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Junos® OS

OpenConfig User Guide

JUNOS

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YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

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About This Guide

Use this guide to configure and model both configurational and operational data of your switches and routers using OpenConfig data models.

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CHAPTER

OpenConfig Overview

OpenConfig Overview

OpenConfig is a collaborative effort in the networking industry to move toward a more dynamic, programmable method for configuring and managing multivendor networks. OpenConfig supports the use of vendor-neutral data models to configure and manage the network. These data models define the configuration and operational state of network devices for common network protocols or services. The data models are written in YANG, a standards-based, data modeling language that is modular, easy to read, and supports remote procedure calls (RPCs). Using industry standard models greatly benefits an operator with devices in a network from multiple vendors. The goal of OpenConfig is for operators to be able to use a single set of data models to configure and manage all the network devices that support the OpenConfig initiative.

OpenConfig for Junos OS supports the YANG data models and uses RPC frameworks to facilitate communications between a client and the router. You have the flexibility to configure your router directly by using Junos OS, or by using a third-party schema, such as OpenConfig. OpenConfig modules define a data model through its data, and the hierarchical organization of and constraints on that data. Each module is uniquely identified by a namespace URL to avoid possible conflicts with the Junos OS name.

The configuration and operational statements in Junos OS have corresponding path statements in OpenConfig. The following is a list of data modules for which mapping of OpenConfig and Junos OS configuration and operational statements is supported:

- BGP

- Interfaces

- LACP

- LLDP

- Local routing

- MPLS

- Network instance

- Platform

- Routing policy

- VLAN

When you configure OpenConfig statements on devices running Junos OS, the following features are *not* supported:

- Using `configure batch` or `configure private` mode

- Configuring statements under the `[edit groups]` hierarchy

For more information on the OpenConfig initiative, see http://www.openconfig.net/.

RELATED DOCUMENTATION

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OpenConfig Data Model Version

Table 1 on page 3 lists the OpenConfig data model versions.

Table 1: OpenConfig Data Model Versions

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
- AAA (**openconfig-aaa.yang**) - AAA Types (**openconfig-aaa-types.yang**) - AAA TACACS (**openconfig-aaa-tacacs.yang**) - AAA RADIUS (**openconfig-aaa-radius.yang**)	19.3	0.4.1	Juniper Networks ACX Series, EX Series, MX Series, PTX Series, and QFX Series
BGP (**openconfig-bgp.yang**)	16.1	2.0.1	Juniper Networks MX Series and PTX Series
	17.1	2.1.1	

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
• BGP NEIGHBOR (**openconfig-bgp-neighbor.yang**)	17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3		Juniper Networks MX Series, PTX Series, and QFX Series
• BGP POLICY (**openconfig-bgp-policy.yang**) • BGP TYPES (**openconfig-bgp-types.yang**)	18.4, 19.1, 19.2	4.0.1	
• BGP COMMON (**openconfig-bgp-common.yang**)	17.1	2.1.1	Juniper Networks MX Series and PTX Series
• BGP COMMON MULTIPROTOCOL (**openconfig-bgp-common-multiprotocol.yang**)	17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3		Juniper Networks MX Series, PTX Series, and QFX Series
• BGP COMMON STRUCTURE (**openconfig-bgp-common- structure.yang**) • BGP GLOBAL (**openconfig-bgp-global.yang**) • BGP PEER GROUP (**openconfig-bgp-peer-group.yang**)	18.4, 19.1, 19.2	4.0.1	
BGP ERRORS (**openconfig-bgp-errors.yang**)	18.4, 19.1, 19.2	4.0.1	Juniper Networks MX Series and PTX Series

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
- IF AGGREGATE (**openconfig-if-aggregate.yang**) - IF ETHERNET (**openconfig-if-ethernet.yang**) - IF IP (**openconfig-if-ip.yang**) - IF IP EXT (**openconfig-if-ip-ext.yang**) - INTERFACES (**openconfig-interfaces.yang**)	16.1, 17.1, 17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	1.0.1	Juniper Networks MX Series and PTX Series
INET TYPES (**openconfig-inet-types.yang**)	17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4	0.1.0	Juniper Networks MX Series, PTX Series, and QFX Series
IKE INTERFACES (**openconfig-ike.yang**)	18.1R3, 18.2DCB, 18.2X75-D5	1.0.0	Juniper Networks MX Series
- ISIS (**openconfig-isis.yang**) - ISIS LSDB TYPES (**openconfig-isis-lsdb-types.yang**) - ISIS LSP (**openconfig-isis-lsp.yang**) - ISIS POLICY (**openconfig-isis-policy.yang**)	17.2X75, 17.4, 18.1, 18.2, 18.3	0.2.1	Juniper Networks MX Series and PTX Series

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
• ISIS ROUTING (**openconfig-isis-routing.yang**) • ISIS TYPES (**openconfig-isis-types**)	18.4, 19.1, 19.2	0.3.3	
LACP (**openconfig-lacp.yang**)	16.1, 17.1	1.0.2	Juniper Networks MX Series and PTX Series
	17.2, 17.2X75, 17.3, 17.4, 18.1		Juniper Networks MX Series, PTX Series, and QFX Series
	18.2, 18.3, 18.4, 19.1, 19.2	1.1.0	
LACP (**openconfig-lacp.yang**)	20.4R1 Evolved, 21.4R1 Evolved, 22.1R1 Evolved	1.1.1	Juniper Networks PTX10001-36MR,PTX10003, PTX10004, PTX10008, and PTX10016 routers.
	22.1R1		Juniper Networks ACX5448, MX10003, and PTX10008 routers and QFX5110, and QFX10002 switches.
• LLDP (**openconfig-lldp.yang**) • LLDP TYPES (**openconfig-lldp-types.yang**)	16.1, 17.1, 17.2, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	0.1.0	Juniper Networks MX Series and PTX Series
LLDP (**openconfig-lldp.yang**)	21.4R1 Evolved	0.2.1	Juniper Networks PTX10008 and PTX10016 routers

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
LOCAL ROUTING (**openconfig-local-routing.yang**)	16.1, 17.1	1.0.0	Juniper Networks MX Series and PTX Series
	17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2, 20.2R1 Junos OS Evolved		Juniper Networks MX Series, PTX Series, and QFX Series
MACsec (**openconfig-macsec**)	22.1R1 Evolved	0.2.0	Juniper Networks PTX10008 and PTX10016 routers. Only physical MACsec is supported.
MPLS (**openconfig-mpls.yang**)	16.1, 17.1	1.0.0	Juniper Networks MX Series and PTX Series
	17.2		Juniper Networks MX Series, PTX Series, and QFX Series
	17.3	1.0.1	
	17.2X75, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	2.2.0	
• MPLS IDP (**openconfig-mpls-ldp.yang**)	16.1, 17.1	1.0.0	Juniper Networks MX Series and PTX Series
• MPLS IGP (**openconfig-mpls-igp.yang**) • MPLS RSVP (**openconfig-mpls-rsvp.yang**) • MPLS SR (**openconfig-mpls-sr.yang**)	17.2, 17.3		Juniper Networks MX Series, PTX Series, and QFX Series

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
• MPLS STATIC (**openconfig-mpls-static.yang**) • MPLS TE (**openconfig-mpls-te.yang**) • MPLS TYPES (**openconfig-mpls-types.yang**)	17.2X75, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	2.2.0	
NETWORK INSTANCE (**openconfig-network-instance.yang**)	17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2, 20.2R1 Junos OS Evolved	0.4.0	Juniper Networks ACX Series, EX Series, MX Series, PTX Series, and QFX Series
	17.2X75	0.4.1	
• NETWORK INSTANCE l2 (**openconfig-network-instance-l2.yang**) • NETWORK INSTANCE l3 (**openconfig-network-instance-l3.yang**) • NETWORK INSTANCE TYPES (**openconfig-network- instance-types.yang**)	17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	0.4.0	Juniper Networks MX Series, PTX Series, and QFX Series
• PLATFORM (**openconfig-platform.yang**) • PLATFORM TYPES (**openconfig-platform-types.yang**)	16.1, 17.1, 17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	0.3.0	Juniper Networks MX Series and PTX Series

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
PLATFORM TRANSCEIVERS (**openconfig-platform-transceiver.yang**)	19.1, 19.2	0.1.0	Juniper Networks MX Series
POLICY TYPES (**openconfig-policy-types.yang**)	16.1, 17.1	2.0.0	Juniper Networks MX Series and PTX Series
	17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2		Juniper Networks MX Series, PTX Series, and QFX Series
• RIB BGP (**openconfig-rib-bgp.yang**) • RIB BGP EXT (**openconfig-rib-bgp-ext.yang**) • RIB BGP TYPES (**openconfig-rib-bgp-types.yang**)	16.1, 17.1	0.2.0	Juniper Networks MX Series and PTX Series
	17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2		Juniper Networks MX Series, PTX Series, and QFX Series
ROUTING POLICY (**openconfig-routing-policy.yang**)	16.1, 17.1	2.0.0	Juniper Networks MX Series and PTX Series
	17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2		Juniper Networks MX Series, PTX Series, and QFX Series
	20.3	2.0.1	EX2300, EX3400, EX4300, EX4600, and EX9200 switches

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
RPC API (**openconfig-rpc-api.yang**)	19.1, 19.2	0.1.0	Juniper Networks MX Series, PTX Series, and QFX Series
SEGMENT ROUTING (**openconfig-segment-routing.yang**)	17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	0.0.3	Juniper Networks MX Series and PTX Series
SYSTEM LOGGING MODEL (**openconfig-syste-logging.yang**)	21.4R1 Evolved	0.3.1	PTX10008 and PTX10016 routers
	22.1R1		ACX5448, ACX7900, MX240, MX480, MX960, MX10003, MX10008, MX10016, MX2008, MX2010, MX2020, and PTX10002 routers
SYSTEM MANAGEMENT MODEL (**openconfig-syste-management.yang**)	21.4R1 Evolved	0.3.0	PTX10008 and PTX10016 routers
	22.1R1		ACX5448, ACX7900, MX240, MX480, MX960, MX10003, MX10008, MX10016, MX2008, MX2010, MX2020, and PTX10002 routers
SYSTEM MODEL (**openconfig-system.yang**)	21.4R1 Evolved	0.6.1	PTX10008 and PTX10016 routers
	22.1R1		ACX5448, ACX7900, MX240, MX480, MX960, MX10003, MX10008, MX10016, MX2008, MX2010, MX2020, and PTX10002 routers

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
SYSTEM TERMINAL MODEL (openconfig-system-terminal.yang)	21.4R1 Evolved	0.3.1	PTX10008 and PTX10016 routers
	22.1R1		ACX5448, ACX7900, MX240, MX480, MX960, MX10003, MX10008, MX10016, MX2008, MX2010, MX2020, and PTX10002 routers
TELEMETRY (**openconfig-telemetry.yang**)	16.1, 17.1, 17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	0.2.0	Juniper Networks MX Series, PTX Series, and QFX Series
TERMINAL DEVICE (**openconfig-terminal-device.yang**)	19.1, 19.2	0.3.1	Juniper Networks MX Series, PTX Series, and QFX Series
TRANSPORT TYPES (**openconfig-transport-types.yang**)	16.1	0.2.0	Juniper Networks MX Series and PTX Series
	17.1, 17.2, 17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	0.3.1	
TYPES (**openconfig-types.yang**)	16.1	0.1.1	Juniper Networks MX Series and PTX Series
	17.1	0.2.0	Juniper Networks MX Series and PTX Series
	17.2, 17.3		Juniper Networks MX Series, PTX Series, and QFX Series

Table 1: OpenConfig Data Model Versions *(Continued)*

OpenConfig Data Model	Junos OS Release	OpenConfig Supported Version	Supported Platform
	17.2X75, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	0.3.2	
• VLAN CONFIGURATION SUPPORT (**openconfig-vlan.yang**) • VLAN TYPES (**openconfig-vlan-types.yang**)	16.1, 17.1, 17.2	1.0.1	Juniper Networks EX Series and QFX Series
	17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2		
YANG TYPES (**openconfig-yang-types.yang**)	17.2X75, 17.3, 17.4, 18.1, 18.2, 18.3, 18.4, 19.1, 19.2	0.1.0	Juniper Networks MX Series, PTX Series, and QFX Series

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Installing the OpenConfig Package

Starting in Junos OS Release 18.3R1, the Junos OS image includes the OpenConfig package; therefore, you do not need to install OpenConfig separately on your device.

By default, the OpenConfig schema is not available through CLI. To unhide the OpenConfig knob from the CLI, run the following command:

```
set system schema openconfig unhide
```

> **NOTE**: The `show system yang package` command in the operational mode does not display native Junos OS OpenConfig package. This is because the Junos OS image includes the OpenConfig package.

OpenConfig package includes the following files:

- OpenConfig set of data models—Data models are written in YANG.

- Translation scripts—Translates OpenConfig configuration schemas to Junos OS configuration schemas for each supported Junos OS release.

- Deviation modules—Specifies the unsupported nodes within the schema for each supported Junos OS release.

- Augmentation module—Specifies additions to various OpenConfig specified models.

- Dynamic rendering files—Maps operational state data for each supported Junos OS release.

In releases before Junos OS Release 18.3R1, OpenConfig for Junos OS software package have the following naming convention:

```
junos-openconfig-XX.YY.ZZ.JJ-signed.tgz (Junos OS)
junos-openconfig-x86-32-XX.YY.ZZ.JJ.tgz (Junos OS with Upgraded FreeBSD)
```

where:

- *XX* represents the OpenConfig major release number.

- *YY* represents the OpenConfig minor release number.

- *ZZ* represents the OpenConfig patch release number.

- *JJ* represents the Juniper Networks release number.

> **NOTE**: The `junos-openconfig-x86-32-XX.YY.ZZ.JJ.tgz` package supports both 32 and 64 bit systems.

To install the OpenConfig for Junos OS software package, use the following command:

`request system software add`

For example:

```
user@router> request system software add junos-openconfig-XX.YY.ZZ.JJ-signed.tgz
```

or

```
user@router> request system software add junos-openconfig-x86-32-XX.YY.ZZ.JJ.tgz
```

For more details on the OpenConfig for Junos OS software package, see Release Notes available with the package on the Juniper Software Download website.

Release History Table

Release	Description
18.3R1	Starting in Junos OS Release 18.3R1, the Junos OS image includes the OpenConfig package; therefore, you do not need to install OpenConfig separately on your device.

RELATED DOCUMENTATION

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Software Installation and Upgrade Guide

Release Information for Junos OS with Upgraded FreeBSD

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CHAPTER

gRPC Overview

Understanding OpenConfig and gRPC on Junos Telemetry Interface

Starting in Junos OS Release 16.1R3, you can use a set of remote procedure call (RPC) interfaces to configure the Junos telemetry interface and stream telemetry data using the gRPC framework.

OpenConfig supports the use of vendor-neutral data models for configuring and managing multivendor networks. gRPC is an open source framework that provides secure and reliable transport of data.

> **NOTE**: OpenConfig for Junos OS and gRPC are supported only on MPCs on MX Series and on PTX Series routers starting with Junos OS Release 16.1R3.
>
> Starting with Junos OS Release 17.2R1, OpenConfig and gRPC are also supported on QFX10000 switches, QFX5200 switches, and PTX1000 routers.
>
> Starting with Junos OS Release 17.3R1, Junos telemetry interface is supported on the Routing Control and Board (RCB) on PTX3000 routers, QFX5110 switches, and EX4600 and EX9200 switches.
> OpenConfig and gRPC are not supported on MX80 and MX104 routers.
>
> Starting with Junos OS Release 17.4R1, MX2008 routers are supported.

Starting with Junos OS Release 18.3R1, ON_CHANGE streaming of LLDP telemetry sensor information is supported through gRPC for MX Series and PTX Series routers.

Starting with Junos OS Release 18.3R1, QFX5120-48Y and EX4650 switches are also supported.

Starting with Junos OS Release 18.4R1, EX4600 switches are also supported.

Starting with Junos OS Release 18.4R1, MX480, MX960, MX2010, MX2020, MX2008 and MX-ELM routers are also supported.

Starting with Junos OS Release 19.1R1, MX Series routers operating with MS-MIC and MS-MPC, QFX10002 switches, and PTX10002 routers are also supported.

Starting in Junos OS Evolved Release 19.1R1, OpenConfig (OC) and Junos telemetry interface (JTI) are supported. Both gRPC APIs and the customer-facing CLI remain the same as for the Junos OS. As was standard for Junos OS, Network Agent (NA) and OC packages are part of the Junos OS Evolved image.

Starting with Junos OS Evolved 19.1R1, Packet Forwarding Engine sensors on PTX10003 routers are also supported.

Starting with Junos OS Release 19.2R1, SRX4100, SRX4200, SRX4600, SRX5400, SRX5600, SRX5800, and vSRX Series Services Gateways.

Starting with Junos OS Release 19.2R1, gNMI services for streaming Packet Forwarding Engine statistics is supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches.

Starting with Junos OS Release 19.2R1, gNMI services for streaming statistics is supported on QFX5100, QFX5110, QFX5120, QFX5200 and QFX5210 switches.

Starting with Junos OS Release 19.3R1, gRPC service for exporting statistics is supported on MX Series routers hosting MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards.

Starting with Junos OS Evolved Release 19.3R1, gRPC service for exporting statistics is supported on QFX5220-128C and QFX5220-32CD switches.

Starting with Junos Release 19.4R1, gRPC service for streaming Packet Forwarding Engine and Routing Engine statistics is supported on EX4300-MP switches.

> **NOTE**: JTI support for PTX10008 routers is documented for Junos OS Evolved Release 19.4R1, but not supported.

Starting with Junos Release 20.R1, gNMI service for streaming telemetry sensors for Packet Forwarding Engine statistics is supported on MX2K-MPC11E line cards on MX2010 and MX2020 routers.

Starting with Junos OS Release 20.1R1, gRPC services version v1.18.0 is supported with JTI. This version includes important enhancements for gRPC. In earlier Junos OS releases, gRPC version v1.3.0 is supported with JTI.

Starting with Junos OS Evolved Release 20.2R1, gRPC service for streaming NDP statistics is supported on PTX10001 routers.

Starting with Junos OS Release 20.2R1, gRPC service for streaming Packet forwarding Engine and Routing Engine statistics is supported on EX2300, EX2300-MP, and EX3400 switches.

Starting with Junos OS Release 20.2R1, gRPC service for streaming BGP routing information base (RIB) and BGP peer statistics is supported on any platform family that supports containerized routing protocol process (cRPD). cRPD is Juniper's routing protocol process (rpd) decoupled from Junos OS and packaged as a Docker container to run in Linux-based environments.

Starting with Junos OS Release 20.2R1, ON_CHANGE BGP peer statistics export using gRPC services and gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000, PTX10000 routers and QFX5100 and QFX5200 switches.

Starting with Junos OS Release 20.2R1, streaming BGP global, peer and perr groups statistics using gRPC services is supported on EX2300, EX3400, EX4300, EX4600, and EX9200 switches.

Starting with Junos OS Release 20.2R1, streaming revenue interface statistics through Packet Forwarding Engine sensors and pseudo interface statistics through Routing Engine sensors using gRPC services and gNMI services is supported on SRX5400, SRX5600, and SRX5800 Services Gateways..

Starting with Junos OS Release 20.2R1, streaming revenue interface statistics through Packet Forwarding Engine sensors and pseudo interface statistics through Routing Engine sensors using gRPC services and gNMI services is supported on SRX5400, SRX5600, and SRX5800 Services Gateways.

Starting with Junos OS Release 20.2R1 sensors to stream standby Routing Engine statistics are supported on MX480, MX960, MX10003, MX2010, and MX2020 routers.

Starting with Junos OS Release 20.2R1 sensors to stream EVPN statistics using gRPC services are supported with QFX5100, QFX5110, QFX5120, QFX5200, QFX10002-60C, QFX10002, QFX10008, and QFX10016 switches.

Network Agent Software

Implementing OpenConfig with gRPC for Junos telemetry interface requires that you download and install a package called Network Agent if your Juniper Networks device is running a version of Junos OS with Upgraded FreeBSD. For all other versions of Junos OS, the Network Agent functionality is embedded in the software. Network Agent functions as a gRPC server and terminates the OpenConfig RPC interfaces. It is also responsible for streaming the telemetry data according to the OpenConfig specification. To view the OpenConfig specification for telemetry, see the OpenConfig Telemetry specification. For more information about OpenConfig for Junos OS, see the OpenConfig User Guide.

The Network Agent component also supports server-based Secure Sockets Layer (SSL) authentication. Client-based SSL authentication is not supported. You must install SSL certificates on your Juniper Networks device.

For information about installing the Network Agent package, see *Installing the Network Agent Package*.

Using OpenConfig for Junos OS to Enable Junos telemetry interface

OpenConfig for Junos OS specifies an RPC model to enable the Junos telemetry interface. You must download and install the OpenConfig for Junos OS package on your Juniper Networks device This package also includes the required YANG models. Using a Web browser, navigate to the All Junos Platforms software download URL on the Juniper Networks webpage: https://www.juniper.net/support/downloads/. From the **Network Management** tab, scroll down to select **OpenConfig**. Select the **Software** tab. Select the appropriate version of OpenConfig module. Two versions are available, one for devices running Junos OS with Upgraded FreeBSD and another for devices running all other versions of Junos OS. For more information, see "Installing the OpenConfig Package" on page 12 and *Understanding Junos OS YANG Modules*.

The programmatic interface `OpenConfigTelemetry` that is installed by the Network Agent package defines the telemetry gRPC service. The `telemetrySubscribe` RPC specifies the following subscription parameters:

- OpenConfig path that identifies the system resource to stream telemetry data, for example:
  `/interfaces/interface/state/counters/`

- Interval at which data is reported and streamed to the collector server, in milliseconds, for example:
  `sample_frequency = 4000`

The `telemetrySubscribe` RPC is used by a streaming server, or collector, to request an inline subscription for data at the specified path. The device should then send telemetry data back on the same connection as the subscription request.

GitHub Resources

GitHub is a code hosting platform for version control and collaboration. It lets you and others work together on projects from anywhere. Juniper Networks is part of the OpenConfig community that uses GitHub to develop telemetry code and store documents. Contribute to Juniper telemetry development by creating an account on GitHub.

Table 2: GitHub Resources

Telemetry Resources	Description
Juniper telemetry on GitHub	Juniper telemetry models, augments, and deviations.
Protobuf file	Juniper protocol buffer files, organized by Junos OS Release.
gNMI protobuf file	Juniper gNMI protocol buffer files, organized by Junos OS Release..

Using gRPC to Stream Data

Per the OpenConfig specification, only gRPC-based transport is supported for streaming data. The gRPC server that is installed by the Network Agent package terminates the gRPC sessions from the management system that runs the client. RPC calls trigger the creation of Junos OS sensors that either stream data periodically or report events, which are then funneled onto the appropriate gRPC channel by Network Agent.

> **NOTE**: Starting in Junos OS Release 18.2R1, when an external streaming server, or collector, provisions sensors to export data through gRPC on devices running Junos OS, the sensor

configuration is committed to the `junos-analytics` instance of the ephemeral configuration database, and the configuration can be viewed by using the `show ephemeral-configuration instance junos-analytics` operational command. In earlier releases, the sensor configuration is committed to the default instance of the ephemeral configuration database.

NOTE: The Juniper telemetry header that was exported as part of updates is now exported as an extension header. GnmiJuniperTelemetryHeader.proto is used to decode the updates from Juniper devices running Junos OS Release 19.3 or earlier and GnmiJuniperTelemetryHeaderExtension.proto is used for devices running Junos OS Release 19.4 or later.

See for a list and descriptions of the RPCs implemented to support the Junos telemetry interface.

Table 3: Telemetry RPCs

RPC Name	Description
`telemetrySubscribe`	Specify telemetry parameters and stream data for the specified list of OpenConfig paths.
`getTelemetrySubscriptions`	Retrieve the list of subscriptions that are created through `telemetrySubscribe`.
`cancelSubscription`	Unsubscribe a subscription created through `telemetrySubscribe`.

Data streamed through gRPC is formatted in OpenConfig key/value pairs in protocol buffers (gpb) messages. In this universal format, keys are strings that correspond to the path of the system resources in the OpenConfig schema for the device being monitored. The values correspond to integers or strings that identify the operational state of the system resource, such as interface counters, and the state of the resource.

NOTE: Starting in Junos OS Release 18.2R1, data streamed through gRPC can be formatted as protobuf in addition to key/value pairs for OpenConfig-based routing engine (RE) sensors. These sensors are in addition to the packet forwarding engine (PFE) sensors.

The following shows the universal key/value format:

```
message KeyValue {
    string key       = 1 [(telemetry_options).is_key = true];
    uint64 int_value = 2;
    string str_value = 3;
    string prefix_str = 4;
}


message TelemetryStream {
    // router name or export IP address
    required string system_id    = 1 [(telemetry_options).is_key = true];

    // line card / RE (slot number)
    optional uint32 component_id  = 2 [(telemetry_options).is_key = true];

    // PFE (if applicable)
    optional uint32 sub_component_id = 3 [(telemetry_options).is_key = true];

    // timestamp (common to all entries in the kv array)
    optional uint64 timestamp     = 4 [(telemetry_options).is_timestamp = true];

    // key / value pairs
    repeated KeyValue kv;
}
```

The following example shows how a set of counters for an interface can be represented:

```
key = "/interfaces/counters/rx-bytes",    int_value = 1000
key = "/interfaces/counters/tx-bytes",    int_value = 2000
key = "/interfaces/counters/rx-packets", int_value = 10
key = "/interfaces/counters/rx-bytes" ,   int_value = 20
key = "/interfaces/counters/oper-state", str_value = "up"
```

The Network Agent package provides a mapping table that maps field names to the OpenConfig key strings.

Exporting Packet Forwarding Engine Traffic Sensor Data

Starting with Junos OS Release 17.4R1, you can export Packet Forwarding Engine traffic statistics through the Junos telemetry interface for MX Series and PTX Series routers. Both UDP and gRPC are supported.

This sensor tracks reporting of Packet Forwarding Engine statistics counters and provides visibility into Packet Forwarding Engine error and drop statistics. The resource name for the sensor is `/junos/system/linecard/packet/usage/`. The OpenConfig paths report data specific to CPU, NPU and center chip (CC). The following paths are supported:

- `/components/component[name='FPC`*id*`:NPU`*id*`']/properties/property[name='`*counter*`']/state/value`, where FPC refers to the Flexible PIC Concentrator and NPU refers to the network processing unit (packet forwarding engine). A sample resource path is `/components/component[name='FPC0:NPU3']/properties/property[name='ts-output-pps']/state/value` where `hwds-data-error` is the counter for `Hardware Discards: Data Error`.

- `/components/component[name='FPC`*id*`:CC`*id*`']/properties/property[name='`*counter*`']/state/value` , where FPC refers to the Flexible PIC Concentrator and CC refers to the center chip. A sample resource path is `/components/component[name='FPC0:CC1']/properties/property[name='lpbk-packets'']/state/value` where `lpbk-packets` is the count of `Forward packets` specific to FPC0, center chip 1.

- `/components/component[name='FPC`*id*`']/properties/property[name='`*counter*`']/state/value` , where FPC refers to the Flexible PIC Concentrator. A sample resource path is `/components/component[name='FPC0']/properties/property[name='lts-input-packets'']/state/value` where `lts-input-packets` is the CPU counter `Local packets input`.

To provision the sensor to export data through gRPC, use the `telemetrySubcribe` RPC to specify telemetry parameters. For streaming through UDP, all parameters are configured at the `[edit services analytics]` hierarchy level.

The following is a map of counters to output fields in the `show pfe statistics traffic` command or `show pfe statistics traffic detail` command (supported only on MX Series routers).

```
CPU stats: (FPCX:CPUY)
Packet Forwarding Engine local traffic statistics:
    Local packets input                  :                 2
    Local packets output                 :                 1
    Software input control plane drops   :                 0
    Software input high drops            :                 0
    Software input medium drops          :                 0
    Software input low drops             :                 0
    Software output drops                :                 0
    Hardware input drops                 :                 0
```

```
Counter
lts-input-packets            Local packets input
lts-output-packets           Local packets output
lts-sw-input-control-drops   Software input control plane drops
lts-sw-input-high-drops      Software input high drops
lts-sw-input-medium-drops    Software input medium drops
lts-sw-input-low-drops       Software input low drops
lts-sw-output-low-drops      Software output drops


NPU stats: (FPCX:CCY)
    Input  packets:              1169              0 pps
    Output packets:                 0              0 pps
    Fabric Input  :         277235149          16078 pps
    Fabric Output :         277235149          16079 pps



Counter
ts-input-packets            Input  packets
ts-input-packets-pps        Input  packets in pps
ts-output-packets           Output packets
ts-output-packets-pps       Output packets in pps
ts-fabric-input-packets     Fabric Input
ts-fabric-input-packets-pps Fabric Input in pps
ts-fabric-output-packets    Fabric Output
ts-fabric-output-packets-pps  Fabric Output in pps

Packet Forwarding Engine loopback statistics:
    Forward packets :               0              0 pps
    Forward bytes   :               0              0 bps
    Drop packets    :               0              0 pps
    Drop bytes      :               0              0 bps



Counter
lpbk-packets                Forward packets
lpbk-packets-pps            Forward packets pps
lpbk-packets-byte           Forward bytes
lpbk-packets-bps            Forward bytes   bps


lpbk-drop-packets           Drop packets
```

```
lpbk-drop-packets          Drop packets pps
lpbk-drop-packets          Drop bytes
lpbk-drop-packets          Drop bytes bps



Lu chips stats: FPCx:NPUY
Counter
lts-hw-input-drops
hwds-normal          Hardware discards normal discard
hwds-fabric          Hardware discards fabric drops
hwds-info-cell       Hardware discards info cell drops
hwds-timeout         Hardware discards timeour
hwds-truncated-key   Hardware discards truncated key
hwds-bits-to-test    Hardware discards bits to test
hwds-stack-underflow Hardware discards stack underflow
hwds-stack-overflow  Hardware discards stack overflow
hwds-data-error      Hardware discards data error
hwds-extended        Hardware discards extended discard
hwds-invalid-iif     Hardware discards invalid interface
hwds-input-checksum  Hardware discards input checksum
hwds-output-mtu
hwds-inet-bad-route
hwds-inet6-bad-route
hwds-filter-discard
hwds-dlu-not-routable
```

Enabling "ON CHANGE" Sensor Support Through gNMI

Periodical streaming of OpenConfig operational states and counters has been supported since Junos OS Release 16.1, exporting telemetry data from Juniper equipment to an external collector. While useful in collecting all the needed information and creating a baseline "snapshot," periodical streaming is less useful for time-critical missions. In such instances, you can configure ON_CHANGE streaming for an external collector to receive information only when operational states experience a change in state.

To support ON_CHANGE streaming, a new specification called gRPC Network Management Interface (gNMI) is implemented for the modification and retrieval of configurations from a network element. Additionally, the gNMI specification can be used to generate and control telemetry streams from a network element to a data collection system. Using the new gNMI specification, one gRPC service definition can provide a single implementation on a network element for both configuration and

telemetry as well as a single NMS element to interact with a device by means of telemetry and configuration RPCs.

The Junos file package (junos-telemetry-interface) includes the gnmi.proto file and GnmiJuniperTelemetryHeader.proto Juniper extension for gNMI support.

Information about the RPCs supporting this feature can be found in the gNMI Proto file version 0.4.0 (the supported version) and the specification released

- https://github.com/openconfig/reference/blob/primary/rpc/gnmi/gnmi-specification.md

- https://github.com/openconfig/gnmi/blob/primary/proto/gnmi/gnmi.proto

The telemetry RPC `subscribe` under gNMI service supports ON_CHANGE streaming. RPC `subscribe` allows a client to request the target to send it values of particular paths within the data tree. Values may be streamed (STREAM), sent one-off on a long-lived channel (POLL), or sent one-off as a retrieval (ONCE).

If a subscription is made for a top level container with a sample frequency of 0, leaves with ON_CHANGE support are streamed based on events. Other leaves will not be streamed.

> **NOTE**: In order to permit a device to decide which nodes will be streamed as ON_CHANGE and which will SAMPLE, the collector must subscribe for TARGET_DEFINED with sample_interval.

Enabling "TARGET_DEFINED" Subscription Mode through gNMI

Starting with Junos OS Release 20.2R1, TARGET_DEFINED subscription mode with gRPC Network Management Interface (gNMI) services is supported for JTI on MX5, MX10, MX40, MX80, MX104, MX150, MX204, MX240, MX480, MX960, MX2008, MX2010, MX2020, MX10003, MX10008, and MX10016 routers.

Using a gNMI subscription, an external collector stipulates how sensor data should be delivered:

- STREAMING mode periodically streams sensor data from the DUT at a specified interval.

- ON_CHANGE mode sends updates for sensor data from the DUT only when data values change.

- Newly supported TARGET_DEFINED mode (submode 0) instructs the DUT to select the relevant mode (STREAMING or ON_CHANGE) to deliver each element (leaf) of sensor data to the external collector. When a subscription for a sensor with submode 0 is sent from the external collector to the DUT, the DUT responds, activating the sensor subscription so that periodic streaming does not include any of the ON_CHANGE updates. However, the DUT will notify the collector whenever qualifying ON_CHANGE events occur.

Subscriptions will default to a periodic streaming frequency of 30 seconds unless otherwise specified by the collector in the subscription request.

The Java Script Object Notification (JSON) file below shows a sample gNMI subscription. TARGET_DEFINED mode is set using submode=0 for the resource (sensor) path **/interfaces/ interface[name='lo0']/state**.

```
$ cat gnmi.json
{
    "dut_list":[
        {
            "port":50051,
            "rpc":["sub_request"],
            "sub_request":{
                "subscription":[
                    {
                        "path":"/interfaces/interface[name='lo0']/state",
                        "submode":0,
                        "sample_interval":30
                    }
                ],
                "mode":0,
                "encoding":2
            }
        }
    ]
$ python ./gnmi_subscribe_client_sample.py -c ./gnmi.json -d 10.53.32.102 -l client.log
```

The Junos file package (junos-telemetry-interface) includes the gnmi.proto file and GnmiJuniperTelemetryHeader.proto Juniper extension for gNMI support.

For more information, see the gNMI specifications and gNMI protocol file here:

gNMI telemetry specification gNMI protocol definition

- https://github.com/openconfig/reference/blob/primary/rpc/gnmi/gnmi-specification.md#35152-stream-subscriptions

- https://github.com/openconfig/gnmi/blob/primary/proto/gnmi/gnmi.proto

Enabling "INITIAL_SYNC" Subscription Mode through gNMI

Starting in Junos OS Release 20.2R1, INITIAL_SYNC statistics from Packet Forwarding Engine sensors using gNMI services on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches is supported.

Starting in Junos OS Evolved Release 20.4R1, INITIAL_SYNC statistics from Packet Forwarding Engine sensors using gNMI services on QFX5130-32CD switches is supported.

When an external collector sends a subscription request for a sensor with INITIAL_SYNC (gnmi-submode 2), the host sends all supported target leaves (fields) under that resource path at least once to the collector with the current value. This is valuable because:

- The collector has a complete view of the current state of every field on the device for that sensor path.

- Event-driven data (ON_CHANGE) is received by the collector at least once before the next event is seen. In this way, the collector is aware of the data state before the next event happens.

- Packet Forwarding Engine sensors that contain zero counter values (zero-suppressed) that normally do not show up in streamed data are sent, ensuring that all fields from each line card (also referred to as source) are known to the collector.

INITIAL_SYNC submode requires that at least one copy to be sent to the collector; however, sending more than one is acceptable.

Subscriptions will default to a periodic streaming frequency of 30 seconds unless otherwise specified by the collector in the subscription request.

The Java Script Object Notification (JSON) file below shows a sample gNMI subscription. INITIAL_SYNC mode is set using `gnmi_submode 2` for the resource (sensor) path **/interfaces/**. The `gnmi_mode` is set to `0`. The protocol encoding is set to `2` for GBP.

```
{
  "influx": {
    "server": "server1",
    "port": 8086,
    "dbname": "gD40",
    "measurement": "OC",
    "user": "influx",
    "password": "influxdb",
    "recreate": true
  },
  "gnmi": {
```

```
   "mode": 0,      <---- STREAM
   "encoding": 2, <--- PROTO encoding
 "prefix":  "/x/y/z"
 },
 "host": "10.10.130.73",
 "port": 10162,
 "user": "user1",
 "password": "password1",
 "cid": "cid-1jk",
  "paths":[
    {
       "path": "/interfaces/",
       "Freq": 10000000000,
       "gnmi_submode": 2    <----  SAMPLE
    }
  ]
}
```

The Junos file package (junos-telemetry-interface) includes the gnmi.proto file and GnmiJuniperTelemetryHeader.proto Juniper extension for gNMI support.

For more information, see the gNMI specifications and gNMI protocol file here:

gNMI telemetry specification gNMI protocol definition

- https://github.com/openconfig/reference/blob/primary/rpc/gnmi/gnmi-specification.md#35152-stream-subscriptions

- https://github.com/openconfig/gnmi/blob/primary/proto/gnmi/gnmi.proto

Enabling Client Streaming and Bidirectional Streaming of Telemetry Sensor Information

Starting with Junos OS Release 18.1R1, OpenConfig support through Remote Procedure Calls (gRPC) and JTI is extended to support client streaming and bidirectional streaming of telemetry sensor information on MX Series and PTX Series routers.

APIs are implemented in Junos based on Protobuf specifications for OpenConfig. These APIs perform configuration, operational state retrieval, and telemetry on Junos routers using gRPC as the transport mechanism.

With client streaming, the client sends a stream of requests to the server instead of a single request. The server typically sends back a single response containing status details and optional trailing metadata. With bidirectional streaming, both client and server send a stream of requests and responses. The client starts the operation by invoking the RPC and the server receives the client metadata, method name, and deadline. The server can choose to send back its initial metadata or wait for the client to start sending requests. The client and server can read and write in any order. The streams operate completely independently.

Junos devices can be managed through API (RPC) prototypes:

- rpc Capabilities (CapabilityRequest)

  Returns (CapabilityResponse). Allows the client to retrieve the set of capabilities that is supported by the target.

- rpc Get (GetRequest)

  Returns (GetResponse). Retrieves a snapshot of data from the target.

- rpc Set (SetRequest)

  Returns (SetResponse). Allows the client to modify the state of data on the target.

- rpc Subscribe (stream SubscribeRequest)

  Returns (stream SubscribeResponse). Allows a client to request the target to send it values for particular paths within the data tree. These values may be streamed (STREAM) or sent one-off on a long-lived channel (POLL), or sent as a one-off retrieval (ONCE). If a subscription is made for a top-level container with a sample frequency of 0, leaves with ON_CHANGE support are streamed based on events. Other leaves will not be streamed.

Juniper Extension Toolkit (JET) support provides insight to users regarding the status of clients connected to JSD. JET support for gRPC includes expanding the maximum number of clients that can connect to JSD from 8 to 30 (the default remains 5). To specify the maximum number of connections, include the `max-connections` statement at the [`edit system services extension-service request-response grpc`] hierarchy level.

To provide information regarding the status of clients connected to JSD, issue the enhanced `show extension-service client information` command and include the `clients` or `servers` options. The `clients` option displays request-response client information. The `servers` option displays request-response server information.

Enabling Streaming of Telemetry Sensor Information for SR-TE policies (BGP or Static)

Starting with Junos OS Release 18.3R1, OpenConfig support for MX Series and PTX Series through gRPC and JTI provides continuous statistics streaming via the same sensor irrespective of the route that is active (BGP or static) for a given Segment Routing Traffic Engineering (SR-TE) policy.

Support is available in Junos OS Evolved Release 21.4R1EVO for PTX10001-36MR, PTX10004, PTX10008, and PTX10016 routers.

This feature provides support for BGP [DRAFT-SRTE] and statically configured SR-TE policies at ingress routers.

To provision the sensor to export data through gRPC streaming, use the telemetrySubscribe RPC to specify telemetry parameters. Include the resource path `/mpls/signaling-protocols/segment-routing/` to export these statistics.

In addition to configuring the sensor, you must enable statistics collection through the Junos OS. To do this, include the `statistics` configuration statement at the [edit protocols `source-packet-routing telemetry`] hierarchy level. Optionally, you can limit statistics by including the `no-transit` or `no-ingress` parameter.

See *Configure a NETCONF Proxy Telemetry Sensor in Junos* for instructions on configuring a sensor.

See *Guidelines for gRPC and gNMI Sensors (Junos Telemetry Interface)* for further information about resource paths.

Support for LSP Statistics

You can provision the LSP statistics sensor **/junos/services/label-switched-path/usage/** to monitor per-MPLS LSP statistics. Telemetry data is streamed from Junos devices and exported through JTI to external collectors at configurable intervals through gRPC without involving polling.

Initial support of this feature in Junos OS Release 15.1F6 supported ingress LSPs only when a subscription was made to **/junos/services/label-switched-path/usage/**. With bypass support added to this feature in Junos OS Release 17.4R1, this subscription now streams both ingress LSP and bypass LSP statistics to a collector.

Statistics that are streamed are similar to the output displayed by the operational mode commands `show mpls lsp bypass statistics` and `show mpls lsp ingress statistics`.

For bypass LSPs, the following are exported:

- Bypass LSP originating at the ingress router of the protected LSP.

- Bypass LSP originating at the transit router of the protected LSP.

- Bypass LSP protecting the transit LSP as well as the locally originated LSP.

When the bypass LSP is active, traffic is exported both on the bypass LSP and the ingress (protected) LSP.

To provision a sensor to export data through gRPC, use the telemetrySubscribe RPC to specify telemetry parameters. Streaming telemetry data through gRPC also requires the OpenConfig for Junos OS module. Both OpenConfig and Network Agent packages are bundled into the Junos OS image by default.

See *Configuring a Junos Telemetry Interface Sensor (CLI Procedure)* for information about configuring a UDP (native) sensor.

See Table 4 on page 32 for the level of LSP sensor support by platform.

Table 4: LSP Support by Platform

Platform	Ingress LSP, UDP Feature Introduced	Ingress LSP, gRPC Strea Feature Introduced
ACX6360		
MX80/MX104	Junos OS Release 15.1F6 Junos OS Release 16.1R3 Junos OS Release 17.2R1	
MX Series with MPC	Junos OS Release 15.1F6	Junos OS Release 16.1R Junos OS Release 17.2R
PTX5000 with FPC3		Junos OS Release 18.2R
PTX3000 with FPC3	Junos OS Release 15.1F6 Junos OS Release 16.1R3 Junos OS Release 17.2R1	Junos OS Release 16.1R Junos OS Release 17.2R Junos OS Release 18.2R

Table 4: LSP Support by Platform *(Continued)*

Platform	Ingress LSP, UDP Feature Introduced	Ingress LSP, gRPC Strea Feature Introduced
PTX Series with FPC1/2	Junos OS Release 15.1F6 Junos OS Release 16.1R3 Junos OS Release 17.2R1	Junos OS Release 16.1R Junos OS Release 17.2R Junos OS Release 18.2R
PTX1000	Junos OS Release 16.1R3	Junos OS Release 16.1R Junos OS Release 17.2R
PTX10000	Junos OS Release 17.3R1	Junos OS Release 17.3R
PTX10001-20C		
PTX10002	Junos OS Release 19.1R1	Junos OS Release 19.1R
VMX	Junos OS Release 17.3R1	Junos OS Release 17.3R
MX150	Junos OS Release 17.4R1	Junos OS Release 17.4R
EX4600	Junos OS Release 18.4R1	
EX4650	Junos OS Release 18.3R1	Junos OS Release 18.3R
EX9200	Junos OS Release 17.3R1	
QFX10000		

Table 4: LSP Support by Platform *(Continued)*

Platform	Ingress LSP, UDP Feature Introduced	Ingress LSP, gRPC Strea Feature Introduced
QFX5200	Junos OS Release 17.2R1	Junos OS Release 17.2F
QFX10002	Junos OS Release 19.1R1	Junos OS Release 19.1F
QFX5100	Junos OS Release 18.2R1	Junos OS Release 18.2F
QFX5110	Junos OS Release 18.2R1	Junos OS Release 18.2F
QFX5120-48Y	Junos OS Release 18.3R1	Junos OS Release 18.3F
QFX5200	Junos OS Release 18.2R1	Junos OS Release 18.2F

Dynamic Tunnel Statistics Support

Starting with Junos OS Release 17.4R1, you can export counter statistics for Packet Forwarding Engine dynamic tunnels to an outside collector using either native (UDP) or OpenConfig telemetry sensors through JTI.

The statistics are used to report various network element performance metrics in a scalable and efficient way, providing visibility into Packet Forwarding Engine errors and drops.

A timestamp indicating when the counters were last reset is included with all the exported data to allow collectors to determine if and when a reset event happened; for example, if the P acket Forwarding Engine hardware restarted.

Exported statistics are similar to the output of the operational mode command `show nhdb hw dynamic-ip-tunnels`.

To provision statistics export through gRPC, use the telemetrySubcribe RPC to create a subscription and specify telemetry parameters. Include the resource path **/junos/services/ip-tunnel[name='tunnel-name']/usage/counters[name='counter-name']/** in the subscription.

Streaming telemetry data through gRPC also requires the OpenConfig for Junos OS module. Starting in Junos OS Release 18.3R1, OpenConfig and Network Agent packages are bundled into the Junos OS image by default. Both packages support JTI.

To configure export of statistics through UDP, include the sensor `/junos/services/ip-tunnel/usage/` in the *sensor (Junos Telemetry Interface)* configuration statement at the [`edit services analytics`] hierarchy level. All parameters for UDP sensors are configured at that hierarchy level. MX80 and MX104 routers support only UDP streaming. They do not support gRPC.

FPC and Optics Support

Starting in Junos OS Release 19.2R1, JTI supports streaming of Flexible PIC Concentrator (FPC) and optics statistics for the MX Series using Remote Procedure Calls (gRPC). gRPC is a protocol for configuration and retrieval of state information. Support includes the addition of a new process (SensorD daemon) to export telemetry data for integration with AFTTelementry and LibTelemetry libraries in the OpenConfig model called AFT platform.

The following base resource paths are supported:

- **/junos/system/linecard/environment/**

- **/junos/system/linecard/optics/**

To provision the sensor to export data through gRPC, use the telemetrySubcribe RPC to specify telemetry parameters. Streaming telemetry data through gRPC also requires the OpenConfig for Junos OS module. Starting in Junos OS Release 18.3R1, OpenConfig and Network Agent packages are bundled into the Junos OS image by default. Both packages support JTI.

JTI Broadband Edge Statistics Support for Junos Fusion on MX Series

Starting in Junos OS Release 19.2R1, subscriber-based telemetry streaming is enabled when an MX router is configured for Broadband Network Gateway (BNG) and Junos Fusion where subscribers are connected through Junos Fusion Satellite devices. You can use remote procedure calls (gRPC) to export broadband edge (BBE) telemetry statistics to external collectors.

You can stream all BBE resource paths except for the following:

- **/junos/system/subscriber-management/access-network/ancp**

- **/junos/system/subscriber-management/client-protocols/l2tp**

- **/junos/system/subscriber-management/infra/network/l2tp/**

To stream BBE statistics, include a resource path starting with **/junos/system/subscriber-management/** in your gRPC subscription.

To provision the sensor to export data through gRPC, use the `telemetrySubscribe` RPC to specify telemetry parameters.

CPU and NPU Sensor Support for MX Series Routers with MPC10E-15C-MRATE Line Cards

Junos OS Release 19.3R1 supports CPU and network processing unit (NPU) sensors on MX Series routers with MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards. JTI enables the export of statistics from these sensors to outside collectors at configurable intervals using gRPC services.

Unlike the Junos kernel implementation for the CPU and NPU sensors in previous Junos releases, this feature uses the OpenConfig AFT model. Because of this, there is a difference in the resource path and key-value (kv) pair output compared to the Junos kernel output.

Use the following resource path to export statistics:

/junos/system/linecard/cpu/memory/

/junos/system/linecard/npu/memory/

/junos/system/linecard/npu/utilization/

To provision the sensor to export data through gRPC services, use the `telemetrySubcribe` RPC to specify telemetry parameters. Streaming telemetry data through gRPC also requires the OpenConfig for Junos OS module. Starting in Junos OS Release 18.3R1, OpenConfig and Network Agent packages are bundled into the Junos OS image by default. Both packages support JTI.

For more information about gRPC resource paths, see Guidelines for gRPC Sensors (Junos Telemetry Interface).

Interface Express Sensor

The interface express sensor is supported by JTI to export interface operational `UP` and `DOWN` status at a user-configurable rate. This sensor leverages statistics out of the physical interface sensor, providing faster and more frequent operational status statistics. Only the physical interfaces' operational status from the Flexible PIC Concentrator (FPC) is collected and reported. Statistics from the Routing Engine interface are not reported.

You can use the sensor to export statistics either through UDP (native) export or through gRPC services.

For either export method, include the following resource path:

- **/junos/system/linecard/intf-exp/**

Junos OS Release 18.1R1 supports interface express sensor for PTX1000, PTX3000, PTX5000, and PTX10000 routers.

Junos OS Release 19.3R1 supports interface express sensor for MX960, MX2010, and MX2020 routers.

For more information about gRPC resource paths, see Guidelines for gRPC and gNMI Sensors (Junos Telemetry Interface).

Standby Routing Engine Sensors for Subscribers

JTI supports streaming standby Routing Engine statistics using gRPC services. This feature is supported on both single chassis and virtual chassis unless otherwise indicated. Use this feature to better track the state of software components running on a standby Routing Engine. Statistics exported to an outside collector through the following sensors (primarily under subscriber management) provide a more complete view of the system health and resiliency state:

- Chassis role (backup or primary) sensor **/junos/system/subscriber-management/chassis** and **/junos/system/subscriber-management/chassis[chassis-index=*chassis-index*]** (for specifying an index for an MX Series Virtual Chassis)

- Routing Engine status and GRES notification sensor **/junos/system/subscriber-management/chassis/routing-engines/routing-engine** and **/junos/system/subscriber-management/chassis/routing-engines/routing-engine[re-index=*RoutingEngineIndex*]** (to specify an index number for a specific Routing Engine)

- Subscriber management process sensor **/junos/system/subscriber-management/chassis/routing-engines/process-status/subscriber-management-processes/subscriber-management-process** and **/junos/system/subscriber-management/chassis/routing-engines/process-status/subscriber-management-processes/subscriber-management-process[pid=*ProcessIdentifier*]** (to specify a PID for a specific process)

- Per Routing Engine DHCP binding statistics for server or relay sensor **/junos/system/subscriber-management/chassis/routing-engines/routing-engine/dhcp-bindings/dhcp-element[dhcp-type-name=*RelayOrServer*/v4]** and **/junos/system/subscriber-management/chassis/routing-engines/routing-engine/dhcp-bindings/dhcp-element[dhcp-type-name=*RelayOrServer*/v6]**

- Virtual Chassis port counter sensor **/junos/system/subscriber-management/chassis/virtual-chassis-ports/virtual-chassis-port** and **/junos/system/subscriber-management/chassis/virtual-chassis-ports/virtual-chassis-port[vcp-interface-name=*vcp-interface-port-string*] (to specify the interface name).** This resource path is only supported on a virtual chassis.

Junos OS Release 20.2R1 supports standby Routing Engine sensors for MX480, MX960, MX10003, MX2010, and MX2020 routers.

For more information about gRPC and gNMI resource paths, see Guidelines for gRPC and gNMI Sensors (Junos Telemetry Interface).

Diameter Application Protocol and Diameter Peer Sensors for Subscribers

JTI supports streaming statistics for subscribers for the diameter application protocols Network Access Server Application (NASREQ), policy and charging rules function (PCRF), and Online Charging System (OCS). There are also new diameter peer sensors that provide response time measurements for messages exchanged between an MX router and the peer for each of the diameter applications. Statistics are exported using JTI and the Juniper AAA Model, which covers telemetry export using gRPC, gNMI, or Juniper proprietary RPC or UDP.

To stream diameter application statistics, include the resource paths:

- For NASREQ statistics, **/junos/system/subscriber-management/aaa/diameter/clients/nasreq**

- For PCRF statistics, **/junos/system/subscriber-management/aaa/diameter/clients/gx**

- For OCS statistics, **/junos/system/subscriber-management/aaa/diameter/clients/gy**

To stream response time measurements for the diameter applications, include the resource paths in a subscription or using the sensor configuration statement:

- For NASREQ measurements, **/junos/system/subscriber-management/aaa/diameter/peers/ peer[peer_address='**_peer-address_**']/nasreq/response-time**

- For PCRF measurements, **/junos/system/subscriber-management/aaa/diameter/peers/ peer[peer_address='**_peer-address_**']/gx/response-time**

- For OCS measurements, **/junos/system/subscriber-management/aaa/diameter/peers/ peer[peer_address='**_peer-address_**']/gy/response-time**

To enable these statistics for an MX Series router for native (UDP) export, include the sensors statement at the [edit services analytics] hierarchy level.

To provision the sensor to export data through gNMI, use the Subscribe RPC defined in the gnmi.proto to specify request parameters.

To provision the sensor to export data through gRPC, use the telemetrySubscribe RPC to specify telemetry parameters. Streaming telemetry data through gRPC also requires the OpenConfig for Junos OS module.

Starting in Junos OS Release 18.3R1, OpenConfig and Network Agent packages are bundled into the Junos OS image by default. Both packages support JTI.

Junos OS Release 19.3R1 supports diameter application protocol sensors for MX5, MX10, MX40, MX150, MX204, MX240, MX480, MX960, MX2008, MX2010, MX2020, MX10003, MX10008, and MX100016 routers.

For more information about gRPC and gNMI resource paths, see Guidelines for gRPC and gNMI Sensors (Junos Telemetry Interface).

Interface Burst Monitoring

Junos OS Evolved Release 19.3R1supports interface burst monitoring on Junos telemetry interface (JTI) to monitor physical interfaces for bursts on QFX5220-128C and QFX5220-32CD switches. Use interface burst monitoring to help troubleshoot problems, make decisions, and adjust resources as needed.

The sampling is done in the millisecond granularity during the export interval (window). The export interval is configured in the sensor with the subscription from the collector. When the sensor is installed, a timer is started in the Packet Forwarding Engine to poll the hardware in 30-100ms intervals. Rates in the first export batch will be 0.

The peak byte is the average of the number of bytes seen in a sampling interval. For bursts lasting less than the sampling interval, the peak byte is averaged out over the interval. Exported statistics also include the time peak bytes are detected, as well as the direction (transmit or receive). The maximum byte rate detected during the export interval among all the samples is considered as the burst. If there are multiple bursts of the same number of bytes rate in the interval, then the first occurring burst is considered as the maximum burst and the timestamp of that burst is considered as the burst timestamp.

Data for all physical interfaces that are UP is exported. Aggregate interfaces are not supported.

You can export interface burst statistics from the Juniper device to an outside collector by including the sensor **/junos/system/linecard/bmon-sw/** in a subscription using remote procedure call (gRPC) services. Only one collector is supported with this sensor.

To provision the sensor to export data through gRPC services, use the `telemetrySubcribe` RPC to specify telemetry parameters. Streaming telemetry data through gRPC also requires the OpenConfig for Junos OS module.

NOTE: This feature does not detect microbursts.

Transceiver Diagnostics

Junos OS Release 19.4R1 supports transciever diagnostic sensors for ON_CHANGE and streaming statistics using JTI and gRPC services or gNMI services on MX960, MX2010, MX2020, PTX1000, PTX5000, and the PTX10000 line of routers. Use transceiver diagnostics to help troubleshoot problems, make decisions, and adjust resources as needed.

This feature supports OpenConfig transceiver model **openconfig-platform-transceiver.yang 0.5.0**.

Use the base resource path **/components/component/transceiver/** in a gRPC or gNMI subscription to export statistics from the Juniper device to an outside collector.

Fields that change continuously, such as temperature, input power, and output power, and laser bias current are not supported for ON_CHANGE.

Physical Ethernet Interface Sensor

Junos OS Release 19.4R1 supports physical Ethernet interface statistics for ON_CHANGE and streaming statistics using JTI and gRPC services or gNMI services on MX960, MX2020, PTX1000, and PTX5000 routers.

This feature supports OpenConfig model **openconfig-if-ethernet.yang** (physical interface level) version 2.6.2 (no configuration).

Use the base resource path **/interfaces/interface/ethernet/state/** in a gRPC or gNMI subscription to export statistics from the Juniper device to an outside collector.

VLAN Sensors

Junos OS Release 19.4R1 supports streaming VLAN statistics for ON_CHANGE using JTI and gRPC services on EX4650 and QFX5120 switches.

This feature supports OpenConfig model openconfig-vlan.yang configuration version 1.0.2.

Use the base resource path **/vlans/** in a gRPC subscription to export statistics from the Juniper device to an outside collector.

Other end points you can use in a subscription include:

- **/vlans/vlan/state/name**

- **/vlans/vlan/state/vlan-id**

- **/vlans/vlan/members/**

- **/vlans/vlan/members/member/interface-ref/state/interface/**

- **/vlans/vlan/members/member/interface-ref/state/interface/switched-vlan/state/interface-mode**

- **/vlans/vlan/members/member/interface-ref/state/interface/switched-vlan/state/native-vlan**

- **/vlans/vlan/members/member/interface-ref/state/interface/switched-vlan/state/access-vlan**

- **/vlans/vlan/members/member/interface-ref/state/interface/switched-vlan/state/trunk-vlan**

- **/vlans/vlan/members/member/interface-ref/state/interface/vlan/state/vlan-id**

Release History Table

Release	Description
20.4R1 Evolved	Starting in Junos OS Evolved Release 20.4R1, INITIAL_SYNC statistics from Packet Forwarding Engine sensors using gNMI services on QFX5130-32CD switches is supported.
20.2R1	Starting with Junos OS Evolved Release 20.2R1, gRPC service for streaming NDP statistics is supported on PTX10001 routers.
20.2R1	Starting with Junos OS Release 20.2R1, gRPC service for streaming Packet forwarding Engine and Routing Engine statistics is supported on EX2300, EX2300-MP, and EX3400 switches.
20.2R1	Starting with Junos OS Release 20.2R1, gRPC service for streaming BGP routing information base (RIB) and BGP peer statistics is supported on any platform family that supports containerized routing protocol process (cRPD). cRPD is Juniper's routing protocol process (rpd) decoupled from Junos OS and packaged as a Docker container to run in Linux-based environments.
20.2R1	Starting with Junos OS Release 20.2R1, ON_CHANGE BGP peer statistics export using gRPC services and gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000, PTX10000 routers and QFX5100 and QFX5200 switches.
20.2R1	Starting with Junos OS Release 20.2R1, streaming BGP global, peer and perr groups statistics using gRPC services is supported on EX2300, EX3400, EX4300, EX4600, and EX9200 switches.
20.2R1	Starting with Junos OS Release 20.2R1, streaming revenue interface statistics through Packet Forwarding Engine sensors and pseudo interface statistics through Routing Engine sensors using gRPC services and gNMI services is supported on SRX5400, SRX5600, and SRX5800 Services Gateways..

20.2R1	Starting with Junos OS Release 20.2R1, streaming revenue interface statistics through Packet Forwarding Engine sensors and pseudo interface statistics through Routing Engine sensors using gRPC services and gNMI services is supported on SRX5400, SRX5600, and SRX5800 Services Gateways.
20.2R1	Starting with Junos OS Release 20.2R1 sensors to stream standby Routing Engine statistics are supported on MX480, MX960, MX10003, MX2010, and MX2020 routers.
20.2R1	Starting with Junos OS Release 20.2R1 sensors to stream EVPN statistics using gRPC services are supported with QFX5100, QFX5110, QFX5120, QFX5200, QFX10002-60C, QFX10002, QFX10008, and QFX10016 switches.
20.2R1	Starting with Junos OS Release 20.2R1, TARGET_DEFINED subscription mode with gRPC Network Management Interface (gNMI) services is supported for JTI on MX5, MX10, MX40, MX80, MX104, MX150, MX204, MX240, MX480, MX960, MX2008, MX2010, MX2020, MX10003, MX10008, and MX10016 routers.
20.2R1	Starting in Junos OS Release 20.2R1, INITIAL_SYNC statistics from Packet Forwarding Engine sensors using gNMI services on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches is supported.
20.2R1	Junos OS Release 20.2R1 supports standby Routing Engine sensors for MX480, MX960, MX10003, MX2010, and MX2020 routers.
20.1R1	Starting with Junos Release 20.R1, gNMI service for streaming telemetry sensors for Packet Forwarding Engine statistics is supported on MX2K-MPC11E line cards on MX2010 and MX2020 routers.
20.1R1	Starting with Junos OS Release 20.1R1, gRPC services version v1.18.0 is supported with JTI. This version includes important enhancements for gRPC. In earlier Junos OS releases, gRPC version v1.3.0 is supported with JTI.
19.4R1 Evolved	Starting with Junos Release 19.4R1, gRPC service for streaming Packet Forwarding Engine and Routing Engine statistics is supported on EX4300-MP switches.
19.4R1	Junos OS Release 19.4R1 supports transciever diagnostic sensors for ON_CHANGE and streaming statistics using JTI and gRPC services or gNMI services on MX960, MX2010, MX2020, PTX1000, PTX5000, and the PTX10000 line of routers.
19.4R1	Junos OS Release 19.4R1 supports physical Ethernet interface statistics for ON_CHANGE and streaming statistics using JTI and gRPC services or gNMI services on MX960, MX2020, PTX1000, and PTX5000 routers.

19.4R1	Junos OS Release 19.4R1 supports streaming VLAN statistics for ON_CHANGE using JTI and gRPC services on EX4650 and QFX5120 switches.
19.3R1-Evolved	Starting with Junos OS Evolved Release 19.3R1, gRPC service for exporting statistics is supported on QFX5220-128C and QFX5220-32CD switches.
19.3R1-Evolved	Junos OS Evolved Release 19.3R1supports interface burst monitoring on Junos telemetry interface (JTI) to monitor physical interfaces for bursts on QFX5220-128C and QFX5220-32CD switches.
19.3R1	Starting with Junos OS Release 19.3R1, gRPC service for exporting statistics is supported on MX Series routers hosting MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards.
19.3R1	Junos OS Release 19.3R1 supports CPU and network processing unit (NPU) sensors on MX Series routers with MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards.
19.3R1	Junos OS Release 19.3R1 supports interface express sensor for MX960, MX2010, and MX2020 routers.
19.3R1	Junos OS Release 19.3R1 supports diameter application protocol sensors for MX5, MX10, MX40, MX150, MX204, MX240, MX480, MX960, MX2008, MX2010, MX2020, MX10003, MX10008, and MX100016 routers.
19.2R1	Starting with Junos OS Release 19.2R1, SRX4100, SRX4200, SRX4600, SRX5400, SRX5600, SRX5800, and vSRX Series Services Gateways.
19.2R1	Starting with Junos OS Release 19.2R1, gNMI services for streaming Packet Forwarding Engine statistics is supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches.
19.2R1	Starting with Junos OS Release 19.2R1, gNMI services for streaming statistics is supported on QFX5100, QFX5110, QFX5120, QFX5200 and QFX5210 switches.
19.2R1	Starting in Junos OS Release 19.2R1, JTI supports streaming of Flexible PIC Concentrator (FPC) and optics statistics for the MX Series using Remote Procedure Calls (gRPC).
19.2R1	Starting in Junos OS Release 19.2R1, subscriber-based telemetry streaming is enabled when an MX router is configured for Broadband Network Gateway (BNG) and Junos Fusion where subscribers are connected through Junos Fusion Satellite devices.

19.1R1 EVO	Starting in Junos OS Evolved Release 19.1R1, OpenConfig (OC) and Junos telemetry interface (JTI) are supported. Both gRPC APIs and the customer-facing CLI remain the same as for the Junos OS. As was standard for Junos OS, Network Agent (NA) and OC packages are part of the Junos OS Evolved image.
19.1R1	Starting with Junos OS Release 19.1R1, MX Series routers operating with MS-MIC and MS-MPC, QFX10002 switches, and PTX10002 routers are also supported.
19.1R1	Starting with Junos OS Evolved 19.1R1, Packet Forwarding Engine sensors on PTX10003 routers are also supported.
18.4R1	Starting with Junos OS Release 18.4R1, MX480, MX960, MX2010, MX2020, MX2008 and MX-ELM routers are also supported.
18.3R1	Starting with Junos OS Release 18.3R1, ON_CHANGE streaming of LLDP telemetry sensor information is supported through gRPC for MX Series and PTX Series routers.
18.3R1	Starting with Junos OS Release 18.3R1, QFX5120-AY and EX4650 switches are also supported.
18.3R1	Starting with Junos OS Release 18.4R1, EX4600 switches are also supported.
18.3R1	Starting in Junos OS Release 18.3R1, OpenConfig and Network Agent packages are bundled into the Junos OS image by default. Both packages support JTI.
18.3R1	Starting in Junos OS Release 18.3R1, OpenConfig and Network Agent packages are bundled into the Junos OS image by default. Both packages support JTI.
18.2R1	Starting in Junos OS Release 18.2R1, when an external streaming server, or collector, provisions sensors to export data through gRPC on devices running Junos OS, the sensor configuration is committed to the `junos-analytics` instance of the ephemeral configuration database, and the configuration can be viewed by using the `show ephemeral-configuration instance junos-analytics` operational command.
18.1R1	Starting with Junos OS Release 18.1R1, OpenConfig support through Remote Procedure Calls (gRPC) and JTI is extended to support client streaming and bidirectional streaming of telemetry sensor information on MX Series and PTX Series routers.
18.1R1	Starting with Junos OS Release 18.3R1, OpenConfig support through gRPC and JTI provides continuous statistics streaming via the same sensor irrespective of the route that is active (BGP or static) for a given Segment Routing Traffic Engineering (SR-TE) policy.

18.1R1	Junos OS Release 18.1R1 supports interface express sensor for PTX1000, PTX3000, PTX5000, and PTX10000 routers.
17.4R1	Starting with Junos OS Release 17.4R1, MX2008 routers are supported.
17.4R1	Starting with Junos OS Release 17.4R1, you can export Packet Forwarding Engine traffic statistics through the Junos telemetry interface for MX Series and PTX Series routers. Both UDP and gRPC are supported.
17.4R1	With bypass support added to this feature in Junos OS Release 17.4R1, this subscription now streams both ingress LSP and bypass LSP statistics to a collector.
17.4R1	Starting with Junos OS Release 17.4R1, you can export counter statistics for Packet Forwarding Engine dynamic tunnels to an outside collector using either native (UDP) or OpenConfig telemetry sensors through JTI.
17.3R1	Starting with Junos OS Release 17.3R1, Junos telemetry interface is supported on the Routing Control and Board (RCB) on PTX3000 routers, QFX5110 switches, and EX4600 and EX9200 switches.
17.2R1	Starting with Junos OS Release 17.2R1, OpenConfig and gRPC are also supported on QFX10000 switches, QFX5200 switches, and PTX1000 routers.
16.1R3	Starting in Junos OS Release 16.1R3, you can use a set of remote procedure call (RPC) interfaces to configure the Junos telemetry interface and stream telemetry data using the gRPC framework.
16.1R3	OpenConfig for Junos OS and gRPC are supported only on MPCs on MX Series and on PTX Series routers starting with Junos OS Release 16.1R3.
15.1F6	Initial support of this feature in Junos OS Release 15.1F6 supported ingress LSPs only when a subscription was made to **/junos/services/label-switched-path/usage/**.

RELATED DOCUMENTATION

Installing the Network Agent Package (Junos Telemetry Interface)

Release Information for Junos OS with Upgraded FreeBSD

Guidelines for gRPC and gNMI Sensors (Junos Telemetry Interface)

statistics

telemetry

Installing the Network Agent Package (Junos Telemetry Interface)

Before you begin:

- Install Junos OS Release 16.1R3 or later.

- Install the OpenConfig for Junos OS module. Using a Web browser, navigate to the All Junos Platforms software download URL on the Juniper Networks webpage: https://www.juniper.net/support/downloads/. From the **Network Management** tab, scroll down to select **OpenConfig**. Select the **Software** tab. Select the **OpenConfig Package (Junos with upgraded FreeBSD)**. For more information, see "Installing the OpenConfig Package" on page 12.

- Install Secure Sockets Layer (SSL) certificates of authentication on your Juniper Networks device.

  NOTE: Only server-based SSL authentication is supported. Client-based authentication is not supported.

Starting with Junos OS Release 16.1R3, the Junos Network Agent software package provides a framework to support OpenConfig and gRPC for the Junos Telemetry Interface on MX Series routers and PTX5000 routers. The Network Agent package functions as a gRPC server that terminates the OpenConfig remote procedure call (RPC) interfaces and streams the telemetry data according to the OpenConfig specification. The Junos Network Agent package, which runs on the Routing Engine, implements local statistics collection and reports data to active telemetry stream subscribers.

Starting with Junos OS Release 17.2R1, the Junos Network Agent Package is also supported on QFX10000 switches and QFX5200 switches.

Starting with Junos OS Release 17.3R1, the Junos Network Agent Package is supported on QFX5110 switches and EX9200 switches.

Starting in Junos OS Release 18.3R1, the Junos OS image includes the Network Agent. You do not need to install Network Agent separately. This is true for Junos OS with upgraded FreeBSD and legacy Junos OS.

The Junos Network Agent is available as a separate package only for Junos OS with Upgraded FreeBSD. This package also includes the required YANG models. For other versions of Junos OS, Network Agent functionality is embedded in the software. For more information about Junos OS with Upgraded FreeBSD, see Release Information for Junos OS with Upgraded FreeBSD.

Network Agent for Junos OS software package has the following naming conventions:

- Package Name—This is `Network-Agent`.

- Architecture—This field indicates the CPU architecture of the platforms, such as `x86`.

- Application Binary Interface (ABI)—This field indicates the "word length" of the CPU architecture. The alue is `32` for 32-bit architectures.

- Release—This field indicates the Junos OS release number, such as `16.1R3.16`.

- Package release and spin number—This field indicates the package version and spin number, such as `C1.1`.

All Junos Network Agent packages are in tarred and gzipped (`.tgz`) format.

> **NOTE**: Each version of the Network Agent package is supported on a single release of Junos OS only. The Junos OS version supported is identified by the Junos OS release number included in the Network Agent package name.

An example of a valid Network Agent package name is:

- `network-agent-x86-32-16.1R4.12-C1.1.tgz`

Use the 32-bit Network Agent package for both 32-bit and 64-bit versions of Junos OS or Junos OS Evolved.

To download and install the Network Agent package:

1. Using a Web browser, navigate to the All Junos Platforms software download URL on the Juniper Networks webpage: https://www.juniper.net/support/downloads/.
2. Select the name of the Junos OS platform for the software that you want to download.
3. Select the release number (the number of the software version that you want to download) from the **Release** drop-down list to the right of the Download Software page.
4. Select the **Software** tab.
5. In the **Tools** section of the **Software** tab, select the **Junos Network Agent** package for the release.
6. Log in to the Juniper Networks authentication system using the username (generally your e-mail address) and password supplied by a Juniper Networks representative.
7. Download the software to a local host.
8. Copy the software to Juniper Networks device or to your internal software distribution site.
9. Install the new `network-agent` package on the device by issuing the `request system software add` *package-name* from the operational mode:

For example:

```
user@host > request system software add network-agent-x86-32-16.1R3.16-C1.0.tgz
```

> **NOTE**: The command uses the `validate` option by default. This option validates the software package against the current configuration as a prerequisite to adding the software package to ensure that the device reboots successfully. This is the default behavior when the software package being added is a different release.

10. Issue the `show version | grep na\ telemetry` command to verify that the Network Agent package was successfully installed.

```
user@host> show version | grep na\ telemetry
JUNOS na telemetry
[20161109.201405_builder_junos_161_r3]
```

For information about configuring gRPC services on your Juniper Networks device, see *gRPC Services for Junos Telemetry Interface*.

Release History Table

Release	Description
18.3R1	Starting in Junos OS Release 18.3R1, the Junos OS image includes the Network Agent.
17.3R1	Starting with Junos OS Release 17.3R1, the Junos Network Agent Package is supported on QFX5110 switches and EX9200 switches.
17.2R1	Starting with Junos OS Release 17.2R1, the Junos Network Agent Package is also supported on QFX10000 switches and QFX5200 switches.
16.1R3	Starting with Junos OS Release 16.1R3, the Junos Network Agent software package provides a framework to support OpenConfig and gRPC for the Junos Telemetry Interface on MX Series routers and PTX5000 routers.

RELATED DOCUMENTATION

Understanding OpenConfig and gRPC on Junos Telemetry Interface

gRPC Services for Junos Telemetry Interface

Configuring gRPC for the Junos Telemetry Interface

Starting with Junos OS Release 16.1R3 on MX Series routers and PTX3000 and PTX5000 routers, you can stream telemetry data for various network elements through gRPC, an open source framework for handling remote procedure calls based on TCP. The Junos Telemetry Interface relies on a so-called push model to deliver data asynchronously, which eliminates polling. For all Juniper devices that run a version of Junos OS with upgraded FreeBSD kernel, you must install the Junos Network Agent software package, which provides the interfaces to manage gRPC subscriptions. For Juniper Network devices that run other all other versions of the Junos OS, this functionality is embedded in the Junos OS software. For more information about installing the Junos Network Agent package, see *Installing the Network Agent Package*.

The Junos Telemetry Interface and gRPC streaming are supported on QFX10000 and QFX5200 switches, and PTX1000 routers starting with Junos OS Release 17.2R1.

The Junos Telemetry Interface and gRPC streaming are supported on QFX5110, EX4600, and EX9200 switches starting with Junos OS Release 17.3R1.

Before you begin:

- Install Junos OS Release 16.1R3 or later on your Juniper Networks device.

- If your Juniper Networks device is running a version of Junos OS with an upgraded FreeBSD kernel, install the Junos Network Agent software package.

- Install the OpenConfig for Junos module. For more information see, "Installing the OpenConfig Package" on page 12.

To configure your system for gRPC services:

1. Specify the API connection setting either based on Secure Socket Layer (SSL) technology.

For example, to set the API connection based on a SSL:

```
[edit system services]
user@host# set extension-service request-response grpc ssl
```

For an SSL-based connection, you must specify a local-certificate name and you can rely on the default IP address (::) to enable Junos to "listen" for all IPv4 and IPv6 addresses on incoming connections. If you would rather specify an IP address, follow stp b. below.

a. Specify a local certificate-name. The certificate can be any user-defined value from the certificate configuration (not shown here). The certificate name should used in thisexample is jsd_certificate:

```
[edit system services extension-service request-response grpc]
user@host# set ssl local-certificate jsd_certificate
```

> **NOTE**: Enter the name of a certificate you have configured with the local *certificate-name* statement at the [edit security certificates] hierarchy level.

b. (Optional) Specify an IP address to listen to for incoming connections. for example, 192.0.2.0:

```
[edit system services extension-service request-response grpc]
user@host# set ssl ip-address 192.0.2.0
```

> **NOTE**: If you do not specify an IP address, the default address of :: is used to listen for incoming connections.

2. Specify port 32767 for accepting incoming connections through gRPC.

> **NOTE**: Port 32767 is the required port for gRPC streaming for both unsecured and SSL-based connections.

```
[edit system services extension-service request-response grpc]
user@host# set  ssl port 32767
```

Configuring Bidirectional Authentication for gRPC for Junos Telemetry Interface

Starting with Junos OS Release 17.4R1, you can configure bidirectional authentication for gRPC sessions used to stream telemetry data. Previously, only authentication of the server, that is, Juniper device, was supported. Now the external client, that is management station that collects data, can also be authenticated using SSL certificates. The JET service process (`jsd`), which supports application interaction with Junos OS, uses the credentials provided by the external client to authenticate the client and authorize a connection.

Before you begin:

- If your Juniper device is running a version of Junos OS with an upgraded FreeBSD kernel, install the Junos Network Agent software package.

- Install the OpenConfig for Junos module. For more information see, "Installing the OpenConfig Package" on page 12.

- Configure the gRPC server. For more information, see *Configuring gRPC for the Junos Telemetry Interface*.

To configure authentication for the external client, that is, management station that collects telemetry data streamed from the Juniper device:

1. Enable bidirectional authentication and specify the requirements for a client certificate.

   For example, to specify the strongest authentication, which requires a certificate and its validation:

   ```
   [edit system services extention-service request-response grpc ssl]
   user@host# set mutual-authentication client-certificate-request require-certificate-and-verify
   ```

   > NOTE: The default is `no-certificate`. The other options are: `request-certificate`, `request-certificate-and-verify`, `require-certificate`, `require-certificate-and-verfiy`.
   >
   > We recommend that you use `no-certificate` option in a test environment only.

2. Specify the certificate authority.

> **NOTE**: For the certificate authority, specify a certificate-authority profile you have configured at the [edit security pki `ca-profile`] hierarchy level. This profile is used to validate the certificate provided by the client.
>
> A digital certificate provides a way of authenticating users through a trusted third-party called a certificate authority (CA). The CA validates the identity of a certificate holder and "signs" the certificate to attest that it has not been forged or altered. For more information, see *Digital Certificates Overview* and *Example: Requesting a CA Digital Certificate*.

For example, to specify a certificate-authority profile named `jsd_certificate`:

```
[edit system services extention-service request-response grpc ssl mutual-authentication]
user@host# set certificate-authority jsd_certificate
```

3. Verify that an external client can successfully connect with the Juniper device through the `jsd` process and invoke OpenConfig RPCs.

   The external client passes username and password credentials as part of metadata in each RPC. The RPC is allowed if valid credentials are used. Otherwise an error message is returned.

SEE ALSO

| ssl

Release History Table

Release	Description
17.4R1	Starting with Junos OS Release 17.4R1, you can configure bidirectional authentication for gRPC sessions used to stream telemetry data.
17.3R1	The Junos Telemetry Interface and gRPC streaming are supported on QFX5110, EX4600, and EX9200 switches starting with Junos OS Release 17.3R1.
17.2R1	The Junos Telemetry Interface and gRPC streaming are supported on QFX10000 and QFX5200 switches, and PTX1000 routers starting with Junos OS Release 17.2R1.
16.1R3	Starting with Junos OS Release 16.1R3 on MX Series routers and PTX3000 and PTX5000 routers, you can stream telemetry data for various network elements through gRPC, an open source framework for handling remote procedure calls based on TCP.

Guidelines for gRPC and gNMI Sensors (Junos Telemetry Interface)

IN THIS SECTION

Starting with Junos OS Release 16.1R3, the Junos Telemetry Interface supports gRPC remote procedure calls (gRPC) to provision sensors and to subscribe to and receive telemetry data on MX Series routers and PTX3000 and PTX5000 routers.

Starting with JunosOS Release 17.2R1, QFX10002, QFX10008, and QFX10016 switches, QFX5200 switches, and PTX1000 and PTX10008 routers are also supported.

Starting with Junos OS Release 17.3R1, QFX5110 switches, EX4600, EX4600-VC, and EX9200 switches and the Routing and Control Board (RCB) on PTX3000 routers are also supported.

Starting with Junos OS Release 17.3R1, broadband edge (BBE) gRPC sensors are supported.

Starting with Junos OS Release 18.2R1, PTX10002 routers are also supported.

Starting with Junos OS Release 17.4R1, PTX10016 routers and virtual MX Series (vMX) routers are also supported.

Starting with Junos OS Release 18.1R1, QFX5210-64C switches and QFX5100 switches are also supported.

Starting with Junos OS Release 18.1R1, ON_CHANGE streaming of ARP, ND, and IP sensor information associated with interfaces is supported through gRPC for MX Series routers and PTX Series routers.

Starting with Junos OS Release 18.3R1, ON_CHANGE streaming of LLDP telemetry sensor information is supported through gRPC for MX Series and PTX Series routers.

Starting with Junos OS Release 18.3R1, QFX5120-AY and EX4650 switches are also supported.

Starting with Junos OS Release 18.4R1, EX4600 switches are also supported.

Starting with Junos OS Release 18.4R1, MX480, MX960, MX2010, MX2020, MX2008 and MX-ELM routers are also supported.

Starting in Junos OS Evolved Release 19.1R1, OpenConfig (OC) and Junos Telemetry Interface (JTI) are supported. Both gRPC APIs and the customer-facing CLI remain the same as for the Junos OS. As was standard for Junos OS, Network Agent (NA) and OC packages are part of the Junos OS Evolved image.

Starting with Junos OS Evolved 19.1R1, Packet Forwarding Engine sensors on PTX10003 routers are also supported.

Starting with Junos OS Release 19.2R1, SRX4100, SRX4200, SRX4600, SRX5400, SRX5600, SRX5800, and vSRX Series Services Gateways.are supported.

Starting with Junos OS Release 19.2R1, gNMI services for streaming Packet Forwarding Engine statistics is supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches.

Starting with Junos OS Release 19.2R1, gNMI services for streaming statistics is supported on QFX5110, QFX5120, QFX5200 and QFX5210 switches.

Starting with Junos OS Release 19.3R1, gNMI services for streaming Packet Forwarding Engine statistics is supported on MX240, MX480 and MX960 routers.

Starting with Junos OS Release 19.3R1, gNMI services for streaming and ON_CHANGE export of Routing Engine statistics is supported on MX960, MX2010, MX2020, PTX5000, PTX1000, and PTX10000 routers.

Starting with Junos OS Release 19.3R1, gRPC service for exporting statistics is supported on MX Series routers hosting MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards. The resource paths **/junos/ system/linecard/cpu/memory/**, **/junos/system/linecard/npu/memory/**, and **/junos/system/ linecard/npu/utilization/** can be updated to call out individual sensors (leaves) and their respective paths for better clarity.

Starting with Junos OS Evolved Release 19.3R1, gRPC service for exporting statistics is supported on QFX5220-128C and QFX5220-32CD switches.

Starting with Junos OS Release 19.4R1, gRPC service for streaming Packet Forwarding Engine and Routing Engine statistics is supported on EX4300-MP switches.

Starting with Junos Release 20.R1, gNMI service for streaming telemetry sensors for Packet Forwarding Engine statistics is supported on MX2K-MPC11E line cards on MX2010 and MX2020 routers.

Starting with Junos OS Evolved Release 20.2R1, gRPC service for streaming NDP statistics is supported on PTX10001 routers.

Starting with Junos OS Release 20.2R1, gRPC service for streaming Packet forwarding Engine and Routing Engine statistics is supported on EX2300, EX2300-MP, and EX3400 switches.

Starting with Junos OS Release 20.2R1, gRPC service for streaming BGP routing information base (RIB) and BGP peer statistics is supported on any platform family that supports containerized routing protocol

process (cRPD). cRPD is Juniper's routing protocol process (rpd) decoupled from Junos OS and packaged as a Docker container to run in Linux-based environments.

Starting with Junos OS Release 20.2R1, ON_CHANGE BGP peer statistics export using gRPC services and gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000, PTX10000 routers and QFX5100 and QFX5200 switches.

Starting with Junos OS Release 20.2R1, streaming BGP global, peer and perr groups statistics using gRPC services is supported on EX2300, EX3400, EX4300, EX4600, and EX9200 switches.

Starting with Junos OS Release 20.2R1, streaming revenue interface statistics through Packet Forwarding Engine sensors and pseudo interface statistics through Routing Engine sensors using gRPC services and gNMI services is supported on SRX5400, SRX5600, and SRX5800 Services Gateways..

Starting with Junos OS Release 20.2R1, streaming revenue interface statistics through Packet Forwarding Engine sensors and pseudo interface statistics through Routing Engine sensors using gRPC services and gNMI services is supported on SRX5400, SRX5600, and SRX5800 Services Gateways.

Starting with Junos OS Release 20.2R1 sensors to stream standby Routing Engine statistics are supported on MX480, MX960, MX10003, MX2010, and MX2020 routers.

Starting with Junos OS Release 20.2R1 sensors to stream EVPN statistics using gRPC services are supported with QFX5100, QFX5110, QFX5120, QFX5200, QFX10002-60C, QFX10002, QFX10008, and QFX10016 switches.

Starting with Junos OS Release 20.2R1, gRPC service for exporting LDP and mLDP statistics is supported on MX Series routers.

Starting with Junos OS Release 20.3R1, gRPC service for exporting LDP and mLDP statistics is supported on MPC10E-10C-MRATE, MPC10E-15C-MRATE, and MX2K-MPC11E line cards.

The Telemetry Explorer tool is the best location to search for and view information about telemetry sensors.

To activate a sensor, use the corresponding resource path. Each resource path enables data streaming for the system resource globally, that is, systemwide. You can also modify each resource path, such as to specify a specific logical or physical interface. For example, to specify a specific interface, include the following at the end of the path: `[name='interface-name']/`

Supported gRPC and gNMI Sensors

See Table 5 on page 56 for a description of supported gRPC and gNMI sensors and Table 6 on page 121 for a description of supported broadband edge (BBE) gRPC sensors, including the subscription path you use to provision the sensors.

Starting with Junos OS Release 20.1R1, the on-device gRPC framework is upgraded to version v1.18.0 and is applicable to both JET and JTI. This version includes important enhancements for gRPC. Earlier legacy Junos OS platform versions (non-Occam) will continue to use version v1.3.0.

Starting with Junos OS Release 20.2R1, JTI supports MX routers with dual Routing Engines or MX Series Virtual Chassis on all Packet Forwarding Engine and Routing Engine sensors currently supported on MX Series routers. The level of sensor support currently available for MX Series routers applies, whether through streaming or ON_CHANGE statistics export, using UDP, remote procedure call (gRPC) services or gRPC Network Management Interface (gNMI) services. Additionally, JTI operational mode commands will provide details for all Routing Engines and MX Series Virtual Chassis, too.

Table 5: gRPC Sensors

resource path	Description
/interfaces/interface/state/forwarding-viable	Packet Forwarding Engine sensor for non-viable aggregated interface member links. This feature does not support non-LAG link members Starting in Junos OS Evolved Release 21.4R1, streaming statistics by means of gRPC and gNMI is supported on PTX10008 and PTX10016 routers.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
/junos/ike-security-associations/ike-security-association/routing-instance [name=' *routing-instance-name*]	Sensor for Internet Key Exchange (IKE) security statistics. When you configure a subscription request, use the `reporting-interval` parameter to configure the interval (in seconds) in which statistics are reported. Starting with Junos OS Release 18.1R1, MX Series routers are supported. • `remote-ip` • `local-ip` • `number-ipsec-sa-created` • `number-ipsec-sa-deleted` • `number-ipsec-sa-rekey` • `exchange-type` • `in-bytes` • `in-packets` • `out-bytes` • `out-packets` • `delete-payload-received` • `delete-payload-transmitted` • `dpd-request-payload-received` • `dpd-request-payload-transmitted` • `dpd-response-payload-received` • `dpd-response-payload-transmitted` • `dpd-response-payload-missed` • `dpd-response-payload-maximum-delay`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	`dpd-response-seq-payload-missed` `invalid-spi-notify-received` `invalid-spi-notify-transmitted` `routing-instance`
`/junos/kernel/tcpip/rtstock`	Sensor for kernel routing table socket (RTSOCK) information. Starting with Junos OS Release 19.3R1, EX9200, EX9251, EX9253, MX240, MX480, MX960, MX2010, MX2020, vMX, PTX1000, PTX10008, PTX10016, PTX3000 with RE-PTX-X8-64G, and PTX5000 with RE-PTX-X8-64G are supported. You can also add the following as the end path for /junos/kernel/rtsock/: `total-error-cnt` `total-veto-cnt`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
/junos/memory/	Sensor for CPU memory. This sensor exports the CPU and memory utilization per process and CPU usage for threads per process. The current implementation is Linux-based; therefore, the export information and gathered output format differs significantly from this sensor's performance on previous platforms. Supported on MX Series routers with MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards starting with Junos OS Release 19.3R1 for exporting telemetry information using gRPC services. This feature provides a different level of exported statistics in comparison to previous releases because it use the OpenConfig AFT model. Supported on MX2010 and MX2020 routers with MX2K-MPC11E line cards starting with Junos OS Release 20.1R1 for streaming telemetry information using gRPC services. Supported on EX2300, EX2300-MP, and EX3400 switches starting with Junos OS Release 20.2R1 and later for streaming telemetry information using gRPC services. Supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 20.2R1 and later for INITIAL_SYNC statistics using gNMI services. The statistics exported from this sensor are found in the following operational mode commands: `show system info`, `show system processes`, and `show system cpu`.
/junos/npu/memory	Starting with Junos OS Release 19.1R1, periodic streaming on QFX10002 switches and PTX10002 routers is supported.
/junos/services/health-monitor/config/	Sensor for the health monitoring configuraiton. Starting with Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
/junos/services/health-monitor/data/	Sensor for health monitoring data. Starting with Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services.
/junos/services/ip-tunnel[name='tunnel-name']/ usage/counters[name='counter-name']/	Sensor for Packet Forwarding Engine dynamic tunnels statistics. The statistics are used to report various network element performance metrics in a scalable and efficient way, providing visibility into Packet Forwarding Engine errors and drops. A timestamp indicating when the counters were last reset is included with all the exported data to allow collectors to determine if and when a reset event happened; for example, if the Packet Forwarding Engine hardware restarted. Exported statistics are similar to the output of the operational mode command `show nhdb hw dynamic-ip-tunnels`. Starting with Junos OS Release 17.4R1, MX Series devices are supported on gRPC services, with the exception of MX80 and MX104 routers. These routers support UDP export only for this sensor. To configure UDP export, include the sensor `/junos/services/ip-tunnel/usage/` in the *sensor (Junos Telemetry Interface)* configuration statement at the `[edit services analytics]` hierarchy level.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/services/label-switched-path/usage/`	Sensor for LSP statistics. On MX Series routers only, the following are also supported: bidirectional LSPs for ultimate-hop popping (UHP). Starting with Junos OS Release 17.2R1, QFX10000 switches and PTX1000 routers are also supported. Starting with Junos OS Release 17.3R1, EX9200 switches are also supported. Starting with Junos OS Release 17.4R1 on MX Series and PTX Series routers only, statistics for bypass LSPs are also exported. Previously, only statistics for ingress LSPs were exported. Starting with Junos OS Release 18.2R1, QFX5100, QFX5110, and QFX5200 switches are also supported. Starting with Junos OS Release 18.3R1, QFX5120-48Y and EX4650 switches are also supported. Starting with Junos OS Release 18.4R1, EX4600 switches are also supported. Starting with Junos OS Release 19.1R1, PTX10001-20C routers support RSVP bypass LSPs originating at the transit node Starting with Junos OS Release 19.1R1, periodic streaming on QFX10002 switches and PTX10002 routers is supported. Starting in Junos OS Evolved Release 19.1R1, PTX10003 routers are supported. Starting with Junos OS Release 19.2R1, ACX6360 routers are supported. Starting with Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services. Supported on QFX5200 switches starting with Junos OS Release 19.2R1 for streaming telemetry information using gNMI services. Starting with Junos OS Evolved Release 19.4R1, periodic streaming using gNMI services with PTX10003 routers is supported.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	Starting with Junos OS Evolved Release 20.2R1, periodic streaming using gRPC services with PTX10001 routers is supported.
	For bypass LSPs, the following are exported:
	• Bypass LSP originating at the ingress router of the protected LSP.
	• Bypass LSP originating at the transit router of the protected LSP.
	• Bypass LSP protecting the transit LSP as well as the locally originated LSP.
	When the bypass LSP is active, traffic is exported both on the bypass LSP and the ingress (protected) LSP.
	NOTE: When you enable a sensor for LSP statistics only, you must also configure the `sensor-based-stats` statement at the [`edit protocols mpls`] hierarchy level. MX Series routers should operate in enhanced mode. If not enabled by default, include either the `enhanced-ip` statement or the `enhanced-ethernet` statement at the [`edit chassis network-services`] hierarchy level.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
/junos/services/segment-routing/interface/ingress/usage/ /junos/services/segment-routing/interface/egress/usage/ /junos/services/segment-routing/sid/usage/	Sensors for aggregate segment routing traffic with IS-IS. This sensor is supported on MX Series and PTX5000 routers starting with Junos OS Release 17.4R1. Starting with Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services. Statistics are exported separately for each routing instance. The first path exports inbound traffic. The second path exports outbound traffic. The third path exports inbound segment routing traffic for each segment identifier. **NOTE**: When you enable a sensor for segment routing statistics, you must also configure the `sensor-based-stats` statement at the [edit protocols isis source-packet-routing] hierarchy level. All MX and PTX5000 routers with FPC3 onwards support enhanced mode. If enhanced mode is not enabled, configure either the `enhanced-ip` statement or the `enhanced-ethernet` statement at the [edit chassis network-services] hierarchy level. On PTX Series routers, configure the `enhanced-mode` statement at the [edit chassis network-services] hierarchy level. **NOTE**: Currently, MPLS labels correspond only to only one instance, instance 0. Since each SID corresponds to a single `instance_identifier`, no aggregation is required to be done by the collector. The `instance_identifier` is stamped as 0. The following end points are supported: • /network-instances/network-instance/mpls/signaling-protocols/segment-routing/interfaces/interface/state/in-pkts • /network-instances/network-instance/mpls/signaling-protocols/segment-routing/interfaces/interface/state/in-octets • /network-instances/network-instance/mpls/signaling-protocols/segment-routing/interfaces/interface/state/out-octets

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `/network-instances/network-instance/mpls/signaling-protocols/segment-routing/interfaces/interface/state/out-pkts` • `/network-instances/network-instance/mpls/aggregate-sid-counters/aggregate-sid-counter/state/in-octets` • `/network-instances/network-instance/mpls/aggregate-sid-counters/aggregate-sid-counter/state/in-pkts` • `/network-instances/network-instance/mpls/aggregate-sid-counters/aggregate-sid-counter/state/out-octets` • `/network-instances/network-instance/mpls/aggregate-sid-counters/aggregate-sid-counter/state/out-pkts` • `/network-instances/network-instance/mpls/interfaces/interface/sid-counters/sid-counter/state/in-octets` • `/network-instances/network-instance/mpls/interfaces/interface/sid-counters/sid-counter/state/in-pkts` • `/network-instances/network-instance/mpls/interfaces/interface/sid-counters/sid-counter/state/out-octets` • `/network-instances/network-instance/mpls/interfaces/interface/sid-counters/sid-counter/state/out-pkts` • `/network-instances/network-instance/mpls/interfaces/interface/sid-counters/sid-counter/forwarding-classes/forwarding-class/state/in-octets` • `/network-instances/network-instance/mpls/interfaces/interface/sid-counters/sid-counter/forwarding-classes/forwarding-class/state/in-pkts` • `/network-instances/network-instance/mpls/interfaces/interface/sid-counters/sid-counter/forwarding-classes/forwarding-class/state/out-octets` • `/network-instances/network-instance/mpls/interfaces/interface/sid-counters/sid-counter/forwarding-classes/forwarding-class/state/out-pkts`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/services/segment-routing/sid/usage/`	Sensors for aggregate segment routing traffic with IS-IS. This sensor is supported on PTX3000 routers and PTX5000 routers with FPC2 starting with Junos OS Release 19.1R1. Statistics are exported separately for each routing instance. The first path exports inbound traffic. The second path exports outbound traffic. The third path exports inbound segment routing traffic for each segment identifier. **NOTE**: When you enable a sensor for segment routing statistics, you must also configure the `sensor-based-stats` statement at the `[edit protocols isis source-packet-routing]` hierarchy level.
`/junos/services/segment-routing/traffic-engineering/ingress/usage`	Packet Forwarding Engine sensor for ingress segment routing traffic engineering statistics. Starting in Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services. Starting in Junos OS Evolved Release 21.4R1,PTX10001-36MR, PTX10003, PTX10004, PTX10008,and PTX10016 routers are supported on gRPC and gNMI services.
`/junos/services/segment-routing/traffic-engineering/transit/usage`	Packet Forwarding Engine sensor for ingress segment routing traffic engineering statistics. Starting in Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services. Starting in Junos OS Evolved Release 21.4R1,PTX10001-36MR, PTX10003, PTX10004, PTX10008,and PTX10016 routers are supported on gRPC and gNMI services.

Table 5: gRPC Sensors *(Continued)*

resource path	Description

`/junos/services/segment-routing/traffic-engineering/tunnel/lsp/ingress/usage/`
 	
`/junos/services/segment-routing/traffic-engineering/tunnel/lsp/transit/usage/`
	Sensor for Segment Routing Traffic Engineering (SR-TE) per Label Switched Path (LSP) route statistics.
	
	You can stream SR-TE telemetry statistics for uncolored SR-TE policies to an outside collector. Ingress statistics include statistics for all traffic steered by means of an SR-TE LSP. Transit statistics include statistics for traffic to the Binding-SID (BSID) of the SR-TE policy.
	
	To enable these statistics, include the **per-source per-segment-list** option at the [`edit protocols source-packet-routing telemetry statistics`] hierarchy level.
	
	Starting in Junos OS Release 20.1R1, MX Series and PTX Series routers support streaming statistics using gRPC services.
	
	Starting in Junos OS Release 20.2R1, MX240. MX480, MX960, MX2010, and MX2020 with MPC-10E or MPC-11E routers support streaming statistics using gRPC services.
	
	When a subscription is made to these resource paths, the following output format is displayed:
	
	• `/mpls/signaling-protocols/segment-routing/sr-te-per-lsp-ingress-policies/sr-te-ingress-lsp-policy\[tunnel-name='srtelsp1' and source='st' and origin='0' and distinguisher='f' and lsp-name='sr1'\]/state/counters\[name='.*'\]/packets`
	
	• `/mpls/signaling-protocols/segment-routing/sr-te-per-lsp-transit-policies/sr-te-transit-lsp-policy\[tunnel-name='srtelsp1' and source='st' and origin='0' and distinguisher='f' and lsp-name='sr1'\]/state/counters\[name='.*'\]/packets`
	
	For the output format above, the field `source`, values can be `ST` (static tunnel) or `PC` (PCEP tunnel). For the field `lsp-name`, the value is the transit output. Other fields, such as `Origin` and `Distinguisher` are fixed for uncolored tunnels.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/cmerror/configuration`	Sensor for error monitoring configuration. Starting in Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services.
`/junos/system/cmerror/counters`	Sensor for error monitoring counters. Starting in Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services.
`/junos/system/linecard/bmon-sw/`	Sensor for interface burst monitoring. Starting in Junos OS Evolved Release 19.3R1, QFX5220-128C and QFX5220-32CD switches are supported for streaming statistics on gRPC services. You can also add the following to the end of the path to stream specific statistics for interface burst monitoring: • `rx_bytes`-Total number of bytes received during the export interval. • `tx_bytes`-Total number of bytes transmitted during the export interval. • `start_ts`-Start timestamp for the data collection window. • `rx_peak_byte_rate`-Maximum bytes rate per millisecond received from all the sampling intervals in the export interval. • `rx_peak_ts`-Timestamp of the first burst. • `tx_peak_byte_rate`-Maximum bytes rate per millisecond, transmitted from all the sampling intervals in the export interval. • `tx_peak_byte_ts`-Timestamp of the first transmit burst.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/cpu/memory/`	Sensor for CPU memory. **NOTE**: On PTX Series routers, FPC1 and FPC2 are not supported. Supported on QFX10000 switches and PTX1000 routers starting with Junos OS Release 17.2R1. Supported on EX9200 switches starting with Junos OS Release 17.3R1. Supported on QFX5100, QFX5110, and QFX5200 switches starting with Junos OS Release 18.2R1. Supported on QFX5120-48Y and EX4650 switches starting with Junos OS Release 18.3R1. Supported on EX4600 switches starting with Junos OS Release 18.4R1. Periodic streaming is supported on on QFX10002 switches and PTX10002 routers starting with Junos OS Release 19.1R1. Starting with Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services. Supported on QFX5200 switches starting with Junos OS Release 19.2R1 for streaming telemetry information using gNMI services. Periodic streaming using gRPC services is supported on EX4300-MP switches starting with Junos OS Release 19.4R1, Periodic streaming using gRPC services is supported on EX2300, EX2300-MP, and EX3400 switches starting with Junos OS Release 20.2R1. You can also include the following to end of the resource path for CPU memory: • `[name="mem-util-<`*`memory-name`*`>-size"]/value` • `[name="mem-util-<`*`memory-name`*`>-bytes-allocated"]/value` • `[name="mem-util-<`*`memory-name`*`>-utilization"]/value`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	[name="mem-util-<*memory-name*><*app-name*>-allocations"]/value [name="mem-util-<*memory-name*><*app-name*>-frees"]/value [name="mem-util-<*memory-name*><*app-name*>-allocations-failed"]/value

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/ddos/`	Distributed denial of service (DDoS) sensor. This sensor supports the Openconfig data model junos/ui/openconfig/yang/ and junos-ddos.yang.
	You can stream information using Juniper proprietary gRPC or UDP (native) export.
	There are 45 packet types for DDoS. To maintain a reasonably sized data stream, data is exported for all protocols that have seen traffic using the zero-suppression model.
	On QFX5000 platforms, multiple protocols can share the same CPU queue. DDoS configurations are applied at the CPU queue level. Consequently, DDoS statistics fetched from the CPU queue will return the aggregate value of all protocols using that queue. For example, if BGP, LDP, and RSVP protocols are using a particular CPU queue, but the DDoS limit is violated only by the BGP protocol, the DDoS violation reported will include all three protocols: BGP, LDP, and RSVP. This information will be exported to the collector with the DDoS sensor.
	Starting in Junos OS Release 22.1R1 EX4650, QFX5110, QFX5120-48Y, QFX5200 and QFX5210 switches are supported.
	You can also add the following leaves to the end of the path to stream specific statistics:
	`group_name` `group_id` `protocol_name` `protocol_id` `received` `arrive-policer` `dropped-individual_policer` `dropped_aggregate_policer`

Table 5: gRPC Sensors *(Continued)*

resource path	Description

	`total_dropped` `final_passed` `arrival_rate` `max_arrival_rate` `pass_rate` `policer_state` `policer_violation_count` `policer_violation_start_time` `policer_violation_end_time` The following packet types are supported:
	
	`------ --------- -------- -------- -----------------------------`
	`CMICQ Channel  bwidth   burst    Qlen        Proto(s)`
	`------ --------- -------- -------- ---------`
	`-----------------------------`
	`    0      3      500      10     200         uncls`
	`    4      1     4000     200     200       vchassis`
	`    7      3      500     200     200         vxlan`
	`    8      3     1500     200     200        localnh`
	`    9      3     1000     200     200       vcipc-udp`
	`   10      3     2000     200     200     sample-source`
	`   11      3     2000     200     200      sample-dest`
	`   12      3       50      10     200       l3mtu-`
	`fail,ttl,ip-opt.`
	`   14      3      100      10     200       garp-reply`
	`   15      3      500      10     200        fw-host`
	`   16      3      500     200     200         ndpv6`
	`   17      3     1000     200     200        dhcpv4v6`
	`   19      3     1500     200     200     ipmc-reserved`
	`   20      3      300     200     200        resolve`
	`   21      3      100      10     200      l3dest-miss`
	`   22      3      100      10     200        redirect`
	`   23      3      300     200     200         l3nhop`
	`   24      3      100      10     200    l3mc-sgvhit-icl`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
| | ```
    25       3       50      10      200    martian-address
    26       3     1000     200      200             l2pt
    27       3       50      10      200         urpf-fail
    28       3     1000     300      300      ipmcast-miss
    29       2      300      10      200    nonucast-switch
    30       2     3000     200      200
rsvp,ldp,bgp
    31       2     3000     200      200          unknown-
l2mc,rip,ospf
    32       2     1000     200      200      fip-snooping
    33       2     1000     200      200              igmp
    34       2      500     200      200               arp
    35       2     1500     200      200          pim-data
    36       2     1500     200      200         ospf-hello
    37       2     1500     200      200          pim-ctrl
    38       2     2000     200      200              isis
    39       1      250     200      200              lacp
    40       1     1200     200      200               bfd
    41       1      100      10      200               ntp
    42       1      500     200      200          vchassis
    43       1     1000     200      200
stp,pvstp,lldp
``` |
| `/junos/system/linecard/environment/` | Sensor for environmental statistics.

Supported on MX10008 routers starting with Junos OS Release 21.4R1 using Juniper proprietary gRPC. |
| `/junos/system/linecard/fabric/` | Sensor for fabric statistics.

Supported on MX10008 routers starting with Junos OS Release 21.4R1 using Juniper proprietary gRPC. |

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/firewall/`	Sensor for firewall filter counters and policer counters. Each line card reports counters separately.
	Supported on QFX10000 switches starting with Junos OS Release 17.2R1.
	Supported on PTX1000 routers and EX9200 switches starting with Junos OS Release 17.3R1.
	Supported on QFX5100, QFX5110, and QFX5200 switches starting with Junos OS Release 18.2R1.
	Supported on QFX5120-48Y and EX4650 switches starting with Junos OS Release 18.3R1.
	Supported on EX4600 switches starting with Junos OS Release 18.4R1.
	Starting with Junos OS Release 19.1R1, periodic streaming is supported on QFX10002 switches and PTX10002 routers.
	Starting in Junos OS Evolved Release 19.1R1, PTX10003 routers are supported.
	Starting in Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services.
	Supported on QFX5200 switches starting with Junos OS Release 19.2R1 for streaming telemetry information using gNMI services.
	Supported on MX240, MX480, and MX960 routers starting with Junos OS Release 19.3R1 for exporting telemetry information using gNMI services. This feature includes support to export telemetry data for integration with AFTTelemetry and LibTelemetry libraries with the OpenConfig model openconfig-aft.
	Periodic streaming using gRPC services with EX4300-MP switches is supported starting with Junos OS Release 19.4R1.
	Periodic streaming using gNMI services with PTX10003 routers is supported starting with Junos OS Evolved Release 19.4R1.
	Periodic streaming using gNMI services on MX2K-MPC11E line cards on MX2010 and MX2020 routers is supported starting with Junos OS Release 20.1R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	Periodic streaming using gRPC services is supported on EX2300, EX2300-MP, and EX3400 switches starting with Junos OS Release 20.2R1.
	INITIAL_SYNC statistics using gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 20.2R1.
	NOTE: Hierarchical policer statistics are collected for MX Series routers only. Traffic-class counter statistics are collected for PTX Series routers and QFX10000 switches only.
	Firewall counters are exported even if the interface to which the firewall filter is attached is operationally down.
	The following OpenConfig paths are supported:
	- junos/firewall/firewall-stats/[name='*filter-name*']/timestamp /junos/firewall/firewall-stats/[name='*filter-name*']/ memory-usage/[name='*memory-type*']/allocated /junos/firewall/firewall-stats/[name='*filter-name*']/ counter-stats/[name='*counter-name*']/packets /junos/firewall/firewall-stats/[name='*filter-name*']/ counter-stats/[name='*couner-name*']/bytes /junos/firewall/firewall-stats/[name='*filter-name*']/ policer-stats/[name='*policer-name*']/out-of-spec-packets /junos/firewall/firewall-stats/[name='*filter-name*']/ policer-stats/[name='*policer-name*']/out-of-spec-bytes /junos/firewall/firewall-stats/[name='*filter-name*']/ policer-stats/[name='*policer-name*']/offered-packets /junos/firewall/firewall-stats/[name='*filter-name*']/ policer-stats/[name='*policer-name*']/offered-bytes /junos/firewall/firewall-stats/[name='*filter-name*']/ policer-stats/[name='*policer-name*']/transmitted-packets

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `/junos/firewall/firewall-stats/[name='`*filter-name*`']/ policer-stats/[name='`*policer-name*`']/transmitted-bytes` • `/junos/firewall/firewall-stats/[name='`*filter-name*`']/ hierarchical-policer-stats/[name='`*hierarchical-policer-name*`']/ premium-packets` (MX Series only) • `/junos/firewall/firewall-stats/[name='`*filter-name*`']/ hierarchical-policer-stats/[name='`*hierarchical-policer-name*`']/ premium-bytes` (MX Series only) • `/junos/firewall/firewall-stats/[name='`*filter-name*`']/ hierarchical-policer-stats/[name='`*hierarchical-policer-name*`']/ aggregate-packets` (MX Series only) • `/junos/firewall/firewall-stats/[name='`*filter-name*`']/ hierarchical-policer-stats/[name='`*hierarchical-policer-name*`']/ aggregate-bytes` (MX Series only)
`/junos/system/linecard/intf-exp/`	Interface express sensor. This sensor leverages statistics out of the physical interface sensor, providing faster and more frequent operational status statistics. Only the physical interfaces' operational status from the Flexible PIC Concentrator (FPC) is collected and reported. Statistics from the Routing Engine interface are not reported. Supported on PTX1000, PTX3000, PTX5000, and PTX10000 starting with Junos OS Release 18.1R1. Supported on MX960, MX2010, and MX2020 routers starting with Junos OS Release 19.3R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/interface/`	Packet Forwarding Engine sensor for physical interface traffic. **NOTE**: For PTX Series routers, for a specific interface, queue statistics are exported for each line card. For MX series routers, interface queue statistics are exported only from the slot on which an interface is configured. For Aggregated Ethernet interfaces, statistics are exported for the member physical interfaces. You must aggregate the counters at the destination server, or collector. If a physical interface is administratively down or operationally down, interface counters are not exported. Issuing an operational `clear` command, such as `clear interfaces statistics all`, does not reset statistics exported by the line card. Supported on PTX Series routers starting with Junos OS Release 15.1F3. Supported on MX Series routers starting with Junos OS Release 15.1F5. Supported on QFX10000 switches and PTX1000 routers starting with Junos OS Release 17.2R1. Supported on EX9200 switches and MX150 routers starting with Junos OS Release 17.3R1. Supported on QFX5100, QFX5110, and QFX5200 switches starting with Junos OS Release 18.2R1. Supported on QFX5120-48Y and EX4650 switches starting with Junos OS Release 18.3R1. Supported on EX4600 switches Starting with Junos OS Release 18.4R1. Periodic streaming is supported on QFX10002 switches and PTX10002 routers starting with Junos OS Release 19.1R1. Supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches with Junos OS Release 19.2R1 on gRPC and gNMI services. Supported on MX240, MX480, and MX960 routers starting with Junos OS Release 19.3R1 for exporting telemetry information using gNMI services. This feature includes support to export telemetry

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	data for integration with AFTTelemetry and LibTelemetry libraries with the OpenConfig model openconfig-aft.
	Starting with Junos OS Release 19.4R1, periodic streaming using gRPC services with EX4300-MP switches is supported.
	Periodic streaming using gNMI services on MX2K-MPC11E line cards on MX2010 and MX2020 routers is supported starting with Junos OS Release 20.1R1.
	Periodic streaming using gRPC services is supported on EX2300, EX2300-MP, and EX3400 switches starting with Junos OS Release 20.2R1.
	INITIAL_SYNC statistics using gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 21.4R1.
	Streaming statistics using gRPC services or gNMI services is supported on PTX10008 routers starting with Junos OS Release 20.2R1.

`/junos/system/linecard/interface/logical/family/ipv4/usage/`
 	
`/junos/system/linecard/interface/logical/family/ipv6/usage/`
	Sensor for per-family logical interface input and output counters for IPv4 and IPv6 traffic.
	
	Streaming statistics using Juniper proprietary gRPC is supported on MX10008 starting with Junos OS Release 21.4R1.
	
	Streaming statistics using Juniper proprietary gRPC is supported on MX Series and PTX Series routers using third-generation FPCs starting with Junos OS Release 21.2R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/interface/logical/usage`	Packet Forwarding Engine sensor for logical interface statistics. **NOTE**: If a logical interface is operationally down, interface statistics continue to be exported. Issuing an operational `clear` command, such as `clear interfaces statistics all`, does not reset statistics exported by the line card. **NOTE**: If a logical interface is operationally down, interface statistics continue to be exported. Issuing an operational `clear` command, such as `clear interfaces statistics all`, does not reset statistics exported by the line card. **NOTE**: Locally injected packets from the Routing Engine are not exported. **NOTE**: Locally injected packets from the Routing Engine are not exported. Supported in Junos OS Release 15.1F5. Supported QFX10000 switches starting with on Junos OS Release 17.2R1. Supported on EX9200 switches and MX150 routers starting with Junos OS Release 17.3R1. Supported on QFX5100, QFX5110, and QFX5200 switches starting with Junos OS Release 18.2R1. Supported on QFX5120-48Y and EX4650 switches starting with Junos OS Release 18.3R1. Supported on EX4600 switches starting with Junos OS Release 18.4R1. Starting with Junos OS Release 19.1R1, periodic streaming is supported on QFX10002 switches and PTX10002 routers. Supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches with Junos OS Release 19.2R1 on gRPC and gNMI services. Supported on QFX5200 switches starting with Junos OS Release 19.2R1 for streaming telemetry information using gNMI services.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	Supported on MX240, MX480, and MX960 routers starting with Junos OS Release 19.3R1 for exporting telemetry information using gNMI services. This feature includes support to export telemetry data for integration with AFTTelemetry and LibTelemetry libraries with the OpenConfig model openconfig-aft.
	Starting with Junos OS Release 19.4R1, periodic streaming using gRPC services with EX4300-MP switches is supported.
	Periodic streaming using gNMI services on MX2K-MPC11E line cards on MX2010 and MX2020 routers is supported starting with Junos OS Release 20.1R1.
	Periodic streaming using gRPC services is supported on EX3400 switches starting with Junos OS Release 20.2R1.
	INITIAL_SYNC statistics using gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 20.2R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/interface/queue/`	Sensor for interface queue statistics. Starting with Junos OS Release 18.3R1, when a subscription is made to `/interfaces` on MX, EX, QFX, PTX, and ACX platforms, traffic and queue statistics are delivered in two separate sensors: • **/junos/system/linecard/interface/traffic/** • **/junos/system/linecard/interface/queue/** This can reduce the reap time for non-queue data for platforms supporting Virtual Output Queues (VOQ), such as PTX Series routers. Starting in Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services. Supported on MX240, MX480, and MX960 routers starting with Junos OS Release 19.3R1 for exporting telemetry information using gNMI services. This feature includes support to export telemetry data for integration with AFTTelemetry and LibTelemetry libraries with the OpenConfig model openconfig-aft. Periodic streaming using gNMI services on MX2K-MPC11E line cards on MX2010 and MX2020 routers is supported starting with Junos OS Release 20.1R1. INITIAL_SYNC statistics using gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 20.2R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/node-slicing/af-fab-stats/`	Sensor to export abstracted fabric (AF) interface-specific load-balancing and fabric queue statistics. This sensor is only supported for in node virtualization configurations on MX routers with an AF Interface as the connecting link between guest network functions (GNFs).The sensor also reports aggregated statistics across all AF interfaces hosted on a source packet forwarding engine of local guest GNFs along with the fabric statistics for all traffic ingressing from and egressing to the fabric from that the packet forwarding engine. Supported on MX480, MX960, MX2010, MX2020, MX2008 and MX-ELM routers with Junos OS Release 18.4R1.
`/junos/system/linecard/npu/memory/`	Sensor for network processing unit (NPU) memory. Supported on EX4650, QFX5110, QFX5120-48Y, QFX5200, and QFX5210 switches starting with Junos OS Release 21.4R1 for exporting telemetry information using gRPC or gNMI services. You can also add the following leaves to the end of the path to stream specific statistics: • `resource_name` • `size` • `allocated` • `utilization` **NOTE**: Collecting telemetry statistics using the NPU memory sensor can cause high CPU cycles when gathering the MPLS ingress statistics (MPLS_Entry leaf). This, in turn, creates performance issues for the packet forwarding engine process. To correct this problem, MPLS ingress statistics are initially collected as a baseline. Statistics are updated after 30 seconds if a route is added or deleted. Otherwise, if there is no route change, statistics are fetched every hour.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/npu/memory/`	Sensor for network processing unit (NPU) memory. Supported on MX Series routers with MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards starting with Junos OS Release 19.3R1 for exporting telemetry information using gRPC services. This feature provides a different level of exported statistics in comparison to previous releases because it use the OpenConfig AFT model. Supported on MX2010 and MX2020 routers with MX2K-MPC11E line cards starting with Junos OS Release 20.1R1 for streaming telemetry information using gRPC services. You can also add the following to the end of the path to stream specific statistics for NPU memory: • `mem-util-edmem-size` • `mem-util-edmem-allocated` • `mem-util-edmem-utilization` • `mem-util-idmem-size` • `mem-util-idmem-allocated` • `mem-util-idmem-utilization` • `mem-util-bulk-dmem-size` • `mem-util-bulk-dmem-allocated` • `mem-util-bulk-dmem-utilization` • `mem-util-next-hop-edmem-size` • `mem-util-next-hop-edmem-allocated` • `mem-util-next-hop-edmem-utilization` • `mem-util-next-hop-bulk-dmem-size` • `mem-util-next-hop-bulk-dmem-allocated` • `mem-util-next-hop-bulk-dmem-utilization`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	`mem-util-next-hop-idmem-size` `mem-util-next-hop-idmem-allocated` `mem-util-next-hop-inline-services-free-count` `mem-util-next-hop-mobile:-timing-profile-bytes-allocated` `mem-util-next-hop-mobile:-timing-profile-allocation-count` `mem-util-next-hop-mobile:-timing-profile-free-count` `mem-util-next-hop-packet-reassembly-(rw)-bytes-allocated` `mem-util-next-hop-packet-reassembly-(rw)-allocation-count` `mem-util-next-hop-packet-reassembly-(rw)-free-count` `mem-util-next-hop-packet-reassembly---persistent-(rw)-bytes-allocated` `mem-util-next-hop-packet-reassembly---persistent-(rw)-allocation-count` `mem-util-next-hop-packet-reassembly---persistent-(rw)-free-count` `mem-util-next-hop-ml-bundle-bytes-allocated` `mem-util-next-hop-ml-bundle-allocation-count` `mem-util-next-hop-ml-bundle-free-count` `mem-util-next-hop-ddos-scfd-params-bytes-allocated` `mem-util-next-hop-ddos-scfd-params-allocation-count` `mem-util-next-hop-ddos-scfd-params-free-count` `mem-util-next-hop-vbf-bytes-allocated` `mem-util-next-hop-vbf-allocation-count` `mem-util-next-hop-vbf-free-count`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• mem-util-next-hop-ptp-ieee-1588-nhs-bytes-allocated
	• mem-util-next-hop-ptp-ieee-1588-nhs-allocation-count
	• mem-util-next-hop-ptp-ieee-1588-nhs-free-count
	• mem-util-next-hop-cos-bytes-allocated
	• mem-util-next-hop-cos-allocation-count
	• mem-util-next-hop-cos-free-count
	• mem-util-next-hop-inline-hash-sessions-bytes-allocated
	• mem-util-next-hop-inline-hash-sessions-allocation-count
	• mem-util-next-hop-inline-hash-sessions-free-count
	• mem-util-next-hop-inline-mdi-bytes-allocated
	• mem-util-next-hop-inline-mdi-allocation-count
	• mem-util-next-hop-inline-mdi-free-count
	• mem-util-next-hop-cos-enhanced-priority-bytes-allocated
	• mem-util-next-hop-cos-enhanced-priority-allocation-count
	• mem-util-next-hop-cos-enhanced-priority-free-count
	• mem-util-firewall-fw-bytes-allocated
	• mem-util-firewall-fw-allocation-count
	• mem-util-firewall-fw-free-count
	• mem-util-counters-fw-counter-bytes-allocated
	• mem-util-counters-fw-counter-allocation-count
	• mem-util-counters-fw-counter-free-count
	• mem-util-counters-fw-policer-bytes-allocated

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	`mem-util-counters-fw-policer-allocation-count` `mem-util-counters-fw-policer-free-count` `mem-util-counters-ifd-error-cntr-bytes-allocated` `mem-util-counters-ifd-error-cntr-allocation-count` `mem-util-counters-ifd-error-cntr-free-count` `mem-util-counters-nh-cntr-bytes-allocated` `mem-util-counters-nh-cntr-allocation-count` `mem-util-counters-nh-cntr-free-count` `mem-util-counters-ifl-cntr-bytes-allocated` `mem-util-counters-ifl-cntr-allocation-count` `mem-util-counters-ifl-cntr-free-count` `mem-util-counters-bridge-domain-counter0-bytes-allocated` `mem-util-counters-bridge-domain-counter0-allocation-count` `mem-util-counters-bridge-domain-counter0-free-count` `mem-util-counters-bridge-domain-counter0-free-count` `mem-util-counters-bridge-domain-cntr-bytes-allocated` `mem-util-counters-bridge-domain-cntr-allocation-count` `mem-util-counters-bridge-domain-cntr-free-count` `mem-util-counters-sample-inline-params-bytes-allocated` `mem-util-counters-sample-inline-params-allocation-count` `mem-util-counters-sample-inline-params-free-count` `mem-util-counters-services-counters-bytes-allocated`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `mem-util-counters-services-counters-allocation-count`
	• `mem-util-counters-services-counters-free-count`
	• `mem-util-counters-exception-counter-bytes-allocated`
	• `mem-util-counters-exception-counter-allocation-count`
	• `mem-util-counters-exception-counter-free-count`
	• `mem-util-counters-issu-policer-bytes-allocated`
	• `mem-util-counters-issu-policer-allocation-count`
	• `mem-util-counters-issu-policer-free-count`
	• `mem-util-counters-ddos-scfd-counters-bytes-allocated`
	• `mem-util-counters-ddos-scfd-counters-allocation-count`
	• `mem-util-counters-ddos-scfd-counters-free-count`
	• `mem-util-counters-ip-reassembly-counter-bytes-allocated`
	• `mem-util-counters-ip-reassembly-counter-allocation-count`
	• `mem-util-counters-ip-reassembly-counter-free-count`
	• `mem-util-hash-hash-edmem-overhead-bytes-allocated`
	• `mem-util-hash-hash-edmem-overhead-bytes-allocated`
	• `mem-util-hash-hash-edmem-overhead-bytes-allocated`
	• `mem-util-hash-hash-edmem-overhead-bytes-allocated`
	• `mem-util-hash-hash-edmem-overhead-bytes-allocated`
	• `mem-util-hash-hash-edmem-overhead-allocation-count`
	• `mem-util-hash-hash-edmem-overhead-free-count`
	• `mem-util-hash-hash-edmem-bkt-bytes-allocated`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	- mem-util-hash-hash-edmem-bkt-allocation-count - mem-util-hash-hash-edmem-bkt-free-count - mem-util-hash-hash-edmem-rec-bytes-allocated - mem-util-hash-hash-edmem-rec-allocation-count - mem-util-hash-hash-edmem-rec-free-count - mem-util-hash-hash-edmem-sideband-bytes-allocated - mem-util-hash-hash-edmem-sideband-allocation-count - mem-util-hash-hash-edmem-sideband-free-count - mem-util-hash-hash-dmem-bkt-bytes-allocated - mem-util-hash-hash-dmem-bkt-allocation-count - mem-util-hash-hash-dmem-bkt-free-count - mem-util-hash-hash-dmem-rec-bytes-allocated - mem-util-hash-hash-dmem-rec-allocation-count - mem-util-hash-hash-dmem-rec-free-count - mem-util-hash-hash-dmem-sideband-bytes-allocated - mem-util-hash-hash-dmem-sideband-allocation-count - mem-util-hash-hash-dmem-sideband-free-count - mem-util-encaps-ueid-bytes-allocated - mem-util-encaps-ueid-allocation-count - mem-util-encaps-ueid-free-count - mem-util-encaps-ueid-shared-bytes-allocated - mem-util-encaps-ueid-shared-bytes-allocated

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `mem-util-encaps-ueid-shared-allocation-count`
	• `mem-util-encaps-ueid-shared-free-count`
	• `mem-util-encaps-fabric-bytes-allocated`
	• `mem-util-encaps-fabric-allocation-count`
	• `mem-util-encaps-fabric-free-count`
	• `mem-util-services-nh-inline-jflow-sample-rr-(svcs)-bytes-allocated`
	• `mem-util-services-nh-inline-jflow-sample-rr-(svcs)-allocation-count`
	• `mem-util-services-nh-inline-jflow-sample-rr-(svcs)-free-count`
	• `mem-util-services-nh-inline-jflow-sample-nh-(svcs)-bytes-allocated`
	• `mem-util-services-nh-inline-jflow-sample-nh-(svcs)-allocation-count`
	• `mem-util-services-nh-inline-jflow-sample-nh-(svcs)-free-count`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/npu/memory/`	Sensor for network processing unit (NPU) memory, NPU memory utilization, and total memory available for each memory type.
	Supported on QFX10000 switches and PTX1000 routers starting with Junos OS Release 17.2R1.
	Supported on EX9200 switches starting with Junos OS Release 17.3R1.
	NOTE: Starting with Junos Release 17.4R1, FPC1 and FCP2 on PTX Series routers export data for NPU memory and NPU memory utilization. Previously, this sensor was supported only on FPC 3. Starting with Junos OS Release 18.3R1, EX4650 switches are supported.
	Starting with Junos OS Release 19.1R1, periodic streaming on PTX10002 routers is supported.
	Starting in Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers and PTX1000 and PTX10000 routers are supported on gRPC and gNMI services.
	The OpenConfig path is `/components/component[name="FPC<`*fpc-id*`>:NPU<`*npu-id*`>"] /properties/property/`
	You can also add the following to the end of the path to stream specific statistics for NPU memory:
	• `[name="mem-util-<`*memory-name*`>-size"]/value`
	• `[name="mem-util-<`*memory-name*`>-bytes-allocated"]/value`
	• `[name="mem-util-<`*memory-name*`>-utilization"]/value`
	• `[name="mem-util-<`*partition-name*`>-<` *app-name*`>-allocation-count"]/ value`
	• `[name="mem-util-<`*partition-name*`>-<` *app-name*`>-bytes-allocated"]/ value`
	• `[name="mem-util-<`*partition-name*`>-<` *app-name*`>-free-count"]/value`
	You can also add the following to the end of the path to stream specific statistics for NPU:

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	[name="util-*<memory-name>*-average-util">/value [name="util-*<memory-name>*-highest-util">/value [name="util-*<memory-name>*-lowest-util">/value [name="util-*<memory-name>*-average-cache-hit-rate">/value [name="util-*<memory-name>*-lowest-cache-hit-rate">/value [name="util-*<packet-identifier>*-rate">/value You can also export the following statistics for NPU memory for PTX routers only - pfe_name - combined_pool_name - combined_size - combined_usage_cnt - combined_utilization - global_pool_name - global_usage_cnt - global_alloc_cnt - global_free_cnt - local_pool_name - local_usage_cnt - local_alloc_cnt - local_free_cnt

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/npu/memory/`	Sensor for NPU Memory utilization statistics. Shown below, statistics are exported for the default FPC (**FPC0**). Multiples FPCs are supported. The component values and property values are names (like interface names). Starting in Junos OS Evolved Release 19.4R1, streaming statistics using gRPC and gNMI services on PTX10008 routers is supported. Starting in Junos OS Release 20.2R1, INITIAL_SYNC statistics using gNMI services on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches are supported. Starting in Junos OS Evolved Release 21.4R1, streaming statistics by means of gRPC and gNMI is supported on PTX10001-36MR, PTX10004, and PTX10008 routers. The following statistics are exported: • `/components-memory/component[name='FPC0:NPU17']/` • `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-epp-mapid-size']/` • `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-epp-mapid-allocated']/` • `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-epp-mapid-utilization']/` • `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-l2domain-size']/` • `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-l2domain-allocated']/` • `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-l2domain-utilizationn']/` • `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-tunnell2domainhash00-size']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-tunnell2domainhash00-allocated']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-tunnell2domainhash00-utilization']/`
	• `:/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-tunnell2domainhash10-size']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-tunnell2domainhash10-allocatedd']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-tunnell2domainhash10-utilization']/`
	• `:/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-slu-my-mac-size']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-slu-my-mac-allocated']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-slu-my-mac-utilization']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-dlu-idb-size']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-dlu-idb-allocated']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-kht-dlu-idb-utilization']/ }`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-jnh-final-size']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-jnh-final-allocated']/`
	• `/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-jnh-final-utilization']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	`/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-remap-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-remap-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-remap-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-refbits-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-refbits-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-refbits-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-nh-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-nh-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-nh-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-mpls-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-mpls-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name=' mem-util-jnh-mpls-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-loadbal-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-loadbal-allocated']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	`/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-loadbal-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-egress-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-egress-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jnh-egress-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jtree-memory-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jtree-memory-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-jtree-memory-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-vfilter-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-vfilter-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-vfilter-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-phyfilter-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-phyfilter-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-phyfilter-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-action-size']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	`/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-action-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-action-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-tcam-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name=' mem-util-flt-tcam-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-tcam-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-0-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-0-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-0-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-1-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-1-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-1-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	`/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-2-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-2-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-2-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-3-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-3-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-3-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-4-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-4-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-fcv-blk-4-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-scv-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-scv-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-scv-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-0-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-0-allocated']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	`/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-0-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-1-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-1-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-1-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-2-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-2-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-2-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-3-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-3-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-3-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-4-size']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-4-allocated']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-4-utilization']/` `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-0-bank-5-size']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-0-bank-5-allocated']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-0-bank-5-utilization']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-0-bank-6-size']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-0-bank-6-allocated']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-0-bank-6-utilization']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-0-bank-7-size']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-0-bank-7-allocated']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-0-bank-7-utilization']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name=' mem-util-flt-beta-1-bank-0-size']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-0-allocated']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-0-utilization']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-1-size']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-1-allocated']/ • /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-1-utilization']/

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-2-size']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-2-allocated']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-2-utilization']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-3-size']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-3-allocated']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-3-utilization']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-4-size']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-4-allocated']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-4-utilization']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-5-size']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-5-allocated']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-5-utilization']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-6-size']/
	• /components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-beta-1-bank-6-allocated']/

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	/components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-6-utilization']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-7-size']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-7-allocated']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-beta-1-bank-7-utilization']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-kht-size']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-kht-allocated']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-kht-utilization']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-bft-0-size']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-bft-0-allocated']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-bft-0-utilization']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-plt-size']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-plt-allocated']/ /components-memory/component[name='FPC0:NPU17']/properties/ property[name='mem-util-flt-alpha-0-plt-utilization']/

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-kht-size']/` • `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-kht-allocated']/` • `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-kht-utilization']/` • `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-bft-0-size']/` • `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-bft-0-allocated']/` • `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-bft-0-utilization']/` • `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-plt-size']/` • `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-plt-allocated']/` • `/components-memory/component[name='FPC0:NPU17']/properties/property[name='mem-util-flt-alpha-1-plt-utilization']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/npu/utilization`	Sensor for NPU utilization on the Packet Forwarding Engine.
	Packet Forwarding Engine utilization is exported exported as a percentage using input notifications.
	The following packet statistics are also exported as part of this field:
	• Loopback (pps)
	• Recirculation (pps)
	• WAN and host inject (pps)
	• ASIC to host (pps)
	Shown below, statistics are exported for the default FPC (**FPC0**). Multiples FPCs are supported. The component values and property values are names (like interface names).
	Starting in Junos OS Evolved Release 19.4R1, streaming statistics using gRPC and gNMI services on PTX10008 routers is supported.
	The following statistics are exported:
	• `/components-utilization/component[name='FPC0:NPU17'`
	• `/components-utilization/component[name='FPC0:NPU17']/properties/property[name='util-metric']`
	• `/components-utilization/component[name='FPC0:NPU17']/properties/property[name='util-Loopback-packet-rate']`
	• `components-utilization/component[name='FPC0:NPU17']/properties/property[name='util-Recirculation-packet-rate']`
	• `/components-utilization/component[name='FPC0:NPU17']/properties/property[name='util-Wan and Host inject-packet-rate']`
	• `/components-utilization/component[name='FPC0:NPU17']/properties/property[name='util-ASIC to host-packet-rate']`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/npu/utilization/`	Packet Forwarding Engine sensor for NPU processor utilization. Supported on MX Series routers with MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards starting with Junos OS Release 19.3R1 for streaming telemetry information using gRPC services. This feature provides a different level of exported statistics in comparison to previous releases because it uses the OpenConfig AFT model. Supported on MX2010 and MX2020 routers with MX2K-MPC11E line cards starting with Junos OS Release 20.1R1 for streaming telemetry information using gRPC services. Supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 20.2R1 and later for INITIAL_SYNC statistics using gNMI services. You can also include the following to the end of the resource path for NPU utilization: • `util-metric` • `util-Disp 0 Pkts-packet-rate` • `util-Disp 0 Pkts-average-instructions-per-packet` • `util-Disp 0 Pkts-average-wait-cycles-per-packet` • `util-Disp 0 Pkts-average-cycles-per-packet` • `util-Disp 1 Pkts-packet-rate` • `util-Disp 1 Pkts-average-instructions-per-packet` • `util-Disp 1 Pkts-average-wait-cycles-per-packet` • `util-Disp 1 Pkts-average-cycles-per-packet` • • `util-Disp 2 Pkts-packet-rate` • `util-Disp 2 Pkts-average-instructions-per-packet`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `util-Disp 2 Pkts-average-wait-cycles-per-packet`
	• `util-Disp 2 Pkts-average-cycles-per-packet`
	• `util-Disp 3 Pkts-packet-rate`
	•
	• `util-Disp 3 Pkts-average-instructions-per-packet`
	• `util-Disp 3 Pkts-average-wait-cycles-per-packet`
	• `util-Disp 3 Pkts-average-cycles-per-packet`
	• `mem-util-EDMEM-average-util`
	• `mem-util-EDMEM-highest-util`
	• `mem-util-EDMEM-lowest-util`
	• `mem-util-EDMEM-average-cache-hit-rate`
	• `mem-util-EDMEM-highest-cache-hit-rate`
	• `mem-util-EDMEM-lowest-cache-hit-rate`
	• `mem-util-IDMEM-average-util`
	• `mem-util-IDMEM-highest-util`
	• `mem-util-IDMEM-lowest-util`
	• `mem-util-IDMEM-average-cache-hit-rate`
	• `mem-util-IDMEM-highest-cache-hit-rate`
	• `mem-util-IDMEM-lowest-cache-hit-rate`
	• `mem-util-Bulk DMEM-average-util`
	• `mem-util-Bulk DMEM-highest-util`
	• `mem-util-Bulk DMEM-lowest-util`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `mem-util-Bulk DMEM-average-cache-hit-rate` • `mem-util-Bulk DMEM-highest-cache-hit-rate` • `mem-util-Bulk DMEM-lowest-cache-hit-rate`
`/junos/system/linecard/npu/utilization/`	Packet Forwarding Engine sensor for NPU processor utilization. Periodic streaming is supported on PTX10002 routers starting with Junos OS Release 19.1R1. Starting with Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers and PTX1000 and PTX10000 routers are supported on gRPC and gNMI services. Starting in Junos OS Evolved Release 21.4R1, streaming statistics by means of gRPC and gNMI is supported on PTX10001-36MR, PTX10004, and PTX10008 routers.
`/junos/system/linecard/optical`	Sensor for optical alarms. Configure this sensor for `et-`*type-fpc/pic/ port* (100-Gigabit Ethernet) interfaces. Supported on ACX6360 Universal Metro, MX Series, and PTX Series routers with a CFP2-DCO optics module starting with Junos OS Release 18.3R1. This module provides a high-density, long-haul OTN transport solution with MACSec capability. Supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 19.2R1 on gRPC and gNMI services.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/otn`	Sensor for G.709 optical transport network (OTN) alarms. Configure this sensor on `ot-`*type-fpc/pic/port* interfaces. Supported on ACX6360 Universal Metro, MX Series, and PTX Series routers with a CFP2-DCO optics module starting with Junos OS Release 18.3R1. This module provides a high-density, long-haul OTN transport solution with MACSec capability. Supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 19.2R1 on gRPC and gNMI services.
`/junos/system/linecard/packet/usage/`	Sensor for Packet Forwarding Engine error and drop statistics. Use these statistics to optimize traffic engineering and improve your network design. When you include the resource path `/junos/system/linecard/packet/usage/` in a subscription, statistics are streamed in the format: `/components/component[name='FPC0:NPU3']/properties/property[name='hwds-dlu-not-routable']/state/value` Supported on PTX1000 and PTX5000 routers and QFX10002-60C switches using Juniper proprietary gRPC starting with Junos OS Release 22.1R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/qmon-sw/`	Sensor for congestion and latency monitoring statistics.
	Supported on QFX5100, QFX5110, and QFX5200 switches starting with Junos OS Release 18.2R1.
	Supported on QFX5120-48Y and EX4650 switches starting with Junos OS Release 18.3R1.
	Supported on EX4600 switches starting with Junos OS Release 18.4R1.
	Supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 19.2R1 on gRPC and gNMI services.
	Supported on QFX5200 switches starting with Junos OS Release 19.2R1 for streaming telemetry information using gNMI services.
	Periodic streaming using gRPC services with EX4300-MP switches is supported starting with Junos OS Release 19.4R1.
	Periodic streaming using gRPC services is supported on EX3400 switches starting with Junos OS Release 20.2R1.
	INITIAL_SYNC statistics using gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 20.2R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/services/inline-jflow`	Sensor for inline active flow monitoring services statistics. Supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 19.2R1 on gRPC and gNMI services. When configuring inline active flow monitoring in Junos, you can apply version 9 or IPFIX flow templates to define a flow record template suitable for IPv4 or IPv6 MPLS and bridging traffic. For more information, see *Configuring Flow Aggregation on MX, M, vMX and T Series Routers and NFX250 to Use Version 9 Flow Templates*. Supported on MX Series operating with MPC10E-15C-MRATE line-rate cards starting with Junos OS Release 19.2R1. Supported on MX240, MX480, and MX960 routers starting with Junos OS Release 19.3R1 for exporting telemetry information using gNMI services. This feature includes support to export telemetry data for integration with AFTTelemetry and LibTelemetry libraries with the OpenConfig model openconfig-aft. Periodic streaming using gNMI services on MX2K-MPC11E line cards on MX2010 and MX2020 routers is supported starting with Junos OS Release 20.1R1. Periodic streaming using gRPC services on PTX10008 routers is supported starting with Junos OS Evolved Release 20.1R1.
/network-instances/network-instance[instance-name='name']/protocols/ protocol/evpn/irb-interfaces/	Local integrated routing and bridging (IRB) interface information sensor. Use the Telemetry Explorer tool to see leafs for this resource path. Starting with Junos OS Release 20.2R1, streaming statistics is supported using gRPC services with QFX5100, QFX5110, QFX5120, QFX5200, QFX10002-60C, QFX10002, QFX10008, and QFX10016 switches.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
/network-instances/network-instance[instance-name='name']/protocols/protocol/evpn/vxlan-tunnel-end-point/	Overlay VX-LAN tunnel information sensor. This sensor also delivers VTEP information ON_CHANGE leafs: • `source_ip_address` • `remote_ip_address` • `status` • `mode` • `nexthop-index` • `event-type` • `source-interface` Starting with Junos OS Release 20.2R1, streaming statistics is supported using gRPC services with QFX5100, QFX5110, QFX5120, QFX5200, QFX10002-60C, QFX10002, QFX10008, and QFX10016 switches.
/network-instances/network-instance[instance-name='name']/mac_db/entries/entry/	EVPN MAC table information sensor. Use the Telemetry Explorer tool to see leafs for this resource path. Starting with Junos OS Release 20.2R1, streaming statistics is supported using gRPC services with QFX5100, QFX5110, QFX5120, QFX5200, QFX10002-60C, QFX10002, QFX10008, and QFX10016 switches.
/network-instances/network-instance[instance-name='name']/macip_db/entries/entry/	MAC-IP or ARP-ND table sensor. Use the Telemetry Explorer tool to see leafs for this resource path. Starting with Junos OS Release 20.2R1, streaming statistics is supported using gRPC services with QFX5100, QFX5110, QFX5120, QFX5200, QFX10002-60C, QFX10002, QFX10008, and QFX10016 switches.

Table 5: gRPC Sensors *(Continued)*

resource path	Description

`/junos/system/linecard/optics/`	Sensor for various optical interface performance metrics, such as transmit and receive power levels.
	
	The following leaves streamed with the /junos/system/linecard/optics/ resource path return a value of -Inf dB milliwatt (dBm) when the power is 0 milliwatt (mW)), To view these statistics from the Junos CLI, use the operational mode command **show interface diagnostics optics**.
	
	• `/interfaces/interface/optics/`
	`laser_output_power_high_alarm_threshold_dbm`
	
	• `/interfaces/interface/optics/`
	`laser_output_power_low_alarm_threshold_dbm`
	
	• `/interfaces/interface/optics/`
	`laser_output_power_high_warning_threshold_dbm`
	
	• `/interfaces/interface/optics/`
	`laser_output_power_low_warning_threshold_dbm`
	
	• `/interfaces/interface/optics/`
	`laser_rx_power_high_alarm_threshold_dbm`
	
	• `/interfaces/interface/optics/`
	`laser_rx_power_low_alarm_threshold_dbm`
	
	• `/interfaces/interface/optics/`
	`laser_rx_power_high_warning_threshold_dbm`
	
	• `/interfaces/interface/optics/`
	`laser_rx_power_low_warning_threshold_dbm`
	
	• `/interfaces/interface/optics/lanediags/lane/`
	`lane_laser_output_power_dbm`
	
	• `/interfaces/interface/optics/ lanediags/lane/`
	`lane_laser_receiver_power_dbm`
	
	Supported on QFX10000 switches starting with Junos OS Release 17.2R1.
	
	Supported on PTX1000 routers and EX9200 switches starting with Junos OS Release 17.3R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	Supported on EX4650 switches starting with Junos OS Release 18.3R1.
	Supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 19.2R1 on gRPC and gNMI services.
	Supported on MX10 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches starting with Junos OS Release 19.2R1 on gRPC and gNMI services.
	Supported on MX10008 routers starting with Junos OS Release 21.4R1 using Juniper proprietary gRPC.

`/mpls/lsps-constrained-path/tunnels/`
`tunnel[name='`*foo-name*`',source='`*foo-source*`']/p2p-`
`tunnel-attributes/p2p-primary-paths[name='`*foo-path*`']/state/name`
	Sensor to export the path name for ingress point-to-point LSPs, point-to-multipoint LSPs, bypass LSPs, and dynamically created LSPs.
	
	This sensor is supported on indicated platforms up to and including Junos OS Release 17.3R1. See the following resource paths for LSP support in Junos OS Release 17.4R1 and higher:
	
	• `/network-instances/network-instance[name='`*instance-name*`']/mpls/`
	`lsps-constrained-path/tunnels/tunnel/p2p-tunnel-attributes/p2p-`
	`primary-paths/`
	
	• `/network-instances/network-instance[name='`*instance-name*`']/mpls/`
	`signaling-protocols/rsvp-te/sessions/session/state/notify-status`
	
	Supported on PTX Series routers, MX Series routers , and QFX10002, QFX10008, and QFX10016 switches starting with Junos OS Release 17.2R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
/mpls/lsps-constrained-path/tunnels/ tunnel[name='*foo-name*',source='*foo-source*']/p2p- tunnel-attributes/p2p-primary-paths[name='*foo-* *path*']/lsp-instances[index='*local-index*']/state/	Sensor to export LSP properties for ingress point-to-point LSPs, point-to-multipoint LSPs, bypass LSPs, and dynamically created LSPs Supported on PTX Series routers, MX Series routers, and QFX10002, QFX10008, and QFX10016 switches starting with Junos OS Release 17.2R1. The following end paths are also supported for the resource path: • bandwidth • metric • max-average-bandwidth • explicit-route-objects • record-route-objects
/mpls/signaling-protocols/ldp/lsp-transit-policies/ lsp-transit-policy/state/counters	Sensor to export statistics for LDP LSP transit traffic. Supported on MX Series routers starting with Junos OS Release 20.2R1.
/mpls/signaling-protocols/ldp/lsp-ingress-policies/ lsp-ingress-policy/state/counters	Sensor to export statistics for LDP LSP ingress traffic. Supported on MX Series routers starting with Junos OS Release 20.2R1.
/mpls/signaling-protocols/ldp/p2mp-lsps/p2mp-lsp/ state/counters	Sensor to export statistics for multipoint LDP LSP traffic. Supported on MX Series routers starting with Junos OS Release 20.2R1.
/mpls/signalling-protocols/ldp/p2mp-interfaces/ p2mp-interface/state/counters/	Sensor to export statistics for multipoint LDP egress traffic per interface. Supported on MX Series routers starting with Junos OS Release 20.2R1.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/mpls/signalling-protocols/ldp/p2mp-egress-interfaces/p2mp-interface/state/counters/`	Sensor to export statistics for multipoint LDP egress traffic per interface. Supported only on MPC10E-10C-MRATE, MPC10E-15C-MRATE, and MX2K-MPC11E line cards line cards on MX Series routers starting with Junos OS Release 20.3R1.
`/mpls/signalling-protocols/ldp/p2mp-interfaces/p2mp-interface/`	Sensor to export statistics for multipoint LDP ingress traffic per interface. Supported on MX Series routers starting with Junos OS Release 20.2R1.

`/mpls/lsps/signaling-protocols/rsvp-te/sessions/session[local-index='`*foo-index*`']/state/notify-status`	Sensor to export statistics for ingress point-to-point LSPs, point-to-multipoint LSPs, bypass LSPs, and dynamically created LSPs.
	
	ON_CHANGE support for LSP events is only activated when the reporting interval is set to 0 in the subscription request.
	
	Supported on PTX Series routers, MX Series routers, and QFX10002, QFX10008, and QFX10016 switches starting with Junos OS Release 17.2R1.
	
	The following events are exported under this resource path:
	
	• `PATHERR_RECEIVED`
	
	    • `TTL_EXPIRED`
	
	    • `NON_RSVP_CAPABLE_ROUTER`
	
	    • `RESVTEAR_RECEIVED`
	
	    • `PATH_MTU_CHANGE`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/network-instances/network-instance/mpls/signaling-protocols/rsvp-te/`	Sensor to export events for ingress point-to-point LSPs, point-to-multipoint LSPs, bypass LSPs, and dynamically created LSPs. Starting in Junos OS Evolved Release 19.2R1, PTX10003 routers support streaming statistics. The following end paths are also supported: • `interface-attributes/interface/bandwidth-reservations/state/active-reservations-count` • `interface-attributes/interface/bandwidth-reservations/state/available-bandwidth` • `interface-attributes/interface/bandwidth-reservations/state/highwater-mark` • `interface-attributes/interface/bandwidth-reservations/state/reserved-bandwidth` • `interface-attributes/interface/counters/in-ack-messages` • `interface-attributes/interface/counters/in-hello-messages` • `interface-attributes/interface/counters/in-path-messages` • `interface-attributes/interface/counters/in-path-tear-messages` • `interface-attributes/interface/counters/in-reservation-error-messages` • `interface-attributes/interface/counters/in-reservation-messages` • `interface-attributes/interface/counters/in-reservation-tear-messages` • `interface-attributes/interface/counters/in-srefresh-messages` • `interface-attributes/interface/counters/out-path-tear-messages` • `interface-attributes/interface/counters/out-ack-messages` • `interface-attributes/interface/counters/out-hello-messages`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• `interface-attributes/interface/counters/out-path-messages`
	• `interface-attributes/interface/counters/out-reservation-error-messages`
	• `interface-attributes/interface/counters/out-reservation-messages`
	• `interface-attributes/interface/counters/out-reservation-tear-messages`
	• `interface-attributes/interface/counters/out-srefresh-messages`
	• `neighbors/neighbor/state/neighbor-status`
	• `sessions/session/record-route-objects/record-route-object`
	• `sessions/session/state/destination-address`
	• `sessions/session/state/label-in`
	• `sessions/session/state/label-out`
	• `sessions/session/state/lsp-id`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/mpls/signaling-protocols/segment-routing/`	Sensor for traffic statistics for both ingress IP traffic and transit MPLS traffic..

Supported on MX Series and PTX Series routers starting with Junos OS Release 18.3R1.

The following end points are also supported and specify BGP Segment Routing traffic Engineering (SR-TE) transit statistics:

- `/sr-te-bsid-policies/sr-te-bsid-policy[binding-sid='80001', to-address='`*foo-to*`' color='`*foo-color*`']/state/counters[name='oc-`*xxx*`']/packets`

- `/sr-te-bsid-policies/sr-te-bsid-policy[binding-sid='80001', to-address='`*foo-to*`' color='`*foo-color*`']/state/counters[name='oc-`*xxx*`']/bytes`

The following end points are also supported and specify BGP Segment Routing traffic Engineering (SR-TE) ingress statistics:

- `/sr-te-ip-policies/sr-te-ip-policy[to-address='`*foo-to*`' color='`*foo-color*`']/state/counters[name='oc-`*xxx*`']/packets`

- `/sr-te-ip-policies/sr-te-ip-policy[to-address='`*foo-to*`' color='`*foo-color*`']/state/counters[name='oc-`*xxx*`']/bytes`

In addition to configuring the sensor, you must enable statistics collection using the statistics statement at the [[edit protocols source-packet-routing telemetry statistics] hierarchy level.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/packet/usage/`	Sensor for Packet Forwarding Engine Statistics. This sensor exports statistics for counters and provides visibility into Packet Forwarding Engine error and drop statistics.
	This sensor is supported starting on MX Series and PTX Series routers starting with Junos OS Release 17.4R1.
	Starting in Junos OS Evolved Release 19.1R1, PTX10003 routers are supported.
	Starting in Junos OS Release 19.2R1, MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches are supported on gRPC and gNMI services.
	Starting with Junos OS Evolved Release 19.4R1, periodic streaming using gNMI services with PTX10003 routers is supported.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/linecard/packet/usage/`	Sensor for Packet Forwarding Engine Statistics. This sensor exports statistics and provides visibility into Packet Forwarding Engine error and drop statistics. Statistics include counters (CC, CPU, and NPU) for traffic data. Note that NPU statistics are different than those streamed from the sensors **/junos/system/linecard/npu/memory/** and **/junos/system/linecard/npu/utilization/** . Sensor output is comparable to the output using the operational mode command **show pfe statistics traffic**.
	Shown below, statistics are exported for the default FPC (**FPC0**). Multiples FPCs are supported. The component values and property values are names (like interface names).
	Starting in Junos OS Evolved Release 19.4R1, streaming statistics using gRPC and gNMI services on PTX10008 routers is supported.
	Starting in Junos OS Release 20.2R1, INITIAL_SYNC statistics using gNMI services on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000 routers, PTX10000 line of routers, and QFX5100 and QFX5200 switches are supported.
	Starting in Junos OS Evolved Release 21.4R1, streaming statistics by means of gRPC and gNMI is supported on PTX10001-36MR, PTX10004, and PTX10008 routers.
	The following paths are also supported:
	• `:/components/component[name='FPC0:CC0']/properties/property[name='ts-input-packets']/`
	• `/components/component[name='FPC0:CC0']/properties/property[name='ts-output-packets']/`
	• `//components/component[name='FPC0:CC0']/properties/property[name='ts-input-packets-pps']/`
	• `/components/component[name='FPC0:CC0']/properties/property[name='ts-output-packets-pps']/`
	• `/components/component[name='FPC0:CC0']/properties/property[name='ts-fabric-input-packets']/`

Table 5: gRPC Sensors *(Continued)*

resource path	Description
	• /components/component[name='FPC0:CC0']/properties/ property[name='ts-fabric-input-packets-pps']/ • /components/component[name='FPC0:CC0']/properties/ property[name='ts-fabric-output-packets']/ • /components/component[name='FPC0:CC0']/properties/ property[name='ts-fabric-output-packets-pps']/ • /components/component[name='FPC0:CPU0']/properties/ property[name='lts-input-packets']/ • /components/component[name='FPC0:CPU0']/properties/ property[name='lts-output-packets']/ • /components/component[name='FPC0:CPU0']/properties/ property[name='lts-sw-input-control-drops']/ • /components/component[name='FPC0:CPU0']/properties/ property[name='lts-sw-input-high-drops']/ • /components/component[name='FPC0:CPU0']/properties/ property[name='lts-sw-input-medium-drops']/ • /components/component[name='FPC0:CPU0']/properties/ property[name='lts-sw-input-low-drops']/ • /components/component[name='FPC0:CPU0']/properties/ property[name='lts-sw-output-low-drops']/ • /components/component[name='FPC0:CPU0']/properties/ property[name='lts-hw-input-drops']/ • /components/component[name='FPC0:NPU0']/properties/ property[name='hwdsNormal']/ • /components/component[name='FPC0:NPU0']/properties/ property[name='hwds-data-error']/ • /components/component[name='FPC0:NPU0']/properties/ property[name='hwds-tcp-error']/

Table 5: gRPC Sensors *(Continued)*

resource path	Description

	`/components/component[name='FPC0:NPU0']/properties/`
	`property[name='hwds-illegal-nh']/` `/components/component[name='FPC0:NPU0']/properties/`
	`property[name='hwds-invalid-iif']/` `//components/component[name='FPC0:NPU0']/properties/`
	`property[name='hwds-fabric']/`

`/qos/interfaces/interface/output/queues/queue/` `state/`	Sensor for CoS telemetry support. To stream statistics, use the resource path **/qos/interfaces/ interface/output/queues/queue/state/** in a subscription to retrieve statistics from a router to a collector in the following format: `/qos/ interfaces/interface[interface-id='xe-1/1/5:0']` . The following end points are supported: `/queues/queue[name='0']/state/transmit-pkts` `/queues/queue[name='0']/state/transmit-octets` `/queues/queue[name='0']/state/dropped-pkts` Starting in Junos OS Evolved Release 21.4R1, streaming statistics by means of gRPC and gNMI is supported on PTX10001-36MR, PTX10003, PTX10004, PTX10008, and PTX10016 routers.

Table 5: gRPC Sensors *(Continued)*

resource path	Description
`/system/alarms/alarm`	INITIAL_SYNC support for OpenConfig data model openconfig-platform.yang and openconfig-alarms.yang. This feature lets the collector have a complete view of the current state of every sensor it is subscribed to. INITIAL_SYNC requires that at least one copy of all the sensors be sent to the collector. Starting in Junos OS Evolved Release 21.4R1, streaming statistics by means of gRPC and gNMI is supported on PTX10001-36MR, PTX10003, PTX10004, PTX10008, and PTX10016 routers.

Table 6: Broadband Edge gRPC Sensors

resource path	Description
`/junos/system/subscriber-management/chassis/virtual-chassis-ports/virtual-chassis-port` `/junos/system/subscriber-management/chassis/virtual-chassis-ports/virtual-chassis-port[vcp-interface-name=`*vcp-interface-port-string*`]` (to specify the interface name)	Virtual chassis port counter sensor. The sensor includes these statistics: • Input packets • Output packets • Input bytes • Output bytes Starting with Junos OS Release 20.2R1, streaming statistics from a virtual chassis is supported using gRPC services with MX480, MX960, MX10003, MX2010, and MX2020 routers.

Table 6: Broadband Edge gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/subscriber_management/dynamic-interfaces/interface-sets/meta-data/interface[sid-id='`*sid-value*`']/`	Sensor for subscriber interface information. ON-CHANGE streaming is supported. The following end paths are supported: • `interface-index`-The system assigned interface index for the interface. • `session-type`-The type of client session (e.g VLAN, DHCP, PPPoE). • `user-name`-The login name for this interface and session. • `profile-name`-The name of the client profile used to create the interface. • `underlying-interface-name`-The name of the associated underlying interface. • `cvlan-tag`-The innermost VLAN tag value associated with the interface. • `svlan-tag`-The outermost VLAN tag value associated with the interface.

Table 6: Broadband Edge gRPC Sensors *(Continued)*

resource path	Description
`/junos/system/subscriber_management/dynamic-interfaces/interface-sets/meta-data/interface[sid-id='`*sid-value*`']/`	Sensor for actual accounting statistics for dynamic subscriber interfaces. The following end paths are supported: • `ip-in-packets`-The number of actual transit IPv4 & IPv6 packets received by the interface. • `ip-out-packets`-The number of actual transit IPv4 & IPv6 packets sent to the interface. • `ip-in-bytes`-The number of actual transit IPv4 & IPv6 bytes received by the interface. • `ip-out-bytes`-The number of actual transit IPv4 & IPv6 bytes received by the interface. • `ipv6-in-packets`-The number of actual transit IPv6 packets received by the interface. • `ipv6-out-packets`-The number of actual transit IPv6 packets sent to the interface. • `ipv6-in-bytes`-The number of actual transit IPv6 bytes received by the interface. • `ipv6-out-bytes`-The number of actual transit IPv6 bytes sent to the interface.
`/junos/system/linecard/ddos/`	This PFE sensor exports the statistics of DDOS from MPC1, MPC2, MPC3, MPC5, MPC6, MPC7, MPC8, and MPC9 line cards.

Release History Table

Release	Description
20.3R1	Starting with Junos OS Release 20.3R1, gRPC service for exporting LDP and mLDP statistics is supported on MPC10E-10C-MRATE, MPC10E-15C-MRATE, and MX2K-MPC11E line cards.
20.2R1	Starting with Junos OS Evolved Release 20.2R1, gRPC service for streaming NDP statistics is supported on PTX10001 routers.

20.2R1	Starting with Junos OS Release 20.2R1, gRPC service for streaming Packet forwarding Engine and Routing Engine statistics is supported on EX2300, EX2300-MP, and EX3400 switches.
20.2R1	Starting with Junos OS Release 20.2R1, gRPC service for streaming BGP routing information base (RIB) and BGP peer statistics is supported on any platform family that supports containerized routing protocol process (cRPD). cRPD is Juniper's routing protocol process (rpd) decoupled from Junos OS and packaged as a Docker container to run in Linux-based environments.
20.2R1	Starting with Junos OS Release 20.2R1, ON_CHANGE BGP peer statistics export using gRPC services and gNMI services is supported on MX960, MX2008, MX2010, MX2020, PTX1000, PTX5000, PTX10000 routers and QFX5100 and QFX5200 switches.
20.2R1	Starting with Junos OS Release 20.2R1, streaming BGP global, peer and perr groups statistics using gRPC services is supported on EX2300, EX3400, EX4300, EX4600, and EX9200 switches.
20.2R1	Starting with Junos OS Release 20.2R1, streaming revenue interface statistics through Packet Forwarding Engine sensors and pseudo interface statistics through Routing Engine sensors using gRPC services and gNMI services is supported on SRX5400, SRX5600, and SRX5800 Services Gateways..
20.2R1	Starting with Junos OS Release 20.2R1, streaming revenue interface statistics through Packet Forwarding Engine sensors and pseudo interface statistics through Routing Engine sensors using gRPC services and gNMI services is supported on SRX5400, SRX5600, and SRX5800 Services Gateways.
20.2R1	Starting with Junos OS Release 20.2R1 sensors to stream standby Routing Engine statistics are supported on MX480, MX960, MX10003, MX2010, and MX2020 routers.
20.2R1	Starting with Junos OS Release 20.2R1 sensors to stream EVPN statistics using gRPC services are supported with QFX5100, QFX5110, QFX5120, QFX5200, QFX10002-60C, QFX10002, QFX10008, and QFX10016 switches.
20.2R1	Starting with Junos OS Release 20.2R1, gRPC service for exporting LDP and mLDP statistics is supported on MX Series routers.
20.1R1	Starting with Junos Release 20.R1, gNMI service for streaming telemetry sensors for Packet Forwarding Engine statistics is supported on MX2K-MPC11E line cards on MX2010 and MX2020 routers.
19.4R1	Starting with Junos OS Release 19.4R1, gRPC service for streaming Packet Forwarding Engine and Routing Engine statistics is supported on EX4300-MP switches.

19.3R1	Starting with Junos OS Release 19.3R1, gNMI services for streaming Packet Forwarding Engine statistics is supported on MX240, MX480 and MX960 routers.
19.3R1	Starting with Junos OS Release 19.3R1, gRPC service for exporting statistics is supported on MX Series routers hosting MPC10E-10C-MRATE and MPC10E-15C-MRATE line cards. The resource paths **/junos/system/linecard/cpu/memory/**, **/junos/system/linecard/npu/memory/**, and **/junos/system/linecard/npu/utilization/** can be updated to call out individual sensors (leaves) and their respective paths for better clarity.
19.3R1	Starting with Junos OS Evolved Release 19.3R1, gRPC service for exporting statistics is supported on QFX5220-128C and QFX5220-32CD switches.
19.2R1	Starting with Junos OS Release 19.2R1, SRX4100, SRX4200, SRX4600, SRX5400, SRX5600, SRX5800, and vSRX Series Services Gateways.are supported.
19.2R1	Starting with Junos OS Release 19.2R1, gNMI services for streaming Packet Forwarding Engine statistics is supported on MX960, MX2008, MX2010 and MX2020 routers, PTX1000 and PTX10000 routers, and QFX5100 and QFX5200 switches.
19.2R1	Starting with Junos OS Release 19.2R1, gNMI services for streaming statistics is supported on QFX5110, QFX5120, QFX5200 and QFX5210 switches.
19.2R1	Starting with Junos OS Release 19.3R1, gNMI services for streaming and ON_CHANGE export of Routing Engine statistics is supported on MX960, MX2010, MX2020, PTX5000, PTX1000, and PTX10000 routers.
19.1R1 EVO	Starting in Junos OS Evolved Release 19.1R1, OpenConfig (OC) and Junos Telemetry Interface (JTI) are supported. Both gRPC APIs and the customer-facing CLI remain the same as for the Junos OS. As was standard for Junos OS, Network Agent (NA) and OC packages are part of the Junos OS Evolved image.
19.1R1	Starting with Junos OS Evolved 19.1R1, Packet Forwarding Engine sensors on PTX10003 routers are also supported.
18.4R1	Starting with Junos OS Release 18.4R1, MX480, MX960, MX2010, MX2020, MX2008 and MX-ELM routers are also supported.
18.3R1	Starting with Junos OS Release 18.3R1, ON_CHANGE streaming of LLDP telemetry sensor information is supported through gRPC for MX Series and PTX Series routers.
18.3R1	Starting with Junos OS Release 18.3R1, QFX5120-AY and EX4650 switches are also supported.

18.3R1	Starting with Junos OS Release 18.4R1, EX4600 switches are also supported.
18.2R1	Starting with Junos OS Release 18.2R1, PTX10002 routers are also supported.
18.1R1	Starting with Junos OS Release 18.1R1, QFX5210-64C switches and QFX5100 switches are also supported.
18.1R1	Starting with Junos OS Release 18.1R1, ON_CHANGE streaming of ARP, ND, and IP sensor information associated with interfaces is supported through gRPC for MX Series routers and PTX Series routers.
17.4R1	Starting with Junos OS Release 17.4R1, PTX10016 routers and virtual MX Series (vMX) routers are also supported.
17.3R1	Starting with Junos OS Release 17.3R1, QFX5110 switches, EX4600, EX4600-VC, and EX9200 switches and the Routing and Control Board (RCB) on PTX3000 routers are also supported.
17.3R1	Starting with Junos OS Release 17.3R1, broadband edge (BBE) gRPC sensors are supported.
17.3R1	In Junos OS Release 17.3R1, broadband edge (BBE) gRPC sensor `/junos/system/subscriber-management/client-protocols/dhcp/v4/routing-instances/routing-instance[ri-name='` *routing-instance-name*`'] /server/statistics/` the only value supported for *routing-instance-name* is `default`.
17.3R1	In Junos OS Release 17.3R1, broadband edge (BBE) gRPC sensor `/junos/system/subscriber-management/client-ancpinstance[ri-name='` *routing-instance-name*`'] /server/statistics/` the only value supported for *routing-instance-name* is `default`.
17.3R1	In Junos OS Release 17.3R1, broadband edge (BBE) gRPC sensor `/junos/system/subscriber-management/client-protocols/dhcp/v4/routing-instances/routing-instance[ri-name='` *routing-instance-name*`']/relay/statistics/` the only value supported for the value *routing-instance-name* is `default`.
17.3R1	In Junos OS Release 17.3R1, broadband edge (BBE) gRPC sensor `/junos/system/subscriber-management/client-protocols/dhcp/v6/ routing-instances/routing-instance[ri-name='` *routing-instance-name*`']/server/statistics` the only value supported for *routing-instance-name* is `default`.
17.3R1	In Junos OS Release 17.3R1, broadband edge (BBE) gRPC sensor `/junos/system/subscriber-management/client-protocols/dhcp/v6/ routing-instances/routing-instance[ri-name='` *routing-instance-name* `']/relay/statistics` the only value supported for *routing-instance-name* is `default`.
17.2R1	Starting with JunosOS Release 17.2R1, QFX10002, QFX10008, and QFX10016 switches, QFX5200 switches, and PTX1000 and PTX10008 routers are also supported.

16.1R3	Starting with Junos OS Release 16.1R3, the Junos Telemetry Interface supports gRPC remote procedure calls (gRPC) to provision sensors and to subscribe to and receive telemetry data on MX Series routers and PTX3000 and PTX5000 routers.

RELATED DOCUMENTATION

Understanding OpenConfig and gRPC on Junos Telemetry Interface

3
CHAPTER

OpenConfig to Junos Mapping

Mapping OpenConfig AAA Commands to Junos Operation

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks ACX Series, EX Series, MX Series, PTX Series, and QFX Series.

The following tables show the mapping of OpenConfig AAA commands with the relevant configuration in Junos OS.

Table 7: Global AAA Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/system/aaa**	
Config-Name	`/server-groups/server-group/` `config/name`	Not supported **NOTE**: There is no equivalent configuration in the Junos OS for this path. The configured server group name is used in the RADIUS/TACACS attributes configuration.
Server-Config-Address	`/server-groups/server-group/` `servers/server/config/address`	Not supported **NOTE**: There is no equivalent configuration in the Junos OS for this path. The configured server address is used in the RADIUS/TACACS attributes configuration.
Server-Config-Name	`/server-groups/server-group/` `servers/server/config/name`	Not supported **NOTE**: There is no equivalent configuration in the Junos OS for this path. You can configure a server name to identify the server.

Table 7: Global AAA Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Config-Timeout	`/server-groups/server-group/` `servers/server/config/timeout`	Not supported **NOTE**: There is no equivalent configuration in the Junos OS for this path. However, the timeout configured is derived from the `timeout` parameter at the Junos OS `edit radius-server` or `edit tacplus-server` hierarchy level.

Table 8: RADIUS Server Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/system/aaa**	
Auth-Port	`/server-groups/server-group/servers/server/` `radius/config/auth-port`	`set system radius-server` *address* `port` *port* **NOTE**: The *address* value is derived from the value configured after `server`. The *port* value is the same value as *auth-port*.
Retransmit-Attempts	`/server-groups/server-group/servers/server/` `radius/config/retransmit-attempts`	`set system radius-server` *address* `retry`*retry* **NOTE**: The *address* value is derived from the value configured after `server`. The *retry* value is the same value as that specified for `retransmit-attempts`.

Table 8: RADIUS Server Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Secret-Key	/server-groups/server-group/servers/server/ radius/config/secret-key	`set system radius-server` *address* `secret` *secret* **NOTE**: The *address* value is derived from the value configured after `server`. The *secret* value is the same value as that specified for `secret-key`.
Source-Address	/server-groups/server-group/servers/server/ radius/config/source-address	`set system radius-server` *address* `source-address` *source-address* **NOTE**: The *address* value is derived from the value configured after `server`. The *source-address* value is the same value as that specified for `source-address`.

Table 9: TACACS Server Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/system/aaa**	
Config-Port	/server-groups/server-group/servers/server/ tacacs/config/port	`set system tacplus-server` *address* `port` *port* **NOTE**: The *address* value is derived from the value configured after `server`. The *port* value is the same value as that specified for `port`.

Table 9: TACACS Server Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Secret-Key	/server-groups/server-group/servers/server/ tacacs/config/secret-key	set system tacplus-server *address* secret *secret* **NOTE**: The *address* value is derived from the value configured after server. The *secret* value is the same value as that specified for secret-key.
Source-Address	/server-groups/server-group/servers/server/ tacacs/config/source-address	set system tacplus-server *address* source-address *source-address* **NOTE**: The *address* value is derived from the value configured after server. The *source-address* value is the same value as that specified for source-address.

Table 10: AAA Admin and User Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/system/aaa**	
Admin-Password	/authentication/admin-user/config/admin-password	set system root-authentication *plain-text-password* **NOTE**: The *plain-text-password-authentication* value is derived from the value configured for admin-password.

Table 10: AAA Admin and User Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Admin-Password-Hashed	/authentication/admin-user/config/admin-password-hashed	set system root-authentication encrypted-password *encrypted-password* **NOTE**: The *encrypted-password* value is derived from the value configured for admin-password-hashed.
Authentication-Method	/authentication/config/authentication-method	set system authentication-order **NOTE**: The *authentication-order* value is derived from the value configured for authentication-method.
Password	/authentication/users/user/config/password	set system login user *user-name* authentication plain-text-password *plain-text-password* **NOTE**: The *user-name* value is derived from the value configured for user. The *plain-text-password* value is derived from the value configured for password.
Password-Hashed	/authentication/users/user/config/password-hashed	set system login user *user-name* authentication encrypted-password *encrypted-password* **NOTE**: The *user-name* value is derived from the value configured for user. The *encrypted-password* value is derived from the value configured for password-hashed.

Table 10: AAA Admin and User Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Role	`/authentication/users/user/config/role`	`set system login user `*`user-name`*` class `*`class`* **NOTE**: The *user-name* value is derived from the value configured for `user`. The *class* value is derived from the value configured for `role`.
Username	`/authentication/users/user/config/username`	Not supported **NOTE**: There is no equivalent configuration in the Junos OS.

Mapping OpenConfig BGP Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks MX Series, PTX Series, and QFX Series.

Table 11 on page 134 to Table 25 on page 153 show the mapping of OpenConfig BGP commands with the relevant configuration in Junos.

Table 11: Global BGP Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/network-instances/network-instance/ protocols/protocol/bgp/global**	

Table 11: Global BGP Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
As	/config/as	set routing-options autonomous-system *as_number*
Router-ID	/config/router-id	set routing-options router-id *router-id*
Confederation	/confederation/config/identifier / confederation/config/member-as	set routing-options confederation *confederation_as* set routing-options confederation members *value*
Always-Compare-MED	/route-selection-options/config/always-compare-med	set protocols bgp path-selection always-compare-med
Ignore-AS-Path-Length	/route-selection-options/config/ignore-as-path-length	set protocols bgp path-selection as-path-ignore
Enable-AIGP	/route-selection-options/config/enable-aigp	set protocols bgp family *family* aigp
Ignore-Nexthop-IGP-Metric	/route-selection-options/config/ignore-next-hop-igp-metric	Not supported
Dynamic-Neighbor-Prefixes	/dynamic-neighbor-prefixes/dynamic-neighbor-prefix/config/prefix /dynamic-neighbor-prefixes/dynamic-neighbor-prefix/config/peer-group	set protocols bgp group *group* allow *ip address*
Graceful-Restart	/graceful-restart/config/enabled / graceful-restart/config/restart-time / graceful-restart/config/stale-routes-time /graceful-restart/config/helper-only	set protocols bgp graceful-restart disable set protocols bgp graceful-restart restart-time *restart -time* set protocols bgp graceful-restart stale-routes-time *stale- routes -time*

Table 12: AFI-SAFI Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/afi-safi** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi** Set the values for address family: **protocol/bgp/global/afi-safi/afi-safi/ <afi-safi-name>/<family-type>/config**	

Table 12: AFI-SAFI Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
	Where, afi-safi-name is one of the following:	
	• IPV4_LABELED_UNICAST Labeled IPv4 unicast (AFI,SAFI = 1,4)	
	• IPV4_MULTICAST Base identify type for IPv4 multicast address family	
	• IPV4_UNICAST IPv4 unicast (AFI,SAFI = 1,1)	
	• IPV6_LABELED_UNICAST Labeled IPv6 unicast (AFI,SAFI = 2,4)	
	• IPV6_MULTICAST Base identify type for IPv6 multicast address family	
	• IPV6_UNICAST IPv6 unicast (AFI,SAFI = 2,1)	
	• L2VPN_EVPN BGP MPLS Based Ethernet VPN (AFI,SAFI = 25,70)	
	• L2VPN_VPLS BGP-signalled VPLS (AFI,SAFI = 25,65)	
	• L3VPN_IPV4_MULTICAST Multicast IPv4 MPLS L3VPN (AFI,SAFI = 1,129)	
	• L3VPN_IPV4_UNICAST Unicast IPv4 MPLS L3VPN (AFI,SAFI = 1,128)	
	• L3VPN_IPV6_MULTICAST Multicast IPv6 MPLS L3VPN (AFI,SAFI = 2,129)	
	• L3VPN_IPV6_UNICAST Unicast IPv6 MPLS L3VPN (AFI,SAFI = 2,128)	

Table 12: AFI-SAFI Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
	Where, family-type is one of the following: • ipv4-labeled-unicast IPv4 Labeled Unicast configuration options • ipv4-unicast IPv4 unicast configuration options • ipv6-labeled-unicast IPv6 Labeled Unicast configuration options • ipv6-unicast IPv6 unicast configuration options • l2vpn-evpn BGP EVPN configuration options • l2vpn-vpls BGP-signalled VPLS configuration options • l3vpn-ipv4-multicast Multicast IPv4 L3VPN configuration options • l3vpn-ipv4-unicast Unicast IPv4 L3VPN configuration options • l3vpn-ipv6-multicast Multicast IPv6 L3VPN configuration options • l3vpn-ipv6-unicast Unicast IPv6 L3VPN configuration options	
AFI-SAFI	`/config/afi-safi-name` `/config/enabled`	`set protocols bgp family` *family*
Add-Path: Send	`/add-paths/config/send`	`set protocols bgp group` *group-name* `family` *family* `add-path send path-count` *number*

Table 12: AFI-SAFI Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Add-Paths: Receive	`/add-paths/config/receive`	`set protocols bgp group` *group-name* `family` *family* `add-path receive`
Add-Paths: Send-Max	`/add-paths/config/send-max` **NOTE**: You must set send-max to non-zero value before setting send to true. If not, you will receive an error message to set the correct values.	`set protocols bgp group` *group-name* `family` *family* `add-path send path-count` *path-count*
Add-Paths: Eligible Prefix Policy	`/add-paths/config/eligible-prefix-policy`	`set protocols bgp group` *group-name* `family` *family* `add-path send prefix-policy` *policy*
Always-Compare-MED	`/route-selection-options/config/always-compare-med`	`set protocols bgp path-selection always-compare-med`
Ignore-AS-Path-Length	`/route-selection-options/config/ignore-as-path-length`	`set protocols bgp path-selection as-path-ignore`
Enable-AIGP	`/route-selection-options/config/enable-aigp`	`set protocols bgp family` *family* `aigp`
Use-Multiple-Paths: Maximum-Paths	`/use-multiple-paths/ebgp/config/maximum-paths /use-multiple-paths/ibgp/config/maximum-paths`	`set chassis maximum-ecmp <num-next-hops>`
Use-Multiple-Paths: Allow-Multiple-AS	`/use-multiple-paths/ebgp/config/allow-multiple-as`	`set protocols bgp group` *group-name* `multipath multiple-as`

Table 13: AFI-SAFI IPv4-Unicast Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/ipv4-unicast** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ ipv4-unicast** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ ipv4-unicast**	
Send-Default-Route	/config/send-default-route	Not supported
Max-Prefixes	/prefix-limit/config/max-prefixes	set protocols bgp family inet unicast accepted-prefix-limit maximum *maximum*
Prevent-Teardown	/prefix-limit/config/prevent-teardown	set protocols bgp family *family* prefix-limit teardown
Shutdown-Threshold-PCT	/prefix-limit/config/shutdown-threshold-pct	set protocols bgp family inet unicast accepted-prefix-limit teardown *limit-threshold*
Restart-Timer	/prefix-limit/config/restart-timer	set protocols bgp family inet unicast accepted-prefix-limit teardown idle-timeout *timeout*

Table 14: AFI-SAFI IPv6-Unicast Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/ipv6-unicast** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/ afi-safi/afi-safi-name/<afi-safi-name>/ ipv6-unicast** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ ipv6-unicast**	
Send-Default-Route	/config/send-default-route	Not supported
Max-Prefixes	/prefix-limit/config/max-prefixes	set protocols bgp family inet6 unicast accepted-prefix-limit maximum *maximum*
Prevent-Teardown	/prefix-limit/config/prevent-teardown	set protocols bgp family *family* prefix-limit teardown
Shutdown-Threshold-PCT	/prefix-limit/config/shutdown-threshold-pct	set protocols bgp family inet6 unicast accepted-prefix-limit teardown *limit-threshold*
Restart-Timer	/prefix-limit/config/restart-timer	set protocols bgp family inet6 unicast accepted-prefix-limit teardown idle-timeout *timeout*

Table 15: AFI-SAFI IPv4-Lbl-Unicast Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/ipv4-labelled-unicast/ prefix-limit** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ ipv4-labelled-unicast/prefix-limit** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ ipv4-labelled-unicast/prefix-limit**	
Max-Prefixes	/config/max-prefixes	set protocols bgp family inet labeled-unicast accepted-prefix-limit maximum *maximum*
Prevent-Teardown	/config/prevent-teardown	set protocols bgp family *family* prefix-limit teardown
Shutdown-Threshold-PCT	/config/shutdown-threshold-pct	set protocols bgp family inet labeled-unicast accepted-prefix-limit teardown *limit-threshold*
Restart-Timer	/config/restart-timer	set protocols bgp family inet labeled-unicast accepted-prefix-limit teardown idle-timeout *timeout*

Table 16: AFI-SAFI IPv6-Lbl-Unicast Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/ipv6-labelled-unicast/ prefix-limit** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ ipv6-labelled-unicast/prefix-limit** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ ipv6-labelled-unicast/prefix-limit**	
Max-Prefixes	/config/max-prefixes	set protocols bgp family inet6 labeled-unicast accepted-prefix-limit maximum *maximum*
Prevent-Teardown	/config/prevent-teardown	set protocols bgp family *family* prefix-limit teardown
Shutdown-Threshold-PCT	/config/shutdown-threshold-pct	set protocols bgp family inet6 labeled-unicast accepted-prefix-limit teardown *limit-threshold*
Restart-Timer	/config/restart-timer	set protocols bgp family inet6 labeled-unicast accepted-prefix-limit teardown idle-timeout *timeout*

Table 17: AFI-SAFI L3VPN-IPv4-Ucast Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/l3vpn-ipv4-unicast/ prefix-limit** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ l3vpn-ipv4-unicast/prefix-limit** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ l3vpn-ipv4-unicast/prefix-limit**	
Max-Prefixes	`/config/max-prefixes`	`set protocols bgp family inet-vpn unicast accepted-prefix-limit maximum` *`maximum`*
Prevent-Teardown	`/config/prevent-teardown`	`set protocols bgp family` *`family`* `prefix-limit teardown`
Shutdown-Threshold-PCT	`/config/shutdown-threshold-pct`	`set protocols bgp family inet-vpn unicast accepted-prefix-limit teardown` *`limit-threshold`*
Restart-Timer	`/config/restart-timer`	`set protocols bgp family inet-vpn unicast accepted-prefix-limit teardown idle-timeout` *`timeout`*

Table 18: AFI-SAFI L3VPN-IPv6-Ucast Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/ l3vpn-ipv6-unicast/prefix-limit** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ l3vpn-ipv6-unicast/prefix-limit** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/neighbor/ afi-safi/afi-safi-name/<afi-safi-name>/ l3vpn-ipv6-unicast/prefix-limit**	
Max-Prefixes	/config/max-prefixes	`set protocols bgp family inet6-vpn unicast accepted-prefix-limit maximum maximum`
Prevent-Teardown	/config/prevent-teardown	`set protocols bgp family family prefix-limit teardown`
Shutdown-Threshold-PCT	/config/shutdown-threshold-pct	`set protocols bgp family inet6-vpn unicast accepted-prefix-limit teardown limit-threshold`
Restart-Timer	/config/restart-timer	`set protocols bgp family inet6-vpn unicast accepted-prefix-limit teardown idle-timeout timeout`

Table 19: AFI-SAFI L3VPN-IPv4-Mcast Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/ l3vpn-ipv4-multicast/prefix-limit** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ l3vpn-ipv4-multicast/prefix-limit** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ l3vpn-ipv4-multicast/prefix-limit**	
Max-Prefixes	/config/max-prefixes	set protocols bgp family inet-vpn multicast accepted-prefix-limit maximum *maximum*
Prevent-Teardown	/config/prevent-teardown	set protocols bgp family *family* prefix-limit teardown
Shutdown-Threshold-PCT	/config/shutdown-threshold-pct	set protocols bgp family inet-vpn multicast accepted-prefix-limit maximum *maximum*
Restart-Timer	/config/restart-timer	set protocols bgp family inet-vpn multicast accepted-prefix-limit teardown idle-timeout *timeout*

Table 20: AFI-SAFI L3VPN-IPv6-Mcast Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/ l3vpn-ipv6-multicast/prefix-limit** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ l3vpn-ipv6-multicast/prefix-limit** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ l3vpn-ipv6-multicast/prefix-limit**	
Max-Prefixes	/config/max-prefixes	`set protocols bgp family inet6-vpn multicast accepted-prefix-limit maximum` *maximum*
Prevent-Teardown	/config/prevent-teardown	`set protocols bgp family` *family* `prefix-limit teardown`
Shutdown-Threshold-PCT	/config/shutdown-threshold-pct	`set protocols bgp family inet6-vpn multicast accepted-prefix-limit teardown` *limit-threshold*
Restart-Timer	/config/restart-timer	`set protocols bgp family inet6-vpn multicast accepted-prefix-limit teardown idle-timeout` *timeout*

Table 21: AFI-SAFI L2VPN-VPLS Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/l2vpn-vpls/ prefix-limit** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ l2vpn-vpls/prefix-limit** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ l2vpn-vpls/prefix-limit**	
Max-Prefixes	`/config/max-prefixes`	`set protocols bgp family l2vpn signaling accepted-prefix-limit maximum `*`maximum`*
Prevent-Teardown	`/config/prevent-teardown`	`set protocols bgp family `*`family`*` prefix-limit teardown`
Shutdown-Threshold-PCT	`/config/shutdown-threshold-pct`	`set protocols bgp family l2vpn signaling accepted-prefix-limit teardown `*`limit-threshold`*
Restart-Timer	`/config/restart-timer`	`set protocols bgp family l2vpn signaling accepted-prefix-limit teardown idle-timeout `*`timeout`*

Table 22: AFI-SAFI L2VPN-EVPN Prefix-Limit Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: • Global—**/network-instances/network-instance/ protocols/protocol/bgp/ global/afi-safi/ afi-safi-name/<afi-safi-name>/l2vpn-evpn/ prefix-limit** • Peer-Group—**/network-instances/ network-instance/ protocols/ protocol/bgp/peer-groups/ peer-group/afi-safi/afi-safi-name/<afi-safi-name>/ l2vpn-evpn/prefix-limit** • Neighbors—**/network-instances/ network-instance/ protocols/ protocol/bgp/neighbors/ neighbor/afi-safi/afi-safi-name/<afi-safi-name>/ l2vpn-evpn/prefix-limit**	
Max-Prefixes	`/config/max-prefixes`	`set protocols bgp family evpn signaling accepted-prefix-limit maximum `*`maximum`*
Prevent-Teardown	`/config/prevent-teardown`	`set protocols bgp family `*`family`*` prefix-limit teardown`
Shutdown-Threshold-PCT	`/config/shutdown-threshold-pct`	`set protocols bgp family evpn signaling accepted-prefix-limit teardown `*`limit-threshold`*
Restart-Timer	`/config/restart-timer`	`set protocols bgp family evpn signaling accepted-prefix-limit teardown idle-timeout `*`timeout`*

Table 23: Peer-Group Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/network-instances/network-instance/ protocols/protocol/bgp/ peer-groups/ peer-group**	
Peer-Group-Name	/config/peer-group-name	set protocols bgp group *group-name*
Peer-AS	/config/peer-as	set protocols bgp group *group-name* peer-as *peer-as*
Peer-Type	/config/peer-type	set protocols bgp group *group-name* type <external | internal>
Auth-Password	/config/auth-password	set protocols bgp group *group-name* authentication-key *authentication-key*
Remove-Private-AS	/config/remote-private-as	set protocols bgp group *group-name* remove-private all set protocols bgp group *group-name* remove-private all replace
Route-Flap-Damping	/config/route-flap-damping	set protocols bgp group *group-name* damping
Send-Community	/config/send-community	Not supported
Description	/config/description	set protocols bgp group *group-name* description *description*
Timers: Connect-Retry	/timers/config/connect-retry	set protocols bgp group *group-name* connect-retry-interval *connect-retry*

Table 23: Peer-Group Configuration *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*
Timers: Hold-Time	`/timers/config/hold-time`	`set protocols bgp group` *group-name* `hold-time` *hold-time*
Timers: Keepalive-Interval	`/timers/config/keepalive-interval`	Not supported
Timers: Minimum-Advertisement-Interval	`/timers/config/minimum-advertisement-interval`	`set protocols bgp group` *group-name* `out-delay` *out-delay*
Timers: Send-Update-Delay	`/timers/config/send-update-delay`	Not supported
Transport: TCP-MSS	`/transport/config/tcp-mss`	`set protocols bgp group` *group-name* `tcp-mss` *tcp-mss*
Transport: MTU-Discovery	`/transport/config/mtu-discovery`	`set protocols bgp group` *group-name* `mtu-discovery`
Transport: Passive-Mode	`/transport/config/passive-mode`	`set protocols bgp group` *group-name* `passive`
Transport: Local-Address	`/transport/config/local-address`	`set protocols bgp group` *group-name* `local-address` *local-address*
Error-Handling: Treat-AS-Withdraw	`/error-handling/config/treat-as-withdraw`	`set protocols bgp group` *group-name* `bgp-error-tolerance`
Logging-Options: Log-Neighbor-State-Changes	`/logging-options/config/ log-neighbor-state-changes`	`set protocols bgp group` *group-name* `log-updown`
EBGP-Multihop: MultiHop-TTL	`/ebgp-multihop/config/multihop-ttl`	`set protocols bgp group` *group-name* `multihop ttl` *ttl*

Table 23: Peer-Group Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Route-Reflector: Route-Reflector-Cluster-ID	`/route-reflector/config/route-reflector-cluster-id`	`set protocols bgp group` *group-name* `cluster` *cluster*
Route-Reflector: Route-Reflector-Client	`/route-reflector/config/route-reflector-client`	`set protocols bgp group` *group-name* `no-client-reflect`
AS-Path-Options: Allow-Own-AS	`/as-path-options/config/allow-own-as`	`set protocols bgp group` *group-name* `local-as loops` *loops*
AS-Path-Options: Replace-Peer-AS	`/as-path-options/config/replace-peer-as`	`set protocols bgp group` *group-name* `as-override`
AS-Path-Options: Disable-Peer-As-Filter	`/as-path-options/config/disable-peer-as-filter`	`set protocols bgp group` *group-name* `advertise-peer-as`
AFI-SAFI	`/afi-safis/afi-safi/`	Supported. See Table 12 on page 136 to Table 22 on page 149
Graceful-Restart	`/graceful-restart/config/`	Supported. See Table 11 on page 134.
Apply-Policy	`/apply-policy/`	Supported. See Table 24 on page 152.

Table 24: Peer-Group Apply-Policy Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/network-instances/network-instance/ protocols/protocol/bgp/ peer-groups/ peer-group/apply-policy**	

Table 24: Peer-Group Apply-Policy Configuration *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*
Import-Policies	`/import-policies`	`set protocols bgp import` *`value`*
Default-Import-Policy	`/default-import-policy`	
Export-Policies	`/export-policies`	`set protocols bgp export` *`value`*
Default-Export-Policy	`/default-export-policy`	

Table 25: Neighbors Configuration

Command Name	*OpenConfig Command Path*	*Junos Configuration*
	Command path prefix: **/network-instances/network-instance/ protocols/protocol/bgp/ neighbors/ neighbor**	
Neighbor-Address	`/config/neighbor-address`	`set protocols bgp group` *`group-name`* `neighbor` *`address`*
Peer-AS	`/config/peer-as`	`set protocols bgp group` *`group-name`* `neighbor` *`address`* `peer-as` *`peer-as`*
Peer-Type	`/config/peer-type`	`set protocols bgp group` *`group-name`* `type` *`<external/internal>`*
Auth-Password	`/config/auth-password`	`set protocols bgp group` *`group-name`* `neighbor` *`address`* `authentication-key` *`authentication-key`*

Table 25: Neighbors Configuration *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*

Remove-Private-AS	`/config/remote-private-as`	`set protocols bgp group` *group-name* `neighbor` *address* `remove-private all`
		
		`set protocols bgp group` *group-name* `neighbor` *address* `remove-private all replace`

Route-Flap-Damping	`/config/route-flap-damping`	`set protocols bgp group` *group-name* `neighbor` *address* `damping`
Send-Community	`/config/send-community`	Not supported
Description	`/config/description`	`set protocols bgp group` *group-name* `neighbor` *address* `description`
Peer-Group	`/config/peer-group`	`set protocols bgp group` *group-name* `neighbor` *address*
Timers – Connect-Retry	`/timers/config/connect-retry`	`set protocols bgp group` *group-name* `neighbor` *address* `connect-retry-interval`
Timers – Hold-Time	`/timers/config/hold-time`	`set protocols bgp group` *group-name* `neighbor` *address* `hold-time` *hold-time*
Timers - Keepalive-Interval	`/timers/config/keepalive-interval`	Not supported
Timers – Minimum-Advertisement-Interval	`/timers/config/minimum-advertisement-interval`	`set protocols bgp group` *group-name* `neighbor` *address* `out-delay` *out-delay*
Timers - Send-Update-Delay	`/timers/config/send-update-delay`	Not supported

Table 25: Neighbors Configuration *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*
Transport – TCP-MSS	`/transport/config/tcp-mss`	set protocols bgp group *group-name* neighbor *address* tcp-mss *tcp-mss*
Transport – MTU-Discovery	`/transport/config/mtu-discovery`	set protocols bgp group *group-name* neighbor *address* mtu-discovery
Transport – Passive-Mode	`/transport/config/passive-mode`	set protocols bgp group *group-name* neighbor *address* passive
Transport – Local-Address	`/transport/config/local-address`	set protocols bgp group *group-name* neighbor *address* local-address *local-address*
Error-Handling – Treat-AS-Withdraw	`/error-handling/config/treat-as-withdraw`	set protocols bgp group *group-name* neighbor *address* bgp-error-tolerance
Logging-Options – Log-Neighbor-State-Changes	`/logging-options/config /log-neighbor-state-changes`	set protocols bgp group *group-name* neighbor *address* log-updown
EBGP-Multihop – Multihop-TTL	`/ebgp-multihop/config/multihop-ttl`	set protocols bgp group *group-name* neighbor *address* multihop ttl *ttl*
Route-Reflector – Route-Reflector-Cluster-ID	`/route-reflector/config/route-reflector-cluster-id`	set protocols bgp group *group-name* neighbor *address* cluster *cluster*
Route-Reflector – Route-Reflector-Client	`/route-reflector/config/route-reflector-client`	set protocols bgp group *group-name* neighbor *address* no-client-reflect
AS-Path-Options – Allow-Own-AS	`/as-path-options/config/allow-own-as`	set protocols bgp group *group-name* neighbor *address* local-as loops *loops*

Table 25: Neighbors Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
AS-Path-Options – Replace-Peer-AS	`/as-path-options/config/replace-peer-as`	`set protocols bgp group` *group-name* `neighbor` *address* `as-override`
AS-Path-Options – Disable-Peer-As-Filter	`/as-path-options/config/disable-peer-as-filter`	`set protocol bgp group` *group-name* `neighbor` *address* `advertise-peer-as`
AFI-SAFI	`/afi-safis/afi-safi/`	Supported. See Table 12 on page 136 to Table 22 on page 149
Graceful-Restart	`/graceful-restart/config/`	Supported. See Table 11 on page 134.
Apply-Policy	`/apply-policy/`	Supported. See Table 26 on page 156.

Table 26: Neighbors Apply-Policy Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/network-instances/network-instance/protocols/ protocol/bgp/neighbors/neighbor/apply-policy**	
Import-Policies	`/import-policies`	`set protocols bgp import` *value*
Default-Import-Policy	`/default-import-policy`	
Export-Policies	`/export-policies`	`set protocols bgp export` *value*
Default-Export-Policy	`/default-export-policy`	

RELATED DOCUMENTATION

Mapping OpenConfig Interface Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks MX Series, PTX Series, and QFX Series.

The following tables show the mapping of OpenConfig interface commands to the relevant configuration in Junos:

- Table 27 on page 158: VRRP Configuration

- Table 28 on page 160: IPv4 and IPV6 Address Configuration

- Table 29 on page 161: Interface AE Configuration

- Table 30 on page 162: LACP Configuration

- Table 31 on page 162: Member Interface Configuration

- Table 32 on page 163: Ethernet Configuration

- Table 33 on page 163: IFD Configuration

- Table 34 on page 164: IFL Configuration

Table 27: VRRP Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Virtual Router ID	ifa/vrrp/vrrp-group/config/virtual-router-id	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id*
Virtual Address	ifa/vrrp/vrrp-group/config/virtual-address	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* virtual-address *address* set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* virtual-inet6-address
VRRP Priority	ifa/vrrp/vrrp-group/config/priority	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* priority set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* priority
VRRP Preempt	ifa/vrrp/vrrp-group/config/preempt	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* preempt set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* preempt
VRRP Preempt Hold Time	ifa/vrrp/vrrp-group/config/preempt-delay	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* preempt hold-time *time* set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* preempt hold-time *time*

Table 27: VRRP Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Accept Data	ifa/vrrp/vrrp-group/config/ accept_mode	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* accept-data set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* accept-data
Advertise Interval	ifa/vrrp/vrrp-group/config/ advertisement_interval	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* advertise-interval set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* inet6-advertise-interval
Track Interface	ifa/vrrp/vrrp-group/interface-tracking/config/track-interface	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* track interface *interface-name* set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* track interface *interface-name*
Priority Cost	ifa/vrrp/vrrp-group/interface-tracking/config/priority-decrement	set interfaces *interface-name* unit *unit-number* family inet address *address* vrrp-group *virtual-router-id* track interface *interface-name* priority-cost *cost* set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* track interface *interface-name* priority-cost *cost*
Virtual Link Local Address	ifa/vrrp/vrrp-group/config/ virtual-link-local	set interfaces *interface-name* unit *unit-number* family inet6 address *address* vrrp-inet6-group *virtual-router-id* virtual-link-local-address

Table 28: IPv4 and IPv6 Address Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Configuration Address	ipv4/addresses/address/ip ipv4/addresses/address/prefix-length	set interfaces *interface-name* unit *unit-number* family inet address *address* set interfaces *interface-name* unit *unit-number* family inet6 address *address*
Neighbor Address	ipv4/neighbors/neighbor/ip ipv6/neighbors/neighbor/ip	set interfaces *interface-name* unit *unit-number* family inet address *address* arp *address* set interfaces *interface-name* unit *unit-number* family inet6 address *address* ndp *address*
Link Layer Address	ip4/neighbors/neighbor/ip/link-layer-address ip6/neighbors/neighbor/ip/link-layer-address	set interfaces *interface-name* unit *unit-number* family inet address *address* arp *address* mac *address* set interfaces *interface-name* unit *unit-number* family inet6 address *address* ndp *address* mac *address*
Neighbor solicitation messages to send for duplicate address detection dup-addr-detect-transmits 0	```openconfig-interfaces:interfaces {
interface <interface_name> {
subinterfaces {
subinterface <unit> {
openconfig-if-ip:ipv6 {
config {
dup-addr-detect-transmits 0;
}
}
}
}
}
}```	```interfaces {
<interface_name> {
unit <unit> {
family inet6 {
dad-disable;
}
}
}
}```

Table 28: IPv4 and IPv6 Address Configuration *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*
Neighbor solicitation messages to send for duplicate address detection dup-addr-detect-transmits <non_zero_value>	```openconfig-interfaces:interfaces { interface <interface_name>{ subinterfaces { subinterface <unit> { openconfig-if- ip:ipv6 { config { dup-addr- detect-transmits <non_zero_value>; } } } } } }```	```system { internet-options { ipv6-duplicate-addr-detection- transmits <non_zero_value>; } } interfaces { <interface_name> { unit <unit> { family inet6 { no-dad-disable; } } } }``` **NOTE**: Junos OS has no equivalent configuration under the `interfaces` hierarchy to map the number of neighbor solicitation messages to send for duplicate address detection. Consequently, this is mapped to the parameter `ipv6-duplicate-addr-detection-transmits` at the `system` hierarchy. When there are multiple instances of OpenConfig `dup-addr-detect-transmits` at the `interfaces` stanza, the Junos OS parameter takes the maximum value configured among them.

Table 29: Interface AE Configuration

Command Name	*OpenConfig Command Path*	*Junos Configuration*

LAG Type	`/aggregation/config/lag-type/lacp`
	
	`/aggregation/config/lag-type/static`
		`set interfaces` *ae-name* `aggregated-ether-options lacp`

Minimum Links	`/aggregation/config/min-links`	`set interfaces` *ae-name* `aggregated-ether-options minimum-links`

Table 30: LACP Configuration

Command Name	OpenConfig Command Path	Junos Configuration

LACP Interval	`/lacp/interfaces/interface/`
	`config/interval`
		`set interfaces` *ae-name* `aggregated-ether-options lacp`
		`periodic fast`
		
		`set interfaces` *ae-name* `aggregated-ether-options lacp`
		`periodic slow`

LACP Mode	`/lacp/interfaces/interface/`
	`config/lacp-mode`
		`set interfaces` *ae-name* `aggregated-ether-options lacp`
		`active`
		
		`set interfaces` *ae-name* `aggregated-ether-options lacp`
		`passive`

System ID	`/lacp/interfaces/interface/` `config/system-id-mac`	`set interfaces` *ae-name* `aggregated-ether-options lacp` `system-id` *address*
System Priority	`/lacp/interfaces/interface/` `config/system-priority`	`set interfaces` *ae-name* `aggregated-ether-options lacp` `system-priority` *system-priority*

Ethernet Options	`/lacp/interfaces/interface/`
	`members/member`
		`set interface` *interface* `gigether-options 802.3ad`
		
		`set interface` *interface* `fastether-options 802.3ad`
		
		`set interface` *interface* `ether-options 802.3ad`

Table 31: Member Interface Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Aggregate ID	`/interface/aggregate-id`	`set interface` *interface* `gigether-options 802.3ad` *aggregate-id* `set interface` *interface* `fastether-options 802.3ad` *aggregate-id* `set interface` *interface* `ether-options 802.3ad` *aggregate-id*

Table 32: Ethernet Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Auto-negotiate	/ethernet/config/auto-negotiate	`set interfaces` *interface* `gigether-options` *auto-negotiation/no-auto-negotiation*
MAC Address	/ethernet/config/mac-address	`set interfaces` *interface* `mac`
Duplex Mode	/ethernet/config/duplex-mode	`set interfaces` *interface* `link-mode`
Port Speed	/ethernet/config/port-speed	`set interface` *interface* `speed`
Flow Control	/ethernet/config/enable-flow-control	`set interface` *interface* `gigether-options flow-control`

Table 33: IFD Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Interface Type	/interfaces/*interface*/config/type	Not supported. Type is derived from the interface name.
Interface MTU	/interfaces/*interface*/config/mtu	`set interface` *interface* `mtu`
Interface Name	/interfaces/*interface*/config/name	`set interface` *interface*
Interface Description	/interfaces/*interface*/config/description	`set interface` *interface* `description`

Interface Enabled/Disabled	/interfaces/*interface*/config/enabled	`set interface` *interface* `disabled`
		
		`set interface` *interface* `enabled`

Hold Time Up	/interfaces/*interface*/config/hold-time/config/up	`set interface` *interface* `hold-time up`

Table 33: IFD Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Hold Time Down	`/interfaces/`*`interface`*`/config/hold-time/` `config/down`	`set interface `*`interface`*` hold-time down`

VLAN tag protocol identifier (TPID)	`openconfig-interfaces:interfaces {`
	`    interfaces <interface_name> {`
	`        config {`
	`            openconfig-vlan:tpid <tpid>;`
	`        }`
	`    }`
	`}`
		`interfaces {`
		`    <interface_name> {`
		`        gigether-options {`
		`            ethernet-switch-profile {`
		`                tag-protocol-id <tpid>;`
		`            }`
		`        }`
		`    }`
		`}`

Table 34: IFL Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Unit Name	`/interfaces/`*`interface`*`/subinterfaces/` `subinterface/config/index`	`set interfaces `*`interface`*` unit `*`unit`*

Unnumbered Address	`/interfaces/`*`interface`*`/config/`
	`subinterfaces/subinterface/config/`
	`unnumbered`
		`set interfaces `*`interface`*` unit `*`unit`*` family`
		`family`` unnumbered-address source `*`ifl`*

Unit Description	`/interfaces/`*`interface`*`/subinterfaces/` `subinterface/config/description`	`set interfaces `*`interface`*` unit `*`unit`* `description`

Unit Enabled/Disabled	`/interfaces/`*`interface`*`/subinterfaces/`
	`subinterface/config/enabled`
		`set interfaces `*`interface`*` unit `*`unit`*` enabled`
		
		`set interfaces `*`interface`*` unit `*`unit`*` disabled`

Interface Alias	`/interfaces/`*`interface`*`/subinterfaces/` `subinterface/config/name`	`set interfaces `*`interface`*` alias`

Mapping OpenConfig LACP Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks ACX Series, MX Series, PTX Series, and QFX Series.

Table 35 on page 165 shows the mapping of OpenConfig LACP configurations with the relevant configuration in Junos.

Table 35: LACP Configuration

Command Name	OpenConfig Configuration	Junos Configuration
System priority	`/lacp/config/system-priority`	`set chassis aggregated-devices ethernet lacp system-priority` *system-priority*
Interval	`/lacp/interfaces/interface/config/interval`	`set interfaces` *ae_name* `aggregated-ether-options lacp periodic [fast|slow]`
LACP mode	`/lacp/interfaces/interface/config/lacp-mode/`	`set interfaces` *ae_name* `aggregated-ether-options lacp [active|passive]`
Name	`/lacp/interfaces/interface/config/name/`	`set interfaces` *ae_name*

Table 35: LACP Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
System ID MAC	`/lacp/interfaces/interface/config/` `system-id-mac/`	`set interfaces ae_name aggregated-ether-options` `lacp system-id system-id-mac`
System Priority	`/lacp/interfaces/interface/config/` `system-priority/`	`set interfaces ae_name aggregated-ether-options` `lacp system-priority system-priority`

RELATED DOCUMENTATION

Mapping OpenConfig LLDP Commands to Junos Configuration

NOTE: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks MX Series and PTX Series.

Table 36 on page 167 and Table 37 on page 167 show the mapping of OpenConfig LLDP commands with the relevant configuration in Junos.

Table 36: Global LLDP Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Enable	/lldp/config/enabled **NOTE:**	set protocols lldp *enable/disable*
Hello time	/lldp/config/hello-timer	set protocols lldp tlv-filter
TLV advertisement	/lldp/config/suppress-tlv-advertisement **NOTE:**	set protocols lldp advertisement-interval *advertisement-interval*
System Information	/lldp/config/system-name /lldp/config/system-description /lldp/config/chassis-id /lldp/config/chassis-id-type	Not supported

Table 37: Interface Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Interface	/lldp/interfaces/interface/ **NOTE:**	set protocols lldp interface *interface-name*
Interface Config	/lldp/interfaces/interface/config/name /lldp/interfaces/interface/config/enabled **NOTE:**	set protocols lldp interface *interface-name* enable

RELATED DOCUMENTATION

Mapping OpenConfig Local Routing Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks ACX Series, EX Series, MX Series, PTX Series, and QFX Series.

Table 38 on page 168 and Table 39 on page 169 show the mapping of OpenConfig local routing commands to the relevant configuration in Junos.

Table 38: Static Route Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/local-routes/static-routes**	
NOTE: Supported in Junos OS Release 21.2R1 for PTX Series and MX Series. Supported in Junos Evolved OS Release 21.3R1 for PTX10003 and PTX10008 routers. Supported in Junos Evolved OS Release 21.4R1 for PTX10016 routers. Local Static Routes	**/static/next-hops/next-hop/config/metric**	`set routing-options static route` `prefix qualified-next-hop nexthop metric value`
Local Static Prefix	`/static/config/prefix`	`set routing-options static route` `prefix`

Table 38: Static Route Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration

Local Static Next Hop	`/static/config/prefix`
	
	 `/static/config/next-hop/`*`ip-address`*
	
	 `/static/config/next-hop/`*`local-defined-next-hop`*
	
	 `/static/config/next-hop/`*`string`*
		`set routing-options static route` *`prefix`* `next-hop (`*`address`* `|` *`interface`*`)`
		
		 `set routing-options static route` *`prefix`* `discard`

Local Static Tag	`/static/config/prefix`
	
	 `/static/config/set-tag`
		`set routing-options static route` *`prefix`* `tag` *`tag`*

Table 39: Local Aggregate Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/local-routes/local-aggregates**	
Local Aggregate Prefix	`/aggregate/config/prefix`	`set routing-options aggregate route` *`prefix`*

Local Aggregate Discard	`/aggregate/config/prefix`
	
	 `/aggregate/config/discard`
		`set routing-options aggregate route` *`prefix`* `discard`

Local Aggregate Tag	`/aggregate/config/prefix`
	
	 `/aggregate/config/set-tag`
		`set routing-options aggregate route` *`prefix`* `tag` *`tag`*

RELATED DOCUMENTATION

Mapping OpenConfig BGP Commands to Junos Configuration **| 134**

Mapping OpenConfig Interface Commands to Junos Configuration **| 157**

Mapping OpenConfig MPLS Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks MX Series, PTX Series, and QFX Series.

Table 40 on page 170 to Table 45 on page 181 show the mapping of OpenConfig MPLS commands with the relevant configuration in Junos.

Table 40: Global MPLS Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Explicit Null	/mpls/global/config/null-label/explicit /mpls/global/config/null-label/implicit	set protocols mpls explicit-null
Interface	/mpls/global/interface-attributes/interface/config/interface-id /mpls/global/interface-attributes/interface/config/mpls-enabled /mpls/global/interface-attributes/interface/interface-ref/config/interface /mpls/global/interface-attributes/interface/interface-ref/config/subinterface	set protocols mpls interface *interface* set protocols mpls interface *interface* disable

Table 41: TE Global Attributes

Command Name	OpenConfig Command Path	Junos Configuration
SRLGs	`/mpls/te-global-attributes/srlg/srlg/config/name`	Flooded: `set routing-options srlg `*`name`* Static: `set routing-options fate-sharing group `*`name`*
SRLG Value	`/mpls/te-global-attributes/srlg/srlg/config/value`	`set routing-options fate-sharing group `*`name`*` srlg-value `*`value`*
SRLG Cost	`/mpls/te-global-attributes/srlg/srlg/config/cost`	Flooded: `set routing-options srlg `*`name`*` srlg-cost `*`cost`* Static: `set routing-options fate-sharing group `*`name`*` cost `*`cost`*
Address	`/mpls/te-global-attributes/srlg/srlg/static-srlg-members/ members-list/config/from-address` `/mpls/te-global-attributes/srlg/srlg/static-srlg-members/ members-list/config/to-address`	`set routing-options fate-sharing group `*`name`*` from `*`address`*` to `*`address`*
Admin Groups	`/mpls/te-global-attributes/mpls-admin-groups/ admin-group/ config/admin-group-name` `/mpls/te-global-attributes/mpls-admin-groups/ admin-group/ config/bit-position`	Bit position (group-value) 0-31: `set protocols mpls admin-groups `*`group-name group-value`* Bit position (group-value) 32-4294967295: `set routing-options admin-groups-extended `*`group-name`*` group-value `*`group-value`*

Table 41: TE Global Attributes *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Delay	/mpls/te-global-attributes/te-lsp-timers/config/install-delay	set protocols mpls optimize-switchover-delay *delay*
	/mpls/te-global-attributes/te-lsp-timers/config/cleanup-delay	set protocols mpls optimize-hold-dead-delay *delay*
	/mpls/te-global-attributes/te-lsp-timers/config/reoptimize-timer	set protocols mpls optimize-timer *timer*

Table 42: TE Interface Attributes

Command Name	OpenConfig Command Path	Junos Configuration
TE Interface	/mpls/te-interface-attributes/interface/config/interface-id /mpls/te-interface-attributes/interface/interface-ref/config/interface /mpls/te-interface-attributes/interface/interface-ref/config/subinterface	set protocols ospf area *id* interface *interface*
TE Metric	/mpls/te-interface-attributes/interface/config/te-metric	set protocols ospf area *id* interface *interface* te-metric *te-metric* set protocols isis interface *interface* level *level* te-metric *te-metric*
SRLG Membership	/mpls/te-interface-attributes/interface/config/srlg-membership	set protocols mpls interface *name* srlg *name*

Table 42: TE Interface Attributes *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Admin Groups	`/mpls/te-interface-attributes/interface/config/admin-group`	If `protocols mpls admin-groups` *name* is configured: `set protocols mpls interface` *name* `admin-group` *name* If `routing-options admin-groups-extended` *name* is configured: `set protocols mpls interface` *name* `admin-group-extended` *name*

IGP Flooding Bandwidth	`/mpls/te-interface-attributes/interface/igp-flooding-bandwidth/config/threshold-type`
	
	`/mpls/te-interface-attributes/interface/igp-flooding-bandwidth/config/delta-percentage`
		`set protocols rsvp interface` *name* `update-threshold` *threshold*

	`/mpls/te-interface-attributes/interface/igp-flooding-bandwidth/config/threshold-specification`
	
	`/mpls/te-interface-attributes/interface/igp-flooding-bandwidth/config/up-thresholds`
	
	`/mpls/te-interface-attributes/interface/igp-flooding-bandwidth/config/down-thresholds`
	
	`/mpls/te-interface-attributes/interface/igp-flooding-bandwidth/config/up-down-thresholds`
		Not supported

Table 43: RSVP Signaling Protocols

Command Name	OpenConfig Command Path	Junos Configuration
Graceful Restart	/mpls/signaling-protocols/rsvp-te/global/ graceful-restart/config/enable /mpls/signaling-protocols/rsvp-te/global/ graceful-restart/config/restart-time /mpls/signaling-protocols/rsvp-te/global/ graceful-restart/config/recovery-time	set protocols rsvp graceful-restart enable set protocols rsvp graceful-restart maximum-helper-recovery-time *time* set protocols rsvp graceful-restart maximum-helper-restart-time *time*
Cleanup Timer	/mpls/signaling-protocols/rsvp-te/global/ soft-preemption/config/enable /mpls/signaling-protocols/rsvp-te/global/ soft-preemption/config/soft-preemption-timeout	set protocols rsvp preemption soft-preemption cleanup-timer *timer*
Hello Interval (All Interfaces)	/mpls/signaling-protocols/rsvp-te/global/ hellos/config/hello-interval /mpls/signaling-protocols/rsvp-te/global/ hellos/config/refresh-reduction	set protocols rsvp interface all hello-interval *interval* set protocols rsvp interface all no-reliable

Table 43: RSVP Signaling Protocols *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*
Hello Interval (Single Interface)	/mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/config/interface-id /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/interface-ref/config/ interface /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/config/interface-name /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/hellos/config/hello-interval /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/hellos/config/refresh-reduction	set protocols rsvp interface *name* hello-interval *interval* set protocols rsvp interface *name* no-reliable
Authentication Key	/mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/config/interface-id /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/interface-ref/config/ interface /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/interface-ref/config/ subinterface /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/authentication/config/ enable /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/authentication/config/ authentication-key	set protocols rsvp interface *name* authentication-key *key*

Table 43: RSVP Signaling Protocols *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Subscription	/mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/config/interface-id /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/interface-ref/config/ interface /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/interface-ref/config/ subinterface /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/subscription/config/ subscription	set protocols rsvp interface *name* subscription *subscription*

Table 43: RSVP Signaling Protocols *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*
Link Protection	/mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/config/interface-id /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/interface-ref/config/ interface /mpls/signaling-protocols/rsvp-te/interface-attributes/ interface/interface-ref/config/ subinterface /mpls/signaling-protocols/rsvp-te/interface-attributes/interface/ protection/config/link-protection-style-requested/unprotected /mpls/signaling-protocols/rsvp-te/interface-attributes/interface/protection/ config/link-protection-style-requested/link-protection-requested /mpls/signaling-protocols/rsvp-te/interface-attributes/interface/protection/ config/link-protection-style-requested/link-node-protection-requested /mpls/signaling-protocols/rsvp-te/interface-attributes/interface/protection/ config/bypass-optimize-interval	set protocols rsvp interface *name* link-protection To disable node-protection: set protocols rsvp interface *name* link-protection no-node-protection set protocols rsvp interface *name* link-protection optimize-timer *timer*

Table 44: Label Switched Paths

Command Name	OpenConfig Command Path	Junos Configuration
Path	/mpls/lsps/constrained-path/named-explicit-paths/ config/name /mpls/lsps/constrained-path/named-explicit-paths/ explicit-route-objects/ config/address /mpls/lsps/constrained-path/named-explicit-paths/ explicit-route-objects/ config/hop-type /mpls/lsps/constrained-path/named-explicit-paths/ explicit-route-objects/ config/index	set protocols mpls path *name* *address hop-type*
Name	/mpls/lsps/constrained-path/tunnel/config/name /mpls/lsps/constrained-path/tunnel/config/type/P2P /mpls/lsps/constrained-path/tunnel/config/ signaling-protocol/path-setup-rsvp	set protocols mpls label-switched-path *name*
Description	/mpls/lsps/constrained-path/tunnel/config/description	set protocols mpls label-switched-path *name* description *description*
Admin-Status	/mpls/lsps/constrained-path/tunnel/config/admin-status	set protocols mpls label-switched-path *name* disable
Preference	/mpls/lsps/constrained-path/tunnel/config/preference	set protocols mpls label-switched-path *name* preference *preference*
Metric	/mpls/lsps/constrained-path/tunnels/tunnel/config/ metric-type /mpls/lsps/constrained-path/tunnels/tunnel/config/ shortcut-eligible /mpls/lsps/constrained-path/tunnel/config/metric	set protocols mpls label-switched-path *name* metric *metric*

Table 44: Label Switched Paths *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Link Protection	/mpls/lsps/constrained-path/tunnel/config/ protection-style-requested/unprotected /mpls/lsps/constrained-path/tunnel/config/ protection-style-requested/link-protection-requested /mpls/lsps/constrained-path/tunnel/config/ protection-style-requested/link-node-protection-requested	set protocols mpls label-switched-path *name* link-protection set protocols mpls label-switched-path *name* node-link-protection
Optimize Timer	/mpls/lsps/constrained-path/tunnel/config/reoptimize-timer	set protocols mpls label-switched-path *name* optimize-timer *timer*
Source	/mpls/lsps/constrained-path/tunnel/config/source	set protocols mpls label-switched-path *name* from *from*
Soft Preemption	/mpls/lsps/constrained-path/tunnel/config/soft-preemption	set protocols mpls label-switched-path *name* soft-preemption
Priority	/mpls/lsps/constrained-path/tunnel/config/setup-priority /mpls/lsps/constrained-path/tunnel/config/hold-priority	set protocols mpls label-switched-path *name* priority *setup reservation*
Bandwidth	/mpls/lsps/constrained-path/tunnel/bandwidth/config/ specification-type/specified /mpls/lsps/constrained-path/tunnel/bandwidth/config/ set-bandwidth	set protocols mpls label-switched-path *name* bandwidth *bandwidth*

Table 44: Label Switched Paths *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*
Min/Max Bandwidth	/mpls/lsps/constrained-path/tunnel/bandwidth/config/ specification-type/auto /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ config/enabled /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ config/min-bw /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ config/max-bw /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ config/adjust-interval /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ config/adjust-threshold	set protocols mpls label-switched-path *name* minimum-bandwidth *minimum* set protocols mpls label-switched-path *name* maximum-bandwidth *maximum* set protocols mpls label-switched-path *name* adjust-interval *interval* set protocols mpls label-switched-path *name* adjust-threshold *threshold*
Overflow Bandwidth	/mpls/lsps/constrained-path/tunnel/bandwidth/ config/ specification-type/auto /mpls/lsps/constrained-path/tunnel/auto-bandwidth/ overflow/ config/enabled /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ overflow/config/overflow-threshold /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ overflow/config/trigger-event-count	set protocols mpls label-switched-path *name* auto-bandwidth adjust-threshold-overflow-limit

Table 44: Label Switched Paths *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Underflow Bandwidth	/mpls/lsps/constrained-path/tunnel/bandwidth/config/ specification-type/auto /mpls/lsps/constrained-path/tunnel/auto-bandwidth/ underflow/ config/enabled /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ underflow/config/underflow-threshold /mpls/lsps/constrained-path/tunnel/bandwidth/auto-bandwidth/ underflowflow/config/trigger-event-count	set protocols mpls label-switched-path *name* auto-bandwidth adjust-threshold-underflow-limit

Table 45: RSVP P2P Tunnel

Command Name	OpenConfig Command Path	Junos Configuration
Destination	/mpls/lsps/constrained-path/tunnel/ p2p-tunnel-attributes/config/destination	set protocols mpls label-switched-path *name* to *to*
Primary Path	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/ name	set protocols mpls label-switched-path *name*

Table 45: RSVP P2P Tunnel *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Primary Path - Locally-Computed	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/ path-computation-method/ locally-computed /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/ use-cspf /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/ cspf-tiebreaker/random /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/ cspf-tiebreaker/least-fill /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/ cspf-tiebreaker/most-fill	set protocols mpls label-switched-path *name* no-cspf set protocols mpls label-switched-path *name* random set protocols mpls label-switched-path *name* least-fill set protocols mpls label-switched-path *name* most-fill
Primary Path - Externally Queried	/mpls/lsps/constrained-path/tunnel/ p2p-tunnel-attributes/p2p-primary-paths/config/ path-computation-method/externally-queried	set protocols mpls label-switched-path *name* lsp-external-controller pccd set protocols pcep pce *name* destination-ipv4-address *address* set protocols pcep pce *name* destination-port 4189
Primary Path - Explicitly Defined	/mpls/lsps/constrained-path/tunnel/ p2p-tunnel-attributes/p2p-primary-paths/config/ path-computation-method/explicitly-defined /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/ explicit-path-name	set protocols mpls label-switched-path *name* primary *path*

Table 45: RSVP P2P Tunnel *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*
Primary Path - Preference	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/preference	set protocols mpls label-switched-path *name* primary *path* preference *preference*
Primary Path - Priorities	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/setup-priority /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/hold-priority	set protocols mpls label-switched-path *name* primary *path* priority *setup reservation*
Primary Path - Retry Timer	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/config/retry-timer	set protocols mpls label-switched-path *name* retry-timer
Primary Path - Candidate Secondary Paths	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/candidate-secondary-paths	Not supported
Primary Path – Admin-Groups	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/admin-groups/config/exclude-group /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/admin-groups/config/include-all-group /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-primary-paths/admin-groups/config/include-any-group	set protocols mpls label-switched-path *name* primary *path* admin-group exclude *group* set protocols mpls label-switched-path *name* primary *path* admin-group exclude *group* set protocols mpls label-switched-path *name* primary *path* admin-group include-any *group*

Table 45: RSVP P2P Tunnel *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Secondary Path	/mpls/lsps/constrained-path/tunnel/config/ name /mpls/lsps/constrained-path/tunnel/config/ type/P2P /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/name	set protocols mpls label-switched-path *name*
Secondary Path - Locally-Computed	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/ path-computation-method/locally-computed /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/use-cspf /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/cspf-tiebreaker/random /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/cspf-tiebreaker/least-fill /mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/cspf-tiebreaker/most-fill	set protocols mpls label-switched-path *name* secondary *path name* no-cspf
Secondary Path - Externally Queried	/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/ path-computation-method/externally-queried	Not supported

Table 45: RSVP P2P Tunnel *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration

Secondary Path - Explicitly Defined	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/ path-computation-method/explicitly-defined`
	
	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/explicit-path-name`
		`set protocols mpls label-switched-path` *name* `secondary` *path*

Secondary Path - Preference	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/preference`	`set protocols mpls label-switched-path` *name* `secondary` *path* `preference` *preference*

Secondary Path - Priorities	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/setup-priority`
	
	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/hold-priority`
		`set protocols mpls label-switched-path` *name* `secondary` *path* `priority` *setup reservation*

Secondary Path - Retry Timer	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/ config/retry-timer`	`set protocols mpls label-switched-path` *name* `secondary` *path* `retry-timer`

Table 45: RSVP P2P Tunnel *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration

Secondary Path - Admin-Groups	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/admin-groups/config/exclude-group`
	
	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/admin-groups/config/include-all-group`
	
	`/mpls/lsps/constrained-path/tunnel/p2p-tunnel-attributes/ p2p-secondary-paths/admin-groups/config/include-any-group`
		`set protocols mpls label-switched-path` *name* `secondary` *path* `admin-group exclude` *group*
		
		`set protocols mpls label-switched-path` *name* `secondary` *path* `admin-group include-all` *group*
		
		`set protocols mpls label-switched-path` *name* `secondary` *path* `admin-group include-any` *group*

RELATED DOCUMENTATION

Mapping OpenConfig Network Instance Commands to Junos Operation

NOTE: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks ACX Series, EX Series, MX Series, PTX Series, and QFX Series.

Network instance models a generic virtual forwarding table on a device. This supports a Layer 3 forwarding construct such as a virtual routing and forwarding (VRF) instance, or a Layer 2 instance such as a virtual switch instance. A mixed Layer 2 and Layer 3 instances are also supported.

Starting with Junos OS Release 17.4R1, network instance based BGP configuration is supported. After the network instance is configured, you will be prompted with options for BGP configuration such as global bgp, neighbor bgp, and so on.

> **NOTE**: There is no change in the existing BGP configuration, you can configure BGP in a specific network instance.

details the network instance commands.

Table 46: Network Instance

Resource Path	Description
`/network-instances/network-instance/config/name`	An assigned unique name for the forwarding instance. In Junos, you need to provide a name because you do not run different BGP in the same routing instance.
`/network-instances/network-instance/config/name/` `description`	Description of the network instance.
`/network-instances/network-instance/config/type`	Type of network instance: • default_instance • l3vrf • l2vsi • l2p2p • l2l3 **NOTE**: Only default_instance and l3vrf instances are supported.

Table 46: Network Instance *(Continued)*

Resource Path	Description
`/network-instances/network-instance/config/enabled`	Whether the network instance should be configured to be active on the network element: *True* or *False*. By default, the value is *True*.
`/network-instances/network-instance/config/router-id`	An identifier for the local network instance.
`/network-instances/network-instance/config/route-distinguisher`	The route distinguisher that should be used for the local VRF instance when it is signalled through BGP.
NOTE: Supported in Junos OS Release 21.2R1 for PTX Series and MX Series. Supported in Junos Evolved OS Release 21.3R1 for PTX10003, PTX10008, and PTX10016 routers. `/network-instances/network-instance/interfaces/config/interface`	Name of interfaces belonging to this routing instance. The Junos CLI mapping is: `set routing-instance` *name* `interface` *name*
NOTE: Supported in Junos OS Release 21.2R1 for PTX Series and MX Series. Supported in Junos Evolved OS Release 21.3R1 for PTX10003 and PTX10008 routers. Supported in Junos Evolved OS Release 21.4R1 for PTX10016 routers. `/network-instances/network-instance/interfaces/config/interface`	The Junos CLI mapping is: `set routing-instance` *name* `interface` *name*

Table 46: Network Instance *(Continued)*

Resource Path	Description
`/network-instances/network-instance/protocols/` `protocol/config/identifier`	Type of identifier: • BGP • ISIS • OSPF • OSPF3 • STATIC • DIRECTLY_CONNECTED • LOCAL_AGGREGATE **NOTE**: Only BGP is supported.
`/network-instances/network-instance/protocols/` `protocol/config/name`	A unique name for the protocol instance. This is not a mandatory field.
• `/network-instances/network-instance/protocols/` `protocol/config/name/enable` • `/network-instances/network-instance/protocols/` `protocol/config/name/target-table` • `/network-instances/network-instance/table-` `connections/table-connection/config/src-table` • `/network-instances/network-instance/table-` `connections/table-connection/config/dst-table` • `/network-instances/network-instance/table-` `connections/table-connection/config/tables`	Not supported.

Table 46: Network Instance *(Continued)*

Resource Path	Description
NOTE: Supported in Junos OS Release 21.2R1 for PTX Series and MX Series. Supported in Junos Evolved OS Release 21.3R1 for PTX10003 and PTX10008 routers. Supported in Junos Evolved OS Release 21.4R1 for PTX10016 routers. /network-instances/network-instance/inter-instance-policies/apply-policy/config/import-policy	The Junos CLI mapping is: `set routing-instances` *instance-name* `routing-options instance-export` *import-policy*
NOTE: Supported in Junos OS Release 21.2R1 for PTX Series and MX Series. Supported in Junos Evolved OS Release 21.3R1 for PTX10003 and PTX10008 routers. Supported in Junos Evolved OS Release 21.4R1 for PTX10016 routers. /network-instances/network-instance/inter-instance-policies/apply-policy/config/export-policy	The Junos CLI mapping is: `set routing-instances` *instance-name* `routing-options instance-export` *export-policy*
/network-instances/network-instance/protocols/protocol/static-routes/static/config/prefix	The prefix of the static route that you configure.
/network-instances/network-instance/protocols/protocol/static-routes/static/next-hops/next-hop/config/next-hop	The IP address of the next-hop for the static route that you configure.
NOTE: Supported in Junos OS Release 21.2R1 for PTX Series and MX Series. Supported in Junos Evolved OS Release 21.3R1 for PTX10003 and PTX10008 routers. Supported in Junos Evolved OS Release 21.4R1 for PTX10016 routers. /network-instances/network-instance/protocols/protocol/static-routes/static/next-hops/next-hop/config/metric	The Junos CLI mapping is: `set routing-instance` *name* `routing-options static route` *prefix* `quaiified-next-hop` *nexthop* `metric` *value*

Table 46: Network Instance *(Continued)*

Resource Path	Description

`/network-instances/network-instance/protocols/`
`protocol/static-routes/static/next-hops/next-hop/`
`interface-ref/config/interface`
	The physical interface of the next-hop for the static route that you configure.

`/network-instances/network-instance/protocols/`
`protocol/static-routes/static/next-hops/next-hop/`
`interface-ref/config/subinterface`
	The logical interface of the next-hop for the static route that you configure.

Release History Table

Release	Description
17.4R1	Starting with Junos OS Release 17.4R1, network instance based BGP configuration is supported.

RELATED DOCUMENTATION

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Mapping OpenConfig Port Mirroring Commands to Junos Configuration

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> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks MX Series and PTX Series.

Remote Port Mirroring

The tables below show the mappings of remote port mirroring commands with the relevant configurations in Junos.

- : Firewall Filter Configuration

- : Forwarding Class Configuration

- : Forwarding Options Configuration

- : Flexible Tunnel Interface (FTI) Configuration

> **NOTE**: In the configurations below, the symbols <> indicate a variable.

Table 47: Remote Port Mirroring: Firewall Filter Configuration

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
| Port mirror instance | ```
acl-set <> ACL_IPV4 {
    acl-entries {
        acl-entry <> {
            actions {
                config {
                    jnx-aug-openconfig-acl:remote-port-mirror <>;
                }
            }
        }
    }
}
``` | ```
firewall {
    family inet {
        filter <> {
            term <> {
                then {
                    count <>;
                    port-mirror-instance <>;
                }
            }
        }
    }
}
``` |

Table 47: Remote Port Mirroring: Firewall Filter Configuration *(Continued)*

Command Name	*OpenConfig configuration with Juniper augmentation*	*Junos EVO Configuration*
| Policer CIR | ```
jnx-aug-openconfig-qos:policers {
    policer <> SINGLE-RATE-2-COLOR {
        one-rate-two-color {
            config {
                cir <>;
            }
        }
    }
}
``` | ```
firewall {
    policer <> {
        if-exceeding {
            bandwidth-limit <>;
        }
    }
}
``` |
| Policer burst size | ```
jnx-aug-openconfig-qos:policers {
    policer <> SINGLE-RATE-2-COLOR {
        one-rate-two-color {
            config {
                bc <>;
            }
        }
    }
}
``` | ```
firewall {
    policer <> {
        if-exceeding {
            burst-size-limit <>;
        }
        then discard;
    }
}
``` |
| Policer action | ```
jnx-aug-openconfig-qos:policers {
    policer <> SINGLE-RATE-2-COLOR {
        one-rate-two-color {
            exceed-action {
                config {
                    drop true;
                }
            }
        }
    }
}
``` | ```
firewall {
    policer <> {
        then discard;
    }
}
``` |

Table 47: Remote Port Mirroring: Firewall Filter Configuration *(Continued)*

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
| Filter action count | ```
acl-set <> ACL_IPV4 {
    acl-entries {
        acl-entry <> {
            actions {
                config {
                    jnx-aug-openconfig-acl:jnx-
count <>;
                }
            }
        }
    }
}
``` | ```
firewall {
    family inet {
        filter <> {
            term <> {
                then {
                    count <>;
                }
            }
        }
    }
}
``` |
| Filter attachment | ```
interfaces {
    interface et-<>/<>/<>.<> {
        interface-ref {
            config {
                interface et-<>/<>/<>;
                subinterface <>;
            }
        }
        ingress-acl-sets {
            ingress-acl-set <>;
        }
    }
}
``` | ```
interfaces {
    et-<>/<>/<> {
        unit <> {
            family inet {
                filter {
                    input <>;
                }
            }
        }
    }
}
``` |

Table 48: Remote Port Mirroring: Forwarding Class Configuration

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
Class of service name	```forwarding-groups { forwarding-group <> { config { name <>; } } }```	```class-of-service { forwarding-classes { class <> queue-num <>; } }```
Class of service priority	```forwarding-groups { forwarding-group <> { config { fabric-priority <>; } } }```	```class-of-service { forwarding-classes { class <> queue-num <>; } }```
Output queue	```forwarding-groups { forwarding-group <> { config { output-queue <>; } } }```	```class-of-service { forwarding-classes { class <> queue-num <>; } }```

Table 48: Remote Port Mirroring: Forwarding Class Configuration *(Continued)*

Command Name	*OpenConfig configuration with Juniper augmentation*	*Junos EVO Configuration*
| Rewrite rule and bindings | ```
interfaces {
    interface et-<>/<>/<>.<> {
        interface-ref {
            config {
                interface et-<>/<>/<>;
                subinterface <>;
            }
        }
        output {
            classifiers {
                classifier <> {
                    config {
                        name <>;
                    }
                }
            }
        }
    }
}
classifiers {
    classifier <> {
        terms {
            term <> {
                actions {
                    config {
                        target-group best-
effort;
                    }
                    remark {
                        config {
                            set-dscp <>;
                        }
                    }
                }
            }
        }
    }
}
``` | ```
class-of-service {
    interfaces {
        et-<>/<>/<> {
            unit <> {
                rewrite-rules {
                    dscp rewrite-dscps;
                }
            }
        }
    }
    rewrite-rules {
        dscp rewrite-dscps {
            forwarding-class assured-
forwarding {
                loss-priority high code-
point <>;
                loss-priority low code-
point <>;
            }
            forwarding-class best-effort {
                loss-priority high code-
point <>;
                loss-priority low code-
point <>;
            }
            forwarding-class expedited-
forwarding {
                loss-priority high code-
point <>;
                loss-priority low code-
point <>;
            }
            forwarding-class network-
control {
                loss-priority high code-
point <>;
                loss-priority low code-
point <>;
            }
        }
``` |

Table 48: Remote Port Mirroring: Forwarding Class Configuration *(Continued)*

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
		``` } } ```

Table 49: Remote Port Mirroring: Forwarding Options Configuration

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
Rate	```jnx-aug-openconfig-pm:port-mirror { remote-port-mirror { instances { instance <> PM_IPV4 { config { input-rate <>; } } } } } ```	```forwarding-options { port-mirroring { instance { <> { input { rate <>; } } } } } ```

Table 49: Remote Port Mirroring: Forwarding Options Configuration *(Continued)*

Command Name	*OpenConfig configuration with Juniper augmentation*	*Junos EVO Configuration*
FTI	```jnx-aug-openconfig-pm:port-mirror {
remote-port-mirror {
instances {
instance <> PM_IPV4 {
config {
egress-interface fti<>;
}
}
}
}
}```	```forwarding-options {
port-mirroring {
instance {
<> {
family inet {
output {
interface fti<>.<>;
}
}
}
}
}
}```
Policer	```jnx-aug-openconfig-pm:port-mirror {
remote-port-mirror {
instances {
instance <> PM_IPV4 {
config {
egress-policer <>;
}
}
}
}
}```	```forwarding-options {
port-mirroring {
instance {
<> {
family inet {
output {
policer <>;
}
}
}
}
}
}```

Table 49: Remote Port Mirroring: Forwarding Options Configuration *(Continued)*

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
| Forwarding class | ```
jnx-aug-openconfig-pm:port-mirror {
    remote-port-mirror {
        instances {
            instance <> PM_IPV4 {
                config {
                    egress-fc <>;
                }
            }
        }
    }
}
``` | ```
forwarding-options {
    port-mirroring {
        instance {
            <> {
                family inet {
                    output {
                        forwarding-class <>;
                    }
                }
            }
        }
    }
}
``` |
| Maximum packet length | ```
jnx-aug-openconfig-pm:port-mirror {
    remote-port-mirror {
        instances {
            instance <> PM_IPV4 {
                config {
                    input-max-packet-length
<>;
                }
            }
        }
    }
}
``` | ```
forwarding-options {
    port-mirroring {
        instance {
            <> {
                input {
                    maximum-packet-length
<>;
                }
            }
        }
    }
}
``` |

Table 50: Remote Port Mirroring: Flexible Tunnel Interface Configuration

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
Source address	<pre>interface fti<> {
openconfig-if-tunnel:tunnel {
config {
src <>;
}
}
}</pre>	<pre>interfaces {
fti<> {
unit <> {
tunnel {
encapsulation gre {
source {
address <>;
}
}
}
}
}
}</pre>
Destination address	<pre>interface fti<> {
openconfig-if-tunnel:tunnel {
config {
dst <>;
}
}
}</pre>	<pre>interfaces {
fti<> {
unit <> {
tunnel {
encapsulation gre {
destination {
address <>;
}
}
}
}
}
}</pre>

Table 50: Remote Port Mirroring: Flexible Tunnel Interface Configuration *(Continued)*

Command Name	*OpenConfig configuration with Juniper augmentation*	*Junos EVO Configuration*
| Tunnel interface IP | ```
interface fti<> {
    opencofig-if-tunnel:tunnel {
        ipv4 {
          addresses {
              address <> {
                  config {
                      ip <>;
                  }
              }
          }
        }
    }
}
``` | ```
interfaces {
    fti<> {
        unit <> {
            family inet {
                address <>/<>;
            }
        }
    }
}
``` |
| Prefix length | ```
interface fti<> {
    opencofig-if-tunnel:tunnel {
        ipv4 {
          addresses {
              address <> {
                  config {
                      prefix-length <>;
                  }
              }
          }
        }
    }
}
``` | ```
interfaces {
    fti<> {
        unit <> {
            family inet {
                address <>/<>;
            }
        }
    }
}
``` |

Local Port Mirroring

The tables below show the mappings of local port mirroring commands with the relevant configurations in Junos.

- : Interface Configuration

- : Forwarding Options Configuration

- : Firewall Filter Configuration

> **NOTE**: In the configurations below, the symbols ◇ are placeholders for variables.

Table 51: Local Port Mirroring: Interface Configuration

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
| Interface (IPv4) | ```
interface et-<>/<>/<> {
    subinterfaces {
        subinterface <> {
            openconfig-if-ip:ipv4 {
                addresses {
                    address <> {
                        config {
                            ip <>;
                            prefix-length <>;
                        }
                    }
                }
            }
        }
    }
}
``` | ```
interfaces {
    et-<>/<>/<> {
        unit <> {
            family inet {
                address <>/<>
            }
        }
    }
}
``` |

Table 51: Local Port Mirroring: Interface Configuration *(Continued)*

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
| Interface (IPv6) | ```
interface et-<>/<>/<> {
    subinterfaces {
        subinterface <> {
            opencocnfig-if-ip:ipv6 {
                addresses {
                    address <> {
                        config {
                            ip <>;
                            prefix-length <>;
                        }
                    }
                }
            }
        }
    }
}
``` | ```
interfaces {
    et-<>/<>/<> {
        unit <> {
            family inet {
                address <>/<>
            }
        }
    }
}
``` |

Table 52: Local Port Mirroring: Forwarding Options Configuration

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
| Rate | ```
jnx-aug-openconfig-pm:port-mirror {
    local-port-mirror {
        instances {
            instance PM_IPV4 {
                config {
                    input-rate <>;
                }
            }
        }
    }
}
``` | ```
forwarding-options {
    port-mirroring {
        input {
            rate <>;
        }
    }
}
``` |

Table 52: Local Port Mirroring: Forwarding Options Configuration *(Continued)*

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
Next hop	```jnx-aug-openconfig-pm:port-mirror { local-port-mirror { instances { instance PM_IPV4 { config { input-rate <>; pm-interface xe-<>/<>/<>; pm-nexthop <>; } } } } }```	```forwarding-options { port-mirroring { family inet { output { interface et-<>/<>/<>.<> { next-hop <>; } } } } }```

Table 53: Local Port Mirroring: Firewall Filter Configuration

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
Filter count	```acl-sets { acl-set <> <> { acl-entries { acl-entry 1 { actions { config { jnx-aug-openconfig-acl:jnx-count <>; } } } } } }```	```firewall { family inet { filter <> { term <> { then { count <>; } } } } }```

Table 53: Local Port Mirroring: Firewall Filter Configuration *(Continued)*

Command Name	OpenConfig configuration with Juniper augmentation	Junos EVO Configuration
| Port mirror | ```
acl-sets {
    acl-set <> <> {
        acl-entries {
            acl-entry <> {
                actions {
                    config {
                        jnx-aug-openconfig-acl:jnx-local-
port-mirror true;
                    }
                }
            }
        }
    }
}
``` | ```
firewall {
    family inet {
        filter <> {
            term <> {
                then {
                    port-mirror;
                }
            }
        }
    }
}
``` |

Mapping OpenConfig QoS Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS or Junos Evolved OS release for Juniper Networks routers and switches.

The following tables show the mapping of OpenConfig QoS commands with the relevant configuration in Junos OS:

Table 54: Forwarding Class Configuration

Command Name	OpenConfig Configuration	Junos Configuration

forwarding-group	`opencofnig-qos:qos {`
	`        forwarding-groups {`
	`                forwarding-group {`
	`                        name af1;`
	`                        config {`
	`                                name <>;`
	`                                fabric-priority 0;`
	`                                output-queue <>;`
	`                        }`
	`                }`
	`                forwarding-group {`
	`                        name nc;`
	`                        config {`
	`                                name <>;`
	`                                fabric-priority 1;`
	`                                output-queue <>;`
	`                        }`
	`                }`
	`        }`
	`}`
		`class-of-service {`
		`    forwarding-classes {`
		`        class <name> queue-num`
		`<num> priority low;`
		`        class <name> queue-num`
		`<num> priority high;`
		`    }`
		`}`

An OpenConfig `fabric-priority` value of 0 indicates low priority. Any non-zero value indicates high priority. The `fabric-priority` value is not supported on the PTX platform.

Table 55: BA Classifier Configuration

Command Name	OpenConfig Configuration	Junos Configuration
| classifier | ```
opencofig-qos:qos {
        classifiers {
                classifier {
                        name DSCP;
                        terms {
                                term {
                                        id 0;
                                        conditions {
                                                ipv4 {
                                                        config {
                                                                dscp
000000;
                                                        }
                                                }
                                        }
                                        actions {
                                                config {
                                                        target-group best-
effort;
                                                }
                                        }
                                }
                        }
                }
        }
}
``` | ```
class-of-service {
  classifiers {
    dscp DSCP {
        forwarding-
class best-effort {
            loss-
priority low code-
points 000000;
        }
    }
  }
}
``` |

Table 55: BA Classifier Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration

To more easily follow the OpenConfig examples below, variables are used in the OpenConfig configuration tree above.

Junos OS expects a `loss-priority` value. The OpenConfig configuration does not provide this. By default, the `loss-priority` value is `low`.

The OpenConfig `code-point` value is provided using bit format as octets and decimal values as decimals. To avoid confusion, provide `code-point` values in decimal format. For example:

set openconfig-qos:qos classifiers classifier DSCP terms term 0 conditions ipv4 config dscp 3

The OpenConfig value `term id` is the same as the `queue-num` value which the forwarding group represents. For example, if best-effort is attached to queue 0, then the `term id` value is 0.

When streaming the telemetry `state` value, the Junos `queue-num` value to which the OpenConfig `target-group` value is mapped will be exported as the `term id` value. For example:

set openconfig-qos:qos classifiers classifier DSCP terms term 0 actions config target-group best-effort

Table 56: Classifier Binding Configuration

Command Name	OpenConfig Configuration	Junos Configuration
Classifier	```openconfig-qos:qos { interfaces { interface { interface-id et-0/0/1.0; input { classifiers { classifier { type IPV4; config { name DSCP; type IPV4; } } } } } } }```	```class-of-service { et-0/0/1 { unit 0 { classifiers { dscp DSCP; } } } }```

To more easily follow the OpenConfig examples below, variables are used in the OpenConfig configuration tree.

Classifier binding can be formed from the interfaces table by mapping classifier and interface.

This configuration also supports wild cards (*). For example:

set openconfig-qos:qos interfaces interface et-*/*/*.0 interface-ref config interface et-*/*/*

set openconfig-qos:qos interfaces interface et-*/*/*.0 interface-ref config subinterface 0

set openconfig-qos:qos interfaces interface et-*/*/*.0 input classifiers classifier IPV4 config name DSCP

Table 57: Scheduler Configuration

Command Name	OpenConfig Configuration	Junos Configuration
scheduler	```openconfig-qos:qos { scheduler-policies { scheduler-policy { name smap; schedulers { scheduler { sequence:4 two-rate-three-color { config { cir-pct:10 } } } scheduler { sequence:1 two-rate-three-color { config { cir-pct:1 } } } scheduler { sequence:5 two-rate-three-color { config { cir-pct:1 } } } scheduler { sequence:2 priority: STRICT two-rate-three-color { config { cir-pct:1 } } } scheduler { sequence:0 two-rate-three-color {```	```cclass-of-service { scheduler-maps { smap { forwarding-class af1 scheduler sched_smap_af1; forwarding-class af2 scheduler sched_smap_ af2; forwarding-class af3 scheduler sched_smap_ af3; forwarding-class af4 scheduler sched_smap_ af4; forwarding-class be1 scheduler sched_smap_ be1; forwarding-class nc1 scheduler sched_smap_ nc1; } } schedulers { sched_smap_af1 { transmit-rate percent 10; buffer-size shared; priority low; } sched_smap_af2 { transmit-rate percent 1; buffer-size shared; priority low; } sched_smap_af3 { transmit-rate percent 1; buffer-size shared; priority low; } sched_smap_af4 { transmit-rate percent 1; buffer-size shared; priority strict-high; }```

Table 57: Scheduler Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
| | ```
        config {
            cir-pct:1
        }
      }
    }
  scheduler {
    sequence:3
    two-rate-three-color {
     config {
      cir-pct:1
     }
    }
   }
  }
 }
}
``` | ```
   sched_smap_be1 {
       transmit-rate percent
1;
       buffer-size shared;
       priority low;
   }
   sched_smap_nc1 {
   transmit-rate percent 1;
       buffer-size shared;
       priority low;
   }
 }
}
``` |

Table 57: Scheduler Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration

To more easily follow the OpenConfig examples below, variables are used in the OpenConfig configuration tree above.

The OpenConfig parameters that are not supported under the `scheduler` command include `buffer-size`, `excess-rates`, and `excess priorities`. Only `STRICT-HIGH` priority is supported. If you configure a priority, it is treated as `STRICT-HIGH`. Otherwise, the priority is `LOW` by default.

The OpenConfig fields that are unsupported fields under `scheduler` command are `cir-pct-remaining`, `pir-pct-remaining`, `be` (excess burst size), and `bc` (committed burst size). These fields are unsupported on the PTX platform but are supported on the MX platform.

There is no parameter to configure a scheduler name in OpenConfig. Instead, the name is deduced by combining the Junos `scheduler-map` name and `forwarding group`. For example, the below parameters creates the scheduler name `sched_smap_assured-forwarding`.

```
<schedulers> {
      <name> "sched" _ "_" _$smap_name _ "_" _ $out_fwd_group;
  }
```

NOTE: The scheduler name can be 64 characters in length. Since scheduler map and forwarding class names are concatenated in OpenConfig configurations, care must be taken when providing them.

The OpenConfig `sequence` number should be same as the `queuenum` value, which the forwarding group represents. For example, if `assured-forwarding` is attached to queue 2, then `sequence` number should be 2. While exporting state, the `queuenum` to which the `target-group` is attached is exported as the `sequence` number.

set openconfig-qos:qos scheduler-policies scheduler-policy smap schedulers scheduler 2 output config output-fwd-group assured-forwarding

Table 57: Scheduler Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
scheduler-map	```opencenfig-qos:qos {
interfaces {
interface {
interface-id et-0/0/1;
output {
scheduler-policy {
config {
name qos-
scheduler-paradise-sps;
}
}
}
}
}
}```	```class-of-service {
interfaces {
et-0/0/1 {
scheduler-map qos-
scheduler-paradise-sps;
}
}
}```

To more easily follow the OpenConfig examples below, variables are used in the OpenConfig configuration tree above.

Scheduler-maps can be bound to physical (IFD) interfaces only.

Wild cards are also supported. For example:

set openconfig-qos:qos interfaces interface et-*/*/* interface-ref config interface et-*/*/*

set openconfig-qos:qos interfaces interface et-*/*/* output scheduler-policy config name smap

Mapping OpenConfig Routing Policy Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks EX2300, EX3400, EX4300, EX4600, and EX9200 switches, MX Series, PTX Series, and QFX Series.

Table 58 on page 214 to Table 60 on page 215 show the mapping of OpenConfig routing policy commands to the relevant configuration in Junos.

Table 58: Defined Set Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Prefix Set	`/routing-policy/defined-sets/prefix-set`	`set policy-options prefix-list name`
Neighbor Set	`/routing-policy/defined-sets/neighbor-set`	`set policy-options neighbor-list name`
Tag Set	`/routing-policy/defined-sets/tag-set`	`set policy-options tag-list name tag-set value`

Table 59: BGP Defined Set Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Community Set	`/routing-policy/defined-sets/bgp-defined-sets/community-set`	`set policy-options community name members value`
AS Path Set	`/routing-policy/defined-sets/bgp-defined-sets/as-path-set`	Not supported

Table 59: BGP Defined Set Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Ext Community Set	`/routing-policy/defined-sets/bgp-defined-sets/ext-community-set`	`set policy-options community` *name* `members` *value*

Table 60: Policy Definition Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/routing-policy/policy-definition/statement**	
Call Policy	`/conditions/call-policy`	`set policy-options policy-statement` *name* `from policy` *value*
Prefix Set	`/conditions/match-prefix-set/prefix-set`	`set policy-options policy-statement` *name* `from prefix-list` *name* `set policy-options policy-statement` *name* `from route-filter` *address* `prefix-length-range` *range*
Match Set Options	`/conditions/match-prefix-set/match-set-options`	Not supported
Neighbor Set	`/conditions/match-neighbor-set/neighbor-set`	`set policy-options policy-statement` *name* `from neighbor` *address*
Match Neighbor Set	`/conditions/match-neighbor-set/match-set-options`	Not supported
Tag Set	`/conditions/match-tag-set/tag-set`	`set policy-options policy-statement` *name* `from tag` *tag*

Table 60: Policy Definition Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
Match Tag Set	`/conditions/match-tag-set/match-set-options`	Not supported
Install Protocol EQ	`/conditions/install-protocol-eq`	`set policy-options policy-statement` *name* `from protocol` *protocol*
IGP Conditions	`/conditions/igp-conditions`	Not supported
BGP Match Community Set	`/conditions/bgp-conditions/match-community-set/community-set`	`set policy-options policy-statement` *name* `from community` *name*
BGP Match Ext Community Set	`/conditions/bgp-conditions/match-ext-community-set`	`set policy-options policy-statement` *name* `from community` *name*
BGP Match Ext Community Set Options	`/conditions/bgp-conditions/match-ext-community-set/match-set-options`	Not supported
BGP Match AS Path Set	`/conditions/bgp-conditions/match-as-path-set`	Not supported
BGP MED EQ	`/conditions/bgp-conditions/med-eq`	`set policy-options policy-statement` *name* `from metric` *metric*
BGP Origin EQ	`/conditions/bgp-conditions/origin-eq`	`set policy-options policy-statement` *name* `from origin (egp | igp | incomplete)`
BGP Next Hop	`/conditions/bgp-conditions/next-hop-in`	`set policy-options policy-statement` *name* `from next-hop` *address*
BGP Local Preference EQ	`/conditions/bgp-conditions/local-pref-eq`	`set policy-options policy-statement` *name* `from local-preference` *preference*

Table 60: Policy Definition Configuration *(Continued)*

Command Name	*OpenConfig Command Path*	*Junos Configuration*

BGP Community Count	/conditions/bgp-conditions/
	community-count
		`set policy-options policy-statement` *name*
		`from community-count` *count* `(equal | orhigher`
		`|orlower)`

BGP AS Path Length	/conditions/bgp-conditions/as-path- length	Not supported
Accept-Route	/actions/config/accept-route	`set policy-options policy-statement example-` `accept then accept`
Reject-Route	/actions/config/reject-route	`set policy-options policy-statement example-` `reject then reject`
IGP Actions	/actions/igp-actions/set-tag	`set policy-options policy-statement` *name* `then tag` *tag*
BGP Actions Set AS Path Prepend	/actions/bgp-actions/set-as-path- prepend	Not supported
BGP Actions Set Community	/actions/bgp-actions/set-community	`set policy-options policy-statement` *name* `then community (set | replace | add)` *name*
BGP Actions Set Ext Community	/actions/bgp-actions/set-ext- community	`set policy-options policy-statement` *name* `then community (set | replace | add)` *name*
BGP Actions Set Route Origin	/actions/bgp-actions/set-route- origin	`set policy-options policy-statement` *name* `then origin (egp |igp | incomplete)`
BGP Actions Set Local Preferences	/actions/bgp-actions/set-local-pref	`set policy-options policy-statement` *name* `then local-preference` *preference*

Table 60: Policy Definition Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
BGP Actions Set Next Hop	`/actions/bgp-actions/set-next-hop`	`set policy-options policy-statement` *name* `then next-hop` *address*
BGP Actions Set Med	`/actions/bgp-actions/set-med`	`set policy-options policy-statement` *name* `then metric` *metric*
BGP Actions As-Path-Prepend	`/actions/bgp-actions/config/set-as-path-prepend/asn`	`set policy-options policy-statement` *name* `then as-path-prepend` *as-path*

RELATED DOCUMENTATION

Mapping OpenConfig System Logging Model Commands to Junos Configuration

NOTE: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks MX Series and PTX Series.

The following tables show the mapping of OpenConfig logging commands with the relevant configuration in Junos OS:

- Table 61 on page 219: Remote Logging Configuration

- Table 62 on page 221: Console Logging Configuration

Table 61: Remote Logging Configuration

Command Name	OpenConfig Configuration	Junos Configuration
| Host | ```
opyenconfig-system:system {
    logging {
        remote-servers {
            remote-server <host> {
                …
            }
        }
    }
}
``` | ```
system {
    syslog {
        host <> {
            ……..
        }
    }
}
``` |

The OpenConfig remote-logging server host leaf maps to the Junos host parameter.

Command Name	OpenConfig Configuration	Junos Configuration
| Source-address | ```
openconfig-system:system {
    logging {
        remote-servers {
            remote-server <> {
                config {
                    source-address <>;
                }
            }
        }
    }
}
``` | ```
system {
    syslog {
        host <> {
            source-address <>;
        }
    }
}
``` |

The OpenConfig source-address leaf maps to the Junos source-address parameter.

Table 61: Remote Logging Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
| Remote-port | ```
opencofig-system:system {
    logging {
        remote-servers {
            remote-server <> {
                config {
                    remote-port <>;
                }
            }
        }
    }
``` | ```
system {
    syslog {
        host <> {
            port <>;
        }
    }
}
``` |

The OpenConfig `remote-port` leaf maps to the Junos `port` parameter.

Command Name	OpenConfig Configuration	Junos Configuration
| Selector | ```
opencofig-system:system {
    logging {
        remote-servers {
            remote-server <> {
                selectors {
                    selector <facility> <severity>;
                }
            }
        }
    }
}
``` | ```
system {
    syslog {
        host <> {
            <facility> <severity>;
        }
    }
}
``` |

The OpenConfig `facility` and `severity` leaves map to the Junos `facility` and `severity` parameters.

Table 62: Console Logging Configuration

Command Name	OpenConfig Configuration	Junos Configuration
Console	```opencenfig-system:system { logging { console { .... } } }```	```system { syslog { console { .... } } }```
Selector	```opencenfig-system:system { logging { console { selectors { selector <facility> <severity> ; } } } }```	```system { syslog { console { <facility> <severity>; } } }```

The OpenConfig `facility` and `severity` leaves map to the Junos `facility` and `severity` parameters.

Mapping OpenConfig System Management Model Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks MX Series and PTX Series.

The following tables show the mapping of OpenConfig system management configuration with the relevant configuration in the Junos OS.

- : DNS Configuration

Table 63: DNS Configuration

Command Name	OpenConfig Configuration	Junos Configuration
| Search | ```
opensconfig-system:system {
    dns {
        config {
            search [ <> … ];
        }
    }
}
``` | ```
system {
    domain-search [<> …];
}
``` |

The OpenConfig DNS `search` leaf maps to the Junos `domain-search` statement.

Table 64: Domain Name Configuration

Command Name	OpenConfig Configuration	Junos Configuration
| Domain-name | ```
openconfig-system:system {
    config {
        domain-name <>;
    }
}
``` | ```
system {
    domain-name <>;
}
``` |

The OpenConfig `domain-name` leaf maps to the Junos `domain-name` statement.

Table 65: Host Name Configuration

Command Name	OpenConfig Configuration	Junos Configuration
Host-name	```openconfig-system:system { config { hostname <>; } }```	```system { host-name <>; } }```

The OpenConfig hostname leaf maps to the Junos hostname statement.

Table 66: Login Banner Configuration

Command Name	OpenConfig Configuration	Junos Configuration
Login-banner	```openconfig-system:system { config { login-banner <>; } }```	```system { login { message <>; } }```

The OpenConfig DNS login-banner leaf maps to the Junos message statement.

Table 67: MOTD Banner Configuration

Command Name	OpenConfig Configuration	Junos Configuration
Motd-banner	```openconfig-system:system { config { motd-banner <>; } }```	```system { login { announcement <>; } }```

The OpenConfig motd-banner leaf maps to the Junos announcement statement.

Table 68: Time Zone Configuration

Command Name	OpenConfig Configuration	Junos Configuration
Time-zone	```opencongfig-system:system { clock { config { timezone-name <>; } } }```	```system { time-zone <>; }```

The OpenConfig `timezone-name` leaf maps to the Junos `time-zone` statement.

Mapping OpenConfig System Model Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS or Junos Evolved OS release for Juniper Networks ACX Series, MX Series and PTX Series.

The following tables show the mapping of OpenConfig system commands with the relevant configuration in Junos OS:

- : SSH Server Configuration

- : NTP Configuration

Table 69: SSH Server Configuration

Command Name	OpenConfig Configuration	Junos Configuration
Timeout	```opieconfig-system:system { ssh-server { config { timeout <>; } } }```	```system { services { ssh { client-alive-count-max 1; client-alive-interval <>; } } }```

The OpenConfig `timeout` leaf value is set to the `client-alive-interval` parameter. The `client-alive-count-max` parameter value is set to 1. It must be set to 1 to overwrite the default value of 3.

| Session limit | ```opieconfig-system:system {   ssh-server {   config {   session-limit <>;   }   } }``` | ```system {   services {   ssh {   connection-limit <>;   }   } }``` |

The OpenConfig `session-limit` leaf value is set to the Junos parameter `connection-connection-limit` value.

| Rate limit | ```openconfig-system:system {   ssh-server {   config {   rate-limit <>;   }   } }``` | ```system {   services {   ssh {   rate-limit <>;   }   } }``` |

The OpenConfig `rate-limit` leaf value is set to the Junos parameter `rate-limit` value.

Table 69: SSH Server Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
| Protocol version | ```
opencofig-system:system {
    ssh-server {
        config {
            protocol-version <>;
        }
    }
}
``` | ```
system {
    services {
        ssh {
            protocol-version <>;
        }
    }
}
``` |

The OpenConfig `protocol-version` leaf value is set to the Junos parameter `protocol-version` value.

Command Name	OpenConfig Configuration	Junos Configuration
| Enable | ```
opencofig-system:system {
    ssh-server {
        config {
            enable <>;
        }
    }
}
``` | ```
system {
    services {
        ssh {
            ..........
        }
    }
}
``` |

The OpenConfig `enable` leaf value toggles the `set system services ssh` configuration. When `enable` is not configured, the SSH configuration is enabled by default. The model defines `TRUE` as the default value for the `enable` leaf.

Table 70: NTP Configuration

Command Name	OpenConfig Configuration	Junos Configuration

Prefer	```
	openconfig-system:system {
	    ntp {
	        servers {
	            server <> {
	                config {
	                    prefer <>;
	                }
	            }
	        }
	    }
	}
	``
		``
		system {
		    ntp {
		        server <> prefer;
		    }
		}
		``

When the OpenConfig `prefer` leaf value is set to `true`, the Junos `prefer` parameter will be set. The Junos `prefer` parameter is a toggle and needs to be set when the OpenConfig value `prefer` is set to `true`.

Command Name	OpenConfig Configuration	Junos Configuration

Version	```
	openconfig-system:system {
	    ntp {
	        servers {
	            server <> {
	                config {
	                    version <>;
	                }
	            }
	        }
	    }
	}
	``
		``
		system {
		    ntp {
		        server <> version <>;
		    }
		}
		``

The OpenConfig NTP `version` leaf value is set to the Junos parameter `version` value.

Table 70: NTP Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
| Port | ```
openconfig-system:system {
    ntp {
        servers {
            server <> {
                config {
                    port <>;
                }
            }
        }
    }
}
``` | Not supported. |

Junos OS doesn't have a parameter for an NTP server port, and instead, always runs at port 1234. Consequently, the OpenConfig leaf port is not supported.

Command Name	OpenConfig Configuration	Junos Configuration
| Enabled | ```
openconfig-system:system {
    ntp {
        config {
            enabled <>;
        }
    }
}
``` | ```
system {
    ntp {
            ........
    }
}
``` |

The OpenConfig enable leaf value toggles the set system ntp configuration. Since its default value is FALSE, the NTP configuration is enabled only when the enable parameter is set to TRUE.

Mapping OpenConfig System Terminal Model Commands to Junos Configuration

The following tables show the mapping of system terminal commands with the relevant configurations in Junos:

- Table 71 on page 229: gRPC Server Configuration

- Table 72 on page 232: Telnet Server Configuration

Table 71: gRPC Server Configuration

Command Name	OpenConfig Configuration	Junos Configuration
Port	```openconfig-system:system { grpc-servers { grpc-server <> { config { port <>; } } } }```	```system { services { extension-service { request-response { grpc { ssl { port <>; } } } } } }```

The OpenConfig `port` leaf value maps to the Junos `port` statement.

Table 71: gRPC Server Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
| Listen address | ```
openconfig-system:system {
    grpc-servers {
        grpc-server  <> {
            config {
                listen-addresses
<>;
            }
        }
    }
}
``` | ```
system {
    services {
        extension-service {
            request-response {
                grpc {
                    ssl {
                        address <>;
                    }
                }
            }
        }
    }
}
``` |

The OpenConfig `listen-addresses` is a leaf-list and maps to the Junos `address` statement. Consequently, the `listen-addresses` leaf value is restricted to a single value.

Command Name	OpenConfig Configuration	Junos Configuration
| Certificate-id | ```
openconfig-system:system {
    grpc-servers {
        grpc-server  <> {
            config {
                certificate-id
<>;
            }
        }
    }
}
``` | ```
system {
    services {
        extension-service {
            request-response {
                grpc {
                    ssl {
                        local-certificate <>;
                    }
                }
            }
        }
    }
}
``` |

The OpenConfig `certificate-id` leaf maps to the Junos statement `local-certificate`. The single OpenConfig certificate value is merged with Junos certificates.

Table 71: gRPC Server Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
| Enable | ```
opetconfig-system:system {
    grpc-servers {
        grpc-server  <> {
            config {
                enable <>;
            }
        }
    }
}
``` | ```
system {
    services {
        extension-service {
            request-response {
                grpc {
                    ssl {
                        ……….
                    }
                }
            }
        }
    }
}
``` |

The OpenConfig `enable` leaf value toggles the `set system services ssh` configuration. When `enable` is not set, the SSH configuration is enabled by default as the data model defines `TRUE` as the default value for leaf `enable`.

| Metadata-authentication | ```
openconfig-system:system {
    grpc-servers {
        grpc-server  <> {
            config {
                metadata-
authentication <>;
            }
        }
    }
}
``` | Not supported. |

Metadata authentication is enabled by default in Junos. There is no Junos statement to enable or disable this feature.

Table 71: gRPC Server Configuration *(Continued)*

Command Name	*OpenConfig Configuration*	*Junos Configuration*
| Transport-security | ```
openconfig-system:system {
    grpc-servers {
        grpc-server  <> {
            config {
                transport-
security <>;
            }
        }
    }
}
``` | ```
system {
    services {
        extension-service {
            request-response {
                grpc {
                    ssl {
                          ........
                    }
                }
            }
        }
    }
}
``` |

The OpenConfig `transport-security` leaf is a toggle to enable or disable gRPC Secure Sockets Layer (SSL)/ Transport Layer Security (TLS). The default value for `transport-security` is `TRUE`. SSL is enabled by default. However, if the value for `transport-security` is `FALSE`, the configuration commit will fail.

Table 72: Telnet Server Configuration

Command Name	*OpenConfig Configuration*	*Junos Configuration*
| Rate-limit | ```
openconfig-system:system {
    telnet-server {
        config {
            rate-limit <>;
        }
    }
}
``` | ```
system {
    services {
        telnet {
            rate-limit <>;
        }
    }
}
``` |

The OpenConfig `rate-limit` leaf is set to the Junos telnet server `rate-limit` value.

Table 72: Telnet Server Configuration *(Continued)*

Command Name	OpenConfig Configuration	Junos Configuration
| Session-limit | ```
openconfig-system:system {
    telnet-server {
        config {
            session-limit <>;
        }
    }
}
``` | ```
system {
    services {
        telnet {
            connection-limit <>;
        }
    }
}
``` |

The OpenConfig `session-limit` leaf is set to the Junos telnet server `connection-limit` value.

| Timeout | ```
openconfig-system:system {
    telnet-server {
        config {
            timeout <>;
        }
    }
}
``` | Not supported. |

The OpenConfig `timeout` leaf is not supported on Junos.

| Enable | ```
openconfig-system:system {
    telnet-server {
        config {
            enable <>;
        }
    }
}
``` | ```
system {
    services {
        telnet {
            ……..
        }
    }
}
``` |

The OpenConfig `enable` leaf is a toggle to enable or disable the telnet server configuration. It's disabled or set to `FALSE` by default.

Mapping OpenConfig VLAN Commands to Junos Configuration

> **NOTE**: See "OpenConfig Data Model Version" on page 3 topic to understand the data models supported version and its Junos OS release for Juniper Networks EX Series and QFX Series.

Table 73 on page 234 to Table 76 on page 235 show the mapping of OpenConfig VLAN commands with the relevant configuration in Junos.

Table 73: Top Level Group VLAN Configuration

Command Name	OpenConfig Command Path	Junos Configuration
Interface VLAN ID	`vlans/vlan/vlan-id`	`set vlans vlan-name vlan-id vid`
Interface VLAN Name	`vlans/vlan/name`	
VLAN Admin State	`vlans/vlan/status`	`deactivate vlans vlan-name`

Table 74: VLAN Tagged IFL Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/ocif:interfaces/ocif:interface/ ocif:subinterfaces/ocif:subinterface/vlan**	
VLAN ID	`/config/vlan-id`	`set interfaces interface unit subinterface index vlan-id vid` `set interfaces interface vlan-tagging`

Table 75: VLAN Membership Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/oc-if:interfaces/oc-if:interface/oc-eth:ethernet/switched-vlan**	
Interface Mode	/config/interface-mode	`set interfaces ge-0/0/0 unit 0 family ethernet-switching interface-mode trunk (l2ng)`
Native VLAN	/config/native-vlan	`set interfaces ge-0/0/0 native-vlan-id` *vid* (for a trunk port) `set interface ge-0/0/0 unit 0 family ethernet-switching interface-mode trunk`

Trunk VLANs	/config/trunk-vlans	`set interfaces ge-0/0/0 unit 0 family ethernet-switching vlan members 600`
		`set interfaces ge-0/0/0 unit 0 family ethernet-switching vlan members [10-200]`
		`Interface-mode = TRUNK`

Access VLAN	/config/access-vlan	`set interfaces ge-0/0/0 unit 0 family ethernet-switching vlan members 600` `Interface-mode = ACCESS`

Table 76: Routed VLAN Interfaces Configuration

Command Name	OpenConfig Command Path	Junos Configuration
	Command path prefix: **/oc-if:interfaces/oc-if:interface/routed-vlan**	

Table 76: Routed VLAN Interfaces Configuration *(Continued)*

Command Name	OpenConfig Command Path	Junos Configuration
VLAN	/config/vlan	Set vlans *vlan-name* l3-interface irb.*vid* **NOTE**: To create IRB IFL, configure IPv4/IPv6 under routed VLAN hierarchy.

RELATED DOCUMENTATION

4

CHAPTER

Configuration Statements

netconf

Syntax

```
netconf {
    flatten-commit-results;
    hello-message {
        yang-module-capabilities {
            advertise-native-yang-modules;
            advertise-custom-yang-modules;
            advertise-standard-yang-modules;
        }
    }
    netconf-monitoring {
        netconf-state-schemas {
            retrieve-custom-yang-modules;
            retrieve-standard-yang-modules;
        }
    }
    notification;
    rfc-compliant;
    ssh {
        client-alive-count-max number;
        client-alive-interval seconds;
```

```
        connection-limit limit;
        port port;
        rate-limit limit;
    }
    tls {
        client-identity client-id {
            fingerprint fingerprint;
            map-type (san-dirname-cn | specified);
            username username;
        }
        default-client-identity {
            map-type (san-dirname-cn | specified);
            username username;
        }
        local-certificate local-certificate;
        traceoptions {
            file <filename> <files files> <match match> <size size> <(world-readable | no-world-
readable)>;
            flag name;
            level (all | error | info | notice | verbose | warning);
            no-remote-trace;
        }
    }
    traceoptions {
        file <filename> <files number> <match regular-expression> <size size> <world-readable |
 no-world-readable>;
        flag flag;
        no-remote-trace;
        on-demand;
    }
    yang-compliant;
    yang-modules {
        device-specific;
        emit-extensions;
    }
}
```

Hierarchy Level

```
[edit system services]
```

Description

Configure the NETCONF XML management protocol.

Default

If you do not include the `netconf` statement, NETCONF connections are not permitted.

Options

`flatten-commit-results`	Suppress the `<commit-results>` XML subtree in the NETCONF server's response for `<commit>` operations. This statement must be configured in conjunction with the `rfc-compliant` statement.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

system—To view this statement in the configuration.

system-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 7.5.

`flatten-commit-results` option added in Junos OS Release 21.2R1.

traceoptions (NETCONF and Junos XML Protocol)

schema

IN THIS SECTION

Syntax

```
schema {
    openconfig {
        unhide;
    }
}
```

Hierarchy Level

```
[edit system]
```

Description

Specify whether OpenConfig statements are available and viewable in the CLI.

Options

`openconfig unhide`	Unhide the OpenConfig statements in the CLI. By default, the OpenConfig schema is not available through the CLI. To rehide the OpenConfig statements, use the following command:

```
delete system schema openconfig unhide
```

Required Privilege Level

admin—To view this statement in the configuration.

admin-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 18.3R1.

RELATED DOCUMENTATION

Installing the OpenConfig Package | **12**

track-igp-metric (LSP)

Syntax

```
track-igp-metric <install-v4-prefixes> <install-v6-prefixes>;
```

Hierarchy Level

The hierarchy level for `track-igp-metric` globally enabled for all LSPs:

```
[edit protocols mpls]
```

The hierarchy level for `track-igp-metric` at the per LSP level:

```
[edit protocols mpls label-switched-path pathname],
```

Description

Track IGP metric for LSP install prefixes

Options

install-v4-prefixes   Track IGP metric for IPV4 prefixes.

install-v6-prefixes   Track IGP metric for IPV6 prefixes.

Required Privilege Level

routing

Release Information

Statement introduced in Junos OS Release 18.4R1.

RELATED DOCUMENTATION

Install Prefix IGP Overview