

# TCX Series Optical Transport System

## Release Notes for proNX Optical Director

### Release 2.1 and TCX1000-RDM20 Release

# 2.2

proNX Optical Director 2.1 and TCX1000-RDM20 2.2  
31 October 2018  
Revision 4

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## Introduction

This release note accompanies proNX Optical Director Release 2.1 and TCX1000-RDM20 Release 2.2, collectively known as the TCX Series Optical Transport System. This document describes new and changed features, known behavior, and known and resolved problems in the software.

You can also find the TCX Series Optical Transport System release notes in the Juniper Networks TechLibrary, located at <https://www.juniper.net/documentation/>.

## TCX Series Optical Transport System

The TCX Series Optical Transport System is a complete open packet optical layer solution that includes hardware, open network management, and disaggregated optical software controls. Disaggregation of the optical control management software from the underlying hardware provides multiple benefits including flexible deployment, scalability, enhanced automation, best-of-breed hardware support, and multi-layer optimization.

The TCX Series Optical Transport System is a portfolio of products that provide the foundation for a comprehensive, open, and programmable optical transport network. This release of the TCX Series Optical Transport System consists of the following software ([Table 1 on page 3](#)):

**Table 1: Software Releases**

Product	Software Release
TCX1000 Programmable ROADM (TCX1000-RDM20)	Release 2.2 (dcian_R2.2.1_103u)
proNX Optical Director	Release 2.1 (2.1.11)  <i>NOTE:</i> Requires Atomic Host Linux: 7.1711 (RedHat or CentOS)

### TCX1000 Programmable ROADM

At the center of the TCX Series portfolio is the TCX1000 Programmable ROADM or TCX1000-RDM20, which forms the foundation for an open, programmable, optical transport network. The TCX1000-RDM20 is a standalone, 20-port, reconfigurable optical add-drop multiplexer (ROADM) that provides all features of a route and select ROADM device in a compact, disaggregated, stackable, form factor. The TCX1000-RDM20 enables you to dynamically add and drop wavelengths in your optical network and pass through channels from one degree to another in multi-degree ROADM nodes. The pass-through capability enables multi-directional switching in ROADM nodes up to 20 degrees.

The TCX1000-RDM20 can be deployed with Juniper Networks passive multiplexer/demultiplexers to support up to 19.2 Tbps using 96 x 200-Gbps coherent channels.

In this release, the TCX1000-RDM20 supports a diverse range of packet optical network use cases, including ultra high-capacity metro and data center interconnect applications,

including point-to-point, linear multi-span, ring, and mesh network configurations. Combining the TCX1000-RDM20 with integrated coherent optics within Juniper Networks routing and switching platforms provides a powerful and comprehensive end-to-end managed solution.

## TCX1000-2D8CMD

The TCX1000-2D8CMD is a passive colorless optical multiplexer/demultiplexer that provides eight colorless client ports and two line ports. You can use the TCX1000-2D8CMD to expand the number of channels supported on the TCX1000-RDM20. By connecting a line port from the TCX1000-2D8CMD to a single universal port on the TCX1000-RDM20, you can add/drop an additional eight channels to the TCX1000-RDM20. This allows you to connect more transponders to the TCX1000-RDM20 while still maintaining the spectrally programmable (colorless) operation of the TCX1000-RDM20.

The TCX1000-2D8CMD is available as an industry standard LGX cassette. Up to 3 cassettes can be housed in a TCX1000 1RU passive chassis.

The dual line ports on the TCX1000-2D8CMD enable multi-direction add/drop connectivity in multi-degree ROADMs or can be used for 1 + 1 redundancy. Channel switching is configured on the TCX1000-RDM20 making reconfiguration of channel paths simple and easy.

## proNX Optical Director

The proNX Optical Director is a distributed software platform that provides optical control and management for all TCX Series optical products. It is an integral component of the TCX1000 Series Optical Transport System.

The proNX Optical Director also provides fault, configuration, accounting, performance and security (FCAPS) functionality and optical service activation on supported transceivers in Juniper Networks equipment.

The proNX Optical Director provides the following functionality:

- Optical control including dynamic real-time control of optical links in your optical transport networks. This includes automatic span loss management and automatic channel power control.

In traditional optical networks, this control function resides on the ROADMs themselves where the ROADMs exchange proprietary control messages with each other on an optical supervisory channel (OSC). This makes interworking across vendor equipment difficult and often leads to the deployment of single-sourced networks. Moving this function to a centralized software controller makes heterogeneous networks with equipment from multiple vendors possible.

- Network management of open optical line system (OLS) networks including network topology, network visualization, and network monitoring and troubleshooting.

The proNX Optical Director displays the topology of the network and provides various visual indicators so that you can see the health of the network at a glance and deal with problem areas in a proactive manner.

- Device management of OLS elements including device configuration, device visualization, and device monitoring and troubleshooting.

The proNX Optical Director discovers OLS elements and reads and displays their configuration. You can change the configuration, view the equipment inventory, pull up a visual representation of the device, or view performance monitoring counters and alarm details.



**NOTE:** TCX Series devices do not support a built-in user interface such as a command line interface. You must use the proNX Optical Director to manage all TCX Series devices.

- Service management of optical services across an OLS network including service provisioning, service activation, and service monitoring and troubleshooting.

The proNX Optical Director supports A-to-Z provisioning and activation of optical services. You select the two service endpoints and the proNX Optical Director provides you a list of paths that you can choose for that service. When you activate the service, the proNX Optical Director automatically configures the service across all the devices in the path.

- Endpoint management of supported transceivers on Juniper Networks equipment.

The OLS network provides optical service connectivity between endpoint transponders (typically). These transponders can be standalone or integrated within routers and switches. Although these endpoints are not technically part of the OLS network, you can use the proNX Optical Director to configure these endpoints on supported transceivers on Juniper Networks equipment.

- Northbound RESTCONF interface for connecting to higher level management systems.
- Web-based user interface. You can access the proNX Optical Director user interface from supported web browsers.

## TCX Series Optical Transport System Models and Licenses

Table 2 on page 5 describes the TCX1000-RDM20 hardware models available in this release.

**Table 2: TCX1000-RDM20 Hardware Models**

Model Number	Description
TCX1000-RDM20-AC	This system includes the chassis, two fan modules, and two AC power supplies.
TCX1000-RDM20-DC	This system includes the chassis, two fan modules, and two DC power supplies.



**NOTE:** You can purchase an AC or DC model of the TCX1000-RDM20 that allows you to use 8 of the 20 universal ports, see [Table 2 on page 5](#). You can purchase additional licenses to enable 2, 4, or 12 additional universal ports. See [Table 4 on page 6](#).

[Table 3 on page 6](#) describes the TCX1000-2D8CMD hardware models.

**Table 3: TCX1000-2D8CMD Hardware Models**

Model Number	Description
TCX1000-2D8CMD	TCX1000 two-degree eight-channel passive multiplexer/demultiplexer.
TCX1000-RCK-1	TCX1000 3-Slot passive 1U chassis.

[Table 4 on page 6](#) describes the TCX1000-RDM20 software licenses.

**Table 4: TCX1000-RDM20 Software Licenses**

Model Number	Description
TCX1000-RDM-2P-UP	License for 2 additional universal ports.
TCX1000-RDM-4P-UP	License for 4 additional universal ports.
TCX1000-RDM-12P-UP	License for 12 additional universal ports.

For a complete list of spares, see the [TCX1000 Programmable ROADM Hardware Guide](#).

[Table 5 on page 6](#) describes the proNX Optical Director software licenses.

**Table 5: proNX Optical Director Software Licenses**

SKU	Description
PRONX-OPT-DIR	<p>proNX Optical Director Software License</p> <p>This software license allows you to download and install the proNX Optical Director.</p> <p>You do not require a right-to-use (RTU) license to use the proNX Optical Director to manage TCX1000 Series devices, but you do require RTU licenses to use the proNX Optical Director to manage other devices.</p>
PRONX-OD-RTU-G1	<p>proNX Optical Director RTU License - Group 1 Devices</p> <p>This RTU license allows you to use the proNX Optical Director to manage MX Series routers.</p>
PRONX-OD-RTU-G2	<p>proNX Optical Director RTU License - Group 2 Devices</p> <p>This RTU license allows you to use the proNX Optical Director to manage PTX Series routers and QFX10000 switches.</p>

Table 5: proNX Optical Director Software Licenses (continued)

SKU	Description
NOTE: All software licenses are perpetual.	

## Documentation

In addition to these release notes, see the following links for the TCX Series Optical Transport System:

- [TCX1000 Programmable ROADM Hardware Guide](#)
- [TCX Series Optical Transport System Feature Guide](#)
- [proNX Optical Director Installation Guide](#)
- [proNX Optical Director User Guide](#)

## High Availability Management Network Requirements

The proNX Optical Director requires frequent updates on the current operating conditions of the ROADMs in your network in order to make the required decisions to maintain the optical performance of the managed device. This requirement for frequent updates drives the need for high availability and low latency in your management network (also known as the Data Communication Network or DCN).

In order to provide the reliability required, the DCN must be designed for high availability (HA). An HA system is intended for continuous operation and has redundant components and adequate backup and failover strategies.

You must connect both the proNX Optical Director and the devices that it manages to your highly available DCN. Refer to the [proNX Optical Director Installation Guide](#) for details on the high availability requirements for the proNX Optical Director.

## Features

This section describes the features for proNX Optical Director Release 2.1 and TCX1000-RDM20 Release 2.2:

- [Features for TCX1000-RDM20 on page 7](#)
- [Features for proNX Optical Director on page 9](#)

### Features for TCX1000-RDM20

#### 20-Port Route and Select ROADM

The TCX1000-RDM20 is a reconfigurable add-drop multiplexer (ROADM) that multiplexes and demultiplexes coherent channels from the 20 universal ports to a single composite signal for transmission out the line port. You can use the universal ports as follows:

- To directly add/drop channels in the optical network.
- To provide a secondary multiplexing function when connected to external optical multiplexer/demultiplexer devices for channel port expansion. For example, connecting the TCX1000-2D8CMD colorless multiplexer adds an additional eight colorless and directionless ports to the TCX1000-RDM20. Connecting the Juniper Networks BT17800-FMD96 fixed optical multiplexer-demultiplexer to a universal port enables the TCX1000-RDM20 to support 96 x 200 Gbps coherent channels.
- To pass channels between ROADM degrees in multi-degree ROADM nodes. Pass-through allows you to create ROADM nodes that scale up to 20 degrees.
- To support manual point-and-click service restoration by connecting to a TCX1000-2D8CMD multiplexer/demultiplexer. By connecting the universal port to a TCX1000-2D8CMD multiplexer/demultiplexer, you can create a protected service where you manually restore the service on a pre-configured protected path if a failure occurs on the primary path.

### Single and Multi-Directional Switching

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The switching capability within the TCX1000-RDM20 enables you to dynamically add and drop wavelengths and pass through channels from one degree to another in multi-degree ROADM nodes.

### Complete End-to-End Juniper Networks Coherent Packet Optical Solution

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The TCX1000-RDM20 can scale up to 19.2 Tbps on the composite line when you use 96 x 200 Gbps coherent channels on the universal ports. It supports a diverse range of packet optical network use cases, including ultra high capacity connectivity in metro and data center interconnect applications. It provides complete support for 100 Gbps and 200 Gbps coherent interfaces across Juniper Networks routing and switching platforms. The proNX Optical Director provides end-to-end optical control and management of the channel from the optical interface in the source router or switch, across the entire optical network to the optical interface in the destination router or switch.

### Integrated Optical Amplification

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The TCX1000-RDM20 integrates booster and pre-amplification to compensate for link and insertion losses.

### Integrated OSC

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This release supports a 1511 nm optical supervisory channel (OSC) for optical link negotiation.

### Automatic Laser Shutdown

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Due to the potential safety hazard that is posed by the high power optical outputs, the TCX1000-RDM20 has an automatic laser shutdown (ALS) mechanism that guards against the risk of direct human exposure to high-powered lasers.

The ALS mechanism acts to detect a fiber disconnection or fiber cuts along the span, and upon doing so, causes the shutdown of the high-powered WDM composite signal.



## Performance Monitoring

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The TCX1000-RDM20 reports performance metrics to the proNX Optical Director for all external ports on the system. The TCX1000-RDM20 also has a number of internal monitors that provide information about the total optical powers and per-channel powers (spectral information) at different points within the system. You can measure performance from these internal monitors at the following external ports:

- **Line In/Line Out** ports:
  - Total power monitoring (In and Out)
  - Spectral power monitoring (In and Out)
- **OSC 0** and **OSC 1** ports:
  - Total power monitoring (In and Out)
- **Universal** ports:
  - Total power monitoring on **Ux In** (add) ports
  - Spectral power on **Ux In** (add) ports

## Features for proNX Optical Director

This release of the proNX Optical Director adds support for the following:

- Optical service creation in ring and mesh networks
- Support for the TCX1000-2D8CMD colorless and 2-direction multiplexer/demultiplexer
- Configuration of manual point-and-click service restoration
- Nodal loss monitoring between universal ports used for pass-through
- New fiber types for ROADM line spans
- End-to-end channel power control
- NTP server configuration for supported MX Series and PTX Series routers and QFX Series switches

## Known Issues

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This section lists the known issues in this release of the TCX Series Optical Transport System.

For the most complete and latest information about known defects, use the Juniper Networks online [Problem Report Search](#) application.

- [Known Issues for the TCX1000-RDM20 on page 10](#)
- [Known Issues for the proNX Optical Director on page 10](#)

## Known Issues for the TCX1000-RDM20

- In some situations, a very low span loss (less than 2 dB) combined with a higher transmit output power at the far end OSC might cause a Receiver Overload alarm to be raised on a TCX1000-RDM20 OSC port.

Workaround: Add a fixed loss attenuator on either the far end transmit line port or the local receive line port to increase span loss by approximately 3 dB. [PR1334598](#)

## Known Issues for the proNX Optical Director

### General

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- In a large network, communication between the proNX Optical Director and managed devices might temporarily time out causing an increased number of raised and cleared Device Unreachable alarms. Traffic is not affected.

Workaround: None required. The proNX Optical Director automatically retries to contact the unreachable device and clears the alarm once the device is reached. If a Device Unreachable alarm is raised but not cleared within 5 minutes, check your network. [PR1361183](#)

- After power is restored following a power outage, the proNX Optical Director might occasionally not recover.

Workaround: This is a rare occurrence. If, after 15 minutes, the output of the `kubectl get pods` command from the master node shows that one or more pods have still not changed STATUS to Running, contact JTAC. The use of an Uninterruptible Power Supply (UPS) will reduce the risk of this problem occurring. [PR1337857](#)

### Optical Control

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- A Tx or Rx Nodal Loss Out of Range alarm might not clear even when the underlying condition causing the alarm no longer persists.

Workaround: Look at the Nodal Loss historical PM on the port that raised the alarm. If the nodal loss is within acceptable range but the alarm is still present, undiscover and then rediscover the device. [PR1351804](#)

### Network Topology and Services

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- Since physical links are not displayed in the service view, the state of physical links does not affect the service view. This can lead to a perceived anomaly where the service view shows all links as green but the service itself is operationally down because a physical link is down.

Workaround: Use the service state in the Network>Services>Provisioned page as the indicator on whether a service is up or down. [PR1324929](#)

## Resolved Issues

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This section lists the issues that have been fixed in the TCX Series Optical Transport system.

For the most complete and latest information about known TCX Series optical transport system defects, use the Juniper Networks online [Problem Report Search](#) application.

- [Resolved Issues for TCX Series Optical Transport System on page 12](#)
- [Resolved Issues for proNX Optical Director on page 12](#)

## Resolved Issues for TCX Series Optical Transport System

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- If a single fiber is cut in a fiber pair, the receiving device detects the failure and invokes automatic laser shutdown (ALS) procedures. This causes the device at the transmitting end of the fiber to correctly raise an Optical Line Failure alarm. However, this alarm is not properly masked, which results in the alarm being raised and cleared every 5 seconds (approximately) for the duration of the failure. ALS functionality continues to operate and is not affected by this issue.

Workaround: None. The alarm will clear and remain cleared once the fiber is repaired.  
[PR1318917](#)

## Resolved Issues for proNX Optical Director

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- The GUI displays the internal software version number for MX Series and PTX Series routers and QFX Series switches.

Workaround: None required. The last part of the internal software version number indicates the external software version number. [PR1316840](#)

- The web socket between the web browser GUI and the proNX Optical Director server might time out too quickly, causing “Failed to connect to device-service for events” and similar messages to be displayed in the notification area.

Workaround: None required. The GUI reconnects automatically. Dismiss the message.  
[PR1322304](#)

- A port can be provisioned as an endpoint for more than one topology link.

Workaround: Before creating a link, ensure the endpoints are not already configured for another link. [PR1324934](#)

- The DEMUX Output Power historical PM metric on a TCX1000-RDM20 universal port is not supported but it is collected and displayed in the Port Metrics page. [PR1329226](#)
- After the proNX Optical Director discovers a TCX1000-RDM20 device that is in factory default state (either because the device is being brought up for the first time or the device has been explicitly reset to factory defaults), some of the initialization tasks that the proNX Optical Director runs on the device might fail. These are shown as failed Device Edit tasks in the Administration>Tasks page.

Workaround: None required. The proNX Optical Director automatically retries the failed tasks. [PR1330318](#)

- When you delete a topology link from the Network>Topology page, the link sometimes remains undeleted.

Workaround: If the link remains undeleted on a refreshed page after a few minutes, manually rediscover the devices at each end of the link. [PR1330606](#)

- When changing port parameters in tail facility ports (for example, a transponder port on a supported router or switch), the changes take effect but are sometimes not displayed.

Workaround: If the port parameter changes are not displayed on a refreshed page after a few minutes, manually rediscover the tail facility device. [PR1330856](#)

- A Tx Span Loss Out of Range alarm, an Rx Span Loss Out of Range alarm, and/or an OTI Communication Failure alarm might occasionally remain raised even when the underlying issue that caused the alarm is resolved.

Workaround: Rediscover the device with the stuck alarm. [PR1332922](#)

- When creating a service with a tail facility endpoint, you can select the tail facility endpoint as the Source Device and Source Endpoint but not as the Destination Device and Destination Endpoint.

Workaround: To select a tail facility endpoint at the Destination, select the TCX1000-RDM20 as the Destination Device and then use the Destination Endpoint drop-down list to select the desired tail facility endpoint. [PR1338788](#)

## Documentation Updates

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This section lists the errata and changes in the TCX Series documentation.

- [TCX1000 Programmable ROADM Quick Start Guide on page 13](#)

### TCX1000 Programmable ROADM Quick Start Guide

This is the updated section for the *TCX1000 Programmable ROADM Compliance Statements for NEBS*:

- The equipment is suitable for installation as part of the Common Bonding Network (CBN).
- The equipment is suitable for installation in Network Telecommunications Facilities.
- The battery return connection is to be treated as an isolated DC return (that is, DC-I), as defined in GR-1089-CORE.
- You must provision a readily accessible device outside of the equipment to disconnect power. The device must also be rated based on local electrical code practice.

The sample output displayed in “Step 9: Perform the Initial Configuration” has been updated. See the [TCX1000 Programmable ROADM Quick Start Guide](#).

## Upgrading the Optical Transport Network

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This procedure explains how to upgrade the software in a TCX Series optical transport network, including upgrading the proNX Optical Director and all the managed TCX1000 Series devices. Upgrading the network can take time, depending on the size and configuration of the network.

You must upgrade the software on the proNX Optical Director before you upgrade the software on the TCX1000 Series device. Additionally, you cannot have a mix of devices running different versions of software in your network (except for transient situations when you are upgrading). The proNX Optical Director and the TCX1000 Series devices that it manages must be running the software versions listed in [Table 1 on page 3](#).



**NOTE:** During the upgrade process, the optical links in your network run without optical controls.

Before you begin, make a list of the managed devices that the proNX Optical Director is currently managing. You will need to rediscover these devices after you upgrade the proNX Optical Director.

1. Undiscover all TCX1000 Series devices in your network.
2. Upgrade the proNX Optical Director software.

See “[Upgrading the proNX Optical Director](#)” on page 14 for more information.



**NOTE:** This requires a reinstallation of the Atomic Host operating system. All data will be lost.

3. Rediscover all the managed devices.
4. Upgrade the software on the TCX1000 Series devices.

See “[Upgrading the TCX1000 Series Devices](#)” on page 15 for more information.



**NOTE:** You must upgrade your devices immediately after you finish upgrading the proNX Optical Director. You will not be able to activate new optical services until the entire network has been upgraded.

After you finish upgrading the proNX Optical Director and all the TCX1000 Series devices in your network, you can begin to activate new optical services.

## Upgrading the proNX Optical Director



**NOTE:** The installation procedures for the proNX Optical Director require you to be familiar with Linux. If you are not comfortable installing Linux or running Linux commands from the command line, ensure that a craftsperson with Linux administration responsibilities is on hand throughout the installation process.

The proNX Optical Director software is installed on a cluster of three Linux machines. You need to set up each cluster server with the required Linux distribution prior to installing the proNX Optical Director.

To facilitate installation, we recommend that you use an additional computer to download, distribute, and install the required images on to the servers in the cluster. This additional computer is called the control machine. Once you set up the control machine, you can use the supplied scripts to carry out the installation on the cluster without having to work with each cluster member individually.

You can set up a new computer for the control machine or you can use an existing computer if you have one available.

The proNX Optical Director software is supplied as a single gzipped tarball. This tarball includes everything you need to install the proNX Optical Director including the installation scripts and the full set of container images. The proNX Optical Director installation process leverages the use of Ansible scripts to facilitate installation.

Refer to the [proNX Optical Director Installation Guide](#) for complete instructions on installing the proNX Optical Director control and management software. If you are running a previous release of the proNX Optical Director, you must perform a fresh installation of the Atomic Host operating system before you install this release of the proNX Optical Director.

## Upgrading the TCX1000 Series Devices

TCX1000 Series devices support non-disruptive software upgrades where the device retains the last known configuration and passes traffic uninterrupted. You can perform software upgrades on a single device or on multiple devices simultaneously. All software upgrades are initiated from the proNX Optical Director across the DCN (management network).

There are two phases in the software upgrade process: Stage and Activate

- Staging copies the software package to the TCX1000 Series device.
  - Activate performs the upgrade on the device
1. Download the TCX1000 software package from the Juniper Networks website.
  2. Save the TCX1000 software package to an SFTP server.
  3. In proNX Optical Director:
    - a. Select the SFTP server on which the software package resides.
    - b. Select the name of the TCX1000 software package.
    - c. Select the **Stage** operation to copy the software package to the TCX1000 device. Ensure this task completes successfully before proceeding.
    - d. Select the **Activate** operation to upgrade the device software. Ensure this task completes successfully before proceeding.

For more information on upgrading the software using the proNX Optical Director, see the [proNX Optical Director User Guide](#).

## Finding More Information

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For the latest, most complete information about known and resolved issues with the TCX Series optical transport system, see Juniper Networks Problem Report Search application at:

<https://prsearch.juniper.net>.

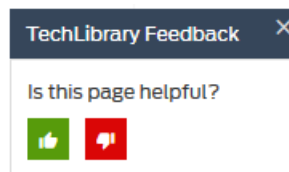
All documentation for the TCX Series optical transport system can be found at [Juniper Networks TechLibrary](#).

## Documentation Feedback

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We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can provide feedback by using either of the following methods:

- Online feedback system—Click TechLibrary Feedback, on the lower right of any page on the [Juniper Networks TechLibrary](#) site, and do one of the following:



- Click the thumbs-up icon if the information on the page was helpful to you.
- Click the thumbs-down icon if the information on the page was not helpful to you or if you have suggestions for improvement, and use the pop-up form to provide feedback.
- E-mail—Send your comments to [techpubs-comments@juniper.net](mailto:techpubs-comments@juniper.net). Include the document or topic name, URL or page number, and software version (if applicable).

## Requesting Technical Support

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Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or Partner Support Service support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at <https://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf>.



- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/>.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

## Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: <https://www.juniper.net/customers/support/>
- Search for known bugs: <https://prsearch.juniper.net/>
- Find product documentation: <https://www.juniper.net/documentation/>
- Find solutions and answer questions using our Knowledge Base: <https://kb.juniper.net/>
- Download the latest versions of software and review release notes: <https://www.juniper.net/customers/csc/software/>
- Search technical bulletins for relevant hardware and software notifications: <https://kb.juniper.net/InfoCenter/>
- Join and participate in the Juniper Networks Community Forum: <https://www.juniper.net/company/communities/>
- Open a case online in the CSC Case Management tool: <https://www.juniper.net/cm/>

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: <https://entitlementsearch.juniper.net/entitlementsearch/>

## Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Management tool in the CSC at <https://www.juniper.net/cm/>.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see <https://www.juniper.net/support/requesting-support.html>.

## Revision History

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31 October 2018 — Revision 4 — Realigned version numbers to match the software and updated descriptions.

20 July 2018 — Revision 3 — Updated document title.

5 July 2018 — Revision 2 — Revised the “Documentation Updates” section.

7 June 2018 — Revision 1 — Initial release.

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