SEL OT SDN

Operational Technology Software-Defined Networking

A better OT network awaits

- Establish deny-by-default, zero-trust local-area network (LAN) access control.

- Improve network failover times to under 100 μs to support demanding real-time control applications like Sample Measured Values.

- Simplify and automate IEC 61850 network configuration by uploading SCD files.

- Streamline data collection for cybersecurity audits and support of NERC CIP compliance efforts.

- Improve situational awareness by knowing what devices are on the network and exactly what conversations each device is allowed to have.

SEL

Key Features

SEL Uses SDN to Optimize OT Networks

Traditional Ethernet switches generally behave similarly regardless of the environment—one size fits all. With SEL OT SDN, LAN switching can be tuned or optimized for the specific requirements of the environment. Only SEL has implemented OT SDN with the goal of optimizing an OT network. OT SDN allows you to purpose-engineer networks like you purpose-engineer the power system.

## Network-Engineer Simply and Accurately

Automate network engineering tasks by importing existing IEC 61850 or Real-Time Automation Controller (RTAC) communication configuration files into the SEL-5056 Software-Defined Network Flow Controller for streamlined network settings. This feature saves time and resources and greatly decreases the chance of input errors or misalignment between relay settings and network communication settings.

Eliminate Cyber Vulnerabilities

Traditional networks use features like media access control (MAC) tables, the Rapid Spanning Tree Protocol (RSTP), and cast types for many conveniences, including plug-and-play functionality. However, these features also make traditional networking vulnerable to cybersecurity threats, including MAC flooding and table poisoning, Address Resolution Protocol (ARP) spoofing, Bridge Protocol Data Unit (BPDU) attacks, and more. With OT SDN, all network flows and backup paths are specifically defined in the controller, so there is no need for MAC tables or RSTP. In addition, OT SDN uses traffic engineering to process forwarding behavior, rather than relying on cast types.

Allowlist All LAN Traffic

OT SDN provides deny-by-default, multilayer packet inspection at each hop to control what conversations each device is allowed to have on the network. Packets that do not match the rules do not get forwarded.

SDN Flow Match Rule

Ingress Port	Ethernet Header	IP Header	TCP/UDP Header	Payload
LAYER 1	LAYER 2	LAYER 3	LAYER 4	

PACKET
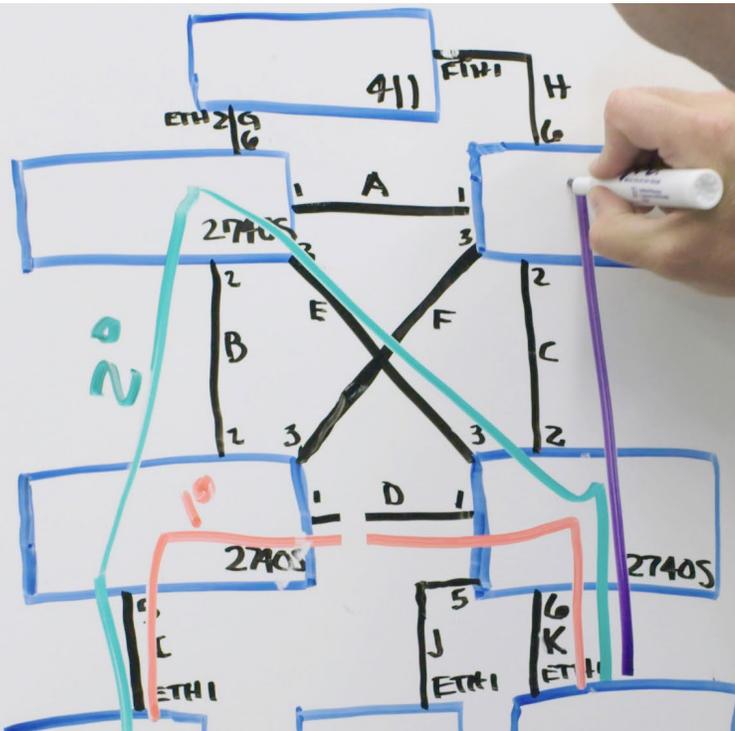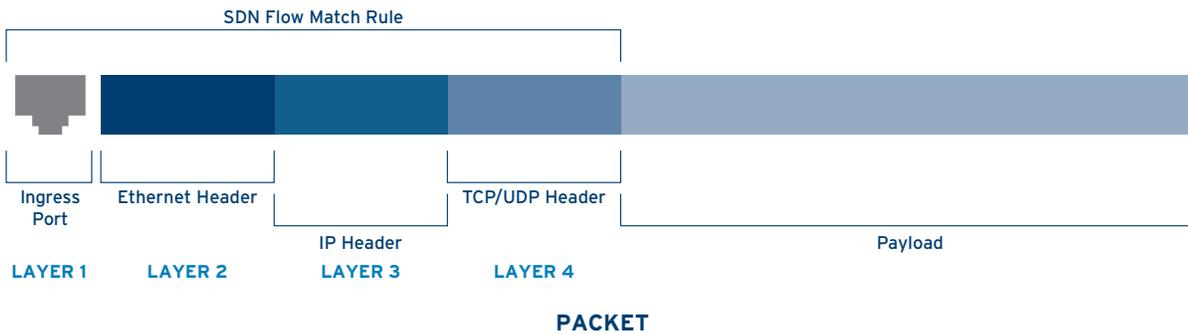
In traditional substations, all traffic in and out of the perimeter is firewalled.

SEL OT SDN adds another layer of cyber defense by allowlisting traffic on the interior LAN.

OT SDN provides strict network access control on both north-south and east-west traffic on the LAN. This provides protection against attacks which physically take place inside the firewalls and also adds protection against unauthorized traffic that slips past firewalls.

Manage the Network Centrally and Securely

The SEL-5056 Flow Controller is the central interface for the commissioning, configuration, and monitoring of all OT SDN switches. The only changes allowed on the network are made through the flow controller. You'll know exactly what devices are on your network and all the conversations each device is having.

OT SDN switches have no engineering access user interfaces, saving you time and money, as there is no need to manage those accounts and passwords. SEL-5056 communication to all OT SDN switches occurs through encrypted and authenticated Transport Layer Security (TLS). Keys are securely managed through X.509 certificates.

You can configure user accounts on the SEL-5056 or use the Lightweight Directory Access Protocol (LDAP) to authenticate users. The OT SDN solution supports syslog and SNMP for secure log and diagnostic management. In addition, the flow controller provides backup and restore features for maintaining high reliability.

Reduce Network Failover Times by Two Orders of Magnitude

The SEL-5056 configures redundant paths for each circuit. This enables OT SDN switches to heal the network significantly faster than RSTP Ethernet switches because there is no waiting for discovery or convergence times. This fast failover is critical for applications using IEC 61850 GOOSE messages and IEC 61850-9-2 Sampled Values.

Control Network Traffic With Greater Precision

With OT SDN, it's easier to manage large amounts of network traffic than it is with traditional networking. The difference is that OT SDN eliminates unnecessary traffic on your network. Instead of having a node broadcast to all other nodes on the LAN, you can engineer specific paths and remove the extraneous ones. This ensures bandwidth availability and high performance in critical applications, such as IEC 61850 GOOSE messaging. And unlike RSTP switches, there are no blocked ports limiting bandwidth. For Ethernet-based control, OT SDN eliminates several problems inherent in traditional Ethernet switches.

Network Failover Times

Traditional RSTP Switches	SEL OT SDN Switches
>10 ms	**<0.1 ms**
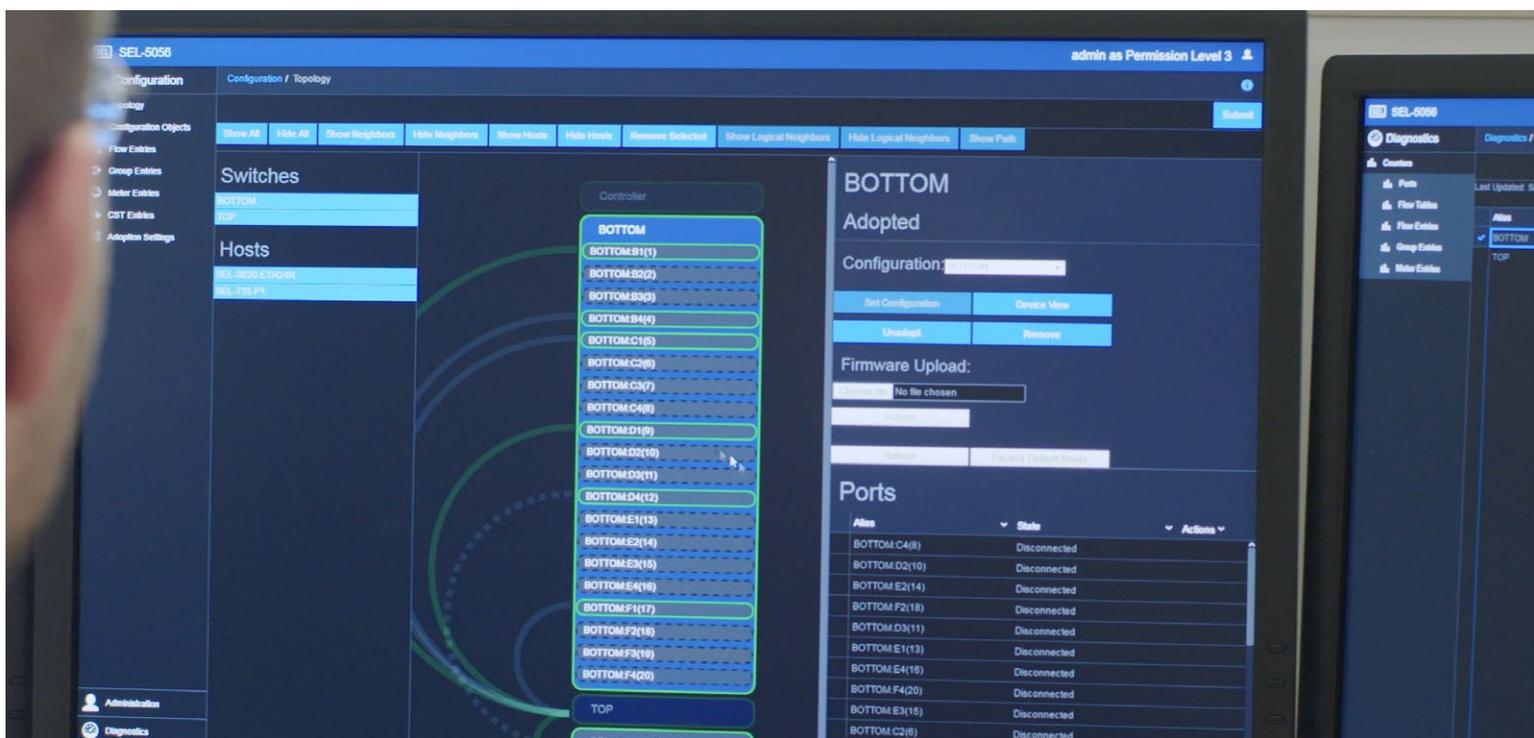
IEC 61850 Substation Configuration Description (SCD) and RTAC Connection Service File Import

Import your IEC 61850 and RTAC Connection Services files directly to the SEL-5056 Flow Controller and watch all the required circuits get provisioned through automated, guided workflows. Have confidence your network is doing exactly what it should and nothing else by unifying the baseline configuration with a single source of truth. The same configuration file used to program your relays or RTAC is now used to program your network, saving you time and improving reliability.

Control Network Flows Precisely

The SEL-5056, a software tool for OT SDN configuration and management, comes either Microsoft Windows Server-based or as an embedded application on the SEL Blueframe® platform. This flow controller provides topology management, circuit provisioning, and telemetry monitoring. The SEL-5056 provides automated OpenFlow programming through user-friendly, circuit orchestration tools. This eliminates the additional network-required tags or labels and simplifies operations. With the removal of RSTP, the network bandwidth is free for operational data and free from RSTP topology design restrictions.

SEL-5056 network configuration can be performed in the field with all IEDs connected or performed offline in a lab. Offline configuration provides flexibility and can reduce the downtime required for field installations.

The SEL-5056 provides comprehensive monitoring of all path- and packet-level network statistics of each communications flow, increasing awareness of the network health and status. In addition, you can programmatically test the network implementation before deployment.

Automate Configuration

Learn & Lock functionality in the SEL-5056 provides supervised automation for commissioning OT SDN switches, learning what conversations are trying to happen, and provisioning circuits to allow those conversations. Learn & Lock streamlines configuration by discovering devices on the LAN and creating a set of flows for the current traffic.

Learn & Lock automates the following functions:

- **Topology Management**—Adopting switches, hosts, and links.

- **Communications Circuit Provisioning**—Discovering the Transmission Control Protocol (TCP), User Datagram Protocol (UDP), ARP, and Internet Control Message Protocol (ICMP) conversations on the network and provisioning the circuits to allow them to happen.

- **Reporting**—The ability for the system operator to review or remove devices or learned communications circuits and to save the final state as the baseline for future reference.

- **Network Reset**—The removal of all previous configurations of past Learn & Lock sessions.

Streamline Data Collection for NERC CIP Reporting

Flow Auditor is the first application in the SEL-5057 SDN Application Suite. It works with the SEL-5056 to generate audit reports for NERC CIP-007-6 R1 for each OT SDN network that the controller manages.

Unlike network scanning, Flow Auditor does not disrupt the operational network or inject any packets on the network. The application audits the controller database for the configuration without needing to pull data from switches. Flow Auditor can create new audit reports at any time for each registered controller without impacting the performance of the operational network. Reports are stored in the Flow Auditor database and can be retrieved and exported through the user interface. Flow Auditor streamlines data collection from days or weeks to minutes!

Flow Auditor supports Microsoft Windows 7, Windows 10, and Windows Server 2016 and is installed on the same computer as the SEL-5056 or on a computer that can reach the flow controller through the network.

Validate Your Design Before It's Deployed

Don't wait until deployment to validate your design. Instead, use the SEL-5056 to programmatically test the network implementation and validate all configurations and contingencies during factory acceptance testing. That way, you eliminate errors before going live and reduce commissioning timelines.

SEL-2731 Overview

- 24-port 1U Ethernet switch
- Eight 1 Gbps and sixteen 100 Mbps ports
- Rack-, surface-, and panel-mount options
- SEL and third-party fiber small form-factor pluggable (SFP) transceiver support
- Syslog and SNMP support for event and status monitoring
- Support for proactive, traffic-engineered OpenFlow for OT SDN

- Dual power supplies for high redundancy
- IEC 61850-3 and IEEE 1613 compliance
- Precision Time Protocol (PTP) transparent clock power profile support
- −40° to +85°C (−40° to +185°F) operating range
- Form C alarm contact
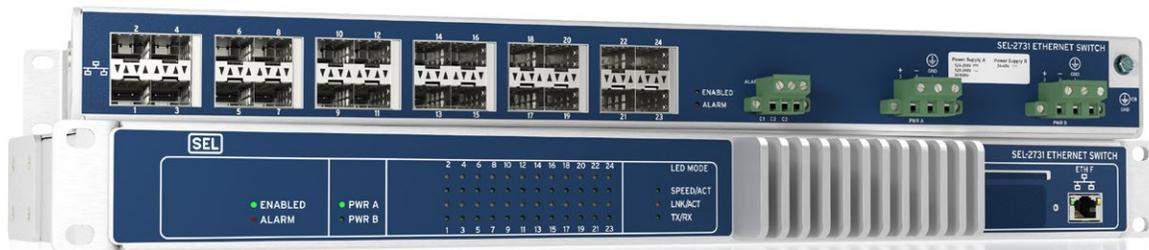
Visit **selinc.com/products/2731** for details.

SEL-2740S Overview

- 20-port 1U Ethernet switch
- Rack-, surface-, and panel-mount options
- Five modular slots for copper or fiber Ethernet interface options (in sets of four)
- 10/100/1,000 Mbps data rate support on Slot D
- Syslog and SNMP support for event and status monitoring
- Support for proactive, traffic-engineered OpenFlow for OT SDN

- Dual power supplies for high redundancy
- IEC 61850-3 and IEEE 1613 compliance
- PTP transparent clock power profile support
- −40° to +85°C (−40° to +185°F) operating range
- Form C alarm contact

Visit **selinc.com/products/2740S** for details.

SEL-2741 Overview

- 24-port 1U Ethernet switch
- 100 Mbps or 1 Gbps support on all 24 ports
- 2 digital inputs for controlling a factory-default reset and a settings lock
- Rack-, surface-, and panel-mount options
- Copper and SFP fiber support
- Syslog and SNMP support for event and status monitoring
- Support for proactive, traffic-engineered OpenFlow for OT SDN
- Dual power supplies for high redundancy
- IEC 61850-3 and IEEE 1613 compliance
- PTP transparent clock power profile support
- −40° to +85°C (−40° to +185°F) operating range
- Form C alarm contact
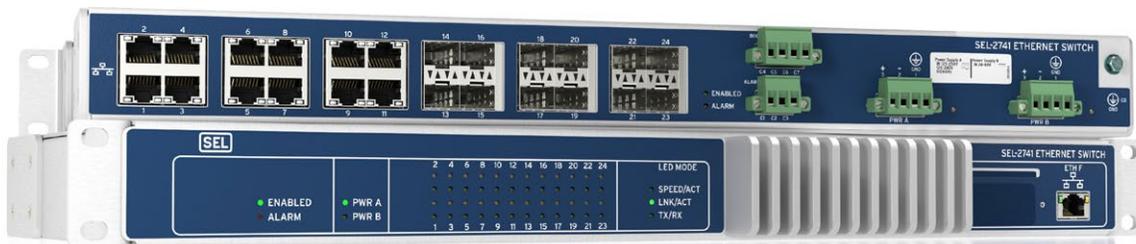
Visit **selinc.com/products/2741** for details.

SEL-2742 Overview

- 12 ports, including 2 PoE+ ports
- DIN-rail and surface-mount options
- Syslog and SNMP support for event and status monitoring
- Support for proactive, traffic-engineered OpenFlow for OT SDN
- Dual power supplies for high redundancy
- IEC 61850-3 and IEEE 1613 compliance
- PTP transparent clock power profile support
- −40° to +85°C (−40° to +185°F) operating range
- Form C alarm contact

Visit **selinc.com/products/2742** for details.