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# Telemetry and Programmability for Network Mode

## Telemetry and programmability

This article outlines the telemetry and programmability features available for configuring, monitoring, automating, and operating the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches. Use the feature topics in this article to find the feature introduction, Smart Switch support, and applicable limitations.

The feature topics are organized from model-driven management interfaces to telemetry, serviceability, and automation tools. Feature support depends on the NX-OS release, platform, configured network mode, and feature dependency.

### Model-driven management

Start with the data models, then select the management interface that matches your configuration or data-retrieval workflow.

- Original and OpenConfig YANG
- NETCONF agent
- RESTCONF agent
- gNMI management interface
- gRPC
- XML management interface

### Operations and serviceability

Use these topics to perform supported operational checks and diagnose programmability or telemetry services.

- gNOI operation interface
- Diagnosis and serviceability

### Telemetry

Use these topics to select telemetry delivery methods, data sources, and subscription types.

- Telemetry
- Streaming telemetry sources
- WebSocket subscription

### Automation and integration

Use these topics to automate configuration and operations through application programming interfaces (APIs), scripts, and external tools.

- Open NX-OS automation
- Cisco NX-API CLI and REST
- Python API

- Scripting with Tcl
- Ansible integration
- Third-party agents

# Original and OpenConfig YANG

Yet Another Next Generation (YANG) models describe the configuration and operational data that model-driven management interfaces expose. NX-OS provides Cisco-native models and OpenConfig models for supported features.

**Support:** Cisco-native and OpenConfig YANG model support is available on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** Model availability and supported data nodes depend on the NX-OS release and the feature being managed. Do not assume that a model or an OpenConfig path supports every operation or every platform.

# NETCONF agent

The Network Configuration Protocol (NETCONF) agent provides a connection-oriented, model-driven interface for retrieving and modifying configuration and operational data represented by supported Yet Another Next Generation (YANG) models.

**Support:** The NETCONF agent is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** The agent uses a persistent Secure Shell (SSH) connection and listens on port 830 on the management address. The Extensible Markup Language (XML) management interface that uses the regular SSH service is a separate interface. Operations are limited to the models and capabilities advertised by the device.

# RESTCONF agent

The Representational State Transfer Configuration Protocol (RESTCONF) agent provides Hypertext Transfer Protocol (HTTP)-based access to supported Yet Another Next Generation (YANG)-modeled configuration and operational data. It supports clients that use Representational State Transfer (REST) application programming interfaces (APIs) instead of a persistent Network Configuration Protocol (NETCONF) session.

**Support:** The RESTCONF agent is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** RESTCONF operations depend on the YANG modules and data nodes supported by the installed release. The agent does not add support for a feature or data path that the underlying NX-OS model does not expose.

# gNMI management interface

The gRPC Network Management Interface (gNMI) provides model-driven operations for getting, subscribing to, and setting supported configuration and operational data. It is commonly used with OpenConfig models and streaming telemetry.

**Support:** The gNMI management interface is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F. The release also supports the Smart Switch gNMI set-replace and commit-confirmed workflow with the origin command-line interface (CLI).

**Limitations:** Supported paths, operations, subscription behavior, and resource limits depend on the model and release. The set-replace commit-confirmed workflow requires the supported origin CLI workflow; verify model and transaction behavior before using it for production changes.

### gNMI set-replace and commit confirmed

gNMI set-replace with commit confirmed provides a transaction workflow that can replace supported configuration data and confirm or roll back a change.

**Support:** This workflow is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** The workflow applies only to supported origin CLI configuration and model paths. Confirm the transaction, timeout, and rollback behavior on the target release before relying on it for remote changes.

### Syslog subscription through gNMI for OpenConfig

Syslog subscription through gNMI for OpenConfig allows a client to subscribe to supported syslog data through an OpenConfig model path.

**Support:** Syslog subscription through gNMI for OpenConfig is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** The client must use the supported OpenConfig path and gNMI subscription operation. Available data and update behavior depend on the sensor support in the installed release.

# gRPC

The Google Remote Procedure Call (gRPC) agent provides a secure, high-performance transport for supported model-driven and operational services. It uses protocol buffers and gRPC-based service definitions.

**Support:** The gRPC agent is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** Available services and operations depend on the configured gRPC service, supported models, certificates, and authentication, authorization, and accounting (AAA) configuration. A gRPC connection does not provide access to unsupported commands or data paths.

### gRPC Tunnel

gRPC Tunnel provides a gRPC-based path for supported management and telemetry clients that communicate with NX-OS services through a tunnel.

**Support:** gRPC Tunnel is documented in the NX-OS programmability feature set. Confirm Smart Switch platform coverage for the installed NX-OS image before enabling it.

**Limitations:** Tunnel behavior depends on the service, transport security, endpoint, and virtual routing and forwarding (VRF) configuration. The tunnel does not bypass the capabilities or scale limits of the service that it carries.

# XML management interface

The Extensible Markup Language (XML) management interface uses XML-based requests to configure and retrieve NX-OS data through a management session. It supports clients that use XML remote procedure call (RPC) messages and schema-defined request and response data.

**Support:** XML management is supported through the Smart Switch model-driven management capabilities beginning with NX-OS 10.6(2)F.

**Limitations:** The XML interface uses the regular Secure Shell (SSH) service and is distinct from the Network Configuration Protocol (NETCONF) agent that listens on port 830. Available operations and elements depend on the XML schema and capabilities supported by the installed release.

# gNOI operation interface

The Google Remote Procedure Call (gRPC) Network Operations Interface (gNOI) provides gRPC-based operational services that perform actions such as connectivity tests without changing persistent configuration.

**Support:** On the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches, gNOI support beginning with NX-OS 10.6(2)F includes ping and traceroute operations for a specified virtual routing and forwarding (VRF) instance.

**Limitations:** gNOI is a collection of individual remote procedure call (RPC) services. Each client must implement the RPC that it uses, and the supported RPC set can vary by platform and release. Do not infer support for an operation from support for the gNOI transport.

# Diagnosis and serviceability

Diagnosis and serviceability capabilities help verify and troubleshoot model-driven programmability interfaces, telemetry, and related NX-OS services.

**Support:** The Smart Switch programmability feature set includes the applicable diagnosis and serviceability utilities beginning with NX-OS 10.6(2)F.

**Limitations:** Diagnosis and serviceability commands report the state of supported services; they do not add support for an unsupported model, remote procedure call (RPC), telemetry source, or management operation.

# Telemetry

Telemetry uses a push model to continuously stream selected operational data from the switch to a collector. The push model gives monitoring and automation systems near-real-time state without repeated polling.

**Support:** Telemetry is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS Release 10.6(2)F.

**Limitations:** Telemetry scale depends on the number and type of subscriptions, selected sources, update frequency, encoding, transport, and available system resources. Select only the sensor paths and update rates required by the monitoring use case.

For configuration information, refer to Telemetry.

### Telemetry and monitoring concepts

Use these terms to distinguish the data source, reporting behavior, and system that receives telemetry.

***Table 1: Telemetry and monitoring terminology***

| Term | Definition | Relationship |
|---|---|---|
| Telemetry | A push-based stream of selected operational data. | Sends state to a collector for automation or monitoring. |

| Term | Definition | Relationship |
|---|---|---|
| Software telemetry | A push-based method for exporting selected operational data. | Provides timely device state to monitoring and automation systems. |
| Telemetry source | Switch state or operational data selected for export. | Provides the observations that the collector receives. |
| Subscription | The selection and reporting behavior for telemetry data. | Defines what the switch sends and how it reports updates. |
| Collector | A monitoring or automation system that receives telemetry. | Consumes the stream to display state, trigger alerts, or drive workflows. |
| Push model | The device sends data without a separate request for every update. | Reduces repeated polling and improves operational visibility. |

### Supported software telemetry features

N9324C-SE1U and N9348Y2C6D-SE1U Smart switches support these software telemetry features:

- DME data collection—Collects operational data from the Data Management Engine (DME) database by using selected object paths for periodic or event-based reporting.
- NX-API data sources—Collects frequency-based telemetry data through NX-API data sources.
- Google Protocol Buffers (GPB) encoding over Google Remote Procedure Call (gRPC) transport—Encodes telemetry data in GPB format and transports it by using gRPC.
- JavaScript Object Notation (JSON) encoding over Hypertext Transfer Protocol (HTTP)—Encodes telemetry data in JSON format and transports it by using HTTP.

# Streaming telemetry sources

Streaming telemetry sources provide the data that telemetry subscriptions send to a collector. Smart Switch sources include DME data collection and NX-API data sources.

**Support:** The N9324C-SE1U and N9348Y2C6D-SE1U Smart switches support Data Management Engine (DME) data collection, NX-API data sources, Google Protocol Buffers (GPB) encoding over Google Remote Procedure Call (gRPC) transport, and JavaScript Object Notation (JSON) encoding over Hypertext Transfer Protocol (HTTP) beginning with NX-OS 10.6(2)F.

**Limitations:** Source, encoding, transport, and update behavior are not interchangeable. Use a source and sensor path supported by the installed release, and account for the resource impact of the selected frequency or event subscription.

# WebSocket subscription

WebSocket subscription provides a persistent connection for delivering supported subscription updates to a client.

**Support:** WebSocket subscription is documented as an NX-OS programmability capability. Confirm Smart Switch platform and release coverage before using it.

**Limitations:** Subscription data, update behavior, and scale depend on the supported telemetry source and installed release. A WebSocket connection does not extend the set of available sensor paths.

# Open NX-OS automation

Open NX-OS automation uses open and programmatic interfaces to automate configuration, monitoring, and operational workflows on the switch.

**Support:** Open NX-OS automation is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** Automation results depend on the underlying interface, command, model, and release. Validate the automation workflow on the target platform before applying it at scale.

# NX-API CLI and REST

NX-API provides programmatic access to NX-OS command-line interface (CLI) operations and management requests that follow Representational State Transfer (REST) principles. Responses can use supported Extensible Markup Language (XML) or JavaScript Object Notation (JSON) formats.

**Support:** NX-API CLI and REST are supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** NX-API exposes only commands and operations supported by the target release and configuration. Confirm the request format, authentication, and output format before integrating a client.

# Python API

The Python application programming interface (API) enables scripts to run programmatic NX-OS operations, including supported command-line-based automation.

**Support:** The Python API is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** Python interpreter behavior, available modules, and API support depend on the installed NX-OS image. Use the supported interpreter and APIs for that release; do not assume that arbitrary third-party Python packages are available.

# Scripting with Tcl

Tool Command Language (Tcl) scripting automates repeated NX-OS command-line interface (CLI) operations and can process command output for operational workflows.

**Support:** Tcl scripting is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** Scripts can use only the commands and output available in the target release and mode. Changes to command output can affect scripts that parse unstructured CLI text.

# Ansible integration

Ansible integration automates switch configuration and operational tasks by using Ansible playbooks and supported NX-OS interfaces.

**Support:** Ansible integration is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** Playbook behavior depends on the Ansible version, collection or module version, connection method, and NX-OS release. Check module support and test idempotence before using a playbook in production.

# Third-party agents

Third-party agents can integrate external management or automation functions with the switch through supported NX-OS programmability interfaces.

**Support:** Third-party agent integration is supported on the N9324C-SE1U and N9348Y2C6D-SE1U Smart switches beginning with NX-OS 10.6(2)F.

**Limitations:** Agent compatibility, packaging, privileges, dependencies, and resource consumption are specific to the agent. Use only agents and integration methods supported for the target NX-OS image.