Electrical utilities worldwide are modernizing their transmission and distribution communications to support a new set of industrial IoT applications such as Automated Metering (AMI), Distributed Energy Resources (DERs) integration, substation automation, and distribution automation.

Similarly, traditional information technology applications like video and voice over IP (VoIP), as well as new IoT applications such as edge computing, are being overlaid on critical infrastructure communications. Ethernet/IP/MPLS, having proven themselves in the world’s most mission-critical networks, provides the scale, network visibility, resilience, reliability, and security for the next generation of communications-dependent applications.

Today, software-defined networking (SDN) and automation, which simplify deployment and operation, are used to address the complexity of converging IT and OT networks, creating a new paradigm in situational awareness, security, and performance. Juniper Networks and SEL Inc. are partnering to provide an end-to-end communications solution converged on Ethernet/IP/MPLS, SDN, and automation—simplifying the engineering required to deploy and operate new and legacy network infrastructure.

The Challenge

The integration of information technology (IT) and operational technology (OT) is not only fundamental to the evolution of the digitally enabled grid, it is the foundation for future business requirements. While utilities recognize the broader business value of convergence, in practice they struggle to merge IT and OT applications and management without risking the safety, reliability, and performance of mission-critical protection and control applications.

The Juniper-SEL IT-OT converged Ethernet grid solution addresses how to:

- Achieve sub-5 millisecond network healing performance for all Ethernet and time-division multiplexing (TDM) circuits with MPLS transport
- Support legacy communications of installed relays, intelligent electronic devices (IEDs), and remote terminal units (RTUs)
- Achieve deployment readiness for IEC 61850 Ethernet-based substation modernization
- Enhance cybersecurity while ensuring no negative impact to the safety and reliability of the electrical grid
- Position utilities for a future in which componentry exposes APIs (instead of CLIs) to higher level automation and orchestration platforms
- Enable the agile adoption and/or decommissioning of software functionality through the use of open APIs
The Juniper-SEL Converged Ethernet Grid Solution

Juniper Networks, a global leader in networking and security, and SEL Inc., a global leader in the protection and control infrastructure for the electrical grid, have joined forces to develop a simplified, automated solution for IT-OT convergence.

The Juniper-SEL IT-OT Converged Ethernet Grid solution addresses electric utilities’ need to transition from legacy communications technologies to packet-based technologies within transport networks and substations. The solution allows true end-to-end network visibility, management, and control while maintaining the rigorous communication performance demanded by critical control applications.

Three distinct features distinguish the joint Juniper-SEL solution from the competition:

1. **Automated configuration:** Juniper and SEL intentionally replaced protocols using APIs and physical networks with an event bus framework, allowing software functions to be stitched together with flexible, automated workflows. By extending sophisticated orchestration and adding an automation “backplane,” you no longer have to configure hardware devices one at a time or through brittle ASCII-based scripting via the CLI.

   **Benefit:** Automating complex, manual tasks reduces errors, improves cybersecurity, and enhances overall situational awareness.

2. **Network programmability:** The unique value of the Juniper-SEL collaboration is predicated on the deterministic, programmable, deny-by-default nature of network components. Pushing network intelligence deeper into the grid supports the re-instrumentation requirements for new applications like Sampled Values. Baseline automation, jointly developed by both companies, simplifies circuit provisioning by applying known best methods to meet the application requirements, improve reliability, and reduce engineering costs.

   **Benefit:** Vastly enhanced cybersecurity, situational awareness, and the ability to obtain telemetry from deeper within the grid. Construct and maintain exactly what communication flows are on your network and the physical paths they are taking. Orchestrate traffic from the source host network interface card (NIC) to the destination host NIC.

3. **Multidimensional extensibility:** The joint Juniper-SEL solution is extensible in two distinct ways. First, it allows for the integration of complementary software systems (functions) and the continued development of new automated workflows. Second, it creates a new end-to-end paradigm on how and where telemetry can be obtained, analytics applied, and action taken.

   **Benefit:** Useful software functionality and investments are preserved while cybersecurity, healing agility, and situational awareness capabilities are extended, ensuring the safety and reliability of the electrical grid.

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**Figure 1:** The joint Juniper-SEL IT-OT converged Ethernet grid solution
With automation, network programmability, and extensibility, utilities can safely accelerate the deployment of:

- TDM-to-IP transport conversions
- IEC 61850 substation digital secondary system (DSS) modernization
- Data or control center modernization
- Safe and secure IT overlay circuits with nondisruptive scalability

A converged Ethernet grid creates an engine for driving down operational expenses. The resulting efficiency gains reduce the TCO for delivering new services and improve security, situational awareness, and performance. Juniper and SEL are closing and automating the gap between IT and OT.

How It Works

The Juniper-SEL IT-OT Converged Ethernet Grid solution leverages components from each company’s respective areas of expertise to provide a complete end-to-end converged solution:

- The Juniper Networks® MX Series 5G Universal Routing Platforms provide the scalable, resilient MPLS backbone required for TDM-to-IP transport modernization.
- The substation-hardened SEL 2740S Software-Defined Switch and SEL 5056 Software-Defined Flow Controller provide 61850 Ethernet fabric for substation modernization.
- SEL Integrated Communications Optical Network (ICON) TDM-to-Ethernet multiplexers support legacy circuit requirements by integrating with the MPLS network while retaining microsecond precision for Teleprotection and Sampled Value applications.
- The Juniper Event-Driven Infrastructure (J-EDI) establishes an automation backplane capable of stitching siloed software systems like trouble-ticketing systems, SDN controllers, and element manager systems together with configurable workflows, creating a new level of business value and cost efficiency.

By embracing the power of automation, Juniper and SEL can help our joint customers:

- Accelerate policy-based deployments of new architectures while reducing the risk of human error
- Leverage existing skillsets and investments in familiar tools
- Bridge the transition from legacy IEDs, RTUs, and relays with a hybrid legacy-modern substation architecture
- Maintain the low latency (<1 ms), low jitter (<0.1 ms), and fast ring-healing time (< 5 ms) required by the most demanding applications

Summary – Grid Modernization through Sound Engineering

Modernizing grid infrastructure can lead to significant management and technical complexity. What today’s utilities need is a healthy dose of engineering simplicity.

For the last 30 years, the IT domain has produced remarkable innovation. However, that innovation introduced a lot of complexity, making IT systems harder to manage and less secure. Wary of the rate of change and level of instability, the OT domain has understandably avoided adopting IT technologies for critical infrastructure. However, IT organizations face the challenges of massively scaling their offerings and capabilities, which requires the adoption of software-defined network functions, orchestration, automation, and new forms of cybersecurity.

Today, through the application of sound engineering principles, it is possible to deploy Ethernet/IP-based packet technologies to critical infrastructure—just in time to address utilities’ needs to support a new generation of distribution edge grid modernization and IoT applications. The introduction of automation can help backfill an aging and retiring OT workforce and safely retire or replace electro-mechanical equipment that has reached its end of life. It has survived this battle with complexity, emerging with a renewed commitment to engineering simplicity. OT should not repeat the battle—it should learn from it.

The Juniper-SEL Converged Ethernet Grid architecture automates complex tasks, such as provisioning circuits end-to-end across multiple networking fabrics and operating systems. The Juniper-SEL solution adopts the best of the software-defined model of abstracting best-of-breed Juniper and SEL physical components into a forwarding plane from the control center to the end devices—all while retaining the ability to centrally manage and control security, situational awareness, and network agility.

Next Steps

To learn more about this joint solution, contact your Juniper account representative at Juniper-SEL-OT-SDN@juniper.net or visit www.juniper.net/us/en/solutions/energy/.

About SEL

SEL invents, designs, and builds digital products and systems that protect power grids around the world. This technology prevents blackouts and enables customers to improve power system reliability and safety at a reduced cost. A 100-percent employee-owned company headquartered in Pullman, Washington, SEL has manufactured products in the United States since 1984 and now serves customers worldwide. Our mission is simple: to make electric power safer, more reliable, and more economical. Learn more at www.selinc.com
About Juniper Networks

Juniper Networks brings simplicity to networking with products, solutions and services that connect the world. Through engineering innovation, we remove the constraints and complexities of networking in the cloud era to solve the toughest challenges our customers and partners face daily. At Juniper Networks, we believe that the network is a resource for sharing knowledge and human advancement that changes the world. We are committed to imagining groundbreaking ways to deliver automated, scalable and secure networks to move at the speed of business.