

Lentronics JunglePAX

Packet Switched Networking Solution for Teleprotection

GE's Lentronics™ JunglePAX is a purpose-built 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 with Transport Profile) technology, that maintains deterministic performance through packet based communications to provide utilities with increased efficiency and ease of integration.

The Lentronics JunglePAX platform employs an optimized version of MPLS-TP, which offers a converged communications platform to reliably transport 64kbps, T1/E1 and Ethernet service 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.

Key Benefits

- Improve service quality with a secure and dependable platform that provides reliable communications for utility applications within harsh industrial environments.
- Maximize service uptime using purpose-built hardware to ensure utility-grade performance through built-in layers of redundancy.
- Address emerging applications by implementing a flexible and scalable solution to assist with network convergence where traffic and application mix change.
- Improve system-wide manageability with integrated and application-driven software that simplifies network management.
- Increase control and promote information assurance with an advanced cyber-security platform that employs defense-in-depth strategies.

Application Defined Networking

The Lentronics JunglePAX is purpose-built for power utility operations and IT applications, supporting the following typical applications:

- Critical Operational Traffic (OT)
 - Protection and Control
 - Purpose-built for Teleprotection
- Essential Operational Traffic (EOT)
 - SCADA
 - Maintenance & Emergency Voice
 - Asset health and status
- Critical Information Traffic (CIT)
 - Surveillance & Intrusion detection
 - Metering
- Essential Information Traffic (EIT)
 - Business service backhaul
 - Connecting field offices and mobile users with operational data



Purpose-built for Teleprotection and Superior Performance

- High speed protection switching within 10ms
- Low end-to-end service latency within 4ms 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, 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
- 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



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.

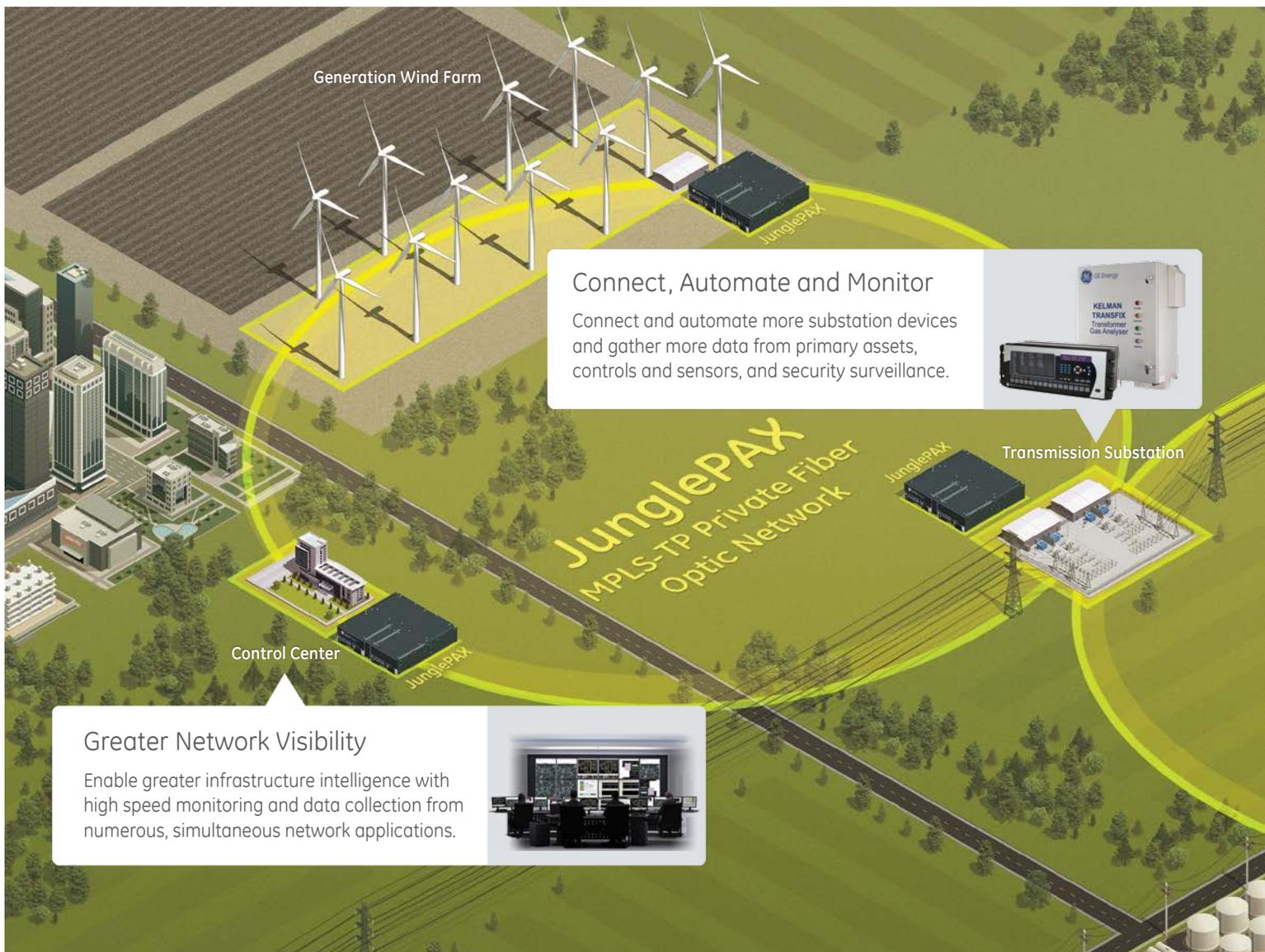
Changing Environment

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.

Lentronics JunglePAX Application Overview



GE's Solution

GE'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.

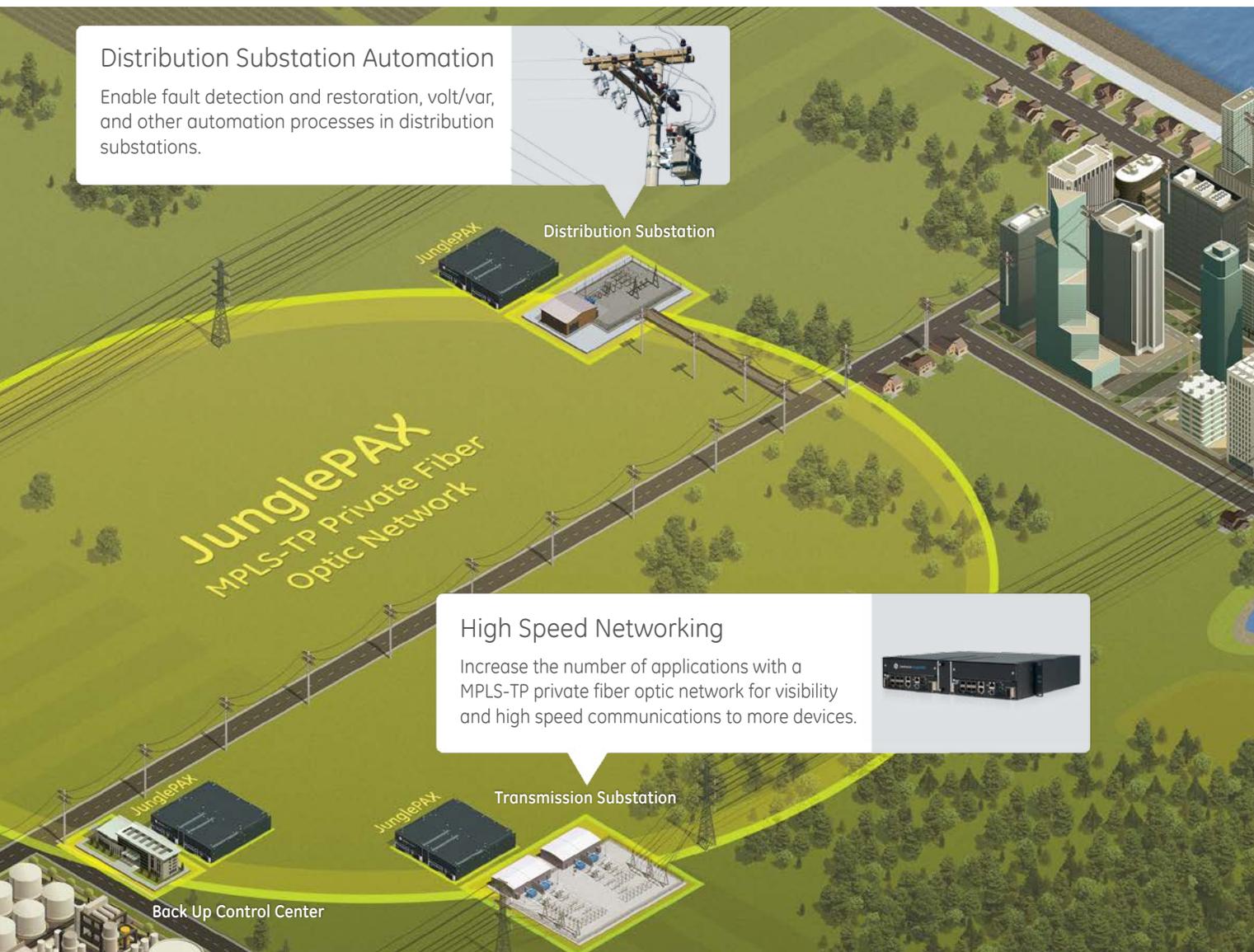
The JunglePAX provides the following benefits:

- Purpose-built 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.

Built upon a SONET/SDH like heartbeat, the JunglePAX accepts and extends clock signaling across the WAN via layer-1 timing inputs and further leverages Synchronous Ethernet (SyncE) to maintain tight control over TDM performance.

Client services are bridged through dedicated Gigabit and TDM links directly into the CORE WAN module where application-defined traffic shaping and policing take place. Hardware-assisted bidirectional fault detection (BFD) is purpose-built for rapid fault detection within 3.3ms increments coupled with 1+1 working and protect paths for all client services to further enhance the low latency switching mechanisms. The JunglePAX is industrially designed to protect the sensitive electronics from contaminations and is fanless; a perfect solution for imperfect substation environments.



Purpose-built 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 within 3.3ms, with sub-10ms protection switching to restore services via a route diverse path verses 50ms for standard MPLS/SONET/SDH equipment
- Utilize Synchronous Ethernet (SyncE) to tightly control variability in transmission that affects critical communication services
- Support co-routed bi-directional paths to eliminate asymmetrical delays that affect critical communication services across a network
- Aligns special overhead packets with the application data to validate path integrity, providing a true measurement of the application performance across the network
- Provide determinism via a connection-oriented approach to packet transmission
- Permit static assignment of working paths and protect paths to ensure application performance and eliminate complexity associated with dynamic control plane protocols
- Maintains strict control over traffic classification to ensure each unique application receives the network treatment that is required to be secure and dependable

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
- Each JunglePAX node can be configured as a Label Edge or Label Swap router
- Built on open standards, interoperable for mixed-vendor heterogeneous environments
- Integrated and application-driven software simplifies the network management model reducing operational costs

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 customers' 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 both the application and its performance criteria. 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 from camera to destination.
- In contrast, line differential relaying applications are interfaced via low bandwidth n* 64kb/s 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'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

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.

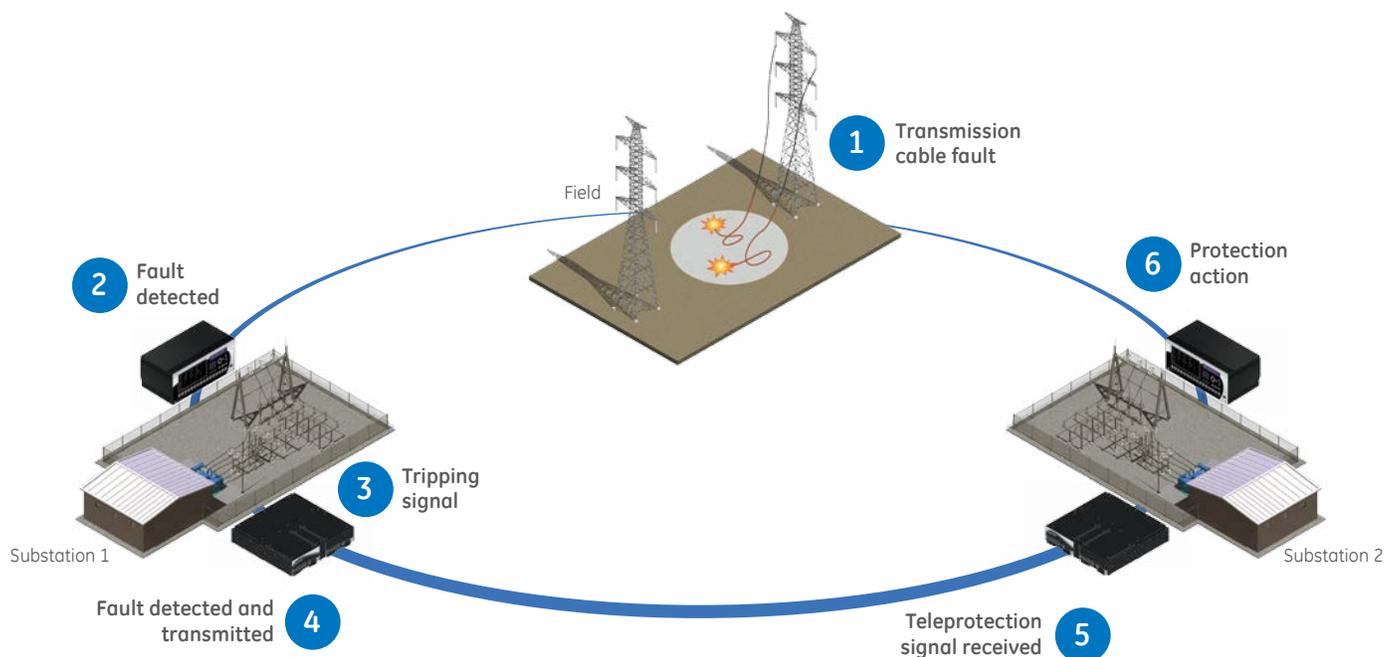
Distance or directional comparison relays require deterministic communications with low propagation delay edge to edge, or substation to substation, often within 8ms. The faster the tripping signal can be transmitted across network, the quicker the dangerous energized state can be removed. Due to their importance, tripping signals

cannot tolerate network disturbances affecting availability, capacity, physical communication failures, maintenance related outages or security vulnerabilities.

The JunglePAX platform has been purpose-built for teleprotection applications with layers of redundancy to ensure there is no single point of failure. It provides high speed protection switching within 3ms (loss of fiber) or 10ms (loss of service), and low end-to-end service latency within 4ms excluding propagation delay.

Typical Application Example of a Transmission Cable Fault

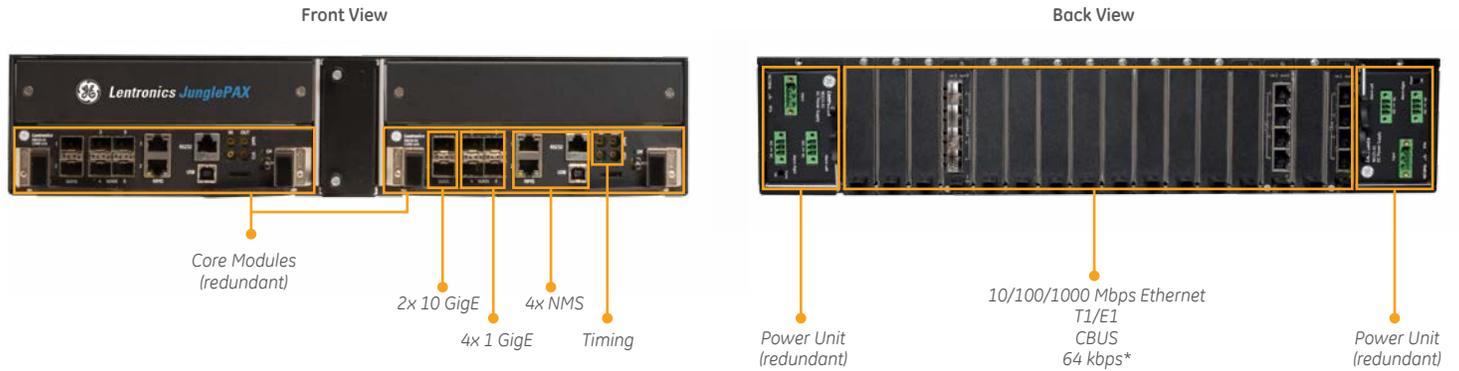
- 1 Transmission cable fault**
There is a transmission cable fault affecting the primary communication path
- 2 Fault detected**
Fault is detected by the protection relay
- 3 Tripping signal**
A tripping signal is sent to the JunglePAX platform
- 4 Fault detected and transmitted**
The JunglePAX in Substation 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 3ms
- 6 Protection action**
Protection relay initiates the action to clear the fault



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

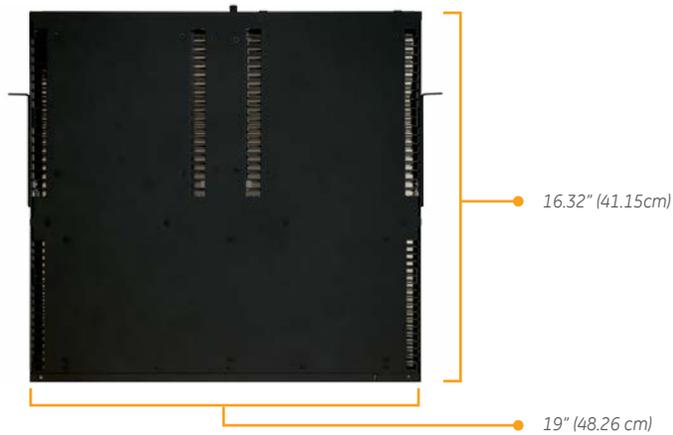
JunglePAX Components

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.



* future release

Platform Dimensions



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

Migrating Data Channels to JunglePAX

CBUS interface modules provide access to existing and field proven JungleMUX & TN1U 64kb/s 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 employee on a new interfaces. These interface units have many years of field experience providing new and repeat customers alike with assurances that these application interfaces are thoroughly tested across hundreds of utility installations.



Technical Specifications

MULTI-SERVICE PLATFORM

Purpose-built, modular in design with layers of redundancy
Hot swap of all redundant components without service interruptions
Utility hardened ensure security and dependability
Non-blocking architecture

WIDE AREA NETWORK (WAN) OPTIONS

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

NETWORK MANAGEMENT

Management	Device management	embedded Management System (eMS)
	Network management	embedded Management System (eMS)
	High availability mode	1+1 protected
		Dedicated microprocessor CORE
	South bound interfaces	CLI, WebUI (HTTPS), SNMPv3 *, NetConf *
Performance	Quality of service	IEEE 802.1p/q with priority queues and priority scheduling
	Node transit delay	< 30us

PERFORMANCE

	CORE Hardware protection	1+1, 20G bypass
	Processors	Dual, Dedicated separately for Data (DP) & Management (eM) plane
	Transport Protocol	MPLS-TP, RFC 5654
	Encapsulation	WAN-Interface Sublayer (WIS)
Switching	Capacity	72G
	Fabric	Redundant
Backplane	Passive	Yes
Client services	TDM and Ethernet	VPWS, VPLS, Emulated TDM over PSN (static)
Packetizer	T1/E1/CBUS TDM ports	8
	Circuit Emulation	CESoPSN, SAToP *
Synchronization	WAN Synchronization method	SyncE
	Internal Modes	Headend with SSM, Freerun
	Accuracy	4.6ppm
	External modes	2KHz, 10MHz, 1PPS, GPS *
	Quality	SSM, ESMC *
Timing	Timing Protocols	NTP, IEEE 1588v2 (telecom and power) *
	Accuracy	1us, Grandmaster (1588v2) *
OAM	Fault Detection	2000/256 Total/HW assisted BFD
	Protection Switching	3.3ms detect, 10ms (3x 3.3) switching failover

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), SWC, EMI, RFI & ESD
Environmental	Operating Temperature	-20°C to +60°C
	Storage Temperature	-40°C to +70°C, IEC60068-2
	Humidity, %RH	5 - 95%, non-condensing
	Altitude	3000m
	Earthquake	NEBS ITL GR-63-CORE Issue 4*
	RoHS	RoHS / WEEE

POWER MANAGEMENT

Power	48 & 130VDC	-48/130VDC floating (ungrounded), isolated inputs, hot swappable
		-48/130VDC (+ve grounded), isolated inputs, hot swappable
		120/240VAC 50/60Hz *
	Redundant	Yes
	Consumption	160W, Overcurrent protection at 180W per power supply
	Storage Temperature	-40°C to +70°C, IEC60068-2
	Humidity, %RH	5 - 95%, non-condensing
	Altitude	3000m
	Earthquake	NEBS ITL GR-63-CORE Issue 4*
	RoHS	RoHS / WEEE

ACCESS CARD INTERFACES

Access Card interfaces	Number of Access slots	16
	Hot swappable	Yes
	4x 1 GigE slots	3
	EF-4A	4 x 1 GigE Fiber ports, SFP (HW redundant port 1/2, 3/4)
	EC-4A	4 x 1 GigE Copper ports, RJ-45 (HW redundant port 1/2, 3/4)
	1 GigE slots	7, using EF or EC-4A units
	TDM slots	4
	T1E1-4A	4x T1/E1 ports, RJ-48C
	CBUS-4A	4x CBUS ports, RJ-48C
	64kbps slots	10
	G703D-1A	1x ITU G.703 n*64k data unit with alarm contact (n<=2) *
	C3794-1A	1x IEEE C37.94 n*64k data unit with alarm contact (n<=30) *

SIZE

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

ACCESS CARD COMPATIBILITY

	Lentronics Access cards compatible with JPAX via the CBUS port	DTT Tx/Rx
		RS232 / V.24
		Nx64E (electrical, V.35) and Nx64F (Fiber, C37.94)
		G.703
		OCUDP
		2W FXS/O, E&M
		4W TO, E&M
		RS422 / V.11
		Contact IO

JunglePAX Ordering Codes

PORT NUMBER	DESCRIPTION
SHELF	
90001-01	JunglePAX Equipment Shelf, 2RU, Modular, 2 x WAN, 1 x TIMING, 16 x ACCESS, 2 x POWER
CORE - WAN	
90010-01	Core Module, MPLS-TP, Unlicensed, 2x 10G, 4x 1G capable, SyncE, IEEE 1588
90010/10G	10 GigE WAN interface licensing
90010/G	1 GigE WAN interface licensing
90010/A, /B, /C	SFP+, 10G, LC, SMF (10km / 40km / 80* km)
90010/AA, /BB, /CC	SFP, 1G, LC, SMF (10km / 40km / 80km)
POWER	
90110-01	Power Module, 48/130VDC
ACCESS	
90200-01	Ethernet Access Module (4G), 4x 1G, SFP
90200/DD	SFP, 1G, LC, 850nm, MMF
90201-01 *	Ethernet Access Module (4 GigE), 4x 10/100/1000Mbps, RJ-45
90300-01	TDM Access Module, 4x T1/E1, RJ-48c
90301-01	TDM Access Module, 4x CBUS, RJ-48c
90360-01 *	PROTECTION - IEEE C37.94 S/MMF 1Channel
90361-01 *	PROTECTION - G703 64kbps 1Channel
CABLES	
90900-01	Serial Cable, USB
90901-01	Ethernet Cable, RJ-45 > RJ-45, CAT-5e, UTP, 3m
90902-01	CBUS Cable, 2m, RJ-45 > IDC Socket (JMUX & TN1U)
90902-02	CBUS Connector, RJ-45 > DB9 (TN1Ue)
MANAGEMENT	
90000-01	Embedded Manager (eMS), DEVICE, per node RTU License
90000-02	Embedded Manager (eMS), NETWORK, per node RTU License

* future release

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