

Modernizing Mission Critical Networks:

Migrating the OT Communications Network used by Utilities, Transport and Defense from SDH/SONET to a Deterministic Packet Transport Network



Modernizing Mission Critical Networks: For Utilities, Rail, and Smart Cities

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

Overview

Operators responsible for mission-critical infrastructure in utilities, rail, and smart cities rely on advanced telecommunications networks to enable monitoring and control of their Operations Technology (OT). Robust, secure telecoms connectivity is essential for prompt access to the operational data, which is essential for maintaining safety, minimising disruptions and outages, and ensuring compliance with regulatory standards for OT assets such as electricity grids, water treatment facilities, gas distribution systems, train operations and traffic management systems.

The 3Ds in the Energy/Power Sector

Decarbonization

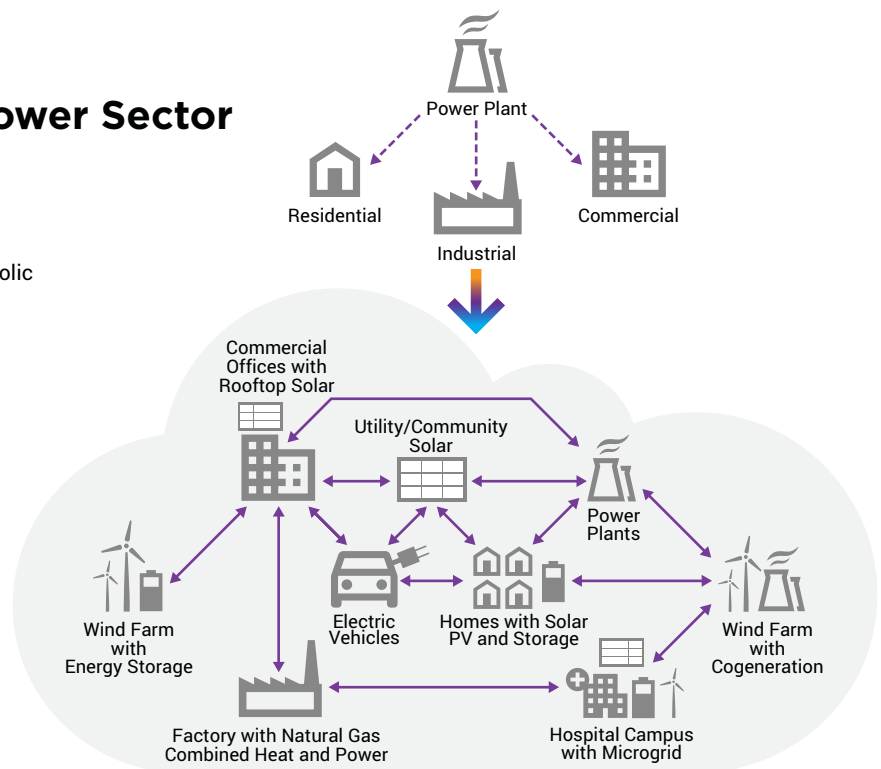
- Transition to renewable sources – Solar, Aeolic
- Smart energy storage

Decentralization

- Distributed Energy Resources
- Micro-grid

Digitalization

- Smart systems (Meters and Grid)
- New challenges (WAMS, SIPS, substation modernization)
- Security and maintenance (CCTV / video, Cybersecurity)



These OT networks are under increasing pressure to modernize to enhance customer satisfaction and to advance sustainability initiatives. This modernisation demands that networks embrace the “3Ds”: **D**ecarbonisation, **D**ecentralisation and **D**igitalisation. Achieving this modernization requires real-time monitoring, control, and automation based on operational data gathered from across the OT environment.

However, many OT telecom networks remain reliant on legacy SDH/SONET technology. While SDH/SONET has historically delivered reliable service, it is increasingly unable to meet the demands of modern OT infrastructure, particularly as high-bandwidth IP/Ethernet applications—such as CCTV, digital substations (IEC61850), and widespread deployment of IIoT devices like AMI (Advanced Metering Infrastructure)—become the norm. Furthermore, SDH/SONET networks are approaching end of support, and the workforce skilled in their operation is steadily retiring.

Modernizing Mission Critical Networks

To support the evolution of OT networks, a modern Packet Transport Network (PTN) is required. This PTN must deliver the same deterministic, secure, and low-latency connectivity that legacy SDH/SONET networks provided. Crucially, the migration of existing services to the PTN should be straightforward and risk-free, enabling the seamless retirement of outdated SDH/SONET infrastructure.

Ribbon provides a modern Packet Transport Network (PTN) engineered specifically for mission-critical environments, delivering deterministic, highly secure connectivity through resilient, mission-critical grade IP routing hardware from the NPT portfolio. This advanced solution is enhanced by the Muse Multilayer Automation Platform, which offers a versatile blend of automation and manual controls, tailored to the unique operational requirements of each user. Ribbon's comprehensive feature set allows seamless integration of both legacy and modern services on a unified PTN. By combining these capabilities with field-hardened processes and extensive real-world expertise, Ribbon assures operators of continuity of service delivery throughout the migration journey. This gives operators the confidence that transitioning from legacy to modern transport networks will be seamless and entirely risk-free.

Requirements for a Mission-Critical Packet Transport Network

Support Continuous Evolution

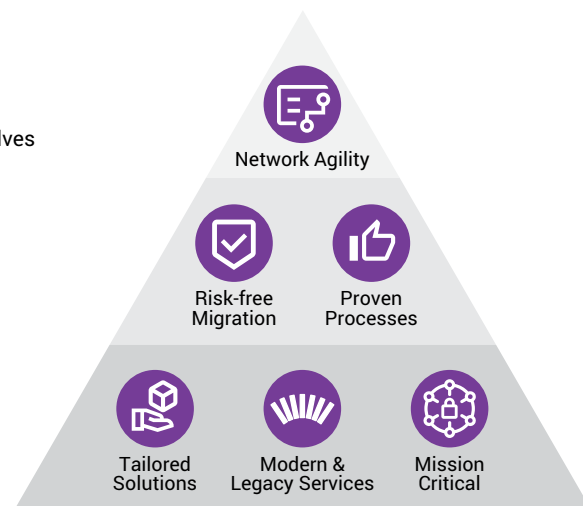
– Agility to evolve as the mission-critical business evolves

Guarantee Risk-free Migration

– Field proven processes, expertise and technology

Mission Critical by Design

– Mission critical grade packet transport network



The modern Packet Transport Network (PTN) used for mission critical networks must support both legacy and modern packet-based services and applications used by the OT and IT teams in the mission-critical network. This includes subsystems such as SCADA, substations, CCTV, and Integrated Control Systems (ICS). To achieve this, the PTN must accommodate various packet networking techniques such as MEF 3.0, L2 VPNs, L3 VPNs, and EVPN. It must also seamlessly integrate packet and optical transport layers to efficiently meet the performance and bandwidth requirements of modern OT and IT services. To achieve this, it requires:

- **Guaranteed network performance:** deterministic low latency and low jitter, with engineered, bi-directional traffic paths and guaranteed restoration behaviour.
- **High availability and resiliency:** to ensure minimal service interruption and rapid recovery from faults, proven protection mechanisms, including sub-50ms switching and architectures such as dual-homing and link aggregation are required.
- **Mission critical grade OAM and operations:** in-band OAM, performance monitoring, centralized provisioning, and an operational model tailored for OT teams, providing enhanced visibility and control over network health.
- **IPoDWDM:** integrates the IP and packet transport layers seamlessly with optical networking, enabling optimal resource utilisation and delivering services that consistently meet stringent performance requirements.

Modernizing Mission Critical Networks

When modernising the telecoms network supporting mission-critical services, a series of stringent requirements must be addressed to guarantee operational continuity throughout the migration process:

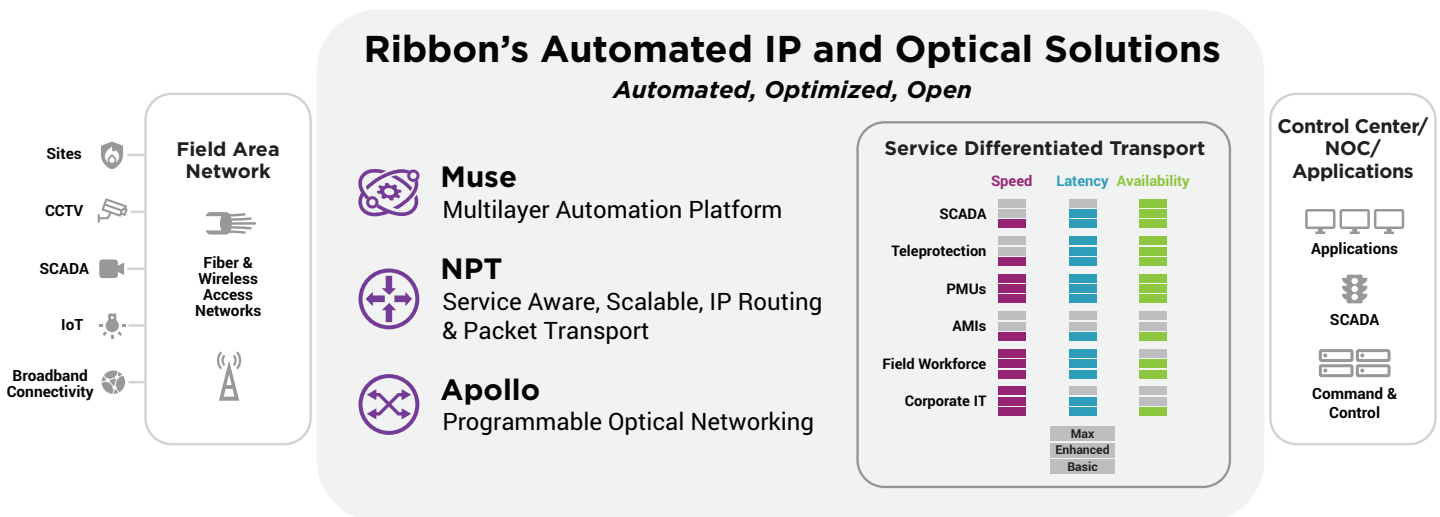
- **Proven, well-defined, field-hardened processes:** a successful migration relies on a structured set of processes, clear timelines, and achievable milestones, all backed by extensive real-world experience.
- **Risk-free modernization:** necessitates the deployment of suitable technology and a flexible migration strategy, precisely tailored for each region and customer to mitigate potential risks.
- **Legacy and modern interface support:** ensures continued support for TDM/SDH/SONET and serial interfaces on the new packet transport network, facilitating seamless integration and transition of the legacy services.

Upon migration to a modern packet transport network, the infrastructure should be capable of evolving to deliver:

- **Continuous evolution:** the ability to introduce new services and technologies over time without disruptive redesign, supporting ongoing innovation and adaptability.
- **Increasing Automation:** enabling operators to easily scale the level of automation used to operate and maintain the network, which improves efficiency and reduces manual intervention.
- **UTelco Evolution:** empower mission critical businesses to diversify into the telecommunications sector, providing telecom services in addition to their established IT and OT functions and support. This diversification may involve acting as bandwidth wholesalers to existing Service Providers or becoming Service Providers themselves. To successfully deliver telecom services, robust multitenancy capabilities are essential, ensuring secure, scalable, and efficient operations to meet the demands of both their traditional business alongside the new telecom services.



Ribbon's Mission Critical Packet Transport Network



Ribbon's Automated IP & Optical Solution for Critical Industries

- **Deterministic Packet Transport for mission critical OT services**
- **IP/MPLS for IT services and Utelco Evolution**
- **Mission critical grade IP routing, Packet Transport and Optical networking**
- **Practical, easily tailorable, blend of automation and manual processes to simplify operations**

Ribbon's automated IP and optical networking solution delivers a robust, end-to-end architecture specifically engineered for mission-critical networks such as utilities, transportation, and defence. Designed to meet the stringent demands of these sectors, the solution combines advanced automation, reliability, and scalability to ensure uninterrupted operations and seamless integration with both legacy and modern systems.

The Ribbon solution comprises of:

- **MUSE:** a multilayer automation platform that orchestrates network operations, streamlining processes and enabling right first time provisioning and rapid fault identification and network restoration across diverse network layers.
- **NPT:** delivers service-aware, highly scalable IP routing and packet transport, ensuring reliable connectivity and seamless integration of legacy and modern network interfaces.
- **Apollo:** provides programmable optical networking for high-capacity connectivity, catering for the growing demands of modern mission-critical applications.

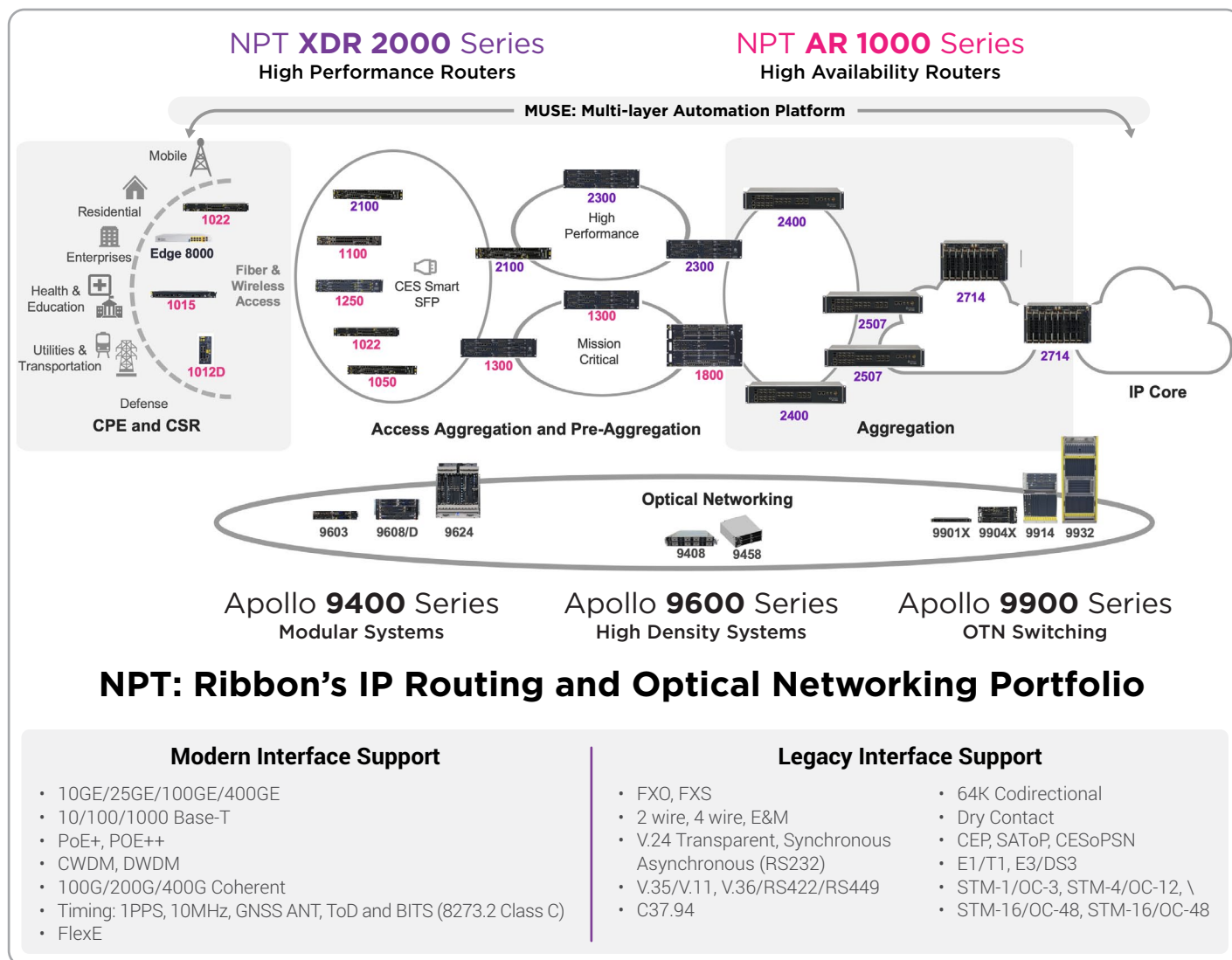
Ribbon's solution guarantees reliable and secure transport for mission-critical operational technology (OT) traffic and IT services.

This is achieved through differentiated service transport, tailored to the specific requirements of each application. For example, SCADA and teleprotection traffic are prioritised to receive the highest performance and reliability, ensuring essential grid operations and safety systems are always protected, whereas corporate IT and consumer broadband services are delivered with service levels appropriate to their needs. This intelligent prioritisation, supported by a blend of automation and manual processes, simplifies operations and preserves the deterministic reliability demanded by critical infrastructure environments, even as new services and technologies are introduced.

Modernizing Mission Critical Networks

A key strength of the Ribbon solution is its ability to combine advanced technology with robust, field-proven processes and deep industry expertise. This enables Ribbon to deliver mission-critical customers the tailored solutions and methodologies essential for safely and efficiently migrating their operational technology (OT) transport networks from legacy SDH/SONET systems to modern packet transport networks (PTN).

Ribbon's Industry Leading IP Routing and Optical Portfolio for Mission Critical Networks



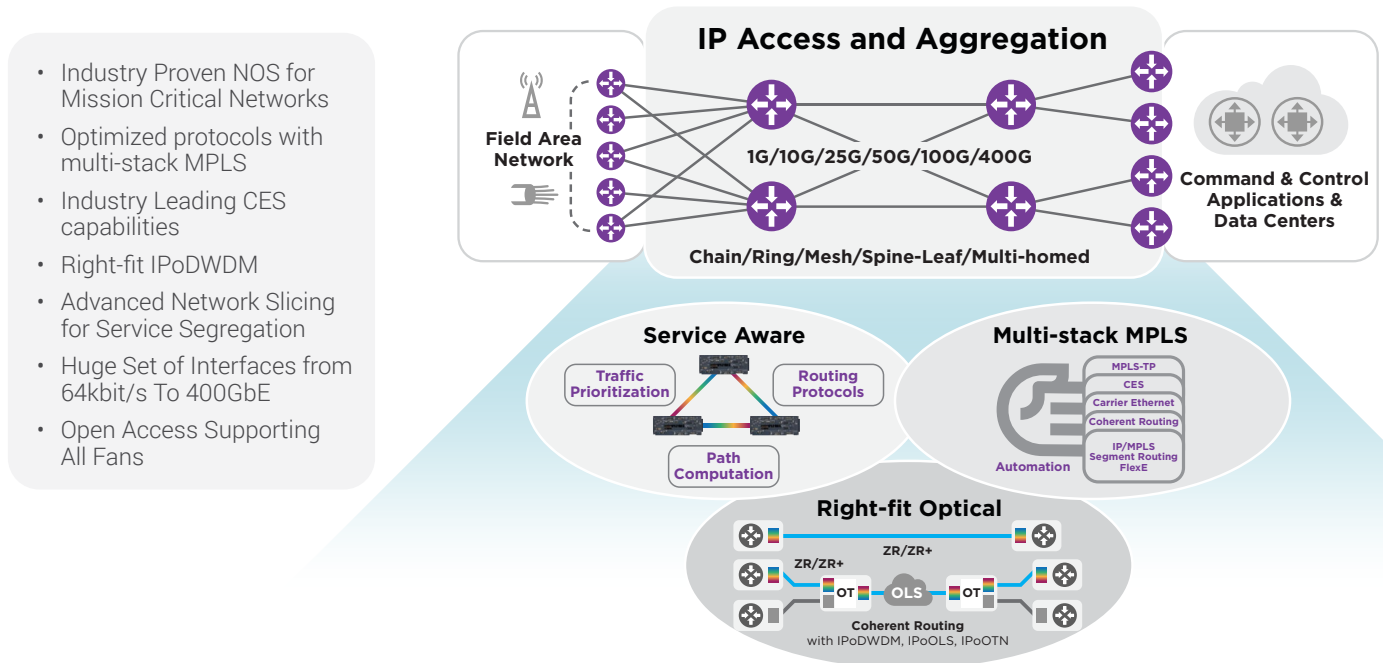
Ribbon's portfolio delivers comprehensive compatibility with both legacy and contemporary network interfaces, facilitating a smooth and uninterrupted transition for mission-critical transport networks as they evolve.

With full support for PCM/TDM and SDH/SONET interfaces—including those essential for teleprotection, voice, and SCADA—operators can carry out phased, risk-free migrations while maintaining continuous operation of their critical services.

Moreover, these same network components are fully equipped to handle the high-capacity interfaces necessary to support the demands of modern digital communications and devices.

Key Elements of Ribbon's Solution

Mission Critical Class IP Routing and Packet Transport



NPT : Ribbon's IP Routing and Packet Transport Portfolio

Industry Proven NOS Supporting Multi-stack MPLS

Ribbon's IP routing and packet transport portfolio (NPT) leverages IP rNOS, a network operating system, which is deployed across the entire Ribbon IP router portfolio. This advanced software supports a wide array of routing and transport protocols, including Ethernet, MPLS-TP, IP/MPLS, RSVP-TE, LDP and Segment Routing. By enabling multiple protocol stacks to operate concurrently within a unified system, operators of mission critical networks are provided with the flexibility to select the optimal protocol for their specific operational requirements. Furthermore, the system facilitates seamless and uninterrupted protocol upgrades, allowing networks to evolve smoothly as demands change, without service disruption.

For operators wanting SDH/SONET like operational behaviour, MPLS-TP is the protocol of choice, it offers centralized management with separation between the control plane and the data plane and provides predictable traffic flows, SDH/SONET compliant protection switching, and guaranteed path symmetry between working and protection paths.

For operators wanting a fully routed network, IP/MPLS including RSVP-TE, LDP, and Segment Routing would be the approach of choice, it offers advanced traffic engineering, fast convergence, and multi-service support for service provider and mixed utility environments.

Modernizing Mission Critical Networks

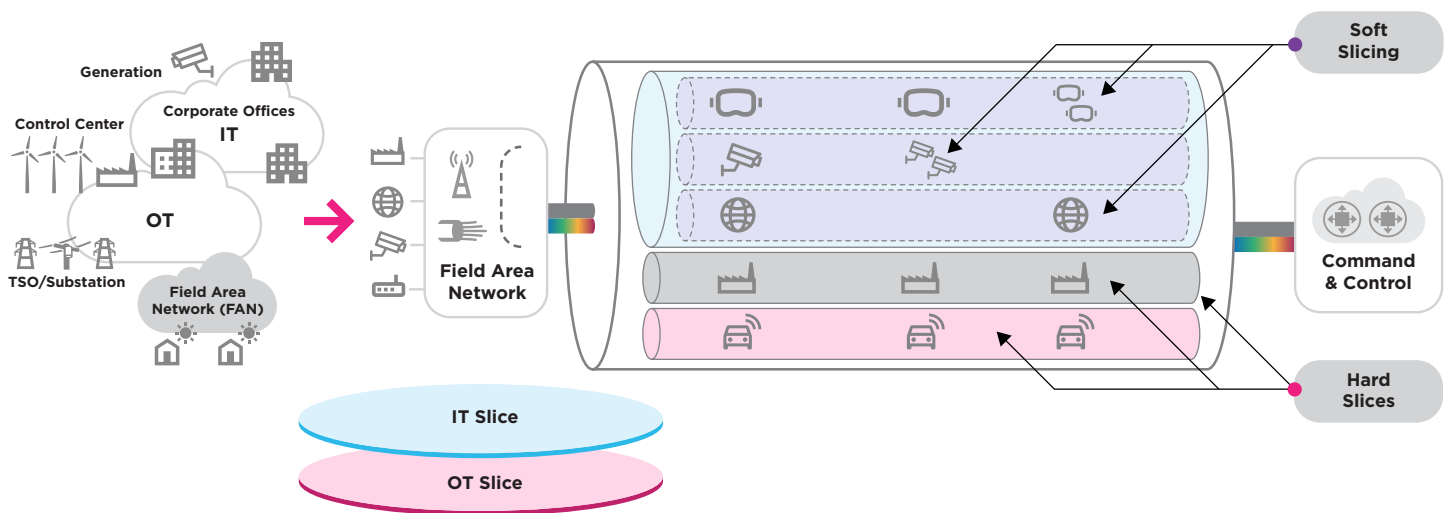
This multi-stack MPLS approach allows operators to have a mix of both approaches in their network and provides them the flexibility to migrate between the approaches as operational demands change.

Industry Leading Circuit Emulation (CES) Capabilities for Risk-Free Legacy Migration

Ribbon offers extensive industry-leading circuit emulation capabilities, supported by robust management systems, proven processes, and deep experience in assisting mission-critical and service provider customers with the migration of legacy services from SDH/SONET transport networks to modern packet transport infrastructures.

Our best-in-class circuit emulation capabilities, together with support for deterministic packet transport and hardened operational management, provide mission-critical network operators with a secure and reliable pathway for migrating legacy services onto packet-based networks. This flexible migration strategy enables operators to transition at their own pace and select the transport protocol that best suits their operational requirements, ensuring continuity and minimising risk throughout the process.

Advanced Network Slicing for Service Segregation



Network Segregation

Ribbon's network slicing strategy uses a combination of hard and soft slicing techniques to deliver secure and reliable service segregation. Hard slicing uses FlexE, dedicated wavelengths, or even entire fibres to ensure absolute transport separation between each slice, making it the ideal solution for mission-critical OT services such as SCADA, command and control, and protection systems, where network segregation is mandatory.

Soft slicing leverages established Quality of Service (QoS) and DiffServ methodologies to deliver differentiated services, making it suitable for non-mission critical OT applications and IT services.

Programmable Optical Networking

Ribbon's Apollo optical networking portfolio provides the high capacity, ultra reliable transport required for mission critical networks. Key Apollo capabilities include power-cost optimized 400G/800G ZR+ transmission, capacity-reach optimized transmission to 1.2T with maximum spectral efficiency, quantum safe encryption, shared spectrum OLS, and access-to-core OTN switching.

Right-fit Integration of IP routing and Optical Networking

Mission-critical networks gain significant advantages from the flexibility to implement the most suitable combination of IP routing and optical networking technologies. Ribbon delivers industry-leading, optimised convergence between the IP routing and optical layers, ensuring the packet transport network is aligned with the unique requirements of each application, including distance, scalability, and operational preferences.

When appropriate, coherent ZR/ZR+ pluggables can be integrated directly into IP routers (IPoDWDM). Extended reach can be achieved by deploying an Optical Line System (OLS), and for scenarios requiring comprehensive optical layer flexibility, an optical transport network may be utilised. In every case, Ribbon's Muse Multilayer Automation Platform delivers unified management across both IP and Optical domains, providing seamless control and visibility across the network.

Control, Automation, and Assurance with Muse

Muse is Ribbon's multilayer automation platform it equips operators of mission-critical networks with robust capabilities to ensure an always-on, never fail communications infrastructure. The platform offers a suite of advanced automation tools alongside manual controls, enabling operators to achieve the optimal balance between automated and hands-on management to suit their operational requirements. This comprehensive lifecycle management covers both legacy and modern services and applications and provides right-first-time provisioning, sophisticated network performance analytics, and rapid, accurate fault detection and recovery—essential for maintaining uninterrupted network performance and reliability. Key elements include:

- **Service lifecycle automation:** intent-based provisioning for MPLS-TP and IP/MPLS services, reducing configuration variance and accelerating deployment.
- **Assurance and OAM visibility:** topology awareness, in-band OAM monitoring, performance trending, and rapid correlation of faults to affected services.
- **Deterministic path control:** engineered paths and traffic engineering to keep mission-critical flows on predictable routes.
- **Operational separation:** role-based access and workflow alignment to help maintain IT/OT segregation while operating shared infrastructure.
- **Integration readiness:** APIs and northbound integrations to ticketing, inventory, and security operations tools, supporting compliance and auditability.

Conclusion

Modernisation of OT communications is no longer optional. By combining Ribbon's mission-critical-grade IP and Optical technology, with field-hardened migration processes and deep industry expertise Ribbon enables risk-free migration to a modern packet transport network which can continuously adapt. The result is a network ready for IT/OT convergence, new digital applications, and future capacity growth, while preserving the deterministic, always-on, never fail performance that mission-critical operations demand.

[Contact Us](#)

Contact us to learn more about Ribbon solutions.

About Ribbon

Ribbon Communications (Nasdaq: RBBN) is a global provider of voice communications software, IP routing, and optical networking to mobile and wireline service providers, enterprises, critical infrastructure and defense sectors. We support our customers' Path to Autonomous Networks by leveraging the latest AIOps automation platforms and Agentic AI technologies, helping them deliver better customer experiences, reduce operational costs, and achieve sustainable growth.

To learn more about Ribbon visit [ribbon.com](https://www.ribbon.com).