Electrical utilities are modernizing their grid communications infrastructure to support a new generation of applications that promise lower operational expenses (OpEx) and significant enhancements to management visibility. From the deployment of automated metering (AMI) to the modernization of substations to allow the integration of distributed energy resources (DERs), new capital investments can streamline the flow of valuable telemetry and produce new sources of data-driven insights. Additionally, the transition from legacy communications to more secure, scalable technologies like Ethernet, IP, and MPLS allows the convergence of traditional IT applications like IP-CCTV surveillance cameras and voice over IP (VoIP) in substations with telemetry rich operational technologies on the same communication medium, dramatically reducing complexity and cost.

However, operations teams question the ability of Ethernet, IP, and MPLS to provide the same stringent communications channel requirements for critical applications like Teleprotection. Doubts about packet switched architectures and their ability to provide the same guaranteed latency, asymmetry, and failover performance as protection-class SONET systems due to their asynchronous shared bandwidth approach remain a sticking point. And the management of IT and OT systems as a single fabric may provoke turf wars, even in the face of a shrinking OT workforce.

Juniper Networks and SEL Inc. are partnering to provide a converged, end-to-end, IT-OT communications and management solution based 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 fundamental to the evolution of the digitally enabled grid and 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 due to concerns about 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 utility operations to benefit from higher level analytics, automation, and orchestration platforms
- Enable the agile adoption and/or decommissioning of software functionality through the use of microservices and 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 with APIs and physical networks with a microservices framework, allowing software functions to be stitched together with flexible, automated workflows. By extending sophisticated orchestration and adding an automation “backplane,” utilities 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 human 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 each and every network component. Pushing prescriptive programmability

![Figure 1: The joint Juniper-SEL IT-OT converged Ethernet grid solution](image-url)
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 which 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.

With automation, network programmability, and extensibility,
utilities can safely accelerate the deployment of:

- TDM-to-IP transport conversions
- IEC 61850 substations digital secondary system (DSS)
  modernization
- Data or control center modernization
- Safe and secure IT overlay circuits that offer scalability
  without impacting OT system performance

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 millisecond precision for line-current differential
  protection and direct transfer trip applications.
- Juniper’s microservices-based management and
  orchestration establish 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 skills 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 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 industrial 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.