from primary assets, controls and sensors, and security surveillance.

JunglePAX
Hybrid MPLS-TP/SONET-SDH Transport Modes

Transmission Substation

Control Center

Greater Network Visibility
Enable greater infrastructure intelligence with high speed monitoring and data collection from numerous, simultaneous network applications.
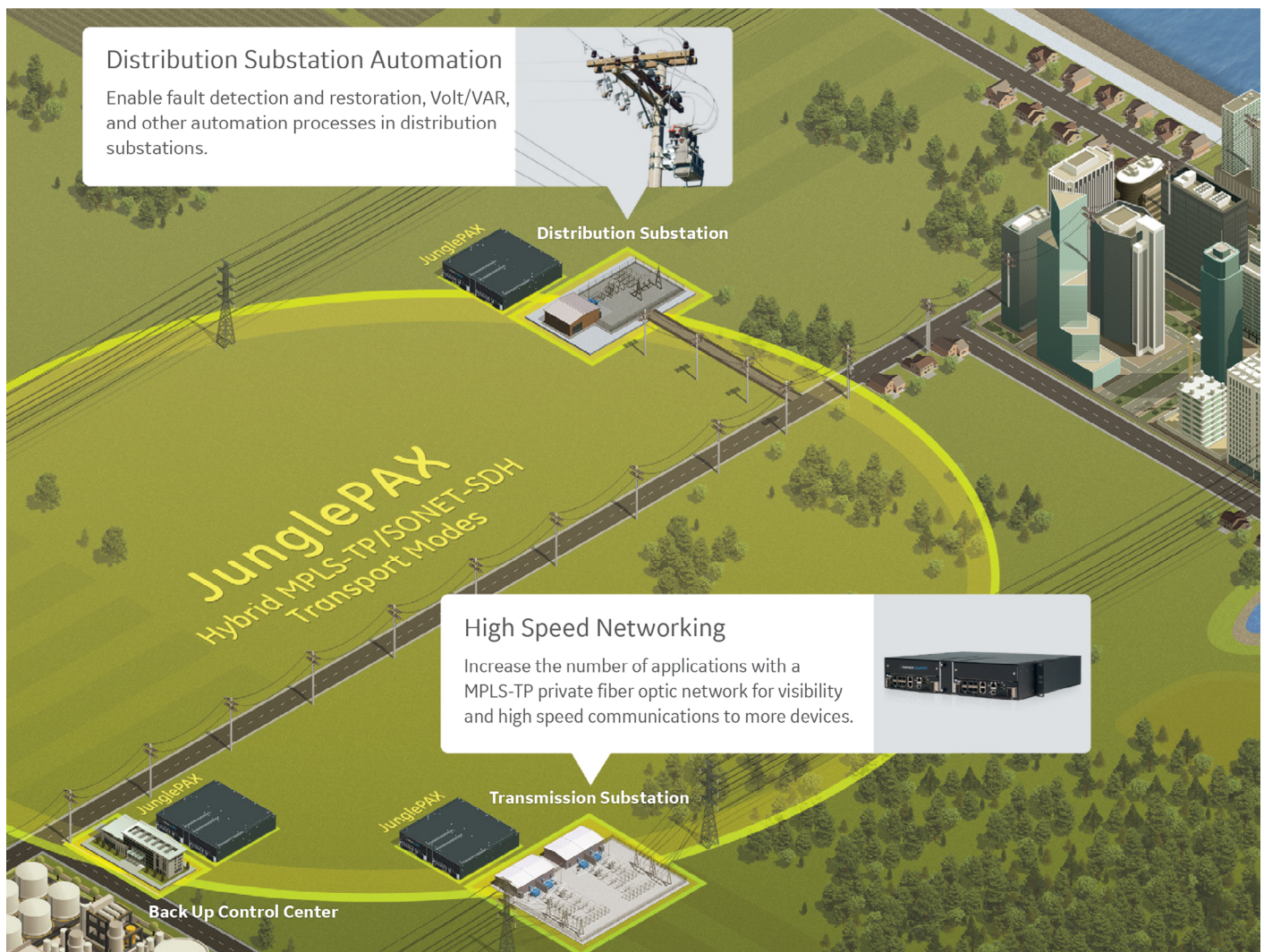
Changing Environment

Without careful planning, essential operational applications may become compromised as new applications and technologies are layered onto the network.

New applications deployed at more locations and supported through newer intelligent field devices each generating more data place pressures on communication networks. Utilities challenged to protect the performance of their essential operational traffic while supporting these next generation service must additionally consider:

- The demand for real-time control in energy delivery and consumption, which requires new system visualization capabilities.
- Network integration of previously segmented and disparate networks from backhaul to the edge.
- The increasing pressure to lower the utility communications operational costs and total cost of ownership.
- Converging onto one network that increases system capabilities and reduces complexity.

Distribution Substation Automation
Enable fault detection and restoration, Volt/VAR, and other automation processes in distribution substations.

Distribution Substation

JunglePAX
Hybrid MPLS-TP/SONET-SDH
Transport Modes

High Speed Networking
Increase the number of applications with a MPLS-TP private fiber optic network for visibility and high speed communications to more devices.

Transmission Substation

Back Up Control Center

GE Vernova's Solution

GE Vernova's Lentronics JunglePAX is a purpose-built fiber optic solution for high-performance industrial communication networks requiring mission-critical and time-sensitive communications within harsh utility environments. The platform provides private, secure, and reliable communication between collection/access sites, and guarantees performance over aggregation and backhaul networks for protection and/or control. The JunglePAX has been designed for utilities with standards-based MPLS-TP for superior performance of packet delivery and network operations, taking into consideration the operational and environmental conditions and addressing the communication challenges that utilities are currently facing as well as meeting future business needs.

The JunglePAX provides the following benefits:

- Designed for teleprotection and superior performance
- Single solution converging and simplifying operations
- Ruggedized and modular design lowering total cost of ownership

The JunglePAX employs an optimized version of the MPLS-TP standard for utilities that provides connection-oriented transport to enable security and dependability. The fully redundant and custom 1+1 protected CORE hardware provides redundancy for critical functions, including real-time control of traffic carried over the Wide Area Network (WAN) and between CORE modules, and a dedicated embedded management system (eMS) for system-wide element level management tasks.

Client services fed through dedicated Ethernet and TDM access modules into redundant CORE WAN modules where application-defined quality of service settings are applied. Hardware-assisted bidirectional fault detection (BFD) coupled with link down indication messages (LDI) and redundant paths allows for fast switching of all client services. The JunglePAX is industrially designed to protect the sensitive electronics from contaminations and is fanless, thus providing a perfect solution for imperfect substation environments.

Engineered Service Quality

JunglePAX employs trTCM-ColorBlind and trTCM-ColorAware Policing Schemes per RFC 4115 for Ethernet-based services. Both Policers and Monitors are available to users at access points and WAN ports (per service/pseudowire) to allow them to engineer SLA (service level agreements) across the entire service/psuedowire path.

For each Ethernet service, users define Committed and Excessive Information Rates (CIR/EIR) as well as Committed and Excessive Burst Sizes (CBS/EBS). The JunglePAX firmware calculates gross information rates for individual pseudowires to allow for accurate WAN link bandwidth engineering and real time monitoring of individual service/pseudowire contributions to each WAN link's bandwidth.

For TDM traffic carried over the MPLS-TP transport layer, bandwidth allocations on WAN links are automatic. Additionally, critical TDM traffic is assigned the highest priority for the best possible latency and packet jitter performance.

The TDM traffic carried over the SONET/SDH transport layer does not require any traffic engineering in addition to standard TDM bandwidth allocation. It also enjoys sub-millisecond latencies critical for mission critical teleprotection applications.

Ideally Suited for Teleprotection

The JunglePAX platform employs an optimized version of MPLS-TP to deliver teleprotection with utility-grade performance. Designed with layers of redundancy, there is no single point of failure, providing customers with an assurance that critical teleprotection circuits are delivered securely and dependably across the network.

Benefits of JunglePAX Networks Include:

- Perform critical low latency applications where security and dependability must be guaranteed
- Employ hardware-based fault detection with protection switching within 3 ms to restore services via route diversed paths (versus 50 ms for standard MPLS-TP/SONET/SDH equipment)
- Utilize Synchronous Ethernet (SyncE) to tightly control variability in transmission that affects critical communication services
- Support co-routed bidirectional paths to eliminate asymmetrical delays that affect critical communication services across a network
- Provide determinism via a connection-oriented approach to packet transmission
- Permit static assignment of working and protect paths to ensure application performance and eliminate complexity associated with dynamic control plane protocols

Traffic policing and monitoring of JPAX nodes in eMS
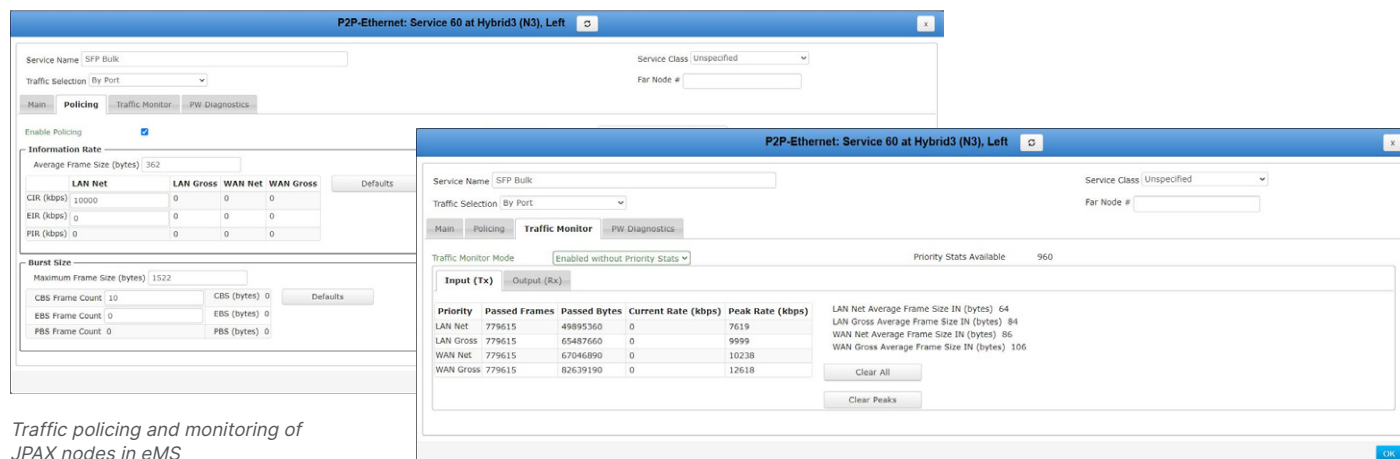
Single Solution for Converged Applications

The Lentronics JunglePAX has been designed as a single box solution primarily for critical operational traffic and additionally supports differentiated IT applications, eliminating the need for separate access, aggregate and core networking products. Through a flexible mix of interfaces and networking protocols, utilities can scale up or scale down to address the diverse needs of each application.

Key features of the single solution design include:

- Integrated Wide-Area interfaces and 16 local access ports supporting 64k, Nx 64k, TDM and 10/100/1000M Ethernet services
- Supports both Label Edge and Label Switching Router functions
- Built on open standards, interoperable for mixed-vendor heterogeneous environments
- Integrated (embedded) management system provides redundant, network-wide status and control without relying on an external NMS engine
- An external NMS solution capable of managing over a thousand device types via numerous protocols (SNMP, CLI, NETCONF) simplifies the network management model, thus reducing operating costs and complexity
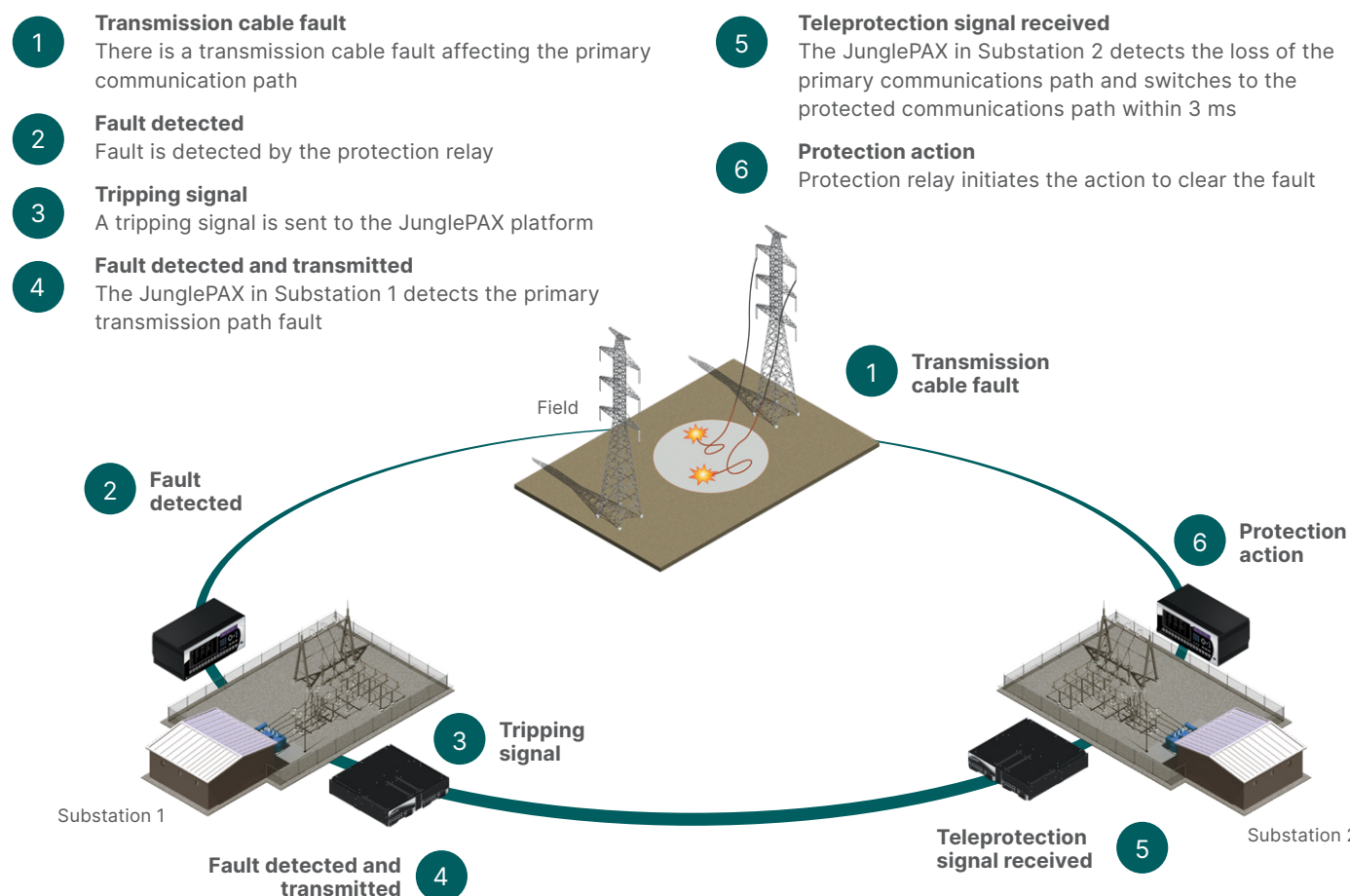
Teleprotection Application Example

Utilities are concerned about the impact on critical infrastructure and damage or injury associated with a fault condition on the transmission network. Teleprotection is a critical utility application that enables protection devices to communicate in a coordinated, reliable and expeditious way.

Distance or directional comparison relays require deterministic communications with low propagation delay edge-to-edge, or substation-to-substation, often within 8ms. The faster the tripping signal can be transmitted across network, the quicker the dangerous energized state can be removed. Due to their importance, tripping signals cannot tolerate network disturbances affecting availability, capacity, physical communication failures, maintenance-related outages or security vulnerabilities.

The JunglePAX platform provides protection switching within 3ms, and sub-millisecond latency for differential relaying applications carried over hybrid WAN links.

Typical Application Example of a Transmission Cable Fault

1 Transmission cable fault
There is a transmission cable fault affecting the primary communication path

2 Fault detected
Fault is detected by the protection relay

3 Tripping signal
A tripping signal is sent to the JunglePAX platform

4 Fault detected and transmitted
The JunglePAX in Substation 1 detects the primary transmission path fault

5 Teleprotection signal received
The JunglePAX in Substation 2 detects the loss of the primary communications path and switches to the protected communications path within 3 ms

6 Protection action
Protection relay initiates the action to clear the fault

JunglePAX provides reliable inter-substation relay communications during primary communications path failures

Flexible Connectivity Future Proofs Investment

The JunglePAX platform has considerable flexibility and scalability, enabling wider deployment options and diverse network connectivity choices. The platform offers customers a solution to address the challenges of capacity constraints while maintaining essential service separation between disparate applications. JunglePAX is a converged platform that future proofs a customer's investment with a lower cost of ownership by offering flexible connectivity options to carry diverse packet and TDM-based client services.

Ruggedized for Longer Life

The JunglePAX is industrially hardened and designed for deployment in harsh substation environments where conditions are not optimal for traditional telecom equipment. The superior thermal design enables reliable operation across an extended temperature range without active cooling, enabling improved reliability, longer life and lower maintenance costs. The rugged, industrial features of the solution include:

- Designed for compliance to IEEE 1613 and IEC 61850-3, with no cooling fans
- Extended temperature range from -20°C to +60°C
- Immune to substation contaminants and foreign objects falling onto the equipment chassis
- Quality component selection / design for five 9's
- Hot-swappable modules

Simplifying and Securing Utility Networks

All utility applications require dependable communications, however not all applications require the same level of performance. Applying the right level requires definition of performance criteria for each application. Application Defined Networking (ADN) is an important concept built into JunglePAX to simplify and secure service provisioning. Due to the complexity and variance in configuring different service types across the network, complex and resource intensive control protocols are often employed that can impact service reliability. Within JunglePAX, ADN with static assignment simplifies and secures utility networking.

Each utility application requires a unique performance criteria, for example:

- A video surveillance application is serviced via an Ethernet interface that is often asymmetrical in nature and is multipoint, leveraging IP multicast protocols often requiring larger amounts of bandwidth.
- In contrast, line differential relaying applications are interfaced via low bandwidth N* 64 kbps service ports (IEEE C37.94) requiring point-to-point paths with engineered determinism, strict performance for low latency, jitter and zero packet loss with ultra-fast protection switching to ensure security and dependability. Line differential services must be bidirectional and completely symmetrical in nature.

Application Defined Networking Walk Through

The JunglePAX provides an application-defined approach to simplify and secure utility communications. Every defined service perceives the MPLS architecture as a single network device dedicated to its use. This is achieved in the following way:

1. Private optical networks are deployed at the physical layer to interconnect disparate utility assets
2. GE Vernova's optimized version of MPLS-TP virtualize the overall network to emulate a single switch or router to simplify the design
3. Application profiles capture unique criteria used to identify and qualify their security and dependability requirements
4. Each profile is applied to the network, enforced by the network and accounted by the network over the life of the application
5. Authorized applications traverse the network based on the assigned profile

Complete Portfolio of Teleprotection Interfaces

JunglePAX supports a complete portfolio of teleprotection interfaces including C37.94 (mmf and smf), G.703 64 kbps, RS-232 and Direct Transfer Trip (DTT) specifically designed for JunglePAX shelf mechanics. The respective cards can be flexibly installed into as many as 10 shelf slots. A choice of high density (4 ports per slot) or low density (1 port per slot) is available for all of them, except for DTT, which supports two bidirectional DTT circuits on a 2-slot card.
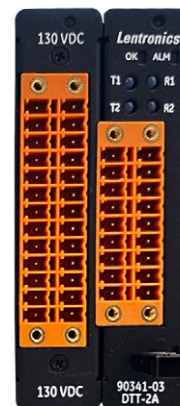
Additionally, JunglePAX supports all 64kbps level cards originally designed for JungleMUX, TN1U, TN1Ue, T1MX and E1MX shelf mechanics including the specialty interface cards for legacy pilot-wire relays including HCB, HCB-1, CPD, SPD, RADHL and DL-91. The sub-millisecond latency performance critical for these services is maintained by using the JunglePAX's SONET/SDH transport layer.

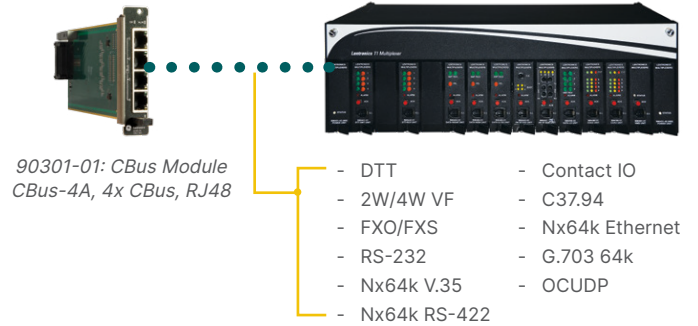*4-port G.703 iDS0 unit (90366-01)*   *4-port C37.94 iDS0 unit (90360-02)*   *2-port Direct Transfer Trip iDS0 unit (90341-03)*
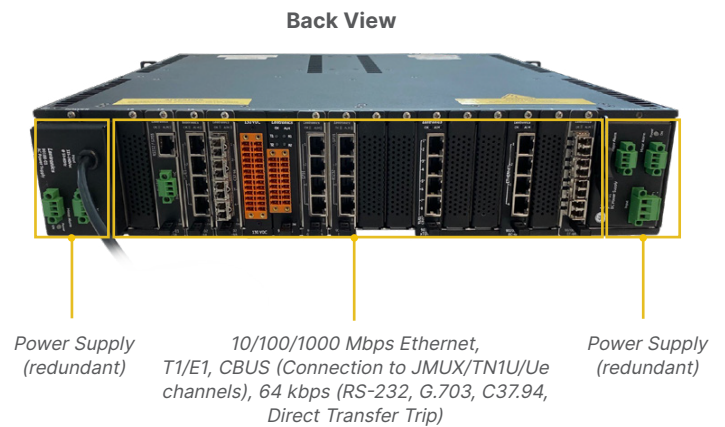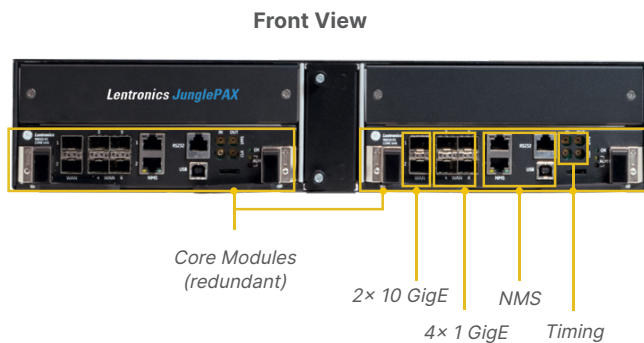
Migrating Data Channels to JunglePAX

CBUS interface modules provide access to existing and field-proven JungleMUX & TN1U 64 kbps channel units. For customers already using these interface units, retention of this equipment not only reduces the overall capital expense associated with equipment replacement, but also allows utilities to defer the added burden of recommissioning, documenting and training employees on new interfaces. These interface units have a proven track record with many years of field operation providing new and repeat customers alike with assurances that these application interfaces are thoroughly tested across hundreds of utility installations.

90301-01: CBus Module
CBus-4A, 4x CBus, RJ48

- DTT
- 2W/4W VF
- FXO/FXS
- RS-232
- Nx64k V.35
- Nx64k RS-422
- Contact IO
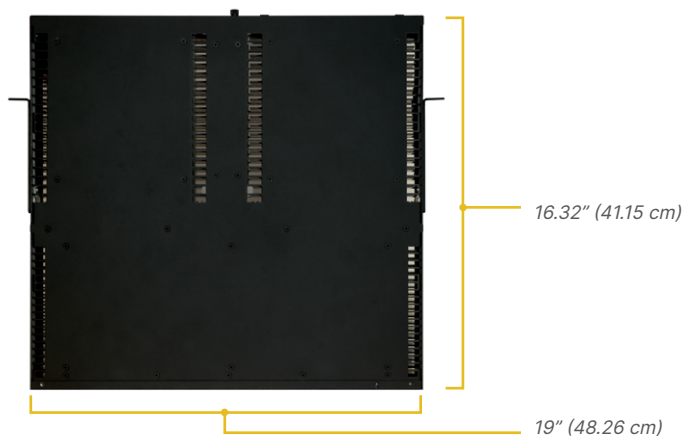- C37.94
- Nx64k Ethernet
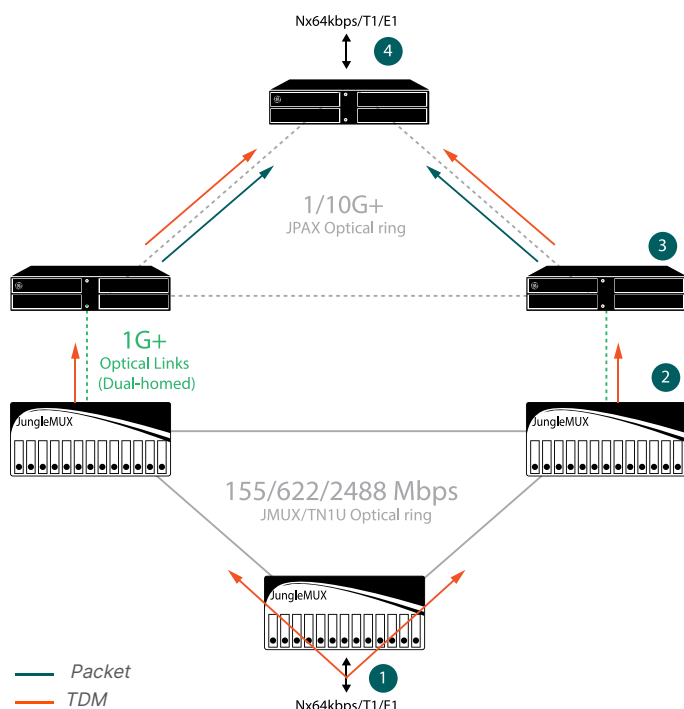- G.703 64k
- OCUDP

JunglePAX Components

The JunglePAX is comprised of replaceable and hot swappable interface cards which ensure that the platform is easy to maintain. The flexible mix of access cards provides utilities with a solution that addresses changing communications requirements.

Front View

Core Modules (redundant)
2× 10 GigE
4× 1 GigE
NMS
Timing

Back View

Power Supply (redundant)
10/100/1000 Mbps Ethernet, T1/E1, CBUS (Connection to JMUX/TN1U/Ue channels), 64 kbps (RS-232, G.703, C37.94, Direct Transfer Trip)
Power Supply (redundant)

Platform Dimensions

16.32" (41.15 cm)

19" (48.26 cm)

2 Rack Units (RU)

90001-01: Shelf
19", 2RU, 2 Core, 2 Power, 1 Timing, 16 Access Slots

JunglePAX allows the flexibility of routing either Packetized traffic or preserving TDM end-to-end

Simplified Migration from JungleMUX/TN1U to JunglePAX Networks

The Evolution module allows for simplified migration of GE Vernova Lentronics SONET/SDH multiplexer networks to JunglePAX MPLS-TP/Hybrid networks on a ring-by-ring or node-by-node basis. The VT1.5/TU-12 traffic originated at JungleMUX/TN1U nodes can be terminated at JunglePAX nodes while its working and protect paths can be either partially or entirely carried over the SONET/SDH layer.

1   *TDM traffic is presented into both left and right fiber directions (1+1 protection)*

2   *JMUX/TN1U node equipped with Evolution Modules pass the TDM traffic over 1G+ optical links to JPAX (single or dual-homed)*

3   *JPAX has the flexibility to convert the TDM traffic to packet or preserve the TDM traffic over a Hybrid transport mode*

4   *JPAX terminates the Packet or TDM traffic from both redundant fiber paths*

Cyber Security

JunglePAX is built around a range of cyber-security standards, guidelines, and industry best practices for critical infrastructure and industrial control systems. Some of the standards include NERC CIP, NIST SP800-82, NISTIR 7628 and FIPS 140-2.

JunglePAX deploys a Secure Communications Framework consisting of:

- Digitally signed firmware
- Secure coding practices with Coverity code review
- Use of secure protocols including RADIUS, HTTPS, NETCONF, SNMPv3, and SSH
- Use of strong authentication, encryption and tunneling algorithms such as SHA-256 and AES 256
- Role-based access control and authorization
- Embedded security policy distribution
- Remote enabling/disabling of LAN and WAN ports
- Optional AES 256-bit encryption of MPLS-TP traffic on WAN ports
- Optional auto-disabling of disconnected operational LAN ports
- Restricted MAC access to LAN ports with optional intrusion detection
- Deployment of security alarms
- Extensive event logging

Optional AES 256-bit encryption of MPLS-traffic is available on all WAN ports. Once enabled on both sides of a WAN link, public/private keys are periodically rolled (configurable to a value between 0.5 and 200 hours). Keys can also be manually renewed on each segment via the Web User Interface.

Network Management

Lentronics™ Advanced Network Management solution is a complete suite of software tools to securely manage the GE Vernova Lentronics family of telecommunications products, consisting of JunglePAX Hybrid MPLS/SONET/SDH, JungleMUX SONET and T1 Multiplexers, TN1U/TN1Ue SDH Multiplexers and E1 Multiplexers.

Telenium™ Advanced Network Management

- Multi-Protocol, multi-vendor capable Manager-of-Managers (MoM) built on the latest Microsoft Windows Presentation Format (WPF) that simplifies infrastructure-wide network management

- Licensed to GE Vernova by Megasys computer technologies to converge multiple platforms onto one pane of glass, including SONET/SDH, MPLS-TP, Hybrid and Industrial Switch platforms

- Employs 'SmartTile' technology to enhance network equipment tasks and provide user-friendly graphical user interface

Key Benefits of Telenium™ Advanced Network Management

- Provides full FCAPS (Fault, Configuration, Administration, Performance and Security) support for GE Vernova equipment with

  - Complete JunglePAX system monitoring, configuring and edge-to-edge provisioning of all tunnels and services via NETCONF

  - Monitoring of SONET/SDH/T1/E1 multiplexer alarms, performance and activity logs via SNMPv3

- Provides a high-availability solution that allows operators to use all systems concurrently, and to ensure full connectivity of the underlying networks

- Is scalable; working with thousands of networking equipment vendor solutions to create an effective over-arching management solution that reduces complexity and operational expenditure (OPEX) of running multiple management solutions

- Is extendable; allowing customers to pay as you grow with new features and functionality

- The Escalation tool allow users to escalate issues automatically via email or SMS

- Advanced Logic Processor monitors and correlates events in real time across multiple systems

SmartTiles

SmartTiles is an evolutionary user interface available within GE Vernova's Advanced NMS platform, that is gaining support across Telenium customers for the following reasons:

- Provide tile relationships (parent/child) for automatic tracking of actions

- Support combination of historical and real-time data correlation

- Implement powerful controls to maximize pattern recognition

- Standardized user interfaces between vendors' products supported within Telenium Spectra

- Supports custom tiles for niche products or application

Numerous SmartTiles are already supported while new tiles are added regularly. A customized tile designed natively for JunglePAX will be released to all JunglePAX customers.
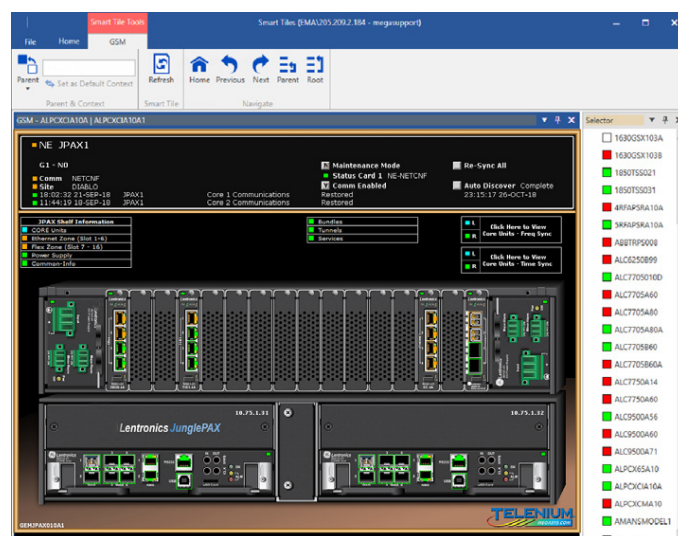
Embedded Management System (eMS)

- Embedded element managers running at each JunglePAX CORE module providing operational staff with network-wide visibility from any node and without access or dependency on the Telenium NMS platform

- Offers CLI and HTTPS connections via a secure web-browser connection

SmartTiles
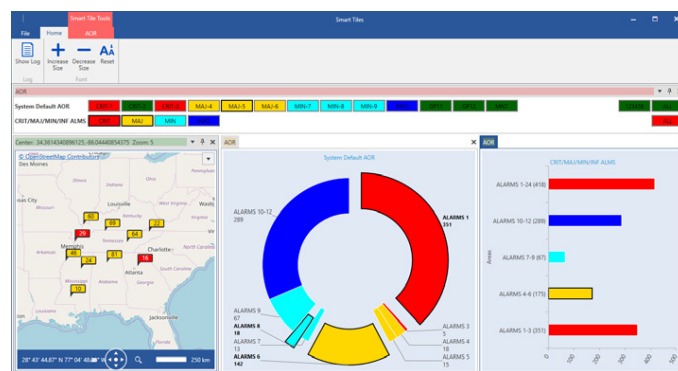
SmartTiles dashboard view

SmartTiles - Graphical Service Manager (GSM)

Technical Specifications

MULTI-SERVICE PLATFORM

	Hybrid MPLS-TP/SONET/SDH platform, Modular in design with layers of redundancy
	Hot swap of all redundant components without service interruptions
	Utility hardened to ensure security and dependability
	Non-blocking architecture

WIDE AREA NETWORK (WAN) OPTIONS

Optical WAN	Capacity	24 Gbps, redundant
	Number of 10G Optical WAN ports	2, SFP+, (up to 80 km)
	Number of 1G Optical WAN ports	4, SFP

NETWORK MANAGEMENT

Management	Device management	embedded Management System (eMS)
	Network management	Advanced NMS (optional)
	High availability mode	1+1 protected
	Console port	USB
	NMS port	RJ-45, 100Base-T
	Inbound / Outbound interfaces	CLI, WebUI (HTTPS), SNMPv3 *, NETCONF

PERFORMANCE

	CORE Hardware protection	1+1, 20G bypass
	Processors	Dual, Dedicated separately for Data Plane (DP) & Management Plane (MP)
	Transport Protocol	MPLS-TP (RFC 5654), Hybrid (MPLS+SONET/SDH)
	Encapsulation on Hybrid ports	WAN-Interface Sublayer (WIS)
	Quality of service	IEEE 802.1p/q with priority queues and priority scheduling; RFC 4115 metering and policing for Ethernet-based services
	Node transit delay	< 30 µs
Switching	Capacity	132G (172G with internal ports considered), excluding TDM services carried over SONET/SDH
	Fabric	Redundant
Backplane	Passive	Yes
Client services	TDM and Ethernet	**TDMoP:** Emulated TDM over PSN CESoPSN, SAToP) **TDMoS:** TDM over SONET/SDH **Ethernet:** E-Line, E-Tree and E-LAN Ethernet Virtual Connections, configurable max frame size (up to 12,000 bytes), 32k MAC addresses per node
Packetizer	T1/E1/CBUS TDM ports	8 on the Core Card (via T1E1-4A modules) and 8 for each xTDM module installed
Synchronization	WAN Synchronization method	SyncE
	Internal Modes	Headend with SSM, Freerun
	Accuracy	4.6ppm (Stratum 3)
	External modes	2 kHz, 10 MHz, 1 PPS, GPS *
	Quality	SSM, ESMC
Timing	Timing Protocols	NTP, IEEE 1588v2 (telecom and power) *
	Accuracy	1us, Grandmaster (1588v2) *
OAM	Fault Detection	LDI, 256 HW-assisted BFD per CORE
	Protection Switching	1+1: <3 ms on fiber break, ~0 ms on CORE module extraction 1:1: <16 ms on fiber break, <50 ms on CORE module extraction

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Technical Specifications

SECURITY

Security	EtherWAN encryption engine	6 independent encryption engines, optionally enabled on each WAN port
	Encryption	AES 256
	Authentication	SHA 256
	Key distribution	Public/Private, User configurable rolling key frequency
	Access Control	Role-based
	User Authentication	RADIUS
	Accounting	Syslog (local)
	Federal Information Processing Standard	140-2

CERTIFICATION

Industry Compliance	SAFETY, UL, EU, CSA	UL 60950-1, ETSI EN/IEC 60950-1, CAN/CSA C22.2, RCM (Australia)
	Conducted and Radiated emissions	FCC Part 15B, CISPR/EN 55022, EN 300 386, VCCI, AS/NZS CISPR 22, CNS13438, and KN 22
	Immunity	EN 55024, EN 300 386 and KN 24
	Power Substation	IEEE 1613 (no cooling fans)
	Hardening	IEEE 1613 (no cooling fans), SWS, EMI, RFI, ESD, IEC 61850-3, IEC 60834-1
Environmental	Operating Temperature	-20°C to + 60°C
	Storage Temperature	-40°C to +70°C, IEC 60068-2
	Humidity, %RH	5 - 95%, non-condensing
	Altitude	3000 m
	Earthquake	NEBS ITL GR-63-CORE Issue 4*
	RoHS	RoHS / WEEE

POWER MANAGEMENT

Power	DC	-48/130 VDC (ungrounded or +ve grounded), isolated inputs, hot swappable
	AC	120/240 VAC, 50/60 Hz, hot swappable
	Redundant	Yes
	Consumption	160 W, Overcurrent protection at 180 W per power supply

ACCESS CARD INTERFACES

Access Card interfaces	Number of Access slots	16
	Hot swappable	Yes
	4×1 GigE slots	3
	EF-4A	4 × 1G/FE fiber ports, SFP, per-port configurable native VLAN ID
	EC-4A	4 × 10/100/1000 Mbps copper ports, RJ-45, per-port configurable native VLAN ID
	1 GigE slots	6, using EF-4A and EC-4A units
	TDM slots	4 (16 if xTDM-8A cards are used)
	T1E1-4A	4 x T1/E1 ports, RJ-48c, G.704, G.706, G.826 E1 formats: PCM30/CAS, PCM31/CCS, Unframed
	CBUS-4A	4x CBUS ports, RJ-48C
	xTDM-8A	8 x T1/E1 ports (G.704, G.706, G.826) or 4 x CBUS ports*, RJ-48C
	64 kbps slots	10
	C3794-1A	1 x IEEE C37.94, mmf/smf, N x 64 kbps(N=1...12), SFP, LC connector
	C3794-4A	4 x IEEE C37.94, mmf/smf, N x 64 kbps (N=1...12), SFP, LC connector
	DR-1A	1 x RS-232/V.24/V.28 (up to 38.4 kbps) or 1 x G.703 64 kbps codirectional
	DR-4A	4 x RS-232/V.24/V.28 (up to 38.4 kbps) or 1 x G.703 64 kbps codirectional
	G703D-4A	4 x G.703 64 kbps codirectional
	DTT-2A	2 x DTT Tx/Rx @48VDC, 130VDC, 250VDC

SIZE

Size	Shelf	19" (48.26 cm) W
		16.32" (41.45 cm) L
		3.49" (8.86 cm) H
	Spacing	1RU above and below for circulation

ACCESS CARD COMPATIBILITY

	Lentronics Access cards compatible with JPAX via the CBUS port	DTT Tx/Rx
		RS-232 / V.24
		Nx64E (electrical, V.35) and Nx64F (Fiber, C37.94)
		G.703
		CDR (HCB, HCB-1, CPD/SPD, RADHL, DL91)
		OCUDP
		2W FXS/FXO, E&M
		4W TO, E&M
		RS-422 / V.11
		Contact IO

future release

JunglePAX Ordering Codes

PART NUMBER	DESCRIPTION
SHELF	
90001-01	JunglePAX Equipment Shelf, 2RU, Modular, 2 x CORE, 1 x EXTERNAL SYNC, 16 x ACCESS, 2 x POWER

PART NUMBER	DESCRIPTION
CORE - WAN	
90010-01	Core Module, MPLS-TP, Unlicensed, 2× 10G, 4× 1G capable
90010/10G	10 GigE WAN interface licensing
90010/G	1 GigE WAN interface licensing
90010/A, /B, /C, /E	SFP+, 10G, LC, SMF (10 km / 40 km / 80 km / 100 km) **
90010/AA, /BB, /CC, /EE, /GG	SFP, 1G, LC, SMF (10 km / 40 km / 80 km / 120km/ 200km) **

PART NUMBER	DESCRIPTION
POWER	
90110-01	DC Power Module, 48/130VDC
90100-01	AC Power Module, 115-240VAC, 50/60 Hz

PART NUMBER	DESCRIPTION
EXTERNAL SYNC	
90081-01	Sync-In Module, 10MHz reference clock, redundant inputs
90081-02*	Sync-Out Module, 10MHz reference clock, redundant outputs

PART NUMBER	DESCRIPTION
ACCESS	
90200-01	Ethernet Access Module, 4 × 1G/FE fiber, SFP
90200/AA	SFP, 1G, LC, 1310 nm, SMF, 10 km
90200/DD	SFP, 1G, LC, 850 nm, MMF, 300 m
86418/AA	SFP, 100M, LC, 1310 nm, SMF, 30 km
86418/DD	SFP, 100M, LC, 850 nm, MMF, 2 km
90201-01	Ethernet Access Module, 4 × 10/100/1000 Mpbs, RJ-45
90300-01	TDM Access Module, 4x T1/E1, RJ-48C
90301-01	TDM Access Module, 4x CBUS, RJ-48C
90308-01	TDM Access Module, 8x T1/E1 or 4x CBUS, RJ-48C
90360-01	1 x IEEE C37.94, MMF/SMF
90360-02	4 x IEEE C37.94, 4 ports, MMF/SMF
90360/AA	SFP, C37.94, LC, SMF, 1310 nm, 15 km
90360/DD	SFP, C37.94, LC, MMF, 850 nm, 2 km
90350-01	1 x RS-232/V.24/V.28, or 1 x G.703 64 kbps
90350-02	4 x RS-232/V.24/V.28, or 3 x RS-232/V.24/V.28 and 1 x G.703 64kpbs
90366-01	4 x G.703 64 kbps
90341-01	2 x DTT Tx/Rx @48 VDC, 130 VDC, 250 VDC

* Future release
** Other distances and CWDM/DWDM SFPs are available upon request

PART NUMBER	DESCRIPTION
CABLES	
90900-01	Serial Cable, USB
90901-01	Ethernet Cable, RJ-45 > RJ-45, CAT-5e, UTP, 3m
86485-99	Simple CBUS paddleboard for connections to JunglePAX CBUS card
90902-01	CBUS Cable, 2m, RJ-45 > IDC Socket (JMUX & TN1U)
90902-02	CBUS Connector, RJ-45 > DB9 (TN1Ue)

PART NUMBER	DESCRIPTION
MANAGEMENT	
90000-02	Embedded Manager (eMS), per node RTU license
90000-50	Advanced NMS - Standard, per node RTU license, 1 client seat
90000-51	High-Availability Advanced NMS - Standard, per node RTU license, 1 client seat
90000-50/G	Advanced NMS - Gold, per node RTU license, 1 client seat
90000-51/G	High-Availability Advanced NMS - Gold, per node RTU license, 1 client seat
90000-55	Single client seat license

For more information, visit
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