ribbon

Accelerating Network Transformation

Modernizing Mission Critical Networks:

Risk-free modernization from SDH/SONET to a Packet Transport Network

Why Evolve from SDH/SONET to a Packet Transport Network (PTN)

SDH and SONET have been highly successful technologies, offering deterministic performance, extensive OAM capabilities, and high reliability. These features have made them ideal for providing Operational Technology (OT) networks in mission-critical industries such as utilities, power companies, and rail operators. However, with the rise of data services and the ubiquitous presence of IP and Ethernet, SDH and SONET are becoming obsolete.

Concurrently, the migration to packet transport using Circuit Emulation (CES) technologies has been well proven. Deterministic packet transport techniques, such as MPLS-TP when used in conjunction with CES, provide the low latency, high availability, and determinism required for mission-critical OT networks.

A Packet Transport Network (PTN) for Critical Industries

To ensure a seamless migration, a modern Packet Transport Network (PTN) utilized by the OT network in critical industries must effectively support both legacy and modern packet-based services and applications. This includes subsystems such as SCADA, substations, CCTV, and Integrated Control Systems (ICS). To achieve this, the PTN must accommodate various packet networking techniques like MEF 3.0, L2 VPNs, L3 VPNs, and EVPN, and must seamlessly integrate both packet and optical transport layers to meet the stringent performance and bandwidth requirements of a modernized OT network.

Evolution to a Packet Transport Network

- **Risk-free migration:** This requires the right technology and processes and the ability to tailor the migration approach and timeline to meet specific operational and business needs
- **Support for legacy devices:** Allow graceful migration by providing continued support for legacy devices alongside new ones on the same network.
- **Guaranteed Network Performance:** Provide deterministic low latency, low jitter, bi-directional traffic paths, guaranteed restoration paths, and availability.
- **Simplified Operations:** Ensure network performance meets operational requirements.

Support for Ongoing Critical Infrastructure Evolution:

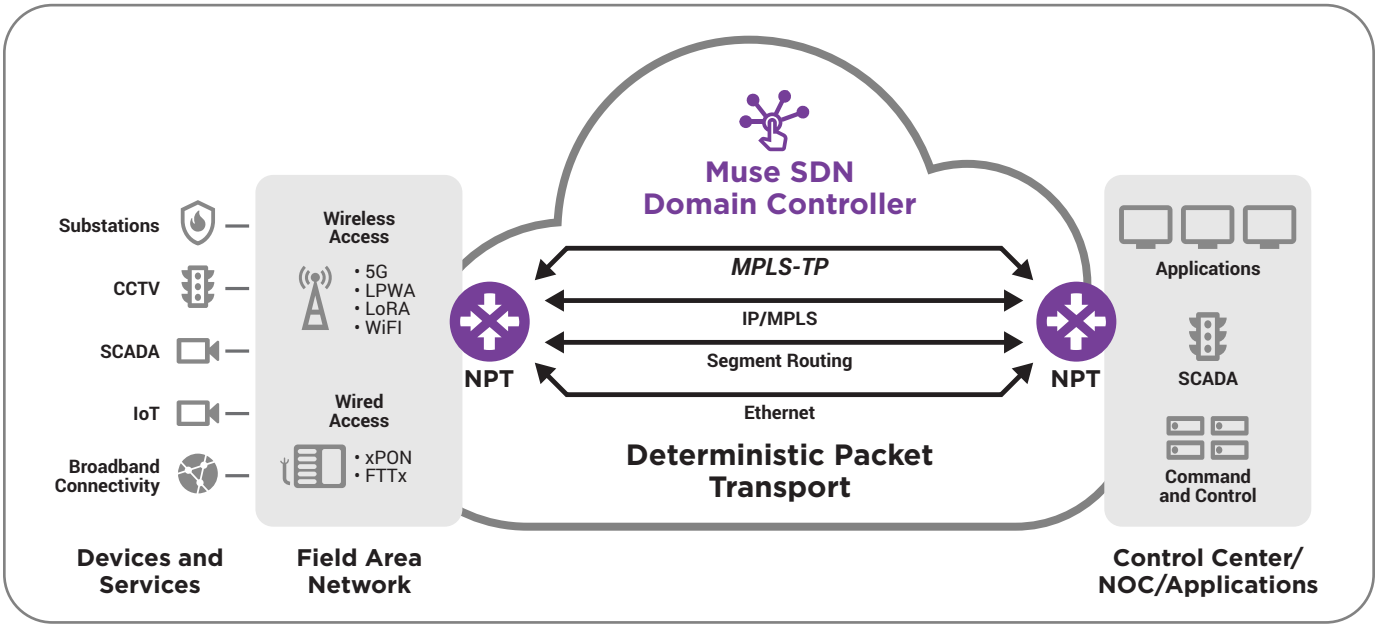
- **Continuous Network Evolution:** Able to support new services and technologies as they are introduced.
- **IT/OT convergence:** Meet the service requirements of both IT and OT networks while segregating IT services from OT services.
- **UTelco Evolution:** Provide the multitenancy capabilities to allow critical industries to offer “telco services” either as bandwidth wholesalers to Service Providers, or even as Service Providers themselves.

Ribbon's Solutions for Power Utilities

Ribbon is a global leader in providing critical industries with the field proven, tailored technology and processes they require to migrate their OT transport networks from SDH/SONET to PTN. Ribbon's PTN solution provides critical industries with the flexibility they need to evolve their transport networks to meet changing regulatory, operational, and business demands.

Key Elements of Ribbon's Solution

Ribbon's Multi-stack MPLS



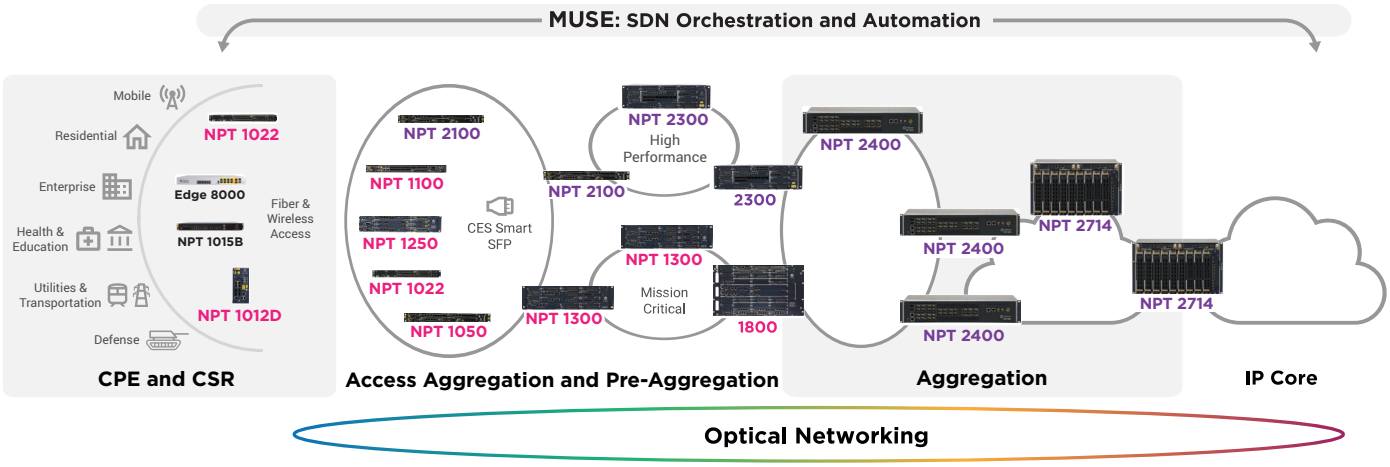
Multi-stack MPLS provides critical industries with the comprehensive multi-protocol support they need for seamlessly integrating both new and legacy operational technology (OT) services and devices. Multi-stack MPLS provides critical infrastructures with the routing protocols they need to make IT/OT convergence and Utelco evolution straightforward:

- **MPLS-TP:** Essential for deterministic packet transport, MPLS-TP supports mission-critical OT services such as SCADA and teleprotection. In conjunction with Circuit Emulation (CES), it facilitates a smooth transition from SDH/SONET networks, as recognized in the Cigre Green Books. MPLS-TP also delivers all the OAM and centralized management capabilities provided by the legacy SDH/SONET networks.
- **SR-TE:** Provides deterministic transport in IP/MPLS networks, though it is not yet a widely field-proven technology for OT networks. Multi-stack MPLS allows critical infrastructures to evolve their MPLS-TP networks to SR-TE, if they decide required.
- **IP/MPLS:** Ideal for non-mission-critical services, such as IT networks and for critical infrastructure companies evolving into UTelcos.
- **Network Slicing:** With a toolkit of hard and soft slicing techniques, network slicing provides critical infrastructures with the strict segregation they require for IT/OT convergence. It also provides the multitenancy needed for critical infrastructure companies transitioning to UTelcos.
- **Future Evolution:** Ribbon's multi-stack MPLS simplifies the addition of new protocols as they become standardized, ensuring future readiness.

Meeting Utilities Modernization Needs: Ribbon's NPT Access and Aggregation Routers

NPT XDR 2000 Series
High Performance Routers

NPT AR 1000 Series
High Availability Routers



Modern Interface Support

- 10GE/25GE/100GE/400GE
- 10/100/1000 Base-T
- PoE+
- CWDM, DWDM
- 100G/200G/400G Coherent
- Timing: 1PPS, 10MHz, GNSS ANT, ToD and BITS (8273.2 Class C)
- FlexE

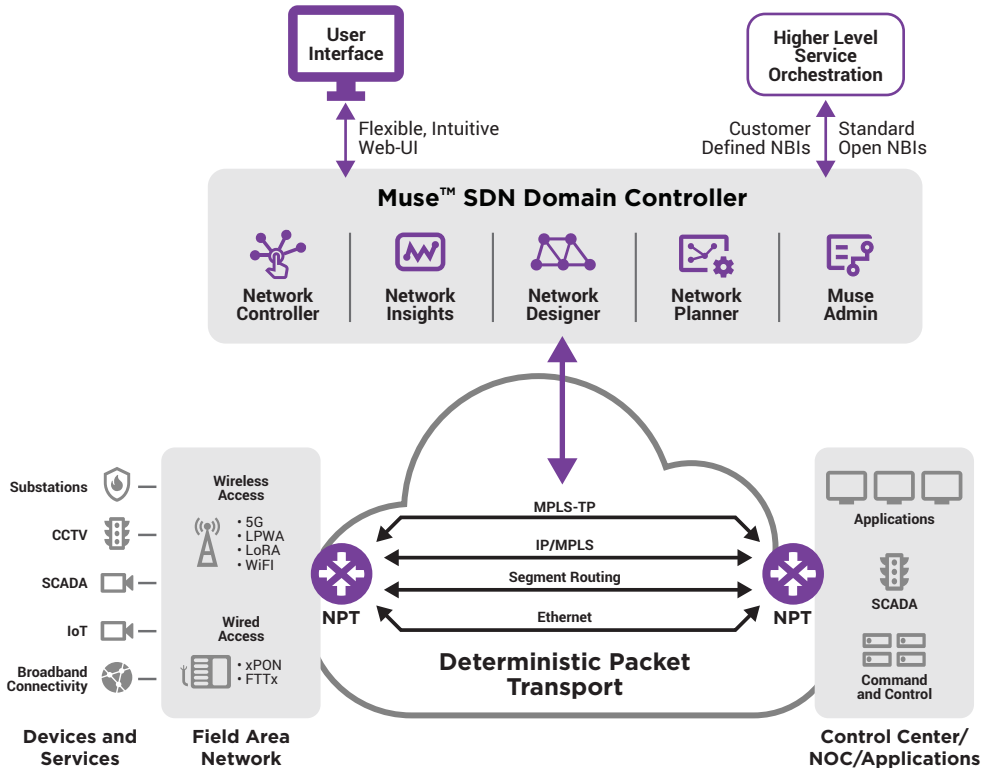
Legacy Interface Support

- FXO, FXS
- 2 wire, 4 wire, E&M
- V.24 Transparent, Synchronous Asynchronous (RS232)
- V.35/V.11, V.36/RS422/RS449
- C37.94
- 64K Codirectional
- Dry Contact
- CEP, SAToP, CESoPSN
- E1/T1, E3/DS3
- STM-1/OC-3, STM-4/OC-12, STM-16/OC-48, STM-16/OC-48

Ribbon NPT routers support all the packet transport needs of OT, IT, and UTelco networks, providing:

- Extensive support for the legacy PCM and SDH/SONET interfaces required by Critical Industries
- Support for the full range of modern interfaces used by in both the OT and IT networks
- Multi-service access routers able to support TDM, L2VPN, EVPN, L3VPNs
- High capacity/multi-tera core routers required in the Core of the network
- The advanced synchronization required in Critical Industries and to support 5G
- The network segregation technology required to support both IT/OT convergence and the multitenancy required in any evolution to Utelco
- Form factors which scale 8G to 14T
- High availability with fully redundant hardware form factors
- Support for redundant architectures such as dual-homing and LAG

Powerful SDN domain controller



Ribbon's MUSE SDN domain controller provides the intuitive management and control which critical industries require to operate their Packet Transport network. Its multi-layer network visualization offers comprehensive lifecycle management capabilities such as planning, provisioning, alarm management, fiber health management, and performance monitoring. With these advanced tools, Muse eliminates manual provisioning errors, enables rapid and accurate fault localization to minimize maintenance truck-rolls, and ensures continuous network monitoring to meet all performance requirements. Using modern, industry-leading cloud-native techniques, Muse provides a powerful workflow engine, the ability to easily integrate into the wider OSS ecosystem, and a high-availability clustered deployment.

Proven Risk-Free Migration

Ribbon offers a comprehensive suite of field-proven products and processes, drawing on over 20 years of experience in helping customers evolve their networks. NPT's unique, multi-stack MPLS combined with Circuit Emulation (CES) capabilities and robust, customizable migration processes enable critical industries to confidently migrate their legacy SDH/SONET networks. The resulting packet transport network is agile enough to meet future needs while maintaining support for legacy interfaces as long as necessary. With a modern PTN in place, Ribbon's multi-stack MPLS facilitates continuous evolution, allowing the network to transition from simple Layer 2 and MEF services provided by MPLS-TP and Carrier Ethernet to newer services requiring SR-TE, EVPN, and Layer 3 VPN.

Contact Us Contact us to learn more about Ribbon solutions.

About Ribbon

Ribbon Communications (Nasdaq: RBBN) delivers communications software, IP and optical networking solutions to service providers, enterprises and critical infrastructure sectors globally. We engage deeply with our customers, helping them modernize their networks for improved competitive positioning and business outcomes in today's smart, always-on and data-hungry world. Our innovative, end-to-end solutions portfolio delivers unparalleled scale, performance, and agility, including core to edge software-centric solutions, cloud-native offers, leading-edge security and analytics tools, along with IP and optical networking solutions for 5G. We maintain a keen focus on our commitments to Environmental, Social and Governance (ESG) matters, offering an annual Sustainability Report to our stakeholders. To learn more about Ribbon visit **rbbn.com**.