Modernizing Communications for Energy and Power Companies

with Ribbon's Optimized Packet and Optical Transport Solution

Digitizing the Network to Support Smart Energy and Power

In the energy business, transmission system operators (TSOs) and distribution system operators (DSOs) are under immense pressure to modernize their networks. Regulators are driving the energy operators for increased energy efficiency by use of renewables, smart metering, and DSO neutrality. The operators themselves want to escalate revenues from energy trading, while increasing network security. To meet these challenges, energy operators need to modernize their energy networks to provide a secure data infrastructure that is able to detect and react instantaneously to changes in energy supply and demand. Accurate, real-time data is key for managing renewables, facilitating good communications between DSOs and TSOs, allowing revenues from energy-trading to be optimized, and managing the data from smart meters. The communications network is essential to transport this data efficiently while continuing to support mission-critical services like teleprotection and SCADA. In the age of Distributed Energy Resources (DER), Ribbon extends smart traffic engineering to the edge of the networks, including the Field Area Network (FAN).

Risk-Free Transition tailor-made evolution for all services and networks

Secure Packet guarantees mission critical services

Multiservice supports evolution to smart energy

High Availability provided by advanced network architecture

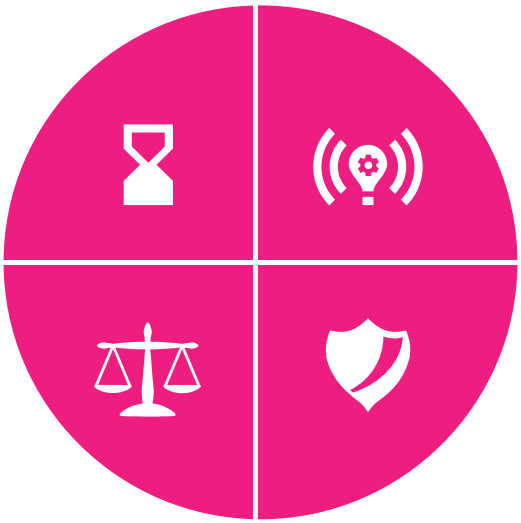
Drivers Of Modernization

Evolution to a Digital Energy

The move to digital energy is dependent on providing a secure digital data infrastructure. The legacy TDM networks used by energy operators cannot support the efficient transport of the packet services that drive the move to digital energy.

Increased Regulation

We see ever-increasing regulation to strengthen, standardize, and safeguard energy networks, all with a view to dramatically improve energy efficiency.



Smart Grid - IoT

With smart grid, we see the introduction of renewable energy sources and smart devices. Renewables require accurate, real-time monitoring to allow them to be used effectively. Smart meters and smart appliances require IoT techniques to allow them to be meet their potential for improving energy efficiency.

Security and Safety

Paramount for energy operators. The networks must be highly secure to reduce both physical and cyber attacks.

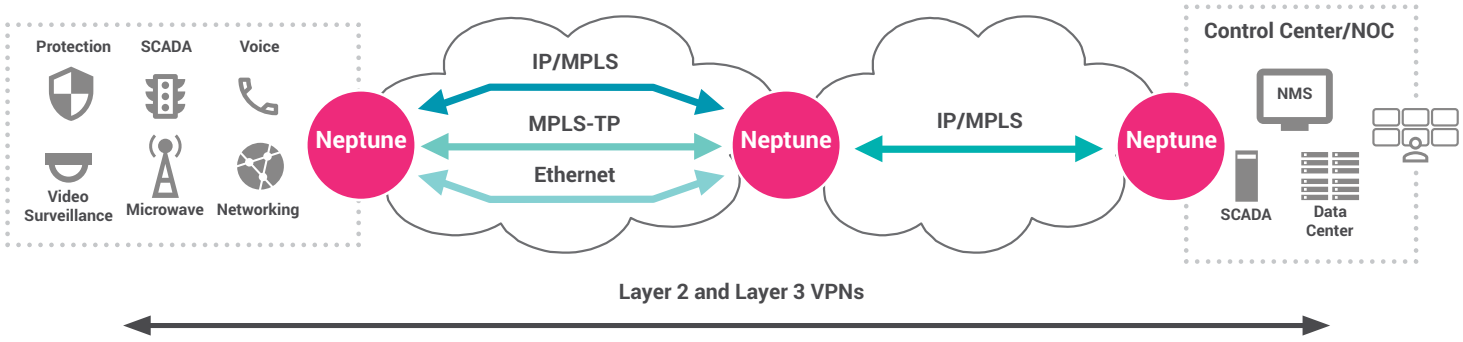
Cost-Effective and Risk-Free Transition to Packet

Ribbons packet solutions are optimized for the communications networks used by power and energy companies used by power and energy companies. We have used them to provide many energy companies around the world with a risk-free evolution to packet based communications infrastructure.

Legacy services and low-rate mission-critical services like SCADA, tele-protection and control are migrated to the packet layer, when it makes sense for the network operator . Our Elastic MPLS, dual stack, packet technology has been designed with mission critical networks in mind. It provides IP/MPLS to support IT networks and MPLS-TP (deterministic MPLS) to support the mission critical OT services which require low latency, high reliability, deterministic performance and extensive OAM. With extensive Circuit emulation (CES) capabilities the correct packet transport technology can be selected to meet the service needs on a service by service basis. Ribbon's field proven processes ensure this migration process is risk free.

The solution provides a pay-as-you grow architecture, making the transition to packet extremely cost-effective:

- **Add capacity when needed** - with unique in-service expansion units and in-service upgradeable packet fabrics (e.g. 10G to 60G, 100G to 200/320G, 1T to 2T).
- **Introduce technology when required** - with unique in-service expansion units to scale connectivity and elasticity (Eth, Optical, PCM, CES); and with integrated WDM, OTN, and bidirectional SFPs to simplify optical connectivity.



Ribbon has extensive experience in transitioning networks and developed field hardened, proven processes for this migration.

Holistic Security Suite

Critical industries are a prime target for cyber-attacks. Data security is a particularly complex matter. It must protect both IT and OT assets and be able to identify tangible threats from amongst the multitude of reported events.

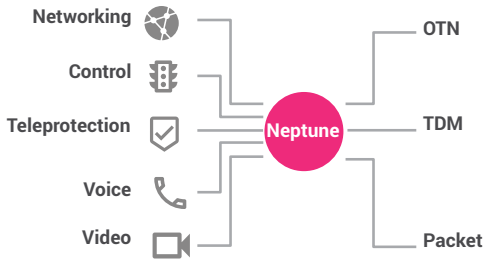
Our solution provides physical layer security, encryption, firewalls, and intrusion detection. It provides the capabilities to identify and tackle potential attacks in several ways:

- **Preventing attacks where they occur** with distributed attack mitigation.
- **Guarding the integrity of the SCADA and OT network.** The system maintains a complete OT network map and continuously monitors all transactions for abnormal behavior, providing early warnings of any tampering.
- **Identifying real threats** with advanced correlation and analysis for a clear view of tangible threats and ranks them by severity.

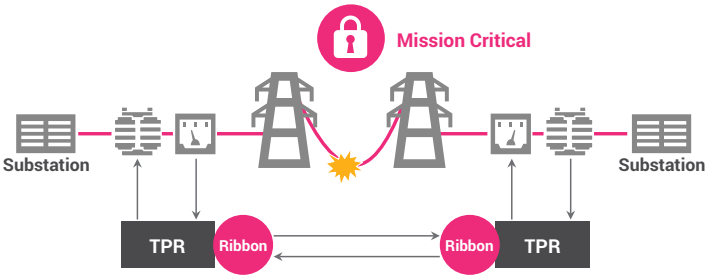
Multiservice Platform

With Ribbon's packet and optical portfolio you have a complete multiservice platform for supporting the (OT) and (IT) services over the most appropriate transport technology. Mission-critical Operational Technologies (OT) like teleprotection and SCADA require the static, deterministic behavior that TDM and MPLS-TP provides. Concurrently, IP/MPLS provides optimized support for Information Technology (IT) services like voice, video, and non-mission-critical networking. The solution seamlessly integrates the packet and optical layers to enable cost-efficient transport of the high-capacity data generated by video and other (IT) applications.

Video technology introduces additional challenges. Cameras used for security in substations generate vast quantities of HD content. This needs to be backhauled to a few control locations to allow the real-time analysis required to search for potential security breaches. The solution provides a multicast architecture with end-to-end QoS monitoring to ensure the quality of the video network. Cost-effective bulk transport of the video traffic is enabled by optical transport and Power over Ethernet (PoE) interfaces. These provide power to the cameras and other outdoor monitoring devices. The solution delivers an open and future-proof way to add new services and applications.



Networking	FE, 1GE, 10GE
Control	V.35, X21,RS-232, RS-449, V.24, V.11, V.36
Teleprotection	IEEE-C37.94
Voice	E1/T1, FXO/FXS, 2/4 E&M, Omni
Video	Ethernet with PoE+



Traditionally, TDM provides the tools to derive and distribute the accurate timing that is fundamental to the operation of energy services. As networks evolve to packet, the timing architecture must remain robust. The solution allows an approach similar to that used in TDM. A built-in GPS receiver or an external timing source provides the master clock. 1588v2 Precision Timing Protocol (PTP) distributes timing across the network and MPLS-TP reduces packet delay variation by using deterministic, bidirectional traffic paths.

Muse provides an intuitive GUI, this simplifies operations with rapid right-first-time network provisioning and fast fault isolation. Advanced operations software provided by Muse™ is able to analyze the network data to ensure the network is operating at maximum availability, utilization, and efficiency. This functionality can be further extended to non-Ribbon transport devices with Ribbon's 3rd-party integration solution.

For energy operators wishing to use their unique geographical footprint to generate extra revenues as a Utelco, the multiservice capabilities of the solution provide the managed L2 and L3 VPNs required for business services, residential services, mobile backhaul, and future IoT applications.

Optimized for High Availabilty

Energy companies require communications networks that provide 'five-9s availability' or better, Ribbons solution for energy and power provides this with:

- **Fully-redundant hardened design of the Network Elements** with 1+1 and 1:1 protection of key units and an extended temperature range for use in energy applications (-25°C to +70°C)
- **Fast protection against single and multiple network failures:** MPLS-TP supports sub-50ms protection switching for single failures. Used in conjunction with pseudowire redundancy, protection is provided for multiple failures.
- **Remote disaster recovery** allows network and management restoration from geographically dispersed sites in the event of catastrophic failure.
- **Potential network failure protection:** Muse monitors the network performance performance in real time and help identify trends over time.

Risk-Free Transition to Packet

Your Challenges	Our Solutions
Need risk-free evolution to packet	Ribbon's energy and power solution provides energy operators with a risk-free evolution path to allow them to move their legacy TDM communications services onto a modern scalable, elastic, multiservice packet transport networks: • Legacy services operate on this platform by using circuit emulation • MPLS-TP is used to provide the deterministic transport and advanced OAM required for mission-critical services • Service assurance is guaranteed with advanced operations software provided by and Muse™
Need enhanced security	The solution provides a tailored, holistic security suite providing comprehensive protection for the communications infrastructure: • Integrated SCADA protection, secured connectivity, and secured services • L1 to L3 encryption with L1 optical intrusion detection

Intelligent High Availability Multiservice

Your Challenges	Our Solutions
Need a multiservice network to support all the services associated with smart energy and power	Extensive multiservice capabilities provide support of OT services, IT services, and advanced consumer services from a single platform: • Mission-critical services like SCADA and teleprotection and supported by MPLS-TP • IP/MPLS is used to support L2 and L3 services • Pay-as-you-grow design, with unique in-service expansion units, scalable crossconnects and in-service upgradable packet fabrics • Easy extension of the services with intuitive, get-it-right-the-first-time introduction of new resources enabled by Muse • Proven SDN capabilities can be introduced as they are required by the energy operators • Supports business services, residential services, mobile backhaul and future IoT applications, allowing energy operators to evolve as a Utelco.
Need highly available telecoms network for mission-critical services	Provides the intelligent, highly-available network required for mission-critical services with: • Hardened network elements and optimized architectures provided by Neptune and Apollo • Intuitive operations and rapid fault isolation provided by Muse • Advanced software provided by Muse ensures the network is operating at maximum availability, utilization, and efficiency • Third-party device management integrated into Ribbon's end-to-end management

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.

Contact Us Contact us to learn more about Ribbon solutions.