Key Features and Benefits

The SEL-5056 SDN Flow Controller is enterprise software based on Microsoft Windows Server and designed to optimize SDN configuration and management for critical infrastructure. The SEL-5056 is designed to work collectively with the SEL-2740S SDN Switch to provide a complete traffic-engineering solution for Ethernet-based local-area networks (LANs). Traffic engineering with the SEL-5056 enables flexible configuration of each communications flow path and the ability to proactively engineer fault-tolerant networks, resulting in greater performance, improved reliability, and more deterministic packet delivery.

- **Automatic Topology Discovery.** Enables touchless commissioning and discovery of network appliances and hosts on the network through use of the SEL-2740S.
- **Circuit Orchestration.** Provides circuit provisioning through simply selecting the source and destination, as well as automated flow configuration and redundancy path planning.
- **Simple Licensing.** Allows selection from three volume tiers with a one-time licensing fee.
- **Ease of Use.** Simplifies complex settings by using application-focused design to construct each network according to the applications running on the network.
- **Holistic Network Visibility.** Allows viewing and management of network appliances as a single asset. Automated network topology discovery allows for near real-time situational awareness.
- **Low-Latency Flow Setup.** Establishes new flows fast with low-latency flow setup times.
- **Scalable Network Deployments.** Manages small or large networks with a single SEL-5056 installation.
- **Secure Configuration.** Provides situational awareness and strong cybersecurity through user-based access controls, encrypted communication, and detailed audit logging.
- **Syslog.** Performs log management through syslog for centrally automated collection and redundancy.
- **Supported Operating System.** Provides high-quality, service-focused performance with Microsoft Windows Server 2012 R2.
➤ **X.509 Certificate.** Supports secure, mutually authenticated communication between the switch and the flow controller, and manages keys through X.509 certificates.

➤ **Central Authentication.** Uses Lightweight Directory Access Protocol (LDAP) to centrally manage and authenticate authorized users.

➤ **Backup and Restore.** Generate backup images for incident recovery and quickly restore the system.

**Functional Overview**

The SEL-5056 is the central interface for the commissioning, configuration, and monitoring of all SEL SDN-enabled network appliances. An SDN is a network architecture that centralizes packet-forwarding control configuration into a central software application. This centralization of control enables all LANs to be managed as a single asset, simplifying deployment, scalability, and operational tasks, all while improving performance.

The SEL-5056 is a standards-based flow controller, compatible with OpenFlow 1.3, designed to optimize the specific tasks of control systems for proactive traffic engineering of high-reliability networks. With the SEL-5056, users can design a deny-by-default network, while considering fault tolerance, by instructing each network appliance how to forward packets and how to respond to a network fault.

**Licensing**

The SEL-5056 has a simple, one-time licensing fee structure and an optional version assurance program. Choose from three volume-based tiers.
Topology

Hypertext Transfer Protocol Secure (HTTPS) provides encryption and authentication for secure management of SEL-5056 web browser communication. SEL-5056 communication to all SEL-2740S Switches occurs through encrypted and authenticated Transport Layer Security (TLS) communication. Touchless topology management and switch discovery ease commissioning and deployment efforts. Touchless node discovery enables new switches and hosts to be discovered and shown in the graphic display before they are added to the inventory, enabled to communicate with the SEL-5056, and prepared for configuration.

Management

The SEL-5056 centrally manages an entire network as a single asset, controlling the access of traffic flows to the network and determining the path each flow takes.

The SEL-5056 improves network performance by using predetermined failover conditions and eliminating the need for dynamic convergence protocols such as Rapid Spanning Tree Protocol (RSTP). The southbound interface is a standards-based OpenFlow 1.3 interface.
The SEL-5056 provides a system-wide change management capability so users can plan changes without interrupting service. The software is designed with a cybersecurity focus. The controller has a whitelisting architecture and deny-by-default network management at each hop. Near real-time operational diagnostics collected from all network assets provide superior situational awareness and detailed audit logging of users. Access control to change management is user-based and centrally controlled and logged.

Application Examples

The SEL-5056 is ideally suited for the commissioning, configuration, and management of an SDN for a substation LAN.

Traffic Engineering

The SEL-5056, coupled with the SEL-2740S, provides touchless device discovery and topology management. The SEL-5056 can discover network topologies, track host locations, and obtain a user interface from which to configure communications flows end-to-end while enabling system-wide visualization of each flow path. The flow controller binds securely to switches and facilitates the easy discovery and addition of new switches to the inventory. Automatic discovery does not impede operational data flows, thus enabling network scalability without interruption. Upon the addition of a switch to the inventory, the SEL-5056 begins the passive automatic discovery of hosts on the network. Configuration of flows occurs either through the addition of host-based logical paths (focusing on end-device functionally), or by direct flow entry into the switch tables. This traffic engineering focuses on improving the ability to proactively design the network for any failure case. Logical flow path configuration allows users to select the end points for each flow, the match criteria, and the action set. This way, every forwarding hop that the packet traverses is automatically programmed. This removes the need to configure flows in each switch individually, and it eliminates many tedious configuration tasks.

Traffic engineering is made simple through the use of aliases for any host, port, link, flow, meter, or group. This allows the engineer to reference friendly names rather than identifier numbers. Counters are also referenced by these aliases, simplifying troubleshooting.

![Configured Network Diagram](image)

Figure 5 Configured Network Diagram

The SEL-5056 provides a global view of the entire network, showing the communications health and diagnostics information for each flow, and enabling system operators to understand what is happening on the communications infrastructure. The SEL-5056 also provides device views of the network so that the configuration of each individual network appliance and the configuration of all allowed host traffic can be centrally controlled and monitored.
Central Management and Monitoring

The SEL-5056 manages and monitors all field networks as a single asset. The SEL-2740S works with the SEL-5056 to provide communications flow configuration and monitoring capabilities. This allows operators to monitor all flows and their attributes from a central location. No engineering access interface is necessary on the SEL-2740S. Everything is conveniently and centrally managed by the SEL-5056, greatly simplifying field deployment. In addition, the SEL-5056 provides backup and restore features for maintaining high reliability. Operators can take a snapshot of the system and use any backup as a restore point from the same version for recovery.

Options and Requirements

The SEL-5056 comes with three licensing options:

<table>
<thead>
<tr>
<th>Tier</th>
<th>Maximum Number of Managed OpenFlow Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>10 Switches</td>
</tr>
<tr>
<td>Two</td>
<td>100 Switches</td>
</tr>
<tr>
<td>Three</td>
<td>Unlimited</td>
</tr>
</tbody>
</table>

The SEL-5056 is the preferred OpenFlow controller for the SEL-2740S. All network configurations and settings are managed through the SEL-5056. The SEL-5056 is available for order either as a Windows application or preinstalled on an SEL-3355 Computer running Windows Server 2012 R2.

Minimum System Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td>Windows Server 2012 R2 (64 bit)</td>
</tr>
<tr>
<td>Hard disk drive</td>
<td>250 GB</td>
</tr>
<tr>
<td>Processor speed</td>
<td>2.5 GHz</td>
</tr>
<tr>
<td>RAM</td>
<td>8 GB</td>
</tr>
<tr>
<td>Screen resolution*</td>
<td>1920 x 1080</td>
</tr>
<tr>
<td>Browser</td>
<td>Google Chrome version 52</td>
</tr>
</tbody>
</table>

* Recommended.

Software Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>.NET</td>
<td>4.5.1</td>
</tr>
<tr>
<td>License</td>
<td>SEL host-based licensing</td>
</tr>
<tr>
<td>WinPcap</td>
<td>4.1.3</td>
</tr>
<tr>
<td>Microsoft Visual C++ Redistributable</td>
<td>Version 12.0.30501.0</td>
</tr>
</tbody>
</table>
Specifications

Operating System Support
Windows Server 2012 R2 Standard

General

Protocols
- OpenFlow 1.3
- Transport Layer Security (TLS)
- Windows group policy manages the cipher negotiation policies
- Syslog (UDP and TLS)
- Hypertext Transfer Protocol Secure (HTTPS)
- Secure REST
- Lightweight Directory Access Protocol (LDAP) over StartTLS

Security
- X.509 certificate
- User-based accounts

Monitoring
- Event collection