GE

Grid Solutions

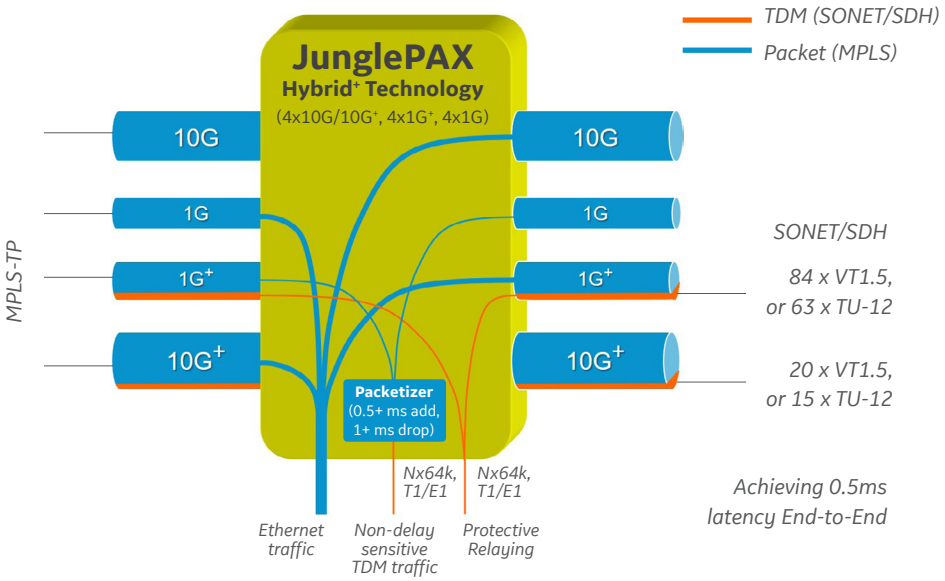
JunglePAX Hybrid+

Combining the Best of Packet and SONET/SDH Worlds in the Same Fiber

Packet-based transport technologies are being rapidly deployed in transport networks worldwide. Power utilities are no exception. While bringing unprecedented flexibility and manageability, these networks are not optimal for carrying traditional TDM services. This is primarily due to increased end-to-end delays associated with their emulation over packet-switched networks (PSN).

In the relaying world, faster is superior. Though many factors weigh into high-voltage line protection communications schemes, deterministic delay margins are critical. For line differential, asymmetrical delays also play a vital role. Relay vendors and protection & control engineers that have leveraged SONET/SDH transport networks with proven delay performance and determinism know this and are reluctant to migrate to PSN. In contrast, communication engineers, who understand advantages of migrating to a PSN for IT and traditional OT services, are challenged to deliver a converged solution providing both the performance for teleprotection and flexibility for all other services.

JunglePAX Hybrid+ Technology is the answer. It offers the best of both worlds by preserving SONET/SDH performance in a packet- switched network. This is achieved by adding an independent SONET/SDH layer alongside the MPLS-TP layer (without impacting its capacity) over the same optical WAN link. Use of this layer is optional and is intended for TDM-based relaying applications (C37.94, RS-232 Mirrored Bit, G.703 64k etc.) that are extremely delay sensitive.



Features & Benefits

- Supports packet-over-packet, TDM-over-packet (TDMoP), and TDM-over-SONET/SDH (TDMoS) transport over the same fiber
- Achieves sub-1ms communication delay to better protect critical Infrastructure
- Delivers JMUX/TN1U latency without QoS or traditional packet-based traffic engineering
- Worry-free transfer of existing TDM-based teleprotection services to packet-based transport infrastructure with guaranteed SONET/SDH-like performance
- Built-in interlayer converter for easy transition between SONET/SDH and MPLS-TP layers
- Allows for evolution of existing GE JungleMUX/TN1U networks to JunglePAX MPLS-TP networks in a ring-by-ring or node-by-node fashion

WAN Interfaces

- 4 x 10G+ and 4 x 1G+ hybrid WAN ports
  - 10G+ : 10G MPLS-TP + 20 x VT1.5* / 15 x TU-12**
  - 1G+ : 1G MPLS-TP + 84 x VT1.5 / 63 x TU-12
- 4 x 1G MPLS-TP non-hybrid WAN ports
- 10G+ WAN ports are convertible to non-hybrid

Superior TDMoS Delay Performance

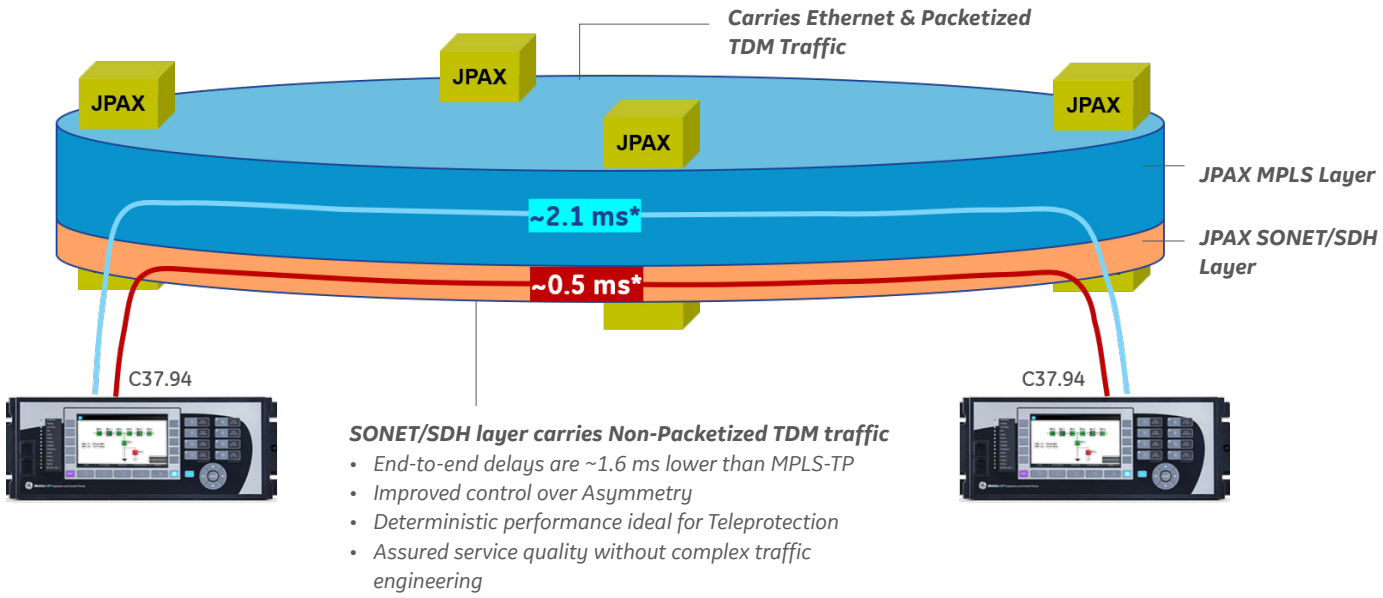
- 0.5 ms end-to-end delay (back to back)
- 17 µs pass-through delay (express mode)

** VT1.5 is a virtual tributary supporting 1.5Mb/s signals*

*** TU-12 is a tributary unit supporting 2.048Mb/s signals*

Modernizing optical communications infrastructure without performance impact

Hybrid+ Technology found only in JunglePAX permits migration from SONET/SDH to Packet-transport technologies without compromising application performance, equipment reliability and network-wide availability.



** Excluding node-through delays and fiber propagation delay (~8 µs/mile)*

	TDMoS	TDMoP
End-to-End Delay*	~ 0.5 ms	~2.1 ms
Node Through Delay	**Deterministic** • 17 µs (express, at ADM node) • 26 µs (at cross-connect node)	• 10G to 10G (L-R CORE, 64/1518 byte frame): 6.5/8.9 µs • 10G to 1G (L-R CORE, 64/1518 byte frame): 10.4/19.9 µs • 1G to 1G (L-R CORE, 64/1518 byte frame): 14.3/30.8 µs • 10G to 10G (Local CORE, 64/1518 byte frame): 4.1/5.3 µs • 10G to 1G (Local CORE, 64/1518 byte frame): 8.2/16.3 µs • 1G to 1G (Local CORE, 64/1518 byte frame): 12.2/27.3 µs ***NOTE**: These are average values. Assuming no added queuing delays due to large/jumbo frames in lower priority queues.*
Delay Asymmetry	< 130 µs	< 250 µs
Protection Switching Time (1+1)	< 3 ms (path failure) ~ 0 ms (CORE card extraction)	< 3 ms (path failure) ~ 0 ms (CORE card extraction)
Protection Switching Time (1:1)	n/a	<16 ms (path failure) <50 ms (CORE card extraction)
** Excluding node through delays and fiber propagation delay (~8 µs/mile)*		

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English
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