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# NorthStar Controller User Guide

Release

4.0.0



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Modified: 2018-10-19

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*NorthStar Controller User Guide*

4.0.0

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## Part 3

### Chapter 11

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# About the Documentation

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## Documentation and Release Notes

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To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at <https://www.juniper.net/documentation/>.

If the information in the latest release notes differs from the information in the documentation, follow the product Release Notes.

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at <https://www.juniper.net/books>.

## Documentation Conventions

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Table 1 on page xviii defines notice icons used in this guide.

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xviii defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
<b>Bold text like this</b>	Represents text that you type.	To enter configuration mode, type the <b>configure</b> command:  user@host> <b>configure</b>
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> <b>show chassis alarms</b>  No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> <li>Introduces or emphasizes important new terms.</li> <li>Identifies guide names.</li> <li>Identifies RFC and Internet draft titles.</li> </ul>	<ul style="list-style-type: none"> <li>A policy <i>term</i> is a named structure that defines match conditions and actions.</li> <li><i>Junos OS CLI User Guide</i></li> <li>RFC 1997, <i>BGP Communities Attribute</i></li> </ul>
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name:  [edit] root@# <b>set system domain-name</b> <i>domain-name</i>

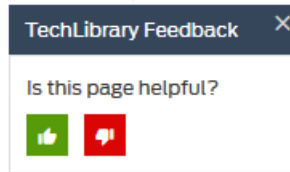
Table 2: Text and Syntax Conventions (continued)

Convention	Description	Examples
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"><li>To configure a stub area, include the <b>stub</b> statement at the <b>[edit protocols ospf area area-id]</b> hierarchy level.</li><li>The console port is labeled <b>CONSOLE</b>.</li></ul>
< > (angle brackets)	Encloses optional keywords or variables.	<b>stub &lt;default-metric <i>metric</i>&gt;;</b>
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	<b>broadcast   multicast</b>  <b>(<i>string1</i>   <i>string2</i>   <i>string3</i>)</b>
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	<b>rsvp { # Required for dynamic MPLS only</b>
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	<b>community name members [ <i>community-ids</i> ]</b>
Indentation and braces ( { } )	Identifies a level in the configuration hierarchy.	<pre>[edit] routing-options {   static {     route default {       nexthop <i>address</i>;       retain;     }   } }</pre>
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"><li>In the Logical Interfaces box, select <b>All Interfaces</b>.</li><li>To cancel the configuration, click <b>Cancel</b>.</li></ul>
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select <b>Protocols&gt;Ospf</b> .

## Documentation Feedback

We encourage you to provide feedback so that we can improve our documentation. You can use 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 <https://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.

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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>.



## PART 1

# Introduction to the NorthStar Controller

- [NorthStar Controller Overview on page 3](#)
- [NorthStar Controller Web UI Introduction on page 13](#)



## CHAPTER 1

# NorthStar Controller Overview

- [Understanding the NorthStar Controller on page 3](#)
- [NorthStar Controller Features Overview on page 6](#)

## Understanding the NorthStar Controller

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The Juniper Networks NorthStar Controller is an SDN controller that enables granular visibility and control of IP/MPLS tunnels in large service provider and enterprise networks. Network operators can use the NorthStar Controller to optimize their network infrastructure through proactive monitoring, planning, and explicit routing of large traffic loads dynamically based on user-defined constraints.

The NorthStar Controller provides network managers with a powerful and flexible traffic engineering solution with some important features:

- Complex inter-domain path computation and network optimization
- Comprehensive network planning, capacity, and topology analysis
- Ability to address multilayer optimization with multiple user-defined constraints
- Specific ordering and synchronization of paths signaled across routed network elements
- Global view of the network state for monitoring, management, and proactive planning
- Ability to receive an abstracted view of an underlying transport network and utilize the information to expand its packet-centric applications
- Active/standby high availability (HA) cluster
- System and network monitoring

The NorthStar Controller relies on PCEP to instantiate a path between the PCC routers. The path setup itself is performed through RSVP-TE signaling, which is enabled in the network and allows labels to be assigned from an ingress router to the egress router. Signaling is triggered by ingress routers in the core of the network. The PCE client runs on the routers by using a version of the Junos operating system (Junos OS) that supports PCEP.

The NorthStar Controller provisions PCEP in all PE devices (PCCs) and uses PCEP to retrieve the current status of the existing tunnels (LSPs) that run in the network. By providing a view of the global network state and bandwidth demand in the network, the

NorthStar Controller is able to compute optimal paths and provide the attributes that the PCC uses to signal the LSP.

The following sections describe the architecture, components, and functionality of the NorthStar Controller:

- [Architecture and Components on page 4](#)
- [Interaction Between the PCC and the PCE on page 5](#)
- [Dynamic Path Provisioning on page 5](#)

## Architecture and Components

Based on the Path Computation Element (PCE) architecture as defined in RFC 5440, the NorthStar Controller provides a stateful PCE that computes the network paths or routes based on a network graph and applies computational constraints. A Path Computation Client (PCC) is a client application that requests the PCE perform path computations for the PCC's external label-switched paths (LSPs). The Path Computation Element Protocol (PCEP) enables communication between a PCC and the NorthStar Controller to learn about the network and LSP path state and communicate with the PCCs. The PCE entity in the NorthStar Controller calculates paths in the network on behalf of the PCCs, which request path computation services. The PCCs receive and then apply the paths in the network.

The stateful PCE implementation in the NorthStar Controller provides the following functions:

- Allows online and offline LSP path computation
- Triggers LSP reroute when there is a need to reoptimize the network
- Changes LSP bandwidth when an application demands an increase in bandwidth
- Modifies other LSP attributes on the router, such as explicit route object (ERO), setup priority, and hold priority

A TCP-based PCEP session connects a PCC to an external PCE. The PCC initiates the PCEP session and stays connected to the PCE for the duration of the PCEP session. During the PCEP session, the PCC requests LSP parameters from the stateful PCE. When receiving one or more LSP parameters from the PCE, the PCC resignals the TE LSP. When the PCEP session is terminated, the underlying TCP connection is closed immediately, and the PCC attempts to reestablish the PCEP session.

The PCEP functions include the following:

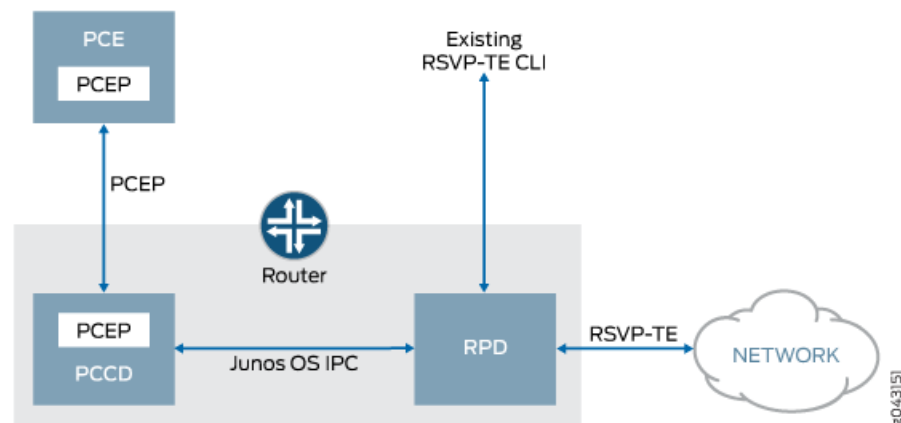
- LSP tunnel state synchronization between a PCC and a stateful PCE— When an active stateful PCE connection is detected, a PCC synchronizes an LSP state with the PCE. PCEP enables a fast and timely synchronization of the LSP state to the PCE.
- Delegation of control over LSP tunnels to a stateful PCE—An active stateful PCE controls one or more LSP attributes for computing paths, such as bandwidth, path (ERO), and priority (setup and hold). PCEP enables such delegation of LSPs.

- Stateful PCE control of timing and sequence of path computations within and across PCEP sessions—An active stateful PCE modifies one or more LSP attributes, such as bandwidth, path (ERO), and priority (setup and hold). PCEP communicates these new LSP attributes from the PCE to the PCC, after which the PCC resignals the LSP in the specified path.

## Interaction Between the PCC and the PCE

For the NorthStar Controller, the PCC runs in a new Junos OS daemon, the Path Computation Client Process (PCCD), which interacts with the PCE and with the Routing Protocol Process (RPD) through an internal Junos OS IPC mechanism. [Figure 1 on page 5](#) shows the interaction among the PCE, PCCD, and RPD.

*Figure 1: PCCD as Relay/Message Translator Between the PCE and RPD*



The PCCD is stateless so it does not keep any state other than current outstanding requests, and does not remember any state for established LSPs. The PCCD requests the state after the response comes back from the PCE and then forwards the response to the RPD. Because the PCCD is stateless, the RPD only needs to communicate with the PCCD when the LSP is first created. After the RPD receives the results from the PCCD, the results are stored (even across RPD restarts), and the RPD does not need to communicate with the PCCD again until the LSP is rerouted (when the LSP configuration is changed or the LSP fails).

## Dynamic Path Provisioning

To provide dynamic path provisioning, each ingress label-edge router (LER) must be configured as a Path Computation Client (PCC). Through PCEP, each PCC informs the NorthStar Controller (PCE server) asynchronously about the state of LSPs, including LSP operational state, admin state, and protection in-use events. The LSP state update and LSP provisioning depend on the TCP/PCEP connection state. If the TCP connection goes down as a result of connection flaps or PCC failure, the NorthStar Controller waits approximately 60 seconds for PCC reconnection then removes the LSP state.

- Related Documentation**
- [NorthStar Controller Features Overview on page 6](#)

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## NorthStar Controller Features Overview

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The NorthStar Controller software provides traffic-engineering-based solutions for WAN and edge (data center edge and WAN edge) networks. After the NorthStar Controller has connected to the network and dynamic topology acquisition is performed to provide a real-time routing view of the network topology, you can view the network model from the NorthStar Controller UI. You can then plan, analyze, and assess the impact of network changes you want to make before implementing them.

Highlights of supported use cases and features include:

- **Multi-user login**—Multiple full-access users can be logged into NorthStar simultaneously. This is achieved with an architecture that distributes the responsibilities of the NorthStar server. A maximum of 64 view-only users and ten full-access users can simultaneously log in to NorthStar, and a single user can log into NorthStar multiple times from different devices, each login occupying one licensed user session slot.
- **Web UI**—Provides Operator access to the NorthStar Controller application. Features available by way of the web UI are defined by user role. The web UI is accessed through a webserver URL, using a modern web browser.



**NOTE:** Planner functionality is not available through the web UI. To perform simulations without affecting the live network, you must use the NorthStar Planner UI.

- **Dynamic topology acquisition**—Use routing protocols (IS-IS, OSPF, and BGP-LS) to obtain real-time topology updates.
- **Label-switched path (LSP) reporting**—Label edge routers (LERs) use PCEP reports to report all types of LSPs (PCC\_controlled, PCC\_delegated, and PCE\_initiated) to the NorthStar Controller.
- **LSP provisioning**—Create LSPs from the NorthStar Controller or update LSPs that have been delegated to the NorthStar Controller. You can also create multiple LSPs at one time.
- **Symmetric pair groups**—Design a pair of LSPs so that the LSP from the ingress LER to the egress LER follows the same path as the LSP from the egress LER to the ingress LER. You can access this feature in the web UI by navigating to **Applications > Provision LSP**, and clicking on the Advanced tab.
- **Diverse LSPs**—From the NorthStar Controller UI, design two LSPs so that the paths are node, link, or SRLG diverse from each other.



**NOTE:** The NorthStar Controller supports diverse point-to-point LSPs. The provisioning of diverse point-to-multipoint LSPs is not supported.



- Standby and secondary LSPs—Provide an alternate route in the event the primary route fails. The tunnel ID, from node, to node, and IP address of a secondary or standby LSP are identical to that of the primary LSP. However, secondary and standby LSPs have the following differences:
  - A secondary LSP is not signaled until the primary LSP fails.
  - A standby LSP is signaled regardless of the status of the primary LSP.
- Time-based LSP scheduling—Schedule the creation of LSPs based on future requirements by using time-based calendaring. You can schedule an LSP as a one-time event or recurring daily event for a specified period of time to schedule setup, modification, and teardown of LSPs based on the traffic load, bandwidth, and setup and hold priority requirements of your network over time. The scheduling of an LSP is configured on the primary path, and the scheduled time applies to all paths (primary, secondary, and standby).
- LSP templates—The NorthStar Controller supports LSP templates configured on the router. A template defines a set of LSP attributes to apply to all PCE-initiated LSPs that provide a name match with the regular expression (regex) name specified in the template. By associating LSPs (through regex name matching) with an LSP template, you can automatically enable or disable LSP attributes across any LSPs that provide a name match with the regex name that is specified in the template. In the NorthStar UI, the same attributes are applied.
- Auto-bandwidth support—Auto-bandwidth parameters are figured on the router, even when the LSP has been delegated to the NorthStar Controller. You can enable auto-bandwidth parameters by way of a template on the router so that any PCE-controlled LSP that provides a name match with a regular expression (regex) name defined in a template inherits the LSP attributes specified in that template. The NorthStar Controller applies the same attributes and displays them in the UI.



**NOTE:** The bandwidth specified in a PCE-initiated LSP must be greater than or equal to the minimum bandwidth that is specified in an auto-bandwidth template, or the template should not contain a minimum-bandwidth clause. In addition, the bandwidth specified in a PCE-initiated LSP should not exceed the maximum bandwidth that is specified in the template.

Auto-bandwidth behavior varies depending on the LSP type:

- Router-controlled (PCC-controlled) LSPs—The NorthStar Controller must learn about router-controlled LSPs. The PCC performs statistical accounting of LSP bandwidth and LSP resizing is driven by bandwidth threshold triggers. The NorthStar Controller is updated accordingly.
- NorthStar Controller-managed (PCC-delegated) LSPs —The PCC performs bandwidth accounting for these LSPs. When bandwidth thresholds are reached, a PCReq message is sent to the NorthStar Controller's Path Computation Server (PCS) to compute the Explicit Route Object (ERO). The PCC determines how to resize the

LSP while the PCS provides the ERO that meets the constraints. These LSPs are delegated as usual, and PCRpt messages are sent with the Delegation bit set.

When bandwidth threshold triggers are reached on the PCC, a PCRpt message is sent to the PCE. The PCRpt message includes the vendor TLV specifying the new requested bandwidth. The following conditions apply:

- If a new path is available, make-before-break (MBB) signaling is attempted and a new path is signaled. The PCRpt message from the PCC to PCE reports the updated path.
- If a new path is not found, the process described above is repeated whenever the adjust interval timer is triggered.
- NorthStar Controller-created (PCE-initiated) LSPs—When an LSP is created from the NorthStar Controller UI, a template defines the auto-bandwidth attributes associated with the LSP, which allows the PCC to treat the LSP as an auto-bandwidth LSP. All other LSP behavior is the same as the NorthStar Controller-managed LSP.
- LSP optimization—Analyze and optimize LSPs that have been delegated to the NorthStar Controller. You can use the Analyze Now feature to run a path optimization analysis and create an optimization report to help you determine whether optimization should be done. You can also use the Optimize Now feature to automatically optimize paths, with or without a user-defined timer. A report is not created when you use Optimize Now, and the optimization is based on the current network conditions, not on the conditions in effect the last time the analysis was done.
- Enable or disable LSP provisioning from the NorthStar Controller—The administrator can globally enable or disable provisioning of LSPs for all NorthStar Controller users by navigating to **Administration > System Settings**. If provisioning is disabled, changes can still be made in the UI, but they are not pushed out to the network.
- Schedule maintenance events—Select nodes and links for maintenance. When you schedule a maintenance event on nodes or links, the NorthStar Controller routes delegated LSPs around those nodes and links that are scheduled for maintenance. After completion of the maintenance event, delegated LSPs are reverted back to optimal paths.
- Run simulations for scheduled maintenance events—Run simulations from the NorthStar Controller on scheduled maintenance events for different failure scenarios to test the resilience of your network, or run simulations before the event occurs. Network simulation is based on the current network state for the selected maintenance events at the time the simulation is initiated. Simulation does not simulate the maintenance event for a future network state or simulate elements from other concurrent maintenance events. You can run network simulations based on selected elements for maintenance or extended failure simulations, with the option to include exhaustive failures.
- TE++ LSPs—A TE++ LSP includes a set of paths that are configured as a specific container statement and individual LSP statements, called sub-LSPs, which all have equal bandwidth.

For TE++ LSPs, a normalization process occurs that resizes the LSP when either of the following two triggers initiates the normalization process:

- A periodic timer
- Bandwidth thresholds are met

When either of the preceding triggers is fired, one of the following events can occur:

- No change is required.
- LSP splitting—Add another LSP and distribute bandwidth across all the LSPs.
- LSP merging—Delete an LSP and distribute bandwidth across all the LSPs.

For a TE++ LSP, the NorthStar Controller displays a single LSP with a set of paths, and the LSP name is based on the matching prefix name of all members. The correlation between TE-LSPs is based on association, and the LSP is deleted when there is no remaining TE LSP.



**NOTE:** TE++ is supported on PCC (router) controlled LSPs and delegated LSPs, but TE++ LSPs cannot be created on the NorthStar Controller.

- Multilayer support—Improves the quality of NorthStar Controller path computations by factoring in a level of information about the transport domain that would otherwise not be available. The topology information is pushed to the NorthStar Controller client in the form of a YANG-based data model over RESTCONF and REST APIs. This ensures that the client and the transport network entity can communicate. For more information about YANG data modeling, see *draft-ietf-teas-yang-te-topo-01, YANG Data Model for TE Topologies*.
- OpenStack support using a two-VM model—The NorthStar Controller can be installed and run using a two-VM OpenStack model. The NorthStar Controller application is installed on top of the Linux VM. The JunosVM is provided in Qcow2 format.
- User authentication with an external LDAP server—You can specify that users are to be authenticated using an external LDAP server rather than the default local authentication. This enables in-house authentication. The client sends an authentication request to the NorthStar Controller, which forwards it to the external LDAP server. Once the LDAP server accepts the request, NorthStar queries the user profile for authorization and sends the response to the client. The NorthStar web UI facilitates LDAP authentication configuration with an admin-only window available from the Administration menu.
- Secondary loopback address support—The NorthStar Controller supports using a secondary loopback address as the MPLS-TE destination address. When you modify a node in the web UI, you have the option to add destination IP addresses in addition to the default IPv4 router ID address, and assign a descriptive tag to each. You can then specify a tag as the destination IP address when provisioning an LSP.



**NOTE:** A secondary IP address must be configured on the router for the LSP to be provisioned correctly.

- **P2MP support**—The NorthStar Controller receives the P2MP names used to group sub-LSPs together from the PCC/PCE, by way of autodiscovery. In the NorthStar Controller web UI, a new P2MP window is now available that displays the P2MP LSPs and their sub-LSPs. Detailed information about the sub-LSPs is also available in the Tunnel tab of the network information table. From the P2MP window, right-clicking a P2MP name displays a graphical tree view of the group.
- **Admin groups**—Admin groups, also known as link coloring or resource class assignment, are manually assigned attributes that describe the “color” of links, such that links with the same color conceptually belong to the same class. You can use admin groups to implement a variety of policy-based LSP setups. Admin group values for PCE-initiated LSPs created in the controller are carried by PCEP.

The NorthStar Controller web UI also supports setting admin group attributes for LSPs in the Advanced tab of the Provision LSP and Modify LSP windows. The admin group for PCC-delegated and locally controlled LSPs can be viewed in the web UI as well. For PCC-delegated LSPs, existing attributes can be modified in the web UI.

- **High availability (active/standby)**—The NorthStar Controller high availability (HA) implementation provides an active/standby solution, meaning that one node in the cluster (the active node) runs the active NorthStar components (PCE, Toposerver, Path Computation, REST), while the remaining (standby) nodes run only those processes necessary to maintain database and BGP-LS connectivity unless the active node fails. HA is an optional, licensed, feature.
- **Multiple Network-Facing Interfaces for High Availability Deployments**—A total of five monitored interfaces are now supported, one of which is designated by the user as the cluster communication (Zookeeper) interface. The `net_setup.py` script allows configuration of the monitored interfaces in both the host configuration (Host interfaces 1 through 5), and JunosVM configuration (JunosVM interfaces 1 through 5). In HA Setup, `net_setup.py` enables configuration of all of the interfaces on each of the nodes in the HA cluster.
- **Source Packet Routing in Networking (SPRING)**, also known as segment routing—Segment routing is a control-plane architecture that enables an ingress router to steer a packet through a specific set of nodes and links in the network. For more information about segment routing, see the following Junos OS documentation: [Understanding Source Packet Routing in Networking \(SPRING\)](#). Adjacency segment ID (SID) labels (associated with links) and node SID labels (associated with nodes) can be displayed on the NorthStar topological map and SR-LSP tunnels can be created using both adjacency SID and node SID labels.
- **Health monitoring**—A process in the NorthStar Controller architecture that provides health monitoring functionality in the areas of process, server, connectivity, and license monitoring, and the monitoring of distributed analytics collectors in an HA environment. Navigate to **Administration > System Health** to view monitored parameters. Critical health monitoring information is pushed to a web UI banner that appears above the Juniper Networks logo.
- **Analytics**—Streams data from the network devices, via data collectors, to the NorthStar Controller where it is processed, stored, and made available for viewing in the web UI. The NorthStar Controller periodically connects to the network in order to obtain the

configuration of the network devices. It uses this information to correlate IP addresses, interfaces, and devices. The collection schedule is user-configured. Junos Telemetry Interface (JTI) sensors generate data from the PFE (LSP traffic data, logical and physical interface traffic data), and send probes through the data-plane. In addition to connecting the routing engine to the management network, a data port must be connected to the collector on one of your devices. The rest of the devices in the network can use that interface to reach the collector. Views and work flows in the web UI support visualization of collected data so it can be interpreted.

- **Netconf Persistence**—Allows you to create a collection task for netconf and display the results of the collection. Netconf collection is used by the Analytics feature to obtain the network device configuration information needed to organize and display collected data in a meaningful way in the web UI.
- **Provisioning of LSPs via Netconf**—As an alternative to provisioning LSPs (P2P) using PCEP (the default), you can now provision using Netconf. And with Netconf, you can provision P2MP LSPs as well. To use Netconf, the NorthStar Controller must rely on periodic device collection to learn about LSPs and other updates to the network. Unlike with PCEP, the NorthStar Controller with Netconf supports logical systems.

**Related Documentation** • [Understanding the NorthStar Controller on page 3](#)



## CHAPTER 2

# NorthStar Controller Web UI Introduction

- [NorthStar Application UI Overview on page 13](#)
- [NorthStar Controller Web UI Overview on page 17](#)
- [User and Account Control on page 22](#)

## NorthStar Application UI Overview

NorthStar has two user interfaces (UIs):

- NorthStar Controller UI (web)—for working with a live network
- NorthStar Planner UI (Java client)—for simulating the effect of various scenarios on the network, without affecting the live network

## UI Comparison

[Table 3 on page 13](#) summarizes the major use cases for the Controller and Planner.



**NOTE:** All user administration (adding, modifying, and deleting users) must be done from the web UI.

**Table 3: Controller Versus Planner Comparison**

NorthStar Controller (web client)	NorthStar Planner (Java client)
Manage, monitor, and provision a live network in real-time.	Design, simulate, and analyze a network offline.
Live network topology map shows node status, link utilization, and LSP paths.	Network topology map shows simulated or imported data for nodes, links, and LSP paths.
Network information table shows live status of nodes, links, and LSPs.	Network information table shows simulated or imported data for nodes, links, and LSPs.
Discover nodes, links, and LSPs from the live network using PCEP or NETCONF.	Import or add nodes, links, and LSPs for network modeling.
Provision LSPs directly to the network.	Add and stage LSPs for provisioning to the network.

**Table 3: Controller Versus Planner Comparison (continued)**

NorthStar Controller (web client)	NorthStar Planner (Java client)
Create or schedule maintenance events to re-route LSPs around the impacted nodes and links.	Create or schedule simulation events to analyze the network model from failure scenarios.
Dashboard reports shows current status and KPIs of the live network.	Report manager provides extensive reports for simulation and planning.
Analytics collects real-time interface traffic or delay statistics and stores the data for querying and chart displays.	Import interface data or aggregate archived data to generate historical statistics for querying and chart displays.

## Groups and Privileges

Users are created into two different permission levels, called groups—Full Access group and View Only group. A user's group determines the privilege level the user is allowed, either full-access privilege or view-only privilege. Full Access group users can log in with either full-access or view-only privilege. View-only group users are restricted to view-only privilege.

In the NorthStar Controller, users logged in with full-access privilege have provision and modify actions available to them in the NorthStar Controller application, while users logged in with view-only privilege do not. The default privilege is view-only. You must click the Enable Full Access checkbox on the login window to request full-access privilege.

Only Full Access group users have access to the NorthStar Planner.

Full-access login is granted when requested if:

- The user belongs to the Full Access group, and
- The permitted number of logged-in full-access privilege users has not been reached.

A maximum of 64 view-only users and ten full-access users can simultaneously log in to NorthStar. Because full-access users can log in to either the NorthStar Controller or the NorthStar Planner, this means there can be a total of ten full-access users combined between both UIs. If a user attempts to log in with full-access privilege when all of the full-access slots are occupied, an error message is displayed. For the web UI, the user can still log in, but with view-only privilege, assuming there are view-only slots available.



**NOTE:** A single user can log into NorthStar multiple times from different devices, each login occupying one user session slot.

## The Administrator Role

The NorthStar Administrator is a special user type, belonging to the Full Access user group. The Administrator (Admin) can log in with either full-access or view-only privilege. When logged in with full-access privilege, the Admin is the only user who can access the User Administration functions. The Admin can always log in to perform admin-only



functions, even when all user session slots are occupied. The Admin can also selectively disconnect user sessions.

## The NorthStar Login Window

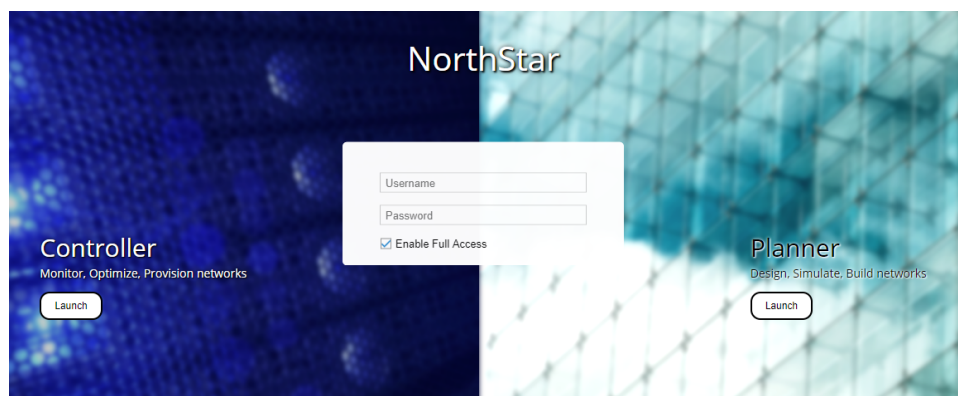
You connect to NorthStar using a modern web browser such as Microsoft Edge, Google Chrome, or Mozilla Firefox.

Your external IP address is provided to you when you install the NorthStar application. In the address bar of your browser window, type that secure host external IP address, followed by a colon and port number 8443 (for example, **https://10.0.1.29:8443**). The NorthStar login window is displayed, as shown in [Figure 2 on page 15](#). This same login window grants access to the NorthStar Controller UI and the NorthStar Planner UI.



**NOTE:** If you attempt to reach the login window, but instead, are routed to a message window that says, “Please enter your confirmation code to complete setup,” you must go to your license file and obtain the confirmation code as directed. Enter the confirmation code along with your administrator password to be routed to the web UI login window. The requirement to enter the confirmation code only occurs when the installation process was not completed correctly and the NorthStar application needs to confirm that you have the authorization to continue.

*Figure 2: NorthStar Login Window*



**WARNING:** To avoid a Browser Exploit Against SSL/TLS (BEAST) attack, whenever you log in to NorthStar through a browser tab or window, make sure that the tab or window was not previously used to surf a non-HTTPS website. A best practice is to close your browser and relaunch it before logging in to NorthStar.

NorthStar Controller features are available through the web UI. NorthStar Planner features are available through the Java Client UI.

A configurable User Inactivity Timer is available to the System Administrator (only). If set, any user who is idle and has not performed any actions (keystrokes or mouse clicks) is automatically logged out of NorthStar after the specified number of minutes. By default, the timer is disabled. To set the timer, navigate to **Administration > System Settings** in the NorthStar Controller web UI.

## Logging In to and Out of the NorthStar Controller Web UI

Table 4 on page 16 shows the Internet browsers that have been tested and confirmed compatible with the NorthStar Controller web UI.

*Table 4: Internet Browsers Compatible with the NorthStar Controller Web UI*

OS	Browser
Windows 10	<ul style="list-style-type: none"> <li>Google Chrome versions 55, 56</li> <li>Mozilla Firefox version 53</li> <li>Microsoft Edge version 38.14393</li> </ul>
Windows 7	<ul style="list-style-type: none"> <li>Google Chrome versions 58</li> <li>Mozilla Firefox version 53</li> </ul>
CentOS 6.8/6.9	<ul style="list-style-type: none"> <li>Google Chrome versions 56</li> <li>Mozilla Firefox version 53</li> </ul>
Mac OS	<ul style="list-style-type: none"> <li>Google Chrome versions 58</li> <li>Apple Safari version 10.1.1</li> </ul>

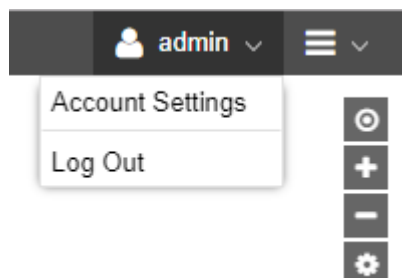
To access the NorthStar Controller web UI, enter the username and password provided to you when you installed the NorthStar application. Optionally click the **Enable Full Access** check box. Click **Launch** on the Controller side of the login window.



**NOTE:** You will be required to change your password after logging in for the first time.

To log out of the web UI, click the User Options drop-down menu (person icon) in the upper right corner of the main window and select **Log Out**. Figure 3 on page 17 shows the User Options drop-down menu. If you close the browser without logging out, you are automatically logged out after 10 seconds.

Figure 3: User Options Menu



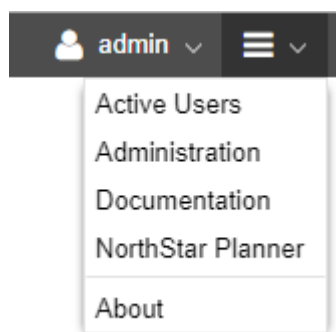
## Logging In to and Out of the NorthStar Planner Java Client UI

To access the NorthStar Planner, enter your credentials on the initial login window and click **Launch** on the Planner side of the login window. The default memory allocation for NorthStar Planner is displayed, which you can modify. Click **Launch** in the memory allocation window.

Depending on the browser you are using, a dialog box might be displayed, asking if you want to open or save the .jnlp file, accept downloading of the application, and agree to run the application. Once you respond to all browser requests, a dialog box is displayed in which you enter your user ID and password. Click **Login**.

You can also launch the NorthStar Planner from within the NorthStar Controller by navigating to **NorthStar Planner** from the More Options menu as shown in [Figure 4 on page 17](#):

Figure 4: More Options Menu



To log out of the NorthStar Planner, select **File > Exit** to display the Confirm Exit screen. Click **Yes** to exit.

## NorthStar Controller Web UI Overview

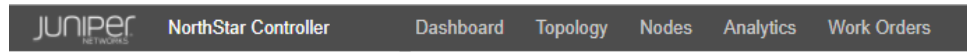
The NorthStar Controller web UI has five main views:

- Dashboard
- Topology
- Nodes

- Analytics
- Work Orders

[Figure 5 on page 18](#) shows the buttons for selecting a view. They are located in the top menu bar.

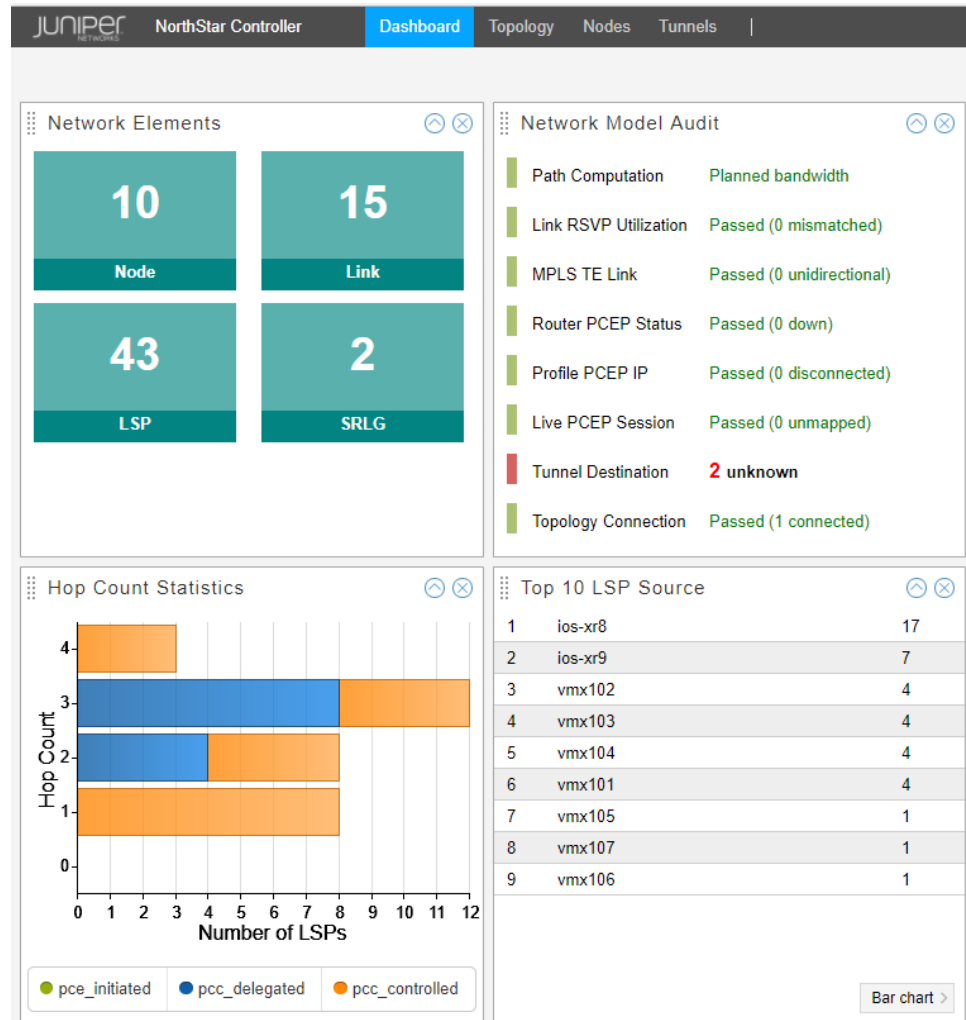
*Figure 5: Web UI View Selection Buttons*



**NOTE:** Some functions and features are not available to users logged in with view-only privilege.

The Dashboard view presents a variety of status and statistics information related to the network, in the form of widgets. [Figure 6 on page 19](#) shows a sample of the available widgets.

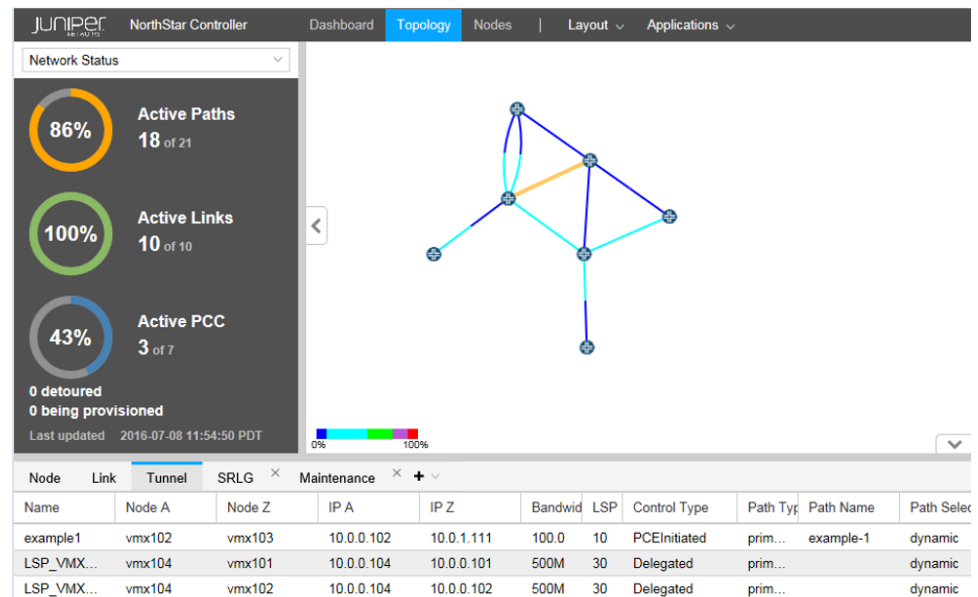
Figure 6: Dashboard View



The Topology view is displayed by default when you first log in to the web UI.

[Figure 7 on page 20](#) shows the Topology view.

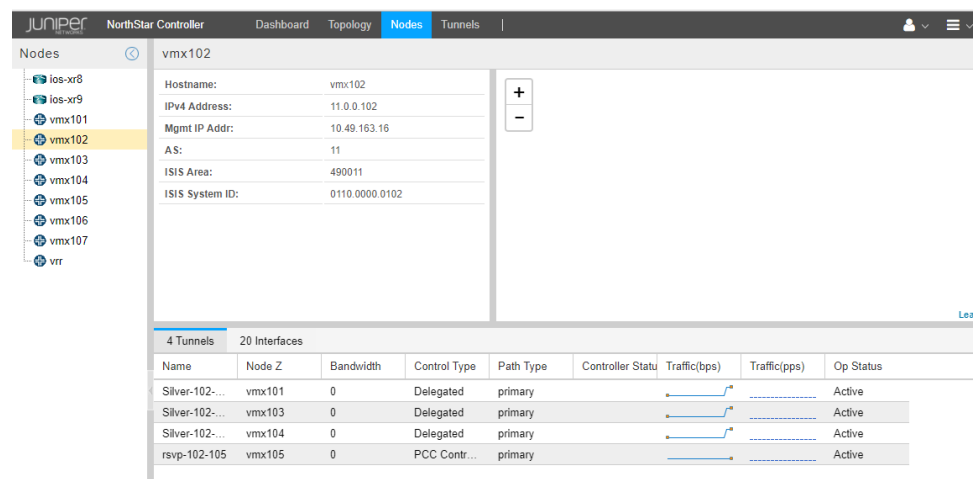
Figure 7: Topology View



The Topology view is the main work area for the live network you load into the system. The Layout and Applications drop-down menus in the top menu bar are only available in Topology view.

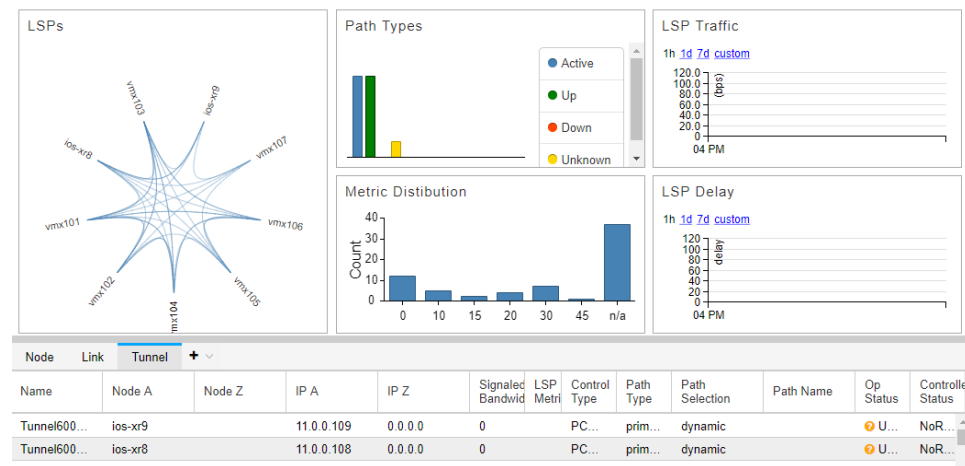
The Nodes view, shown in [Figure 8 on page 20](#), displays detailed information about the nodes in the network. With this view, you can see node details, tunnel and interface summaries, groupings, and geographic placement (if enabled), all in one place.

Figure 8: Nodes View



The Analytics view, shown in [Figure 9 on page 21](#), provides a collection of quick-reference widgets related to analytics.

Figure 9: Analytics View



The Work Orders view, shown in Figure 10 on page 21, presents a table listing all scheduled work orders. Clicking on a line item in the table displays detailed information about the work order in a second table.

Figure 10: Work Orders View

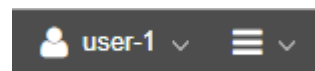
Workflow <span>▼</span> Modify Submitter Comment									
Action	ID <span>↓</span>	Status	Submitter	Submitted Time	Submitter Comment	Approver	Approved Time	Approver Comment	Activator
modify	1509546327102	Activated	admin	2017-11-01...	modify lsp	admin	2017-11-01...	Auto Appro...	admin

Details								
Request	Name <span>↑</span>	LspIndex	IP A	IP Z	Bandwidth	Setup	Hold	Planned Metric
Old	Silver-104-101	13	11.0.0.104	11.0.0.101	500	7	0	
New	Silver-104-101	0	11.0.0.104	11.0.0.101	500	7	0	

Functions accessible from the right side of the top menu bar have to do with user and administrative management. Figure 11 on page 21 shows that portion of the top menu bar. These functions are accessible whether you are in the Dashboard, Topology, Nodes, Analytics, or Work Orders view.

Figure 11: Right Side of the Top Menu Bar



The user and administrative management functions consist of:

- User Options (person icon)
  - Account Settings
  - Log Out
- More Options (menu icon)

- Active Users
- Administration (the options available to any particular user depend on the user's group and full-access versus view-only privilege level)
  - System Health
  - Analytics
  - Authentication (System administrator only)
  - Device Profile
  - Device Collection
  - License (System administrator only)
  - Logs
  - Subscribers (System administrator only)
  - System Settings (System administrator only)
  - Transport Controller
  - Users (System administrator only)

The system administrator (admin) functions can only be accessed by the admin and only when logged in with full-access privilege.

- Documentation (link to NorthStar customer documentation)
- NorthStar Planner (launches the NorthStar Planner Java client UI, without closing your NorthStar Controller web UI)
- About (version and license information)

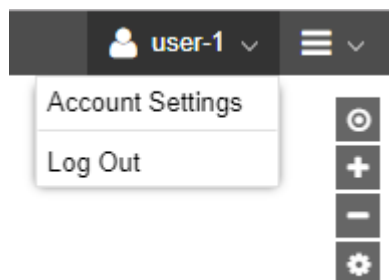
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## User and Account Control

Click the person icon to view the User Options drop-down menu, which includes Account Settings and Log Out.

Figure 12 on page 22 shows the user options menu.

*Figure 12: User Options Menu*





Select Account Settings to display the Account Settings window shown in [Figure 13 on page 23](#).

*Figure 13: Account Settings Window*

**Account Settings**

**User Info**

Username: user-1

New Password:

Confirm Password:

**Contact Information**

Profile Name:

Email:

Phone:

**Preferences**

Timezone: America/Los\_Angeles ▼

Date/Time Format: YYYY-MM-DD HH:mm:ss z ▼

Preview: 2018-04-12 16:22:17 PDT

Cancel Update

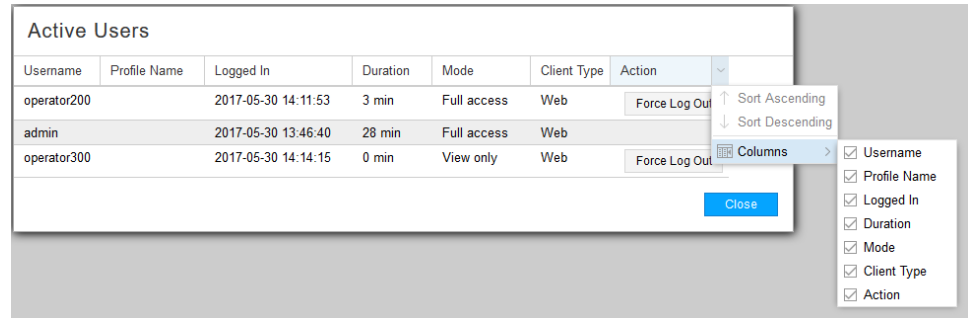
The Account Settings window allows you to change your password, create a profile name (like a nickname) for yourself, enter your contact information (e-mail address and telephone number), and set up date/time and time zone preferences for your web UI display. You cannot change your username. Click **Update** to save your changes, or **Cancel** to discard them.

The Active Users window shows who is currently logged in to the system, when they logged in, how long they have been logged in, whether they have full-access or view-only-access, and whether they are logged in to the web UI or the NorthStar Planner. This window is a good user management tool for the Administrator.

Access the Active Users window from the More Options icon (horizontal bars) in the upper right corner of the web UI.

Figure 14 on page 24 shows the Active Users window, including the sorting and column selection options that are available when you hover over a column heading and click on the down arrow that appears.

*Figure 14: Active Users Window*



The screenshot shows the 'Active Users' window. It contains a table with the following columns: Username, Profile Name, Logged In, Duration, Mode, Client Type, and Action. The table lists three users: operator200, admin, and operator300. The 'admin' user is highlighted. A context menu is open over the 'Action' column, showing options for 'Sort Ascending', 'Sort Descending', and 'Columns'. The 'Columns' option is selected, and a sub-menu is open showing a list of columns with checkboxes: Username, Profile Name, Logged In, Duration, Mode, Client Type, and Action. All checkboxes are checked. A 'Close' button is visible at the bottom right of the window.

Username	Profile Name	Logged In	Duration	Mode	Client Type	Action
operator200		2017-05-30 14:11:53	3 min	Full access	Web	Force Log Out
admin		2017-05-30 13:46:40	28 min	Full access	Web	Force Log Out
operator300		2017-05-30 14:14:15	0 min	View only	Web	Force Log Out

The Force Log Out button is available only to the Admin, for the purpose of selectively disconnecting NorthStar Controller (as opposed to Planner) user sessions. To disconnect a user session, select the user name to disconnect and click **Force Log Out**.

## PART 2

# NorthStar Controller Features

- [Interactive Network Topology on page 27](#)
- [LSP Management on page 79](#)
- [Path Computation and Optimization on page 123](#)
- [Working with Transport Domain Data on page 149](#)
- [High Availability on page 169](#)
- [System Monitoring on page 173](#)
- [Network Monitoring on page 177](#)
- [Data Collection and Analytics on page 189](#)



## CHAPTER 3

# Interactive Network Topology

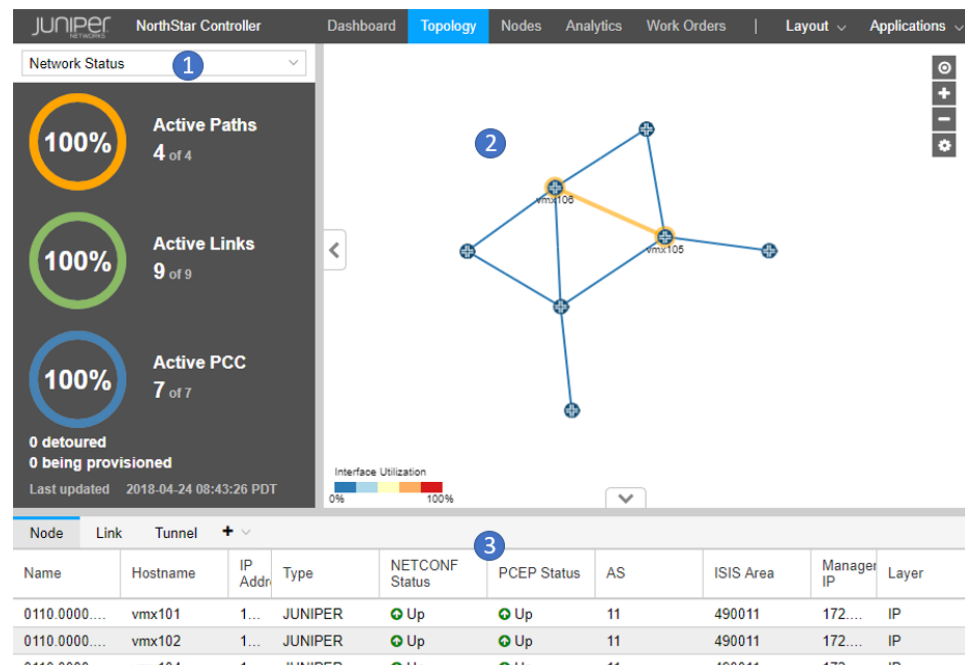
- [Topology View Overview on page 27](#)
- [Navigation Functions in the Topology View on page 29](#)
- [Interactive Map Features on page 30](#)
- [Layout Menu Overview on page 40](#)
- [Manage Layouts on page 41](#)
- [Configuration Viewer on page 42](#)
- [Applications Menu Overview on page 44](#)
- [Group and Ungroup Selected Nodes on page 45](#)
- [Distribute Nodes on page 48](#)
- [Reset Topology by Latitude and Longitude on page 49](#)
- [Left Pane Options on page 50](#)
- [Network Information Table Overview on page 66](#)
- [Sorting and Filtering Options in the Network Information Table on page 68](#)
- [Network Information Table Bottom Tool Bar on page 70](#)

### Topology View Overview

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When you first log in to the web user interface, the initial window displays the Topology view by default, as shown in [Figure 15 on page 28](#).

Figure 15: Topology View



The Topology view is the main work area for the live network you load into the system, and has the following panes (numbers correspond to the callouts in [Figure 15 on page 28](#)):

1. Left Pane—Drop-down menu of map presentation options. Your selections are reflected in the topology map pane.
2. Interactive graphical topology map pane—Use the topology map to access element information and further customize the map display. The color legend at the bottom is configurable and is tied to the Performance selection from the drop-down menu in the Left Pane.
3. Network information table—The network information table at the bottom of the window has Node, Link, Tunnel, SRLG, Interface, P2MP, Demand, and Maintenance tabs across the top of the table. Click a tab to display the properties for the network elements of the type selected. The Maintenance tab displays scheduled maintenance events, which are scheduled failures of selected network elements.



**NOTE:** If the Topology view should ever fail to refresh as expected, we recommend you click the refresh button at the bottom of the window, below the network information table.

#### Related Documentation




- [Navigation Functions in the Topology View on page 29](#)
- [Left Pane Options on page 50](#)
- [Network Information Table Overview on page 66](#)

- [Sorting and Filtering Options in the Network Information Table on page 68](#)
- [Network Information Table Bottom Tool Bar on page 70](#)

## Navigation Functions in the Topology View

Many familiar navigation functions are supported in the Topology window, and are summarized in [Table 5 on page 29](#).

*Table 5: Supported Topology Window Navigation Functions*

Function	Method
Drag and drop	Left-click an element, hold while repositioning the cursor, then release.
Select an element	Click a link or node to select it.
Select multiple elements	<ol style="list-style-type: none"> <li>1. Hold down the Shift key and left mouse button while dragging the mouse to create a rectangular selection box. All elements within the box are selected.</li> <li>2. Hold down the Shift key and click multiple items, one at a time.</li> </ol> <p>One application for selecting multiple elements is creating node groups.</p>
Filter the network information table to display an element	Double click a link or node to display only that element in the network information table.
Zoom in and out 	<ol style="list-style-type: none"> <li>1. Use the mouse scroll wheel.</li> <li>2. Click the +/- buttons in the upper right corner of the window.</li> </ol>
Zoom to fit 	Click the circular button that looks like a bull's eye in the upper right corner of the window to size and center the topology map to fit the window.
Right-click to access functions	Right-click a blank part of the topology map or on a map element to access context-relevant functions.
Hover	You can hover over some network elements in the topology map to display the element name or ID.
Collapse/expand pane 	When a left, right, up, or down arrow appears at the margin of a pane, you can click to collapse or expand the pane.
Resize panes	You can click and drag many of the pane margins to resize the panes in a display.

## Interactive Map Features

The topology map is interactive, meaning that you can use features within the map itself to customize the map and the network information table. The map uses a geographic coordinate reference system. Some features enabled by that system include:

- Constrained zooming: NorthStar Controller performs coordinate checking so the view is constrained to the coordinates of the earth.
- World wrapping/map wrapping: Scrolling the map in one direction is like spinning a globe. This enables representation of links across an ocean, for example.

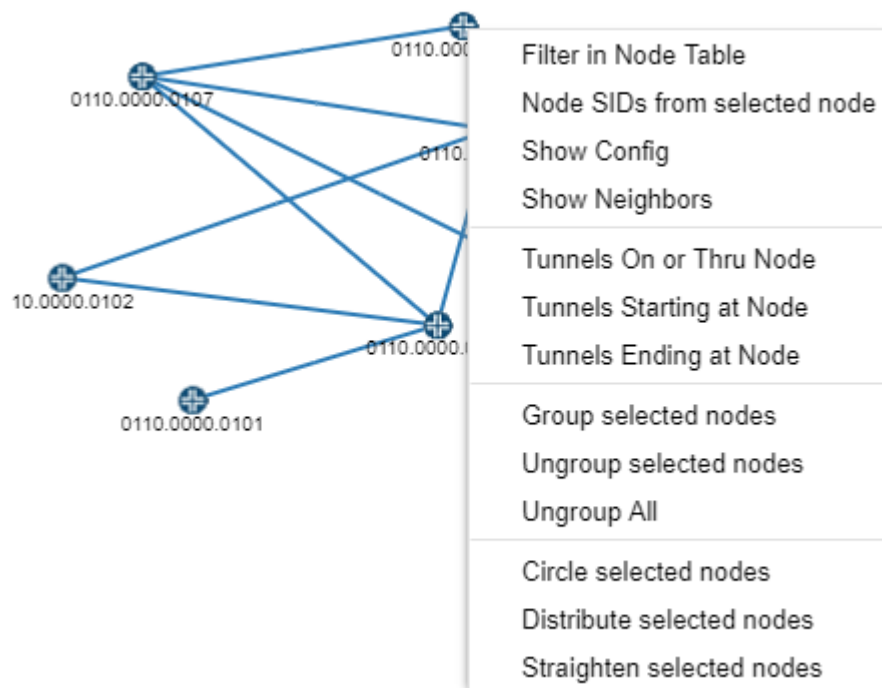
The following sections describe additional map features and functionality:

- [Right-Click Functions on page 30](#)
- [Topology Menu Bar on page 33](#)
- [Topology Settings Window on page 34](#)

### Right-Click Functions

Right-click a node, selected nodes, or node group on the topology map to execute node-specific filtering as shown in [Figure 16 on page 30](#) and described in [Table 6 on page 31](#).

*Figure 16: Right-Click Options for Nodes or Groups*





**Table 6: Right-Click Options for Nodes or Groups**

Option	Function
Filter in Node Table	Filters the nodes displayed in the network information table to display only the selected node(s) or node group(s).
Node SIDs from selected node	Labels the nodes in the topology with the node SIDs from the perspective of the node on which you right-clicked.
Show Config	Opens the Configuration Viewer, displaying the configuration of the node on which you right-clicked. See <a href="#">"Configuration Viewer" on page 42</a> for prerequisites for the configuration to be available.
Show Neighbors	Opens a new window displaying the neighbors of the node on which you right-clicked.
Tunnels On or Thru Node	Filters the tunnels displayed in the network information table to include only those that meet the On or Thru Node criteria.
Tunnels Starting at Node	Filters the tunnels displayed in the network information table to include only those that meet the Starting at Node criteria.
Tunnels Ending at Node	Filters the tunnels displayed in the network information table to include only those that meet the Ending at Node criteria.
Group selected nodes	Prompts you to give the group of nodes a name, after which the group can be expanded or collapsed on the topology map. This is a shortcut to the <b>Layout &gt; Group selected nodes</b> function.
Ungroup selected nodes	Ungroups the nodes in the selected group. This is a shortcut to the <b>Layout &gt; Ungroup selected nodes</b> function.
Ungroup All	Ungroups the nodes in all groups. This is a shortcut to the <b>Layout &gt; Ungroup All</b> function.
Circle selected nodes	Arranges the selected nodes in a roughly circular pattern with the nodes and links separated as much as possible. This is a shortcut to the <b>Layout &gt; Circle selected nodes</b> function.
Distribute selected nodes	Forces the selected elements away from each other and minimizes overlap. This is a shortcut to the <b>Layout &gt; Distribute selected nodes</b> function.
Straighten selected nodes	Aligns the selected nodes in a linear pattern. This is a shortcut to the <b>Layout &gt; Straighten selected nodes</b> function.

Right-click a link on the topology map to execute link-specific filtering as shown in [Figure 17 on page 32](#) and described in [Table 7 on page 32](#).

Figure 17: Right-Click Options for Links

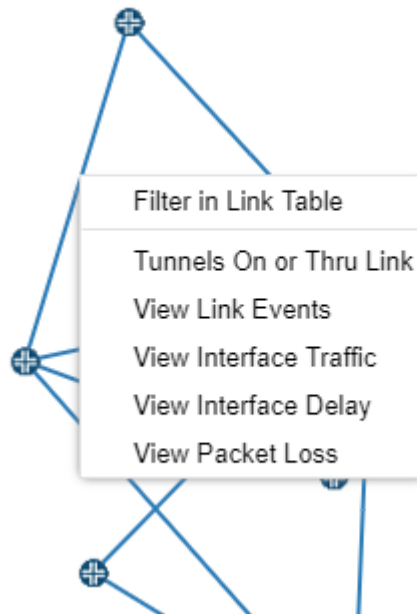


Table 7: Right-Click Options for Links

Option	Function
Filter in Link Table	Filters the tunnels displayed in the network information table to display only the selected link.
Tunnels On or Thru Link	Filters the tunnels displayed in the network information table to include only those that meet the On or Thru Link criteria.
View Link Events	Opens a new window in which you select the time range for the events you wish to view. Click <b>Submit</b> to open the Events window.
View Interface Traffic	Opens a new tab in the network information table at the bottom of the window, displaying the interface traffic.
View Interface Delay	Opens a new tab in the network information table at the bottom of the window, displaying interface delay over time.
View Packet Loss	Opens a new tab in the network information table at the bottom of the window, displaying packet loss statistics.



**NOTE:** To clear the tunnel filter so that all tunnels are again displayed, click a different tab (Node, for example), and then click the Tunnel tab again.

Right-click blank space in the topology map pane to access the whole-map functions shown in [Figure 18 on page 33](#) and described in [Table 8 on page 33](#).

Figure 18: Right-Click Options for the Topology Map as a Whole

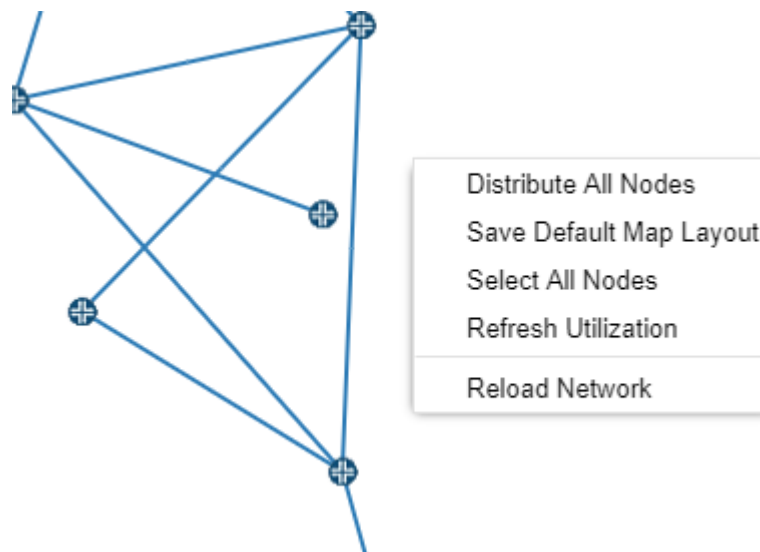


Table 8: Right-Click Options for the Topology Map as a Whole

Option	Function
Distribute All Nodes	Distributes all the nodes in the map, pushing elements away from each other and minimizing overlap. This is a shortcut to selecting all nodes and navigating to <b>Layout&gt;Distribute selected nodes</b> .
Save Default Map Layout	Saves the current layout as your default. The default layout is displayed when you first log in to NorthStar Controller. If you already have a default layout, this function overrides the existing default. You can also designate a default layout by navigating to <b>Layout&gt;Manage Layouts</b> .
Select All Nodes	Selects all nodes on the topology map. This is a shortcut to using shift-left-click to create a selection box around all nodes or individually shift-clicking on all nodes.
Refresh Utilization	Refreshes the display of link colors based on RSVP utilization.  <b>NOTE:</b> Updates are periodically pushed to the client by the server.
Reload Network	Reloads the network to update the display.

## Topology Menu Bar

On the right side of the topology window is a menu bar offering various topology settings, as shown in [Figure 19 on page 34](#).

*Figure 19: Topology Settings Menu Bar*



From the menu bar, you can:

- Center the topology in the window (target icon).
- Enlarge the topology in the window (plus symbol).
- Reduce the size of the topology in the window (minus symbol).
- Access the topology settings window (settings icon).

## Topology Settings Window

Access the Topology Settings window by clicking on the settings icon (gear) in the upper right corner of the topology window. [Figure 20 on page 34](#) shows the settings icon.

*Figure 20: Settings Icon to Access Topology Settings*



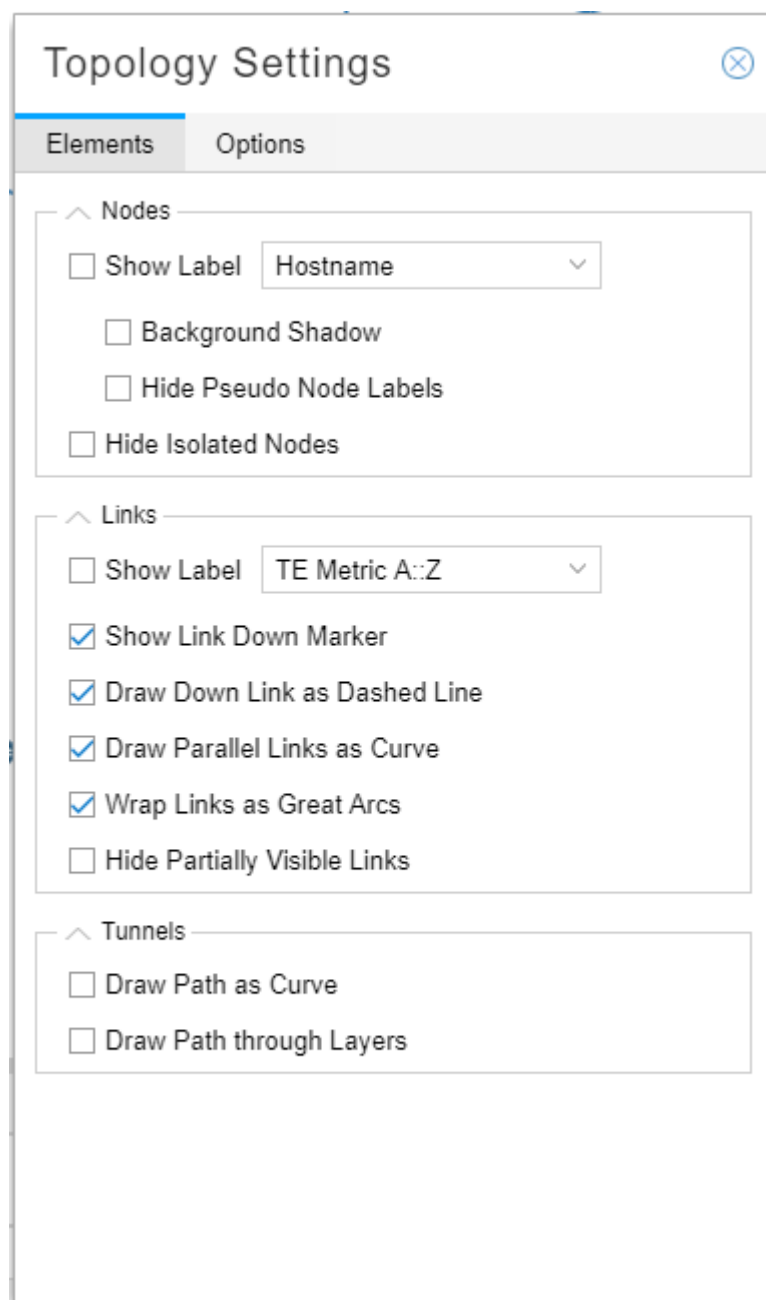
The Topology Settings window contains many topology display settings, all in one place. [Figure 21 on page 35](#) shows the Topology Settings window with the two tabs that group related settings.

On the Elements tab, you can select as many settings as you like by clicking the associated check boxes. When you select to Show Label for nodes or links, you can select only one label from the corresponding drop-down menu.



**NOTE:** NorthStar does not display node or link labels over a certain quantity, even if the Topology Settings call for labels to be displayed. This improves performance when redrawing a large number of graphic elements.

Figure 21: Topology Settings Window, Elements Tab



**Topology Settings**

**Elements** | Options

^ Nodes

☐ Show Label Hostname

☐ Background Shadow

☐ Hide Pseudo Node Labels

☐ Hide Isolated Nodes

^ Links

☐ Show Label TE Metric A::Z

☒ Show Link Down Marker

☒ Draw Down Link as Dashed Line

☒ Draw Parallel Links as Curve

☒ Wrap Links as Great Arcs

☐ Hide Partially Visible Links

^ Tunnels

☐ Draw Path as Curve

☐ Draw Path through Layers



**NOTE:** Drawing down links as a solid, rather than dashed, line can improve performance when redrawing the topology.

A few of these settings might not be self-explanatory:

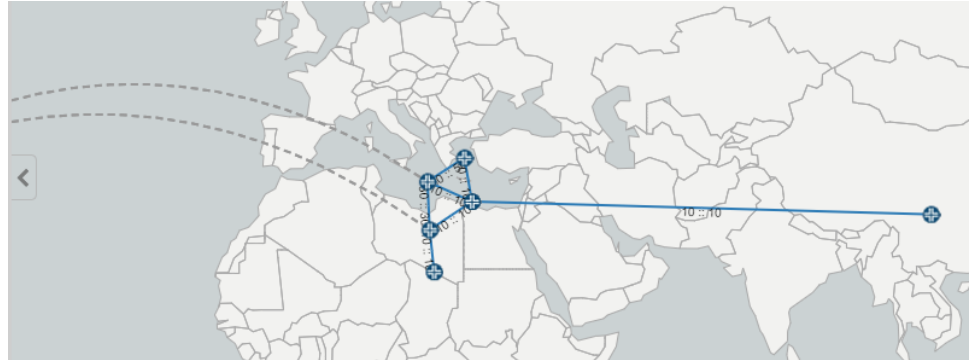
- Hide Partially Visible Links

Removes from the display any links for which both end nodes are not within the field of view. This is useful for focusing on a subset of a large network.

- Wrap Links as Great Arcs

Distinguishes links that would have to wrap around the world map. An example is shown in [Figure 22 on page 36](#).

*Figure 22: Wrap Links as Great Arcs Example*



The Options tab offers a variety of topology display preferences, as shown in [Figure 23 on page 37](#).

Figure 23: Topology Settings Window, Options Tab

**Topology Settings**

Elements Options

^ Topology View

☒ Nodes and Links

☐ Clusters and Bundles

^ Map Style

☒ Light

☐ Dark

☐ Show World Map

☐ Graticules

☐ Populated Places

^ General

☐ Show Tooltips

☒ Show Maintenance Marker

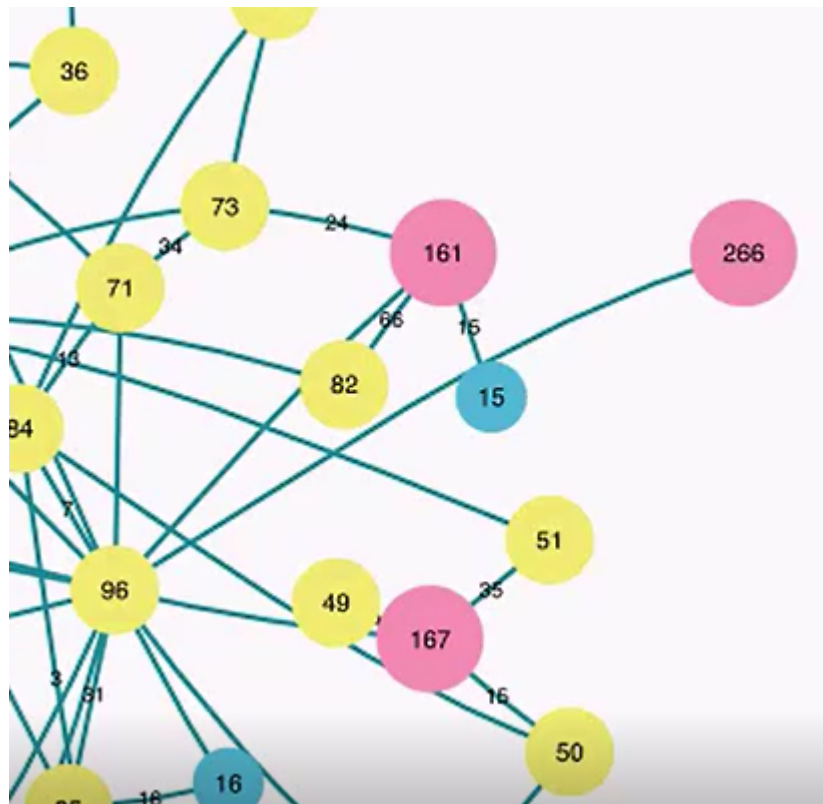
☐ Zoom to Selected Node from Table

Label Size: 10

### Topology View section

The two options available in this section are mutually exclusive; select one radio button or the other. Clusters and Bundles is useful where the display of a large number of nodes and links obscures visualization of the network as a whole. Clusters (of nodes) and bundles (of links) simplify visualization by representing groups of nodes that are close together as single, color-coded circles (clusters). Bundles (of links) are derived from the links between nodes and clusters. [Figure 24 on page 38](#) shows an example of how a portion of a large network looks when represented as clusters and bundles.

Figure 24: Clusters and Bundles Example



The number in each circle indicates the number of nodes in the cluster. The color coding of the clusters corresponds to the number of nodes in the cluster. You can customize the ranges by clicking on the color legend in the lower left corner of the map window as shown in [Figure 25 on page 38](#).

Figure 25: Customizing the Clusters Legend

The 'Clusters Legend' dialog box is shown. It has a title bar with a close button. The legend contains three entries:

Color	Range
Blue	20
Yellow	150
Pink	150+

A 'Submit' button is located at the bottom right of the legend.



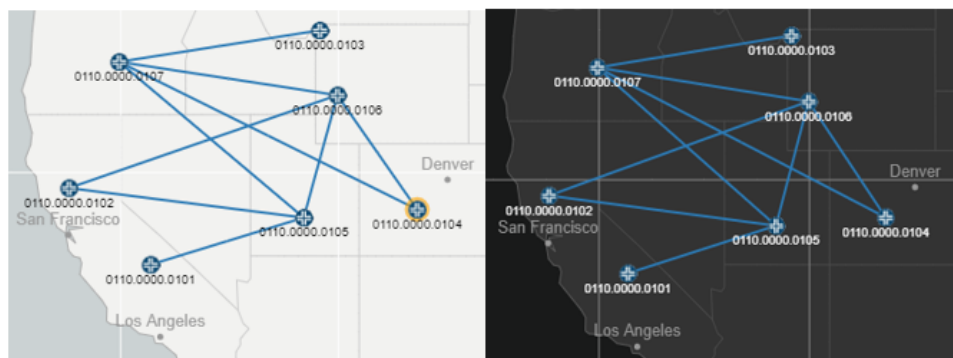


**NOTE:** When you select Clusters and Bundles, node and link labels are not displayed.

### Map Style section

The Light and Dark options available in this section are mutually exclusive; select one radio button or the other. [Figure 26 on page 39](#) shows an example of the light and dark map styles.

*Figure 26: Light and Dark Map Styles*



If you select to Show World Map, you can opt to display graticules (a grid of lines parallel to meridians of longitude and parallels of latitude) and labeling of major populated places (both shown in [Figure 26 on page 39](#)).



**NOTE:** Even if you deselect Show World Map, the topology still behaves according to geographical coordinates in terms of displaying the topology within the field of view.

### General section

Select the check boxes for as many of the options in this group as you like:

- **Show Tooltips:** Displays additional information about a node or link in the bottom right corner of the map pane when you mouse over a network element.
- **Show Maintenance Marker:** Displays a red M over any link currently part of a maintenance event.
- **Zoom to Selected Node from Table:** With this option enabled, when you click on a node entry in the network information table (Node tab), the topology automatically centers the view on that selected node.

Use the Label Size drop-down menu to select a font size for node and link labels.

### Related Documentation

- [Navigation Functions in the Topology View on page 29](#)
- [Group and Ungroup Selected Nodes on page 45](#)

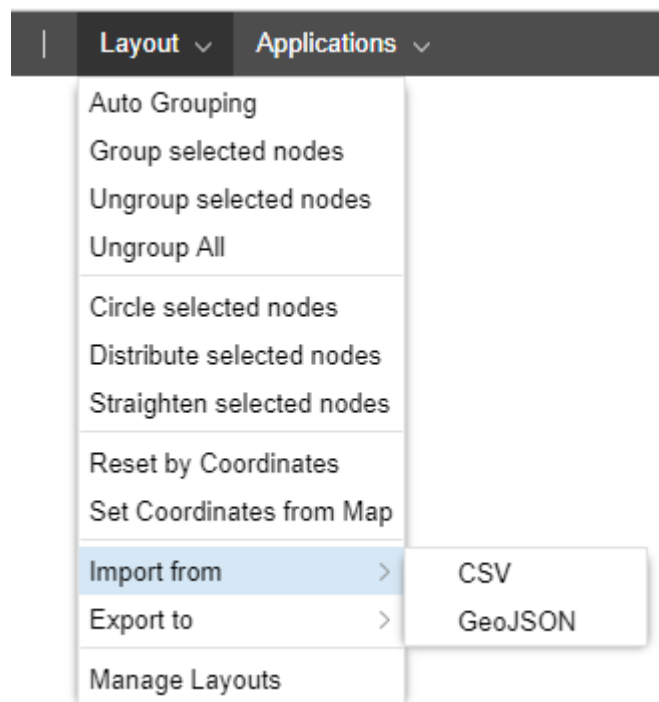
- [Distribute Nodes on page 48](#)
- [Configuration Viewer on page 42](#)
- [Event View on page 178](#)

## Layout Menu Overview

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The Layout drop-down menu in the top menu bar includes a number of options for arranging elements on the topology map. [Figure 27 on page 40](#) shows the Layout drop-down menu options.

*Figure 27: Layout Drop-Down Menu*



From the Layout menu, you can group and ungroup nodes, distribute nodes using different models, reset the topology map according to geographical coordinates, save layouts, and manage saved layouts.

The import and export options allow you to:

- Import a layout from a CSV file.
- Import a layout from a GeoJSON file. JSON format is stricter than CSV, requiring key-value pairs.
- Export a layout to a CSV file, which has headers only for hostname, longitude, latitude, and group (less information than the GeoJSON file has).
- Export a layout to a GeoJSON file which you could then use in various mapping applications that support GeoJSON format.

**Related Documentation**

- [Group and Ungroup Selected Nodes on page 45](#)
- [Distribute Nodes on page 48](#)
- [Reset Topology by Latitude and Longitude on page 49](#)
- [Manage Layouts on page 41](#)

## Manage Layouts

To save a layout so you can quickly load it into the topology map pane at any time, navigate to **Layout>Manage Layouts**. The Map View window is displayed as shown in [Figure 28 on page 41](#).

*Figure 28: Map View Window*

Type	Name	Description	Creator	Last Updated	Default
Shared	circle	circle	admin	2016-01-22	<input type="checkbox"/>
Shared	distributed	distributed	admin	2016-01-23	<input type="checkbox"/>

Save Load Edit ▼ Delete

Click **Save**. The Save Map window is displayed as shown in [Figure 29 on page 41](#).

*Figure 29: Save Map Window*

Map View

Type	Name	Description	Creator	Last Updated	Default
Shared	circle	circle	admin	2016-01-22	<input type="checkbox"/>

Save Load Edit ▼ Delete

**Save Map**

Type: ☒ Shared ☐ Private

Name:

Description:

Cancel Submit

Enter a name and description for the current layout and specify whether the saved layout is to be shared by all operators (shared) or is to be available only to you (private). Click **Submit**.

From the Map View window, where all your saved layouts are listed, you can click the check box beside the layout you want as your default. The default layout is displayed initially whenever you log in to NorthStar Controller.



**NOTE:** You can also right-click a blank part of the topology map pane and select **Save Default Map Layout** to save the current layout as your default. This action saves the current layout as your default, but does not change the name of the default in the Manage Layouts window.

Select a layout and use the buttons at the bottom of the window to perform the functions listed in [Table 9 on page 42](#).

**Table 9: Map View Window Buttons**

Button	Function
Save	Save a new layout or update an existing layout.  <b>NOTE:</b> If you select an existing layout and click <b>Save</b> , the existing layout is replaced by the new layout, without changing the name of the layout in the Manage Layouts window.
Load	Load the layout into the map pane.
Edit	Edit the name or description of the selected layout.
Delete	Delete the selected layout from your saved layouts.

- Related Documentation**
- [Layout Menu Overview on page 40](#)
  - [Group and Ungroup Selected Nodes on page 45](#)
  - [Distribute Nodes on page 48](#)
  - [Reset Topology by Latitude and Longitude on page 49](#)

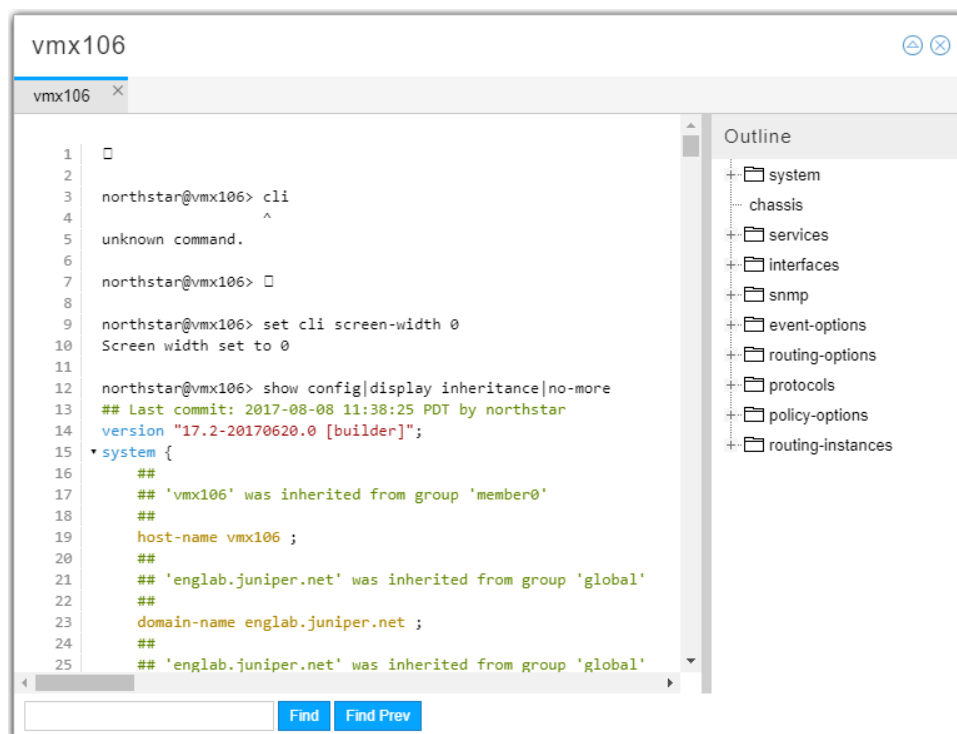
## Configuration Viewer

You can view (view-only) the configuration of a router in the network using the Configuration Viewer. You must set up the Device Profile (**Administration > Device Profile**) and Netconf Device Collection (**Administration > Device Collection**) to retrieve the configuration files before they are available in the Configuration Viewer.

To access the viewer for a node in the topology, right-click a node in the topology map and select **Show Config**.

[Figure 30 on page 43](#) shows an example of the configuration viewer.

Figure 30: Configuration Viewer



The left pane displays the router configuration file. The right pane displays an outline view that groups the configuration by statement blocks in which you can drill down. When you click a specific statement in the right pane, it is displayed in context in the left pane.

The colored text in the configuration file in the left pane highlights nested levels, version, password, and comment statements.

Clicking the triangle icon in the upper right corner of the viewer window opens the search field at the bottom of the window. Enter your search text and click **Find** or **Find Prev** to move forward or backward through the search results.

You can also access the Configuration Viewer from the Integrity Checks report. After you perform device collection, the router configuration files are scanned and the NorthStar Controller flags anything suspicious. The resulting report provides hints as to what might need attention.

To inspect the router configuration file from this report, right-click a line item in the report and select **Show Config** to open the Configuration Viewer. If the report line item is for an LSP, the configuration viewer opens a separate tab for each end of the tunnel so you can see both relevant configuration files.

#### Related Documentation

- [Scheduling Device Collection for Analytics via Netconf on page 202](#)
- [Reports Overview on page 185](#)

## Applications Menu Overview

From the Applications menu in the top menu bar, you can perform some of the functions also available in the network information table including provisioning LSPs, diverse LSPs, and multiple LSPs. You can also configure LSP delegation, set up optimization, and access reports.

The Top Traffic option displays a pane on the right side of the Topology window that lists the computed Top N Traffic over X period of time by Node, Interface, LSP, or Interface Delay. Select N and X by clicking on the currently selected settings in the lower right corner of the display.

Two utilities that open in separate browser windows or tabs are also launched from this menu:

- Bandwidth Calendar—Used to visualize and manage scheduled LSPs.

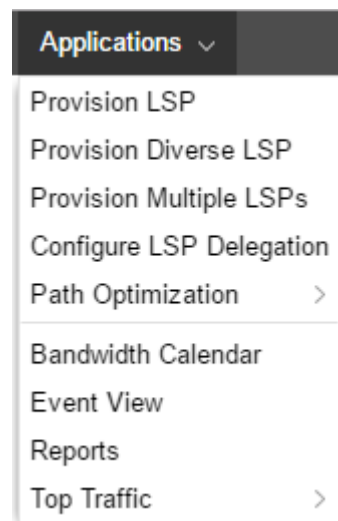


**NOTE:** The bandwidth calendar timeline is empty until you schedule LSPs.

- Event View—Displays events coming in from the topology server. You have a number of options for how this information is organized and displayed.

Figure 31 on page 44 shows the Applications drop-down menu.

*Figure 31: Applications Drop-Down Menu*



### Related Documentation

- [Provision LSPs on page 87](#)
- [Provision Diverse LSP on page 96](#)
- [Provision Multiple LSPs on page 97](#)
- [Configure LSP Delegation on page 101](#)

- [Path Optimization on page 123](#)
- [Maintenance Events on page 139](#)
- [Reports Overview on page 185](#)
- [Bandwidth Calendar on page 116](#)
- [Event View on page 178](#)

## Group and Ungroup Selected Nodes

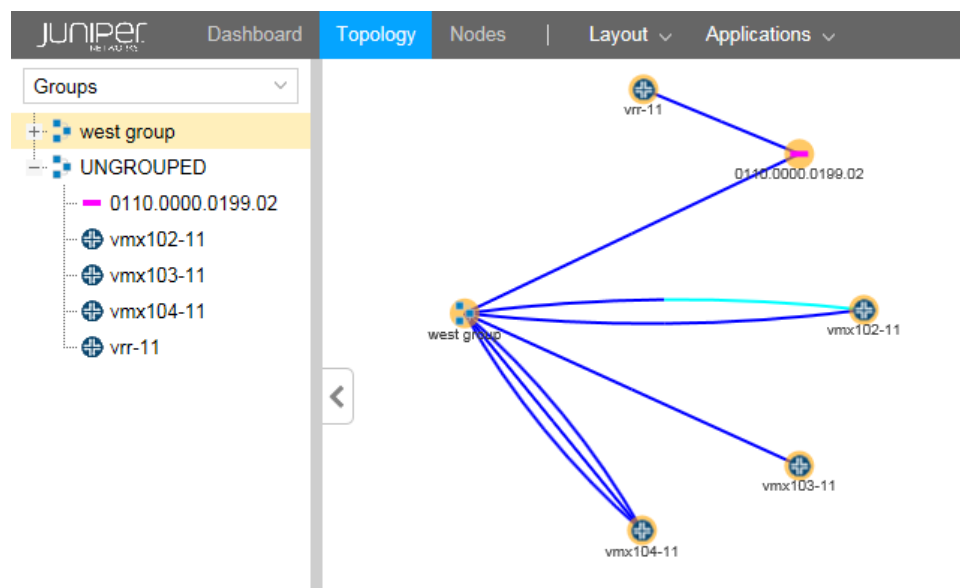
You can represent a collection of nodes on the topology map as a single entity by first selecting the nodes, and then navigating to **Layout>Group selected nodes** where you are prompted to give the group a name. To ungroup the nodes in a group, select the group on the map and then navigate to **Layout>Ungroup selected nodes**.



**NOTE:** A shortcut to these functions is available. Select the nodes to be included in the group and then right-click on any one of them.

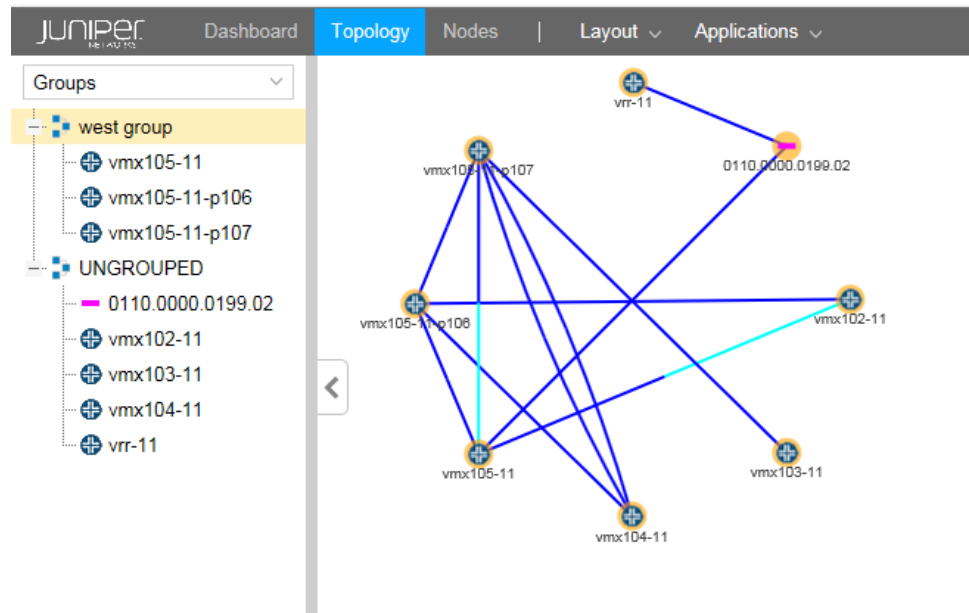
Using the Groups list in the left pane, you can control how the group is displayed in the topology map—as a single group entity or as individual member nodes. When you expand a group in the Groups list using the plus (+) sign next to the group name, all the member nodes are listed in the left pane and are displayed in the map. When you collapse a group in the Groups list using the minus sign (-), only the group name appears in the left pane, and the group is represented by a single icon in the map. [Figure 32 on page 45](#) shows a collapsed group in the Groups list in the left pane and the resulting representation of the group in the topology map.

*Figure 32: Topology Map with Collapsed Group List*



As shown in [Figure 33 on page 46](#), when the group is expanded in the Groups list, the individual nodes are displayed in the map instead of a single group icon.

*Figure 33: Topology Map with Expanded Group List*



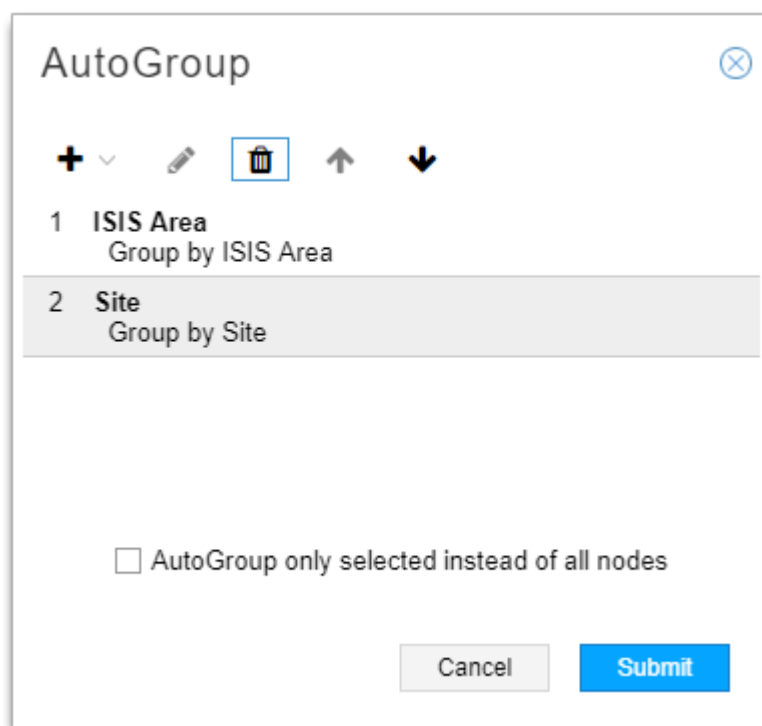
## Auto Grouping

You can auto group nodes by navigating to **Layout > Auto Grouping**.

The Auto Grouping option allows you to use multiple rules in sequence to group nodes, using rule set builder functionality. [Figure 34 on page 47](#) shows the AutoGroup Window with two levels of grouping configured. In this example, nodes are to be grouped first by ISIS area and then by site.



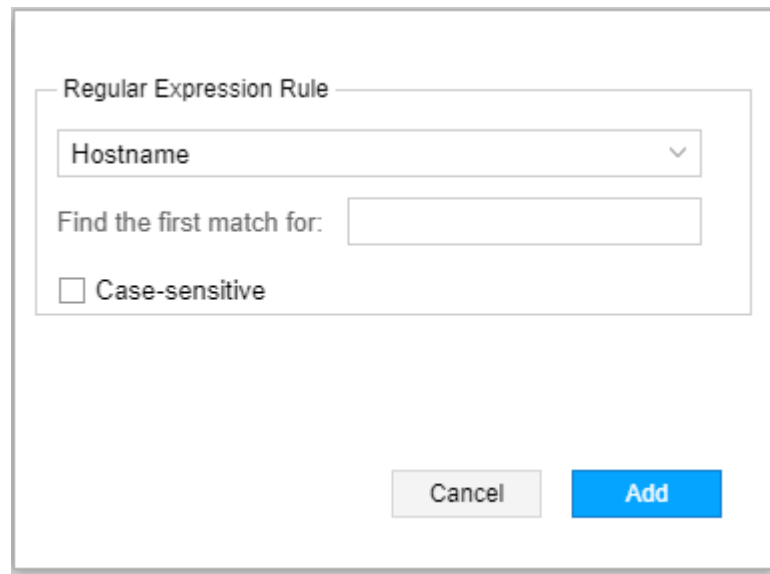
Figure 34: AutoGroup Window



When you click the Add button (+) to add a new rule, you then specify rule type as either City, Country, Continent, AS, ISIS Area, OSPF Area, Site, or Regular Expression. You can change the order of the rules by clicking on a rule and using the up and down arrows to reposition the rule in the list. You can also select to apply auto-grouping to all nodes or just to the nodes that you have selected on the topology map. To delete a rule, select it and click the Delete button (trash can). The Edit function (pencil icon) is only available for Regular Expression rules.

When you select Regular Expression as the rule type, the Regular Expression Rule window is displayed as shown in [Figure 35 on page 48](#).

Figure 35: Regular Expression Rule Window



The image shows a 'Regular Expression Rule' dialog box. It contains a dropdown menu with 'Hostname' selected. Below the dropdown is a text input field labeled 'Find the first match for:'. There is an unchecked checkbox labeled 'Case-sensitive'. At the bottom right are 'Cancel' and 'Add' buttons.

Use the drop down menu to select Hostname, Name, IP Address, or Type. Then enter the text in the **Find the first match for** field. Click the check box if you want the match to be case sensitive.

#### Related Documentation

- [Interactive Map Features](#)
- [Layout Menu Overview on page 40](#)
- [Left Pane Options on page 50](#)
- [Distribute Nodes on page 48](#)
- [Reset Topology by Latitude and Longitude on page 49](#)
- [Manage Layouts on page 41](#)

## Distribute Nodes

From the Layouts menu, you can select multiple nodes and redistribute them to improve visual clarity or for personal preference. You can select all the nodes in the topology to apply a distribution model, or you can select a subset such as edge devices or core devices.

Three models are available as described in [Table 10 on page 48](#).

Table 10: Node Distribution Models

Model	Description
Circle	Arranges the selected nodes in a roughly circular pattern with the nodes and links separated as much as possible.
Distribute	Forces the selected elements away from each other and minimizes overlap.

Table 10: Node Distribution Models (continued)

Model	Description
Straighten	Aligns the selected nodes in a linear pattern.



**NOTE:** A shortcut is available to access the distribution options. Select the nodes on the topology map and then right-click on any one of them.

#### Related Documentation

- [Interactive Map Features on page 30](#)
- [Layout Menu Overview on page 40](#)
- [Group and Ungroup Selected Nodes on page 45](#)
- [Reset Topology by Latitude and Longitude on page 49](#)
- [Manage Layouts on page 41](#)

## Reset Topology by Latitude and Longitude

You can reset the distribution of nodes on the topology map according to geographical coordinates if you have set the latitude and longitude values of the nodes. It can be useful to have the country map backdrop displayed when you use this distribution model.

To configure latitude and longitude for a node, select the node in the network information table at the bottom of the Topology view, and click **Modify** in the bottom tool bar. In the Modify Node window, click the Location tab. [Figure 36 on page 49](#) shows the Location tab of the Modify Node window.

Figure 36: Modify Node Window

### Modify Node

Properties
Location
Addresses

Latitude:

Longitude:

Site:

Cancel
Submit

Click the Location tab and enter latitude and longitude values using signed degrees format (DDD.dddd):

- Latitudes range from -90 to 90.
- Longitudes range from -180 to 180.
- Positive values of latitude are north of the equator; negative values (precede with a minus sign) are south of the equator.
- Positive longitudes are east of the Prime Meridian; negative values (precede with a minus sign) are west of the Prime Meridian.



**NOTE:** You can either enter the values directly or you can use the up and down arrows to increment and decrement.

---

You can optionally enter a site name in the Site field.

Click **Submit**.

To redistribute the nodes in the topology map according to the latitude and longitude values of the nodes, navigate to **Layout > Reset by Coordinates**.

Turning on the World Map also triggers a reset by latitude and longitude. To turn on the World Map in the topology window, click the Tools icon (gear) on the right side of the topology window and select the Options tab. Click the check box for Show World Map.

You can also set node latitude and longitude coordinates in the NorthStar Planner client, and copy those values to the nodes in the Live Network model. Any existing coordinate values in the Live Network model are overwritten by this action, an important consideration since the Live Network model is shared by all users.

#### Related Documentation

- [Layout Menu Overview on page 40](#)
- [Network Information Table Bottom Tool Bar on page 70](#)
- [Group and Ungroup Selected Nodes on page 45](#)
- [Distribute Nodes on page 48](#)
- [Manage Layouts on page 41](#)

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## Left Pane Options

The left pane drop-down menu offers several ways to filter the data that is displayed in the NorthStar Controller topology map pane, as well as several views related to status and network properties. When you first log in to the web user interface, the initial view shows Network Status. [Table 11 on page 51](#) summarizes the left pane drop-down menu choices.

*Table 11: NorthStar Controller Topology View Left Pane Options*

Option	Description
Network Status	Displays a summary of the current status of network elements.
Timeline	Displays a list of timestamped network events. You can use filtering to narrow the display to specific types of event. This information can be useful for debugging purposes.
Types	Lists node types you can opt to display or hide on the topology map.
Nodes/Groups	Displays user-created groups with or without listing the member nodes. Expanded groups are represented on the topology map by individual node icons. Collapsed groups are represented on the topology map by group icons, and the individual member nodes are not displayed. All nodes start out as ungrouped.
Performance	Current (live network) and historical groups of performance options.
Protocols	Selects protocols to include in the topology map. Nodes configured with selected protocols are displayed. The default option includes all protocols.
AS	Selects autonomous systems (ASs) to include in the topology map.
ISIS Areas	Selects ISIS areas to include in the topology map.
OSPF Areas	Selects OSPF areas to include in the topology map.
Path Optimization Status	Displays path optimization statistics and information.
Link Coloring	Provides bit-level link coloring.
Layers	Reflects the multilayer feature. If you have a multilayer license, information can be displayed that has been parsed from Transport Layer vendors. The topology map shows interlayer links between nodes as dotted lines.

The following sections describe the left pane display options:

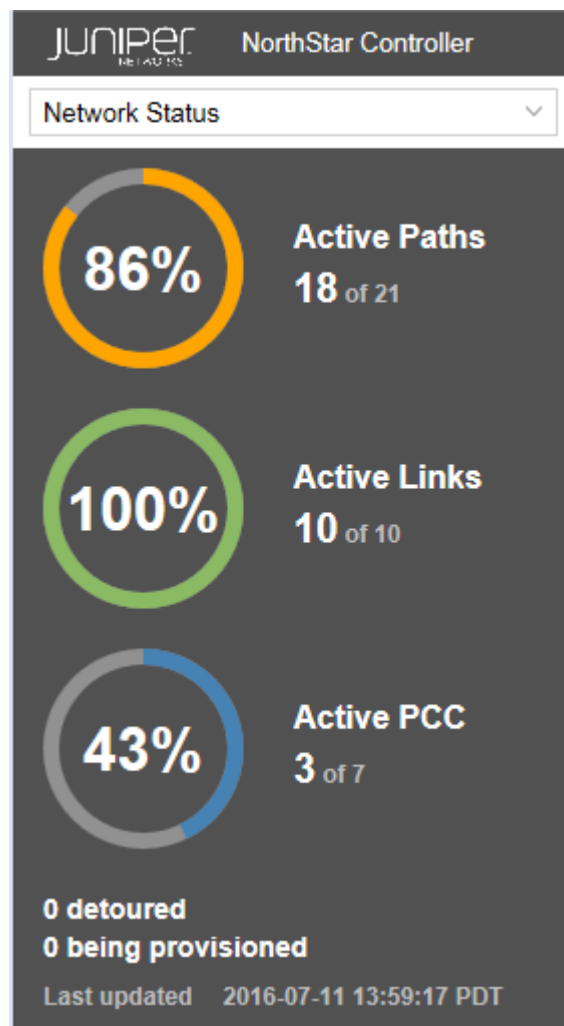
- [Network Status on page 52](#)
- [Timeline on page 53](#)
- [Types on page 54](#)
- [Nodes/Groups on page 56](#)
- [Performance on page 57](#)
- [Protocols on page 58](#)
- [AS on page 58](#)
- [ISIS Areas on page 59](#)
- [OSPF Areas on page 60](#)

- [Path Optimization Status on page 61](#)
- [Link Coloring on page 62](#)
- [Layers on page 63](#)

## Network Status

Figure 37 on page 52 shows an example of the Network Status display in the left side pane of the Topology view. Network Status is the view that is displayed in the left pane when you first launch the NorthStar Controller application.

*Figure 37: Left Pane Network Status Example*

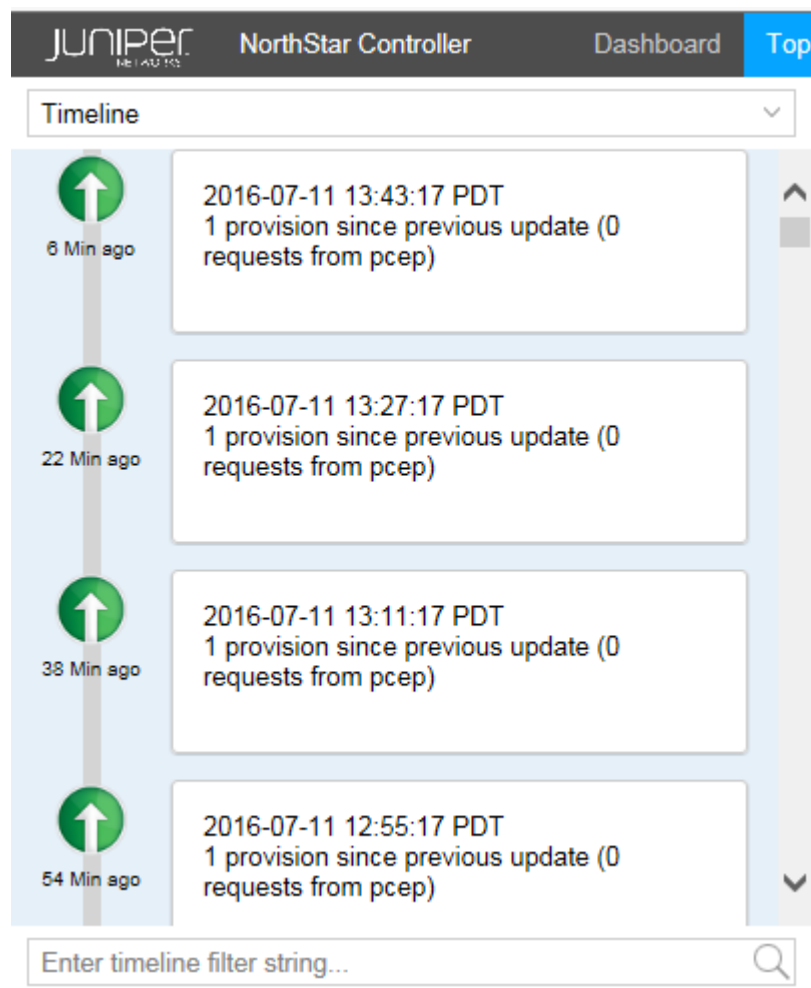


The panel displays the percentage and count of the network's active paths, active links, and active PCCs that are in an up state. The number detoured and in the process of being provisioned are also noted.

## Timeline

Figure 38 on page 53 shows an example of the Timeline display in the left side pane of the Topology view.

Figure 38: Left Pane Timeline Example



The timeline lists activities and status checkpoints with the most recent notations first.

You can use the Timeline to track chronological events as they occur in the network, in order to take appropriate action in real time. You can also use the scroll bar to view past network activities, going back as far as needed.

You can use the filtering box at the bottom of the pane to narrow the display to specific types of event, or to events associated with a specific day or time.

When the timeline is not current, a message is displayed at the top of the Timeline pane inviting you to “click here” to update the display.

You can assess the stability of the MPLS network by tracking changes in the number of LSP Up and Down events over time. You can then analyze whether the occurrence of specific other events affects the number of LSP Up and Down events.

The following event types are included in the Timeline:

Related to nodes:

- PCEP session goes Down
- PCEP session goes Up
- PCEP session becomes ACTIVE

Related to links:

- Link goes Up
- Link goes Down

Related to LSPs:

- Change in the number of LSPs that are Up
- Change in the number of LSPs that are Down
- Change in the number of LSPs that are being provisioned

Related to NorthStar Controller:

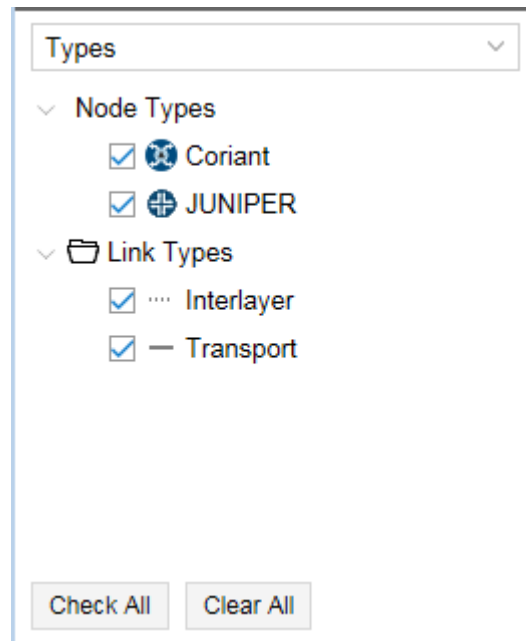
- Path optimization start and end times
- Maintenance events start and end times

## Types

The Types list in the left pane of the Topology view includes categories of nodes and links found in the network. [Figure 39 on page 55](#) shows a sample Types list.



Figure 39: Left Pane Types List



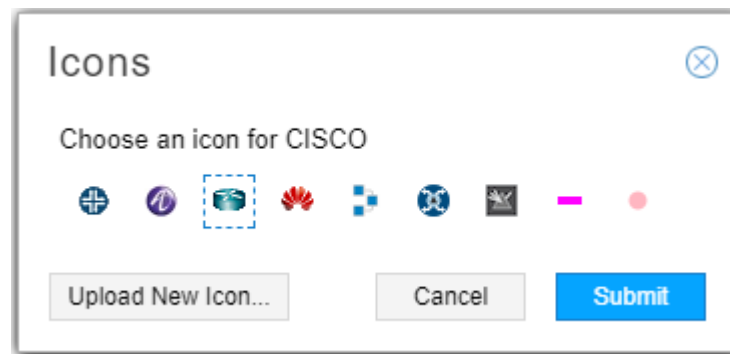
Different types are associated with different icons, which are reflected in the topology map. The example shown in [Figure 39 on page 55](#) includes transport and interlayer link types associated with the Coriant transport controller vendor.

You can select or deselect a type by checking or clearing the check box beside it. Only selected options are displayed in the topology map. Click **Check All** to select all check boxes; click **Clear All** to clear all check boxes.

You can right-click on a node type and select Properties to choose the icon that will represent that node type in the topology map. You can also upload your own icon from there.

[Figure 40 on page 55](#) shows the icon selection window.

Figure 40: Icon Selection Window





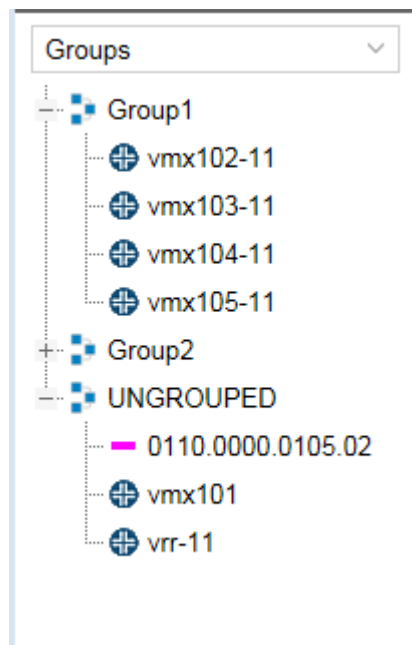
**NOTE:** All nodes of one type use the same icon.

## Nodes/Groups

You can create groups of nodes using the topology map and the Layout menu. Once you have groups in your topology, the Groups list in the left pane of the Topology view shows all your node groups, and lists all nodes not included in any group under the heading UNGROUPED.

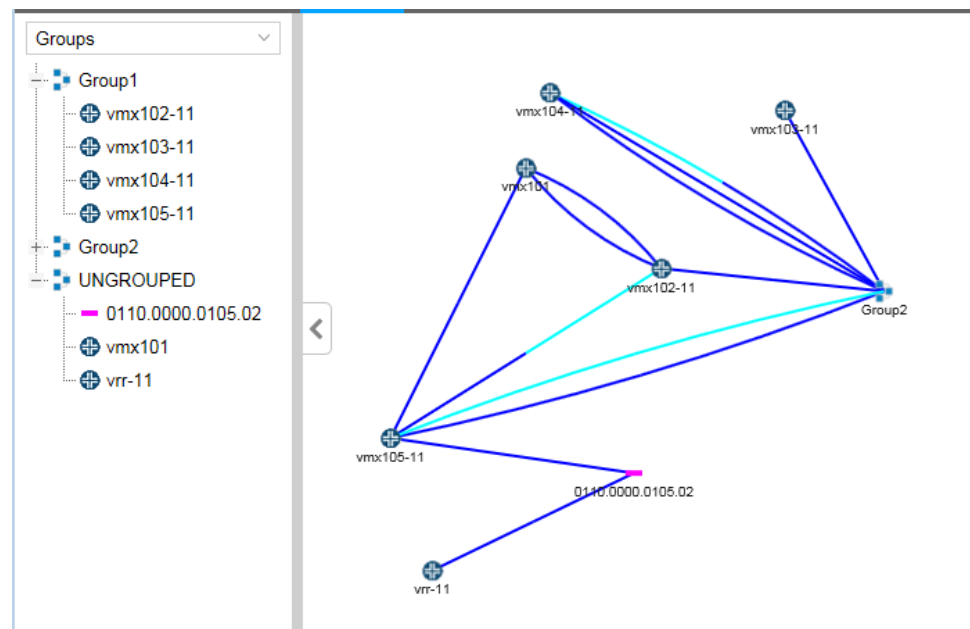
When you expand a group listing using the plus (+) sign next to the group name, all the member nodes are listed. When you collapse a group listing using the minus sign (-), only the group name appears. In [Figure 41 on page 56](#), Group1 and UNGROUPED are expanded, and Group 2 is collapsed.

*Figure 41: Groups List Showing Expanded and Collapsed Groups*



The topology map reflects the expansion and collapse of the groups in the groups list. For an expanded group, all individual nodes are displayed in the topology map, without indication of which group they belong to. For a collapsed group, the individual node icons are collectively represented by a group icon. Hover over or click on the group icon in the map to display the group name. If you collapse UNGROUPED in the Groups list, the nodes disappear from the topology map. [Figure 42 on page 57](#) shows the arrangement from [Figure 41 on page 56](#) along with the corresponding topology map.

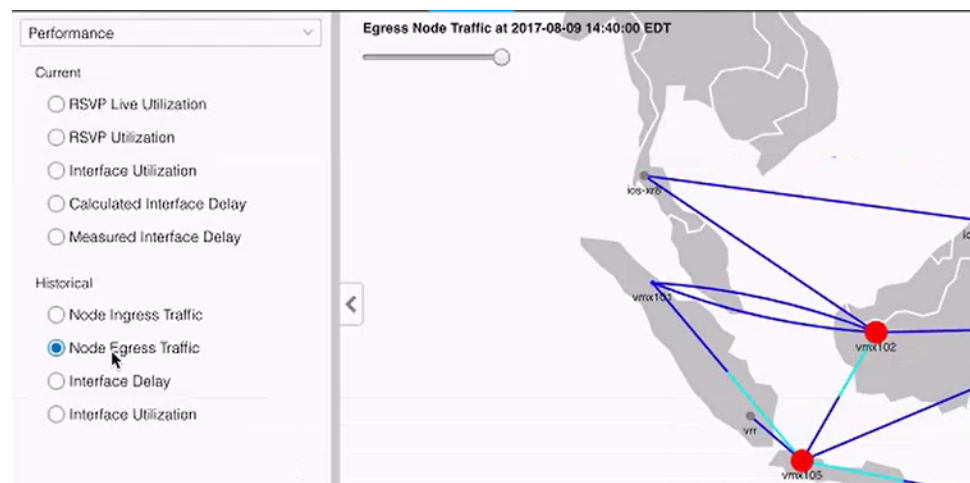
Figure 42: Topology Map Showing a Collapsed Group



## Performance

Under Performance, you have the option to display on the topology map current (live network) or historical (analytic traffic collection) data as shown in Figure 43 on page 57.

Figure 43: Performance Options



Click the radio button for the option you want displayed on the topology map. You can only have one option selected at a time. The color legend at the bottom of the topology map changes to correspond with your selection. See [“Topology Map Color Legend” on page 126](#) for information about customizing the legend.

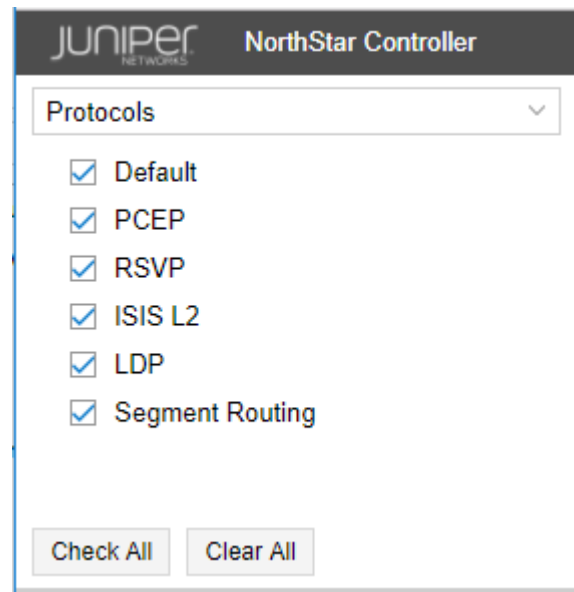
For the historical options, there is a slide bar in the upper left corner of the map, visible in Figure 43 on page 57. See [“Viewing Analytics Data in the Web UI” on page 210](#) for more

information about how to use this feature to help visualize and interpret analytics data. Click **Settings** at the bottom of the Performance options window to select the amount of historical data to load.

## Protocols

The Protocols list includes all protocols present in the current topology. [Figure 44 on page 58](#) shows an example.

*Figure 44: Protocols List*



Protocols can be selected or deselected by selecting or clearing the corresponding check boxes. Only network elements that support selected protocols are displayed in the topology map.



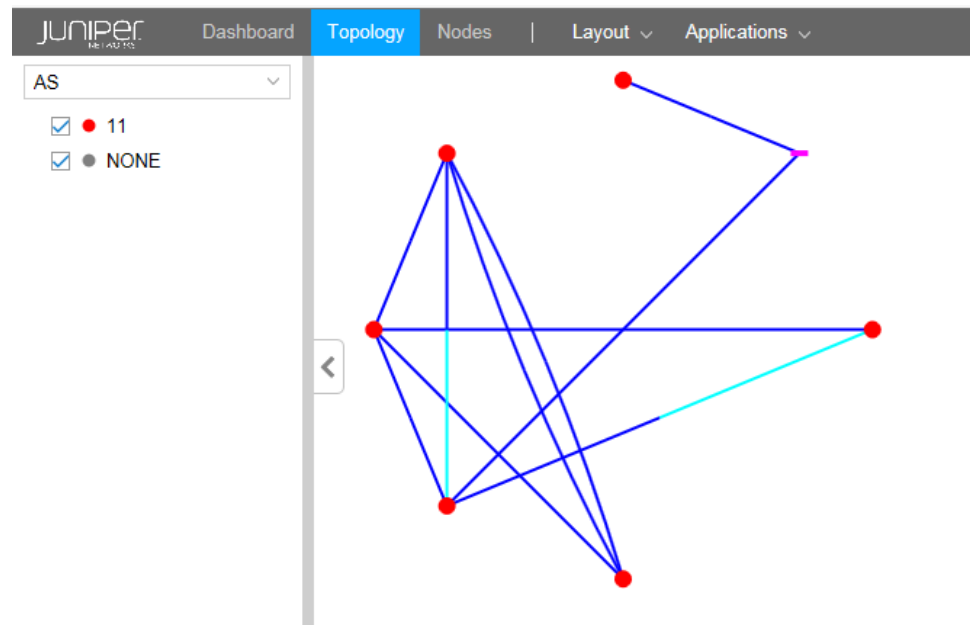
**NOTE:** Select **Default** to display all protocols on the topology map. If you do not want elements supporting all protocols to be displayed on the topology map, be sure to clear the Default check box.

Click **Check All** to select all check boxes; click **Clear All** to clear all check boxes.

## AS

The autonomous systems (AS) list assigns a color, for purposes of representation on the topology map, for each AS number configured in the network. In [Figure 45 on page 59](#), routers configured with AS 11 appear on the topology map as red dots. NONE shows the color assigned to routers with no AS configured.

Figure 45: AS List



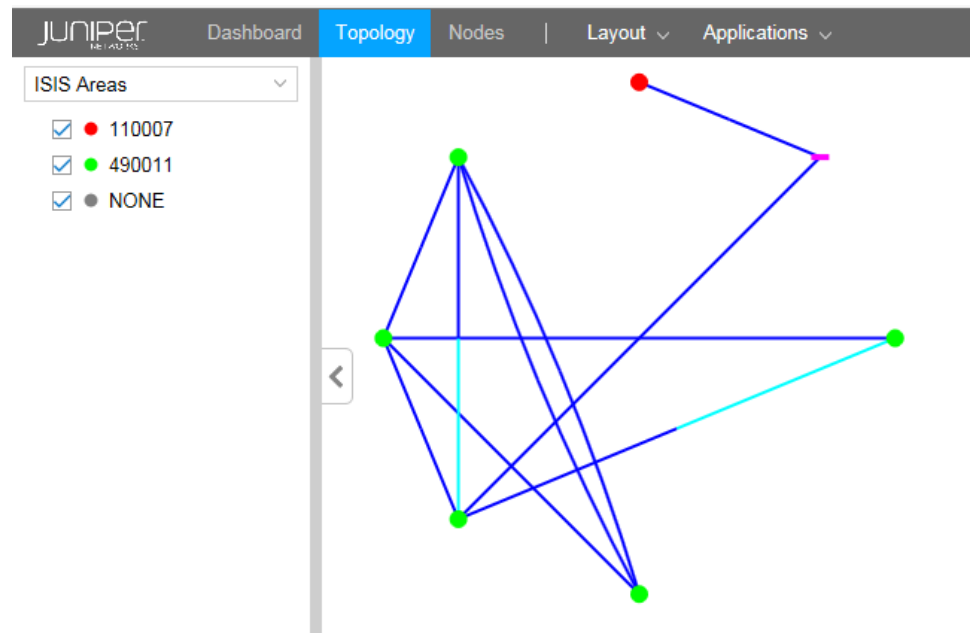
Select or deselect AS numbers by selecting or clearing the corresponding check boxes. Only selected AS numbers are displayed in the topology map.

Click **Check All** to select all check boxes; click **Clear All** to clear all check boxes.

## ISIS Areas

The ISIS Areas list assigns a color, for purposes of representation on the topology map, for each IS-IS area identifier configured in the network. The area identifier is the first three bytes of the ISO network entity title (NET) address. In [Figure 46 on page 60](#), routers whose NET addresses include area identifier 11.0007 appear on the topology map as red dots. Those with area identifier 49.0011 appear as green dots. NONE shows the color assigned to routers with no NET address configured.

Figure 46: ISIS Areas List



ISIS area identifiers can be selected or deselected by checking or clearing the corresponding check boxes. Only selected area identifiers are displayed in the topology map.

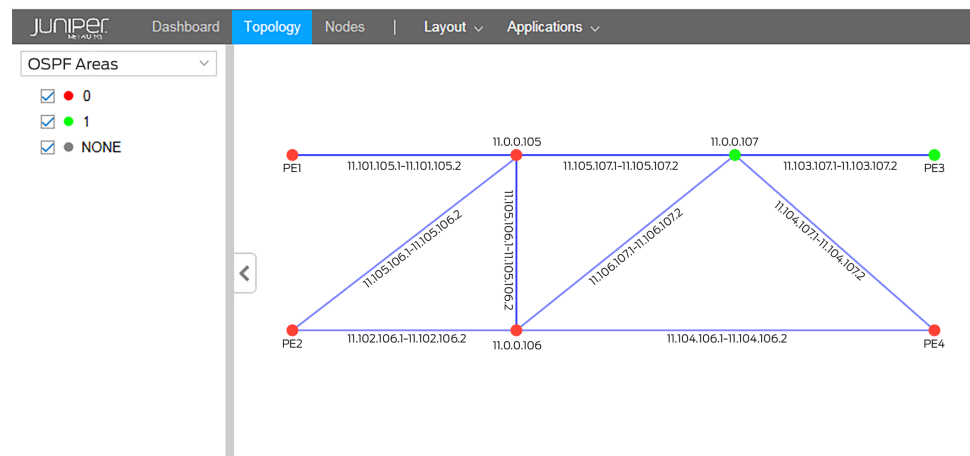
Click **Check All** to select all check boxes; click **Clear All** to clear all check boxes.

## OSPF Areas

The OSPF Areas list assigns a color, for purposes of representation on the topology map, for each OSPF area configured in the network. NONE shows the color assigned to routers with no OSPF area configured.

In [Figure 47 on page 61](#), routers with OSPF area 0 configured appear on the topology map as red dots. Those with OSPF area 1 appear as green dots. NONE shows the color assigned to routers with no OSPF area configured.

Figure 47: OSPF Areas List



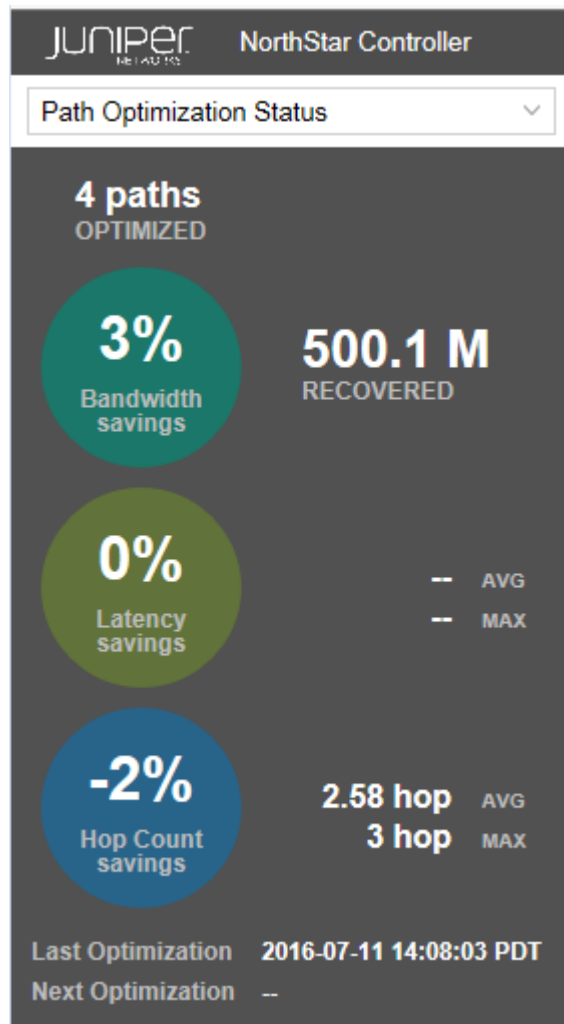
Select or deselect OSPF areas by selecting or clearing the corresponding check boxes. Only selected areas are displayed in the topology map.

Click **Check All** to select all check boxes; click **Clear All** to clear all check boxes.

## Path Optimization Status

Figure 48 on page 62 shows an example of the Path Optimization Status display in the left side pane of the Topology view.

Figure 48: Left Pane Path Optimization Status Example



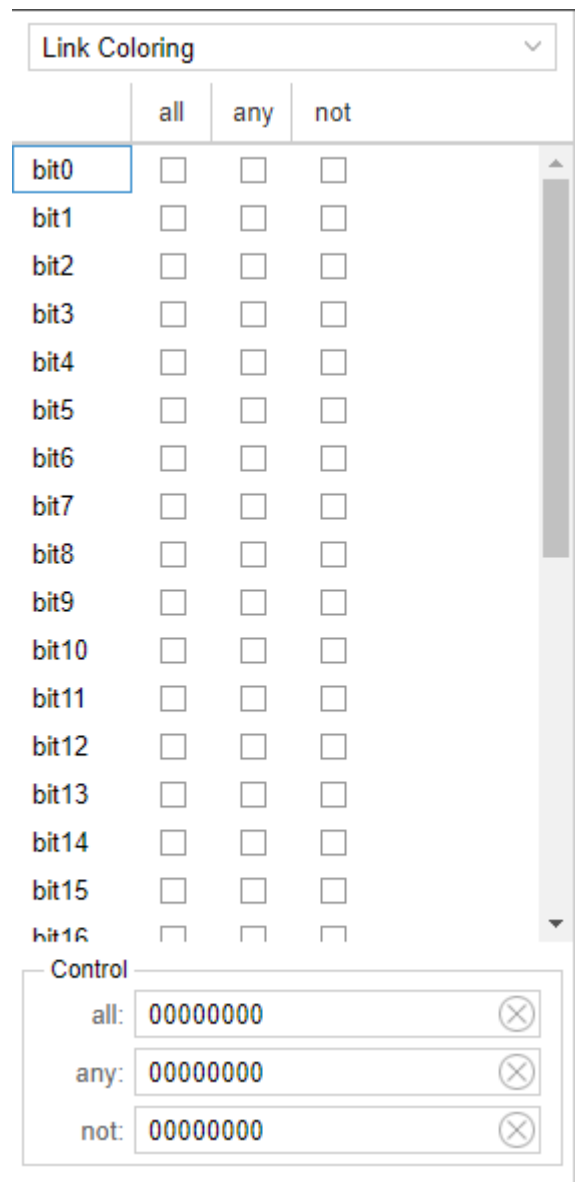
Displays path optimization statistics and information, such as the number of paths that were last optimized, the percent of bandwidth savings achieved, the percent hop count savings, and the time and date of the next optimization if one is scheduled.

## Link Coloring

This option offers bit-level link coloring as shown in [Figure 49 on page 63](#).



Figure 49: Bit-Level Link Coloring



	all	any	not
bit0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit15	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit16	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Control

all: 00000000

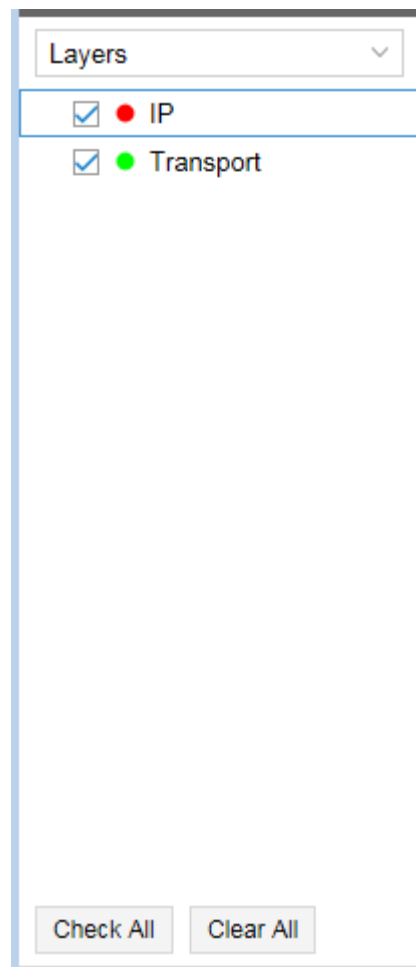
any: 00000000

not: 00000000

## Layers

The Layers list gives you the option to exclude or include individual layer information in the topology map.

Figure 50 on page 64 shows an example of the Layers list with IP and transport layer options.

*Figure 50: Layers List*

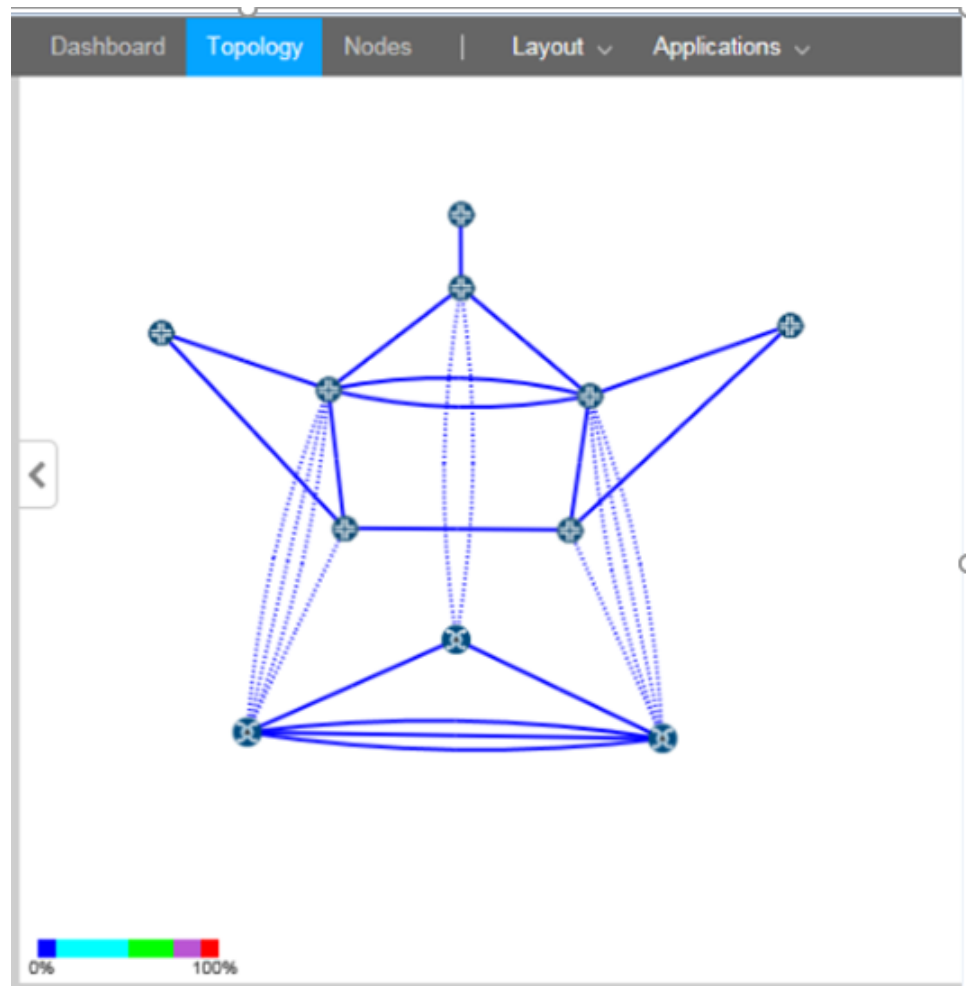
The screenshot shows a 'Layers List' dialog box. At the top is a dropdown menu with the text 'Layers' and a downward arrow. Below the dropdown are two list items. The first item is 'IP' preceded by a red dot and a checked checkbox. The second item is 'Transport' preceded by a green dot and a checked checkbox. At the bottom of the dialog box are two buttons: 'Check All' and 'Clear All'.

Use the Layers list to select the layers (IP or Transport or both) that you want to display. If you are not using the Multilayer feature, the Layers list contains only IP and is not an applicable filter.

Click **Check All** to select all check boxes; click **Clear All** to clear all check boxes.

[Figure 51 on page 65](#) shows an example of a topology map that includes both IP Layer and Transport Layer elements. The dotted link lines indicate interlayer links.

Figure 51: Topology with IP and Transport Layers



**Related  
Documentation**

- [Topology View Overview on page 27](#)
- [Viewing Analytics Data in the Web UI on page 210](#)

## Network Information Table Overview

Network information is displayed in the pane at the bottom of the Topology view, below the topology map. An example of the table is shown in [Figure 52 on page 66](#).

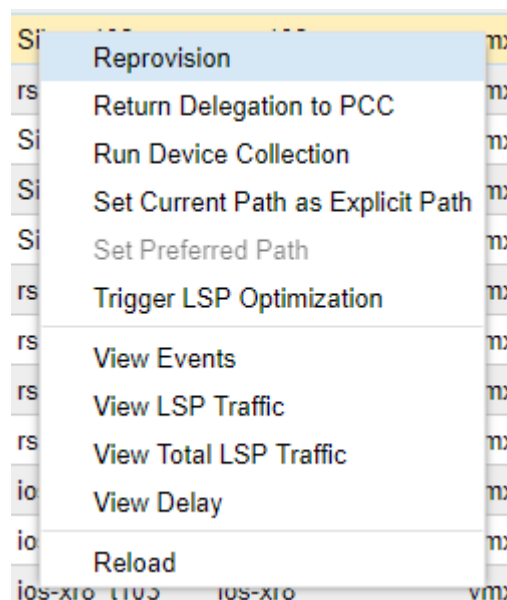
**Figure 52: Network Information Table**

Node Link Tunnel Demand × Interface × Maintenance × P2MP Group × SRLG × + ▾										
Name	Status	Node A	Node Z	Interface A	Interface Z	IP A	IP Z	TE Metric A	TE Metric Z	BW AZ
L11.101.10...	Up	vmx101	vmx105	ge-0/1/1.0	ge-0/1/1.0	11.1...	11.10...	10	10	10M
L11.102.10...	Up	vmx102	vmx105	ge-0/1/2.0	ge-0/1/2.0	11.1...	11.10...	10	10	10M
L11.102.10...	Up	vmx102	vmx106	ge-0/1/3.0	ge-0/1/3.0	11.1...	11.10...	50	50	10M
L11.103.10...	Up	vmx103	vmx107	ge-0/1/8.0	ge-0/1/8.0	11.1...	11.10...	10	10	10M
L11.104.10...	Up	vmx104	vmx106	ge-0/1/7.0	ge-0/1/7.0	11.1...	11.10...	50	50	10M
L11.104.10...	Up	vmx104	vmx107	ge-0/1/9.0	ge-0/1/9.0	11.1...	11.10...	10	10	10M
L11.105.10...	Up	vmx105	vmx106	ge-0/0/2.0	ge-0/0/3.0	11.1...	11.10...	10	10	10M

Tabs appear across the top of the network information table. The columns of information change according to the tab you select (Node, Link, Tunnel, Demand, Interface, Maintenance, P2MP Group, SRLG). Within the tables, each row represents an element. The element information can be rearranged and, in some cases, added to, filtered, modified, or deleted. When you select an element in the network information table, the corresponding element is selected in the topology map.

On any element, you can right-click for options relevant to that element. For example, if you right-click a tunnel, you have the options shown in [Figure 53 on page 66](#).

**Figure 53: Right-Click Options Example**



If you select View Events, for example, you are first prompted to select a time range and click **Submit**, after which a window similar to the example shown in [Figure 54 on page 67](#) is displayed.

**Figure 54: View Events Example**

Events for "test-_vmx102_vmx105"					
Events					
Action	Bandwidth	Current Path	PCS Event	Type	Timestamp
LSP Update	0	11.102.105.2	[NETCONF]<Active	R_IPCCROUTED.A...	2018-04-05 20:38:4...
LSP Update	0	11.102.105.2	[PCEP]<Active	R_AZZ_LSPTYPE=P...	2018-04-05 20:38:3...
LSP Add	0		[NETCONF]<Unknown	R_IPCCROUTED.A...	2018-04-05 20:38:3...
LSP PCE_Session_Closed	0		PCC session closed.	R_AZZ_MCTest1_IDA...	2018-04-05 20:38:3...
LSP Add	0		[REST]<Add provisioning...	R_AZZ_MCTest1_IDA...	2018-04-05 20:38:3...
Animate Path Changes   Change Range   Export to CSV					5 displayed



**NOTE:** The events included in the View Events window are restricted to external communication to and from NorthStar. Most of the communications internal to NorthStar are captured only in the log files. This allows you to focus on the information most likely to be useful to you as a NorthStar operator.



On any element, you can double click for detailed information about that specific element. For example, if you double click a node, you see information similar to that shown in [Figure 55 on page 67](#).

**Figure 55: Example of Information Displayed by Double Clicking a Node**

Node: vmx104																													
<ul style="list-style-type: none"> <li>ISIS</li> <li>NETCONF</li> <li>PCEP</li> <li>SR</li> <li>configurationDataSource</li> <li>management</li> <li>prefixes</li> <li>ASno : 11</li> <li>canFail : true</li> <li>delay : ""</li> <li>filtered : false</li> <li>hasPCE_SR : true</li> <li>hasSR : true</li> <li>hostName : "vmx104"</li> </ul>	<table> <tr> <th>Name ↑</th><th>Value</th></tr> <tr><td>ASno</td><td>11</td></tr> <tr><td>canFail</td><td>true</td></tr> <tr><td>delay</td><td></td></tr> <tr><td>filtered</td><td>false</td></tr> <tr><td>hasPCE_SR</td><td>true</td></tr> <tr><td>hasSR</td><td>true</td></tr> <tr><td>hostName</td><td>vmx104</td></tr> <tr><td>id</td><td>0110.0000.0104</td></tr> <tr><td>ipv4</td><td>11.0.0.104</td></tr> <tr><td>isisArea</td><td>490011</td></tr> <tr><td>isisId</td><td>0110.0000.0104</td></tr> <tr><td>lat</td><td>0</td></tr> <tr><td>layer</td><td>IP</td></tr> </table>	Name ↑	Value	ASno	11	canFail	true	delay		filtered	false	hasPCE_SR	true	hasSR	true	hostName	vmx104	id	0110.0000.0104	ipv4	11.0.0.104	isisArea	490011	isisId	0110.0000.0104	lat	0	layer	IP
Name ↑	Value																												
ASno	11																												
canFail	true																												
delay																													
filtered	false																												
hasPCE_SR	true																												
hasSR	true																												
hostName	vmx104																												
id	0110.0000.0104																												
ipv4	11.0.0.104																												
isisArea	490011																												
isisId	0110.0000.0104																												
lat	0																												
layer	IP																												

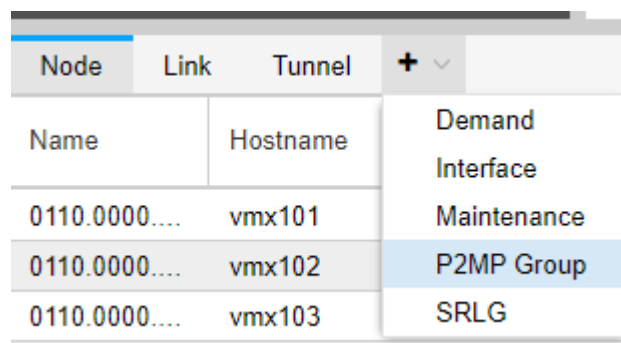
The teardrop-shaped icon in the upper right corner of the details window controls the pin behavior described in [Table 12 on page 68](#).

Table 12: Pin Behavior in Network Element Detail Windows

Pin State	Behavior
 Unpinned	<p>When unpinned, double clicking a second element in the network information table replaces the contents of the first details window with the details of the second element. In this scenario, there is only one details window open at a time.</p>
 Pinned	<p>When pinned, double clicking a second element in the network information table opens a new details window, leaving the first window intact.</p> <p><b>TIP:</b> If you double click a second element, but you still only see one details window, try moving the window to the side by clicking-and-dragging the window heading. The windows might be stacked.</p>

The Node, Link, and Tunnel tabs are always displayed. The other tabs are optionally displayed. Click the + sign in the tabs heading bar to add a tab as shown in [Figure 56 on page 68](#).

Figure 56: Adding a Tab to the Network Information Table



Click the X beside any optionally displayed tab heading to remove the tab from the display.

#### Related Documentation

- [Sorting and Filtering Options in the Network Information Table on page 68](#)
- [Network Information Table Bottom Tool Bar on page 70](#)

## Sorting and Filtering Options in the Network Information Table

For many of the columns in the network information table, sorting and filtering options become available when you hover over the column heading and click the down arrow that appears.

[Table 13 on page 69](#) describes the sorting and filtering options that could be available, depending on the data column.

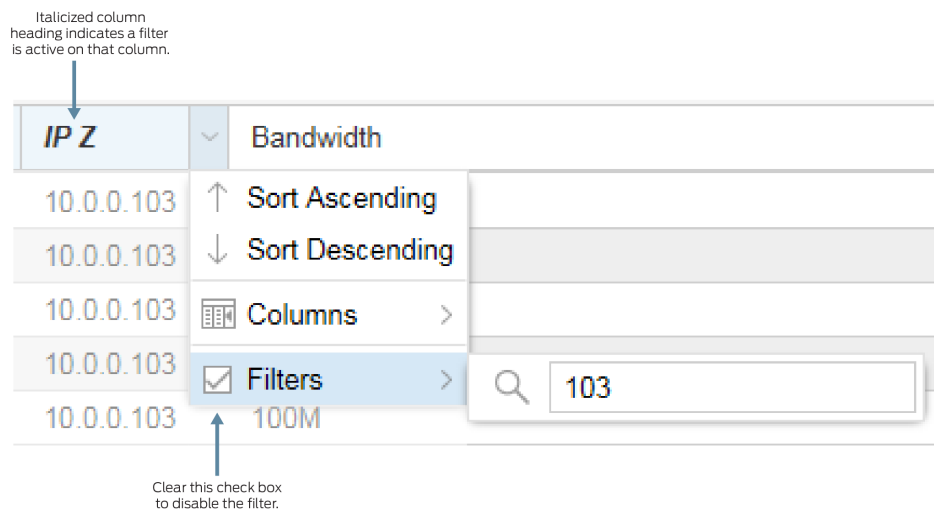
**Table 13: Sorting and Filtering Options**

Option	Description
Sort Ascending	Sorts the list of elements from lowest to highest.
Sort Descending	Sorts the list of elements from highest to lowest.
Columns	Click the check boxes to add or remove columns in the network information table.
Filters	For some columns, the Filters option provides a search box. For other columns, the Filters option allows you to enter values in greater than (>), less than (<), or equal to (=) fields. To remove a filter, clear the check box next to the Filters option.



**NOTE:** In some topologies, the list of network elements can include multiple pages of data. NorthStar only offers sorting capabilities on the active page. In that case, try filtering to narrow down the number of rows displayed.

Using the Filters option, you can filter the devices that are included in the display by activating a filter on any column. For example, if you want to display only the tunnels that have 103 in their configured IP Z address, hover over the IP Z column heading, click the down arrow that appears, and enter **103** in the filter box. The Filters check box is automatically selected, and the display is filtered accordingly. The IP Z column heading appears as italicized to indicate an active filter on the column. [Figure 57 on page 69](#) illustrates this example.

**Figure 57: Example: Filtering on a Column**

To remove a filter, clear the Filters check box. You do not need to remove the filter text, allowing you to toggle the filter on and off without reentering the text.

- Related Documentation**
- [Network Information Table Overview on page 66](#)
  - [Network Information Table Bottom Tool Bar on page 70](#)

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## Network Information Table Bottom Tool Bar

The bottom tool bar in the network information table has tools for navigating through the network element data, as well as Add, Modify, and Delete buttons for performing actions on elements.

The Add, Modify, and Delete buttons behave differently, depending on which type of element you are working with; these functions are not always allowed. When they are not allowed, the buttons are grayed out. The Modify and Delete buttons become enabled when an individual element row is selected, as long as the action is allowed on that element.

The topology server (Toposerver) requires that certain conditions be met before it will allow you to delete a link or node.

- To delete a link:
  - The link's operational status must be down. The operational status is changed to down when Toposerver receives the first LINK WITHDRAW message from NTAD.
  - The link cannot have active IS-IS or OSPF adjacencies. IS-IS and OSPF adjacencies are dropped when Toposerver receives the second LINK WITHDRAW message from NTAD.

To delete a node:

- The node must be isolated, meaning that all links associated with the node have been deleted (after the link deletion conditions have been met).
- The node cannot have IS-IS, OSPF, or PCEP connections. IS-IS and OSPF adjacencies are cleared when Toposerver receives a NODE WITHDRAW message from NTAD and the PCEP session has been terminated. This workflow ensures that TED and Toposerver are synchronized.

For some elements, you can modify or delete multiple items at once (bulk modify) by Ctrl-clicking or Shift-clicking multiple line items in the table. For example, if you select multiple items in the Tunnel tab and click **Modify**, the Modify LSP (X LSPs) window is displayed as shown in [Figure 58 on page 71](#).



Figure 58: Modify Multiple LSPs Window

The window supports deleting the contents of a field, leaving the contents unchanged, or changing the contents to a specific value. Depending on the type of data the field contains, you can click to toggle, use the up and down arrows to select a value, or double-click to set a value. For fields where a blank value is not allowed (required fields), the option to delete is not available.

## Navigation Tools







The tools in the network information table bottom tool bar are available to help you navigate through rows of data, refresh the display, and change the number of rows per loaded page. These tools are especially useful for large models with many elements.

[Table 14 on page 71](#) describes the tools in the bottom tool bar. Not all of the tools are available for all element types (node, link, interface, and so on).

Table 14: Navigation Tools in the Network Information Bottom Tool Bar

Tool or Button	Description
<<	Displays the first page of data.
<	Displays the previous page of data.
Page __ of <total pages>	Displays the specific page of data you enter.
>	Displays the next page.
>>	Displays the last page.

Table 14: Navigation Tools in the Network Information Bottom Tool Bar (continued)

Tool or Button	Description
	Manually refreshes the data.
	Downloads the table information to spreadsheet.
	Opens a search criteria field. Enter the search criteria and click the Filter button on the far right of the field. The table and the topology display only the results of the search.
	After a search, restores the topology to the full network display.
	Click the down arrow to specify a grouping for the table contents.
	Specifies the number of rows per loaded page.

## Actions Available for Nodes

For nodes, Add is not a supported function. Delete is allowed as long as the prerequisites for node deletion have been met, as described earlier in this topic. Modify is allowed and is optionally used to set or change the latitude and longitude of a node, change node properties, or add IP addresses.

[Figure 59 on page 73](#) shows the Properties tab of the Modify Node window. All of the fields on this tab can be modified.

Figure 59: Properties Tab of the Modify Node Window

**Modify Node**

Properties Location Addresses

Name: 0100.0000.0102

OS:

Comment:

☒ Support Secondary Path

Cancel Submit

Figure 36 on page 49 shows the Location tab of the Modify Node window. NorthStar Controller uses latitude and longitude settings to position nodes on the country map, and also to calculate distances when performing routing by distance.

Figure 60: Location Tab of the Modify Node Window

**Modify Node**

Properties Location Addresses

Latitude:

Longitude:

Site:

Cancel Submit

Enter latitude and longitude values using signed degrees format (DDD.dddd):

- Latitudes range from -90 to 90.
- Longitudes range from -180 to 180.

- Positive values of latitude are north of the equator; negative values (precede with a minus sign) are south of the equator.
- Positive longitudes are east of the Prime Meridian; negative values (precede with a minus sign) are west of the Prime Meridian.

Enter a site name in the Site field.



**NOTE:** When provisioning diverse LSPs, NorthStar might return an error if the value you enter in the Site field contains special characters, depending on the version of Node.js in use. We recommend using alphanumeric characters only.

Figure 61 on page 74 shows the Addresses tab of the Modify Node window.

Figure 61: Addresses Tab of the Modify Node Window

Modify Node		
Properties	Location	Addresses
Add		
Tag	IP Address	
default	10.0.0.102	
Cancel Submit		

The NorthStar Controller supports using a secondary loopback address as the MPLS-TE destination address. In the Addresses tab of the Modify Node window, you have the option to add destination IP addresses in addition to the default IPv4 router ID address, and assign a descriptive tag to each. You can then specify a tag as the destination IP address when provisioning an LSP.



**NOTE:** A secondary IP address must be configured on the router for the LSP to be provisioned correctly.

Click **Add** to create a new line where you can enter the IP address and the tag.

Click **Submit** to complete the node modification.

## Actions Available for Links

For links, Add is not a supported function. Delete is allowed as long as the prerequisites for link deletion have been met, as described earlier in this topic. Modify is available and is primarily used in support of the Multilayer feature. Sometimes, when interlayer links are initially loaded into the model, only the source is known. In those cases, you can select Node Z (the remote node name) from the drop-down menu, and enter IP Z (the corresponding IP link end on Node Z) to manually connect the Transport Layer to the IP Layer. You can also specify the Type of the link and add your comments for reference. On the Advance tab, you can specify Delay and Admin Weight values for the link. On the User Properties tab, you can add properties not already defined. The Properties tab of the Modify Link window is shown in [Figure 62 on page 75](#).

*Figure 62: Modify Link Window, Properties Tab*

**Modify Link**

Properties   Advanced   Configuration   User Properties

Name:

Node A: 0110.0000.0102

Node Z: 0110.0000.0105

Protected: ☐

Type:

Comment:

## Actions Available for Tunnels

For tunnels, Add, Modify, and Delete are available functions for PCE-initiated tunnels. Delegated tunnels cannot be added or deleted.

[Figure 63 on page 76](#) shows the Provision LSP window.

Figure 63: Provision LSP Window

The screenshot shows the 'Provision LSP' window with the following fields and tabs:

- Tabs:** Properties (selected), Path, Advanced, Design, Scheduling, User Properties.
- Provisioning Method:** NETCONF (dropdown)
- Name:** (text input)
- Node A:** (dropdown)
- Node Z:** (dropdown)
- IP Z:** (dropdown)
- Provisioning Type:** RSVP (dropdown)
- Path Type:** primary (dropdown)
- Path Name:** (text input)
- Planned Bandwidth:** 0 (text input)
- Setup:** 7 (spin box)
- Hold:** 7 (spin box)
- Planned Metric:** (spin box)
- Comment:** (text input)
- Buttons:** Preview Path, Cancel, Submit.



**NOTE:** You can also reach the Provision LSP window from the Applications menu in the top menu bar by navigating to **Applications > Provision LSP**. See [“Provision LSPs” on page 87](#) for descriptions of the data entry fields in this window.

The Modify LSP window has the same data entry fields as the Provision LSP window (not all of which can be modified).

## Actions Available for SRLGs

Shared Link Risk Group (SRLG) information can come from two sources:

- BGP-LS
- Transport controller

The information from these sources is merged and presented in the web UI. You can also Add, Modify, and Delete user-defined SRLGs.

## Actions Available for Maintenance Events

Add, Modify, and Delete are available functions in the network information table for maintenance events. You can also reach the Add Maintenance Event window from the Applications menu in the top menu bar by navigating to **Applications>Maintenance**. See [“Maintenance Events” on page 139](#) for descriptions of the data entry fields in the Add Maintenance Event window.

The Modify Maintenance Event window contains the same fields as the Add Maintenance Event window.



**NOTE:** You can access the Maintenance Event Simulation window by right-clicking in a maintenance event row and selecting **Simulate**.

## Actions Available for Interfaces

Interfaces cannot be added, modified, or deleted from the network information table.

## Actions Available for P2MP Groups

Add, Modify, and Delete are available functions in the network information table for P2MP groups. These functions are for P2MP *groups* only, not for sub-LSPs within a group. To modify or delete sub-LSPs, use the Tunnel tab.

See [“Provision and Manage P2MP Groups” on page 108](#) for descriptions of the data entry fields in the Add P2MP Group window.

## Actions Available for Demand

The Demand tab displays LDP Forwarding Equivalent Class (FEC) data compiled as a result of LSP collection tasks. This data cannot be added, modified, or deleted from the network information table. See [“LDP Traffic Collection” on page 232](#) for information about this data.

The Demand tab also displays demands resulting from the Netflow Collector, which you can delete, but not add or modify. Demands are never automatically deleted. See *Netflow Collector* for more information about Netflow Collector data.

### Related Documentation

- [Network Information Table Overview on page 66](#)
- [Sorting and Filtering Options in the Network Information Table on page 68](#)
- [Maintenance Events on page 139](#)
- [Provision and Manage P2MP Groups on page 108](#)
- [LDP Traffic Collection on page 232](#)
- *Netflow Collector*





## CHAPTER 4

# LSP Management

- [Understanding Label-Switched Paths on the NorthStar Controller on page 79](#)
- [Understanding the Behavior of Delegated Label-Switched Paths on page 82](#)
- [Work Order Management on page 84](#)
- [Provision LSPs on page 87](#)
- [Provision Diverse LSP on page 96](#)
- [Provision Multiple LSPs on page 97](#)
- [Configure LSP Delegation on page 101](#)
- [Templates for Netconf Provisioning on page 102](#)
- [Provision and Manage P2MP Groups on page 108](#)
- [Bandwidth Calendar on page 116](#)
- [Creating Templates to Apply Attributes to PCE-Initiated Label-Switched Paths on page 117](#)
- [Creating Templates with Junos OS Groups to Apply Attributes to PCE-Initiated Label-Switched Paths on page 119](#)

## Understanding Label-Switched Paths on the NorthStar Controller

The NorthStar Controller uses PCEP or Netconf to learn about LSPs in the discovered network topology, and all LSPs and their attributes can be viewed from the NorthStar Controller user interface. However, the LSP type determines whether the Path Computation Client (PCC) or NorthStar Controller maintains the operational and configuration states.

The following LSP types are supported on the NorthStar Controller:

- **PCC-controlled LSP:** The LSP is configured locally on the router, and the router maintains both the operational state and configuration state of the LSP. The NorthStar Controller learns these LSPs for the purpose of visualization and comprehensive path computation. Using Netconf, these LSPs can be created or modified in NorthStar.
- **PCC-delegated LSP:** The LSP is provisioned on the PCC (router) and has been delegated to the NorthStar Controller for subsequent management. The operational state and configuration state of the LSP is stored in the PCC. For delegated LSPs, the ERO, bandwidth, LSP metric, and priority fields can be changed from the NorthStar Controller

user interface. However, the NorthStar Controller can return delegation back to the PCC, in which case, the LSP is reclassified as PCC-controlled.

- PCE-initiated LSP: The LSP is provisioned from the NorthStar Controller UI. For these LSPs, only the operational state is maintained in the router, and only NorthStar can update the LSP attributes.



**NOTE:** There are a couple of circumstances under which the NorthStar Controller would discover these LSPs from the router, even though they are PCE-initiated:

- A PCE-initiated LSP could be created by a controller other than the NorthStar Controller, and then discovered by NorthStar from the router.
- When you reset the topology in the NorthStar Controller, NorthStar re-learns the LSPs from the router.

The NorthStar Controller supports the discovery, control, and creation of protection LSPs (standby and secondary LSPs). For protection LSPs, the primary, secondary, and standby LSP must be of the same type (PCC-controlled, PCC-delegated, or PCE-initiated). Each LSP can have its own specific bandwidth, setup priority, and hold priority or can use the values of the primary LSP (the default). A primary LSP must always be present for controller-initiated LSPs.

## Provisioning Method

NorthStar Controller supports two methods for provisioning and managing LSPs: PCEP and Netconf. When you provision an LSP using PCEP, the LSP is added as a PCE-initiated LSP. When you provision using Netconf, the LSP is added as a PCC-controlled LSP.



**NOTE:** At this time, NorthStar Controller supports Netconf provisioning on Juniper devices only.

Table 15 on page 80 summarizes the provisioning actions available for each type of LSP in the NorthStar Controller.

**Table 15: NorthStar Provisioning Actions by LSP Type**

LSP Type	Provision LSP	Modify LSP	Delete LSP
PCC-controlled LSP	Netconf	Netconf	Netconf
PCC-delegated LSP	N/A	PCEP	Netconf
PCE-initiated LSP	PCEP	PCEP	PCEP



**NOTE:** NorthStar does not offer a way to directly provision a new PCC-delegated LSP. What you can do though, is provision a new PCC-controlled LSP using Netconf and then delegate the LSP to NorthStar Controller by navigating to **Applications > Configure LSP Delegation**.

In NorthStar, both PCEP and Netconf device collection discover the same LSP attributes (in other words, there are no additional LSP attributes discovered only by device collection).

The following actions are performed or available when LSP provisioning is done via PCEP, but not when done via Netconf:

- **Automatic reprovisioning upon provisioning failure:** If provisioning via NETCONF fails, such as when there is a commit failure or the NETCONF session is down, NorthStar does not retry the provisioning and you would need to resubmit the provisioning order. This is applicable to any provisioning for PCC-controlled LSPs and deletion of PCE-delegated LSPs.
- **LSP rerouting:** When receiving an LSP down event from the network, NorthStar does not automatically recompute and reprovision a new path for PCC-controlled LSPs.
- **Path Optimization:** When you run path optimization, PCC-controlled LSPs are not optimized.
- **Maintenance:** PCC-controlled LSPs are not rerouted to avoid scheduled maintenance events.

## Routing Method and Path Selection

When provisioning PCC-controlled LSPs via Netconf in NorthStar, you have the option to specify that NorthStar should compute and provision the path for the LSP, or not. You specify this option by setting the LSP routing method:

- **routeByDevice routing method**—This is the default routing method when a PCC-controlled LSP is created or learned by NorthStar. When a PCC-controlled LSP has routeByDevice routing method, the NorthStar Controller does not compute and provision a path.
- **Other routing methods (default, delay, and so on)**— When a PCC-controlled LSP has a routing method that is not routeByDevice, the NorthStar Controller computes and provisions the path as a strict explicit route when provisioning the LSP. The LSP's existing explicit route might be modified to a NorthStar-computed strict explicit route. For example, a loose explicit route specified by the user or learned from the router would be modified to a strict explicit route.



**NOTE:** NorthStar saves the computed strict explicit route with **Preferred** path selection. This allows NorthStar, when it needs to re-compute the LSP path, to try to follow the strict explicit path, while still enabling it to compute an alternate path if the strict explicit path is no longer valid.

## Deletion of LSPs on the Router

When an LSP is removed from the router, and therefore from the network, it is automatically deleted from NorthStar unless it has been modified by a NorthStar user (via the web UI or REST APIs), and therefore has a Persist state associated with it. Any LSP with a Persist state that is deleted from the router would require manual deletion in NorthStar.

- Related Documentation**
- [Understanding the NorthStar Controller on page 3](#)
  - [Understanding the Behavior of Delegated Label-Switched Paths on page 82](#)

---

## Understanding the Behavior of Delegated Label-Switched Paths

You can delegate the management of a router-configured label-switched path (LSP) to the NorthStar Controller by configuring the LSP from the router to be externally controlled. Any router-controlled LSP on the PCC can be delegated to the NorthStar Controller.

When an LSP is externally controlled, the controller manages the following LSP attributes:

- Bandwidth
- Setup and Hold priorities
- LSP metric
- ERO

Any configuration changes to the preceding attributes performed from the router are overridden by the values configured from the controller. Changes made to these attributes from the PCC do not take effect as long as the LSP is externally controlled. Any configuration changes made from the PCC take effect only when the LSP becomes locally or router controlled.

In both standalone and high availability (HA) cluster configurations, whenever a PCEP session goes down on a PCC, all the LSPs that originated from that PCC are removed from NorthStar except those with design parameters saved in NorthStar Controller. Examples of LSPs with design parameters include:

- PCE-initiated LSPs
- PCC-delegated LSPs with LSP attributes such as path, that have been modified by Northstar

The following sections provide additional information:

- [Behavior of Delegated LSPs That Are Returned to Local PCC Control on page 83](#)
- [Modifying Attributes of Delegated LSPs on the NorthStar Controller on page 84](#)

## Behavior of Delegated LSPs That Are Returned to Local PCC Control

When an LSP is externally controlled, any attempt to change the configuration of the LSP from the PCC (except for auto-bandwidth parameters) results in the display of a warning message from the router CLI. For delegated LSPs, any parameters configured from the PCC take effect only after the LSP is returned to local (PCC) control. When the LSP is returned to local control, the PCEP report messages report the state to the NorthStar Controller. If the NorthStar Controller is not available when the PCC configuration is changed locally, but becomes available some time after the configuration changes are made, the LSP is delegated with the reports carrying the latest state. When an LSP is externally controlled, configuration changes to bandwidth, setup and hold priorities, LSP metric, and ERO are overridden by the controller. Any configuration changes to these attributes made from the PCC do not take effect as long as the LSP is externally controlled. Only after the LSP becomes locally or router controlled will any configuration changes made from the PCC take effect. [Table 16 on page 83](#) shows the LSP parameters that can and cannot be configured from the PCC.

**Table 16: Behavior of LSP Configurations Initiated from PCC**

Configuration Statement	Description
<b>admin-down</b>	Not applicable to packet LSP.
<b>admin-group</b>	Results in an MBB. The new LSP is reported; the old LSP is reported with the R-bit set.
<b>auto-bandwidth</b>	PCC automatically adjusts bandwidth based on the traffic on the tunnel. Supported on Juniper Networks routers only.
<b>bandwidth</b>	Results in an MBB. The new LSP is reported; the old LSP is reported with the R-bit set.
<b>bandwidth ct0</b>	Results in an MBB. The new LSP is reported; the old LSP is reported with the R-bit set.
<b>class-of-service</b>	No change reported from PCE.
<b>description</b>	No change reported from PCE.
<b>disable</b>	LSP is deleted on the router. The PCRpt message is sent with R-bit.
<b>entropy-label</b>	No change reported from PCE.
<b>fast-reroute</b>	Results in detour path setup; the detours are not reported to the controller.
<b>from</b>	LSP name change results in a new LSP being signaled, and the old LSP is deleted. The new LSP is reported through PCRpt message with D-bit. The old LSP is removed.
<b>install</b>	The prefix is applied locally and is not reflected to the PCE.
<b>metric</b>	Results in an MBB. The new LSP is reported, and the old LSP is reported with the R-bit set.
<b>name</b>	LSP name change results in a new LSP being signaled, and the old LSP is deleted. The new LSP is reported through PCRpt message with D-bit. The old LSP is removed.

*Table 16: Behavior of LSP Configurations Initiated from PCC (continued)*

<b>node-link-protection</b>	No change is reported from PCE. The LSP is brought down and then brought back up again. This sequence does not use an MBB.
<b>priority</b>	Results in an MBB. The new LSP is reported; the old LSP is reported with the R-bit set.
<b>standby</b>	Implementation of stateful path protection draft along with association object; see section 5.2.
<b>to</b>	LSP name change results in a new LSP being signaled, and the old LSP is deleted.

## Modifying Attributes of Delegated LSPs on the NorthStar Controller

When an LSP is externally controlled, local path computation is disabled, and you can modify the following attributes for the delegated LSP from the NorthStar Controller:

- **priority**—Modifying this attribute results in a make-before-break (MBB) operation.
- **admin-group**—Modifying this attribute results in an MBB operation.
- **ERO**—Modifying this attribute results in an MBB operation. The new LSP state is reported, and the old state is deleted.

### Related Documentation

- [Understanding Label-Switched Paths on the NorthStar Controller on page 79](#)

## Work Order Management

Work order management provides authorization and tracking for all functions related to the provisioning of LSPs and resulting changes to the live network and network model. Such change requests are captured as work orders and must be approved and activated before they can take effect and be seen in the network information table and in the topology.

The life cycle of a work order is typically:

1. Created/submitted
2. Approved or rejected
3. Activated (if approved)
4. Closed

Full-access users who create LSP provisioning or modification requests are “submitters”. Submitters can submit work orders, activate approved work orders, and close activated or rejected work orders.

The only approver is the Admin user. Approvers can approve/reject work orders submitted by others, activate approved work orders, submit their own work orders which are automatically approved and activated (Admin bypass mode), and close activated or rejected work orders.

All users can monitor the status of work orders using the Work Orders window accessible from the top menu bar in the web UI.

Work orders are stored in the Cassandra database, each with a number of attributes such as:

- Work order ID and state
- Identification of the submitter, approver, activator, and closer
- Comments added at any stage of the work order life cycle
- Provisioning status
- Error messages, if any
- LSP request data (source, destination, bandwidth, and so on)
- List of affected network elements and the pending actions on them

The Cassandra database is queried to populate the Work Order window. Changes in the Work Order window are immediately saved back to the Cassandra database and broadcast to all users in real time, so everyone has the most current information.

## Submitter Work Flow

The following steps describe a typical work flow for submitters:

1. Complete the web UI windows appropriate for the desired request, such as Provision LSP, Modify LSP, Provision Multiple LSPs, and so on, and click **Submit**. This submits a work order.
2. Access the Work Order window from the top Menu Bar in the web UI.

Figure 64 on page 85 shows the Work Order window with sample work orders listed in the top portion. The bottom portion of the window (Details) shows detailed information for the highlighted work order. In this example, there is only one LSP in the work order, but there could be multiple LSPs. For modification work orders, the Details portion shows the old and new parameters.

**Figure 64: Work Order Window**

Workflow

Modify Submitter Comment

Action	ID ↓	Status	Submitter	Submitted Time	Submitter Comment	Approver	Approved Time	Approver Comment	Activator	Activated Time	Activator Comment	Provisioning Status
add	1512335667020	Submitted	Submitter-1	2017-12-03...	Notify Submitter-5							
modify	1512335548541	Submitted	Submitter-1	2017-12-03...	modify lsp							
add	1512335445734	Submitted	Submitter-1	2017-12-03...	add lsp							
modify	1509546327102	Activated	admin	2017-11-01...	modify lsp	admin	2017-11-01...	Auto Approved	admin	2017-11-01...	Auto Activa...	Successful

<< < Page 1 of 1 > >>

Displaying 1 - 4 of 4

Details

Request	Name ↑	LspIndex	IP A	IP Z	Bandwidth	Setup	Hold	Planned Metric
New	test-1	0	11.0.0.108	11.0.0.105	0	7	7	

3. The Submitter Comment column is populated automatically based on the type of work order. To modify the comment, click **Modify Submitter Comment** in the upper right corner, enter your new comment, and click **OK**.
4. When the Admin user approves the work order, the Status column is updated to Approved. At that time, activate the work order by clicking **Workflow** in the upper right corner of the window and selecting **Activate**. Once activated, NorthStar Controller attempts to provision the LSP, and the LSP appears in the network information table (Tunnel tab) and in the topology.
5. Verify the provisioning is successful. The Work Order window includes a column for Provisioning Status.
6. When the work order is no longer needed, close it by clicking **Workflow** in the upper right corner of the window and selecting **Close**.



**NOTE:** Only open work orders are displayed in the Work Order window. We recommend that you keep this display as streamlined as possible by closing activated or rejected work orders when they are no longer needed, thereby removing them from the Work Order window.

## Approver Work Flow

The following steps describe a typical work flow for approvers (the Admin user):

1. Monitor the Work Order window and approve or reject work orders submitted by others. Highlight a work order and click **Workflow**. Select **Approve** or **Reject** and add comments as appropriate. Click **OK**.
2. Complete the web UI windows appropriate for the desired request, such as Provision LSP, Modify LSP, Provision Multiple LSPs, and so on, and click **Submit**. This submits a work order. In this case, the submitter is also the approver. Work orders submitted by the approver are auto-approved and auto-activated by the work order management system, and the changes can be seen immediately in the UI. This is called Admin bypass mode.

Admin bypass mode is also applied to REST API, making automated northbound integration possible with third-party systems or scripts.

**Related Documentation** • [Provision LSPs on page 87](#)



## Provision LSPs

LSPs can be provisioned using either PCEP or Netconf. For Netconf, unlike PCEP, the NorthStar Controller requires periodic device collection to learn about LSPs and other updates to the network. See [“Scheduling Device Collection for Analytics via Netconf” on page 202](#) for more information. Once you have created Netconf collection tasks, NorthStar Controller should be able to discover LSPs provisioned via Netconf. Also unlike PCEP, the NorthStar Controller with Netconf supports logical systems.

To provision an LSP, navigate to **Applications>Provision LSP**. The Provision LSP window is displayed as shown in [Figure 65 on page 87](#).

Figure 65: Provision LSP Window, Properties Tab

**Provision LSP**

Properties Path Advanced Design Scheduling User Properties

Provisioning Method: NETCONF

Name: \*

Node A: \*

Node Z: \*

IP Z:

Provisioning Type: RSVP

Path Type: primary

Path Name:

Planned Bandwidth: \* 0

Setup: \* 7

Hold: \* 7

Planned Metric:

Comment:

Preview Path Cancel Submit



**NOTE:** You can also reach the Provision LSP window from the Tunnel tab of the network information table by clicking the Add button at the bottom of the pane.

As shown in [Figure 65 on page 87](#), the Provision LSP window has several tabs:

- Properties
- Path
- Advanced
- Design
- Scheduling
- User Properties

From any tab, you can click **Preview Path** at the bottom of the window to see the path drawn on the topology map, and click **Submit** to complete the LSP provisioning. These buttons become available as soon as Name, Node A, and Node Z have been specified.

[Table 17 on page 88](#) describes the data entry fields in the Properties tab of the Provision LSP window.

**Table 17: Provision LSP Window, Properties Fields**

Field	Description
Provisioning Method	<p>Use the drop-down menu to select PCEP or NETCONF. The default is NETCONF.</p> <p>See <a href="#">“Templates for Netconf Provisioning” on page 102</a> for information about using customized provisioning templates to support non-Juniper devices.</p> <p><b>NOTE:</b> For IOS-XR routers, NorthStar LSP Netconf-based provisioning has the same capabilities as NorthStar PCEP-based provisioning.</p>
Name	A user-defined name for the tunnel. Only alphanumeric characters, hyphens, and underscores are allowed. Other special characters and spaces are not allowed. Required for primary LSPs, but not available for secondary or standby LSPs.
Node A	Required. The name or IP address of the ingress node. Select from the drop-down list. You can start typing in the field to narrow the selection to nodes that begin with the text you typed.
Node Z	Required. The name or IP address of the egress node. Select from the drop-down list. You can start typing in the field to narrow the selection to nodes that begin with the text you typed.
IP Z	IP address of Node Z.
Provisioning Type	Use the drop-down menu to select RSVP or SR (segment routing) for PCEP LSPs. Only RSVP is available for NETCONF.
Path Type	Use the drop-down menu to select primary, secondary, or standby as the path type.
secondary (or standby) for	LSP name. Required and only available if the Path Type is set to secondary or standby. Identifies the LSP for which the current LSP is secondary (or standby).
Path Name	Name for the path. Required and only available for primary LSPs if the provisioning type is set to RSVP, and for all secondary and standby LSPs.

Table 17: Provision LSP Window, Properties Fields (continued)

Field	Description
Planned Bandwidth	Required. Bandwidth immediately followed by units (no space in between). Valid units are: <ul style="list-style-type: none"> <li>• B or b (bps)</li> <li>• M or m (Mbps)</li> <li>• K or k (Kbps)</li> <li>• G or g (Gbps)</li> </ul> Examples: 50M, 1000b, 25g. If you enter a value without units, bps is applied.
Setup	Required. RSVP setup priority for the tunnel traffic. Priority levels range from 0 (highest priority) through 7 (lowest priority). The default is 7, which is the standard MPLS LSP definition in Junos OS.
Hold	Required. RSVP hold priority for the tunnel traffic. Priority levels range from 0 (highest priority) through 7 (lowest priority). The default is 7, which is the standard MPLS LSP definition in Junos OS.
Planned Metric	Static tunnel metric. Type a value or use the up and down arrows to increment or decrement by 10.
Comment	Free-form comment describing the LSP.

The Path tab includes the fields shown in [Figure 66 on page 89](#) and described in [Table 18 on page 89](#).

Figure 66: Provision LSP Window, Path Tab

Table 18: Provision LSP Window, Path Fields

Field	Description
Selection	Use the drop-down menu to select dynamic, required, or preferred.

Table 18: Provision LSP Window, Path Fields (continued)

Field	Description
Hop 1	Only available if your initial selection is either required or preferred. Enter the first hop and specify whether it is strict or loose. To add an additional hop, click the + button.

The Advanced tab includes the fields shown in [Figure 67 on page 90](#) and described in [Table 19 on page 90](#).

Figure 67: Provision LSP Window, Advanced Tab

**Provision LSP**

Properties Path **Advanced** Design Scheduling User Properties

Coloring Include All:

Coloring Include Any:

Coloring Exclude:

Symmetric Pair Group:

☐ Create Symmetric Pair

Diversity Group:

Diversity Level: default ▾

☐ Route on Protected IP Link

Preview Path Cancel Submit

Table 19: Provision LSP Window, Advanced Fields

Field	Description
Coloring Include All	Double click in this field to display the Modify Coloring Include All window. Select the appropriate check boxes. Click <b>OK</b> when finished.
Coloring Include Any	Double click in this field to display the Modify Coloring Include Any window. Select the appropriate check boxes. Click <b>OK</b> when finished.

Table 19: Provision LSP Window, Advanced Fields (continued)

Field	Description
Coloring Exclude	Double click in this field to display the Modify Coloring Exclude window. Select the appropriate check boxes. Click <b>OK</b> when finished.
Symmetric Pair Group	When there are two tunnels with the same end nodes but in opposite directions, the path routing uses the same set of links. For example, suppose Tunnel1 source to destination is NodeA to NodeZ, and Tunnel2 source to destination is NodeZ to NodeA. Selecting Tunnel1-Tunnel2 as a symmetric pair group places both tunnels along the same set of links. Tunnels in the same group are paired based on the source and destination node.
Create Symmetric Pair	Select the checkbox to create a symmetric pair.
Diversity Group	Name of a group of tunnels to which this tunnel belongs, and for which diverse paths is desired.
Diversity Level	Use the drop-down menu to select the level of diversity as default, site, link, or SRLG.
Route on Protected IP Link	Select the check box if you want the route to use protected IP links as much as possible.

The Design tab includes the fields shown in [Figure 68 on page 91](#) and described in [Table 20 on page 92](#).

Figure 68: Provision LSP Window, Design Tab

**Provision LSP**

Properties Path Advanced **Design** Scheduling User Properties

Routing Method: routeByPCC ▾

Max Delay (ms): ▾

Max Hop: ▾

Max Cost: ▾

High Delay Threshold: ▾

Low Delay Threshold: ▾

High Delay Metric: ▾

Low Delay Metric: ▾

Preview Path Cancel Submit

Table 20: Provision LSP Window, Design Fields

Field	Description
Routing Method	Use the drop-down menu to select a routing method. Available options include default, adminWeight, delay, constant, distance, ISIS, OSPF, and routeByDevice.
Max Delay	Type a value or use the up and down arrows to increment or decrement by 100.
Max Hop	Type a value or use the up and down arrows to increment or decrement by 1.
Max Cost	Type a value or use the up and down arrows to increment or decrement by 100.
High Delay Threshold	Type a value or use the up and down arrows to increment or decrement by 100.
Low Delay Threshold	Type a value or use the up and down arrows to increment or decrement by 100.
High Delay Metric	Type a value or use the up and down arrows to increment or decrement by 100.
Low Delay Metric	Type a value or use the up and down arrows to increment or decrement by 100.

When provisioning via PCEP, the NorthStar Controller's default behavior is to compute the path to be used when provisioning the LSP. Alternatively, you can select the `routeByDevice` routing method in the Design tab, in which the router controls part of the routing. This alternate routing method is only meaningful for two types of LSP:

- RSVP TE PCC-controlled LSP



**NOTE:** For provisioning via Netconf, `routeByDevice` is the default routing method.

- Segment routing PCE-initiated LSP

To select `routeByDevice` as the routing method:

1. On the Design tab, select **routeByDevice** from the Routing Method drop-down menu.
2. On the Path tab, select **dynamic** from the Selection drop-down menu.

The LSP is then set up to be provisioned with the specified attributes, and no explicit path.

The Scheduling tab relates to bandwidth calendaring. By default, tunnel creation is not scheduled, which means that tunnels are provisioned immediately upon submission. Click the Scheduling tab in the Provision LSP window to access the fields for setting up the date/time interval. [Figure 69 on page 93](#) shows the Scheduling tab of the Provision LSP window.

Figure 69: Provision LSP Window, Scheduling Tab

Select **Once** to select start and end parameters for a single event. Select **Daily** to select start and end parameters for a recurring daily event. Click the calendar icon beside the fields to select the start and end dates, and beginning and ending times.



**NOTE:** The time zone is the server time zone.

In the User Properties tab shown in [Figure 70 on page 94](#), you can add provisioning properties not directly supported by the NorthStar UI. For example, you cannot specify a hop-limit in the Properties tab when you provision an LSP. However, you can add hop-limit as a user property in the User Properties tab.

Figure 70: Provision LSP Window, User Properties Tab

Name	Value
hop-limit	7

The following steps describe how to utilize User Properties for LSP provisioning:

1. Access the netconf template file that is used for adding new LSPs (lsp-add-junos.hjson), located in the /opt/northstar/netconfd/templates/ directory.
2. At the edit > protocols > mpls > label-switched-path hierarchy level, add the statements needed to provision with the property you are adding. For example, to provision with a hop-limit of 7, you would add the lines below in **bold**:

```

protocols {
  mpls {
    label-switched-path {{ request.name }} {
      to {{ request.to }};
      {{ macros.ifexists('from', request.from) -}}
      {{ if request['user-properties'] %}}
      {{ if request['user-properties']['hop-limit'] %}}
      hop-limit {{ request['user-properties']['hop-limit'] }};
      {{ endif %}}
      {{ endif %}}
      {{ macros.ifexistandnotzero('metric', request.metric) -}}
      {{ macros.ifexists('p2mp', request['p2mp-name']) -}}
      {{ if request['lsp-path-name'] %}}

```



```

.
.
.

```

The result of adding these statements is that if hop-limit, with the value defined in the user properties, is present, then the provisioning statement is executed. You could also edit the template used for modifying LSPs (lsp-modify-junos.hjson).

3. Restart netconfd so the changes can take effect:

```

[root@system1 templates]# supervisorctl restart netconf:netconfd
netconf:netconfd: stopped
netconf:netconfd: started

```

4. Add the user property and corresponding value in the User Properties tab of the Provision LSP window (see [Figure 70 on page 94](#)).
5. Verify the router configuration:

```

label-switched-path test-user {
    from 10.0.0.101;
    to 10.0.0.104;
    hop-limit 7;
    primary test-user.p0 {
        bandwidth 0;
        priority 7 7;
    }
}

```

Click **Submit** when you have finished populating fields in all of the tabs of the Provision LSP window. The LSP is entered into the work order management process.

To modify an existing LSP, select the tunnel on the Tunnels tab in the network information table and click **Modify** at the bottom of the table. The Modify LSP window is displayed, which is very similar to the Provision LSP window.

If you modify an existing LSP via Netconf, NorthStar Controller only generates the configuration statements necessary to make the change, as opposed to re-generating all the statements in the full LSP configuration as is required for PCEP.



**NOTE:** After provisioning P2P or P2MP LSPs, if there is a PCEP flap, the UI display for RSVP utilization and RSVP live utilization might be out of sync. You can display those utilization metrics by navigating to **Performance** in the left pane of the UI. This is a UI display issue only. The next live update from the network or the next manual sync using **Sync Network Model** (**Administration > System Settings > Advance Settings**) corrects the UI display. In the System Settings window, you toggle between General and Advanced Settings using the button in the upper right corner of the window.

## Related Documentation

- [Scheduling Device Collection for Analytics via Netconf on page 202](#)
- [Work Order Management on page 84](#)
- [Provision Diverse LSP on page 96](#)
- [Provision Multiple LSPs on page 97](#)
- [Provision and Manage P2MP Groups on page 108](#)
- [Netconf Persistence on page 218](#)
- [Left Pane Options on page 50](#)
- [Templates for Netconf Provisioning on page 102](#)

## Provision Diverse LSP

When creating a route between two sites, you might not want to rely on a single LSP to send traffic from one site to another. By creating a second LSP routing path between the two sites, you can protect against failures and balance the network load.

To provision a diverse pair of tunnels in the network topology, navigate to **Applications > Provision Diverse LSP**. The Provision Diverse LSP window is displayed as shown in [Figure 71 on page 96](#).

*Figure 71: Provision Diverse LSP Window, Properties Tab*

**Provision Diverse LSP**

Properties | Scheduling

**Tunnel 1**

Name: \*

Node A: \*

Node Z: \*

IP Z: \*

Provisioning Type: RSVP

Planned Bandwidth: \* 0

Coloring:

Setup: \* 7

Hold: \* 7

Comment:

**Tunnel 2**

Name: \*

Node A: \*

Node Z: \*

IP Z: \*

Provisioning Type: RSVP

Planned Bandwidth: \* 0

Coloring:

Setup: \* 7

Hold: \* 7

Comment:

☐ Create Symmetric Pair

Diversity Level: ☒ Link ☐ Site ☐ SRLG

Preview Paths

Cancel Submit

On the Properties tab, the data entry fields are the same as for adding a single tunnel, with the addition of an indication as to whether the tunnels are link, site, or SRLG diverse from each other and a check box to create a symmetric pair. The Create Symmetric Pair option allows you to create the symmetric pair in the same operation as creating the diverse LSP.

By default, the tunnel creation is not scheduled, which means the tunnels are provisioned immediately upon submission. Click the Scheduling tab to access scheduling options. Select **Once** to enable the scheduler options for a single event. Select **Daily** to enable the scheduler options for a recurring daily event. Click the calendar icon beside the fields to select the start and end dates, and the beginning and ending times.

Click **Preview Paths** at the bottom of the window to see the paths drawn on the topology map. Click **Submit** to complete the diverse LSP provisioning.

A few things to keep in mind with regard to provisioning diverse LSPs:

- The time zone is the server time zone.
- If NorthStar Controller is not able to achieve the diversity level you request, it still creates the diverse tunnel pair, using a diversity level as close as possible to the level you requested.
- NorthStar Controller does not, by default, reroute a diverse LSP pair when there is a network outage. Instead, use the Path Optimization feature (**Applications > Path Optimization**). One option is to schedule path optimization to occur at regular intervals.
- When provisioning diverse LSPs, NorthStar might return an error if the value you entered in the Modify Node window's Site field contains special characters, depending on the version of Node.js in use. We recommend using alphanumeric characters only. See [“Network Information Table Bottom Tool Bar” on page 70](#) for the location of the Site field in the Modify Node window.

#### Related Documentation

- [Provision LSPs](#)
- [Provision Multiple LSPs on page 97](#)
- [Network Information Table Bottom Tool Bar on page 70](#)

## Provision Multiple LSPs

To provision multiple LSPs in the network topology, navigate to **Applications>Provision Multiple LSPs**. The Provision Multiple LSPs window is displayed as shown in [Figure 72 on page 98](#).

Figure 72: Provision Multiple LSPs Window, Properties Tab

**Provision Multiple LSPs**

Properties | Advanced | Scheduling

ID Prefix:  Count:

Bandwidth:  Hold:

Setup:

placement

Node A

Node Z

Node Z Tag:

Cancel Submit

The Provision Multiple LSPs window has Properties, Advanced, and Scheduling tabs. [Table 21 on page 98](#) describes the fields available in the Properties tab.

Table 21: Provision Multiple LSPs Window, Properties Tab

Field	Description
ID Prefix	You can enter a prefix to be applied to all of the tunnel names that are created.
Bandwidth	<p>Required. Bandwidth immediately followed by units (no space in between). Valid units are:</p> <ul style="list-style-type: none"> <li>• B or b (bps)</li> <li>• M or m (Mbps)</li> <li>• K or k (Kbps)</li> <li>• G or g (Gbps)</li> </ul> <p>Examples: 50M, 1000b, 25g.</p> <p>If you enter a value without units, bps is applied.</p>
Setup	RSVP setup priority for the tunnel traffic. Priority levels range from 0 (highest priority) through 7 (lowest priority). The default is 7, which is the standard MPLS LSP definition in Junos OS.

**Table 21: Provision Multiple LSPs Window, Properties Tab (continued)**

Field	Description
Count	Number of copies of the tunnels to create. The default is 1. For example, if you specify a count of 2, two copies of each tunnel are created.
Hold	RSVP hold priority for the tunnel traffic. Priority levels range from 0 (highest priority) through 7 (lowest priority). The default is 7, which is the standard MPLS LSP definition in Junos OS.
Node A column	Select the Node A nodes. If you select the same nodes for Node A and Node Z, a full mesh of tunnels is created. See <a href="#">Table 22 on page 99</a> for selection method options.
Node Z column	Select the Node Z nodes. If you select the same nodes for Node Z and Node A, a full mesh of tunnels is created. See <a href="#">Table 22 on page 99</a> for selection method options.
Node Z Tag	The only available value at this time is default.

Under the Node A and Node Z columns are several buttons to aid in selecting the tunnel endpoints. [Table 22 on page 99](#) describes how to use these buttons.

**Table 22: Node Selection Buttons**

Button	Function
(world)	Select one or more nodes on the topology map, then click the globe button to add them to the Node column.
(plus)	Click the plus button to add all of the nodes in the topology map to the Node column.
(minus)	Select a node in the Node column and click the minus button to remove it from the Node column. Ctrl-click to select multiple nodes.
(rt arrow)	Click the right-arrow button to add all of the nodes in the Node A column to the Node Z column.

On the Advanced tab, you can specify coloring parameters as shown in [Figure 73 on page 100](#) and described in [Table 23 on page 100](#).

Figure 73: Provision Multiple LSPs Window, Advanced Tab

**Provision Multiple LSPs**

Properties | **Advanced** | Scheduling

Comment:

Coloring Include All:

Coloring Include Any:

Coloring Exclude:

Cancel Submit

Table 23: Provision Multiple LSPs Window, Advanced Tab Fields

Field	Description
Comment	Enter free-form comment.
Coloring Include All	Double click in this field to display the Modify Coloring Include All window. Select the appropriate check boxes. Click <b>OK</b> when finished.
Coloring Include Any	Double click in this field to display the Modify Coloring Include Any window. Select the appropriate check boxes. Click <b>OK</b> when finished.
Coloring Exclude	Double click in this field to display the Modify Coloring Exclude window. Select the appropriate check boxes. Click <b>OK</b> when finished.

Scheduling relates to bandwidth calendaring. By default, tunnel creation is not scheduled, which means that tunnels are provisioned immediately upon submission. Click the Scheduling tab in the Provision Multiple LSPs window to access the fields for setting up the date/time interval.

Select **Once** to select start and end parameters for a single event. Select **Daily** to select start and end parameters for a recurring daily event. Click the calendar icon beside the fields to select the start and end dates, and beginning and ending times.



**NOTE:** The time zone is the server time zone.

- Related Documentation**
- [Provision LSPs](#)
  - [Provision Diverse LSP on page 96](#)

## Configure LSP Delegation

Navigate to **Applications > Configure LSP Delegation** to reach the Configure LSP Delegation window where you can select LSPs to either delegate to NorthStar Controller or remove from delegation.

Figure 74 on page 101 shows the Configure LSP Delegation window.

*Figure 74: Configure LSP Delegation Window*

Add	Name	Node A	Node Z	IP A	IP Z	Bandwidth
<input type="checkbox"/>	rsvp-104-105	vmx104	vmx105	11.0.0.104	11.0.0.105	0
<input type="checkbox"/>	rsvp-107-105	vmx107	vmx105	11.0.0.107	11.0.0.105	0
<input type="checkbox"/>	rsvp-106-105	vmx106	vmx105	11.0.0.106	11.0.0.105	0
<input type="checkbox"/>	rsvp-105-106	vmx105	vmx106	11.0.0.105	11.0.0.106	0
<input type="checkbox"/>	rsvp-103-105	vmx103	vmx105	11.0.0.103	11.0.0.105	0
<input type="checkbox"/>	rsvp-102-105	vmx102	vmx105	11.0.0.102	11.0.0.105	0
<input type="checkbox"/>	rsvp-101-105	vmx101	vmx105	11.0.0.101	11.0.0.105	0
<input type="checkbox"/>	tunnel-te101	ios-xr8	vmx101	11.0.0.108	11.0.0.101	0
<input type="checkbox"/>	tunnel-te102	ios-xr8	vmx102	11.0.0.108	11.0.0.102	0
<input type="checkbox"/>	tunnel-te103	ios-xr8	vmx103	11.0.0.108	11.0.0.103	0
<input type="checkbox"/>	tunnel-te104	ios-xr8	vmx104	11.0.0.108	11.0.0.104	0
<input type="checkbox"/>	tunnel-te105	ios-xr8	vmx105	11.0.0.108	11.0.0.105	0
<input type="checkbox"/>	tunnel-te106	ios-xr8	vmx106	11.0.0.108	11.0.0.106	0
<input type="checkbox"/>	tunnel-te107	ios-xr8	vmx107	11.0.0.108	11.0.0.107	0
<input type="checkbox"/>	tunnel-te109	ios-xr8	ios-xr9	11.0.0.108	11.0.0.109	0
<input type="checkbox"/>	Tunnel600...	ios-xr8		11.0.0.108	0.0.0.0	0
<input type="checkbox"/>	tunnel-te101	ios-xr9	vmx101	11.0.0.109	11.0.0.101	0

Check All   Uncheck All   Cancel   Submit

Click the check boxes for the desired LSPs on either the Add Delegation or Remove Delegation tab. You can also **Check All** or **Uncheck All**. Then click **Submit** at the bottom of the window.

When you add or remove delegation to/from the NorthStar Controller using this operation, the delegation statement block is added or removed from the router configuration.



**NOTE:** This is not the same as the temporary removal you achieve when you right-click a tunnel in the network information table and select **Return Delegation to PCC**. In that case, control is temporarily returned back to the PCC for a period of time based on the router's timer statement.

**Related Documentation**

- [Understanding the NorthStar Controller on page 3](#)

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## Templates for Netconf Provisioning

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NorthStar Controller supports NETCONF provisioning for Juniper devices and Cisco IOS-XR devices. You can customize provisioning templates by modifying the templates provided in the `/opt/northstar/netconfd/templates/` directory on the NorthStar server, or by creating new, customized templates.



**NOTE:** For IOS-XR routers, NorthStar LSP Netconf-based provisioning has the same capabilities as NorthStar PCEP-based provisioning.

The syntax and semantics used in the template attributes are based on Jinja Templates, a template engine for Python. Help/support for using Jinja Templates is readily available online.

You can use customized templates for:

- LSP Provisioning: make use of provisioning properties not directly supported by the NorthStar UI.

For example, you cannot specify a hop-limit in the Properties tab in the Provision LSP window. However, you can add hop-limit in the User Properties tab of the Provision LSP or Modify LSP window and then modify the appropriate provisioning template accordingly.

- Service mapping: associate LSPs being provisioned with a VPN service.

When an LSP is created, it can be tagged with user properties that, when also defined in the Jinja template, cause the corresponding service mapping statement to be generated in the router configuration.

Example VPN services include:

- Mapping P2P LSPs to circuit cross-connect (CCC) VPNs



**NOTE:** The CCC service must already exist in the network before you perform this type of service mapping.

- Mapping P2MP LSPs to multicast VPNs (MVPNs)





**NOTE:** An MVPN routing instance must already exist before you perform this type of service mapping.

## General Workflow for Modifying a Template

The following steps describe the general workflow for modifying a provided Jinja template and ensuring that the desired provisioning takes effect:

1. Decide on the user properties needed and their values.
2. Edit the appropriate Jinja template to include those properties.
3. Restart netconfd so the changes can take effect:

```
[root@system1 templates]# supervisorctl restart netconf:netconfd
netconf:netconfd: stopped
netconf:netconfd: started
```

4. Provision or modify the LSP using the web UI, and include the user properties and their values in the User Properties tab of the Provision LSP or Modify LSP window.
5. Verify the router configuration.

## Overview of Netconf Provisioning Templates

There are two types of templates provided in the templates directory:

- Encoding templates are for internal use only and should never be modified or deleted. All of these templates have “encoding” in their names (**lsp-modify-encoding.hjson**, for example).
- Configuration templates are for transforming JSON document keys into device configuration statements. These templates are available for modification and to use as models for creating new templates. Currently, these templates all have “junos” in their names, (**lsp-modify-junos.hjson**, for example), although, as long as you use the .hjson suffix, you can name new templates according to your preference.

## Template Requirements

Keep in mind the following template requirements:

- If you create a new template, be sure the PCS user has Unix file permission to read it.
- Template files are hjson documents, so their file names must have the .hjson suffix.
- The Netconf daemon (NETCONFD) must be restarted for template changes to be applied:

```
[root@pcs-1 templates]# supervisorctl restart netconf:netconfd
netconf:netconfd: stopped
netconf:netconfd: started
```

- Text format is supported for device configuration statements. XML format is supported for modifying Cisco IOS XR devices.
- When you upgrade a NorthStar build, the templates provided in the new build replace the ones that were provided with the original build. You can prevent loss of your template changes by backing up your templates to a different directory on the server before upgrading NorthStar, or by saving your modified files with different file names.

## Template Structure

Each template has two types of attributes:

- Routing-key attributes which describe the type of provisioning for which the template should be used. The value of routing-key is not fixed in NETCONF, but the following keys are currently agreed upon between NETCONF and ConfigServer for LSP provisioning:

- **rest\_eventd\_request\_key**  
Use for adding a new LSP.
- **rest\_eventd\_update\_key**  
Use for modifying an existing LSP.
- **rest\_eventd\_delete\_key**  
Use for deleting an LSP

- Device profile attributes that define the device to be provisioned when using the template.

You can use any device profile attributes (**Administration > Device Profile**) such as routerType (Vendor field in Device Profile), model, and so on. NETCONF tries to match the attributes in the template with the attributes in the device profiles of the targeted devices.

- User properties attributes that define such things as service mapping attributes.

User properties is a generic mechanism that allows you to “tag” LSPs with additional properties. One use of user properties is to tag an LSP with the vpn-name, source-ip, and group-ip that are related to the associated MVPN (for service mapping).

In the Jinja template, when those user properties are defined, a corresponding set of statements (related to service mapping) are also generated. The support in the REST body and the web UI is the same. In the REST body, you include the user properties under “userParameters”, while in the web UI, you include them in the User Properties tab of the Provision (or Modify) LSP window.

Table 24 on page 105, Table 25 on page 106, and Table 26 on page 106 detail the supported JSON document keys for adding LSPs, modifying LSPs, deleting LSPs, and link modification.



**NOTE:** Keys that do not “always exist” only exist conditionally. For example:

- request[“logical-system”] is used to specify the logical-system name, so it only exists in the JSON document if the provisioning order is for logical-system devices.
- request[“p2mp-name”] is used to specify the P2MP name, so it only exists in the JSON document if the provisioning order is for P2MP LSPs.

**Table 24: Keys for Adding or Modifying LSPs**

Key	Value	Always Exists	Description
request.name	text	yes	LSP name
request.from	IPv4 address	yes	LSP source address
request.to	IPv4 address	yes	LSP destination address
request['lsp-path-name']	text	yes	LSP path name
request.bandwidth	integer	yes for adding no for modifying	LSP path bandwidth
request.metric	integer	no	LSP metric
request.type	[primary  secondary  standby]	yes	LSP path type
request['path-attributes']['ero']['ipv4-address']	IPv4 address	no	LSP path hop
request['path-attributes']['ero']['loose']	[true]	no	LPS path loose flag
request['path-attributes']['setup-priority']	[0-7]	yes for adding no for modifying	LSP path setup priority
request['path-attributes']['reservation-priority']	[0-7]	yes for adding no for modifying	LSP path reservation priority
request['logical-system']	text	no	LSP headend logical system name
request['p2mp-name']	text	no	LSP P2MP group name

**Table 24: Keys for Adding or Modifying LSPs (continued)**

Key	Value	Always Exists	Description
request['select-manual']	[true]	no	LSP path manual selection
request['user-properties']	text	yes	Additional properties as defined by user

**Table 25: Keys for Deleting LSPs**

Key	Value	Always Exists	Description
request.name	text	yes	LSP name
request.from	IPv4 address	yes	LSP source address
request.to	IPv4 address	yes	LSP destination address
request['lsp-path-name']	text	no	LSP path name
request.type	[primary  secondary  standby]	yes	LSP path type
request.delete	[true]	no	Specifies whether the deletion order is for deleting the LSP (value of “true”) or the LSP path
request['logical-system']	text	no	LSP headend logical system name
request['user-properties']	text	yes	Additional properties as defined by user

**Table 26: Keys for Link Modification**

Key	Value	Always Exists	Description
request.new_interface.name	text	yes	Interface name
request.new_interface.isis1_metric	integer	no	ISIS level 1 metric
request.new_interface.isis2_metric	integer	no	ISIS level 2 metric
request.new_interface.ospf_metric	integer	no	OSPF metric
request.new_interface.ospf_area_id	integer	no	OSPF area
request.logical_system	text	no	Router logical system name



**NOTE:** The pcs\_provisioning\_order\_key order is currently used specifically for OSPF/ISIS metric modification.

## Template Macros

Jinja Templates support macros for defining reusable functions. The NorthStar template directory includes the macros listed in [Table 27 on page 107](#).

*Table 27: Template Macros Included in the Template Directory*

Macro	Function
ifexist	Generates a Junos configuration statement if the evaluated key in the JSON document exists.
Ifnotzero	Generates a Junos configuration statement if the evaluated key in the JSON document has a value that is not equal to zero.
Ifnotnone	Generates a Junos configuration statement if the evaluated key in the JSON document has any value.
decodeuserprops	Decodes the user defined properties in the JSON document.
lsys	Generates a configuration statement for Junos logical system.

## Jinja Template Examples for Service Mapping

In the following Jinja template snippet, the statements related to service mapping of the P2MP LSP to the multicast MVPN are provisioned with the LSP if the LSP has associated with it the “vpn-name” user property.

```
{% if request['user-properties'] and request['user-properties']['vpn-name']
is defined %}
routing-instances {
  {{ request['user-properties']['vpn-name'] }} {
    provider-tunnel {
      selective {
        group {{ request['user-properties']['group-ip'] }} {
          source {{ request['user-properties']['source-ip'] }} {
            rsvp-te {
              static-lsp {{ request['p2mp-name'] }};
            }
          }
        }
      }
    }
  }
}
{% endif %}
```

In the following Jinja template snippet, the statement related to service mapping of the LSP to the CCC-VPN is provisioned with the LSP if the LSP has associated with it the “ccc-vpn-name” user property.

```
{% if request['user-properties'] and request['user-properties']['ccc-vpn-name']
is defined %}
protocols {
  connections {
```

```

        remote-interface-switch {{ request['user-properties']['ccc-vpn-name']
    }} {
        interface {{ request['user-properties']['ccc-interface'] }};
        transmit-lsp {{ request['user-properties']['transmit-lsp'] }};
        receive-lsp {{ request['user-properties']['receive-lsp'] }};
    }
}
{% endif %}

```

#### Related Documentation

- [Provision LSPs on page 87](#)
- [IGP Metric Modification from the NorthStar Controller on page 137](#)
- [Device Profile and Connectivity Testing on page 190](#)

## Provision and Manage P2MP Groups

In the NorthStar Controller, you can provision P2MP groups; view and modify group attributes; and view, add, or delete sub-LSPs. This is a separate workflow from provisioning P2P LSPs, initiated from the P2MP tab in the network information table. Netconf is the only provisioning method supported for P2MP.



**NOTE:** In Junos OS Release 15.1F6 and later, you can enable the router to send P2MP LSP information to a controller (like the NorthStar Controller) in real time, automatically. Without that configuration, you must run device collection for NorthStar to learn about newly provisioned P2MP LSPs.

In the Junos OS, the configuration is done in the [set protocols pcep] hierarchy for PCEs and for PCE groups:

```
set protocols pcep pce pce-id p2mp-lsp-report-capability
```



**NOTE:** After provisioning P2P or P2MP LSPs, if there is a PCEP flap, the UI display for RSVP utilization and RSVP live utilization might be out of sync. You can display those utilization metrics by navigating to Performance in the left pane of the UI. This is a UI display issue only. The next live update from the network or the next manual sync using **Sync Network Model** (**Administration > System Settings > Advance Settings**) corrects the UI display. In the System Settings window, you toggle between General and Advanced Settings using the button in the upper right corner of the window.

The following sections describe viewing, provisioning, and managing P2MP groups in the NorthStar Controller.

- [Viewing P2MP Groups and Their Sub-LSPs on page 109](#)
- [Provisioning a P2MP Group on page 110](#)

- [Modifying a P2MP Group on page 114](#)
- [Deleting a P2MP Group on page 115](#)

## Viewing P2MP Groups and Their Sub-LSPs

P2MP group information is displayed in the P2MP Group tab of the network information table, and is also reflected in the topology map.

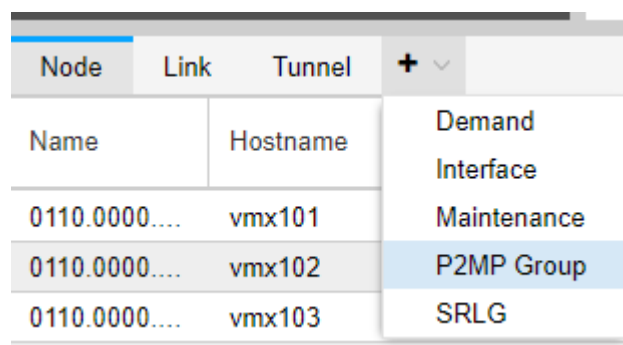
To display P2MP Group information, use the following steps:

1. On the tabs bar of the network information table, click the plus sign (+) and select **P2MP Group** from the drop-down menu as shown in [Figure 75 on page 109](#).



**NOTE:** When you launch the web UI, only the Node, Link, and Tunnel tabs are displayed by default; P2MP Group is one of the tabs you can optionally display.

Figure 75: Adding the P2MP Group Tab



2. The P2MP Group tab is added to the tab bar and the contents are displayed as shown in [Figure 76 on page 109](#).

Figure 76: P2MP Group Tab in the Network Information Table

Node	Link	Tunnel	P2MP Group							
P2MP Name	From	IP Address	Planned Bandwidth	Setup	Hold	Controller	Control Type	Routing Method	Sub LSPs	
10.0.0.106.200.vpls.vpn_200	vmx106	10.0.0.106	0	7	0	External	Device Co...	routeByDe...	3	
10.0.0.104.300.vpls.vpn_200	vmx104	10.0.0.104	0	7	0	External	Device Co...	routeByDe...	3	
10.0.0.103.200.vpls.vpn_200	vmx103	10.0.0.103	0	7	0	External	Device Co...	routeByDe...	3	
10.0.0.101.300.vpls.vpn_200	vmx101	10.0.0.101	0	7	0	External	Device Co...	CSPF	3	
test_NC_1	vmx101	10.0.0.101	10K	7	7	External	Device Co...	routeByDe...	2	
sample_p2mp_102	vmx102	10.0.0.102	0	3	3	External	Device Co...	CSPF	3	
test_101	vmx101	10.0.0.101	10K	7	7	External	Device Co...	routeByDe...	2	
sample_p2mp_101_NC	vmx102	10.0.0.102	200K	4	4	External	Device Co...	routeByDe...	2	
sample_p2mp_102_NC	vmx102	10.0.0.102	200K	4	4	External	Device Co...	routeByDe...	2	
sample_p2mp11	vmx101	10.0.0.101	200K	4	4	External	Device Co...	routeByDe...	2	

Columns for group attributes are shown across the top. You can add columns and filter the display in the usual ways. See [“Sorting and Filtering Options in the Network Information Table” on page 68](#) for more information.

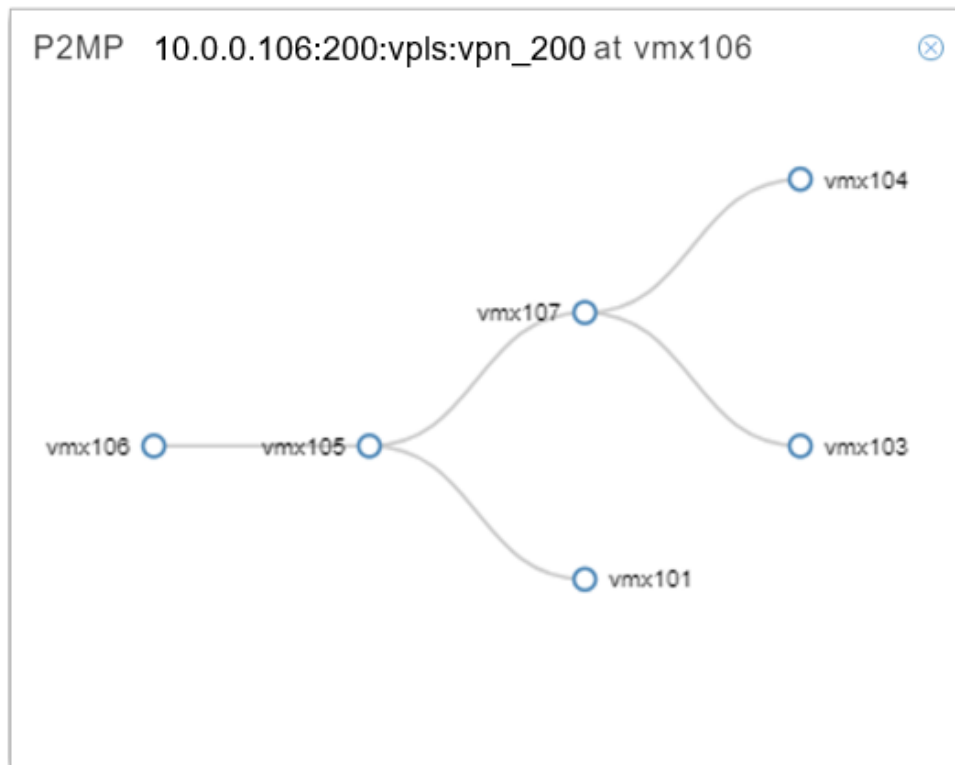
3. Click a row in the table to highlight the path in the topology map.
4. Right-click a row in the table to display either a graphical tree view of the group, or a list of the sub-LSPs that make up the group. [Figure 77 on page 110](#) shows these options.

*Figure 77: Right-Click a P2MP Group*

P2MP Name	
10.0.0.106:200:vp1s	P2MP Tree View
10.0.0.104:300:vp1s	View Sub LSPs

The tree diagram opens as a separate pop-up as show in [Figure 78 on page 110](#).

*Figure 78: P2MP Group Graphical Tree Diagram*



The sub-LSPs that make up the group are displayed in the network information table, on the Tunnel tab. On the list of sub-LSPs, you have all the display options normally available on the Tunnel tab. See [“Network Information Table Overview” on page 66](#) for more information.

## Provisioning a P2MP Group

On the P2MP Group tab of the network information table, click **Add** at the bottom of the table. The Add P2MP Group window is displayed as shown in [Figure 79 on page 111](#). Red asterisks denote required fields.



Figure 79: Add P2MP Group Window, Properties Tab

**Add P2MP Group**

Properties | Advanced | Design | Scheduling | User Properties

P2MP Name: \*  ID Prefix:

Bandwidth: \* 0 Provisioning Type: RSVP ▾

Setup: \* 7 ▴ ▾ Hold: \* 0 ▴ ▾

placement

Node A

Node Z

Table 28 on page 111 describes the data entry fields in the Properties tab of the Add P2MP Group window.

Table 28: Add P2MP Group Window, Properties Fields

Field	Description
P2MP Name	Required. A user-defined name for the P2MP group. Only alphanumeric characters, hyphens, and underscores are allowed. Other special characters and spaces are not allowed.
ID Prefix	You can enter a prefix to be applied to all of the tunnel names that are created.
Bandwidth	<p>Required. Planned bandwidth immediately followed by units (no space in between). Valid units are:</p> <ul style="list-style-type: none"> <li>• B or b (bps)</li> <li>• M or m (Mbps)</li> <li>• K or k (Kbps)</li> <li>• G or g (Gbps)</li> </ul> <p>Examples: 50M, 1000b, 25g.</p> <p>If you enter a value without units, bps is applied.</p>
Provisioning Type	Use the drop-down menu to select RSVP. This is the only provisioning type supported.

Table 28: Add P2MP Group Window, Properties Fields (continued)

Field	Description
Setup	Required. RSVP setup priority for the tunnel traffic. Priority levels range from 0 (highest priority) through 7 (lowest priority). The default is 7, which is the standard MPLS LSP definition in Junos OS.
Hold	Required. RSVP hold priority for the tunnel traffic. Priority levels range from 0 (highest priority) through 7 (lowest priority). The default is 7, which is the standard MPLS LSP definition in Junos OS.
Node A	Required. The name or IP address of the source node. Select from the drop-down list.
Node Z	At least one is required. The names or IP addresses of the destination nodes. To select nodes from the topology map, Shift-click the nodes on the map and then click the world button at the bottom of the Node Z field. To add all nodes in the network, click the plus (+) button. To remove a node, highlight it in the Node Z field and click the minus (-) button.

The Advanced tab includes the fields shown in [Figure 80 on page 112](#) and described in [Table 29 on page 113](#).

Figure 80: Add P2MP Group Window, Advanced Tab

### Add P2MP Group

- Properties
- Advanced**
- Design
- Scheduling
- User Properties

Coloring Include All:

Coloring Include Any:

Coloring Exclude:

Diversity Group:

Diversity Level: default ▼

Comment:

Cancel Submit

**Table 29: Add P2MP Group Window, Advanced Fields**

Field	Description
Coloring Include All	Double click in this field to display the Modify Coloring Include All window. Select the appropriate bits. Click <b>OK</b> when finished.
Coloring Include Any	Double click in this field to display the Modify Coloring Include Any window. Select the appropriate bits. Click <b>OK</b> when finished.
Coloring Exclude	Double click in this field to display the Modify Coloring Exclude window. Select the appropriate bits. Click <b>OK</b> when finished.
Diversity Group/Level	Diverse P2MP is currently not supported via the web UI, so these fields are not used. You can use the REST APIs, however.
Comment	Free-form comments if needed.

The Design tab includes the Routing Method options shown in [Figure 81 on page 113](#).

**Figure 81: Add P2MP Group Window, Design Tab**

The screenshot shows the 'Add P2MP Group' window with the 'Design' tab selected. The 'Routing Method' dropdown menu is open, displaying a list of routing methods. The 'routeByDevice' option is highlighted at the bottom of the list. The window also features 'Cancel' and 'Submit' buttons at the bottom right.

For P2MP, the default routing method is `routeByDevice` (since it uses NETCONF as the provisioning method). You can select a different routing method in which PC server calculates the path for all the sub-LSPs. The behavior for all routing methods is similar to P2P LSP provisioning.

The Scheduling tab is identical to the one you use to provision P2P LSPs.

For P2MP, the User Properties tab is used for P2MP tree to MVPN service mapping. See *Templates for Netconf Provisioning* for more information.

Once you are finished defining the group, click **Submit**. The group is added to the network information table, on the P2MP Group tab.



**NOTE:**

- Naming of the sub-LSPs is automatic, based on the Prefix-ID if provided, and the A and Z node names.
- If the routing method is routeByDevice, the path for all sub-LSPs is dynamic. If you select any other routing method from the drop-down menu, the path is preferred. This can be changed for individual sub-LSPs.

## Modifying a P2MP Group

### Modifying a P2MP Group

To modify a P2MP group, select the group in the P2MP Group tab of the network information table, and click **Modify** at the bottom of the table. The Modify P2MP Group window is displayed as shown in [Figure 82 on page 114](#).

*Figure 82: Modify P2MP Group Window, Properties Tab*

**Modify P2MP Group**

Properties | Advanced | Design | Scheduling | User Properties

P2MP Name: \* test\_101 ID Prefix:

Bandwidth: \* 10K Provisioning Type: RSVP

Setup: \* 7 Hold: \* 7

placement

Node A

vmx101

Node Z

vmx103  
vmx104

Cancel Submit

Using the tabs on the Modify P2MP Group window, you can change the value of attributes (affects all sub-LSPs in the group), add or remove destination nodes (which adds or removes sub-LSPs), and set up or change scheduling for the group.



**NOTE:** There are two ways you can remove sub-LSPs from a group:

- In the Properties tab of the Modify P2MP Group window, select the destination node(s) in the Node Z field and click the minus sign (-).
- Display the sub-LSPs by right-clicking the group in the P2MP Group tab and selecting **View Sub LSPs**. In the resulting list of sub-LSPs in the Tunnel tab, select the LSP(s) to delete and click **Delete** at the bottom of the table.

When you have finished making changes, click **Submit**.



**NOTE:** The following six attributes must be the same for all sub-LSPs in a P2MP group, and can therefore only be modified at the group level, using the Modify P2MP Group window:

- Bandwidth
- Setup
- Hold
- ColoringIncludeALL
- ColoringIncludeANY
- ColoringExclude

To modify other attributes on the individual sub-LSP level (such as path or Max Hop, for example), select the tunnel in the Tunnel tab of the network information table and click **Modify** at the bottom of the table. If you attempt to modify one of the six group-level-only attributes at the sub-LSP level, an error message is displayed when you click **Submit** and the change is not made.

## Deleting a P2MP Group

When you delete a P2MP group, all sub-LSPs that are part of that group are also deleted.

To delete a P2MP group, select the group on the P2MP Group tab of the network information table and click **Delete** at the bottom of the table. Respond to the confirmation message to complete the deletion.

Alternatively, you can use the Tunnel tab of the network information table to delete all the sub-LSPs in the P2MP group, which also deletes the group itself.

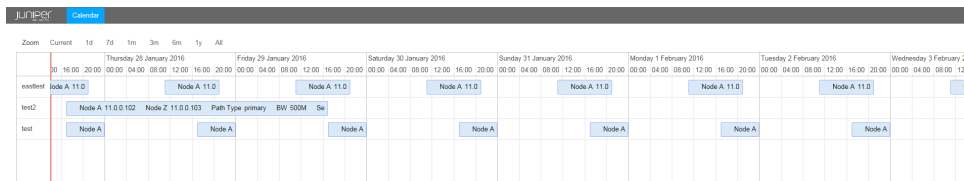
### Related Documentation

- [Sorting and Filtering Options in the Network Information Table on page 68](#)
- [Network Information Table Overview on page 66](#)
- *Provision LSPs*
- *Templates for Netconf Provisioning*

## Bandwidth Calendar

The Bandwidth Calendar opens in a new browser window or tab when you navigate to **Applications > Bandwidth Calendar**. The calendar displays all scheduled LSPs on a timeline, along with their properties, so you can see the total bandwidth requirements for any given time. [Figure 83 on page 116](#) shows an example bandwidth calendar.

**Figure 83: Bandwidth Calendar**



**NOTE:** The bandwidth calendar timeline is empty until you schedule LSPs.

On the timeline, a red vertical line represents the current date and time, so you can easily distinguish between past and future events. Zoom functions at the top of the window allow you to select from the following:

**Current**—LSPs scheduled from the current date and time forward

**1d**—LSPs scheduled from the current date and time, plus 24 hours

**7d**—LSPs scheduled from the current date and time, plus 7 days

**1m**—LSPs scheduled from the current date and time, plus 1 month

**3m**—LSPs scheduled from the current date and time, plus 3 months

**6m**—LSPs scheduled from the current date and time, plus 6 months

**1y**—LSPs scheduled from the current date and time, plus 1 year

**All**—all scheduled LSPs, past and future

You can also:

- Use the scroll wheel on your mouse to zoom in and out.
- Left-click and drag to move the display forward or backward in time.

Click a specific event to display all the tunnel properties.

### Related Documentation

- [Provision LSPs](#)
- [Provision Diverse LSP on page 96](#)

## Creating Templates to Apply Attributes to PCE-Initiated Label-Switched Paths

---

From a PCC router's CLI, you can create LSP templates to define a set of LSP attributes to apply to PCE-initiated LSPs. Any PCE-initiated LSPs that provide a name match with the regular expression (regex) name specified in the template automatically inherit the LSP attributes that are defined in the template. By associating LSPs (through regex name matching) with a specific user-defined LSP template, you can automatically turn on (or turn off) LSP attributes across all LSPs that provide a name match with the regex name specified in the template.

When auto-bandwidth is enabled, LSP auto-bandwidth parameters must be configured from the router, even when the LSP has been delegated. Under no circumstances can the NorthStar Controller modify the bandwidth of an externally-controlled LSP when auto-bandwidth is enabled. The PCC enforces this behavior by returning an error if it receives an LSP update for an LSP that has auto-bandwidth enabled. Currently, there is no way to signal through PCEP when auto-bandwidth is enabled, so the NorthStar Controller cannot know in advance that an LSP has auto-bandwidth enabled. However, when auto-bandwidth is enabled by way of a template, then the NorthStar Controller knows that the LSP has auto-bandwidth enabled and disallows modification of bandwidth.

The following configuration example shows how to define the regex-based LSP name for a set of LSP “container” templates that you can deploy to apply specific attributes to any LSPs on the network that provide a matching LSP name.

Create the templates under the **lsp-external-controller-pccd** hierarchy to specify the regex-based character string to be used to identify the LSPs whose attributes you want to update.

1. Create a name matching scheme to identify the NorthStar Controller provisioned (PCE-initiated) LSPs to which you want to apply specific link protection attributes.
  - a. To specify that any PCE-initiated LSP that provides a name match with the prefix **PCE-LP-\*** will inherit the LSP link-protection attributes defined in the **LINK-PROTECT-TEMPLATE** template, configure the following statement from the PCC router CLI:

```
[edit protocols mpls lsp-external-controller pccd]
user@PE1# set pce-controlled-lsp PCE-LP-* label-switched-path-template
LINK-PROTECT-TEMPLATE
```

- b. To specify that any PCE-initiated LSP that provides a name match with the prefix **PCE-AUTOBW-\*** will inherit the LSP auto-bandwidth attributes defined in the **AUTO-BW-TEMPLATE** template, configure the following statement from the PCC router CLI:

```
[edit protocols mpls lsp-external-controller pccd]
user@PE1# set pce-controlled-lsp PCE-AUTOBW-* label-switched-path-template
AUTO-BW-TEMPLATE
```

2. Create the templates that define the attributes you want to apply to all PCE-initiated LSPs that provide a name match.
  - a. Define link-protection attributes for the **LINK-PROTECT-TEMPLATE** template.

```
[edit protocols mpls ]
user@PE1# set label-switched-path-template LINK-PROTECT-TEMPLATE template
user@PE1# set label-switched-path-template LINK-PROTECT-TEMPLATE hop-limit
3
user@PE1# set label-switched-path-template LINK-PROTECT-TEMPLATE
link-protection
```

- b. Define auto-bandwidth attributes for the **AUTO-BW-TEMPLATE** template.

```
[edit protocols mpls ]
user@PE1# set label-switched-path-template AUTO-BW-TEMPLATE template
user@PE1# set label-switched-path-template AUTO-BW-TEMPLATE
auto-bandwidth adjust-interval 300
user@PE1# set label-switched-path-template AUTO-BW-TEMPLATE
auto-bandwidth adjust-threshold 20
user@PE1# set label-switched-path-template AUTO-BW-TEMPLATE
auto-bandwidth minimum-bandwidth 10m
user@PE1# set label-switched-path-template AUTO-BW-TEMPLATE
auto-bandwidth maximum-bandwidth 100m
user@PE1# set label-switched-path-template AUTO-BW-TEMPLATE
auto-bandwidth adjust-threshold-overflow-limit 5
user@PE1# set label-switched-path-template AUTO-BW-TEMPLATE
auto-bandwidth adjust-threshold-underflow-limit 5
```



3. Apply the auto-bandwidth and link-protection templates to configure the auto-bandwidth and link-protection attributes to any LSPs that match the corresponding regex-based character string.

```
[edit protocols mpls lsp-external-controller pccd]
user@PE1# set pce-controlled-lsp PCE-AUTOBW-* label-switched-path-template
    AUTO-BW-TEMPLATE
user@PE1# set pce-controlled-lsp PCE-LP-* label-switched-path-template
    LINK-PROTECT-TEMPLATE
```

4. Create LSPs in NorthStar by specifying LSP names based on the regex-based name defined in Step 1 above.
5. Verify the LSP configuration on the PCC router.

```
user@PE1> show mpls lsp detail
```

#### Related Documentation

- [Creating Templates with Junos OS Groups to Apply Attributes to PCE-Initiated Label-Switched Paths on page 119](#)
- [Provision LSPs](#)

## Creating Templates with Junos OS Groups to Apply Attributes to PCE-Initiated Label-Switched Paths

From the Path Computation Client (PCC) router's command line interface, you can use the Junos OS **groups** statement with label-switched path (LSP) templates to define a set of LSP attributes to apply to PCE-initiated LSPs. Any PCE-initiated LSP that provides a name match with the regular expression (regex) name that is specified in the template automatically inherits the LSP attributes that are specified in the template. Thus, by associating PCE-initiated LSPs with a user-defined LSP template, you can automatically turn on (or turn off) LSP attributes across all LSPs that provide a name match with the regex name that is specified in the template.

The following example show how you can use templates to apply auto-bandwidth and link-protection attributes to LSPs. For example, when auto-bandwidth is enabled, LSP auto-bandwidth parameters must be configured from the router, even when the LSP has been delegated. Under no circumstances can the NorthStar Controller modify the bandwidth of an externally controlled LSP when auto-bandwidth is enabled. A PCC enforces this behavior by returning an error if it receives an LSP update for an LSP that has auto-bandwidth enabled. Currently, there is no way to signal through PCEP when auto-bandwidth is enabled, so the NorthStar Controller cannot know in advance that the LSP has auto-bandwidth enabled. However, if auto-bandwidth is enabled by way of a template, the NorthStar Controller knows that the LSP has auto-bandwidth enabled and disallows modification of bandwidth.

To configure and apply groups to assign auto-bandwidth and link protection attributes to label-switched paths:

1. From the PCC router CLI, configure groups to specify that any PCE-initiated LSP that provides a name match with the specified prefix will inherit the LSP attributes defined in the template:

- a. Configure a group to specify that an LSP that provides a name match with the prefix ***AUTO-BW-\**** will inherit the LSP auto-bandwidth attributes defined in the ***AUTO-BW-TEMPLATE*** template.

```
[edit groups AUTO-BW-GROUP]
user@PE1# set protocols mpls label-switched-path AUTO-BW-* autobandwidth
adjust-interval 300
user@PE1# set protocols mpls label-switched-path AUTO-BW-* autobandwidth
adjust-threshold 20
user@PE1# set protocols mpls label-switched-path AUTO-BW-* autobandwidth
minimum-bandwidth 10m
user@PE1# set protocols mpls label-switched-path AUTO-BW-* autobandwidth
maximum-bandwidth 100m
user@PE1# set protocols mpls label-switched-path AUTO-BW-* autobandwidth
adjust-threshold-overflow-limit 5
user@PE1# set protocols mpls label-switched-path AUTO-BW-* autobandwidth
adjust-threshold-underflow-limit 5
```

- b. Configure a group to specify that any LSP that provides a name match with the prefix ***LINK-PROTECT-\**** will inherit the LSP link-protection attributes defined in the ***LINK-PROTECT-TEMPLATE*** template.

```
[edit groups LINK-PROTECT-GROUP]
user@PE1# set protocols mpls label-switched-path LINK-PROTECT-* hop-limit 5
user@PE1# set protocols mpls label-switched-path LINK-PROTECT-* link-protection
user@PE1# set protocols mpls label-switched-path LINK-PROTECT-* adaptive
```

2. Configure the templates to apply the attributes defined for the two groups in the previous step.

```
[edit protocols mpls]
user@PE1# set label-switched-path AUTO-BW-TEMPLATE apply-groups
AUTO-BW-GROUP
user@PE1# set label-switched-path AUTO-BW-TEMPLATE template
user@PE1# set label-switched-path LINK-PROTECT-TEMPLATE apply-groups
LINK-PROTECT-GROUP
user@PE1# set label-switched-path LINK-PROTECT-TEMPLATE template
```

3. Apply the auto-bandwidth and link-protection templates to assign the auto-bandwidth and link-protection attributes to any LSPs that match the corresponding regex-based character-string.

```
[edit protocols mpls lsp-external-controller pccd]
user@PE1# set pce-controlled-lsp AUTO-BW-* label-switched-path-template
AUTO-BW-TEMPLATE
```

```
user@PE1# set pce-controlled-lsp LINK-PROTECT-* label-switched-path-template  
LINK-PROTECT-TEMPLATE
```

4. Create LSPs from the NorthStar Controller by specifying LSP names based on the regex-based name defined in Step 1.
5. Verify the LSP configuration on the PCC router.

```
user@PE1> show mpls lsp detail
```

**Related  
Documentation**

- [Creating Templates to Apply Attributes to PCE-Initiated Label-Switched Paths on page 117](#)
- *Provision LSPs*



## CHAPTER 5

# Path Computation and Optimization

- [Path Optimization on page 123](#)
- [Topology Map Color Legend on page 126](#)
- [Segment Routing on page 128](#)
- [IGP Metric Modification from the NorthStar Controller on page 137](#)
- [LSP Path Manual Switch on page 138](#)
- [Maintenance Events on page 139](#)

## Path Optimization

---

For many large networks, when a tunnel is rerouted due to a network failure, the new path remains in use even when the network failure is resolved. Over time, a suboptimal set of paths might evolve in the network. The path analysis and optimization feature re-establishes an optimal set of paths for a network by finding the optimal placement of tunnels using the current set of nodes and links in the network. You can request path analysis on demand, and path optimization either on demand or according to a schedule that you define.

Navigate to **Applications>Path Optimization** to access the path optimization sub-menu. [Figure 84 on page 124](#) shows the navigation path and the sub-menu options.

Figure 84: Navigating to Path Optimization

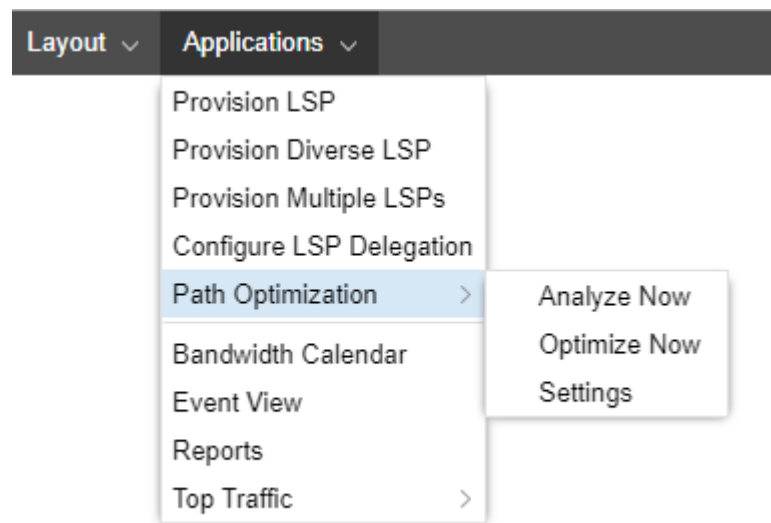
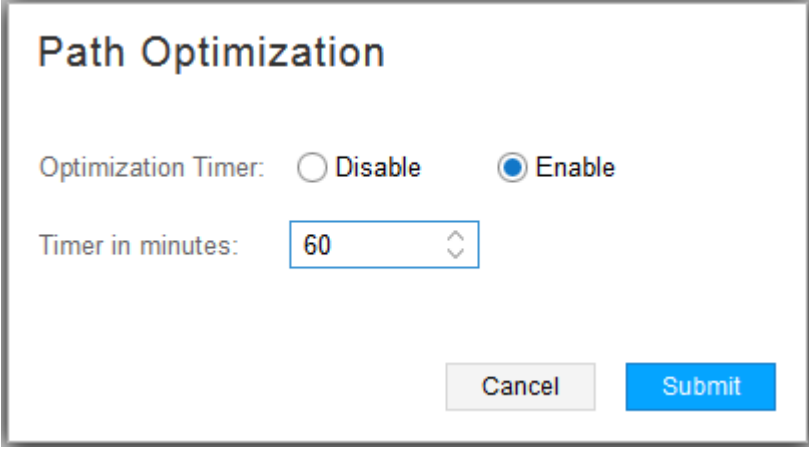


Table 30 on page 124 describes the purpose of each sub-menu option.

Table 30: Path Optimization Sub-Menu Options.

Sub-Menu Option	Purpose
Analyze Now	<p>Analyzes the network for optimization opportunities, and generates a results report. Reviewing the report gives you the opportunity to consider the effects of optimization before you actually execute it.</p> <p>Navigate to <b>Applications&gt;Reports</b> to view the latest analysis report.</p> <p><b>NOTE:</b> The path analysis and optimization reports do not contain any information about PCC-controlled LSPs because NorthStar does not attempt to optimize them.</p>
Optimize Now	<p>Optimizes the network immediately.</p> <p><b>NOTE:</b> The optimization is based on the current network, not on the most recent Analyze Now report.</p>
Settings	<p>Enables or disables an optimization schedule. For example, in <a href="#">Figure 85 on page 125</a>, path optimization would occur every 60 minutes.</p>

*Figure 85: Path Optimization Settings Example*

The image shows a 'Path Optimization' settings dialog box. It has a title bar at the top. Below the title, there are two radio buttons: 'Disable' and 'Enable'. The 'Enable' radio button is selected. Below the radio buttons, there is a label 'Timer in minutes:' followed by a text input field containing the number '60' and a small up/down arrow icon. At the bottom right of the dialog, there are two buttons: 'Cancel' and 'Submit'.

**Path Optimization**

Optimization Timer: ☐ Disable ☒ Enable

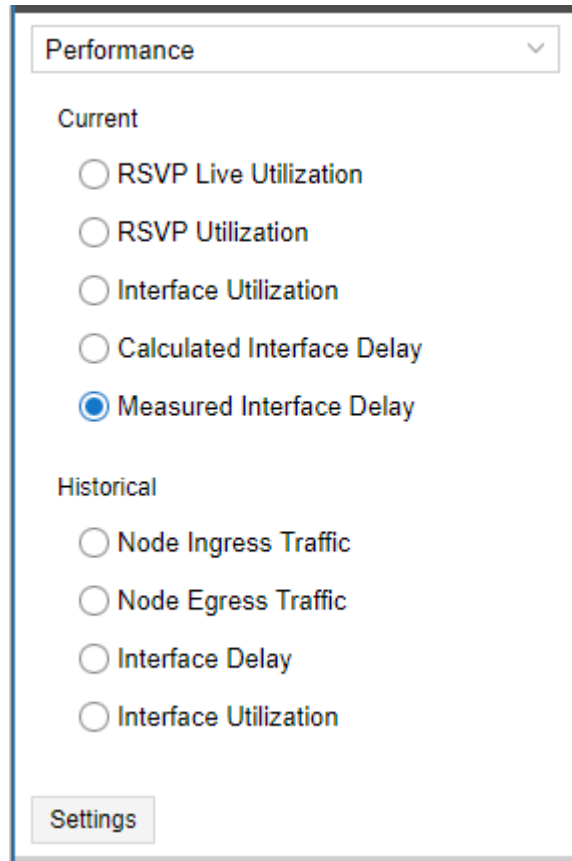
Timer in minutes:

- Related Documentation**
- [Applications Menu Overview](#)
  - [Bandwidth Calendar on page 116](#)
  - [Event View on page 178](#)

## Topology Map Color Legend

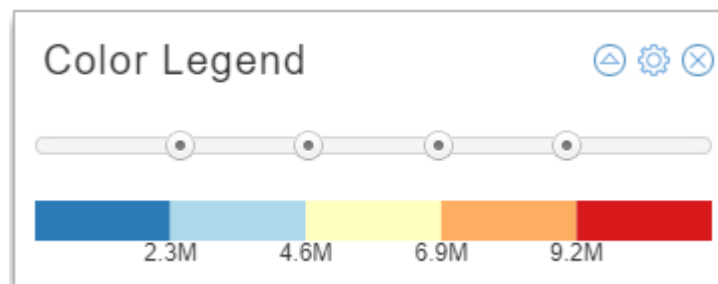
In the lower left corner of the topology map pane, there is a color legend for the links displayed in the map. The title of the legend and the units it represents (percent, milliseconds, megabytes) correspond to the display option you select in the Performance window in the left pane, shown in [Figure 86 on page 126](#).

Figure 86: Left Pane, Performance Options



Click the legend to enlarge it and enable configuration as shown in [Figure 87 on page 126](#).

Figure 87: Color Legend

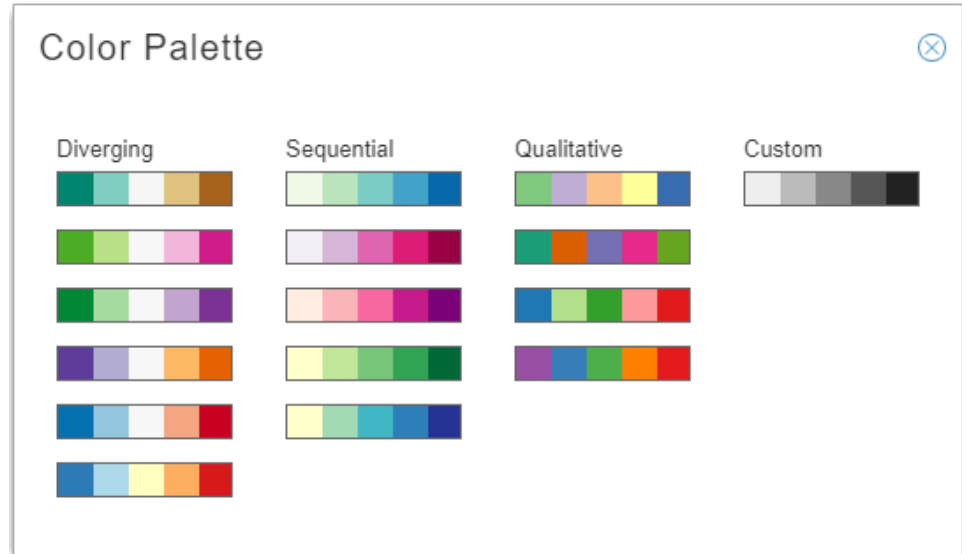




Click the triangle icon in the upper right corner to open the color palette where you can choose a color scheme. The color scheme options are designed to support any network visualization goals, including a create-your-own-palette option (Custom).

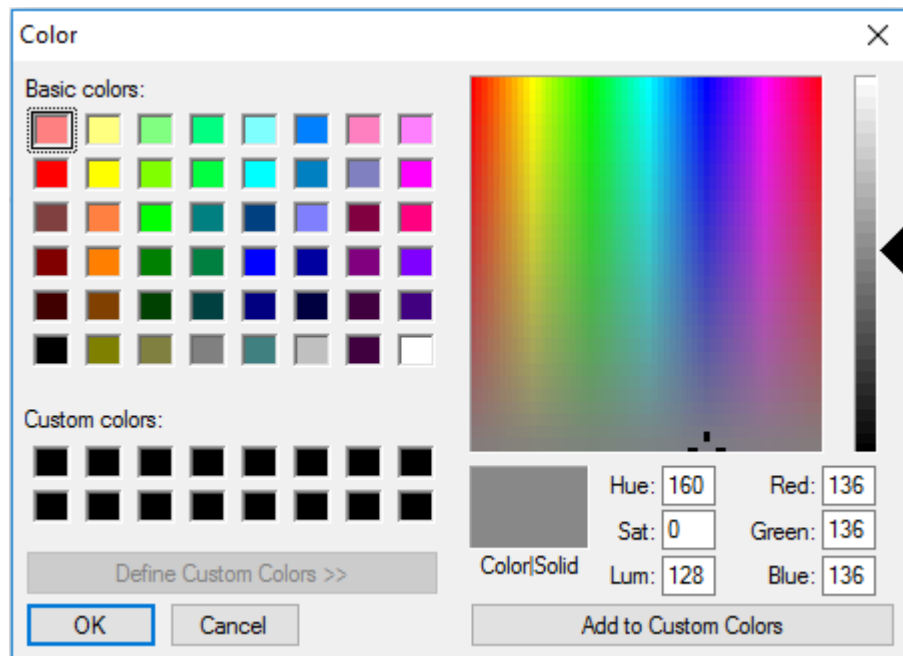
[Figure 88 on page 127](#) shows the color palette options.

*Figure 88: Color Palette Options*



Double click in one segment on the Custom palette to open the custom color window where you can select a color for that segment. [Figure 89 on page 127](#) shows the custom color window.

*Figure 89: Custom Color Window*

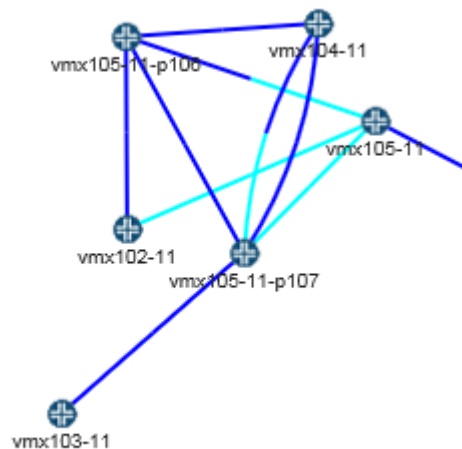


Click **OK** to add the color to the palette. Double click another segment, and so on until you have selected all five colors for the Custom palette. If you save a layout, the active palette is saved with the layout, even if it is a custom palette.

The ranges represented in the color legend are configurable. Click and drag the slider buttons between colors on the legend to change the ranges. The links in the topology map change color accordingly. The max value option (gear icon) appears in the upper right corner of the legend when your Performance selection (left pane) calls for units other than a percentage. Click the gear icon to set the maximum value for the legend.

Sometimes links display as half one color and half another color. The presence of two different colors indicates that the utilization in one direction (A to Z) is different from the utilization in the other direction (Z to A). The half of the link originating from a certain node is colored according to the link utilization in the direction from that node to the other node. [Figure 90 on page 128](#) shows two colors in one of the links between vmx104-11 and vmx105-11-p107.

*Figure 90: Two Utilization Color Codes in One Link*



- Related Documentation**
- [Left Pane Options on page 50](#)
  - [Interactive Map Features on page 30](#)

## Segment Routing

NorthStar Controller supports Source Packet Routing in Networking (SPRING), also known as segment routing. Segment routing is a control-plane architecture that enables an ingress router to steer a packet through a specific set of nodes and links in the network. For more information about segment routing, see [Understanding Source Packet Routing in Networking \(SPRING\)](#).

Junos OS Release 17.2R1 or later is required to utilize NorthStar Controller SPRING features. However, NorthStar Controller does not report the correct record route object (RRO) in

the web UI and via the REST API when routers are configured with Junos OS Release 17.2R1. Instead of showing a list of link adjacency SIDs, the web UI and REST API report a list of “zero” labels. This issue has been fixed in Junos OS Releases 17.2.R1-S1 and 17.2R2.



**NOTE:** OSPF is not supported for SPRING.

## Segment ID Labels

Adjacency segment ID (SID) labels (associated with links) and node SID labels (associated with nodes) can be displayed on the topological map.



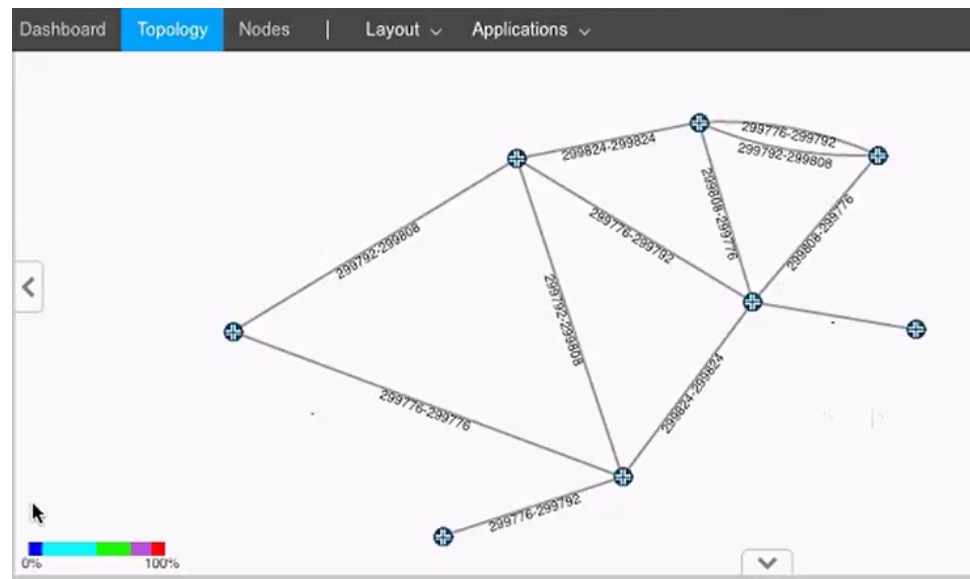
**NOTE:** You can use either BGP-LS peering or IGP adjacency from the JunosVM to the network to acquire network topology. However, for SPRING information to be properly learned by NorthStar when using BGP-LS, the network should have RSVP enabled on the links and the TED database available in the network.

You can display adjacency SID labels on the map. On the right side of the topology window is a menu bar offering various topology settings. Click the Tools icon and select the Link Label tab. Click the radio button for **SID A::Z**. An example topology map showing adjacency SID labels is shown in [Figure 91 on page 129](#)



**NOTE:** In the Topology Settings window, be sure to select **Show Link Labels** in the Options tab.

*Figure 91: Topology Map Showing Adjacency SID Labels*



To view adjacency SID labels in the network information table, click the down arrow beside any column heading under the Link tab, and click **Columns** to display the full list of available columns. Click the check boxes beside **SID A** and **SID Z**.

When you display the detailed information for a specific link (by double clicking the link in the map or in the network information table), you will see an attribute folder for both endA and endZ called SR (segment routing). You can drill down to display attributes for each SID as shown in [Figure 92 on page 130](#). At present, only IPv4 SIDs are supported, and only one per interface.

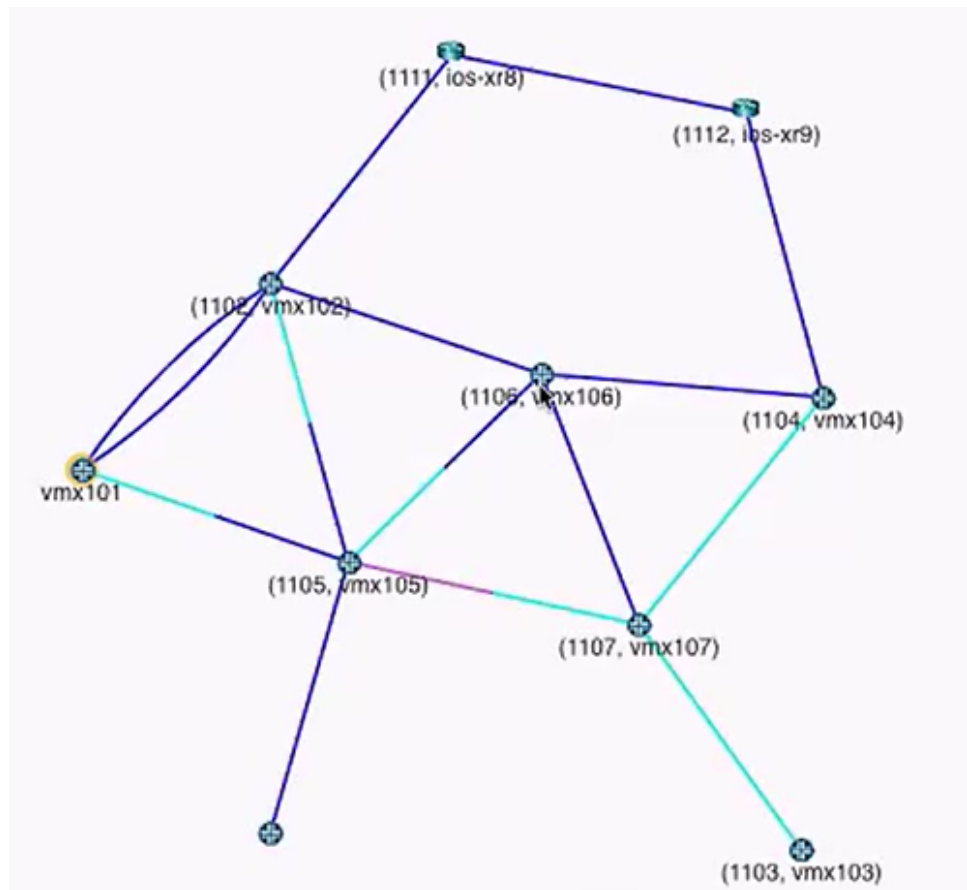
*Figure 92: New SR Attribute Folder in Link Details*

Name ↑	Value
bwA	
bwZ	
canFail	true
clientMapping	
delayA	
delayZ	
diffRsvpUtilAZ	0
diffRsvpUtilZA	0
distanceAZ	
distanceZA	
filtered	false
hostNameA	vmx101
hostNameZ	vmx102

Node SID labels are displayed a little differently because the value of the label depends on the perspective of the node assigning it. A node might be given different node SID labels based on the perspective of the assigning nodes. To display node SID labels on the topology map, specify the perspective by right-clicking on a node and selecting **Node SIDs from selected node**. The node SID labels are then assigned from the perspective of that selected node.

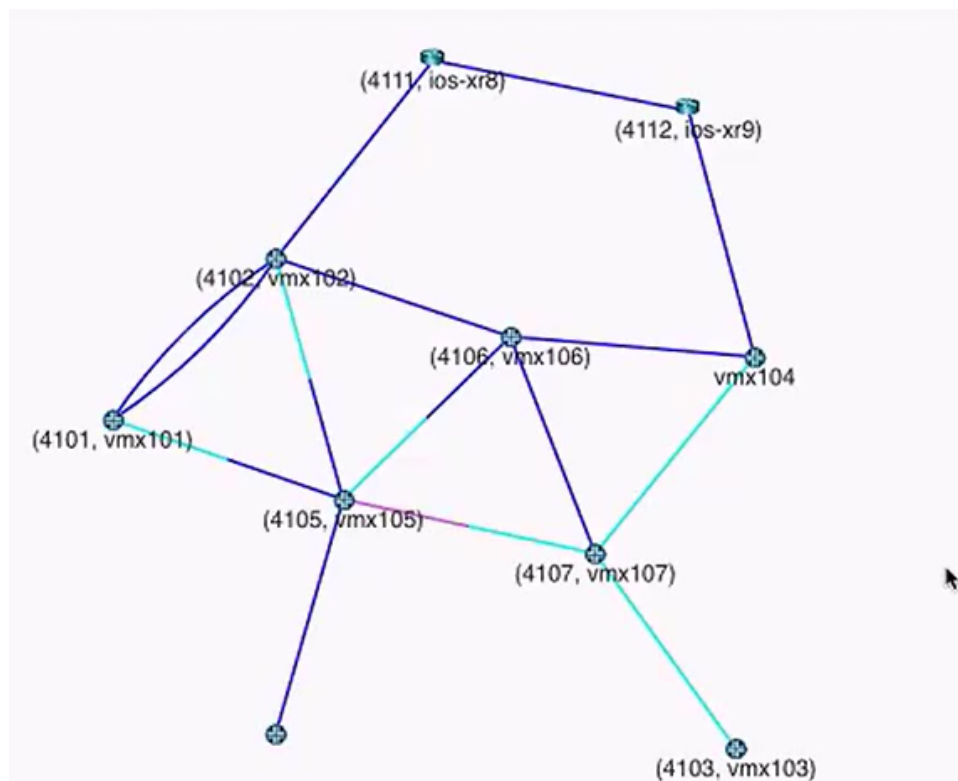
For example, [Figure 93 on page 131](#) shows a topology displaying the SID node labels from the perspective of node vmx101. Note that the node SID label for node vmx106 is 1106.

Figure 93: Node SID Labels from Node vmx101's Perspective



If you right-click on node vmx104 and select **Node SIDs from selected node**, the node SID labels on the topology change to reflect the perspective of node vmx104 as shown in Figure 94 on page 132. Note that the node SID label for node vmx106 is now 4106.

Figure 94: Node SID Labels from Node vmx104's Perspective



The selected node does not display a node SID label for itself. Any other nodes in the topology map that do not display a node SID label do not have the segment routing protocol configured.



**NOTE:** Node SID information is not available in the network information table.

## SR-LSPs

SR-LSP tunnels can be created using both adjacency SID and node SID labels.

An SR-LSP tunnel is a label stack that consists of a list of adjacency SID labels, node SID labels, or a mix of both. To create an SR-LSP, navigate to the Tunnel tab in the network information table and click **Add** at the bottom of the table to display the Provision LSP window. The Provision LSP window has a Provisioning Type drop-down selection offering RSVP and SR options. Select **SR**. Complete the remaining fields as needed and click **Submit** to see the new path highlighted in the topology map.

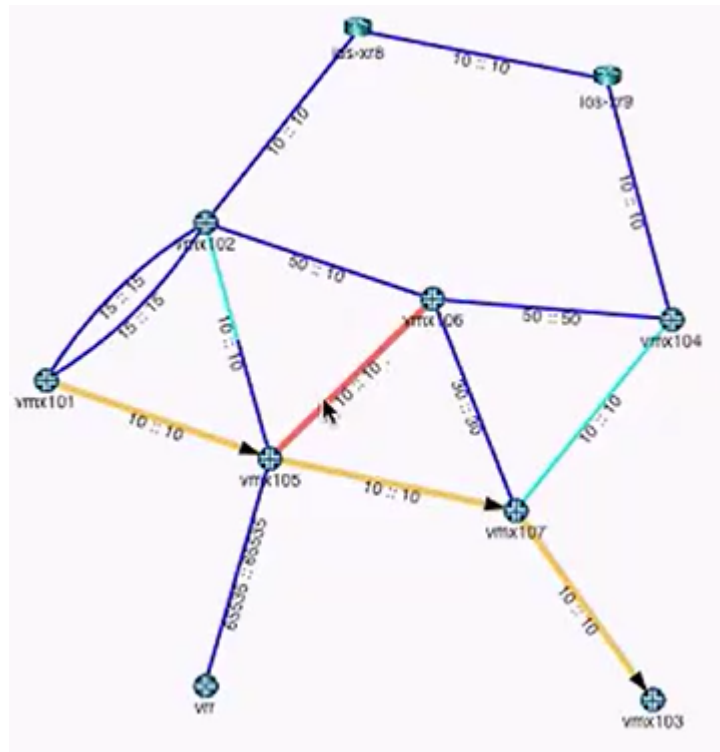
There are multiple ways to view the details of the path:

- The IP address and the SID are the two parts of the explicit route. The IP address part is displayed in the ERO column in the network information table, Tunnel tab. The SID part is displayed in the Record Route column.

- Double-click on the tunnel row in the network information table and drill down into the liveProperties to see the details of the ERO.
- Use Junos OS **show** commands on the router. Some examples are:
  - **show spring-traffic-engineering lsp name *lsp-name* detail** to display the LSP status and SID labels.
  - **show route table inet.3** to display the mapping of traffic destinations with SPRING LSPs.

If a link in a path is used in both directions, it is highlighted in a different color in the topology, and does not have arrowheads to indicate direction. [Figure 95 on page 133](#) shows an example in which the link between vmx105 and vmx106 is used in both directions.

*Figure 95: Example of Link Used in Both Directions*



To avoid encountering an equipment limitation on the maximum SID depth (MSD), you can use the Routing Method drop-down menu in the Provision LSP window (Design tab) to select **routeByDevice** as shown in [Figure 96 on page 134](#). This option allows the router to control part of the routing, so fewer labels need to be explicitly specified.



**NOTE:** routeByDevice is to be used when you want to create an SR-LSP with Node SID.

Figure 96: routeByDevice Selection

The screenshot shows the 'Provision LSP' window with the 'Design' tab selected. The 'Routing Method' dropdown menu is open, displaying the following options: default, adminWeight, delay, constant, distance, ISIS, OSPF, and routeByPCC. The 'routeByPCC' option is highlighted. Other fields in the window include 'Max Delay (ms):', 'Max Hop:', 'Max Cost:', 'High Delay Threshold:', 'Low Delay Threshold:', 'High Delay Metric:', and 'Low Delay Metric:'. At the bottom, there are buttons for 'Preview Path', 'Cancel', and 'Submit'.



**NOTE:** A symptom of encountering the MSD limitation when you are not using routeByDevice is that although a row for the new LSP is added to the network information table, the Op Status is listed as **Unknown** and the Controller Status is listed as **Reschedule in x minutes**.

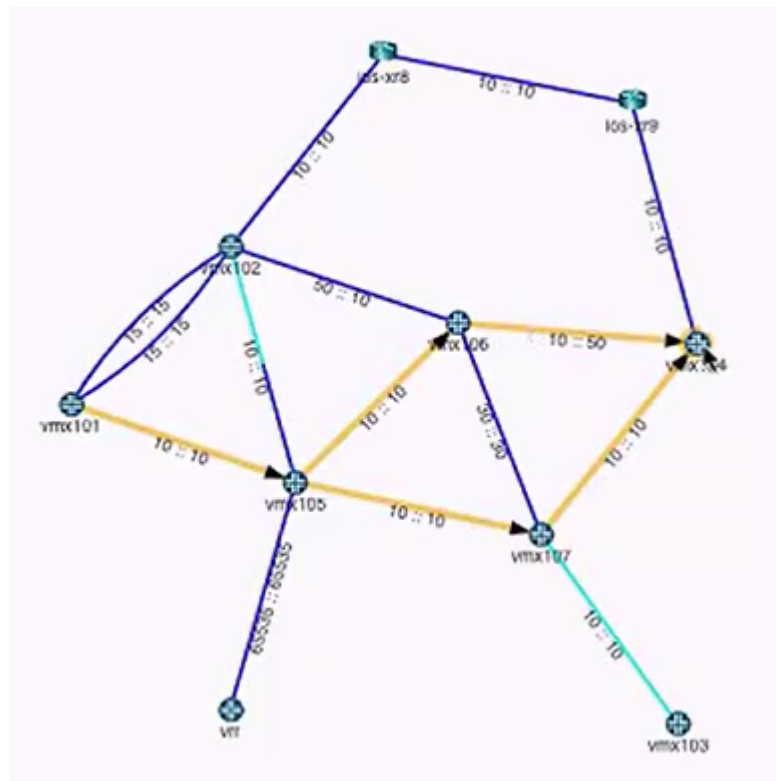
In [Figure 97 on page 135](#), the routing paths highlighted are the equal cost paths for the t2 LSP.

For t2 in this example:

- Node A is vmx101 and Node Z is vmx104.
- The provisioning type is **SR**, designated in the Properties tab of the Provision LSP window.
- The routing method is **routeByDevice**, designated in the Advanced tab of the Provision LSP window. The highlighting of the equal cost paths can only be viewed in the topology if the routing is being done by the PCC.



Figure 97: View of Equal Cost Paths for SR LSP



The mandatory transit router can be part of the generated ERO using the adjacency SID passing through that transit router. However, specifying a mandatory transit router usually increases the label stack depth, violating the MSD. In that case, you can try using the `routeByDevice` method. To specify a mandatory transit router using Node SID, select the routing method as `routeByDevice` (Design tab), and specify the loopback of the mandatory transit router as loose hop (Path tab).

A possible downside to using `routeByDevice` is that other constraints you impose on the LSP links (bandwidth, coloring, and so on) cannot be guaranteed. The NorthStar Controller does not provision the LSP if it sees that the constraints cannot be met. But if the information available indicates that the constraints can be met, the NorthStar Controller provisions the LSP even though those constraints are not guaranteed. Turning on the path optimization timer enables NorthStar to periodically check the constraints.

If the NorthStar Controller later learns (during the execution of an optimization request, for example) that the constraints are no longer being met, it will try to reroute the tunnel by changing the first hop outgoing interface if a specific one was not configured. If that is not possible, the LSP remains in the network, even though constraints are violated.

For SR-LSPs, the router is only able to report on the operational status (Op Status in the network information table) of the first hop. After the first hop, the NorthStar Controller takes responsibility for monitoring the SID labels, and reporting on the operational status. If the labels change or disappear from the network, the NorthStar Controller tries to reroute and re-provision the LSPs that are in a non-operational state.

If NorthStar is not able to find an alternative routing path that complies with the constraints, the LSP is deleted from the network. These LSPs are not, however, deleted from the data model (they are deleted from the network, and persist in the data storage mechanism). The goal is to minimize traffic loss from non-viable SR-LSPs (black holes) by deleting them from the network. Op Status is listed as **Unknown** when an SR-LSP is deleted, and the Controller Status is listed as **No path found** or **Reschedule in x minutes**.

You can mitigate the risk of traffic loss by creating a secondary path for the LSP with fewer or more relaxed constraints. If the NorthStar Controller learns that the original constraints are not being met, it first tries to reroute using the secondary path.



**NOTE:** Although NorthStar permits adding a secondary path to an SR-LSP, it is not provisioned as a secondary path to the PCC because the SR-LSP protocol itself does not support secondary paths.

Some additional notes about SR-LSPs:

- Provisioning of an SR-LSP can include hop information that somewhat influences the routing. In the Provision LSP window, select the **Path** tab. There, you can select hops up to the MSD hop limitation that is imposed on the ingress router, and specify **Strict** or **Loose** adherence.
- NorthStar diverse LSP and multiple LSP provisioning supports segment routing. Select **SR** from the Provisioning Type drop-down menu on the Provision Diverse LSP or Provision Multiple LSPs window.
- Maintenance events are supported with SR-LSPs.

**Related  
Documentation**

- [Provision LSPs on page 87](#)
- [Path Optimization on page 123](#)

## IGP Metric Modification from the NorthStar Controller

You can change the IGP metric from within the NorthStar Controller web UI, without having to configure anything on the router. Modifying metrics is one way to cause the path selection process to favor one path over the other available paths.



**NOTE:** Interface data must have been collected using a Netconf device collection task as described in [“Scheduling Device Collection for Analytics via Netconf” on page 202](#) before you can modify IGP metrics.

To modify IGP metrics from within the web UI, perform the following steps:

1. In the Link tab of the network information table, highlight the link to be modified. Click **Modify** at the bottom of the table to display the Modify Link window.
2. Click the new Configuration tab where you can change the ISIS Level1, ISIS Level2, or OSPF metric for either side of the link, or for both sides.



**NOTE:** If the Configuration tab is not available, device collection has not been run.

3. Click the Properties tab and add a description of the change you are making in the Comment field. This is optional, but we recommend it because it serves as a reference if you want to revert to the original metric.
4. Click **Submit**. A confirmation window is displayed. Click **Yes** to continue.

If your system uses BGP-LS for topology acquisition, only the TE metric can be immediately updated in the web UI. To retrieve and display other updated metrics (ISIS1, ISIS2, OSPF), right-click the link in the network information table and select **Run Device Collection**.

If your system is configured to use IGP adjacency for topology acquisition, this step is not necessary because all metrics are immediately updated.

### Related Documentation

- [Device Profile and Connectivity Testing on page 190](#)
- [Scheduling Device Collection for Analytics via Netconf on page 202](#)

## LSP Path Manual Switch

---

Manual switching allows you to select which LSP path is to be active for PCC-controlled LSPs where the path name is not empty. One use case for this feature is to proactively switch the active path in preparation for a maintenance event that would make the currently active path unavailable.

To manually switch the active path, perform the following steps:

1. In the Tunnel tab of the network information table, right-click the LSP.
2. Select **Set Preferred Path** to display the Select Preferred Path window.



**NOTE:** This menu option is grayed out if the LSP is not a PCC-controlled LSP for which the path name is not empty.

3. In the list of available paths, click the radio button for the path you want to make active. When you click a radio button, you can see the corresponding path highlighted in the topology map.



**NOTE:** The list of paths comes from the router's configuration under the path statement blocks. If the network does not run PCEP, you must first run a Netconf device collection task to populate the list of paths.

4. Click **Submit**. The Op Status of the paths is updated in the network information table. In the Configured Preferred Path column, the manually-selected path is designated as Manual Preferred.

To remove the manual path designation, perform the following steps:

1. In the Tunnel tab of the network information table, right-click the LSP.
2. Select **Set Preferred Path** to display the Select Preferred Path window.
3. In the list of available paths, click the radio button next to None.
4. Click **Submit**. This returns the primary path to active state.

### Related Documentation

- [Maintenance Events on page 139](#)
- [Scheduling Device Collection for Analytics via Netconf on page 202](#)

## Maintenance Events

Use the Maintenance option to schedule maintenance events for network elements, so you can perform updates or other configuration tasks. Maintenance events are planned failures at specific future dates and times. During a scheduled maintenance event, the selected elements are considered logically down, and the system reroutes the LSPs around those elements during the maintenance period. After the maintenance event is completed, the default behavior is that all LSPs that were affected by the event are reoptimized. There is an option that allows you to disable that reoptimization if you want to complete the maintenance event, but keep the paths in their rerouted condition.



**NOTE:** NorthStar only attempts to reoptimize PCE-initiated and PCC-delegated LSPs (not PCC-controlled LSPs).



**NOTE:** Maintenance events can also be created by NorthStar when the link packet loss threshold has been exceeded, triggering LSP rerouting. See [“LSP Routing Behavior” on page 244](#) for more information about LSP rerouting.

## Viewing Scheduled Maintenance Events

You can view scheduled maintenance events for network elements in the Maintenance tab of the network information table. In the network information table, the Node, Link, and Tunnel tabs are always displayed. Maintenance is one of the tabs you can optionally display. Click the plus sign (+) in the tabs heading bar and select **Maintenance** from the drop-down menu.

[Table 31 on page 139](#) describes the columns displayed in the Maintenance tab.

**Table 31: Network Information Table Maintenance Tab Columns**

Field	Description
Name	Name assigned to the scheduled maintenance event. The name specified for the maintenance event is also used to name the subfolder for reports in the Report Manager.  <b>NOTE:</b> The names of triggered maintenance events (created by NorthStar) indicate they were triggered by packet loss.
Nodes	Number of nodes scheduled for maintenance.
Links	Number of links scheduled for maintenance.
SRLGs	Number of SRLGs scheduled for maintenance.
Start Time	Start time for the maintenance event.
End Time	End time for the maintenance event.

*Table 31: Network Information Table Maintenance Tab Columns (continued)*

Estimated Duration	Estimated duration for the maintenance event, which is calculated as the duration between the Start Time and End Time in the Maintenance Scheduler window.
Owner	Owner (creator) of the maintenance event.
Operation Status	<p>Possible status conditions are:</p> <ul style="list-style-type: none"> <li>Planned—Event scheduled some time in the future.</li> <li>Completed—Event finished in the past.</li> <li>In Progress—Event is in progress.</li> <li>Canceled—The scheduled event has been canceled. A canceled event is different from a deleted event. Canceled events remain in the maintenance table for tracking purposes or for reactivating later.</li> <li>Deleted—Event has been deleted from the Maintenance table.</li> </ul>
Comment	Comments entered when the event was added or modified.
Auto Complete	<p>When selected, NorthStar automatically sets the event's Operation Status to Completed at the specified End Time.</p> <p><b>NOTE:</b> For NorthStar-created maintenance events, this option is not available. NorthStar-created events require manual completion via the Modify Maintenance Event window.</p>
No LSP Reoptimization	When selected, NorthStar does not automatically reoptimize LSPs when the event is completed.
Node Names	Nodes included in the event.
Link Names	Links included in the event.
SRLG Names	SRLGs included in the event.

## Adding a Maintenance Event

Add a new maintenance event by clicking the Maintenance tab in the network information table, and clicking **Add** at the bottom of the table. The Add Maintenance Event window is displayed as shown in [Figure 98 on page 141](#).

Figure 98: Add Maintenance Event Window, Properties Tab


**Add Maintenance Event**


Properties Nodes Links SRLG

Name: \*

Owner:

Comment:

Starts: \*  

Ends: \*  

☐ Auto Complete at End Time

☐ No LSP Reoptimization Upon Completion

Cancel Submit

Table 32 on page 141 describes the data entry fields available in the Properties tab. A red asterisk denotes a required field.

Table 32: Add Maintenance Event Window, Properties Fields

Field	Description
Name	Required. Enter a name for the maintenance event.
Owner	This field auto-populates with the user that is scheduling the maintenance event.
Comment	Enter a comment for the maintenance event.
Starts	Required. Click the calendar icon to display a monthly calendar from which you can select the year, month, day, and time.
Ends	Required. Click the calendar icon to display a monthly calendar from which you can select the year, month, day, and time.

Table 32: Add Maintenance Event Window, Properties Fields (continued)

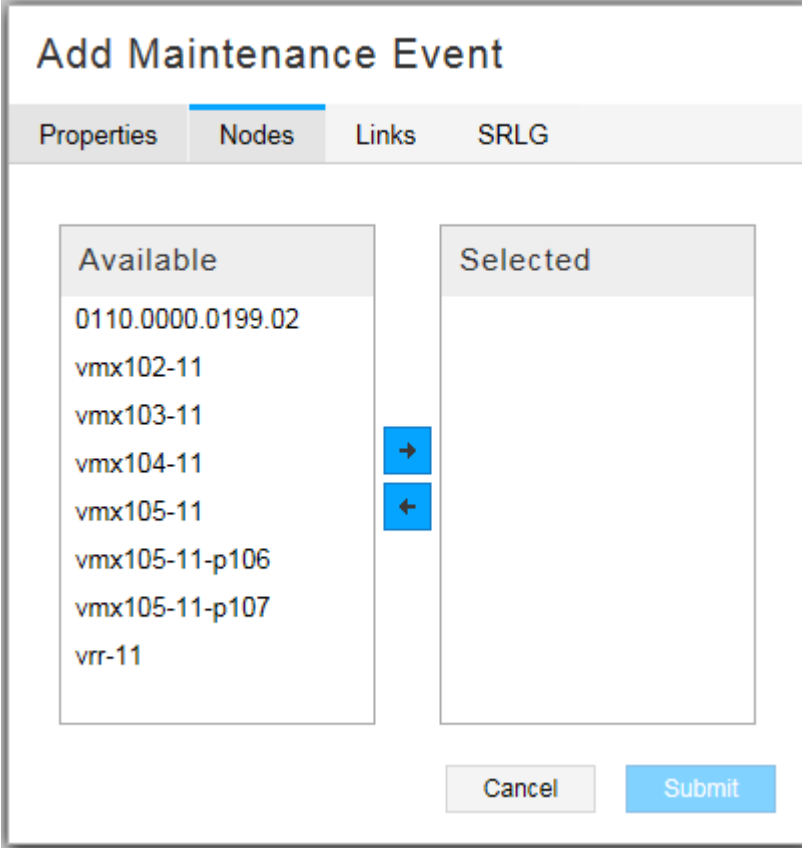
Field	Description
Auto Complete at End Time	<p>Select the Auto Complete at End Time check box to automatically complete the maintenance event (bring the elements back up) at the specified end time. If the check box is not selected, you must manually complete the maintenance event after it finishes.</p> <p><b>NOTE:</b> To manually complete an event, select it in the network information table, click <b>Modify</b>, and use the drop-down menu in the Status field to select <b>Completed</b>.</p> <p>When a maintenance event is completed, it triggers NorthStar to bring the maintenance elements back to an Up state, ready for path reoptimization. The affected LSPs are then rerouted to optimal paths unless you selected <b>No LSP Reoptimization Upon Completion</b>.</p>
No LSP Reoptimization Upon Completion	<p>The default behavior is for the system to reoptimize those LSPs that were affected by the maintenance event when the maintenance event is completed. When you check the No LSP Reoptimization Upon Completion option, that behavior is disabled. This allows you to use a maintenance event to temporarily disable a link in NorthStar.</p> <p>You can reoptimize all LSPs by navigating to <b>Applications &gt; Path Optimization</b>. You can reoptimize specific LSPs by selecting them in the Tunnel tab of the network information table, right-clicking, and selecting <b>Trigger LSP Optimization</b> from the drop-down menu. You can also right-click on links in the Link tab to reoptimize LSPs on those links.</p>

Use the Nodes, Links, and SRLG tabs to select the elements that are to be included in the maintenance event. All three of these tabs are structured in the same way.

[Figure 99 on page 143](#) shows an example.



Figure 99: Select Elements for Maintenance Event



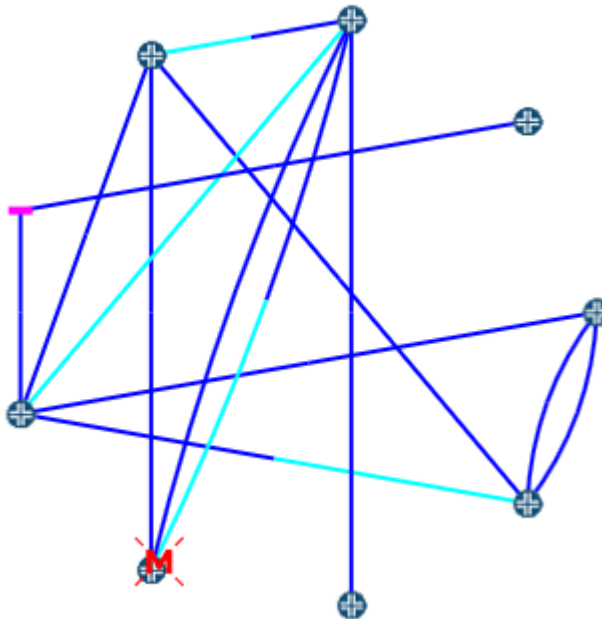
The dialog box titled "Add Maintenance Event" has four tabs: "Properties", "Nodes", "Links", and "SRLG". The "Nodes" tab is selected. It contains two columns: "Available" and "Selected". The "Available" column lists the following nodes: 0110.0000.0199.02, vmx102-11, vmx103-11, vmx104-11, vmx105-11, vmx105-11-p106, vmx105-11-p107, and vrr-11. Between the columns are two blue arrows: a right-pointing arrow and a left-pointing arrow. At the bottom right are "Cancel" and "Submit" buttons.

Available	Selected
0110.0000.0199.02	
vmx102-11	
vmx103-11	
vmx104-11	
vmx105-11	
vmx105-11-p106	
vmx105-11-p107	
vrr-11	

Select elements in the Available column and click the right arrow to move them to the Selected column. Click the left arrow to deselect elements. Click **Submit** when finished. The new maintenance event appears in the network information table at the bottom of the Topology view.

When an element (node, link, or SRLG) is undergoing a maintenance event, it appears on the topology map with an M (for maintenance) through the element.

[Figure 100 on page 144](#) shows an example.

*Figure 100: Node Undergoing Maintenance*

## NorthStar-Created Maintenance Events

In the Maintenance tab of the network information table, you might also see maintenance events created by NorthStar in response to packet loss on a link. These events include just one link per event, and they are named to indicate that they were created in response to packet loss. The corresponding link in the topology map displays with the M through it that indicates the link is logically down due to a maintenance event.

These events start immediately when the link packet loss threshold is exceeded, and the end time is set for one hour later. Because this type of maintenance event requires manual completion, the end time is not significant.

These events do not automatically complete because there is no way for NorthStar to know when troubleshooting efforts have been successful and the link has been restored to stability. Therefore, you must manually complete these events using the Modify Maintenance Event window.

## Modifying Maintenance Events

To modify a planned maintenance event, select the maintenance event row in the Maintenance tab of the network information table and click **Modify** at the bottom of the table. The Modify Maintenance Event window is displayed where you can change the parameters, schedule, or status. [Figure 101 on page 145](#) shows the Properties tab in the Modify window.

Figure 101: Modify Maintenance Event Window, Properties Tab

**Modify Maintenance Event**

Properties Nodes Links SRLG

Name: \* JB-test-2

Owner: admin

Comment:

Starts: \* 2018-04-10 11:07

Ends: \* 2018-04-11 11:07

☒ Auto Complete at End Time

☒ No LSP Reoptimization Upon Completion

Status: planned

Cancel Submit

See [Table 32 on page 141](#) and [Table 31 on page 139](#) for descriptions of these fields and possible values.

When you are finished updating the fields, click **OK**. The updates you made are reflected in the network information table.

## Canceling and Deleting Maintenance Events

When you cancel a maintenance event, it remains in the Maintenance tab of the network information table, with an operation status of **Cancelled**. When you delete an event, it is completely removed from the network information table. You might want to cancel an event rather than delete it if you think you will reactivate it later, possibly with modifications, or if you need it for tracking purposes.



**NOTE:** You cannot delete a maintenance event that is in progress. You can, however, cancel one.

To cancel a maintenance event, select the event row in the Maintenance tab of the network information table and click **Modify** at the bottom of the table. Use the drop-down menu in the Status field to select **Cancelled**.

To delete a maintenance event, you can select the event row and click **Delete** at the bottom of the table. Alternatively, you can select the event row and click **Modify** at the bottom of the table. Use the drop-down menu in the Status field to select **Deleted**. With either method, the row is removed from the table.

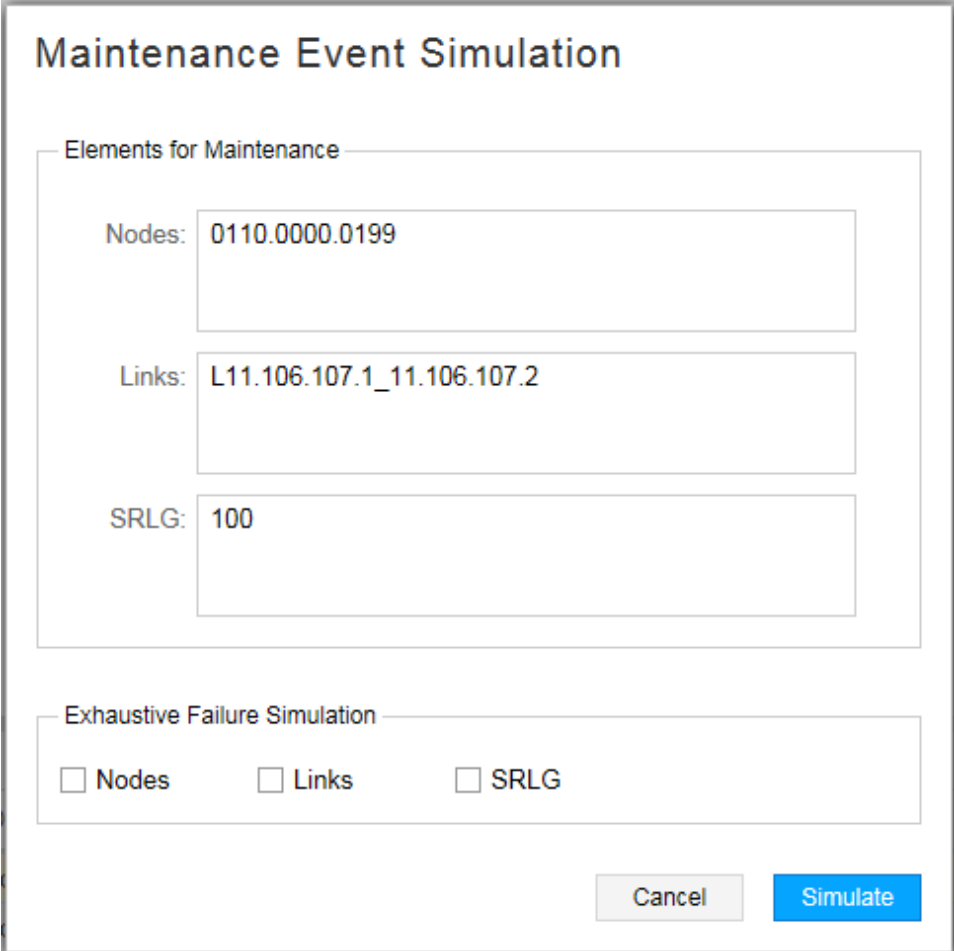
## Simulating Maintenance Events

You can run scheduled maintenance event simulations to test the resilience of your network. Network simulation is based on the current network state for the selected maintenance events at the time the simulation is initiated. Simulation does not simulate the maintenance event for a future network state or simulate elements from other concurrent maintenance events. You can run network simulations based on elements selected for a maintenance event, with the option to include exhaustive failure testing.

To access this function, right-click in the maintenance event row in the network information table and select **Simulate**.

The Maintenance Event Simulation window, as shown in [Figure 102 on page 146](#), displays the nodes, links, and SRLGs you selected to include in the event.

*Figure 102: Maintenance Event Simulation Window*



The image shows a 'Maintenance Event Simulation' window. It has a title bar at the top. Below the title, there is a section titled 'Elements for Maintenance' which contains three input fields: 'Nodes' with the value '0110.0000.0199', 'Links' with the value 'L11.106.107.1\_11.106.107.2', and 'SRLG' with the value '100'. Below this section is another section titled 'Exhaustive Failure Simulation' which contains three checkboxes: 'Nodes', 'Links', and 'SRLG', all of which are currently unchecked. At the bottom right of the window are two buttons: 'Cancel' and 'Simulate'.

**Maintenance Event Simulation**

Elements for Maintenance

Nodes: 0110.0000.0199

Links: L11.106.107.1\_11.106.107.2

SRLG: 100

Exhaustive Failure Simulation

☐ Nodes ☐ Links ☐ SRLG

Cancel Simulate

The Exhaustive Failure Simulation section at the bottom of the window is optional. It provides check boxes for selecting the element types you want to include in an exhaustive failure simulation. If you do not perform an exhaustive failure simulation (all check boxes under Exhaustive Failure Simulation are cleared), all the nodes, links, and SRLGs selected for the maintenance event fail concurrently. In [Figure 102 on page 146](#), for example, node 0110.0000.0199, link L11.106.107.1\_11.106.107.2, and SRLG 100 would all fail at the same time.

Using this same example, but with Nodes selected under Exhaustive Failure Simulation, the simulation still fails all the maintenance event elements concurrently, but simultaneously fails each of the other nodes in the topology, one at a time. If you select multiple element types for exhaustive failure simulation, all possible combinations involving those elements are tested. The subsequent report reflects peak values based on the worst performing combination.

Whether or not you select exhaustive failure, click **Simulate** to perform the simulation and generate reports.

## Viewing Failure Simulation Reports

When a simulation completes, the Reports menu is displayed, showing a list of the newly generated reports for the simulation, grouped into a folder with the same name as the maintenance event. You can also view the reports any time by navigating to **Applications>Reports**.

The following reports are available for each maintenance event simulation:

- **RSVP Link Utilization Changes:** Shows changes to the tunnel paths, number of hops, path cost, and delay.
- **Peak Simulation Stat Summary:** Shows the summary view of the count, bandwidth, and hops of the impacted and failed tunnels.
- **Peak Simulation Tunnel Failure Info:** Lists the tunnels that were unable to reroute and the causing events during exhaustive failure simulation.
- **LSP Path Changes:** Shows changes to the tunnel paths, number of hops, path cost, and delay.
- **Link Peak Utilization:** For each link, this report shows the peak utilization encountered from one or more elements that failed.
- **Link Oversubscription Stat Summary:** Lists the links that reached over 100% utilization during exhaustive failure simulation.
- **Physical Interface Peak Utilization Report:** Physical interfaces report with normal utilization, the worst utilization, and the causing events during exhaustive failure simulation.
- **Maintenance Event Simulation Report:** Link utilization and LSP routing changes during failure simulation caused by maintenance events.
- **Path Delay Information Report:** Shows the worst path delay and distance experience by each tunnel and the associated failure event that caused the worst-case scenario.

**Related Documentation**

- [LSP Routing Behavior on page 244](#)

## CHAPTER 6

# Working with Transport Domain Data

- [Multilayer Feature Overview on page 149](#)
- [Configuring the Multilayer Feature on page 152](#)
- [Linking IP and Transport Layers on page 159](#)
- [Managing Transport Domain Data Display Options on page 160](#)

## Multilayer Feature Overview

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The multilayer feature enables NorthStar Controller to receive an abstracted view of an underlying transport network and utilize the information to expand its packet-centric applications. NorthStar Controller does not use the information to compute paths for the transport domain. The transport layer topology information comes in the form of a YANG-based data model over southbound RESTCONF and REST APIs.

The following sections describe how multilayer support is integrated into the NorthStar Controller:

- [Key Features of NorthStar Controller Multilayer Support on page 149](#)
- [SRLGs on page 150](#)
- [Maintenance Events on page 150](#)
- [Latency on page 151](#)
- [SRLG Diverse LSP Pairs on page 151](#)
- [Protected Transport Links on page 151](#)

## Key Features of NorthStar Controller Multilayer Support

The following features apply to NorthStar Controller multilayer support:

- A single instance of NorthStar Controller (or multiple NorthStar Controller instances deployed as a high availability cluster) can receive abstract topology information from multiple transport controllers simultaneously.
- You can configure multiple devices associated with a single transport controller, and at least one device is required. If multiple devices are configured, NorthStar Controller attempts connection to them in round-robin fashion.
- The transport controller should provide the NorthStar Controller with the local and remote identifier information for each interlayer link. If the transport controller is not

able to provide the interlayer link identifiers on the packet domain side, it provides open ended interlayer links that you can complete using the NorthStar Controller Web UI.

- Juniper Networks provides an open source script to be used optionally for configuring interlayer links.
- Transport link failures can be reported by transport controllers and are displayed in the NorthStar Controller UI as failed transport links. Only failures reported in the traffic engineering database (TED) are taken into account for rerouting. IP links associated with transport link failures reported by a transport controller are not considered down by NorthStar Controller unless reported down in the TED.
- Transport controller profile configuration can be done in the NorthStar Controller Web UI or directly via the NorthStar Controller's northbound REST API. You can view and manage transport layer elements in both the web UI and the NorthStar Planner.
- The web UI and the northbound REST API offer premium delay-related path design options for transport links. In the web UI, navigate to **Applications>Provision LSP**, and click the **Design** tab. These options are also available in the NorthStar Planner.

When the transport domain is known, the delay information does not need to be populated manually or imported from a static file because the information is learned dynamically by NorthStar Controller.

- Once the interlayer links mapping is completed, the data used by the path design options (delay, SRLGs, Protected) is populated automatically and updated dynamically through communication between the transport and NorthStar controllers.

## SRLGs

NorthStar Controller considers transport shared risk link group (SRLG) information whenever a path optimization occurs or whenever some event triggers rerouting.

By default, NorthStar Controller associates transport SRLGs to IP links based on information received from the transport controller. Connecting NorthStar Controller to more than one transport controller introduces the possibility of overlap of SRLG ranges, which might not be desirable. The configuration of transport controller profiles in the NorthStar Controller Web UI allows for the specification of an additional TSRLG prefix (a prefix extension) for each transport controller to prevent unintentional overlap.

Preventing unintentional SRLG range overlap requires particular vigilance when you have transport controller ranges and you also manually assign SRLGs to IP links in NorthStar Controller.

## Maintenance Events

Maintenance events that include transport layer elements can be scheduled in the NorthStar Controller UI because transport SRLGs are automatically discovered by NorthStar Controller. You can select any transport layer elements or combination of transport and packet layer elements to be included in a maintenance event. Of the transport layer elements only the transport SRLGs can trigger the rerouting of packet layer LSPs.



Both the NorthStar Controller and NorthStar Planner support creation of maintenance events that include transport layer elements. The transport controller is not made aware of these maintenance events as they exist only in the scope of NorthStar.

## Latency

NorthStar Controller can dynamically learn latency information for transport links and interlayer links, to support latency-based routing constraints for packet LSPs. There are three possible sources for latency values. All of the values are collected and saved, but when multiple values are present for the same object, the NorthStar Controller can only accept one. The NorthStar Controller resolves conflicts by accepting latency values according to their source in the following order of preference:

- Manual configuration by the user
- Probes on the routers that support analytics
- Transport controller

## SRLG Diverse LSP Pairs

In the web UI, you can create LSP pairs that are SRLG-diverse to each other. Use the same processes and UI windows you use to create other diverse LSP pairs, and specify SRLG for diversity. This functionality is also available in the NorthStar Planner.

## Protected Transport Links

NorthStar supports preferred protected links routing constraint for packet LSPs. When this constraint is selected, NorthStar computes the path that maximizes the number of protected links, and therefore offers the best overall protection. Protected links can be implemented by way of REST APIs or using the web UI. In the web UI, navigate to **Applications > Provision LSP**, and click the **Advanced** tab. By default, the Route on Protected IP Link option is not selected.

### Related Documentation

- [Configuring the Multilayer Feature on page 152](#)
- [Linking IP and Transport Layers on page 159](#)
- [Managing Transport Domain Data Display Options on page 160](#)

## Configuring the Multilayer Feature

This section describes transport controller configuration tasks in the web UI.

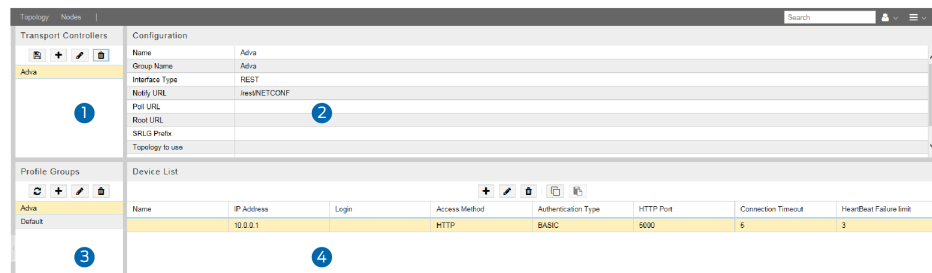


**NOTE:** Transport layer elements can be viewed in both the web UI and NorthStar Planner.

NorthStar Controller can attempt connection to multiple IP addresses (configured as multiple devices) for the same transport controller profile in a round-robin fashion, until a connection is established. Once a connection is established, the transport topology elements are added and can be displayed on the topology map. This configuration is done by way of a profile group.

Navigate to **Administration > Transport Controller** to open the Transport Controller window shown in [Figure 103 on page 152](#).

*Figure 103: Transport Controller Window*



The Transport Controller window consists of the following panes (numbers correspond to the numbers in [Figure 103 on page 152](#)):

1. Transport Controllers (upper left pane)—Lists configured transport controllers, and used to save, add, modify, and delete transport controllers.
2. Configuration (upper right pane)—Displays the properties of the transport controller selected in the Transport Controllers pane, and used to enter and modify transport controller properties.
3. Profile Groups (lower left pane)—Lists configured profile groups, and used to reload, add, modify, and delete profile groups.
4. Device List (lower right pane)—Lists the devices that are part of the profile group selected in the Profile Groups pane, and used to add, modify, delete, and copy devices.

The general configuration workflow is:




1. Create a profile group in the Profile Groups pane.
2. Select the group in the Profile Groups pane. In the Device List pane, create at least one device for the group. A group can have multiple devices.

- 3. Select (or create and select) the transport controller in the Transport Controllers pane.
- 4. In the Configuration pane for the selected transport controller, enter the requested information, including selecting the Group Name from the drop-down menu. The devices in the group are then associated with the transport controller.
- 5. Save the transport controller.

Adding or Deleting a Profile Group

The buttons across the top of the Profile Groups pane perform the functions described in [Table 33 on page 153](#).

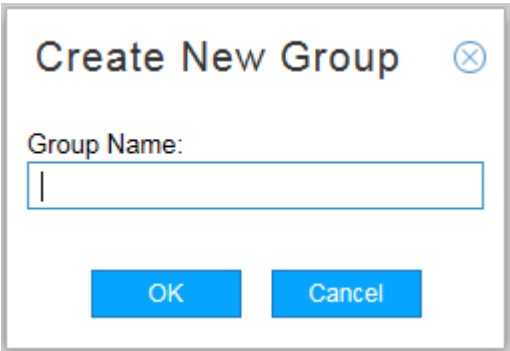
Table 33: Profile Groups Pane Button Functions

Button	Function
	Reloads the selected profile group. Used to update the device list in the UI when devices have been added using the REST API.
	Adds a new profile group.
	Deletes the selected profile group.

To create a profile group, perform the following steps:

- 1. In the Profile Groups pane (lower left pane), click the Add (+) button to display the Create New Group window. [Figure 104 on page 153](#) shows the Create New Group window that is displayed.

Figure 104: Create New Group Window






- 2. Enter a name for the new group and click **OK**.

To delete a selected group, click the Delete button, and respond to the request for confirmation.

### Adding Devices

The buttons across the top of the Device List pane perform the functions described in [Table 34 on page 154](#).

*Table 34: Device List Button Functions*

Button	Function
	Adds a new device.
	Modifies the selected device.
	Deletes the selected device.

---

To create the devices that are part of the new profile group, perform the following steps:

1. In the Device List pane (lower right pane), click the Add (+) button to display the Add New Device window as shown in [Figure 105 on page 155](#).

Figure 105: Add New Device Window

Add New Device

Device Name:

Device IP:

Login:

Password:

Access Method:

HTTP

HTTP Port:

5000

Connection Timeout:

300

Heartbeat Failure Limit:

3

Authentication Method:

BASIC

Reset

Cancel

Submit

2. Enter the requested information. Some fields are populated with default values, but you can change them. [Table 35 on page 155](#) describes the fields in the Add New Device window.

Table 35: Add New Device Window Field Descriptions

Field	Description
Device Name	Name of the device for display and reporting purposes.
Device IP (required)	The IP address used to connect to the HTTP server on the device. This address is typically provided by the vendor.
Login (required unless the authentication method is NOAUTH)	Username for basic authentication. The username must match the username configured on the server running the device being configured.
Password (required unless the authentication method is NOAUTH)	Password for basic authentication. The password must match the password configured on the server running the device being configured.

**Table 35: Add New Device Window Field Descriptions (continued)**

Field	Description
Access Method	Use the drop-down menu to select either HTTP or HTTPS. The default is HTTP.
HTTP Port	The HTTP port on the device. The default is 5000.
Connection Timeout	Number of seconds before a connection request to the device times out. The default is 300. Use the up and down arrows to increment or decrement this value or type a different value in the field.
Heartbeat Failure Limit	Number of connection retries before the device is considered down. The default is 3.
Authentication Method	Use the drop-down menu to select BASIC or NOAUTH. The default is BASIC.

[Table 36 on page 156](#) shows the fields that require specific values for particular transport controller vendors. Fields not listed are not typically vendor-specific. Confirm all values with the vendor before using them.

**Table 36: Vendor-Specific Device Field Values**

Field	ADVA	Coriant	PSM
Access Method	HTTPS	HTTP	HTTPS
HTTP Port	8080	8081	443
Authentication Method	BASIC	BASIC	BASIC

3. Click **Submit**.

4. Repeat the procedure to add all the devices for the profile group.

You can drag and drop device rows to change the order in the Device list. Changing the order in the list changes the order in which connection to the devices is attempted.



## Configuring the Transport Controller Profile

The buttons across the top of the Transport Controllers pane perform the functions described in [Table 37 on page 156](#).

**Table 37: Transport Controllers Pane Button Functions**

Button	Function
	Saves the transport controller profile.

Table 37: Transport Controllers Pane Button Functions (continued)

Button	Function
	Adds a new transport controller profile.
	Deletes the selected transport controller profile.

To configure a transport controller profile, perform the following steps:

1. In the Transport Controllers pane (upper left pane), click the Add (+) button. The default name newController is added to the Transport Controllers pane in red text (because it has not yet been saved), and is selected so you can populate the properties in the Configuration pane (upper right pane).
2. In the Configuration pane, enter the requested information. [Table 38 on page 157](#) describes the transport controller profile configuration fields and identifies the ones that are required.

Table 38: Transport Controller Configuration Fields

Field	Description
Name (required)	Name of the transport controller profile. The default name for a new profile is newController. We recommend you use the name of the vendor (ADVA, for example) as the name of the transport controller profile, so NorthStar Controller can use corresponding icons in the UI. Otherwise, it uses generic icons.
Group Name (required)	Use the drop-down menu to select a group name from those configured in the Profile Groups pane.
Interface Type (required)	Use the drop-down menu to select REST or RESTCONF. The default is REST.
Notify URL (required)	REST or RESTCONF URL on the transport controller that publishes topology change notifications.
Poll URL	The server URL used to poll server liveness. If the interface type is RESTCONF and no value is entered, NorthStar Controller uses /.well-known/host-meta by default. If the interface type is REST, you must enter a value which you obtain from the vendor.
Root URL	Default root URL for RESTCONF datastores.
SRLG Prefix	Enables separation of shared risk link group (SRLG) spaces when multiple controllers are configured. <ul style="list-style-type: none"> <li>• If a prefix is entered, the SRLG takes the form TSRLG_&lt;prefix&gt;_&lt;SRLG&gt;.</li> <li>• If no prefix is entered, the SRLG takes the form TSRLG_&lt;SRLG&gt;.</li> </ul>

**Table 38: Transport Controller Configuration Fields (continued)**

Field	Description
Topology to use	Specifies the topology to use in the event that a controller returns multiple topologies. This is your choice from the topologies provided, but there are typical topologies for each vendor. The filter is applied to the model's te-topology-id field. The field can be left empty, in which case all topologies are imported. If the value does not match a topology exported by the transport controller, no topology is shown.
Topology URL (required)	URL on the transport controller that provides the abstract topology.
Reconnect Interval	Number of seconds between reconnection attempts to the devices included in the profile group. The default is 300.

[Table 39 on page 158](#) shows the fields that require specific values for particular vendors. Confirm all values with the vendor before using them.

**Table 39: Typical Transport Controller Field Values by Vendor**

Field	ADVA	Coriant	PSM
Name	ADVA	Coriant	proNX Service Manager (PSM)
Interface Type	REST	RESTCONF	REST
Notify URL	/rest/NETCONF	/streams/NETCONF-JSON	/notify
Poll URL	/rest/data/ietf-te-topology:te-topologies-state	(None)	/health
Topology to Use	ADVA_TOPOLOGY_1	Customized_Topology_for_NorthStar_1_Demands	
Topology URL	/rest/data/ietf-te-topology:te-topologies-state	/rest/data/ietf-te-topology:te-topologies-state	/topology

- Click the Save button in the Transport Controllers pane to save the transport controller profile. The profile name turns from red to black if saved successfully. If it does not become black when you save it, double-check the data in the Configuration pane.

#### Related Documentation

- [Multilayer Feature Overview on page 149](#)
- [Linking IP and Transport Layers on page 159](#)
- [Managing Transport Domain Data Display Options on page 160](#)



## Linking IP and Transport Layers

Sometimes, when interlayer links are initially loaded into the model, only the source is known. To complete the linking of the transport layer to the IP layer, you must supply the missing remote node (node Z) information in one of the ways described in the following sections:

- [Linking the Layers Manually on page 159](#)
- [Linking the Layers Using an Open Source Script on page 160](#)

### Linking the Layers Manually

To provide the missing Node Z IP address for an interlayer link, perform the following steps:

1. Select the Link tab in the network information table of the Web UI topology window.
2. Select the link to update.
3. Click **Modify** in the bottom tool bar to display the Modify Link window shown in [Figure 106 on page 159](#).

*Figure 106: Modify Link Window*

The screenshot shows a 'Modify Link' dialog box. It has a title bar with the text 'Modify Link'. Below the title bar is a tab labeled 'Properties'. The main area of the dialog contains three input fields: 'Node A:' with a dropdown menu showing 'W2.2', 'Node Z:' with a dropdown menu showing 'W1.2', and 'IP Z:' with an empty text box. At the bottom right of the dialog are two buttons: 'Cancel' and 'Submit'.

4. In the Node Z field, use the drop-down menu to select the remote node.

5. In the IP Z field, enter the IP address for the corresponding IP link on the remote node.
6. Click **Submit**.

## Linking the Layers Using an Open Source Script

Juniper Networks provides an open source script for use in completing the configuration of interlayer links. The script is particularly useful when there are a large number of interlayer links to configure at once.

### Input File Requirements

---

The script requires an input file that identifies at least one side of each IP link. It is not necessary to include both sides of the IP links because the missing side can be determined from the transport circuits provided by the transport controller.

The text file must include just one mapping per interlayer link and must be formatted with just one mapping per line. If you are providing both sides of an IP link, use two lines, one per side.

The format of a mapping is:

***transport-node-name|transport-link-ID IP-address***

For example:

**Transport:0.1.0.5|1008001 11.112.122.2**

### Run the Script

---

The script is installed at the following location on the NorthStar Controller server:

***/opt/northstar/mlAdapter/tools/configureAccessLinks.py***

Run the script from the CLI using your username (full-access user group required), password, and input file:

***./configureAccessLinks.py --user=username --password=password input\_file\_name***

- Related Documentation**
- [Multilayer Feature Overview on page 149](#)
  - [Managing Transport Domain Data Display Options on page 160](#)

## Managing Transport Domain Data Display Options

---

Layers, types, transport circuits, transport SRLGs, and latency values can all be displayed in the web UI and the NorthStar Planner. The REST API offers the option to use protected links. This topic focuses on navigating to the display options you have in each case.

- [Displaying Layers on page 161](#)
- [Displaying Node and Link Types on page 162](#)

- [Displaying Transport Circuits and Associated IP Links on page 163](#)
- [Displaying Latency on page 163](#)
- [Displaying Transport SRLGs on page 165](#)
- [Displaying Link Protection Status on page 165](#)

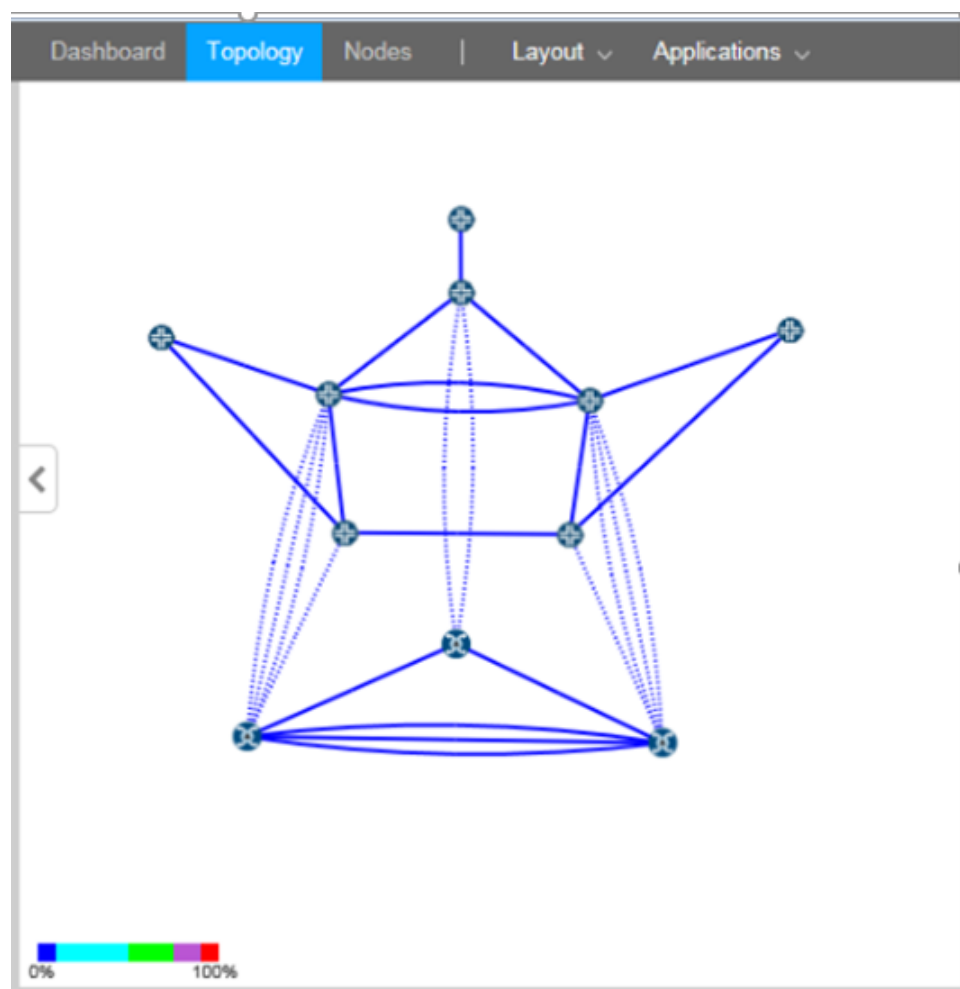
## Displaying Layers

### Displaying Layers in the Web UI

In the left pane of the topology window, select Layers from the drop-down menu to display the Layers list. The Layers list gives you the option to exclude or include individual layer information in the topology map.

The colors indicated in the Layers list are reflected in the topology map so you can distinguish the nodes belonging to the different layers. [Figure 107 on page 161](#) shows an example of a topology map that includes both IP Layer and Transport Layer elements. The dotted link lines are interlayer links.

*Figure 107: Topology with IP and Transport Layers*



## Displaying Layers in the NorthStar Planner

In the left pane of the topology map window, access advanced filters by selecting **Filters>Advanced**.

From the Advanced filters window you have the option to hide various elements on the topology map including IP layer, transport layer, and interlayer links. To hide an element, select the corresponding check box. To display an element, clear the corresponding check box.

## Displaying Node and Link Types

### Displaying Types in the Web UI

In the left pane of the Topology window, select Types from the drop-down menu to display the Types list. The list includes categories of nodes and links found in the network. Different types are associated with different icons, which are reflected in the topology map.

You can select or deselect a type by checking or clearing the corresponding check box. Only selected options are displayed in the topology map. [Figure 108 on page 162](#) shows a Types list and topology map for a network that includes an Coriant transport layer.

*Figure 108: Left Pane Types List with Transport Layer*

The screenshot shows the Juniper NorthStar Controller web UI. The 'Topology' tab is selected in the top navigation bar. On the left, the 'Types' list is expanded, showing 'Node Types' (Coriant, JUNIPER) and 'Link Types' (Interlayer, Transport). The 'Transport' link type is highlighted. The main area displays a network topology map with nodes and links. A color scale bar at the bottom indicates 0% to 100%.

Node	Link	Tunnel	SRLG	Maintenance			
Name	Status	Node A	Node Z	IP A	IP Z	Ifindex A	Ifindex Z

The network information table below the topology map in [Figure 108 on page 162](#) shows the Layer column that is available on the Links tab. The Layer column is also available

on the Node and Tunnel tabs. If you do not see the column, hover over any column heading and click the down arrow that appears. A column selection window is displayed. Select the Layers check box to include that column in the table.

### Displaying Types in the NorthStar Planner

In the Left pane of the Topology Map window, select **Filters>Types** to display categories of nodes and links that you can opt to display or hide on the topology map.

You can select or deselect a type (Interlayer, for example) by checking or clearing the corresponding check box. Only selected options are displayed in the topology map. You can also change the line color and style for a link type by clicking the line indicator next to the check box.

The Network Info table below the topology map includes tabs for L1 Links, L1 Nodes, and Interlayer Links.

If you do not see a column, click the plus sign (+) at the end of the row of column headings to display available columns. Click the column you want to display.

## Displaying Transport Circuits and Associated IP Links

Once the interlayer links are mapped, the transport paths for the corresponding IP links are known and are displayed in the UI.

### Displaying Transport Circuits in the Web UI

In the web UI, the paths are added to the network information table in the Tunnel tab. In the Layer column, they are identified as Transport. The names are the same as the corresponding IP link names.

If a selected IP link in the Link tab of the network information table has an associated transport circuit, it is automatically highlighted.

### Displaying Transport Circuits in the NorthStar Planner

In the NorthStar Planner, the paths are added to the network information table in the Tunnels tab together with normal packet tunnels. The names are the same as the corresponding IP link names. In the Type column, they are identified as L1Circuit.

Right-click an IP link in the Network Info table Tunnels tab or on the topology map to access the option to display the L1 circuit path if there is an associated transport circuit.

## Displaying Latency

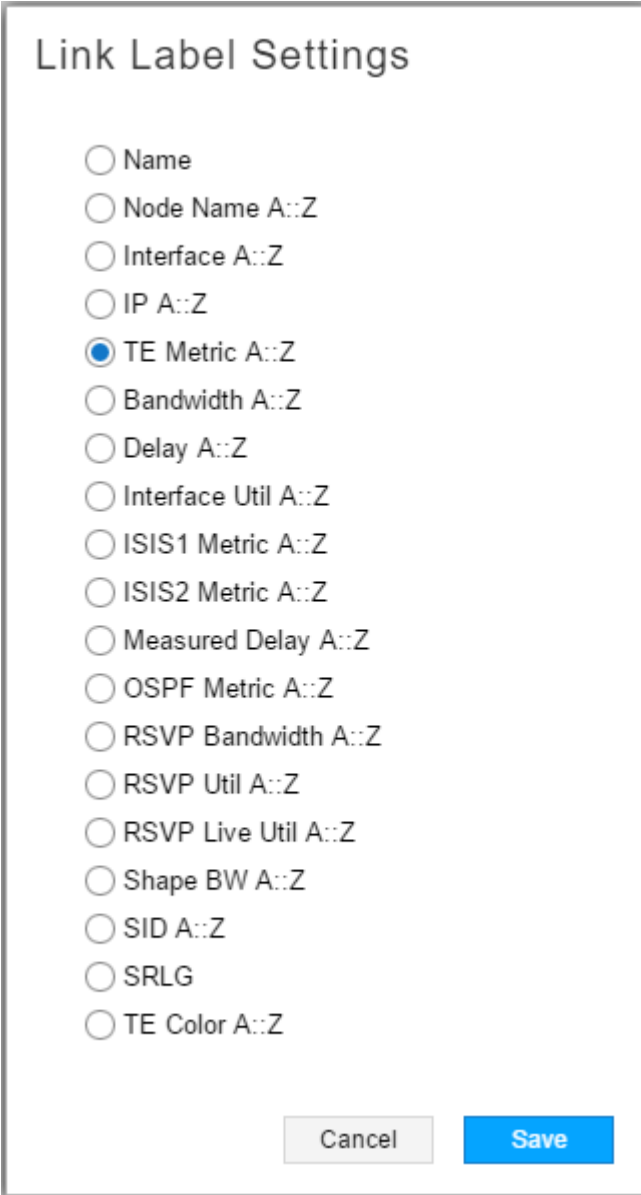
### Displaying Latency in the Web UI

Through the Link Label Settings window, you can opt to display latency on the topology map. Perform the following steps:

1. In the left pane of the Topology window, click **Options**. Select the Show Link Labels check box.

2. In the Settings drop-down menu at the bottom of the pane, select **Configure Link Label** to display the Link Label Settings window shown in [Figure 109 on page 164](#).

Figure 109: Link Label Settings

A dialog box titled "Link Label Settings" with a list of radio button options. The options are: Name, Node Name A::Z, Interface A::Z, IP A::Z, TE Metric A::Z (selected), Bandwidth A::Z, Delay A::Z, Interface Util A::Z, ISIS1 Metric A::Z, ISIS2 Metric A::Z, Measured Delay A::Z, OSPF Metric A::Z, RSVP Bandwidth A::Z, RSVP Util A::Z, RSVP Live Util A::Z, Shape BW A::Z, SID A::Z, SRLG, and TE Color A::Z. At the bottom right are "Cancel" and "Save" buttons.

Link Label Settings

- ☐ Name
- ☐ Node Name A::Z
- ☐ Interface A::Z
- ☐ IP A::Z
- ☒ TE Metric A::Z
- ☐ Bandwidth A::Z
- ☐ Delay A::Z
- ☐ Interface Util A::Z
- ☐ ISIS1 Metric A::Z
- ☐ ISIS2 Metric A::Z
- ☐ Measured Delay A::Z
- ☐ OSPF Metric A::Z
- ☐ RSVP Bandwidth A::Z
- ☐ RSVP Util A::Z
- ☐ RSVP Live Util A::Z
- ☐ Shape BW A::Z
- ☐ SID A::Z
- ☐ SRLG
- ☐ TE Color A::Z

Cancel Save

3. Select **Delay A-Z**. Click **Save**.

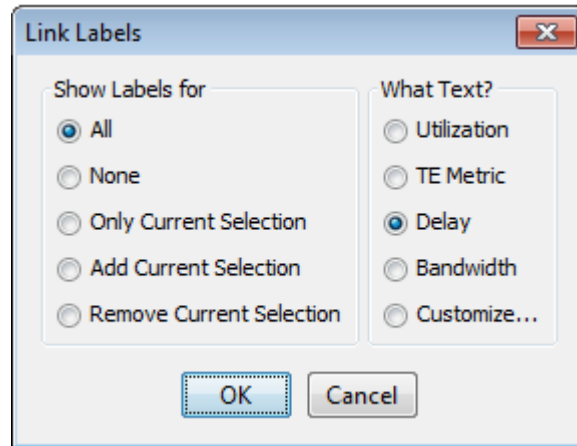
The topology map displays the latency values for each link in the form delayA-delayZ (252-252, for example), in milliseconds. In the Link tab of the network information table, the Delay A and Delay Z columns also display these latency values.

### Displaying Latency in the NorthStar Planner

Through the Link Labels window, you can opt to display latency on the topology map. Perform the following steps:

1. Right-click in the topology map window and navigate to **Labels>Link Labels**. The Link Labels window is displayed as shown in [Figure 110 on page 165](#).

*Figure 110: Link Labels Window*



2. In the “What Text?” column, select **Delay** and click **OK**.

The topology map displays the latency values for each link in the form delayA-delayZ (252-252, for example).

### Displaying Transport SRLGs

Displaying SRLG information is the same in both the web UI and the Network Planner. Click the SRLG tab in the network information table to display all SRLGs, including transport SRLGs. Transport SRLGs have names beginning with TSRLG by default. For example, TSRLG\_4. If you configured an optional prefix extension in the transport controller profile (to help prevent range overlap), that is also displayed in the Name column. For example, TSRLG\_Coriant\_4.

When you select an SRLG, all links in all layers in the group are highlighted in the topology map.

In the web UI, you can also use the Link Label settings window shown in [Figure 109 on page 164](#) to specify that transport SRLGs are to be displayed on the topology map as link labels.

### Displaying Link Protection Status

#### Displaying Link Protection Status in the web UI

In the network information table, you can display a column that shows the protection status of transport and IP layer links. Perform the following steps:

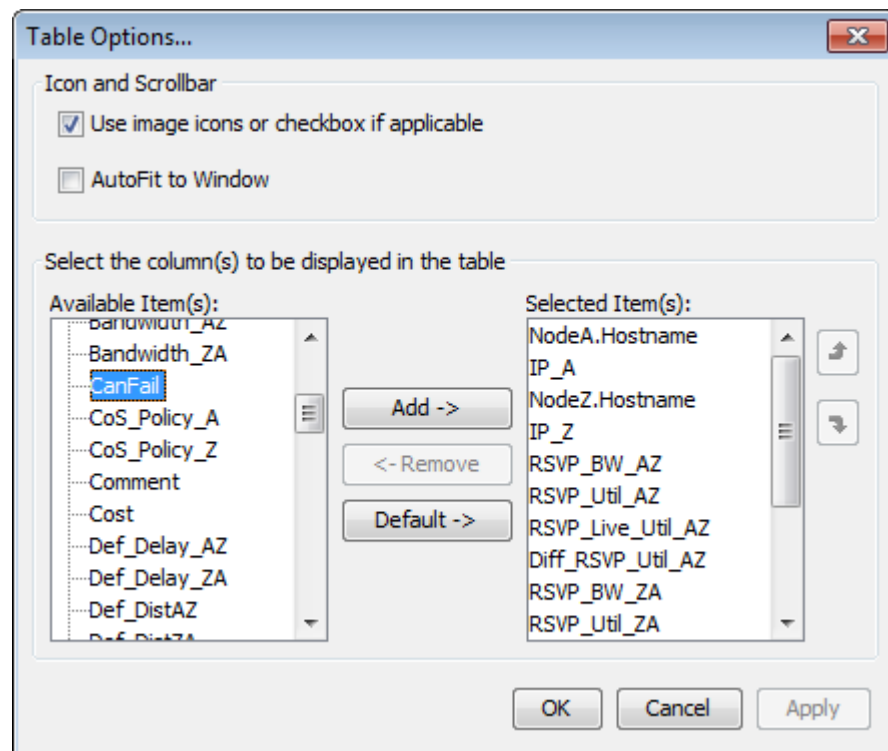
1. Select the Link tab in the network information table.
2. Click the down arrow in any column heading, and select **Columns**.
3. Click the checkbox beside Protected.
4. You can then manually change the protection status of any link by selecting the link and clicking **Modify** at the bottom of the table. Click in the Protected checkbox to select or deselect protected status. Protected links are highlighted in the topology map.

### Displaying Link Protection Status in the NorthStar Planner

In the NorthStar Planner network information table, you can view the protection status of transport as well as IP layer links. Perform the following steps:

1. In the network information table, select the Links or L1Links tab.
2. Right-click in any column heading and select **Table Options** to display the Table Options window shown in [Figure 111](#) on page 166.

Figure 111: Table Options Window





3. On the left side, select **CanFail** and click **Add** to add the column to the display.
4. By default, links are set to CanFail=yes, and the corresponding check boxes are selected. If the transport controller indicates that a link is protected, NorthStar Controller clears the check box for that link, making it protected.

The option to display the link protection status is not available in the web UI.

The REST API offers the ability to use a protected link, which suspends the link's protected status.

**Related  
Documentation**

- [Multilayer Feature Overview on page 149](#)
- [Configuring the Multilayer Feature on page 152](#)
- [Linking IP and Transport Layers on page 159](#)



## CHAPTER 7

# High Availability

- [High Availability Overview on page 169](#)

## High Availability Overview

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High Availability (HA) on NorthStar Controller is an active/standby solution. That means that there is only one active node at a time, with all other nodes in the cluster serving as standby nodes. All of the nodes in a cluster must be on the same subnet for HA to support virtual IP (VIP). On the active node, all processes are running. On the standby nodes, those processes required to maintain connectivity are running, but NorthStar processes are in a stopped state. If the active node experiences a hardware- or software-related connectivity failure, the NorthStar HA\_agent process elects a new active node from amongst the standby nodes. Complete failover is achieved within five minutes. One of the factors in the selection of the new active node is the user-configured priorities of the candidate nodes.

All processes are started on the new active node, and the node configures the virtual IP address based on the user configuration (via `net_setup.py`). The virtual IP can be used for client-facing interfaces as well as for PCEP sessions.

- [Failure Scenarios on page 169](#)
- [Failover and the NorthStar Controller User Interfaces on page 170](#)
- [Support for Multiple Network-Facing Interfaces on page 170](#)
- [LSP Discrepancy Report on page 170](#)
- [Cluster Configuration on page 171](#)
- [Ports that Must be Allowed by External Firewalls on page 171](#)

## Failure Scenarios

NorthStar Controller HA protects the network from the following failure scenarios:

- Hardware failures (server power outage, server network-facing interfaces, or network-facing Ethernet cable failure)
- Operating system failures (server operating system reboot, server operating system not responding)
- Software failures (failure of any process running on the active server when it is unable to recover locally)

## Failover and the NorthStar Controller User Interfaces

If failover occurs while you are working in the NorthStar Controller Java Planner client, the client is disconnected and you must re-launch NorthStar Controller using the client-facing interface virtual IP address.



**NOTE:** If the server has only one interface or if you only want to use one interface, the network-facing interface is then also the client-facing interface.

The Web UI also loses connectivity upon failover, requiring you to log in again.

## Support for Multiple Network-Facing Interfaces

Up to five network-facing interfaces are supported for High Availability (HA) deployments, one of which you designate as the cluster communication (Zookeeper) interface. The `net_setup.py` utility allows configuration of the monitored interfaces in both the host configuration (Host interfaces 1 through 5), and JunosVM configuration (JunosVM interfaces 1 through 5). In HA Setup, `net_setup.py` enables configuration of all the interfaces on each of the nodes in the HA cluster.

The `ha_agent` sends probes using ICMP packets (ping) to remote cluster endpoints (including the Zookeeper interface) to monitor the connectivity of the interfaces. If the packet is not received within the timeout period, the neighbor is declared unreachable. The `ha_agent` updates Zookeeper on any interface status changes and propagates that information across the cluster. You can configure the interval and timeout values for the cluster in the HA setup script. Default values are 10 seconds and 30 seconds, respectively.

Also in the HA setup utility is an option to configure whether switchover is to be allowed for each interface.

For nested VM configurations, you may need to modify `supervisord-junos.sh` to support the additional interfaces for `junosVM`.

## LSP Discrepancy Report

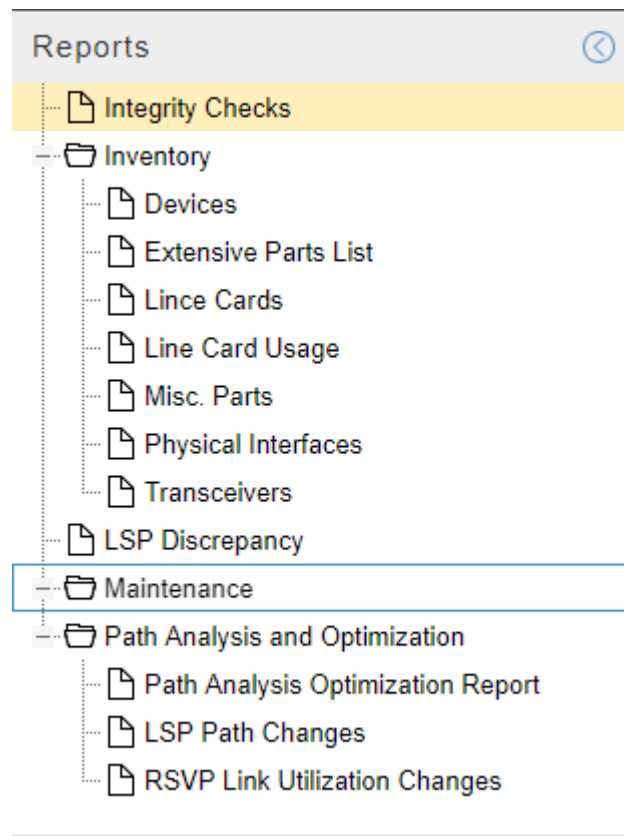
During an HA switchover, the PCS server performs LSP reconciliation. The reconciliation produces the LSP discrepancy report which identifies LSPs that the PCS server has discovered might require re-provisioning.



**NOTE:** Only PCC-initiated and PCC-delegated LSPs are included in the report.

Access the report by navigating to **Applications > Reports**. [Figure 112 on page 171](#) shows a list of available reports, including the LSP Discrepancy report.

Figure 112: Reports List Available from Applications &gt; Reports



## Cluster Configuration

The NorthStar implementation of HA requires that the cluster have a quorum, or majority, of voters. This is to prevent “split brain” when the nodes are partitioned due to failure. In a five-node cluster, HA can tolerate two node failures because the remaining three nodes can still form a simple majority. The minimum number of nodes in a cluster is three.

There is an option within the NorthStar Controller setup utility for configuring an HA cluster. First, configure the standalone servers; then configure the cluster. See *Configuring a NorthStar Cluster for High Availability* in the *NorthStar Controller Getting Started Guide* for step-by-step cluster configuration instructions.

## Ports that Must be Allowed by External Firewalls

Among the ports used by NorthStar, there are a number that must be allowed by external firewalls in order for NorthStar Controller servers to communicate. See *NorthStar Controller System Requirements* in the *NorthStar Controller Getting Started Guide* for a list of ports used by NorthStar Controller that must be allowed by external firewalls. The ports with the word **cluster** in their purpose descriptions pertain specifically to HA configuration.



## CHAPTER 8

# System Monitoring

- Dashboard Overview on page 173
- Logs on page 175

## Dashboard Overview

The Dashboard view is shown in [Figure 113 on page 173](#). The Dashboard presents a variety of status and statistics information related to the network, in a collection of widgets that you can arrange according to your preference. The information displayed is read-only.

*Figure 113: Dashboard Widgets, Not All Showing the Same Network*

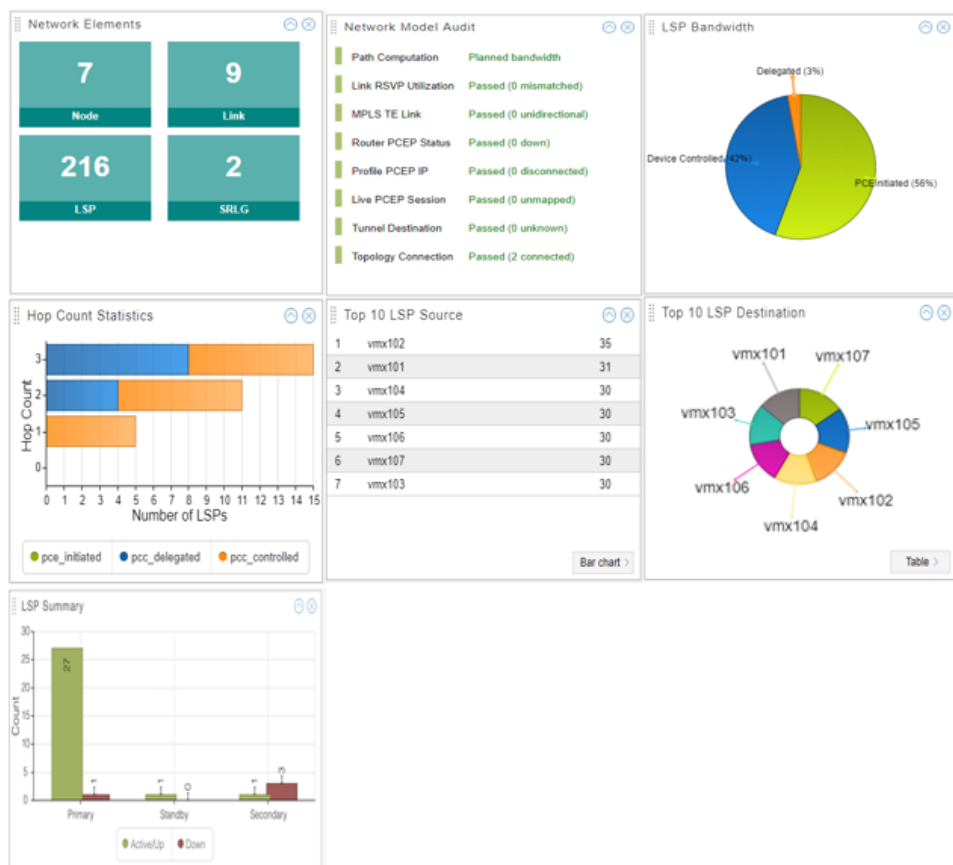


Table 40 on page 174 describes the available dashboard widgets.

**Table 40: Widgets Available in the Dashboard**

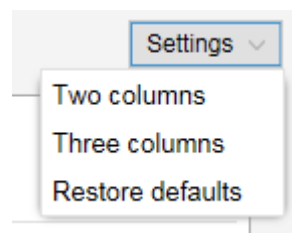
Widget	Description
Network Elements	Summation of the elements (nodes, links, LSPs, SRLGs) in the model, computed from the client. If the values differ from the information reported in the Network Status (left pane) or in the network information table, it is because they have different sources of data for the calculations and different rates of synchronizing to the client.
Network Model Audit	Periodically polls for status. This is a troubleshooting tool.
LSP Bandwidth	Pie chart showing the percentage of the total LSP bandwidth that is accounted for by each LSP type (PCE-initiated, PCC-delegated, PCC-controlled).
Hop Count Statistics	Aggregates the number of LSPs by hop count, per LSP type (PCE-initiated, PCC-delegated, PCC-controlled). In other words, it shows the number of LSPs of each type with three hops, with two hops, and so on. The LSP types are color coded according to the key at the bottom. Click an LSP type in the key to toggle between hiding and un hiding the LSP type. Mouse over the color bar to see the count.
Top 10 LSP Source	Top 10 routers that have LSPs originating there, and the number of originating LSPs. Click the button in the lower right corner to toggle between table, bar chart, and pie chart representation.
To 10 LSP Destination	Top 10 routers that have LSPs terminating there, and the number of terminating LSPs. Click the button in the lower right corner to toggle between table, bar chart, and pie chart representation.
LSP Summary	Number of active, standby, and secondary LSPs that are Up and Down.

The dashboard offers the following options for customizing the arrangement of widgets:

- The Settings drop-down menu in the upper right corner of the Dashboard view allows you to change the number of widget columns.

As shown in Figure 114 on page 174, you can select either **Two columns** or **Three columns**.

**Figure 114: Dashboard Settings Menu**



- Minimize a widget by clicking on the up arrow in the upper right corner of the widget.
- Close a widget by clicking on the X in the upper right corner of the widget.



- Drag and drop widgets to relocate them on the dashboard.
- From the Settings drop-down menu in the upper right corner of the dashboard, select **Restore defaults** to return all the widgets to the original display arrangement.

## Logs

Navigate to **Administration > Logs** to view a list of the available NorthStar logs. Click any log name to display the contents of the log itself.

Figure 115 on page 175 shows a sample list of logs.

Figure 115: List of Logs

File	Size	Last Modified Time
<a href="#">archives</a>	4.10K	2016-01-12 13:21
<a href="#">cassandra.msg</a>	498.23K	2016-01-29 09:04
<a href="#">cassandra.msg.1</a>	1.05M	2016-01-21 07:45
<a href="#">event_listener.log</a>	230.75K	2016-01-29 09:48
<a href="#">event_listener.log.1</a>	1.05M	2016-01-29 07:18
<a href="#">event_listener.log.10</a>	1.05M	2016-01-14 05:01
<a href="#">event_listener.log.2</a>	1.05M	2016-01-27 14:25
<a href="#">event_listener.log.3</a>	1.05M	2016-01-25 20:30
<a href="#">event_listener.log.4</a>	1.05M	2016-01-24 02:35
<a href="#">event_listener.log.5</a>	1.05M	2016-01-22 09:04
<a href="#">event_listener.log.6</a>	1.05M	2016-01-20 19:57
<a href="#">event_listener.log.7</a>	1.05M	2016-01-19 02:35
<a href="#">event_listener.log.8</a>	1.05M	2016-01-17 08:39
<a href="#">event_listener.log.9</a>	1.05M	2016-01-15 14:44
<a href="#">ha_agent.msg</a>	107.22K	2016-01-29 08:10
<a href="#">haproxy.log</a>	2.95M	2016-01-29 09:47
<a href="#">haproxy.msg</a>	4.73K	2016-01-29 08:06
<a href="#">junosvm.msg</a>	78.17K	2016-01-29 08:10
<a href="#">keepalived_api.log</a>	8.99K	2016-01-29 08:10
<a href="#">keepalived.msg</a>	10.06K	2016-01-29 08:10
<a href="#">mlAdapter.log</a>	50.79K	2016-01-29 08:10
<a href="#">mlAdapter.msg</a>	16.39K	2016-01-29 08:07
<a href="#">net_setup.log</a>	43.17K	2016-01-29 09:12
<a href="#">nodejs.msg</a>	41.61K	2016-01-29 09:48
<a href="#">nodejs.msg.1</a>	1.05M	2016-01-29 09:34
<a href="#">nodejs.msg.2</a>	1.05M	2016-01-26 09:30
<a href="#">nodejs.msg.3</a>	1.05M	2016-01-22 12:28

Hover over any column heading and click the down arrow that appears to view sorting and column selection options. Figure 116 on page 176 shows an example of sorting and column selection options.

Figure 116: Sorting and Column Selection Options

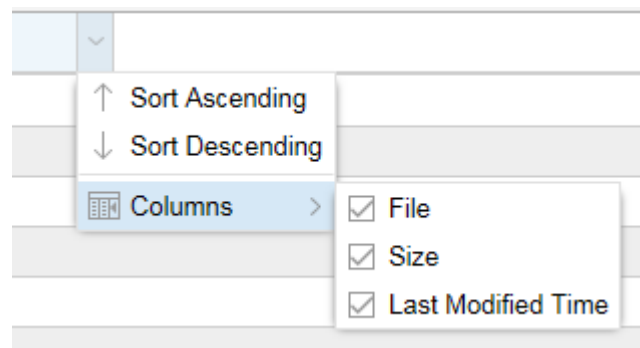
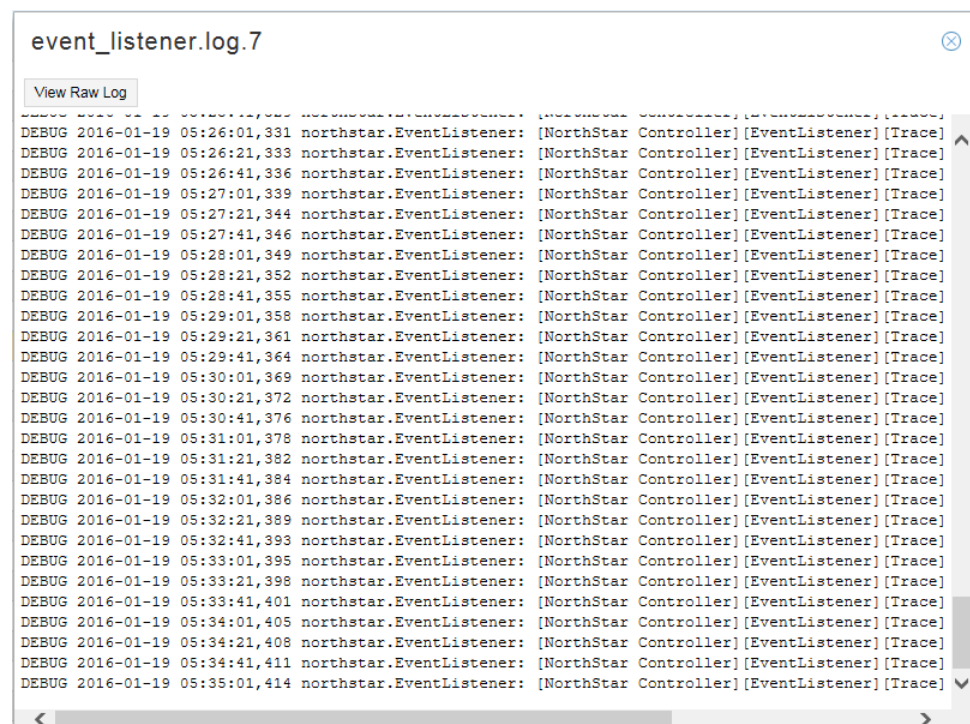


Figure 117 on page 176 shows a sample log.

Figure 117: Sample Log



Click **View Raw Log** in the upper left corner to view the log in a new browser window or tab. This enables you to keep the log viewable while you perform other actions in NorthStar Controller.

Logs are typically used by system administrators and for troubleshooting purposes.

## CHAPTER 9

# Network Monitoring

- [System Health on page 177](#)
- [Event View on page 178](#)
- [Viewing Link Event Changes on page 180](#)
- [NorthStar REST API Notifications on page 182](#)
- [Reports Overview on page 185](#)
- [Navigating in Nodes View on page 187](#)

## System Health

---

NorthStar System Health enhances health monitoring functionality in the areas of process, server, connectivity (topology and PCEP), license monitoring, and the monitoring of distributed analytics collectors in an HA environment.

- NorthStar Controller licenses are inspected to determine validity. When a login is attempted on a license that is not valid, a license upload page is presented to the user.
- You can display cluster, data collector, and connectivity status information by navigating to **Administration > System Health**. For HA cluster environments, you can view the process status of all processes in all cluster members. Both BGP-LS and ISIS/OSPF peering statuses are also available.



**NOTE:** Hover over any column heading and click the down arrow that appears to view sorting and column selection options.

- Critical health monitoring information is pushed to a web UI banner that appears above the Juniper Networks logo. Conditions that are considered critical include expiring license, disk utilization exceeds threshold, and a server time difference of more than 60 seconds between application servers in an HA cluster.

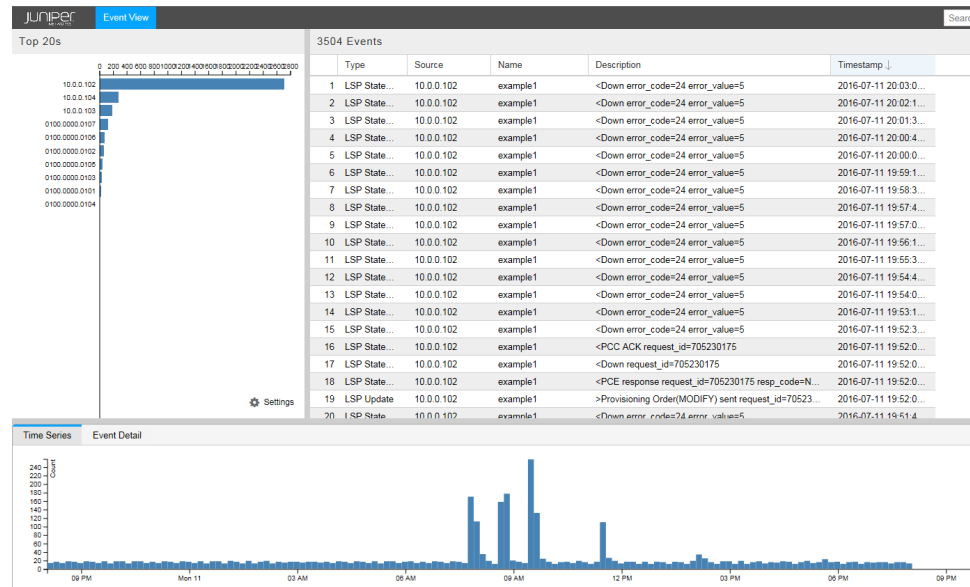


**NOTE:** The health monitor does not enable NorthStar Controller to take any corrective action regarding these notices. Its responsibility is to monitor and report so the user can respond as appropriate.

## Event View

The Event View opens in a new browser window or tab when you navigate to **Applications > Event View**. [Figure 118 on page 178](#) shows the Event View.

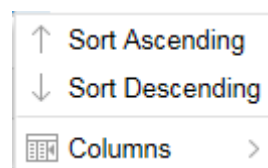
**Figure 118: Event View**



The event data displayed in the Event View is stored in the database. The number of events depends on the NorthStar configuration.

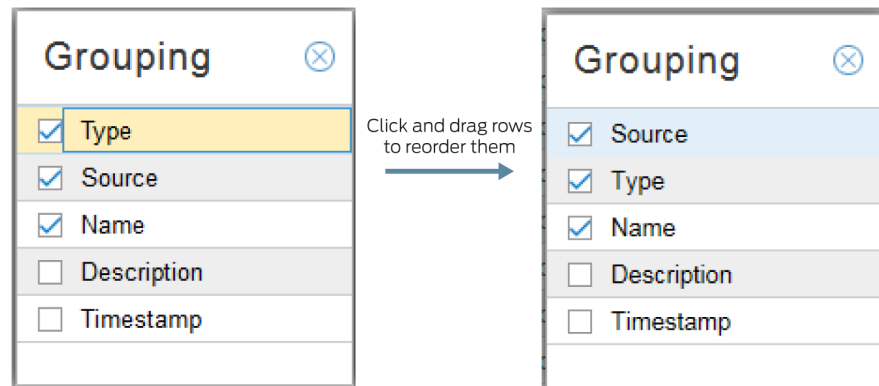
In the upper right pane of the view is a table of events, listed in chronologically descending order by default. You can change the order by using the sort options available when you hover over any column heading and click in the down arrow that is displayed. You can sort by any column, in ascending or descending order. You can also select the columns you want to display. [Figure 119 on page 178](#) shows the options displayed when you hover over a column heading and click the down arrow.

**Figure 119: Event View Sorting and Column Display Options**



In the upper left pane is a grouping bar chart. By clicking on the Settings menu in the lower right corner of the pane, you can select the groupings you want to include. Click and drag groupings to reorder them as shown in [Figure 120 on page 179](#).

Figure 120: Event View Bar Chart Settings



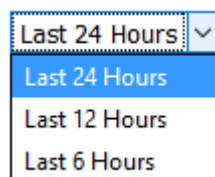
On the bar chart, any blue bar can be broken down further until you drill down to the lowest level, which is portrayed by a gray bar. Click a blue bar to drill down to the next level. To go back to a previous level, click empty space below the bar chart.

For example, if the Settings menu has Source, Type, and Name selected, in that order, the first bar chart display has events grouped by Source. If you click the bar representing the events for one source, the display refreshes to show all the events for that source grouped by Type, which is the next grouping in the menu. If you then click the bar representing the events for one type, the display refreshes again, showing all the events for that source and type, grouped by name, and those bars are gray.

Each time the bar chart refreshes, the table of events refreshes accordingly.

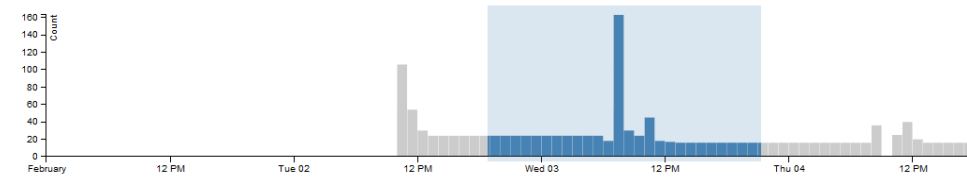
In the pane at the bottom of the view is a timeline that shows the number of events on the vertical axis and time on the horizontal axis. You can select the time span displayed by opening the drop-down menu in the upper right corner of the pane as shown in [Figure 121 on page 179](#).

Figure 121: Event View Time Span Options



You can also left-click and drag in the timeline to highlight a discrete period of time. The event table and bar chart panes refresh to display only the events included in the time frame you selected. [Figure 122 on page 180](#) shows a selected period of time in the timeline.

Figure 122: Event View Timeline Partial Selection



**Related Documentation**

- [Dashboard Overview on page 173](#)

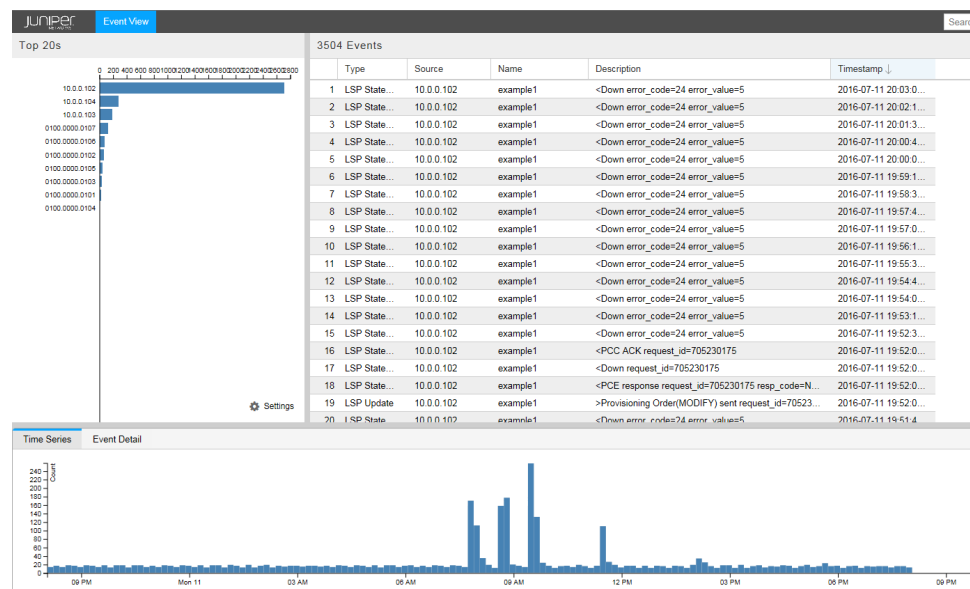
## Viewing Link Event Changes

To identify the root cause of frequent LSP changes or flaps, you can view changes to the link that the LSP traverses that occurred during the time period of the LSP changes. The NorthStar Controller records all the link events and allows you to query on those link changes (such as operational status and bandwidth) over any specified time period.

All link events are stored in the database. However, to display all raw events would result in an excess of unnecessary information for NorthStar Controller users. To avoid this situation, the Path Computation Server (PCS) processes the link events and displays only the events that trigger actual link changes. You can view these link change entries in the Event View that opens as a separate browser window or tab.

The Event View opens in a new browser window or tab when you navigate to **Applications>Event View**. Figure 123 on page 180 shows the Event View.

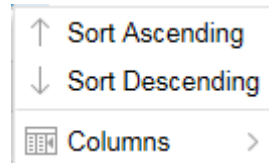
Figure 123: Event View



The event data displayed in the Event View is stored in the database. The number of events depends on the NorthStar configuration.

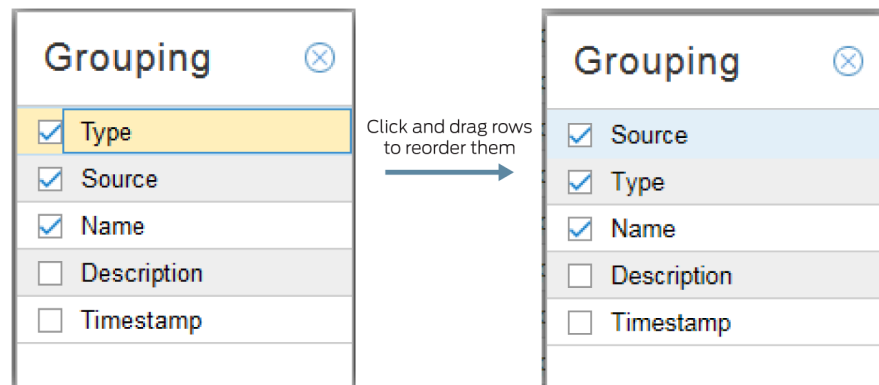
In the upper right pane of the view is a table of events, listed in chronologically descending order by default. You can change the order by using the sort options available when you hover over any column heading and click in the down arrow that is displayed. You can sort by any column, in ascending or descending order. You can also select the columns you want to display. [Figure 124 on page 181](#) shows the options displayed when you hover over a column heading and click the down arrow.

*Figure 124: Event View Sorting and Column Display Options*



In the upper left pane is a grouping bar chart. By clicking on the Settings menu in the lower right corner of the pane, you can select the groupings you want to include. Click and drag groupings to reorder them as shown in [Figure 125 on page 181](#).

*Figure 125: Event View Bar Chart Settings*



On the bar chart, any blue bar can be broken down further until you drill down to the lowest level, which is portrayed by a gray bar. Click a blue bar to drill down to the next level. To go back to a previous level, click empty space below the bar chart.

For example, if the Settings menu has Source, Type, and Name selected, in that order, the first bar chart display has events grouped by Source. If you click the bar representing the events for one source, the display refreshes to show all the events for that source grouped by Type, which is the next grouping in the menu. If you then click the bar representing the events for one type, the display refreshes again, showing all the events for that source and type, grouped by name, and those bars are gray.

Each time the bar chart refreshes, the table of events refreshes accordingly.

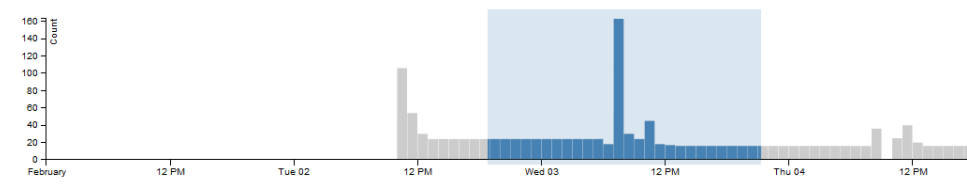
In the pane at the bottom of the view is a timeline that shows the number of events on the vertical axis and time on the horizontal axis. You can select the time span displayed by opening the drop-down menu in the upper right corner of the pane as shown in [Figure 126 on page 182](#).

Figure 126: Event View Time Span Options



You can also left-click and drag in the timeline to highlight a discrete period of time. The event table and bar chart panes refresh to display only the events included in the time frame you selected. [Figure 127 on page 182](#) shows a selected period of time in the timeline.

Figure 127: Event View Timeline Partial Selection



## NorthStar REST API Notifications

This feature allows third-party applications to receive NorthStar Controller event notifications by subscribing to the NorthStar REST API push notification service. The notifications are pushed by way of the socket.io interface. The following event types are included:

- Node (nodeEvent)
- Link (linkEvent)
- LSP (lspEvent)
- P2MP (p2mpEvent)
- Facility (facilityEvent)
- HA (haEvent)

[Table 41 on page 182](#) lists the schema for each of these event notification types.

Table 41: NorthStar Event Notification Types

Event Type	Schema	Description
nodeEvent	topology_v2.json#/definitions/nodeNotification	Node event notification.
linkEvent	topology_v2.json#/definitions/linkNotification	Link event notification.
lspEvent	topology_v2.json#/definitions/lspNotification	LSP event notification.
p2mpEvent	topology_v2.json#/definitions/p2mpGroupNotification	P2MP group event notification. The LSPs in the update are reduced to their lspIndex values to reduce the size of the event.
facilityEvent	topology_v2.json#/definitions/facilityNotification	Facility/SRLG event notification.



Table 41: NorthStar Event Notification Types (continued)

Event Type	Schema	Description
haEvent	topology_v2.json#/definitions/haHostNotification	Node state event notification. Only update (no add or remove) events are supported. The notification does not include the list of processes and only contains operational information.
healthEvent	topology_v2.json#/definitions/healthThresholdNotification	Node health event notification. Only update (no add or remove) events are supported. The notifications include utilization of CPU, disk, memory that exceed certain threshold, and processes status.

## Examples



**NOTE:** The following examples are written in Python. Lines preceded by # are comments.

To ensure secure access, a third party application must be authenticated before it can receive NorthStar event notifications. Use the NorthStar OAuth2 authentication API to obtain a token for authentication purposes. The token allows subscription to the socket.io channel. The following example shows connecting to NorthStar and requesting a token.

```
#!/usr/bin/env python
import requests,json,sys
serverURL = 'https://northstar.example.net'
username = 'user'
password = 'password'
# use NorthStar OAuth2 authentication API to get a token
payload = {'grant_type': 'password','username': username,'password': password}
r = requests.post(serverURL +
':8443/oauth2/token',data=payload,verify=False,auth=(username, password)) data
=r.json()
if "token_type" not in data or "access_token" not in data:
    print "Error: Invalid credentials"
    sys.exit(1)
# The following header needs to be passed on all subsequent request to REST
or Notifications
auth_headers= {'Authorization': "{token_type} {access_token}".format(**data)}
```

The following example retrieves the NorthStar topology nodes and links.

```
#!/usr/bin/env python
import requests,json,sys
serverURL = 'https://northstar.example.net'
# auth_headers : see Authentication Token retrieval
data = requests.get(serverURL +
':8443/NorthStar/API/v2/tenant/1/topology/1/',verify=False,headers=auth_headers)

topology=data.json()
```

The following example subscribes to the NorthStar REST API push notification service.

```
#!/usr/bin/env python
from socketIO_client import SocketIO, BaseNamespace
serverURL = 'https://northstar.example.net'
class NSNotificationNamespace(BaseNamespace):
    def on_connect(self):
        print('Connected to %s:8443/restNotifications-v2'%serverURL)
    def on_event(key,name,data):
        print "NorthStar Event: %r,data:%r"%(name,json.dumps(data))
# auth_headers : see Authentication Token retrieval
socketIO = SocketIO(serverURL, 8443,verify=False,headers= auth_headers)
ns = socketIO.define(NSNotificationNamespace, '/restNotifications-v2')
socketIO.wait()
```

## Reports Overview

Navigate to **Applications>Reports** to access the reports described in [Table 42 on page 185](#).



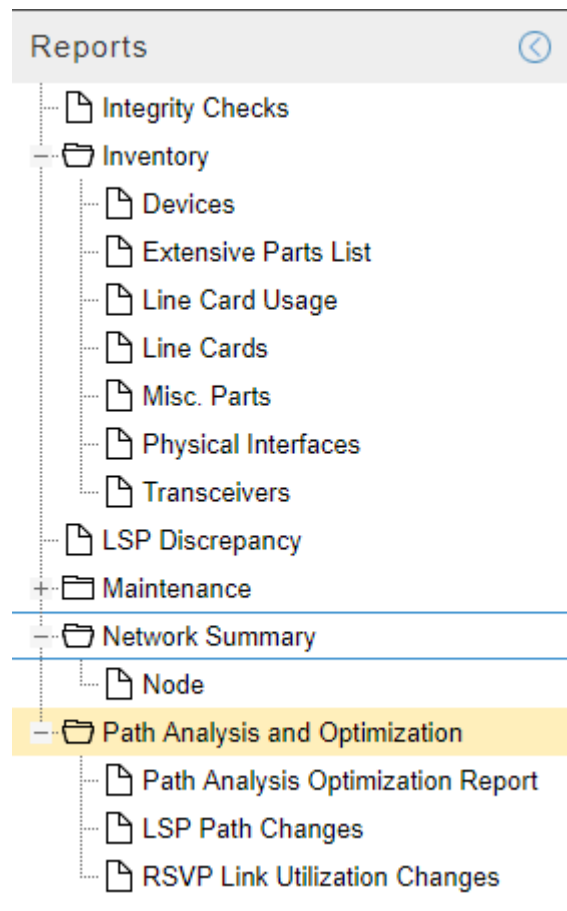
**NOTE:** Click the Help icon (question mark) in the upper right corner of the NorthStar window to display more information about the selected report.

**Table 42: Available Reports**

Report	Source
Demand Reports	Generated when you run a Demand Reports Collection task. You select the specific reports you want to generate when you schedule the collection task.
Integrity Checks	Generated when you run the Netconf Collection task and select configuration data as a collection option.  <b>NOTE:</b> You must run a collection to generate a network archive for this report to be available.
Inventory	Generated when you run the Netconf Collection task and select equipment CLI data as a collection option.  <b>NOTE:</b> You must run a collection to generate a network archive for this report to be available.
LSP Discrepancy	During an HA switchover, the PCS server performs LSP reconciliation and produces the LSP discrepancy report. This report identifies LSPs that the PCS server has discovered might require re-provisioning.
Maintenance	Generated when you use the Simulate Maintenance Event function.
Network Summary	Updated summary of network elements. One report is currently available in this category, called Nodes. It displays counts of LSPs that start, end, or transit through each node in the topology.
Path Analysis and Optimization	Generated when you use the Analyze Now function for path optimization.  <b>NOTE:</b> PCC-controlled LSPs are not included in the reports because NorthStar does not attempt to optimize PCC-Controlled LSPs.  <ul style="list-style-type: none"> <li>• Path Analysis Optimization Report: lists LSPs that are currently not in an optimized path, suggests what the optimized paths should be, and provides data about what could be gained (in terms of delay, metric, distance, and so on) if the LSP were to be optimized.</li> <li>• LSP Path Changes: lists changes to PCE-initiated and PCC-delegated LSPs as a result of analysis.</li> <li>• RSVP Link Utilization Changes: lists the changes in Link RSVP bandwidth reservation if all LSPs were to be routed over their optimized paths instead of their current paths.</li> </ul>

[Figure 128 on page 186](#) shows the Reports menu.

Figure 128: Reports Menu



Report details are displayed in a pane to the right of the menu when you click an individual report in the menu. Click the Help icon (question mark) in the upper right corner of the report details pane to display a description of the report.

In the Integrity Check report, you can right-click a line in the report and select **Show Config** to bring up the Configuration Viewer.

At the bottom of the Reports window, click the export icon to export the report to a CSV file.

#### Related Documentation

- [Maintenance Events on page 139](#)
- [Configuration Viewer on page 42](#)
- [Scheduling Device Collection for Analytics via Netconf on page 202](#)
- [Collection Tasks to Create Network Archives on page 240](#)
- [High Availability Overview on page 169](#)
- [Path Optimization on page 123](#)

## Navigating in Nodes View

The Nodes view displays detailed information about the nodes in the network. With this view, you can see node details, tunnel and interface summaries, and groupings, all in one place.

Figure 129 on page 187 shows the Nodes view.

*Figure 129: Web User Interface Nodes View*

The screenshot shows the Juniper NorthStar Controller Web User Interface. The top navigation bar includes 'Juniper', 'NorthStar Controller', 'Dashboard', 'Topology', 'Nodes' (selected), and 'Tunnels'. The left sidebar shows a list of nodes: ios-xr8, ios-xr9, vmx101, vmx102 (selected), vmx103, vmx104, vmx105, vmx106, vmx107, and vrr. The main panel displays details for the selected node, vmx102:

Hostname:	vmx102
IPv4 Address:	11.0.0.102
Mgmt IP Addr:	10.49.163.16
AS:	11
ISIS Area:	490011
ISIS System ID:	0110.0000.0102

Below the details are two tables: '4 Tunnels' and '20 Interfaces'.

Name	Node Z	Bandwidth	Control Type	Path Type	Controller Status	Traffic(bps)	Traffic(pps)	Op Status
Silver-102-...	vmx101	0	Delegated	primary				Active
Silver-102-...	vmx103	0	Delegated	primary				Active
Silver-102-...	vmx104	0	Delegated	primary				Active
rsvp-102-105	vmx105	0	PCC Contr...	primary				Active

The Nodes view is divided into three panes:

- Nodes list on the far left—Lists all nodes in the topology, including any node groups. Click a node to select it. Click the plus (+) or minus (-) sign next to a group to expand or collapse the list of nodes within the group.
- Detailed node information to the right of the Nodes list—Shows detailed information for the node selected in the Nodes list.
- Tunnels and Interfaces tables on the bottom of the display—Lists all the tunnels and interfaces that start at the selected node, along with their properties. Mouse over any column heading and click the down arrow to select or deselect columns. Sorting and filtering options are also available.

### Related Documentation

- [Topology View Overview on page 27](#)



## CHAPTER 10

# Data Collection and Analytics

- [NorthStar Analytics Data Retention Policy on page 189](#)
- [Device Profile and Connectivity Testing on page 190](#)
- [Scheduling Device Collection for Analytics via Netconf on page 202](#)
- [Viewing Analytics Data in the Web UI on page 210](#)
- [Netconf Persistence on page 218](#)
- [Data Collection via SNMP on page 220](#)
- [Link Latency Collection on page 227](#)
- [LDP Traffic Collection on page 232](#)
- [Collection Tasks to Create Network Archives on page 240](#)
- [LSP Routing Behavior on page 244](#)

### NorthStar Analytics Data Retention Policy

---

The two parameters described in [Table 43 on page 189](#) work together to control how long collection logs remain in the elasticsearch database. Both parameters are located in `/opt/northstar/data/northstar.cfg`, and both are user-configurable.

*Table 43: Data Retention Policy Parameters*

Parameter	Description
collection_cleanup_task_interval	Controls how often the collector-utils.py utility is called upon to clean up old logs. The default is one day (1d). The collector-utils.py utility runs at approximately 1:00 AM, NorthStar server time.  Units can be hours (h), days (d), or weeks (w).
es_log_retention_days	Defines what is considered an “old log”. The default is 90 days. This can be expressed only in days, so no unit designation is required.

The collector-utils.py utility uses the elasticsearch APIs to clean up logs older than the value of the es\_log\_retention\_days parameter. The cleanup task is called from the NorthStar server.

To modify the collection\_cleanup\_task\_interval or es\_log\_retention\_days parameter, use a text editing tool such as vi and modify the value of the parameter. For example:

```
vi /opt/northstar/data/northstar.cfg
.
.
.
collection_cleanup_task_interval=7d
es_log_retention_days=30
```

In this example, logs older than 30 days are purged every seven days.

## Device Profile and Connectivity Testing

Completing device profiles is a prerequisite to running collection tasks. Navigate to **Administration>Device Profile** to open the Device Profile window where you can:

- Set up or modify the device list. Initially, the device list contains all the devices discovered from the traffic engineering database (TED). The device IP address (if not already discovered) and the PCEP IP address for each device are required. The PCEP IP address is the local address of the PCC located in the PCE statement stanza block.
- Supply a hostname for each router for OSPF networks. This is necessary because the TED does not contain hostnames for OSPF networks.
- Specify an MD5 key to secure PCEP communication between the NorthStar Controller and the PCC.
- Specify device SNMP parameters for SNMP connectivity.
- Test connectivity of devices using ping, SSH, SNMP, and Netconf.

Figure 130 on page 190 shows the Device Profile window, including the device list in the upper pane and details about the highlighted device in the lower pane.

Figure 130: Device Profile Window

The screenshot displays the 'Device List' window. At the top, there are buttons for 'Save Changes', 'Sync with Live Network', 'Test Connectivity', 'Add', 'Modify', and 'Delete'. Below these is a table with columns: Name, Group, Type, IP Address (with an upward arrow), Management IP, PCEP IP, Login, and NETCONF Enabled. Two devices are listed: 'vmx101' and 'vmx102'. 'vmx101' is highlighted in yellow. Below the table is a search bar with a 'Filter' button and icons for refresh, expand, download, and upload. A status bar indicates '10 displayed'. The lower pane shows the configuration for 'vmx101'.

Name	Group	Type	IP Address ↑	Management IP	PCEP IP	Login	NETCONF Enabled
vmx101	Juniper	JUNIPER	10.0.0.101	172.16.18.101	10.49.163.67	northstar	yes
vmx102	Juniper	JUNIPER	10.0.0.102	172.16.18.102	10.49.163.63	northstar	yes

vmx101

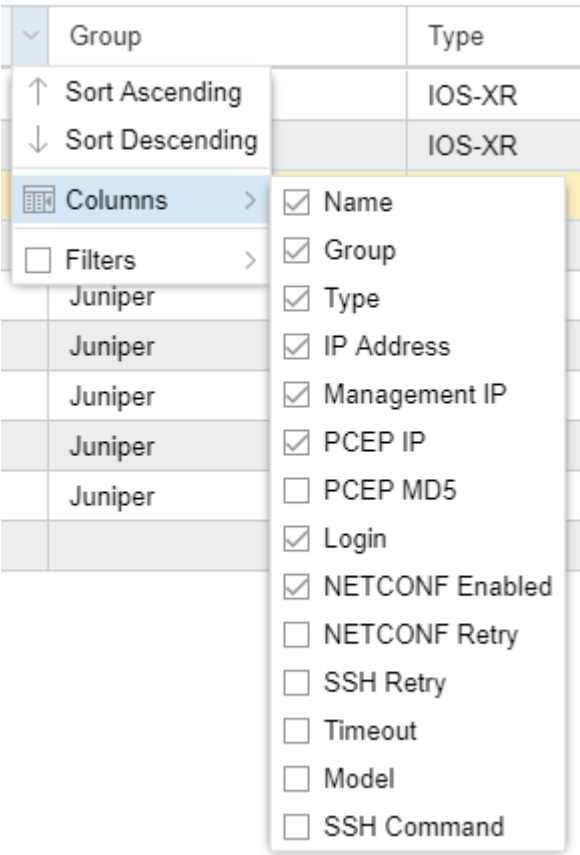
Device Name: <b>vmx101</b>	SSH Timeout: <b>300</b>	Login: <b>northstar</b>
Device IP: <b>10.0.0.101</b>	SSH Retry: <b>3</b>	Privilege Login:
Management IP: <b>172.16.18.101</b>	SSH Command: <b>ssh</b>	
Vendor: <b>JUNIPER</b>	NETCONF Enabled: <b>yes</b>	
Model:	NETCONF Retry: <b>3</b>	
OS:	PCEP IP: <b>10.49.163.67</b>	
OS Version:		



Device List Pane

The Device List pane shows all the devices in the profile along with many of their properties. You can change the order of the devices in the list by clicking and dragging rows. Sorting, column selection, and filtering options are available when you hover over a column heading and click the down arrow that appears. [Figure 131 on page 191](#) shows an example.



Figure 131: Sorting, Column Selection, and Filter Options



You can filter the devices that are included in the display by activating a filter on any column. See [“Sorting and Filtering Options in the Network Information Table” on page 68](#) for a description of the column filtering functionality, along with an example.

The buttons across the top and bottom of the Device List pane perform the functions described in [Table 44 on page 192](#). Button labels are displayed when you hover over icon buttons.

Table 44: Device List Button Functions

Button	Function
Save Changes	Saves the device profile changes. The button becomes active when modifications or edits have been made to entries or fields in the device list. When the button is active, you must click it to finalize your changes.
Sync with Live Network	Synchronizes devices with the live network. This function does not delete devices from the selected profile that do not exist in the live network, but it does add devices that are missing from the live network, and it synchronizes all devices with a corresponding live network device.
Test Connectivity	Tests connectivity on the selected devices.
Add	Adds a device.
Modify	Modifies the selected device.
Delete	Deletes the selected device.
Filter	Filters the list of devices according to the text you enter.
 (Reload Device Profiles)	Reloads the device profiles. This is useful when you are modifying a device entry and then realize that you don't want to save it. Reload will reload the device list back to the last saved state.
 (Device Grouping)	Offers device group management and group display options.
Export Device Profiles	Exports device profiles to a comma separated values (CSV) file named DeviceProfiles.csv.
Import Device Profiles	Imports devices from a CSV file. This is particularly useful when there are a large number of devices to add. Clicking the button opens the Import Devices from CSV window where you browse to the CSV file and specify the appropriate delimiter. A preview of the data appears in the Data Preview box.

You can perform many of these functions on multiple devices simultaneously. To select multiple devices, Ctrl-click or Shift-click the device rows and then click the button for the function you wish to perform.

### Test Connectivity

The Test Connectivity button opens the Profile Connectivity window shown in [Figure 132 on page 193](#).

Figure 132: Profile Connectivity Window

Profile Connectivity

Device	IP Address	Management IP	Type	Ping	SSH	SNMP	NETCONF
vmx101	10.0.0.101	172.16.18...	JUNIPER				

☐ Use Management IP

Connectivity Check Results

Device	vmx101
IP Address	10.0.0.101
NETCONF Test	notTested
Ping Test	notTested
SNMP Test	notTested
SSH Test	notTested

Start

Stop

Profile Fix

Options

Close

Click the Use Management IP check box if the devices to be tested have management IP addresses specified for out-of-band use. Click **Options** to open the Test Connectivity Options window shown in [Figure 133 on page 193](#).

Figure 133: Test Connectivity Options Window

Test Connectivity Options

GeneralSNMPLogin/Password

Test by using the selected method(s)

☒ Ping

☒ SSH

☒ SNMP

☒ NETCONF

Select all

Clear

Simultaneous access

7

( min = 1, max = 16 )

OK

Cancel

In the General tab, you can:

- Specify which test methods you want to use (Ping, SSH, SNMP, NETCONF). Multiple methods are allowed (by default, all methods are tested). To select or deselect methods, click the corresponding check boxes.
- Allow for concurrent access of a number of devices by specifying a simultaneous access limit from 1 to 16. The default is 7.

In the SNMP tab, you can add optional SNMP get community string(s), one per line. If an SNMP connectivity check fails with the community string specified in the device profile (SNMP Parameters tab), these additional community strings are tried until one succeeds.

In the Login/Password tab, you can enter alternate login credentials to be used in case of login/password failure.

Click **OK** to submit your selections and close the Test Connectivity Options window.

In the Profile Connectivity window, click **Start** to begin the connectivity test. You can click **Stop** if the test fails to complete quickly. The test is complete when the green (pass) or red (fail) status icons are displayed. [Figure 134 on page 194](#) shows an example.

**Figure 134: Connectivity Test Results**

Profile Connectivity ✕

Device	IP Address	Management IP	Type	Ping	SSH	SNMP	NETCONF
vmx101-re0	10.0.0.101	10.49.164.97	JUNIPER	✓	✓	✓	✓
vmx102	10.0.0.102	10.49.164.77	JUNIPER	✓	✓	✓	✓
vmx103	10.0.0.103	10.49.164.74	JUNIPER	✓	✓	✓	✓
vmx104	10.0.0.104	10.49.164....	JUNIPER	✓	✓	✓	✓

☒ Use Management IP

---

**Connectivity Check Results**

Device	vmx103
IP Address	10.0.0.103
NETCONF Test	success
Ping Test	success
SNMP Test	success
SSH Test	success

Start Stop Profile Fix Options Close

In SNMP connectivity testing, the host name and device type (vendor) are polled and are auto-populated in the test results if the information was previously missing or incorrect in the device profile. A red triangle in the upper left corner of a field in the test results indicates that a change was automatically made. You can see an example in the Device column in [Figure 134 on page 194](#). To propagate those changes to the device profile, click **Profile Fix** at the bottom of the Connectivity Test Results window.

To display the detailed test results for an individual device in the lower part of the window, click the device row in the upper portion of the window, even if you only tested connectivity for a single device.



**NOTE:** The Start button remains unavailable after test completion until you close the window and reopen it to begin a new connectivity test.

Add Device

The Add button opens the Add New Device window shown in [Figure 135 on page 195](#).

Figure 135: Add New Device Window

Add New Device

General

Access

SNMP

User Defined Properties

Device Name:

Device IP: \*

Management IP:

PCEP IP:

Vendor: JUNIPER

Model:

OS:

OS Version:

Device Group:

Credentials

Login:

Password:

Privilege Login:

Privilege Password:

Reset

Cancel

Add

[Table 45 on page 195](#) describes the data entry fields under the General tab.

Table 45: Add New Device General Field Descriptions

Field	Description
Device Name	Name of the network device, which should be identical to the hostname. During configuration collection, the software uses this name as part of the name of the collected configuration file. The configuration filename uses the format ip.name.cfg. If the device name is left blank, the configuration filename uses the format ip.cfg.
Device IP	Required field: IP address of the network device.

**Table 45: Add New Device General Field Descriptions (continued)**

Management IP	Management IP address for the device. NorthStar Controller first attempts connection using the management IP address if it is specified, and then the IP address.  <b>NOTE:</b> The management IP address is required for out-of-band management access.
PCEP IP	The local address of the PCC located in the PCE statement stanza block.  <b>NOTE:</b> We highly recommend that this field be populated.
Vendor (Type)	Select the device vendor from the drop-down menu. The default is JUNIPER. The vendor is displayed in the Device List under the column heading Type.
Model	Model number of the device.
OS	Type of operating system installed on the device.
OS Version	Version number of the operating system build installed on the network device. The default value is > 14.2x.  <b>NOTE:</b> For routers configured with PCEP using Junos OS Release 14.2x and earlier, select <= 14.2x for this parameter.
Device Group	Device group name you assign to the device, such as a regional group.  <b>NOTE:</b> A device can only have one group designation.
Login	Login ID for the network device.
Password	Password for the network device.
Privilege Login	Login ID for situations that require a higher-security login.
Privilege Password	Password for situations that require a higher-security login.



**NOTE:** We recommend you do not use the credentials of Junos OS root users when running device collection. NorthStar Controller will not raise a warning when such credentials are used, even if the task fails.

Table 46 on page 196 describes the data entry fields under the Access tab.

**Table 46: Add New Device Access Field Descriptions**

Field	Description
SSH Timeout	Number of milliseconds after which a connection attempt times out. The default is 300. To enter a different value, type the number of milliseconds in the field or use the up and down arrows to increment or decrement the displayed value.
SSH Retry	Number of times a connection to the device is attempted. The default is 3. To enter a different value, type the number of retries in the field.

Table 46: Add New Device Access Field Descriptions (continued)

Field	Description
SSH Command	Command to use for SSH connection. The default is ssh. To enter a different value, type the command in the field. Include the full path of the command and options used for ssh, such as <code>/usr/bin/ssh -l -p 8888</code> .
Enable Netconf	Select this checkbox to enable Netconf communication to the device.
Enable Bulk Commit	Select this checkbox to allow NorthStar to do a single commit instead of multiple commits when you provision multiple LSPs on the same router.  <b>NOTE:</b> This is mandatory for P2MP-TE.
Netconf Retry	Enter the number of times a Netconf connection is to be attempted. The default is three.  <b>NOTE:</b> A value of 0 means an unlimited number of retries - connection attempts never stop.
PCEP MD5 String	Message Digest 5 Algorithm (MD5) key string, also configured on the router. <a href="#">“Configuring MD5” on page 201</a> provides information on configuring MD5 authentication.  <b>NOTE:</b> All the routers in the network must have their PCEP IP addresses in the profile. This is especially important if any router in the network is configured with an MD5 authentication key.

The fields on the SNMP Parameters tab are required to set up for SNMP collection. The SNMP parameters are described in [Table 47 on page 197](#).

Table 47: SNMP Parameters

SNMP Parameter	Description
Version	Use the drop-down menu to select SNMPv1, SNMPv2c, or SNMPv3. The default is SNMPv2c.
Port	SNMP port. The default is 161. Must match the port configured on the router.
Get Community	SNMP get community string as configured on the router. The default is “public” if you leave it blank.
Retry	Number of times connection will be attempted. The default is 3.
Timeout	Number of seconds after which connection attempts will stop. The default is 3.



**NOTE:** Additional fields become available if you select SNMPv3 as the version.

In the User Defined Properties tab, you can add properties not directly supported by the NorthStar UI.

Click **Submit** to complete the device addition. The new device appears in the device list.

## Modify Device

The Modify button opens the Modify Device(s) window, which has the same fields as the Add New Device window. Edit the fields you want to change and click **Submit**. Click **Save Changes** to complete the modification. You can wait until you have completed all your device modifications to click **Save Changes**, which will have become active to flag that there are unsaved changes.

To modify one or more fields in the same way for multiple devices, Ctrl-click or Shift-click to select the devices in the device list and click **Modify**. On the resulting Modify Device(s) window, you can make changes that affect all the selected devices.



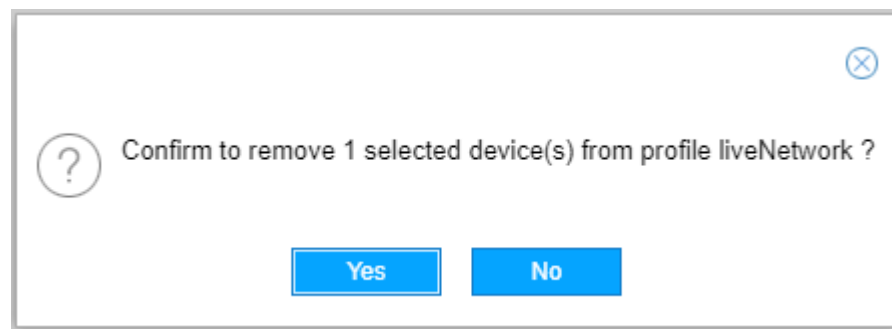
**NOTE:** As an alternative to opening the Modify Device(s) window, you can change some of the device properties directly in the Device List pane by double-clicking the fields.

## Delete Device

To delete a device, select the device row in the Device List and click **Delete**. A confirmation window is displayed as shown in [Figure 136 on page 198](#).

Click **Yes** to complete the deletion.

*Figure 136: Delete Device Confirmation Window*



**NOTE:** If you delete a device from the liveNetwork profile, you are not deleting it from the live network itself. You can restore the device to the profile using the Sync with Live Network button.

## Device Grouping Options

With device grouping, you can group devices in ways that are independent of topological groups. Since Netconf task collection supports collection by device profile group, one way to use this functionality is to manage Netconf sub-collection tasks by group.

When you click the down arrow beside the Device Grouping icon, the two options displayed are:



- Toggle Device Grouping
- Manage Device Grouping

Select **Toggle Device Grouping** to either display the devices in the Device List according to their assigned groups, or not. [Figure 137 on page 199](#) shows an example of a device list in which device grouping is toggled on.

*Figure 137: Device List Displayed by Group*

Device List					
					Save Changes
Name	Group ↓	Type	IP Address	Management IP	PCEP IP
Group: Region-1 (5 Items)					
vmx104	Region-1	JUNIPER	11.0.0.104	172.16.18.104	10.49.163
vmx101	Region-1	JUNIPER	11.0.0.101	172.16.18.101	10.49.163
vmx107	Region-1	JUNIPER	11.0.0.107	172.16.18.107	10.49.163
vrr	Region-1	JUNIPER	11.0.0.199	10.49.165.108	
vmx103	Region-1	JUNIPER	11.0.0.103	172.16.18.103	10.49.163
Group: Region-2 (2 Items)					
vmx106	Region-2	JUNIPER	11.0.0.106	172.16.18.106	10.49.163
vmx105	Region-2	JUNIPER	11.0.0.105	172.16.18.105	10.49.163

**Filter**

ios-xr8

Device Name: **ios-xr8**  
 Device IP: **11.0.0.108**

SSH Timeout: 300  
 SSH Retry: 3

Privi

Toggle Device Grouping >  
 Manage Device Grouping

☒ Group  
☐ Disable Grouping  
☐ Collapse All  
☐ Expand All

To return to the ungrouped device list, select **Disable Grouping**. To display just the group names without displaying the group members, select **Collapse All**. To return to the grouped display in which the group members are also shown, select **Expand All**.

Select **Manage Device Grouping** to open the Manage Device Groups window as shown in [Figure 138 on page 199](#).

*Figure 138: Manage Device Groups Window*

Manage Device Groups

Device Groups
 

Region-1
 Region-2
 Region-3

Group Name: 
☐ New Group

Select device(s) from
 

IP Address	Hostname	Group

 Search

Devices in the group
 

IP Address	Hostname

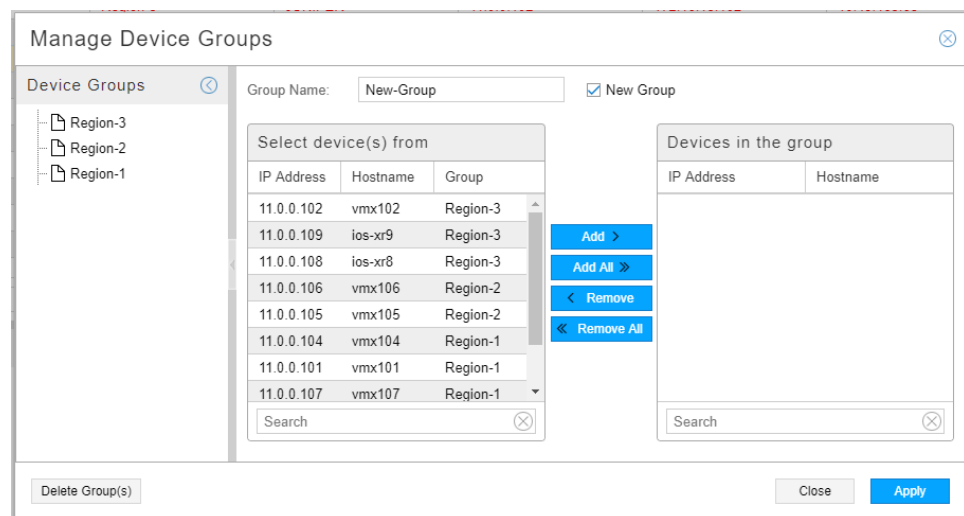
 Search

Existing groups are listed on the left side. Click the name of an existing group to display its members in the “Devices in the group” list on the right. All other devices are listed in the “Select device(s) from” list where you can select devices to add.

To delete a group, click the name of an existing group on the left and click **Delete Group(s)** at the bottom. This action removes the group assignment from the member devices. Groups with no members are automatically deleted.

To create a new group and add devices to it, type the group name at the top and click the New Group check box. All devices are then listed in the “Select device(s) from” list so you can choose the group members. [Figure 139 on page 200](#) shows an example. If you add devices that are already assigned to a group, the new assignment removes the previous assignment.

**Figure 139: Manage Device Groups Window**



Click **Apply** to save your work.

You can also assign a group to a device profile in the Add New Device or Modify Device(s) window (General tab). The Manage Device Groups window is particularly useful for making changes to multiple devices at once.

## Device Detail Pane

The Device Detail pane displays the properties of the device that is highlighted in the Device List pane. There are two ways to minimize this pane:

- Click the down arrow at the top center of the pane. Click the up arrow to maximize the pane.
- Click the down arrow in the top right corner of the pane. Click the up arrow to maximize the pane.

Click and drag the top margin of the pane to resize the pane.

## Configuring MD5

MD5 can be used to secure PCEP sessions as described in RFC 5440, *Path Computation Element (PCE) Communication Protocol (PCEP)*. MD5 authentication must be configured on both the NorthStar Controller (in the Device Profile window) and on the router (using the Junos OS CLI). The authentication key must be the same in both configurations. The device profile acts as a “white list” when MD5 is configured. The NorthStar Controller does not report LSPs or provision LSPs for the routers not included in the device profile.



**NOTE:** The first time MD5 is enabled on the router, all PCEP sessions to routers are reset to apply MD5 at the system level. Whenever the MD5 enabled status on a router or the MD5 key changes, that router resets the PCEP connection to the NorthStar Controller.

The first four steps are done in the NorthStar Controller Device Profile window, to configure MD5 for the PCEP session to a router.

1. Select a router in the Device List pane.
2. Click **Modify** to open the Modify Device(s) window.
3. In the MD5 String field (Access tab), enter the MD5 key string. Click **Modify**.
4. Click **Save Changes** to save your changes. The PCEP MD5 Configured field for the router changes from no to yes.



**NOTE:** All the routers in the network must have their PCEP IP addresses in the profile. When you save your changes, you might receive a warning, reminding you of this.

5. The final step is done in the Junos OS CLI on the router, to configure MD5 for the PCEP session to the NorthStar Controller.

Use the **set authentication-key** command at the **[edit protocols pcep pce]** hierarchy level to configure the MD5 authentication key.

```
user@pcc# set protocols pcep pce pce-id authentication-key md5-key
```

### Related Documentation

- [Scheduling Device Collection for Analytics via Netconf on page 202](#)
- [Data Collection via SNMP on page 220](#)
- [Link Latency Collection on page 227](#)

## Scheduling Device Collection for Analytics via Netconf

The NorthStar Controller Analytics features require that the Controller periodically connect to the network in order to obtain the configuration of the network devices. It uses this information to correlate IP addresses, interfaces, and devices, as well as collecting various types of statistics. There are five types of collection tasks that can be scheduled in NorthStar:

- Netconf
- SNMP (tunnel and interface traffic)
- Link latency
- Network Archive
- LDP Traffic

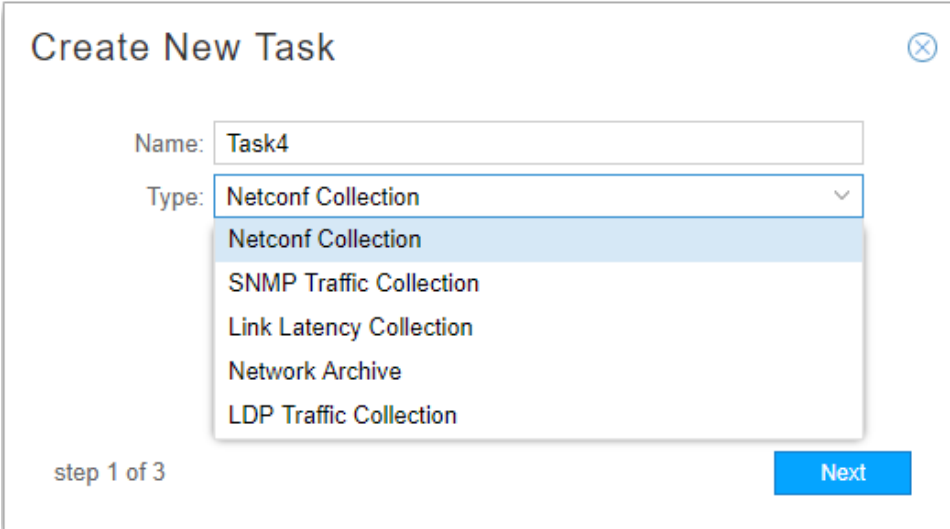
This topic addresses Netconf device collection.

Completion of device profiles (**Administration > Device Profile**) is a prerequisite for successfully running collection tasks.

To schedule a new collection task, navigate to **Administration > Device Collection**.

1. Click **Add** in the upper right corner. The Create New Task window is displayed as shown in [Figure 140 on page 202](#).

*Figure 140: Create New Task Window*



**Create New Task**

Name:

Type:  ▼

- Netconf Collection
- SNMP Traffic Collection
- Link Latency Collection
- Network Archive
- LDP Traffic Collection

step 1 of 3

**Next**

2. Enter a name for the task and use the drop-down menu to select the task type Netconf Collection. Click **Next** to display the first Create New Task – Netconf window as shown in [Figure 141 on page 203](#).

Figure 141: Netconf Device Collection Task, All Devices

**Create New Task - Netconf Collection**

**Task Options** | Collection Options

Select Device(s) to be collected

☒ All devices    ☐ Selective devices    ☐ Groups

Other Options

Use management IP: ☒

Parse collection: ☒

Archive raw data: ☒

step 2 of 3

Previous Next

On the Task Options tab, you can choose All devices, Selective devices, or Groups as a method for specifying the devices to be included in the collection task. For all three of those choices, the following fields are available:

- Use management IP (the default is yes).
- Parse collection (the default is yes).

Parsing reads the content of the files and updates the network model accordingly. If parsing is not selected, the configuration files are collected on the server, but not used in the model.

- Archive raw data (the default is yes).

If you select “Selective devices”, you are presented with a list of all the devices available to be included in the collection task. [Figure 142 on page 204](#) shows an example.

Figure 142: Netconf Device Collection Task, Selective Devices

### Create New Task - Netconf Collection

Task Options

Collection Options

Select Device(s) to be collected

☐ All devices

☒ Selective devices

☐ Groups

<input type="checkbox"/> IP Address	Hostname
<input type="checkbox"/> 11.0.0.104	vmx104
<input type="checkbox"/> 11.0.0.101	vmx101
<input type="checkbox"/> 11.0.0.107	vmx107
<input type="checkbox"/> 11.0.0.103	vmx103
<input type="checkbox"/> 11.0.0.106	vmx106
<input type="checkbox"/> 11.0.0.105	vmx105
<input type="checkbox"/> 11.0.0.102	vmx102

Other Options

Use management IP: ☒

Parse collection: ☒

Archive raw data: ☒

step 2 of 3

PreviousNext

Click the check boxes corresponding to the devices you want to include.

If you opt for Groups, you are presented with a list of the device groups that have been configured in **Administration > Device Profile**, as shown in [Figure 143 on page 205](#).

Figure 143: Netconf Device Collection Task, Groups

**Create New Task - Netconf Collection**

**Task Options** | Collection Options

Select Device(s) to be collected

☐ All devices    ☐ Selective devices    ☒ Groups

- ☐ Device Group
- ☒ Region-2
- ☐ Region-1
- ☐ Independent

Other Options

Use management IP: ☒

Parse collection: ☒

Archive raw data: ☒

step 2 of 3    Previous    Next

Click the check boxes corresponding to the groups you want to include.

Click **Next** to continue.

On the Collection Options tab, you can select the types of data to be collected or processed as shown in [Figure 144 on page 206](#).

Figure 144: Netconf Device Collection Task, Collection Options

**Create New Task - Netconf Collection**

Task Options | **Collection Options**

Data to be collected or processed

☐ Select All      ☐ Deselect All

	Collect
Configuration	<input checked="" type="checkbox"/>
Interface	<input checked="" type="checkbox"/>
Tunnel Path	<input checked="" type="checkbox"/>
Transit Tunnel	<input checked="" type="checkbox"/>
Switch CLI	<input type="checkbox"/>
Equipment CLI	<input type="checkbox"/>

step 2 of 3      Previous      Next

Click the appropriate check boxes to select or deselect options. You can also Select All or Deselect All. By default, the first four options listed are collected.



**NOTE:** We recommend that you collect router configuration, tunnel path and tunnel transit show commands when running the device collection task so that NorthStar can update the tunnel status and details based on the latest collection.

Equipment CLI data is collected in Netconf collection tasks that include the Equipment CLI option. The Process Equipment CLI option in Network Archive collection parses the Equipment CLI data collected in Netconf collection and generates the Inventory Report available in both the NorthStar Controller and the NorthStar Planner.

To view Hardware Inventory in the NorthStar Planner, you must run Netconf collection with the Equipment CLI collection option (collects the inventory data) and you must run Network Archive collection with the Process Equipment CLI option (processes the inventory data).

Each of the options results in the collection task capturing the results of various show commands. [Table 48 on page 207](#) lists the show command output captured for each option.



*Table 48: Show Command Output Captured by Netconf Collection Options*

Data Type	For Juniper Devices	For IOS-XR Devices
Configuration	show configuration   display inheritance brief   no-more	show running
Interface	show configuration system host-name   display inheritance brief show interfaces   no-more	show running   include hostname show interfaces show ipv4 interface
Tunnel Path	show configuration system host-name   display inheritance brief show mpls lsp statistics ingress extensive logical-router all   no-more	show running   include hostname show mpls traffic-eng tunnels detail role head
Transit Tunnel	show configuration system host-name   display inheritance brief show rsvp session ingress detail logical-router all   no-more show rsvp session transit detail logical-router all   no-more	show running   include hostname show mpls traffic-eng tunnels backup
Switch CLI	show configuration system host-name   display inheritance brief show l ldp neighbor   no-more show virtual-chassis status   no-more	show running   include hostname show cdp neighbor detail
Equipment CLI	show configuration system host-name   display inheritance brief show version   no-more show chassis hardware   no-more show chassis fpc   no-more show chassis hardware models   no-more	show version show diag show env all admin show inventory show inventory raw

3. Click **Next** to proceed to the scheduling parameters. The Create New Task - Schedule window is displayed as shown in [Figure 145 on page 208](#). You can opt to run the collection only once, or to repeat it at configurable intervals. The default interval is 15 minutes.

Figure 145: Netconf Device Collection Task, Scheduling

**Create New Task - Schedule**

**Startup Options**

Starts: ☐ Now

☒ On 2017-11-26 09:44

☐ Chain after another task

**Recurrence Options**

Repeats: Minute(s)

Every: 15 Minute(s)

Ends: ☒ Never

☐ On

step 3 of 3

Previous Submit

Instead of scheduling recurrence, you can select to chain the task after an already-scheduled recurring task, so it launches as soon as the other task completes. When you select the “Chain after another task” radio button, a drop-down list of recurring tasks is displayed from which to select.

- Click **Submit** to complete the addition of the new collection task and add it to the Task List. Click a completed task in the list to display the results in the lower portion of the window. There are three tabs in the results window: Summary, Status, and History. [Figure 146 on page 209](#) shows an example of the Summary tab. [Figure 147 on page 209](#) shows an example of the Status tab.

Figure 146: Netconf Device Collection Results, Summary Tab

Task List								
Type	Name	Created	Frequency	Repeats	Starts	Ends	Last Executed	Status
Netconf Collection	test-123	11/17/20...	Immediat...	N/A	11/17/20...	N/A	11/25/20...	Scheduled
Netconf Collection	test	11/25/20...	Immediat...	N/A	11/25/20...	N/A	11/25/20...	Completed
Network Archive	network_...	10/31/20...	Daily	1	10/31/20...	12/1/201...	11/25/20...	Scheduled
Netconf Collection	first	11/25/20...	Immediat...	N/A	11/25/20...	N/A	11/25/20...	Completed
Netconf Collection	test-2	10/31/20...	Immediat...	N/A	10/31/20...	N/A	11/25/20...	Scheduled
Netconf Collection	Manual d...	11/1/201...	Immediat...	N/A	11/1/201...	N/A	11/1/201...	Completed
SNMP Traffic Collection	SNMP-test	11/25/20...	Immediat...	N/A	11/25/20...	N/A	11/25/20...	Completed
Netconf Collection	test-jeanne	10/31/20...	Hourly	5	10/31/20...	12/1/201...	11/25/20...	Scheduled

Summary	Status	History
<p>✓ Start Time 11/25/2017, 12:32:40 PM</p> <p>✓ Data Collection ...Done</p> <p>✓ End Time 11/25/2017, 12:33:49 PM</p>		

Figure 147: Netconf Device Collection Results, Status Tab

Task List

Add

Modify

Delete

Type	Name	Created	Frequency	Repeats	Starts	Ends	Last Executed	Status
Netconf Collection	test-123	11/17/2017,...	Immediatel...	N/A	11/17/2017,...	N/A	11/25/2017,...	Scheduled
Netconf Collection	test	11/25/2017,...	Immediately	N/A	11/25/2017,...	N/A	11/25/2017,...	Completed
Netconf Collection	Monthly	11/25/2017,...	Monthly	1	11/25/2017,...	Never	11/25/2017,...	Scheduled
Network Archive	network_ar...	10/31/2017,...	Daily	1	10/31/2017,...	12/1/2017, ...	11/25/2017,...	Scheduled
Netconf Collection	first	11/25/2017,...	Immediately	N/A	11/25/2017,...	N/A	11/25/2017,...	Completed
Netconf Collection	test-2	10/31/2017,...	Immediatel...	N/A	10/31/2017,...	N/A	11/25/2017,...	Scheduled
Netconf Collection	Manual dev...	11/1/2017, ...	Immediately	N/A	11/1/2017, ...	N/A	11/1/2017, ...	Completed
SNMP Traffic Collection	SNMP-test	11/25/2017,...	Immediately	N/A	11/25/2017,...	N/A	11/25/2017,...	Completed
Netconf Collection	test-123	11/17/2017,...	Immediatel...	N/A	11/17/2017,...	N/A	11/25/2017,...	Scheduled

Summary

Status

History

IP Address	Hostname	Status	Job Type
11.0.0.101	vmx101	ACCESS_FAIL	configinterface tunnel_path transit_tunnel
11.0.0.107	vmx107	ACCESS_FAIL	configinterface tunnel_path transit_tunnel
11.0.0.105	vmx105	ACCESS_FAIL	configinterface tunnel_path transit_tunnel
11.0.0.104	vmx104	OK	configinterface tunnel_path transit_tunnel
11.0.0.102	vmx102	OK	configinterface tunnel_path transit_tunnel
11.0.0.106	vmx106	OK	configinterface tunnel_path transit_tunnel
All Devices		COMPLETE	Collection (Dir: /opt/northstar/data/collection/1f085722-49d8-4b9b-9f5c-f94b5476ec1d/1511643281407)
All Devices		COMPLETE	Processing

The device collection data is sent to the PCS server for routing and is reflected in the Topology view. See [“Viewing Analytics Data in the Web UI” on page 210](#) for more information.

#### Related Documentation

- [Provision LSPs](#)
- [Netconf Persistence on page 218](#)
- [Device Profile and Connectivity Testing on page 190](#)
- [Viewing Analytics Data in the Web UI on page 210](#)
- [Collection Tasks to Create Network Archives on page 240](#)

## Viewing Analytics Data in the Web UI

There are views and work flows in the web UI that support visualization of collected data so it can be interpreted and acted upon.

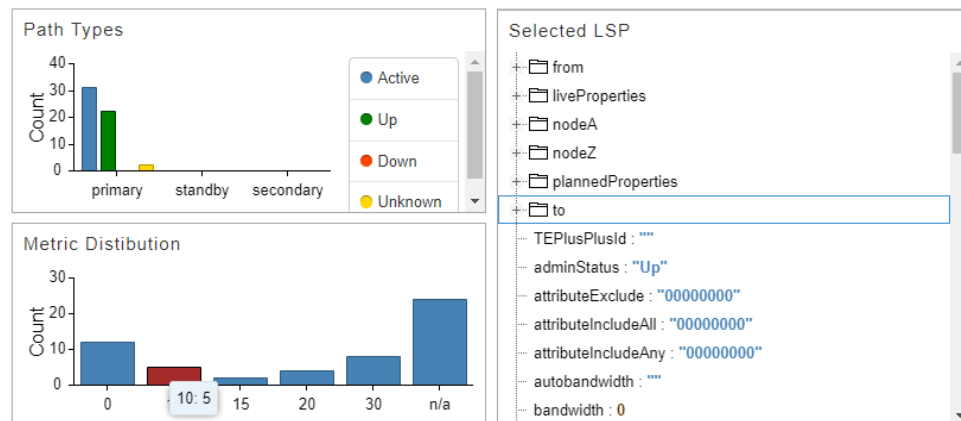
Data collectors must be installed and devices must be configured to push the data to the data collectors. The health monitoring feature also uses information from the data collectors.

To view information about installed data collectors, navigate to **Administration > System Health**.

### Analytics Widgets View

There are a number of widgets related to collected analytics data available when you click the Analytics option in the top navigation bar. The network information table is displayed along with the analytics widgets. Some of the widgets can display information specific to one or more tunnels you select in the table. [Figure 148 on page 210](#) shows a few examples of the widgets that are available.

*Figure 148: Analytics Widget Examples*



### Interface Utilization in Topology View

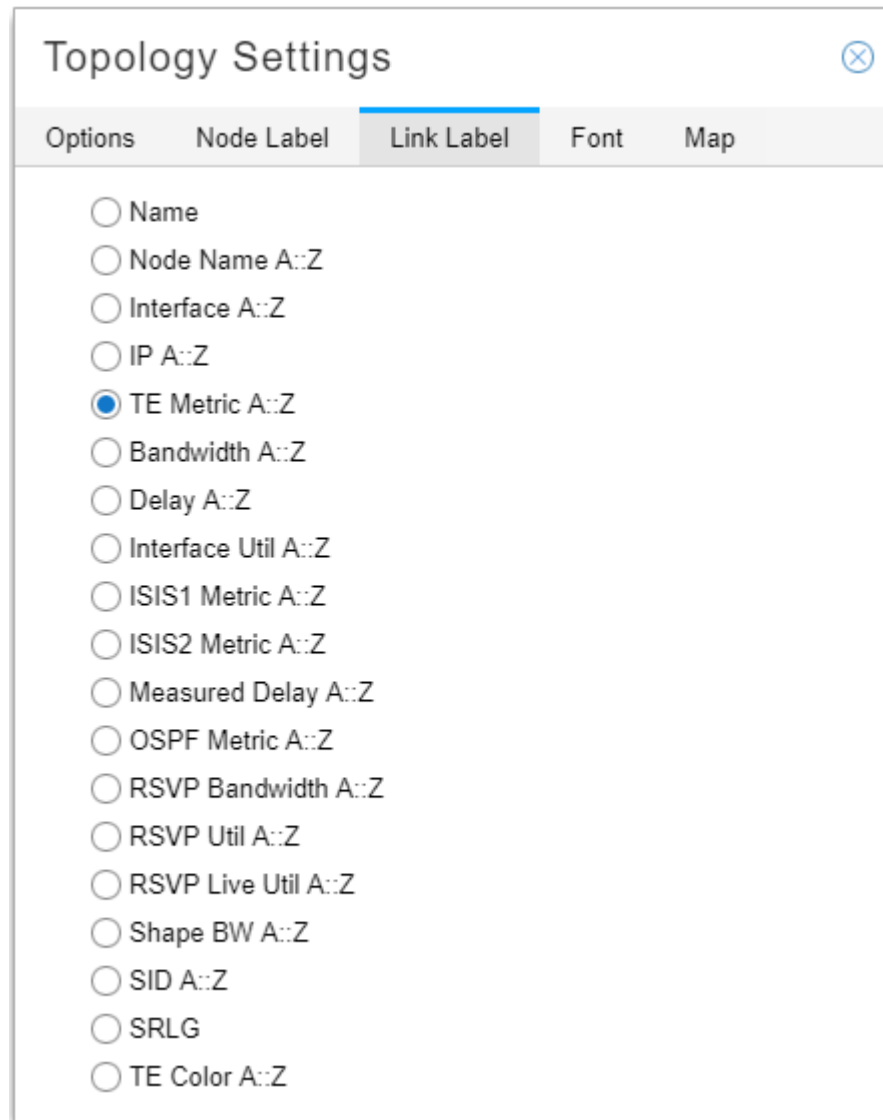
Interface Utilization is available as an option in the left pane of the topology view under Options. When selected, the amount of traffic (RSVP and other traffic) that is going through the network at the time is displayed in the topology, and is updated once every minute. This allows you to see how much traffic is going through the network as a function of time, as opposed to only being able to see reserved bandwidth.



**NOTE:** Interface Utilization, RSVP Live Utilization, and RSVP Utilization are mutually exclusive. You can display only one of those three in the topology at a time.

In the Topology Settings menu bar on the right side of the window, click the Tools icon and select the Link Label tab. You will see link label settings that pertain to interface utilization, as shown in [Figure 149 on page 211](#). The topology then displays the percentage utilization of the links in the format *percentage AZ::percentage ZA*. Additional labels are also available to display information that is collected through a Netconf collection task, and is used by the analytics feature. Interface names, interface bandwidth values, and shape bandwidth values are some examples.

Figure 149: Link Label Settings: Interface Util A::Z

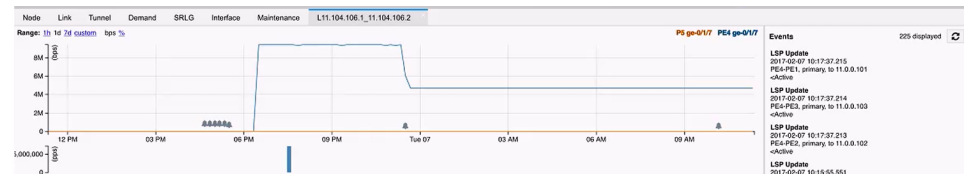


### Reaching the Traffic Chart from the Topology or the Network Information Table

You can right-click a link in the topology and select **View Interface Traffic** to see traffic statistics over time for the link. In this chart, you can select to display one or both interfaces, adjust the time range, and select the units as bps or % (of the link bandwidth).

You can also view LSP events on the right side of the chart. Double click an event to see event details. A bell icon in the chart indicates that one or more events took place. Click a bell to filter the list of events on the right to include only those that occurred at that timestamp. [Figure 150 on page 212](#) shows the traffic view chart.

**Figure 150: Traffic View**



**NOTE:** The events displayed are only those pertaining to the LSPs currently routed through the link being viewed, as opposed to all events for all LSPs in the network.

You can also reach this traffic-over-time view by right-clicking a link in the network information table (Link tab) and selecting **View Interface Traffic**. To see LSP traffic over time, click the Tunnel tab in the network information table. Right-click on an LSP and select **View Traffic**. You can choose multiple objects at a time if you want to compare them. The top portion of the chart shows traffic over time. The bottom portion shows packets over time.

Also available by right-clicking a link in either the topology or the network information table are the options to View Link Events and View Interface Delay.

## Interface Delay in Topology View

In the Topology Settings menu bar on the right side of the window, click the Tools icon and select the Link Label tab. You can opt to display live interface delay measurements on the topology map by **Measured Delay A::Z**. Select **Performance** in the left pane drop-down menu in Topology View, and select **Interface Delay** to display planned delay data in the topology map.



**NOTE:** Interface delay information is only available if the devices have been prepared:

- RPM probes have been configured.
- The rpm-log.slax script has been loaded, to send the results of the probes to the data collectors.



**NOTE:** The NorthStar Controller does not automate the installation of this script on the router. You must install the script manually.

## Graphical LSP Delay View

To view graphical LSP delay information for tunnels in the web UI, you must enable the functionality. The functionality is not enabled by default due to the possible impact on performance. Enabling the functionality allows PCViewer to calculate LSP delay and display the data in the web UI.

At any given time, the NorthStar Controller is aware of the paths of all LSPs in the network. Periodically, the controller uses the reported link delays to compute the end-to-end LSP delay as the simple sum of all link delays in the LSP path.

To enable the functionality:

1. Add the following statement to the `/opt/northstar/data/northstar.cfg` file:

```
pcs_lsp_latency_interval_sec=seconds
```

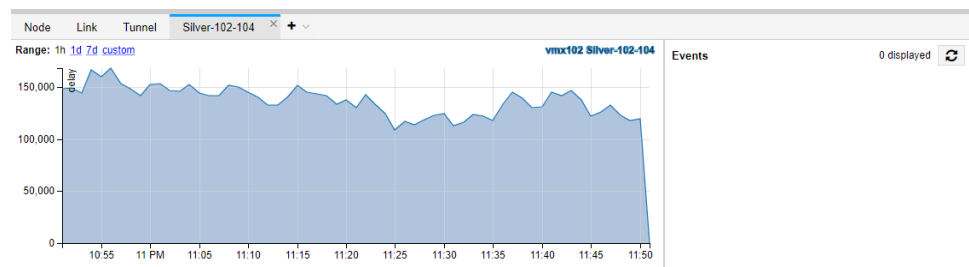
The *seconds* variable is the interval at which you want PCViewer to update the LSP delay metric.

2. Restart PCViewer:

```
supervisorctl restart northstar_pcs:PCViewer
```

Once the functionality is enabled, you can right-click a tunnel in the network information table in Topology view and select View Delay. The data is also available in the Tunnels view. [Figure 151 on page 213](#) shows the LSP delay view, using data for the Silver-102-104 LSP as an example.

**Figure 151: Graphical LSP Delay View**

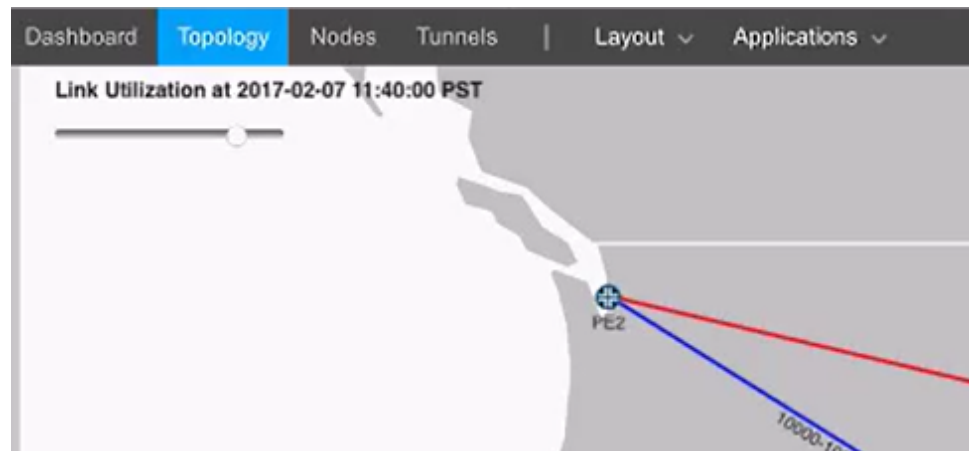


## Performance View

The Performance View shows you how utilization has changed over time. In the left pane of the topology view, select **Performance** from the drop-down menu. If you click the Interface Utilization check box, for example, and then move the slide bar in the upper left corner of the topology map, you see the link colors change to reflect the utilization at the time. Interface utilization is calculated using Layer 3 bandwidth (interface utilization = Layer 3 traffic divided by Layer 3 bandwidth). This is different from RSVP bandwidth which is initialized via BGP-LS and automatically adjusted. The two bandwidth values (RSVP and Layer 3) can be the same, but in some networks, they are not.

[Figure 152 on page 214](#) shows the location of the slide bar.

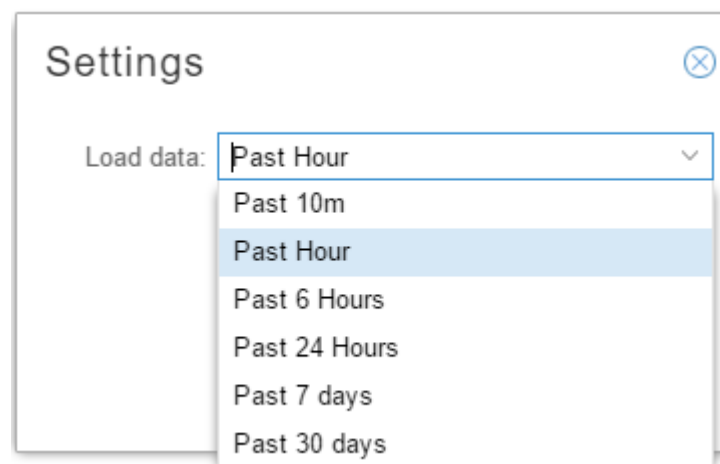
Figure 152: Performance-Over-Time Slide Bar



Node Ingress Traffic, Node Egress Traffic, and Interface Delay are also available, in addition to Interface Utilization. In the case of Node Ingress and Node Egress Traffic, the size of the node on the map is proportional to the amount of traffic being handled by the node. Ingress and egress traffic for a node are not always equal. Generally, most traffic is simply forwarded by a router (as opposed to being generated or consumed), so it might seem reasonable to expect that the sum of all ingress traffic would be roughly equal to the sum of all egress traffic. But in practice, nodes can replicate traffic, as is commonly the case for multicast traffic or unknown unicast traffic when doing L2 Ethernet forwarding. In such cases, the total egress traffic can (and should) exceed the total ingress traffic.

For all four options (Node Ingress Traffic, Node Egress Traffic, Interface Delay, Interface Utilization), the Settings button at the bottom of the left pane allows you to select how far back you want the data to show, with options up to 30 days back. [Figure 153 on page 214](#) shows these options.

Figure 153: Performance Settings

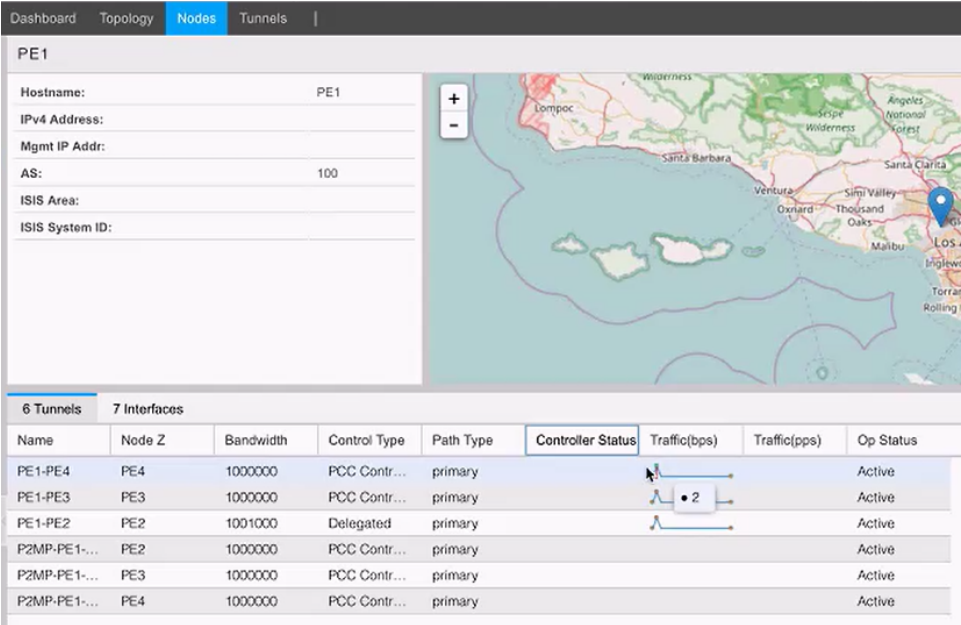




Nodes View

Two columns of data in the Nodes View reflect a snapshot of traffic in bps and pps over the last hour. This is for quick reference in case there are conditions that require attention. You can see this snapshot for both Interfaces and Tunnels. [Figure 154 on page 215](#) shows these two columns.

Figure 154: Analytics in Nodes View



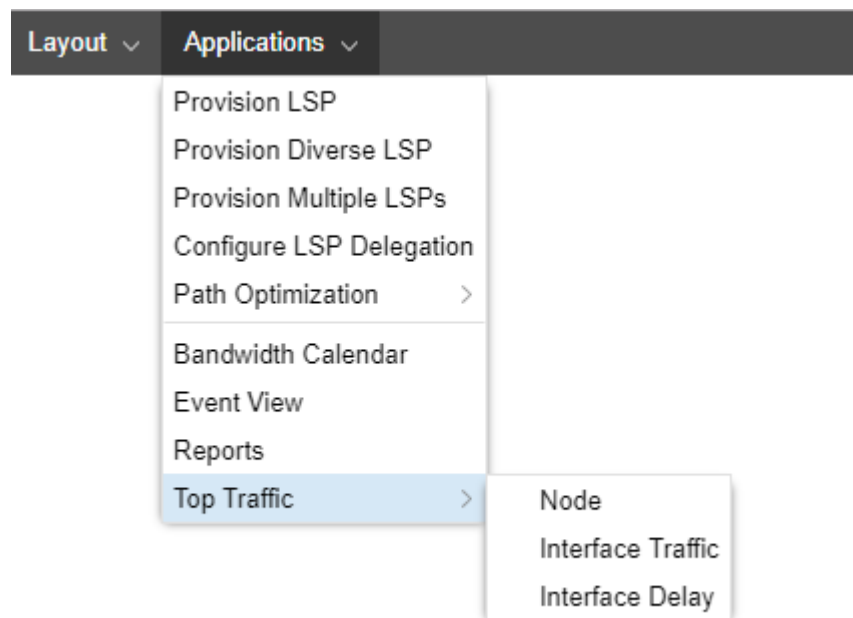
Interface Protocols Display

Data collection allows the NorthStar Controller to gather information about the protocols that are configured on each interface. The Protocols column in the network information table under the Interface tab displays OSPF, LDP, RSVP, and MPLS when configured. Be sure you have selected this column to be included in the display.

Displaying Top Traffic

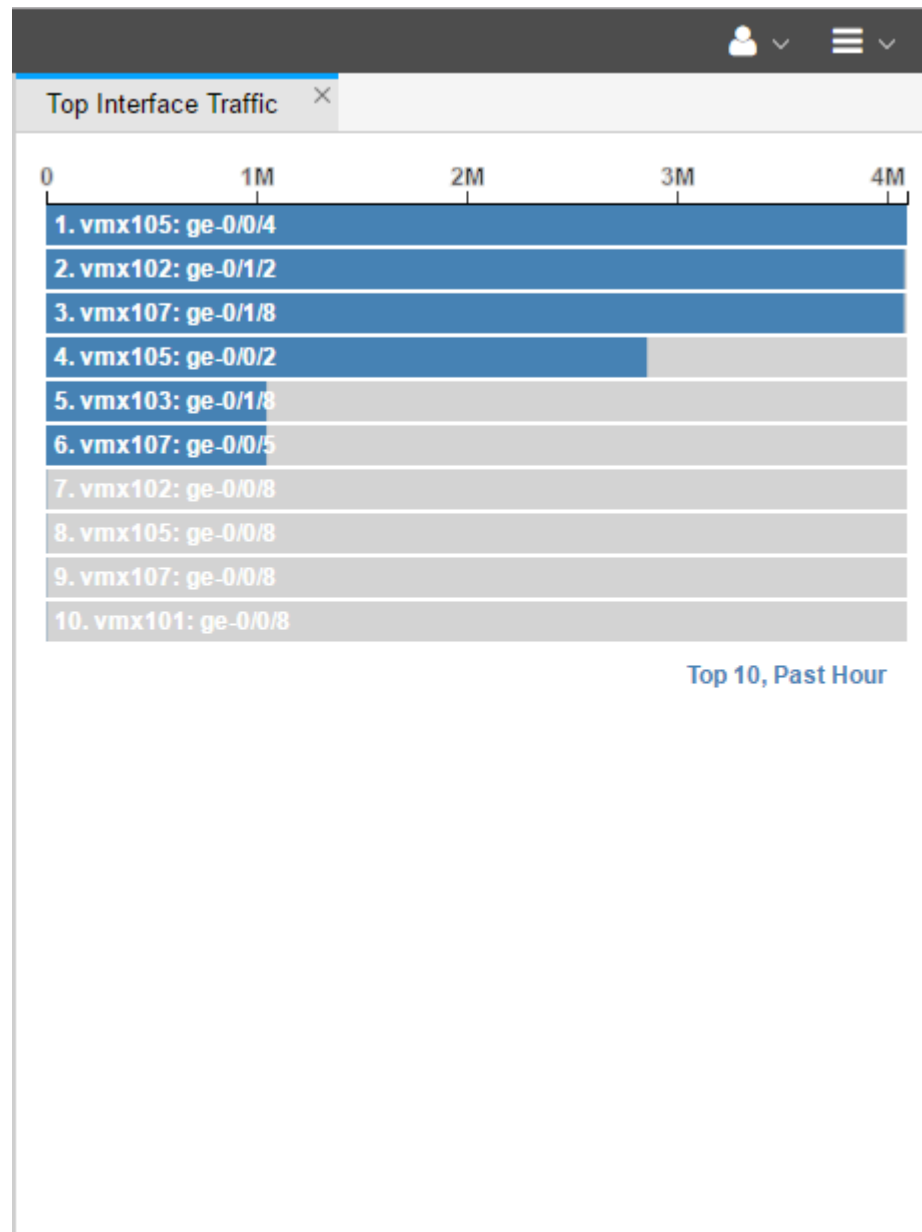
You can display the recent top traffic by navigating to **Applications > Top Traffic** as shown in [Figure 155 on page 216](#).

Figure 155: Accessing Top Traffic



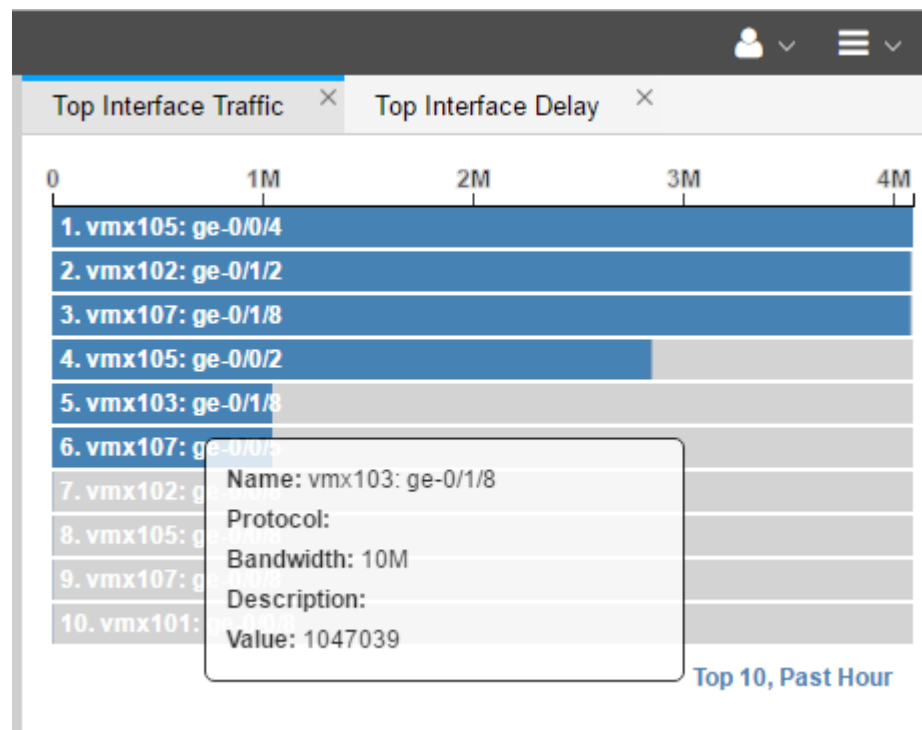
Top traffic is the computed top N traffic over X period of time by Node, Interface Traffic, or Interface Delay. You can select N and X by clicking on the currently selected values in the lower right corner of the display as shown in figx. In the resulting Top Traffic Settings window, you can select the number of top elements you want to see, and the period of time they cover. [Figure 156 on page 217](#) shows Top Interface Traffic with the top 10 elements over the past hour displayed. To modify the settings in this example, you would click on **Top 10, Past Hour** at the bottom of the display, which would bring up the Top Traffic Settings window where you could make different setting selections.

Figure 156: Top Traffic Example



You can select any or all of the top traffic options (Node, Interface Traffic, Interface Delay) to be included in the display. Multiple selections appear as tabs that you can toggle between. There is interactivity between the topology map and the top traffic charts: you can select a line item on the chart and it will highlight the corresponding object on the topology map. You can also mouse over a line item on the chart to display details about the object as shown in [Figure 157 on page 218](#).

Figure 157: Top Traffic With Mouseover Information



- Related Documentation**
- [Provision LSPs](#)
  - [Netconf Persistence on page 218](#)
  - [Left Pane Options on page 50](#)

## Netconf Persistence

Netconf Persistence allows you to create collection tasks to discover information from device configurations (such as hostname and interface name), and from operational commands (such as LSP on non-PCEP enabled devices). The Analytics features rely on the results of Netconf collection to associate statistics with the correct network elements. As an alternative to provisioning LSPs (P2P or P2MP) using PCEP (the default), you can also provision LSPs using Netconf.

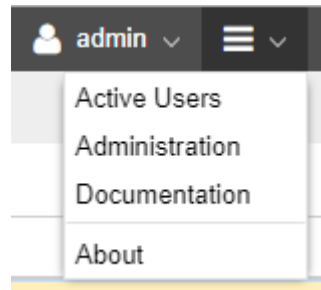
### Enabling Netconf Connections

Before using Netconf features, you must enable your system to allow NorthStar Controller to modify the router configuration files via Netconf. Perform the following steps:

1. Ensure that port 830 is allowed by any external firewall being used. Port 830 enables Netconf communication between the NorthStar Controller and other devices.
2. Populate the Device Profile (only the Admin user can perform this step). From the More Options menu in the upper right corner of the NorthStar Controller web UI,

navigate to **Administration > Device Profile**. Figure 158 on page 219 shows the More Options menu.

Figure 158: More Options Menu



3. Highlight a device in the Device List and click **Modify**. The Modify Device(s) window is displayed.
4. On the General tab, the following fields are required:



**NOTE:** If these fields are not populated, the Netconf connection will fail.

- Management IP: The IP address NorthStar Controller can use to establish Netconf sessions.
  - Vendor: Use the drop-down menu to select the vendor for the device (Juniper, Cisco, and so on).
  - Login and Password: Enter the credentials that allow the NorthStar Controller to authenticate with the router.
5. Enable NorthStar Controller to use Netconf by clicking the check box beside **Enable Netconf** in the Netconf section of the Access tab.
  6. Click **Modify** at the bottom of the Modify Device(s) window.
  7. Click **Save Changes** (which should be red to signal there are unsaved changes) which should turn black once the save operation is complete.
  8. In the Topology view, verify that the NorthStar Controller can establish a Netconf session. On the Node tab in the network information table, look for the NETCONF Status column. You can select that column for display if it is not already selected by clicking the down arrow next to any column heading, and selecting Columns. The Netconf status should be reported as Up.



**NOTE:** In Junos OS Release 15.1F6 and later, you can enable the router to send P2MP LSP information to a controller (like the NorthStar Controller) in real time, automatically. Without that configuration, you must run live network collection tasks for NorthStar to learn about newly provisioned P2MP LSPs.

In the Junos OS, the configuration is done in the [set protocols pcep] hierarchy for PCEs and for PCE groups:

```
set protocols pcep pce pce-id p2mp-lsp-report-capability
set protocols pcep pce pce-group p2mp-lsp-report-capability
```

#### Related Documentation

- [Provision LSPs](#)
- [Device Profile and Connectivity Testing on page 190](#)
- [Scheduling Device Collection for Analytics via Netconf on page 202](#)

## Data Collection via SNMP

Data collection via SNMP is a useful alternative for collecting network statistics in systems where Juniper Telemetry Interface (JTI) is not available or in multi-vendor systems. Data collection via SNMP enables the following performance management features:

- Collection of interface statistics using SNMP collection tasks that poll the SNMP MIB (Juniper Networks and Cisco devices).
- Collection of LSP statistics using SNMP collection tasks that poll the SNMP MIB (Juniper Networks and Cisco devices).

Cisco LSP statistics can also be collected by polling the interface MIB because in Cisco devices, an LSP tunnel is a special interface entry.

- Collection of P2MP LSP statistics by polling the Juniper LSP MIB for Juniper Networks devices, or by polling the standard IFMIB for Cisco devices. Even older Juniper devices are supported.
- Collection of class of service (CoS) statistics. To collect this data for Juniper Networks devices, the SNMP collector polls the JUNIPER-COS-MIB.
- The specific OIDs that are collected in SNMP collection tasks are described in [Table 49 on page 220](#), [Table 50 on page 221](#), and [Table 51 on page 221](#).

**Table 49: OIDs for Interface and LSP Statistics**

OID Name	Counter	Vendor Type
1.3.6.1.2.1.31.1.1.1.1	ifName	Generic
1.3.6.1.2.1.31.1.1.1.10	ifHCOutOctets	Generic

**Table 49: OIDs for Interface and LSP Statistics (continued)**

OID Name	Counter	Vendor Type
1.3.6.1.2.1.31.1.1.1.13	ifHCOutBroadcastPkts	Generic
1.3.6.1.2.1.31.1.1.1.6	ifHCInOctet	Generic
1.3.6.1.2.1.31.1.1.1.9	ifHCInBroadcastPkts	Generic
1.3.6.1.4.1.2636.3.2.3.1.1	mplsLspInfoName	Juniper
1.3.6.1.4.1.2636.3.2.3.1.3	mplsLspOctets	Juniper

**Table 50: OIDs for CoS Statistics - Juniper Devices**

OID Name	Counter
1.3.6.1.4.1.2636.3.15.4.1.5	jnxCosQstatQedBytes
1.3.6.1.4.1.2636.3.15.4.1.9	jnxCosQstatTxdBytes
1.3.6.1.4.1.2636.3.15.4.1.23	jnxCosQstatTotalRedDropBytes
1.3.6.1.4.1.2636.3.15.7.1.5	jnxCosIngressQstatQedBytes
1.3.6.1.4.1.2636.3.15.7.1.9	jnxCosIngressQstatTxdBytes
1.3.6.1.4.1.2636.3.15.7.1.23	jnxCosIngressQstatTotalRedDropBytes

**Table 51: OIDs for CoS Statistics - Cisco Devices**

OID Name	Table
1.3.6.1.4.1.9.9.166.1.1.1	CISCO-CLASS-BASED-QOS-MIB::cbQosServicePolicyTable
1.3.6.1.4.1.9.9.166.1.6.1	CISCO-CLASS-BASED-QOS-MIB::cbQosPolicyMapCfgTable
1.3.6.1.4.1.9.9.166.1.5.1	CISCO-CLASS-BASED-QOS-MIB::cbQosObjectsTable
1.3.6.1.4.1.9.9.166.1.7.1	CISCO-CLASS-BASED-QOS-MIB::cbQosCMCfgTable
1.3.6.1.4.1.9.9.166.1.15.1.1.10	CISCO-CLASS-BASED-QOS-MIB:: cbQosClassMapStats.cbQosCMPostPolicyByte64
1.3.6.1.4.1.9.9.166.1.15.1.1.17	CISCO-CLASS-BASED-QOS-MIB:: cbQosClassMapStats.cbQosCMDropByte64

The process involves the following tasks:

- [Installation of Collectors on page 222](#)
- [Configure Devices in Device Profile and Test Connectivity on page 222](#)
- [Run Netconf Device Collection on page 222](#)
- [Schedule and Run SNMP Data Collection Tasks on page 223](#)
- [Access the Data from the NorthStar Planner on page 227](#)

## Installation of Collectors

The collectors are installed in the same machine as the NorthStar Controller application server (single-server deployment) by the install.sh script when you install the controller itself. Once installed, you can see the collector group of processes:

```
[root@pcs-q-pod05 ~]# supervisorctl status
```

analytics:elasticsearch	RUNNING	pid 3374, uptime 6:33:42
analytics:esauthproxy	RUNNING	pid 3373, uptime 6:33:42
analytics:logstash	RUNNING	pid 5600, uptime 6:31:15
collector:es_publisher	RUNNING	pid 12899, uptime 0:37:03
collector:task_scheduler	RUNNING	pid 12900, uptime 0:37:03
collector:worker1	RUNNING	pid 3385, uptime 6:33:42
collector:worker2	RUNNING	pid 3387, uptime 6:33:42
collector:worker3	RUNNING	pid 3386, uptime 6:33:42
collector:worker4	RUNNING	pid 3388, uptime 6:33:42

## Configure Devices in Device Profile and Test Connectivity

Before you can run SNMP collection, you must configure login credentials and SNMP parameters for the devices. In the web UI, from the More Options menu, navigate to **Administration > Device Profile**. Select a device and click **Modify**. Click the **Access Parameters** tab to enter login credentials and the **SNMP Parameters** tab to enter SNMP parameters.

See [“Device Profile and Connectivity Testing” on page 190](#) for detailed instructions on setting up devices with SNMP parameters, and also on testing SNMP connectivity to those devices.

## Run Netconf Device Collection

You must run Netconf device collection before attempting to run SNMP traffic collection. This is necessary to establish the baseline network information including the interfaces and LSPs. Once Netconf device collection has been run, SNMP traffic collection tasks have the information they need to poll the interfaces and the LSPs.

See [“Scheduling Device Collection for Analytics via Netconf” on page 202](#).



## Schedule and Run SNMP Data Collection Tasks



**NOTE:** Completion of device profiles (**Administration > Device Profile**) and running Netconf device collection are prerequisites for successfully running SNMP collection.

To schedule a new SNMP collection task, navigate to **Administration > Device Collection** from the More Options menu.

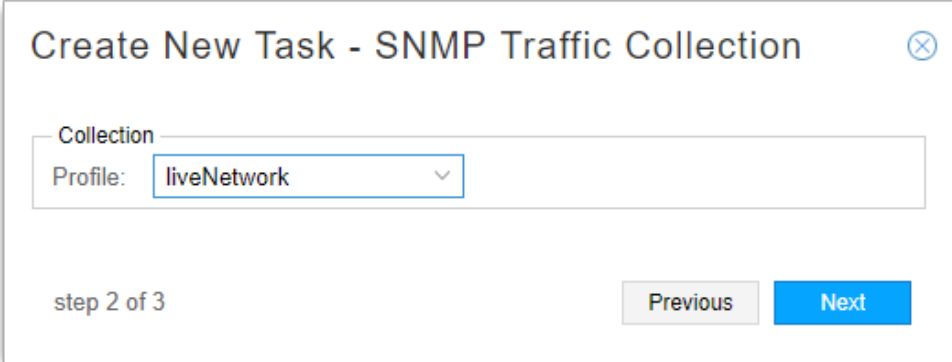
1. Click **Add** in the upper right corner. The Create New Task window is displayed as shown in [Figure 140 on page 202](#).

*Figure 159: Create New Task Window*

The screenshot shows a 'Create New Task' dialog box. It has a title bar with a close button. Inside, there is a 'Name' field with the text 'Task4'. Below it is a 'Type' dropdown menu. The dropdown is open, showing a list of options: 'Netconf Collection' (which is highlighted), 'SNMP Traffic Collection', 'Link Latency Collection', 'Network Archive', and 'LDP Traffic Collection'. At the bottom left of the dialog, it says 'step 1 of 3'. At the bottom right, there is a blue button labeled 'Next'.

2. Enter a name for the task and use the drop-down menu to select the task type as **SNMP Traffic Collection**. Click **Next**.

The next window displayed does not offer any options because at this time, liveNetwork is the only device profile available. [Figure 160 on page 224](#) shows this window for SNMP traffic collection.

*Figure 160: Device Collection Task, Step 2 for SNMP Traffic Collection*

**Create New Task - SNMP Traffic Collection** ⓧ

Collection

Profile: liveNetwork ▼

step 2 of 3

Previous Next

3. Click **Next** to proceed to the scheduling parameters. The Create New Task - Schedule window is displayed as shown in [Figure 161 on page 225](#). At least two collections are necessary for the calculation of statistics. We recommend setting up automatic recurrence of the task every 10 to 20 minutes.

Figure 161: SNMP Collection Task, Scheduling

**Create New Task - Schedule**

**Startup Options**

Starts: ☐ Now  
☒ On 2017-11-26 09:44  
☐ Chain after another task

**Recurrence Options**

Repeats: Minute(s)  
 Every: 15 Minute(s)  
 Ends: ☒ Never  
☐ On

step 3 of 3 Previous Submit

Instead of scheduling recurrence, you can select to chain the task after an already-scheduled recurring task, so it launches as soon as the other task completes. When you select the “Chain after another task” radio button, a drop-down list of recurring tasks is displayed from which to select.

- Click **Submit** to complete the addition of the new collection task and add it to the Task List. Click a completed task in the list to display the results in the lower portion of the window. There are three tabs in the results window: Summary, Status, and History. An example of the Summary tab is shown in [Figure 162 on page 226](#). An example of the Status tab is shown in [Figure 163 on page 226](#).

Figure 162: Collection Results for SNMP Traffic Collection Task, Summary Tab

Task List								
							<a href="#">Add</a>	<a href="#">Modify</a>
								<a href="#">Delete</a>
Type	Name	Created	Frequency	Repeats	Starts	Ends	Last Executed	Status
Netconf Collection	test-123	11/17/20...	Immediat...	N/A	11/17/20...	N/A	11/25/20...	Scheduled
Netconf Collection	test	11/25/20...	Immediat...	N/A	11/25/20...	N/A	11/25/20...	Completed
Network Archive	network_...	10/31/20...	Daily	1	10/31/20...	12/1/201...	11/25/20...	Scheduled
Netconf Collection	first	11/25/20...	Immediat...	N/A	11/25/20...	N/A	11/25/20...	Completed
Netconf Collection	test-2	10/31/20...	Immediat...	N/A	10/31/20...	N/A	11/25/20...	Scheduled
Netconf Collection	Manual d...	11/1/201...	Immediat...	N/A	11/1/201...	N/A	11/1/201...	Completed
SNMP Traffic Collection	SNMP-test	11/25/20...	Immediat...	N/A	11/25/20...	N/A	11/25/20...	Completed
Netconf Collection	test-jeanne	10/31/20...	Hourly	5	10/31/20...	12/1/201...	11/25/20...	Scheduled

Summary	Status	History
<p>✓ Start Time 11/25/2017, 12:32:40 PM</p> <p>✓ Data Collection ...Done</p> <p>✓ End Time 11/25/2017, 12:33:49 PM</p>		

Figure 163: Collection Results for SNMP Traffic Task, Status Tab

Task List								
							<a href="#">Add</a>	<a href="#">Modify</a>
							<a href="#">Delete</a>	<a href="#">⌵</a>
Type	Name	Created	Frequency	Repeats	Starts	Ends	Last Executed	Status
SNMP Traffi...	snmp	2017-11-28 ...	Minutes	5	2017-11-28 ...	Never	2017-11-30 ...	Scheduled
Netconf Coll...	Manual devi...	2017-11-22 ...	Immediately	N/A	2017-11-22 ...	N/A	2017-11-22 ...	Completed
Netconf Coll...	echotest	2017-11-24 ...	Immediately	N/A	2017-11-24 ...	N/A	2017-11-24 ...	Completed
Network Arc...		2017-11-29 ...	Immediately	N/A	2017-11-29 ...	N/A	2017-11-29 ...	Completed
Netconf Coll...	1511850516...	2017-11-28 ...	Immediately	N/A	2017-11-28 ...	N/A	2017-11-28 ...	Completed
Network Arc...		2017-11-22 ...	Immediately	N/A	2017-11-22 ...	N/A	2017-11-22 ...	Completed
Netconf Coll...	first	2017-11-21 ...	Immediately	N/A	2017-11-21 ...	N/A	2017-11-21 ...	Completed
Netconf Coll...	1511938493...	2017-11-29 ...	Immediately	N/A	2017-11-29 ...	N/A	2017-11-29 ...	Completed
Link Latency...	newdelay	2017-11-28 ...	Minutes	5	2017-11-28 ...	Never	2017-11-30 ...	Scheduled

Summary	Status	History																																	
<table> <tr> <th>Hostname</th><th>Interface Data</th><th>LSP Data</th></tr> <tr> <td>vmx103</td><td>Collected 2 Interfaces</td><td>Collected 7 LSPs</td></tr> <tr> <td>vmx102</td><td>Collected 10 Interfaces</td><td>Collected 4 LSPs</td></tr> <tr> <td>vmx107</td><td>Collected 6 Interfaces</td><td>Collected 1 LSPs</td></tr> <tr> <td>vmx106</td><td>Collected 7 Interfaces</td><td>Collected 4 LSPs</td></tr> <tr> <td>vmx105</td><td>Collected 10 Interfaces</td><td>Collected 1 LSPs</td></tr> <tr> <td>vmx104</td><td>Collected 6 Interfaces</td><td>Collected 7 LSPs</td></tr> <tr> <td>vmx101-re0</td><td>Collected 6 Interfaces</td><td>Collected 7 LSPs</td></tr> <tr> <td>ios-xr9</td><td>Collected 1 Interfaces</td><td>Collection successful</td></tr> <tr> <td>ios-xr8</td><td>Collected 1 Interfaces</td><td>Collection successful</td></tr> <tr> <td colspan="3">All Devices Collection Complete</td></tr> </table>			Hostname	Interface Data	LSP Data	vmx103	Collected 2 Interfaces	Collected 7 LSPs	vmx102	Collected 10 Interfaces	Collected 4 LSPs	vmx107	Collected 6 Interfaces	Collected 1 LSPs	vmx106	Collected 7 Interfaces	Collected 4 LSPs	vmx105	Collected 10 Interfaces	Collected 1 LSPs	vmx104	Collected 6 Interfaces	Collected 7 LSPs	vmx101-re0	Collected 6 Interfaces	Collected 7 LSPs	ios-xr9	Collected 1 Interfaces	Collection successful	ios-xr8	Collected 1 Interfaces	Collection successful	All Devices Collection Complete		
Hostname	Interface Data	LSP Data																																	
vmx103	Collected 2 Interfaces	Collected 7 LSPs																																	
vmx102	Collected 10 Interfaces	Collected 4 LSPs																																	
vmx107	Collected 6 Interfaces	Collected 1 LSPs																																	
vmx106	Collected 7 Interfaces	Collected 4 LSPs																																	
vmx105	Collected 10 Interfaces	Collected 1 LSPs																																	
vmx104	Collected 6 Interfaces	Collected 7 LSPs																																	
vmx101-re0	Collected 6 Interfaces	Collected 7 LSPs																																	
ios-xr9	Collected 1 Interfaces	Collection successful																																	
ios-xr8	Collected 1 Interfaces	Collection successful																																	
All Devices Collection Complete																																			



**NOTE:** You can have only one SNMP traffic collection task per NorthStar server. If you attempt to add a second, the system will prompt you to approve overwriting the first one.

By default, NorthStar only collects statistics from the following interfaces when running SNMP traffic collection:

- Physical, logical loopback, or logical management interfaces that can be associated with nodes in NorthStar

- Logical interfaces associated with links in NorthStar
- Logical interfaces belonging to a VRF

The interface types that can be discovered on devices and that should be used by traffic collection can be modified by editing the `/opt/northstar/data/northstar.cfg` file. Use a text editing tool such as `vi`, and use a comma as a separator. For example:

```
configServer_include_interfaceType=physical, loopbackMgmt, vrfInterface,
linksInterface
```

The supported interface types are:

- `physical`: Physical interfaces, expressed as the interface name without a dot (.) in it.
- `loopbackMgmt`: Loopback and management interfaces expressed as the interface name starting with `lo`, `fxp`, `me`, or `em`.
- `vrfIf`: Interfaces with which a VRF is associated.
- `linksIf`: Interfaces on links.
- `all`: All interfaces

These supported interface types are also commented in the `northstar.cfg` file.

## Access the Data from the NorthStar Planner

You can access the collected data from the NorthStar Planner for planning and simulation purposes. In the NorthStar Planner, navigate to **Traffic > Traffic aggregation**. You can aggregate the traffic by hour and create a 24-hour traffic load file for each hour, aggregating the data for that particular hour across multiple days. The resulting file can be used as input into the traffic matrix solver.

### Related Documentation

- [Device Profile and Connectivity Testing on page 190](#)
- [Scheduling Device Collection for Analytics via Netconf on page 202](#)

## Link Latency Collection

You can collect link delay statistics using Link Latency collection tasks that use a ping operation (Juniper Networks and Cisco devices).

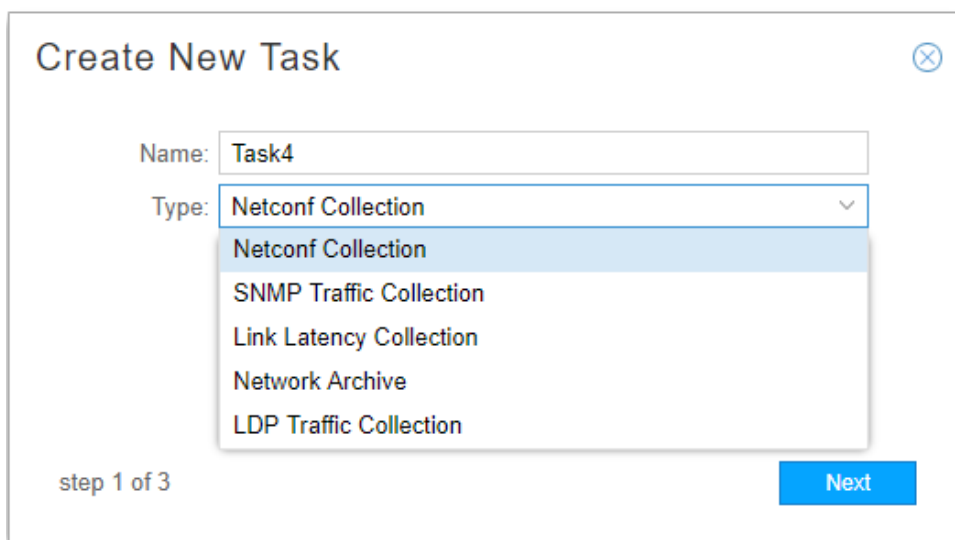
When a link latency collection task is run, the collector issues a ping from one device to the endZ address of all links to gather round trip time (RTT) statistics. The RTT is the amount of time in milliseconds from when the ping packet is sent to the time a reply is received. The minimum, maximum, and average RTT is calculated based on multiple pings.

You must run Netconf device collection before attempting to run link latency collection. This is necessary to establish the baseline network information including the interfaces and LSPs. Once Netconf device collection has been run, link latency collection tasks have the information they need.

To schedule a new link latency collection task, navigate to **Administration > Device Collection** from the More Options menu.

1. Click **Add** in the upper right corner. The Create New Task window is displayed as shown in [Figure 164 on page 228](#).

*Figure 164: Create New Task Window*

The image shows a 'Create New Task' dialog box. At the top, the title 'Create New Task' is displayed next to a close button (an 'X' in a circle). Below the title, there are two input fields. The first is labeled 'Name:' and contains the text 'Task4'. The second is labeled 'Type:' and is a dropdown menu. The dropdown menu is open, showing a list of options: 'Netconf Collection' (which is highlighted with a blue background), 'SNMP Traffic Collection', 'Link Latency Collection', 'Network Archive', and 'LDP Traffic Collection'. At the bottom left of the dialog, it says 'step 1 of 3'. At the bottom right, there is a blue button labeled 'Next'.

2. Enter a name for the task and use the drop-down menu to select the task type as Link Latency. Click **Next**.

The next window displayed does not offer any options because at this time, liveNetwork is the only device profile available. [Figure 165 on page 229](#) shows this window for link latency collection.

*Figure 165: Device Collection Task, Step 2 for Link Latency Collection*

The screenshot shows a web-based configuration window titled "Create New Task - Link Latency Collection". The window has a close button (X) in the top right corner. Below the title, there is a "Collection" section with a "Profile:" label and a dropdown menu currently showing "liveNetwork". At the bottom of the window, there is a progress indicator showing "step 2 of 3", a "Previous" button, and a blue "Next" button. The window has a scrollbar on the right side.

3. Click **Next** to proceed to the scheduling parameters. The Create New Task - Schedule window is displayed as shown in [Figure 166 on page 230](#). You can opt to run the collection only once, or to repeat it at configurable intervals. The default interval is 15 minutes.

Figure 166: Link Latency Collection Task, Scheduling

**Create New Task - Schedule**

**Startup Options**

Starts: ☐ Now

☒ On 2017-11-26 09:44

☐ Chain after another task

**Recurrence Options**

Repeats: Minute(s)

Every: 15 Minute(s)

Ends: ☒ Never

☐ On

step 3 of 3

Previous Submit

Instead of scheduling recurrence, you can select to chain the task after an already-scheduled recurring task, so it launches as soon as the other task completes. When you select the “Chain after another task” radio button, a drop-down list of recurring tasks is displayed from which to select.

- Click **Submit** to complete the addition of the new collection task and add it to the Task List. Click a completed task in the list to display the results in the lower portion of the window. There are three tabs in the results window: Summary, Status, and History. An example of the Summary tab is shown in [Figure 167 on page 231](#). An example of the Status tab is shown in [Figure 168 on page 231](#).



Figure 167: Collection Results for Link Latency Collection Task, Summary Tab

Task List								
							<a href="#">Add</a>	<a href="#">Modify</a> <a href="#">Delete</a>
Type	Name	Created	Frequency	Repeats	Starts	Ends	Last Executed	Status
Netconf C...	test-123	11/17/201...	Immediat...	N/A	11/17/201...	N/A	12/1/2017...	Scheduled
Netconf C...	test	11/25/201...	Immediately	N/A	11/25/201...	N/A	11/25/201...	Completed
Netconf C...	Monthly	11/25/201...	Monthly	1	11/25/201...	Never	11/25/201...	Scheduled
Network A...	network_a...	10/31/201...	Daily	1	10/31/201...	12/1/2017...	12/1/2017...	Completed
Netconf C...	test-2	10/31/201...	Immediat...	N/A	10/31/201...	N/A	12/1/2017...	Scheduled
Network A...	jmb-task1	11/25/201...	Immediately	N/A	11/25/201...	N/A	11/25/201...	Completed
Link Laten...	test1	12/4/2017...	Immediately	N/A	12/4/2017...	N/A	12/4/2017...	Completed
Netconf C...	first	11/25/201...	Immediately	N/A	11/25/201...	N/A	11/25/201...	Completed
Netconf C...	Manual d...	11/1/2017...	Immediately	N/A	11/1/2017...	N/A	11/1/2017...	Completed
Summary   Status   History								
<p>✓ Start Time 12/4/2017, 10:36:59 AM</p> <p>✓ Data Collection ...Done</p> <p>✓ End Time 12/4/2017, 10:37:11 AM</p>								

Figure 168: Collection Results for Link Latency Task, Status Tab

Task List								
							<a href="#">Add</a>	<a href="#">Modify</a> <a href="#">Delete</a>
Type	Name	Created	Frequency	Repeats	Starts	Ends	Last Executed	Status
Netconf C...	test-123	11/17/201...	Immediat...	N/A	11/17/201...	N/A	12/1/2017...	Scheduled
Netconf C...	test	11/25/201...	Immediately	N/A	11/25/201...	N/A	11/25/201...	Completed
Netconf C...	Monthly	11/25/201...	Monthly	1	11/25/201...	Never	11/25/201...	Scheduled
Network A...	network_a...	10/31/201...	Daily	1	10/31/201...	12/1/2017...	12/1/2017...	Completed
Netconf C...	test-2	10/31/201...	Immediat...	N/A	10/31/201...	N/A	12/1/2017...	Scheduled
Network A...	jmb-task1	11/25/201...	Immediately	N/A	11/25/201...	N/A	11/25/201...	Completed
Link Laten...	test1	12/4/2017...	Immediately	N/A	12/4/2017...	N/A	12/4/2017...	Completed
Netconf C...	first	11/25/201...	Immediately	N/A	11/25/201...	N/A	11/25/201...	Completed
Netconf C...	Manual d...	11/1/2017...	Immediately	N/A	11/1/2017...	N/A	11/1/2017...	Completed
Summary   Status   History								
Hostname		Description						
vmx105		ACCESS_FAIL						
vmx102		Collected 2 link(s) latency						
vmx106		Collected 0 link(s) latency						
vmx103		Collected 0 link(s) latency						
vmx101		ACCESS_FAIL						
vmx104		Collected 1 link(s) latency						
ios-xr8		Collected 0 link(s) latency						



**NOTE:** You can have only one link latency traffic collection task per NorthStar server. If you attempt to add a second, the system will prompt you to approve overwriting the first one.

**Related Documentation**

- [Scheduling Device Collection for Analytics via Netconf on page 202](#)

## LDP Traffic Collection

---

LDP traffic statistics track the volume of traffic passing through forwarding equivalence classes. In addition to monitoring the LDP traffic statistics in the Northstar Controller, the data can also be imported into the NorthStar Planner for capacity planning and failure simulation studies.



**NOTE:** You must run Netconf device collection before attempting to run LDP traffic collection so NorthStar (Toposerver) can discover LDP-enabled links. Learning which links are LDP-enabled allows NorthStar to compute LDP equal cost paths between sources and destinations.

See [“Scheduling Device Collection for Analytics via Netconf”](#) on page 202.

The Netconf collection task extracts LDP-enabled interfaces from the Junos OS configuration at the [protocols ldp] and [protocols mpls] hierarchy levels. ConfigServer correlates these interfaces with the links discovered by Toposerver.

To schedule a new LDP traffic collection task, navigate to **Administration > Device Collection** from the More Options menu.

1. Enter a name for the task and use the drop-down menu to select the task type **LDP Traffic Collection**. Click **Next** to display the first Create New Task – LDP Traffic Collection window as shown in [Figure 169 on page 233](#).

*Figure 169: LDP Traffic Collection Task, All Devices*

**Create New Task - LDP Traffic Collection** [Close]

Select Device(s) to be collected

Profile: liveNetwork [v]

☒ All devices
 ☐ Selective devices
 ☐ Groups

Other Options

☒ Use ECMP: 6 [v]

step 2 of 3

Previous
Next

Under Select Device(s) to be collected, you can choose All devices, Selective devices, or Groups as a method for specifying the devices to be included in the collection task. For all three of those choices, the following fields are available:

- Profile: At this time, the only profile available for collection is the liveNetwork.
- Use ECMP (the default is yes, with a value of 6).

If you select “Selective devices”, you are presented with a list of all the devices available to be included in the collection task. [Figure 170 on page 233](#) shows an example.

*Figure 170: LDP Traffic Collection Task, Selective Devices*

### Create New Task - LDP Traffic Collection

Select Device(s) to be collected

Profile: liveNetwork

☐ All devices ☒ Selective devices ☐ Groups

IP Address	Hostname	Collect
11.0....	vmx104	<input type="checkbox"/>
11.0....	vmx101	<input type="checkbox"/>
11.0....	vmx107	<input type="checkbox"/>
11.0....	vmx103	<input type="checkbox"/>
11.0....	vmx106	<input type="checkbox"/>
11.0....	vmx105	<input type="checkbox"/>

Other Options

☒ Use ECMP: 6

step 2 of 3

Previous Next

Click the check boxes corresponding to the devices you want to include.

If you opt for Groups, you are presented with a list of the device groups that have been configured in **Administration > Device Profile**, as shown in [Figure 171 on page 235](#).

Figure 171: Netconf Device Collection Task, Groups

**Create New Task - LDP Traffic Collection**

Select Device(s) to be collected

Profile: **liveNetwork**

☐ All devices ☐ Selective devices ☒ Groups

Device Group	Collect
test1	<input type="checkbox"/>
test2	<input type="checkbox"/>

Other Options

☒ Use ECMP: 6

step 2 of 3

Previous Next

Click the check boxes corresponding to the groups you want to include.

2. Click **Next** to proceed to the scheduling parameters. The Create New Task - Schedule window is displayed as shown in [Figure 172 on page 236](#). At least two collections are necessary for the calculation of demand statistics. We recommend setting up automatic recurrence of the task every 10 to 20 minutes.

Figure 172: LDP Traffic Collection Task, Scheduling

**Create New Task - Schedule**

**Startup Options**

Starts: ☒ Now  
☐ On   
☐ Chain after another task

**Recurrence Options**

Repeats:

step 3 of 3

[Previous](#) [Submit](#)

The option to chain the task after an already-scheduled recurring task is available, but we do not recommend it for LDP collection. LDP collection is better handled as a recurring, independent task.

3. Click **Submit** to complete the addition of the new collection task and add it to the Task List. The LDP traffic collection task executes **show ldp traffic-statistics** at configured intervals for the selected devices. Elasticsearch stores and indexes the collected data for further query.

Click a completed task in the list task list to display the results in the lower portion of the window. There are three tabs in the results window: Summary, Status, and History. An example of the Summary tab is shown in [Figure 173 on page 237](#). An example of the Status tab is shown in [Figure 174 on page 237](#).

Figure 173: Example Collection Results for LDP Traffic Collection Task, Summary Tab

Task List				
Type	Name	Created	Frequency	Repeats
Netconf Collection	first	2018-04-10 14:40:09...	Immediately	N/A
LDP Traffic Collection		2018-04-10 15:17:28...	Minutes	5

Summary	Status	History
<p>✓ Start Time 2018-04-10 15:37:28 PDT</p> <p>✓ Task completed, check the 'Status' tab to find the result...</p> <p>✓ End Time 2018-04-10 15:37:37 PDT</p>		

Figure 174: Example Collection Results for LDP Traffic Collection Task, Status Tab

Task List								
<div> <span>Add</span> <span>Modify</span> <span>Delete</span> <span>⌵</span> </div>								
Type	Name	Created	Frequency	Repeats	Starts	Ends	Last Executed	Status
Netconf Coll...	first	2018-...	Imme...	N/A	2018-...	N/A	2018-...	Comp...
LDP Traffic ...	103	2018-...	Minutes	5	2018-...	Never	2018-...	Sche...

Summary	Status	History
IP Address	Hostname	Description
11.0....	vmx101	Collected 6 FEC
11.0....	vmx105	Collected 6 FEC
11.0....	vmx104	Collected 6 FEC
11.0....	vmx103	Collected 6 FEC
11.0....	vmx102	Collected 6 FEC
11.0....	vmx107	Collected 6 FEC
11.0....	vmx106	Collected 6 FEC



**NOTE:** You can have only one LDP traffic collection task per NorthStar server. If you attempt to add a second, the system will prompt you to approve overwriting the first one.

- Once the traffic collection task has completed, view the collected data in the Demand tab of the network information table. The Node, Link, and Tunnel tabs are always

displayed. The other tabs are optionally displayed. Click the plus sign (+) in the tabs heading bar to add a tab as shown in [Figure 175 on page 238](#).

Figure 175: Adding a Tab to the Network Information Table

Node	Link	Tunnel	+
Name	Hostname		Demand
0110.0000....	vmx101		Interface
0110.0000....	vmx102		Maintenance
0110.0000....	vmx103		P2MP Group
			SRLG

See “[Network Information Table Overview](#)” on [page 66](#) for network information table navigation and functionality options.

The Demand tab lists the LDP Forwarding Equivalent Class (FEC) data, including Node A, Node Z, IP A, IP Z, and Bandwidth. NorthStar creates the FEC names using the source name and the destination IP address. [Figure 176 on page 238](#) shows an example of the Demand tab.

Figure 176: Network Information Table, Demand Tab

Node	Link	Tunnel	Demand		
Name	Node A	Node Z	IP A	IP Z	Bandwidth
vmx103_11...	vmx103	vmx106	11.0...	11.0...	37.0
vmx103_11...	vmx103	vmx107	11.0...	11.0...	187.0
vmx103_11...	vmx103	vmx104	11.0...	11.0...	37.0
vmx103_11...	vmx103	vmx105	11.0...	11.0...	38.0
vmx103_11...	vmx103	vmx102	11.0...	11.0...	37.0
vmx103_11...	vmx103	vmx101	11.0...	11.0...	1.03431...
vmx106_11...	vmx106	vmx107	11.0...	11.0...	0
vmx106_11...	vmx106	vmx104	11.0...	11.0...	0
vmx106_11...	vmx106	vmx105	11.0...	11.0...	0
vmx102_11...	vmx102	vmx101	11.0...	11.0...	133.0
vmx102_11...	vmx102	vmx103	11.0...	11.0...	35.0
vmx102_11...	vmx102	vmx104	11.0...	11.0...	0
vmx102_11...	vmx102	vmx105	11.0...	11.0...	187.0
vmx102_11...	vmx102	vmx106	11.0...	11.0...	187.0
vmx102_11...	vmx102	vmx107	11.0...	11.0...	35.0
vmx105_11...	vmx105	vmx106	11.0...	11.0...	342.0

<< < | Page 1 of 1 | > >> |

Add Modify Delete

- To view LDP-enabled links in the topology map, navigate to **Protocols** in the left pane and check **LDP** as shown in [Figure 177 on page 239](#).



*Figure 177: Network Information Table, Demand Tab*

**JUNIPER** NETWORKS NorthStar Controller

Protocols

- ☒ Default
- ☒ PCEP
- ☒ RSVP
- ☒ ISIS L2
- ☒ LDP
- ☒ Segment Routing

Check All Clear All

**Related  
Documentation**

- [Scheduling Device Collection for Analytics via Netconf on page 202](#)
- [NorthStar Analytics Data Retention Policy on page 189](#)
- [Network Information Table Overview on page 66](#)
- [Left Pane Options on page 50](#)

## Collection Tasks to Create Network Archives

In the Collection Task window, you can create collection tasks that create a network model in a database, for use in the NorthStar Planner. You also have the option to archive the network model.

Tunnel design attributes that are configured in the web UI are inherited by the NorthStar Planner, even though they are never pushed to the router. When you run Network Archive device collection, the tunnel information in the Planner (which came from the router) is merged with the tunnel information in the Controller (which includes design attributes that are not pushed to the router). The merged version is then available in the Planner.

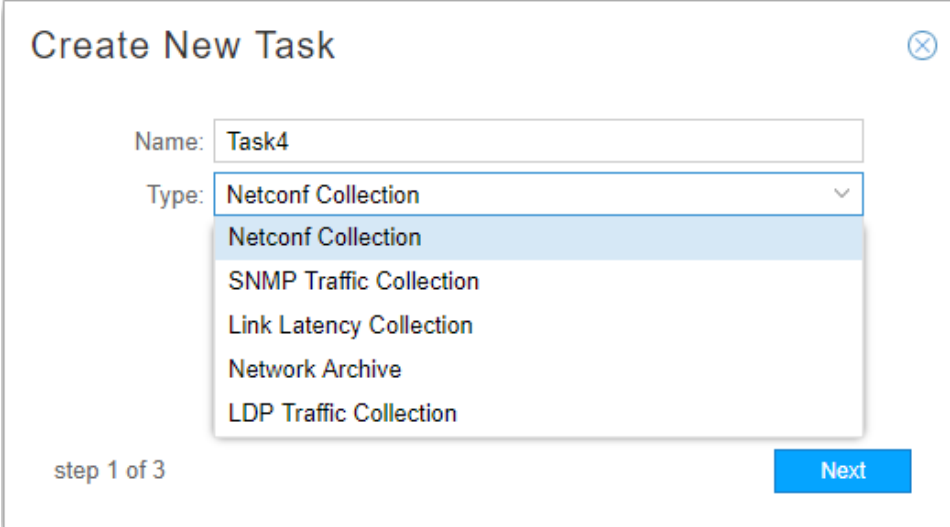
The following design attributes that are configured in the Advanced, Design, and Scheduling tabs of the Provision LSP window in the web UI are inherited by the Planner via network archive collection:

- Advanced tab: Symmetric Pair Group, Diversity Group, Diversity Level
- Design tab: Routing Method, Max Delay, Max Hop, Max Cost
- Scheduling tab: all scheduling information

To schedule a new collection task, navigate to **Administration > Device Collection**.

1. Click **Add** in the upper right corner. The Create New Task window is displayed as shown in [Figure 140 on page 202](#).

*Figure 178: Create New Task Window*



2. Enter a name for the task and use the drop-down menu to select the task type **Network Archive**. Click **Next** to display the first Create New Task – Network Archive window as shown in [Figure 179 on page 241](#).

Figure 179: Create New Task—Network Archive

**Create New Task - Network Archive**

☒ Process Equipment CLI

☒ Archive Network data after processing

☒ Include LDP traffic

**LDP traffic options**

Range for past N days(1 to 60):

Aggregation Statistic: 99th Percentile ▼

- 99th Percentile
- 95th Percentile
- 90th Percentile
- 80th Percentile
- Average
- Max

step 2 of 3

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Click the check boxes beside the options in this window to select or deselect them:

- Process Equipment CLI

Equipment CLI data is collected in Netconf collection tasks that include the Equipment CLI option. The Process Equipment CLI option in Network Archive collection parses the Equipment CLI data collected in Netconf collection and generates the Inventory Report available in both the NorthStar Controller and the NorthStar Planner.

To view Hardware Inventory in the NorthStar Planner, you must run Netconf collection with the Equipment CLI collection option (collects the inventory data) and you must run Network Archive collection with the Process Equipment CLI option (processes the inventory data).

- Archive network data after processing

This option makes the created model available in the NorthStar Planner under the Archives tab in the Network Browser window. Otherwise, the result of the Network

Archive collection task is reflected in the new spec file for the Latest Network Archive in the NorthStar Planner, but it is overwritten by the next Latest Network Archive.

- Include LDP traffic

This option loads the aggregated results of LDP traffic collection into the network model created by the Network Archive task. The LDP traffic is loaded as demand with 24 periods of statistics. You can choose up to 60 days' worth of LDP traffic to be aggregated, using the specified aggregation statistic, into 24 data points that represent hours of the day. The options in the **Aggregation Statistic** drop-down menu are described in [Table 52 on page 242](#).



**NOTE:** This option is only applicable if you have scheduled LDP traffic collection.

**Table 52: Aggregation Statistics Options**

Aggregation Statistic	Description
Max	For each of the 24 hours, the maximum of the sample values within that hour is used.
Average	For each of the 24 hours, the samples within that hour are averaged. If there are N samples for a particular hour, the result is the sum of the all the sample values divided by N.
80th, 90th, 95th, 99th Percentile (X percentile)	For each of the 24 hours, the X percentile value of the samples within that hour is used. The X percentile is computed from an equation that takes into consideration the average for the hour and the standard deviation. The result is that X percent of the sample values lie at or below the calculated value.

Selecting the Include LDP Traffic data option is required for full utilization and manipulation of traffic load data in the Network Planner.

3. Click **Next** to proceed to the scheduling parameters. The Create New Task - Schedule window is displayed as shown in [Figure 145 on page 208](#). You can opt to run the collection only once, or to repeat it at configurable intervals. The default interval is 15 minutes.

Figure 180: Device Collection Task, Scheduling

**Create New Task - Schedule**

**Startup Options**

Starts: ☐ Now

☒ On 2017-11-26 09:44

☐ Chain after another task

**Recurrence Options**

Repeats: Minute(s)

Every: 15 Minute(s)

Ends: ☒ Never

☐ On

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Previous Submit

Instead of scheduling recurrence, you can select to chain the task after an already-scheduled recurring task, so it launches as soon as the other task completes. When you select the “Chain after another task” radio button, a drop-down list of recurring tasks is displayed from which to select.

- Click **Submit** to complete the addition of the new collection task and add it to the Task List. Click a completed task in the list to display the results in the lower portion of the window. There are three tabs in the results window: Summary, Status, and History. [Figure 181 on page 244](#) shows an example of the Status tab for a complete Network Archive collection task.

Figure 181: Network Archive Collection Results, Status Tab

Summary	Status	History
<b>Details</b>		
Parsed config files		
Parsed tunnel path and added to the spec file		
Added traffic to the spec file		
Parsed equipment_cli		
Archived network		

5. Access the archives in the NorthStar Planner.

The network archive files are stored in the Cassandra database and can be accessed from there through the NorthStar Planner. See *Network Browser Window* and *Network Browser Recently Opened and Archived Networks* in the *NorthStar Planner User Guide*.

**Related  
Documentation**

- [Scheduling Device Collection for Analytics via Netconf on page 202](#)

## LSP Routing Behavior

You can configure NorthStar Controller to automatically reroute LSPs based on interface traffic or link delay conditions. The parameters that trigger rerouting can be configured on a global level (applied to all links in the network, in both directions), and you can override global thresholds with link-specific thresholds.

### Analytics Parameters Affecting LSP Routing Behavior

[Table 53 on page 245](#) summarizes the Analytics parameters that affect LSP routing behavior.

**Table 53: Analytics Parameters Affecting LSP Routing Behavior**

Parameter	Description	How to Access
Reroute Interval	User-defined, global parameter applied to both Layer 3 link utilization and LSP delay violations. It is the minimum interval after which the controller reacts to any traffic/delay violations. The minimum value is 1 minute and there is no maximum. The smaller the value, the higher the number of rerouting processes, and consequently, the greater the impact on the network. It is a mandatory parameter to trigger a Layer 3 link utilization violation or LSP delay violation rerouting process.	<b>Administration &gt; Analytics</b>
Link Utilization Threshold (%)	User-defined, global parameter applied to all links for Layer 3 link utilization violation scenarios. When this threshold is exceeded, the controller starts moving LSPs away from the congested links. It is a mandatory parameter to enable this controller behavior when Layer 3 link utilization violations occur. Once the link utilization crosses the defined threshold and no previous rerouting processes have occurred within the defined Reroute Interval, the rerouting process is triggered.	<b>Administration &gt; Analytics</b>
Packet Loss Threshold (%)	<p>When packet loss on a link exceeds this threshold, the link is considered unstable and rerouting of traffic to avoid the link is triggered. To achieve this, NorthStar creates a maintenance event for each link, temporarily making the link unavailable for traffic. The event name reflects that it was triggered by packet loss. The event start time is immediate (the link displays a red M indicating it is in maintenance mode) and the end time is set for one hour later. Because this type of maintenance event requires manual completion, the end time is not significant.</p> <p>See <a href="#">“Maintenance Events” on page 139</a> for information on viewing and managing maintenance events, including how to manually complete a triggered event once the link has been restored to stability.</p>	<b>Administration &gt; Analytics</b>

Table 53: Analytics Parameters Affecting LSP Routing Behavior (continued)

Parameter	Description	How to Access
Link Delay Increase	<p>User-defined, global parameter applied to all the links. The controller continuously monitors the link delays and computes the delta for all links. The delay increase is the absolute difference between two consecutive received link delays. It is a mandatory parameter to enable this controller behavior when LSP delay violations occur.</p> <p>To reduce unnecessary LSP delay computation, the PCS server calculates all LSPs delays only when this delta is exceeded. If any LSP calculated delay exceeds its own Max Delay settings, and no previous rerouting process has occurred within the defined Reroute Interval, then the controller attempts to perform LSP rerouting.</p> <p><b>NOTE:</b> LSP delay is the sum of all the delays of the links that belong to the LSP routing path. The controller does not directly monitor LSP delays.</p>	<b>Administration &gt; Analytics</b>
Max Delay	<p>User-defined, local parameter applied to each LSP. It is a mandatory parameter to trigger any LSP delay violation rerouting process. When an LSP is configured with a Max Delay, and there is also a global link delay threshold value, the controller checks the LSP upon LSP delay violations.</p>	<p><b>Applications &gt; Provision LSP</b> (Design Tab), or modify an existing tunnel from the network information table by selecting the tunnel row and clicking <b>Modify</b> at the bottom of the window.</p> <p>The REST API can also be used.</p>

For LSP rerouting based on link utilization (bandwidth), you can specify a reroute interval (in minutes) and a link utilization threshold (%). The reroute interval is used to pace back-to-back rerouting events. LSPs are rerouted when both of the following conditions are true:

- A link utilization threshold has been crossed.
- No previous utilization-triggered reroute has occurred within the configured reroute interval (in this sense, this timer specifies the minimum time interval between successive reroute actions).



**NOTE:** When utilization for a link crosses a configured threshold, it appears in the Timeline as an event, as does any subsequent rerouting.

For packet loss-based and delay-based rerouting, configuration of real-time performance monitoring (RPM) in Junos and installation of the rpm-log.slax script on the router are



prerequisites. See *Configuring Routers to Send JTI Telemetry Data and RPM Statistics to the Data Collectors* in the *NorthStar Controller Getting Started Guide*. Once this is done, Junos OS can monitor the links for packet loss and link latency and capture the results as syslog events.

For delay-based rerouting, the Link Delay Increase parameter controls when the LSP delay calculation (and reroute) are triggered. Only if the delay measured on a link increases by more than the link delay increase value (milliseconds), are the LSPs re-optimized. For delay-based rerouting to work, the LSPs must be configured with a Max Delay constraint (on the Provision LSP window, Design tab).

Figure 182 on page 247 shows the Provision LSP Design tab. The thresholds in this window use the delay information to derive the metrics of the LSPs, which are, in turn, used by the devices when choosing which LSPs to use to forward traffic to a given destination.

Figure 182: Provision LSP, Design Tab Showing Delay Thresholds

The screenshot shows the 'Provision LSP' window with the 'Design' tab selected. The window has five tabs: Properties, Path, Advanced, Design (active), and Scheduling. The Design tab contains the following fields:

- Routing Method: default (dropdown)
- Max Delay (ms): (input field with up/down arrows)
- Max Hop: (input field with up/down arrows)
- Max Cost: (input field with up/down arrows)
- High Delay Threshold: (input field with up/down arrows)
- Low Delay Threshold: (input field with up/down arrows)
- High Delay Metric: (input field with up/down arrows)
- Low Delay Metric: (input field with up/down arrows)

At the bottom of the window, there are three buttons: 'Preview Path', 'Cancel', and 'Submit'.

Max Delay is used by the NorthStar Path Computation Server (PCS) to constrain the routing path of an LSP. If this constraint is not met, the LSP is not routed by PCS. Max Delay is also used by the NorthStar Telemetry module to trigger LSP rerouting.

High Delay Threshold is used to penalize the LSP so it is not used by the data plane as long as there are other parallel LSPs with lower metrics. The availability of the LSP is not restored once the delay is lower than the High Delay Threshold, until the LSP delay reaches Low Delay Threshold. This prevents excess impact on the network. When the LSP delay drops below the Low Delay Threshold, its metric is set to Low Delay.

## Setting Global Parameters

To set the global configuration parameters, navigate to **Administration > Analytics**. The LSP Routing Behavior window is displayed as shown in [Figure 183 on page 248](#).

*Figure 183: LSP Routing Behavior*

^ LSP Routing Behavior

When enabled and configured, NorthStar will automatically reroute LSP based on interface traffic or link delay conditions.

Reroute: ☐ Disabled ☒ Enabled

Reroute Interval: \* 5 minutes

Link Utilization Threshold: 100%

Packet Loss Threshold: 100%

Link Delay Increase: ☐ Use increasing link delay measurements to reroute. milliseconds

Save

For LSP rerouting to work, you must select Reroute: **Enabled** in this window, which causes the additional fields to be displayed. Click **Save** to configure the global settings.

## Setting Link-Specific Thresholds

The link utilization threshold, packet loss threshold, and link delay increase can be set at the link level. Link-level configuration of these thresholds overrides the global settings.

Link level thresholds are set in the Link tab of the network information table. Select a link and click **Modify** at the bottom of the table. The Modify Link window is displayed as shown in [Figure 184 on page 249](#).

Figure 184: LSP Routing Behavior

**Modify Link**

< Properties Advanced **Analytics** Configuration User Pr >

	Direction: <b>A to Z</b>	<b>Z to A</b>
Node/Interface:	vmx104 ge-0/1/7.0	vmx106 ge-0/1/7.0
Link Utilization Threshold:	<input type="text"/>	<input type="text"/>
Packet Loss Threshold:	<input type="text"/>	<input type="text"/>
Link Delay Increase:	<input type="text"/>	<input type="text"/>

Cancel Submit

In the Analytics tab, you can set any or all of the three thresholds on a per-direction basis (A-to-Z, Z-to-A) for that specific link.



**NOTE:** Interface A and Interface Z fields must be populated in a link for the Analytics tab to be available in the Modify Link window. This information comes from Netconf collection, so you can either wait for the next scheduled Netconf collection task to run, or you can create a collection task that runs immediately.

## Viewing Threshold-Related Information

You can view interface traffic, interface delay, and packet loss in chart form by right-clicking a link in the network information table as shown in [Figure 185 on page 250](#).

Figure 185: Right-Clicking a Link in the Network Information Table

Node			
Link			
Tunnel			
Maintenance			
Name	Status	Node A	Node Z
L11.10...	... Up	vmx101	vmx105
L11.10...	... Up	vmx101	vmx105
L11.10...	... Up	vmx101	vmx106
L11.10...	... Up	vmx101	vmx107
L11.10...	... Up	vmx101	vmx106
L11.10...	... Up	vmx101	vmx107
L11.10...	... Up	vmx101	vmx106
L11.10...	... Up	vmx105	vmx107

In the topology map, you can choose to display interface utilization, measured delay, or packet loss labels for the links. Click the Settings icon on the right side of the topology view to open the Topology Settings window where you can control link labels and other display options.

- Related Documentation
- [Maintenance Events on page 139](#)
  - [Viewing Analytics Data in the Web UI on page 210](#)
  - [Left Pane Options on page 50](#)
  - [Provision LSPs](#)
  - [Interactive Map Features on page 30](#)

## PART 3

# Troubleshooting the NorthStar Controller

- [Troubleshooting Strategies on page 253](#)
- [Frequently Asked Troubleshooting Questions on page 281](#)
- [Additional Troubleshooting Resources on page 285](#)



# Troubleshooting Strategies

- [NorthStar Controller Troubleshooting Overview on page 253](#)
- [NorthStar Controller Troubleshooting Guide on page 254](#)

## NorthStar Controller Troubleshooting Overview

In the Web UI, the Dashboard View and Event View (**Applications>Event View**) provide information that can help with troubleshooting.

For additional information to help identify and troubleshoot issues with the Path Computation Server (PCS) or NorthStar Controller application, you can access the log files.



**NOTE:** If you are unable to resolve a problem with the NorthStar Controller, we recommend that you forward the debug files generated by the NorthStar Controller debugging utility to JTAC for evaluation. Currently all debug files are located in subdirectories under the `u/wandl/tmp` directory.

You can use either of the following methods to collect debug files:

- Log in to the NorthStar Controller Java Client Operator UI as administrator and click **Collect Debug Traces**. The NorthStar Controller generates a debug file, for example, `NS-Trace-2015-04-10T22-18-55.919.tbz`.
- Log in to the NorthStar Controller CLI, and execute the command `u/wandl/bin/system-diagnostic.sh filename`.

The output is generated and available from the `/tmp` directory in the `filename.tbz2` debug file.

[Table 54 on page 253](#) lists the NorthStar Controller log files most commonly used to identify and troubleshoot issues with the PCS and PCE. All log files are located under the `/opt/northstar/logs` directory.

*Table 54: NorthStar Controller Log Files*

Log Files	Description
<code>cassandra.msg</code>	Log events related to the cassandra database.

**Table 54: NorthStar Controller Log Files (continued)**

<b>configServer.msg</b>	Log files related to maintaining LSP configuration states in NorthStar Controller. LSP configuration states are updated by collecting show commands and NETCONF provisioning.
<b>ha_agent.msg</b>	HA coordinator log.
<b>mlAdaptor.log</b>	Interface to transport controller log.
<b>netconfd.msg</b>	Log files related to communication between NorthStar Controller and devices via NETCONF sessions.
<b>net_setup.log</b>	Configuration script log.
<b>nodejs.msg</b>	Log events related to nodejs.
<b>pcep_server.log</b>	Log files related to communication between the PCC and the PCE in both directions.
<b>pcs.log</b>	Log files related to the PCS, which includes any event received by PCS from Toposerver and any event from Toposerver to PCS including provisioning orders. This log also contains any communication errors as well as any issues that prevent the PCS from starting up properly.
<b>rest_api.log</b>	Logs files of REST API requests.
<b>toposerver.log</b>	<p>Log files related to the topology server.</p> <p>Contains the record of the events between the PCS and topology server, the topology server and NTAD, and the topology server and the PCE server</p> <p><b>NOTE:</b> Any message forwarded to the <b>pcshandler.log</b> file is also forwarded to the <b>pcs.log</b> file.</p>

- Related Documentation**
- [NorthStar Controller Troubleshooting Guide on page 254](#)
  - [FAQs for Troubleshooting the NorthStar Controller on page 281](#)

## NorthStar Controller Troubleshooting Guide

This document includes strategies for identifying whether an apparent problem stems from the NorthStar Controller or from the router, and provides troubleshooting techniques for those problems that are identified as stemming from the NorthStar Controller.

Before you begin any troubleshooting investigation, confirm that all system processes are up and running. A sample list of processes is shown below. Your actual list of processes could be different.

```
[root@user-PCS ~]# supervisorctl status
collector:es_publisher      RUNNING   pid 2557, uptime 0:02:18
collector:task_scheduler    RUNNING   pid 2558, uptime 0:02:18
collector:worker1           RUNNING   pid 404, uptime 0:07:00
collector:worker2           RUNNING   pid 406, uptime 0:07:00
```



```

collector:worker3      RUNNING  pid 405, uptime 0:07:00
collector:worker4      RUNNING  pid 407, uptime 0:07:00
infra:cassandra         RUNNING  pid 402, uptime 0:07:01
infra:ha_agent          RUNNING  pid 1437, uptime 0:05:44
infra:healthmonitor     RUNNING  pid 1806, uptime 0:04:26
infra:license_monitor   RUNNING  pid 399, uptime 0:07:01
infra:prunedb           RUNNING  pid 395, uptime 0:07:01
infra:rabbitmq          RUNNING  pid 397, uptime 0:07:01
infra:redis_server      RUNNING  pid 401, uptime 0:07:01
infra:web               RUNNING  pid 2556, uptime 0:02:18
infra:zookeeper         RUNNING  pid 396, uptime 0:07:01
listener1:listener1_00  RUNNING  pid 1902, uptime 0:04:15
netconf:netconfd        RUNNING  pid 2555, uptime 0:02:18
northstar:mladapter     RUNNING  pid 2551, uptime 0:02:18
northstar:npat          RUNNING  pid 2552, uptime 0:02:18
northstar:pcserver      RUNNING  pid 1755, uptime 0:04:29
northstar:scheduler     RUNNING  pid 2553, uptime 0:02:18
northstar:toposerver    RUNNING  pid 2554, uptime 0:02:18
northstar_pcs:PCServer  RUNNING  pid 2549, uptime 0:02:18
northstar_pcs:PCViewer  RUNNING  pid 2548, uptime 0:02:18
northstar_pcs:configServer  RUNNING  pid 2550, uptime 0:02:18

```

Restart any processes that display as STOPPED instead of RUNNING.



**NOTE:** To stop, start, or restart all processes, use the service `northstar stop`, `service northstar start`, and `service northstar restart` commands.

To access system process status information from the NorthStar Controller Web UI, navigate to **More Options>Administration** and select **System Health**.

The current CPU %, memory usage, virtual memory usage, and other statistics for each system process are displayed. [Figure 186 on page 255](#) shows an example.



**NOTE:** Only processes that are running are included in this display.

**Figure 186: Process Status Display**

Process	PID	User	Group	CPU %	Memory	Virtual Memori	CPU Time	CMD
Cluster : 172.25.152.150 (14)								
npat_ro	1892	pcs	pcs	0.0	815.10K	15.74M	00:00:00	/opt/pcs/bin/npatservice 47004 pcservice
pcserver	1894	root	root	0.0	2.17M	111.30M	00:04:26	/bin/bash -x /opt/northstar/thirdparty/supervisord/supervisord-pcs.sh
toposerver	1913	pcs	pcs	0.0	14.89M	956.68M	00:00:18	/opt/pcs/bin/TopoServer /opt/northstar/data/toposerver.properties
pcserver	1928	pcs	pcs	0.0	1.27G	2.54G	00:00:09	/opt/pcs/bin/PCServer -port 47003 -borgPort 7913 -handlerPort 7915
mladapter	1932	pcs	pcs	0.1	40.19M	719.11M	00:10:03	/opt/northstar/thirdparty/python/bin/python /opt/northstar/mlAdapter/mlAdapter.py
npat	1946	pcs	pcs	0.0	823.30K	15.74M	00:00:00	/opt/pcs/bin/npatservice 7000 0
nodejs	16658	pcs	pcs	0.0	206.79M	8.37G	00:02:03	/opt/pcs/thirdparty/node-v0.12.7-linux-x64/bin/node /opt/pcs/Node/Slapp.js
listener1_00	26003	root	root	0.0	19.33M	384.43M	00:02:36	/opt/northstar/thirdparty/python/bin/python /opt/northstar/haagent/event_listener.py
junosvm	26004	root	root	0.0	2.06M	111.30M	00:03:05	/bin/bash /opt/northstar/thirdparty/supervisord/supervisord-junosvm.sh
haproxy	26005	pcs	pcs	0.0	3.72M	39.92M	00:00:08	/opt/northstar/thirdparty/haproxy/sbin/haproxy -db -f /opt/northstar/data/haproxy.cfg
zookeeper	26007	pcs	pcs	0.0	1.46M	110.76M	00:00:00	/bin/bash /opt/northstar/thirdparty/supervisord/supervisord-zookeeper.sh
rabbitmq	26008	pcs	pcs	0.0	1.48M	110.76M	00:00:00	/bin/bash /opt/northstar/thirdparty/supervisord/supervisord-rabbitmq.sh
ha_agent	26011	root	root	0.0	22.11M	401.29M	00:02:17	/opt/northstar/thirdparty/python/bin/python /opt/northstar/haagent/ha_agent.py
cassandra	26012	pcs	pcs	0.0	1.47M	110.76M	00:00:00	/bin/bash /opt/northstar/thirdparty/supervisord/supervisord-cassandra.sh

[Table 55 on page 256](#) describes each field displayed in the Process Status table.

*Table 55: Descriptions of Process Status Fields*

Field	Description
Process	The name of the NorthStar Controller process.
PID	The Process ID number.
User	The NorthStar Controller user permissions required to access information about this process.
Group	NorthStar Controller user group permissions required to access information about this process.
CPU%	Displays current percentage of CPU currently in use by this process.
Memory	Displays current percentage of memory currently in use by this process.
Virtual Memory	Displays current Virtual memory in use by this process.
CPU Time	The amount of time the CPU was used for processing instructions for the process
CMD	Displays the specific command options for the system process.

The troubleshooting information is presented in the following sections:

- [NorthStar Controller Log Files on page 256](#)
- [Empty Topology on page 259](#)
- [Incorrect Topology on page 261](#)
- [Missing LSPs on page 262](#)
- [PCC That is Not PCEP-Enabled on page 264](#)
- [LSP Stuck in PENDING or PCC\\_PENDING State on page 265](#)
- [LSP That is Not Active on page 266](#)
- [Disappearing Changes on page 267](#)
- [Investigating Client Side Issues on page 270](#)
- [Configuring NorthStar Server to Use Remote Syslog on page 273](#)
- [Collecting NorthStar Controller Debug Files on page 275](#)
- [Enabling the SNMP Daemon on the NorthStar Controller on page 276](#)

## NorthStar Controller Log Files

Throughout your troubleshooting efforts, it can be helpful to view various NorthStar Controller log files. To access log files:

1. Log in to the NorthStar Controller Web UI.
2. Navigate to **More Options** > **Administration** and select **Logs**.

A list of NorthStar system log and message files is displayed, a truncated example of which is shown in [Figure 187 on page 257](#).

*Figure 187: Sample of System Log and Message Files*

File	Size	Last Modified Time
<a href="#">archives</a>	4.10K	2016-01-12 13:21
<a href="#">cassandra.msg</a>	498.23K	2016-01-29 09:04
<a href="#">cassandra.msg.1</a>	1.05M	2016-01-21 07:45
<a href="#">event_listener.log</a>	230.75K	2016-01-29 09:48
<a href="#">event_listener.log.1</a>	1.05M	2016-01-29 07:18
<a href="#">event_listener.log.10</a>	1.05M	2016-01-14 05:01
<a href="#">event_listener.log.2</a>	1.05M	2016-01-27 14:25
<a href="#">event_listener.log.3</a>	1.05M	2016-01-25 20:30
<a href="#">event_listener.log.4</a>	1.05M	2016-01-24 02:35
<a href="#">event_listener.log.5</a>	1.05M	2016-01-22 09:04
<a href="#">event_listener.log.6</a>	1.05M	2016-01-20 19:57
<a href="#">event_listener.log.7</a>	1.05M	2016-01-19 02:35
<a href="#">event_listener.log.8</a>	1.05M	2016-01-17 08:39
<a href="#">event_listener.log.9</a>	1.05M	2016-01-15 14:44
<a href="#">ha_agent.msg</a>	107.22K	2016-01-29 08:10
<a href="#">haproxy.log</a>	2.95M	2016-01-29 09:47
<a href="#">haproxy.msg</a>	4.73K	2016-01-29 08:06
<a href="#">junosvm.msg</a>	78.17K	2016-01-29 08:10
<a href="#">keepalived_api.log</a>	8.99K	2016-01-29 08:10
<a href="#">keepalived.msg</a>	10.06K	2016-01-29 08:10
<a href="#">mlAdapter.log</a>	50.79K	2016-01-29 08:10
<a href="#">mlAdapter.msg</a>	16.39K	2016-01-29 08:07
<a href="#">net_setup.log</a>	43.17K	2016-01-29 09:12
<a href="#">nodejs.msg</a>	41.61K	2016-01-29 09:48
<a href="#">nodejs.msg.1</a>	1.05M	2016-01-29 09:34
<a href="#">nodejs.msg.2</a>	1.05M	2016-01-26 09:30
<a href="#">nodejs.msg.3</a>	1.05M	2016-01-22 12:28

3. Click the log file or message file that you want to view.

The log file contents are displayed in a pop-up window.

4. To open the file in a separate browser window or tab, click **View Raw Log** in the pop-up window.
5. To close the pop-up window and return to the list of log and message files, click X in the upper right corner of the pop-up window.

Table 54 on page 253 lists the NorthStar Controller log files most commonly used to identify and troubleshoot issues with the PCS and PCE.

**Table 56: Top NorthStar Controller Troubleshooting Log Files**

Log File	Description	Location
<b>pcep_server.log</b>	Log entries related to the PCEP server. The PCEP server maintains the PCEP session. The log contains information about communication between the PCC and the PCE in both directions.  To configure verbose PCEP server logging:  1. From the NorthStar Controller CLI, run <b>pcep_cli</b> .  2. Type <b>set log-level all</b> .  3. Press CTRL-C to exit.	<b>/var/log/jnc</b>
<b>pcs.log</b>	Log entries related to the PCS. The PCS is responsible for path computation. This log includes events received by the PCS from the Toposerver, including provisioning orders. It also contains notification of communication errors and issues that prevent the PCS from starting up properly.	<b>/opt/northstar/logs</b>
<b>toposerver.log</b>	Log entries related to the topology server. The topology server is responsible for maintaining the topology. These logs contain the record of the events between the PCS and the Toposerver, the Toposerver and NTAD, and the Toposerver and the PCE server	<b>/opt/northstar/logs</b>

Table 57 on page 258 lists additional log files that can also be helpful for troubleshooting. All of the log files in Table 57 on page 258 are located under the **/opt/northstar/logs** directory.

**Table 57: Additional Log Files for Troubleshooting NorthStar Controller**

Log Files	Description
<b>cassandra.msg</b>	Log events related to the cassandra database.
<b>ha_agent.msg</b>	HA coordinator log.
<b>mlAdaptor.log</b>	Interface to transport controller log.
<b>net_setup.log</b>	Configuration script log.
<b>nodejs.msg</b>	Log events related to nodejs.
<b>pcep_server.log</b>	Log files related to communication between the PCC and the PCE in both directions.

Table 57: Additional Log Files for Troubleshooting NorthStar Controller (continued)

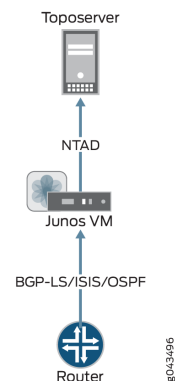
<b>pcs.log</b>	Log files related to the PCS, which includes any event received by PCS from Toposerver and any event from Toposerver to PCS including provisioning orders. This log also contains any communication errors as well as any issues that prevent the PCS from starting up properly.
<b>rest_api.log</b>	Logs files of REST API requests.
<b>toposerver.log</b>	<p>Log files related to the topology server.</p> <p>Contains the record of the events between the PCS and topology server, the topology server and NTAD, and the topology server and the PCE server</p> <p><b>NOTE:</b> Any message forwarded to the <b>pcshandler.log</b> file is also forwarded to the <b>pcs.log</b> file.</p>

To see logs related to the Junos VM, you must establish a telnet session to the router. The default IP address for the Junos VM is 172.16.16.2. The Junos VM is responsible for maintaining the necessary BGP, ISIS, or OSPF sessions.

## Empty Topology

Figure 188 on page 259 illustrates the flow of information from the router to the Toposerver that results in the topology display in the NorthStar Controller UI. When the topology display is empty, it is likely this flow has been interrupted. Finding out where the flow was interrupted can guide your problem resolution process.

Figure 188: Topology Information Flow



The topology originates at the routers. For NorthStar Controller to receive the topology, there must be a BGP-LS, ISIS, or OSPF session from one of the routers in the network to the Junos VM. There must also be an established Network Topology Abstractor Daemon (NTAD) session between the Junos VM and the Toposerver.

To check these connections:

1. Using the NorthStar Controller CLI, verify that the NTAD connection between the Toposerver and the Junos VM was successfully established as shown in this example:

```
[root@northstar ~]# netstat -na | grep :450
```

```
tcp        0      0 172.16.16.1:55752    172.16.16.2:450
ESTABLISHED
```



**NOTE:** Port 450 is the port used for Junos VM to Toposerver connections.

In the following example, the NTAD connection has not been established:

```
[root@northstar ~]# netstat -na | grep :450
```

```
tcp        0      0 172.16.16.1:55752    172.16.16.2:450
LISTENING
```

2. Log in to the Junos VM to confirm whether NTAD is configured to enable topology export:

```
[root@northstar ~]# telnet 172.16.16.2
```

```
Trying 172.16.16.2...
Connected to 172.16.16.2.
Escape character is '^['.
```

```
northstar_junosvm (ttyp0)
```

```
login: northstar
```

```
Password:
```

```
--- JUNOS 14.2R4.9 built 2015-08-25 21:01:39 UTC
```

```
This JunOS VM is running in non-persistent mode.
If you make any changes on this JunOS VM,
Please make sure you save to the Host using net_setup.py utility, otherwise
the config will be lost if this VM is restarted.
```

```
northstar@northstar_junosvm> show configuration protocols | display set
```

```
set protocols topology-export
```

If the **topology-export** statement is missing, the Junos VM cannot export data to the Toposerver.

3. Use Junos OS **show** commands to confirm whether the BGP, ISIS, or OSPF relationship between the Junos VM and the router is ACTIVE. If the session is not ACTIVE, the topology information cannot be sent to the Junos VM.

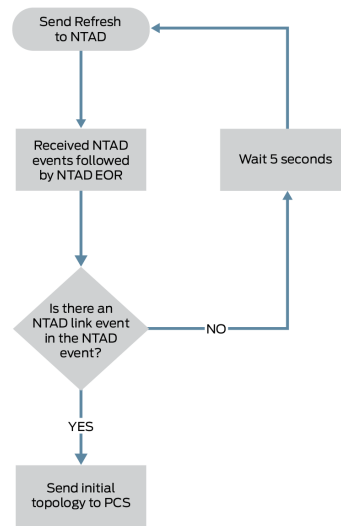
4. On the Junos VM, verify whether the `lsdist.0` routing table has any entries:

```
northstar@northstar_junosvm> show route table lsdist.0 terse | match lsdist.0
lsdist.0: 54 destinations, 54 routes (54 active, 0 holddown, 0 hidden)
```

If you see only zeros in the `lsdist.0` routing table, there is no topology that can be sent. Review the *NorthStar Controller Getting Started Guide* sections on configuring topology acquisition.

5. Ensure that there is at least one link in the `lsdist.0` routing table. The Toposerver can only generate an initial topology if it receives at least one NTAD link event. A network that consists of a single node with no IGP adjacency with other nodes (as is possible in a lab environment, for example), will not enable the Toposerver to generate a topology. [Figure 189 on page 261](#) illustrates the Toposerver's logic process for creating the initial topology.

**Figure 189: Logic Process for Initial Topology Creation**



If an initial topology cannot be created for this reason, the `toposerver.log` generates an entry similar to the following example:

```
Dec 9 16:03:57.788514 fe-cluster-03 TopoServer Did not send the topology because no links were found.
```

## Incorrect Topology

One important function of the Toposerver is to correlate the unidirectional link (interface) information from the routers into bidirectional links by matching source and destination IPv4 Link\_Identifiers from NTAD link events. When the topology displayed in the NorthStar UI does not appear to be correct, it can be helpful to understand how the Toposerver handles the generation and maintenance of the bidirectional links.

Generation and maintenance of bidirectional links is a complex process, but here are some key points:

- For the two nodes constituting each bidirectional link, the Node ID that was assigned first (and therefore has the lower Node ID number) is given the Node A designation, and the other node is given the Node Z designation.



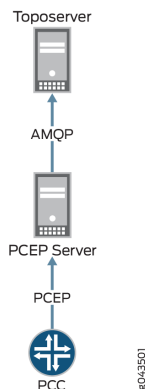
**NOTE:** The Node ID is assigned when the Toposerver first receives the Node event from NTAD.

- Whenever a Node ID is cleared and reassigned (such as during a Toposerver restart or network model reset), the Node IDs and therefore, the A and Z designations, can change.
- The Toposerver receives a Link Update message when a link in the network is added or modified.
- The Toposerver receives a Link Withdraw message when a link is removed from the network.
- The Link Update and Link Withdraw messages affect the operational status of the nodes.
- The node operational status, together with the protocol (IGP versus IGP plus MPLS) determine whether a link can be used to route LSPs. For a link to be used to route LSPs, it must have both an operational status of UP and the MPLS protocol active.

## Missing LSPs

When your topology is displaying correctly, but you have missing LSPs, take a look at the flow of information from the PCC to the Toposerver that results in tunnels being added to the NorthStar Controller UI, as illustrated in [Figure 190 on page 262](#). The flow begins with the configuration at the PCC, from which an LSP Update message is passed to the PCEP server by way of a PCEP session and then to the Toposerver by way of an Advanced Message Queuing Protocol (AMQP) connection.

*Figure 190: LSP Information Flow*





To check these connections:

1. Look at the `toposerver.log`. The log prints a message every 15 seconds when it detects that its connection with the PCEP server has been lost or was never successfully established. Note that in the following example, the connection between the Toposerver and the PCEP server is marked as down.

```
Toposerver log:
Apr 22 16:21:35.016721 user-PCS TopoServer Warning, did not receive the PCE
beacon within 15 seconds, marking it as down. Last up: Fri Apr 22 16:21:05
2016
Apr 22 16:21:35.016901 user-PCS TopoServer [->PCS] PCE Down: Warning, did not
receive the PCE beacon within 15 seconds, marking it as down. Last up: Fri
Apr 22 16:21:05 2016
Apr 22 16:21:50.030592 user-PCS TopoServer Warning, did not receive the PCE
beacon within 15 seconds, marking it as down. Last up: Fri Apr 22 16:21:05
2016
Apr 22 16:21:50.031268 user-PCS TopoServer [->PCS] PCE Down: Warning, did not
receive the PCE beacon within 15 seconds, marking it as down. Last up: Fri
Apr 22 16:21:05 2016
```

2. Using the NorthStar Controller CLI, verify that the PCEP session between the PCC and the PCEP server was successfully established as shown in this example:

```
[root@northstar ~]# netstat -na | grep :4189
tcp        0      0 0.0.0.0:4189          0.0.0.0:*
LISTEN
tcp        0      0 172.25.152.42:4189   172.25.155.50:59143
ESTABLISHED
tcp        0      0 172.25.152.42:4189   172.25.155.48:65083
ESTABLISHED
```



**NOTE:** Port 4189 is the port used for PCC to PCEP server connections.

Knowing that the session has been established is useful, but it does not necessarily mean that any data was transferred.

3. Verify whether the PCEP server learned about any LSPs from the PCC.

```
[root@user-PCS ~]# pcep_cli
# show lsp all list
2016-04-22 17:09:39.696061(19661)[DEBUG]: pcc_lsp_table.begin:
2016-04-22 17:09:39.696101(19661)[DEBUG]: pcc-id:1033771436/172.25.158.61,
state: 0
2016-04-22 17:09:39.696112(19661)[DEBUG]: START of LSP-NAME-TABLE
...
2016-04-22 17:09:39.705358(19661)[DEBUG]: Summary pcc_lsp_table:
2016-04-22 17:09:39.705366(19661)[DEBUG]: Summary LSP name tabl:
2016-04-22 17:09:39.705375(19661)[DEBUG]:
client_id:1033771436/172.25.158.61, state:0,num LSPs:13
2016-04-22 17:09:39.705388(19661)[DEBUG]:
```

```

client_id:1100880300/172.25.158.65, state:0,num LSPs:6
2016-04-22 17:09:39.705399(19661)[DEBUG]:
client_id:1117657516/172.25.158.66, state:0,num LSPs:23
2016-04-22 17:09:39.705410(19661)[DEBUG]:
client_id:1134434732/172.25.158.67, state:0,num LSPs:4
2016-04-22 17:09:39.705420(19661)[DEBUG]: Summary LSP id table:
2016-04-22 17:09:39.705429(19661)[DEBUG]:
client_id:1033771436/172.25.158.61, state:0, num LSPs:13
2016-04-22 17:09:39.705440(19661)[DEBUG]:
client_id:1100880300/172.25.158.65, state:0, num LSPs:6
2016-04-22 17:09:39.705451(19661)[DEBUG]:
client_id:1117657516/172.25.158.66, state:0, num LSPs:23
2016-04-22 17:09:39.705461(19661)[DEBUG]:
client_id:1134434732/172.25.158.67, state:0, num LSPs:4

```

In the far right column of the output, you see the number of LSPs that were learned. If this number is 0, no LSP information was sent to the PCEP server. In that case, check the configuration on the PCC side, as described in the *NorthStar Controller Getting Started Guide*.

## PCC That is Not PCEP-Enabled

The Toposerver associates the PCEP sessions with the nodes in the topology from the TED in order to make a node PCEP-enabled. This Toposerver function is hindered if the IP address used by the PCC to establish the PCEP session was not the one automatically learned by the Toposerver from the TED. For example, if a PCEP session is established using the management IP address, the Toposerver will not receive that IP address from the TED.

When the PCC successfully establishes a PCEP session, it sends a PCC\_SYNC\_COMPLETE message to the Toposerver. This message indicates to NorthStar that synchronization is complete. The following is a sample of the corresponding toposerver log entries, showing both the PCC\_SYNC\_COMPLETE message and the PCEP IP address that NorthStar might or might not recognize:

```

Dec 9 17:12:11.610225 fe-cluster-03 TopoServer NSTopo::updateNode (PCCNodeEvent)
ip: 172.25.155.26 pcc_ip: 172.25.155.26 evt_type: PCC_SYNC_COMPLETE
Dec 9 17:12:11.610230 fe-cluster-03 TopoServer Adding PCEP fflag to pcep_ip:
172.25.155.26 node_id: 0880.0000.0026 router_ID: 88.0.0.26 protocols: 4
Dec 9 17:12:11.610232 fe-cluster-03 TopoServer Setting live pcep_ip:
172.25.155.26 for router_ID: 88.0.0.26

```

Some options for correcting the problem of an unrecognized IP address are:

- Manually input the unrecognized IP address in the device profile in the NorthStar Web UI by navigating to **More Options > Administration > Device Profile**.
- Ensure there is at least one LSP originating on the router, which will allow Toposerver to associate the PCEP session with the node in the TED database.

Once the IP address problem is resolved, and the Toposerver is able to successfully associate the PCEP session with the node in the topology, it adds the PCEP IP address to the node attributes as can be seen in the PCS log:

```
Dec 9 17:12:11.611392 fe-cluster-03 PCServer [<-TopoServer] routing_key =
ns_node_update_key
Dec 9 17:12:11.611394 fe-cluster-03 PCServer [<-TopoServer] NODE UPDATE(Live):
ID=0880.0000.0026 protocols=(20)ISIS2,PCEP status=UNKNOWN hostname=skynet_26
router_ID=88.0.0.26 iso=0880.0000.0026 isis_area=490001 AS=41 mgmt_ip=172.25.155.26
source=NTAD Hostname=skynet_26 pcep_ip=172.25.155.26
```

## LSP Stuck in PENDING or PCC\_PENDING State

Once nodes are correctly established as PCEP-enabled, you could start provisioning LSPs. It is possible for the LSP controller status to indicate PENDING or PCC\_PENDING as seen in the Tunnels tab of the Web UI network information table (Controller Status column). This section explains how to interpret those statuses.

When an LSP is being provisioned, the PCS server computes a path that satisfies all the requirements for the LSP, and then sends a provisioning order to the PCEP server. Log messages similar to the following example appear in the PCS log while this process is taking place:

```
Apr Apr 25 10:06:44.798336 user-PCS PCServer [->TopoServer] push lsp configlet,
action=ADD
Apr 25 10:06:44.798341 user-PCS PCServer
Apr 25 10:06:44.798341 user-PCS PCServer [->TopoServer] push lsp configlet, action=ADD
Apr 25 10:06:44.802500 user-PCS PCServer provisioning order sent, status = SUCCESS
Apr 25 10:06:44.802519 user-PCS PCServer [->TopoServer] Save LSP action,
id=928380025 event=Provisioning Order(ADD) sent request_id=928380025
Apr 25 10:06:44.802534 user-PCS PCServer lsp action=ADD JTAC@11.0.0.102 path=
controller_state=PENDING
```

The LSP controller status is PENDING at this point, meaning that the provisioning order has been sent to the PCEP server, but an acknowledgement has not yet been received. If an LSP is stuck at PENDING, it suggests that the problem lies with the PCEP server. You can log into the PCEP server and configure verbose log messages which can provide additional information of possible troubleshooting value:

```
pcep_cli
set log-level all
```

There are also a variety of **show** commands on the PCEP server that can display useful information. Just as with Junos OS syntax, you can enter **show ?** to see the **show** command options.

If the PCEP server successfully receives the provisioning order, it performs two actions:

- It forwards the order to the PCC.
- It sends an acknowledgement back to the PCS.

The PCEP server log would show an entry similar to the following example:

```
2016-04-25 10:06:45.196263(27897) [EVENT]: 172.25.158.66:JTAC UPD RCVD FROM PCC,
ack 928380025
2016-04-25 10:06:45.196517(27897) [EVENT]: 172.25.158.66:JTAC ADD SENT TO PCS
928380025, UP
```

The LSP controller status changes to PCC\_PENDING, indicating that the PCEP server received the provisioning order and forwarded it on to the PCC, but the PCC has not yet responded. If an LSP is stuck at PCC\_PENDING, it suggests that the problem lies with the PCC.

If the PCC receives the provisioning order successfully, it sends a response to the PCEP server, which in turn, forwards the response to the PCS. When the PCS receives this response, it clears the LSP controller status completely, indicating that the LSP is fully provisioned and is not waiting for action from the PCEP server or PCC. The operational status (Op Status column) then becomes the indicator for the condition of the tunnel.

The PCS log would show an entry similar to the following example:

```
Apr 25 10:06:45.203909 user-PCS PCServer [<-TopoServer] JTAC@11.0.0.102, LSP
event=(0)CREATE request_id=928380025 tunnel_id=9513 lsp_id=1 report_type=ACK
```

## LSP That is Not Active

If an LSP provisioning order is successfully sent and acknowledged, and the controller status is cleared, it is still possible that the LSP is not up and running. If the operational status of the LSP is DOWN, the PCC cannot signal the LSP. This section explores some of the possible reasons for the LSP operational status to be DOWN.

Utilization is a key concept related to LSPs that are stuck in DOWN. There are two types of utilization, and they can be different from each other at any specific time:

- Live utilization—This type is used by the routers in the network to signal an LSP path. This type of utilization is learned from the TED by way of NTAD. You might see PCS log entries such as those in the following example. In particular, note the reservable bandwidth (**reservable\_bw**) entries that advertise the RSVP utilization on the link:

```
Apr 25 10:10:11.475686 user-PCS PCServer [<-TopoServer] LINK UPDATE:
ID=L11.105.107.1_11.105.107.2 status=UP nodeA=0110.0000.0105 nodeZ=0110.0000.0107
protocols=(260)ISIS2,MPLS
Apr 25 10:10:11.475690 user-PCS PCServer [A->Z] ID=L11.105.107.1_11.105.107.2
IP address=11.105.107.1 bw=10000000000 max_rsvp_bw=10000000000 te_metric=10
color=0 reservable_bw={9599699968 8599699456 7599699456 7599699456 7599699456
7599699456 7599699456 7099599360 }
Apr 25 10:10:11.475694 user-PCS PCServer [Z->A] ID=L11.105.107.1_11.105.107.2
IP address=11.105.107.2 bw=10000000000 max_rsvp_bw=10000000000 te_metric=10
color=0 reservable_bw={10000000000 10000000000 10000000000 8999999488 7899999232
7899999232 7899999232 7899999232 }
```

- Planned utilization—This type is used within NorthStar Controller for path computation. This utilization is learned from PCEP when the router advertises the LSP and communicates to NorthStar the LSP bandwidth and the path the LSP is to use. You might see PCS log entries such as those in the following example. In particular, note the bandwidth (**bw**) and record route object (**RRO**) entries that advertise the RSVP utilization on the link:

```
Apr 25 10:06:45.208021 feffendy-PCS PCServer [<-TopoServer] routing_key =
ns_lsp_link_key
Apr 25 10:06:45.208034 feffendy-PCS PCServer [<-TopoServer] JTAC@11.0.0.102,
LSP event=(2)UPDATE request_id=0 tunnel_id=9513 lsp_id=1 report_type=STATE_CHANGE
Apr 25 10:06:45.208039 feffendy-PCS PCServer JTAC@11.0.0.102, lsp add/update
event lsp_state=ACTIVE admin_state=UP, delegated=true
Apr 25 10:06:45.208042 feffendy-PCS PCServer from=11.0.0.102 to=11.0.0.104
Apr 25 10:06:45.208046 feffendy-PCS PCServer primary path
Apr 25 10:06:45.208049 feffendy-PCS PCServer association.group_id=128
association_type=1
Apr 25 10:06:45.208052 feffendy-PCS PCServer priority=7/7 bw=100000 metric=30
Apr 25 10:06:45.208056 feffendy-PCS PCServer admin group bits exclude=0
include_any=0 include_all=0
Apr 25 10:06:45.208059 feffendy-PCS PCServer PCE initiated
Apr 25 10:06:45.208062 feffendy-PCS PCServer
ERO=0110.0000.0102--11.102.105.2--11.105.107.2--11.114.117.1
Apr 25 10:06:45.208065 feffendy-PCS PCServer
RRO=0110.0000.0102--11.102.105.2--11.105.107.2--11.114.117.1
Apr 25 10:06:45.208068 feffendy-PCS PCServer samepath, state changed
```

It is possible for the two utilizations to be different enough from each other that it causes interference with successful computation or signalling of the path. For example, if the planned utilization is higher than the live utilization, a path computation issue could arise in which the PCS cannot compute the path because it thinks there is no room for it. But because the planned utilization is higher than the actual live utilization, there may very well be room.

It's also possible for the planned utilization to be lower than the live utilization. In that case, the PCC does not signal the path because it thinks there is no room for it.

To view utilization in the Web UI topology map, navigate to Options in the left pane of the Topology view. If you select RSVP Live Utilization, the topology map reflects the live utilization that comes from the routers. If you select RSVP Utilization, the topology map reflects the planned utilization which is computed by the NorthStar Controller based on planned properties.

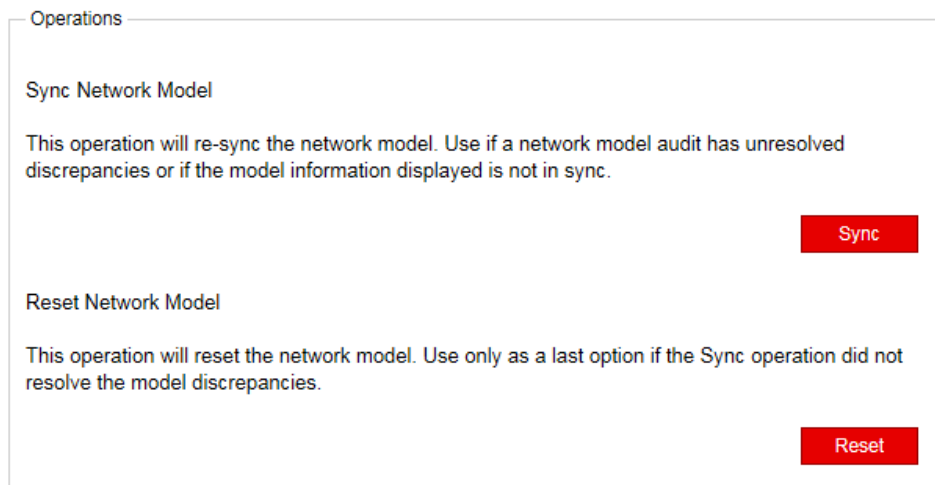
A better troubleshooting tool in the Web UI is the Network Model Audit widget in the Dashboard view. The Link RSVP Utilization line item reflects whether there are any mismatches between the live and the planned utilizations. If there are, you can try executing Sync Network Model from the Web UI by navigating to **Administration > System**.

## Disappearing Changes

Two options are available in the Web UI for synchronizing the topology with the live network. These options are only available to the system administrator, and can be

accessed by navigating to **Administration > System**. [Figure 191 on page 268](#) shows the two options.

*Figure 191: Synchronization Operations*



It is important to be aware that if you execute Reset Network Model in the Web UI, you will lose changes that you've made to the database. In a multi-user environment, one user might reset the network model without the knowledge of the other users. When a reset is requested, the request goes from the PCS server to the Toposerver, and the PCS log reflects:

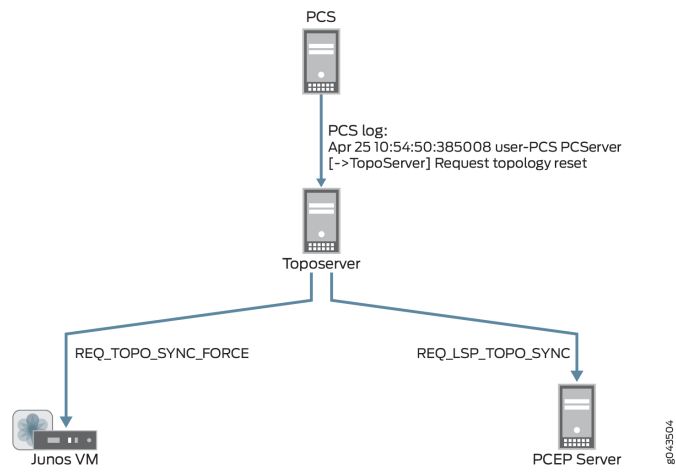
```
Apr 25 10:54:50.385008 user-PCS PCServer [->TopoServer] Request topology reset
```

The Toposerver log then reflects that database elements are being removed:

```
Apr 25 10:54:50.386912 user-PCS TopoServer Truncating pcs.links...
Apr 25 10:54:50.469722 user-PCS TopoServer Truncating pcs.nodes...
Apr 25 10:54:50.517501 user-PCS TopoServer Truncating pcs.lsp...
Apr 25 10:54:50.753705 user-PCS TopoServer Truncating pcs.interfaces...
Apr 25 10:54:50.806737 user-PCS TopoServer Truncating pcs.facilities...
```

The Toposerver then requests a synchronization with both the Junos VM to retrieve the topology nodes and links, and with the PCEP server to retrieve the LSPs. In this way, the Toposerver relearns the topology, but any user updates are missing. [Figure 192 on page 269](#) illustrates the flow from the topology reset request to the request for synchronization with the Junos VM and the PCEP Server.

Figure 192: Reset Model Request

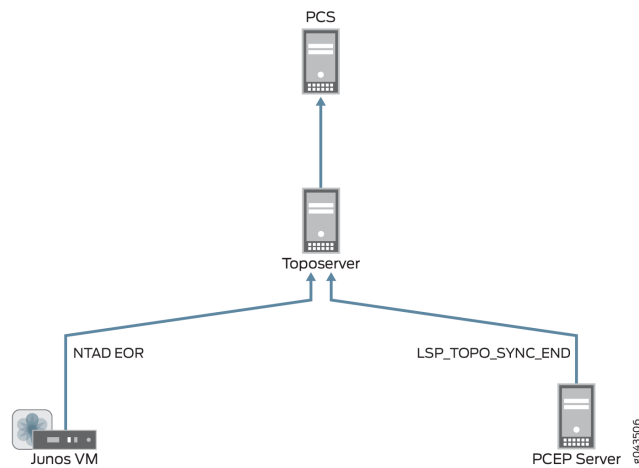


Upon receipt of the synchronization requests, Junos VM and the PCEP server return topology updates that reflect the current live network. The PCS log shows this information being added to the database:

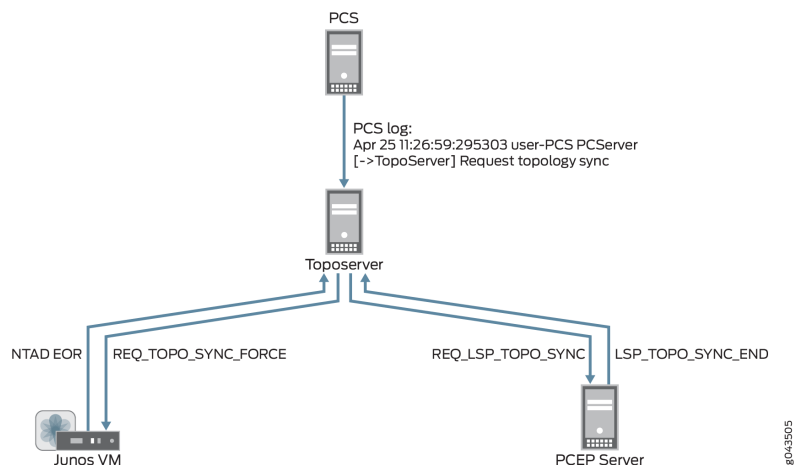
```

Apr 25 10:54:52.237882 user-PCS PCServer  [<-TopoServer] Update Topology
Apr 25 10:54:52.237894 user-PCS PCServer  [<-TopoServer] Update Topology Persisted
Nodes (0)
Apr 25 10:54:52.238957 user-PCS PCServer  [<-TopoServer] Update Topology Live
Nodes (7)
Apr 25 10:54:52.242336 user-PCS PCServer  [<-TopoServer] Update Topology Persisted
Links (0)
Apr 25 10:54:52.242372 user-PCS PCServer  [<-TopoServer] Update Topology live
Links (10)
Apr 25 10:54:52.242556 user-PCS PCServer  [<-TopoServer] Update Topology Persisted
Facilities (1)
Apr 25 10:54:52.242674 user-PCS PCServer  [<-TopoServer] Update Topology Persisted
LSPs (0)
Apr 25 10:54:52.279716 user-PCS PCServer  [<-TopoServer] Update Topology Live
LSPs (47)
Apr 25 10:54:52.279765 user-PCS PCServer  [<-TopoServer] Update Topology Finished
  
```

Figure 193 on page 270 illustrates the return of topology updates from the Junos VM and the PCEP Server to the Toposerver and the PCS.

*Figure 193: Model Updates Using Reset Network Model*

You should use the Reset Network Model when you want to start over from scratch with your topology, but if you don't want to lose user planning data when synchronizing with the live network, execute the Sync Network Model operation instead. With this operation, the PCS still requests a topology synchronization, but the Toposerver does not delete the existing elements. [Figure 194 on page 270](#) illustrates the flow from the PCS to the Junos VM and PCEP server, and the updates coming back to the Toposerver.

*Figure 194: Synchronization Request and Model Updates Using Sync Network Model*

## Investigating Client Side Issues

If you are looking for the source of a problem, and you cannot find it on the server side of the system, there is a debugging flag that can help you find it on the client side. The flag enables detailed messages on the web browser console about what has been exchanged between the server and the client. For example, you might notice that an update is not reflected in the Web UI. Using these detailed messages, you can identify possible miscommunication between the server and the client such as the server not actually sending the update, for example.



To enable this debug flag, modify the URL you use to launch the Web UI as follows:

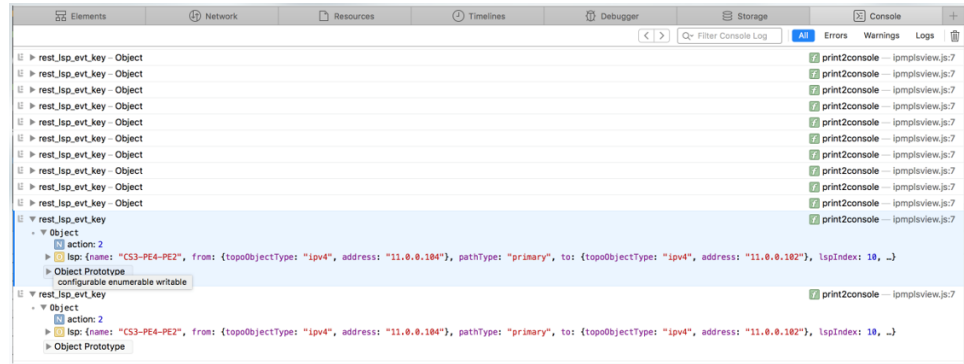
```
https://server_address:8443/client/app.html?debug=true
```



**NOTE:** If you are already in the Web UI, it is not necessary to log out; simply add `?debug=true` to the URL and press Enter. The UI reloads.

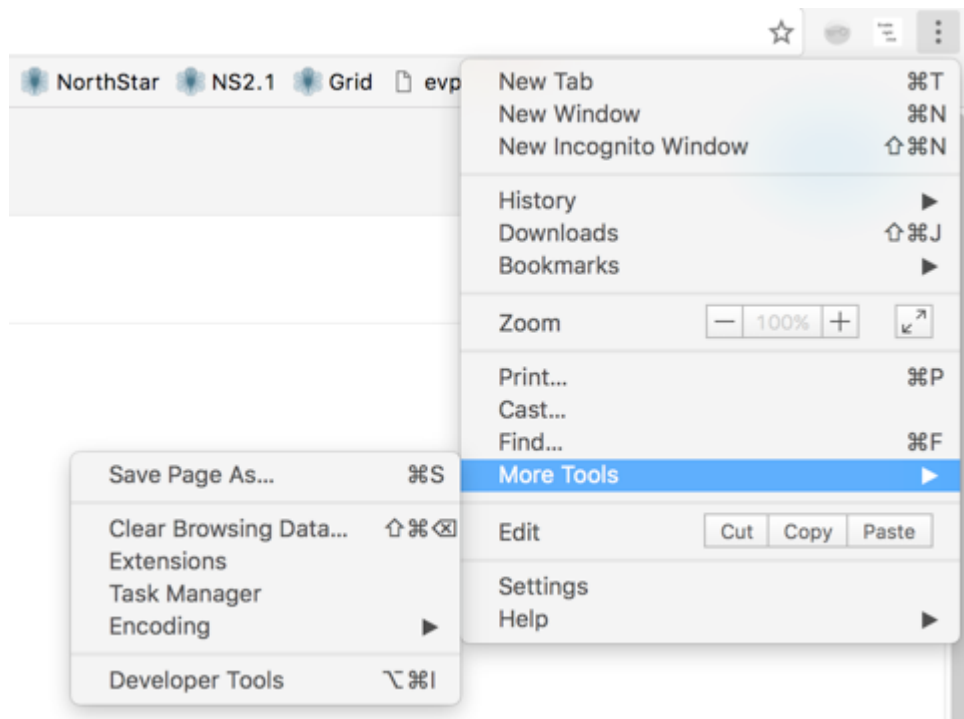
Figure 195 on page 272 shows an example of the web browser console with detailed debugging messages.

*Figure 195: Web Browser Console with Debugging Messages*



Accessing the console varies by browser. [Figure 196 on page 272](#) shows an example: accessing the console on Google Chrome.

*Figure 196: Accessing the Google Chrome Console*



## Configuring NorthStar Server to Use Remote Syslog

### NorthStar 2.1 CentOS Server Configuration

Open up `/etc/rsyslog.conf` with your preferred text editor and scroll to the bottom section starting with “begin forwarding rule# rsyslog v5 configuration file.

```
# An on-disk queue is created for this action. If the remote host is
# down, messages are spooled to disk and sent when it is up again.
$WorkDirectory /var/lib/rsyslog # where to place spool files
$ActionQueueFileName fwdRule1 # unique name prefix for spool files
$ActionQueueMaxDiskSpace 1g # 1gb space limit (use as much as possible)
$ActionQueueSaveOnShutdown on # save messages to disk on shutdown
$ActionQueueType LinkedList # run asynchronously
$ActionResumeRetryCount -1 # infinite retries if host is down
# remote host is: name/ip:port, e.g. 192.168.0.1:514, port optional
*. * @172.25.153.208:514 <- Server you are going to be forwarding your logs to.
Single @ for UDP double @@ for TCP configurations.
# ### end of the forwarding rule ###
```

Remove `&~` from below each of the following entries:

```
if $programname startswith 'PCServer' then :omfile:$log_rotation_pcs
if $programname startswith 'TopoServer' then :omfile:$log_rotation_toposerver
if $programname startswith 'REST_API' then :omfile:$log_rotation_rest
if $programname startswith 'WEB_AUTH' then :omfile:$log_rotation_web_auth
if $programname startswith 'northstar.MLAdapter' then
:omfile:$log_rotation_mladapter
if $programname startswith 'Keepalived_vrrp' then :omfile:$log_rotation_keepalived
if $programname startswith 'haproxy' then :omfile:$log_rotation_haproxy
if $programname startswith 'rtserver' then :omfile:$log_rotation_rtserver
```

Restart your rsyslog service:

```
[root@dw-host log]# service rsyslog restart
```

### Remote syslog Server Configurations

Create a log file:

```
#touch /var/log/northstar.log
```

Modify your `/etc/rsyslog.conf` file and uncomment lines for UDP or TCP reception:

```
# Provides UDP syslog reception
$ModLoad imudp
$InputUDPServerRun 514
```

Add a line:

```
$AllowedSender UDP, 172.25.155.185/32
:FROMHOST-IP, isequal, "172.25.155.185" /var/log/northstar.log
```

Restart your rsyslog service:

```
[root@dw-host log]# service rsyslog restart
Shutting down system logger:          [ OK ]
Starting system logger:               [ OK ]
[root@dw-host log]#
```

Sample rsyslog file from remote syslog server:

```
# rsyslog v5 configuration file
```

For more information see [/usr/share/doc/rsyslog-\\*/rsyslog\\_conf.html](/usr/share/doc/rsyslog-*/rsyslog_conf.html). If you experience problems, see <http://www.rsyslog.com/doc/troubleshoot.html>.

---

### Additional Information

```
#### MODULES ####

$ModLoad imuxsock # provides support for local system logging (e.g. via logger
command)
$ModLoad imklog   # provides kernel logging support (previously done by rklogd)
#$ModLoad immark  # provides --MARK-- message capability

# Provides UDP syslog reception
$ModLoad imudp
$UDPServerRun 514

# Provides TCP syslog reception
#$ModLoad imtcp
#$InputTCPServerRun 514
$AllowedSender UDP, 172.25.155.185/32
:FROMHOST-IP, isequal, "172.25.155.185" /var/log/northstar.log
&~

#### GLOBAL DIRECTIVES ####

# Use default timestamp format
$ActionFileDefaultTemplate RSYSLOG_TraditionalDateFormat

# File syncing capability is disabled by default. This feature is usually not
required,
# not useful and an extreme performance hit
#$ActionFileEnableSync on

# Include all config files in /etc/rsyslog.d/
$IncludeConfig /etc/rsyslog.d/*.conf

#### RULES ####
```

```

# Log all kernel messages to the console.
# Logging much else clutters up the screen.
#kern.* /dev/console

# Log anything (except mail) of level info or higher.
# Don't log private authentication messages!
*.info;mail.none;authpriv.none;cron.none /var/log/messages

# The authpriv file has restricted access.
authpriv.* /var/log/secure

# Log all the mail messages in one place.
mail.* -/var/log/maillog

# Log cron stuff
cron.* /var/log/cron

# Everybody gets emergency messages
*.emerg *

# Save news errors of level crit and higher in a special file.
uucp,news.crit /var/log/spooler

# Save boot messages also to boot.log
local7.* /var/log/boot.log


# ### begin forwarding rule ###
# The statement between the begin ... end define a SINGLE forwarding
# rule. They belong together, do NOT split them. If you create multiple
# forwarding rules, duplicate the whole block!
# Remote Logging (we use TCP for reliable delivery)
#
# An on-disk queue is created for this action. If the remote host is
# down, messages are spooled to disk and sent when it is up again.
#$WorkDirectory /var/lib/rsyslog # where to place spool files
#$ActionQueueFileName fwdRule1 # unique name prefix for spool files
#$ActionQueueMaxDiskSpace 1g # 1gb space limit (use as much as possible)
#$ActionQueueSaveOnShutdown on # save messages to disk on shutdown
#$ActionQueueType LinkedList # run asynchronously
#$ActionResumeRetryCount -1 # infinite retries if host is down
# remote host is: name/ip:port, e.g. 192.168.0.1:514, port optional
#*. * @remote-host:514
# ### end of the forwarding rule ###

```

## Collecting NorthStar Controller Debug Files

If you are unable to resolve a problem with the NorthStar Controller, we recommend that you forward the debug files generated by the NorthStar Controller debugging utility to JTAC for evaluation. Currently all debug files are located in subdirectories under the **u/wandl/tmp** directory.

To collect debug files, log in to the NorthStar Controller CLI, and execute the command **u/wandl/bin/system-diagnostic.sh filename**.

The output is generated and is available from the `/tmp` directory in the `filename.tbz2` debug file.

## Enabling the SNMP Daemon on the NorthStar Controller

The SNMP daemon (SNMPD) responds to SNMP request packets. This section describes and provides examples for enabling and running SNMPD on the NorthStar Controller. SNMPD is useful if you prefer to monitor the NorthStar server using your own monitoring system.

The <http://www.net-snmp.org/docs/man/snmpd.conf.html> net-SNMP man page is a good resource for additional information and configuration help.

Perform the steps that follow to enable SNMPD on the NorthStar server. Run all commands in this procedure as the root user on the NorthStar server.

1. Juniper Networks provides a sample `snmpd.conf` file in the NorthStar build in the following directory:

```
/opt/northstar/utils/examples/snmpd.conf
```

Copy the sample file to your local `/usr/share/snmp/` directory.

2. Modify the `/usr/share/snmp/snmpd.conf` file to include your company's settings.
3. Start the service:

```
#service snmpd start
```

4. Configure the service to turn on in the event of a reboot:

```
#chkconfig snmpd on
```

5. Confirm that your server is listening on port 161 (default snmpd):

```
#netstat -na | grep 161
```

6. Wait five minutes for trap collection, then check your SNMP collection device or host.

The sample `snmpd.conf` file included with the NorthStar build sends the following traps by default:

- Physical location
- Contact information
- Running processes (the supervisord process has been predefined)
- Mounted filesystems (`/` and `/home` have been pre-established)
- System load on the machine, including memory and CPU

The trap2sink line in the sample configuration file tells the host the address of the traps receiver.

Sample **snmpd.conf** file included with the NorthStar build:

```
# snmpd.conf
#
#   - created by the snmpconf configuration program
#
#####
# SECTION: System Information Setup
#
#   This section defines some of the information reported in
#   the "system" mib group in the mibII tree.

# syslocation: The [typically physical] location of the system.
#   Note that setting this value here means that when trying to
#   perform an snmp SET operation to the sysLocation.0 variable will make
#   the agent return the "notWritable" error code. IE, including
#   this token in the snmpd.conf file will disable write access to
#   the variable.
#   arguments:  location_string

syslocation Unknown (edit /etc/snmp/snmpd.conf)
syslocation  Bridgewater

# syscontact: The contact information for the administrator
#   Note that setting this value here means that when trying to
#   perform an snmp SET operation to the sysContact.0 variable will make
#   the agent return the "notWritable" error code. IE, including
#   this token in the snmpd.conf file will disable write access to
#   the variable.
#   arguments:  contact_string

syscontact Root <root@localhost> (configure /etc/snmp/snmp.local.conf)
syscontact  "John Doe"
syscontact  "John Doe"

# sysservices: The proper value for the sysServices object.
#   arguments:  sysservices_number

sysservices 78

#####
# SECTION: Extending the Agent
#
#   You can extend the snmp agent to have it return information
#   that you yourself define.

# pass_persist: Run a persistant process that interpretes the request for an
#   entire tree.
#   The pass program defined here will get called for all
#   requests below a certain point in the mib tree. It is then
#   responsible for returning the right data beyond that point.
#   The pass_persist scripts must be able to stay running and accept input
#   from stdin.
#
```

```

# arguments: miboid program
#
# example: pass_persist .1.3.6.1.4.1.2021.255 /path/to/local/pass_persisttest
#
# See the snmpd.conf manual page for further information.

pass_persist

# dlmod: dynamically extend the agent using a shared-object
# arguments: module-name module-path

dlmod

#####
# SECTION: Monitor Various Aspects of the Running Host
#
# The following check up on various aspects of a host.

# proc: Check for processes that should be running.
#   proc NAME [MAX=0] [MIN=0]
#
#   NAME: the name of the process to check for. It must match
#         exactly (ie, http will not find httpd processes).
#   MAX: the maximum number allowed to be running. Defaults to 0.
#   MIN: the minimum number to be running. Defaults to 0.
#
# The results are reported in the prTable section of the UCD-SNMP-MIB tree
# Special Case: When the min and max numbers are both 0, it assumes
# you want a max of infinity and a min of 1.
# The following line will be monitoring the supervisord process.

proc /opt/northstar/thirdparty/python/bin/supervisord 1 1

# disk: Check for disk space usage of a partition.
# The agent can check the amount of available disk space, and make
# sure it is above a set limit.
#
#   disk PATH [MIN=100000]
#
#   PATH: mount path to the disk in question.
#   MIN: Disks with space below this value will have the Mib's errorFlag
# set.
# Can be a raw integer value (units of kB) or a percentage followed
# by the %
#       symbol. Default value = 100000.
#
# The results are reported in the diskTable section of the UCD-SNMP-MIB tree
# The following will monitor the root and home filesystems.

disk /
disk /home

# load: Check for unreasonable load average values.
# Watch the load average levels on the machine.
#
#   load [1MAX=12.0] [5MAX=12.0] [15MAX=12.0]
#
#   1MAX: If the 1 minute load average is above this limit at query
#         time, the errorFlag will be set.
#   5MAX: Similar, but for 5 min average.

```



```

# 15MAX: Similar, but for 15 min average.
#
# The results are reported in the laTable section of the UCD-SNMP-MIB tree

load 5 5 5

# file: Check on the size of a file.
# Display a files size statistics.
# If it grows to be too large, report an error about it.
#
# file /path/to/file [maxsize_in_kilobytes]
#
# if maxsize is not specified, assume only size reporting is needed.
#
# The results are reported in the fileTable section of the UCD-SNMP-MIB tree

file

#####
# SECTION: Access Control Setup
#
# This section defines who is allowed to talk to your running
# snmp agent.

# rouser: a SNMPv3 read-only user
# arguments: user [noauth|auth|priv] [restriction_oid]

rouser northstar

# rocommunity: a SNMPv1/SNMPv2c read-only access community name
# arguments: community [default|hostname|network/bits] [oid]

rocommunity northstar

#####
# SECTION: Trap Destinations
#
# Here we define who the agent will send traps to.

# trap2sink: A SNMPv2c trap receiver
# arguments: host [community] [portnum]

trap2sink 192.168.1.161

#
# Unknown directives read in from other files by snmpconf
#
com2sec notConfigUser default public
group notConfigGroup v1 notConfigUser
group notConfigGroup v2c notConfigUser
view systemview included .1.3.6.1.2.1.1
view systemview included .1.3.6.1.2.1.25.1.1
access notConfigGroup "" any noauth exact systemview none none
dontLogTCPWrappersConnects yes

```

- Related Documentation**
- [FAQs for Troubleshooting the NorthStar Controller on page 281](#)
  - [Enabling the SNMP Daemon on NorthStar Controller on page 285](#)

- [Managing the Path Computation Server and Path Computation Element Services on the NorthStar Controller on page 289](#)

# Frequently Asked Troubleshooting Questions

- [FAQs for Troubleshooting the NorthStar Controller on page 281](#)

## FAQs for Troubleshooting the NorthStar Controller

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The following frequently asked questions (FAQs) are provided to help answer questions you might have about troubleshooting NorthStar Controller features, functionality, and behavior.

- *What commands can I use to stop, start, or restart NorthStar?*

**service northstar stop**

**service northstar start**

**service northstar restart**



**NOTE:** DO NOT USE `supervisorctl stop all`, `supervisorctl start all`, or `supervisorctl restart all`. Use of these commands can cause errors later, when you try to modify LSPs.

- *Should I use an "in-band" or "out-of-band" management interface for the PCEP session?*

We recommend in-band management, but if in-band is not an option, out-of-band management will work with some limitations. If you use an out-of-band management interface as the PCEP local address, configure PCC management IP address mapping.



**NOTE:** We also recommend that you use the router loopback IP address as the PCEP local address with the assumption that the loopback IP address is also the TE router ID.

- *What is an "ethernet" node and why is "ethernet" node shown even though there are only two routers on that link?*

Ethernet node represents a switch or hub in the broadcast environment. Unless explicitly configured otherwise, OSPF and IS-IS perform adjacency in broadcast mode. Displaying

this "ethernet" in the network topology makes it possible to detect which part of the network has non-explicit point-to-point Interior Gateway Protocol (IGP) configuration.

- *The OSPF Broadcast link doesn't sync up, and the NorthStar Controller UI displays an isolated router and an isolated Ethernet node. What is the problem here?*

Verify that each router's interface that is connected to the isolated subnet is configured with the **family mpls enable** statement (for routers running Junos OS).

- *The PCEP session between the PCC and PCE stays in the "connecting" state. Why isn't the connection established?*

Verify that the PE router has been correctly configured as a PCC, for example:

- Enable external control of LSPs from the PCC router to the NorthStar Controller:

```
[edit protocols]
user@PE1# set mpls lsp-external-controller pccd
```

- Specify the NorthStar Controller (**northstar1**) as the PCE that the PCC connects to, and specify the NorthStar Controller host external IP address as the destination address:

```
[edit protocols]
user@PE1# set pcep pce northstar1 destination-ipv4-address <IP-address>
```

- Configure the destination port for the PCC router that connects to the NorthStar Controller (PCE server) using the TCP-based PCEP:

```
[edit protocols]
user@PE1# set pcep pce northstar1 destination-port 4189
```

- You must also make sure no firewall (or anything else) is blocking the traffic.

- *Does the NorthStar Controller UI show the LSP and topology events in real time?*

In most cases, the LSP and topology events are displayed in real time. However, the PCS can perform some event aggregation to reduce protocol communication between the server and client if the PCS receives too many events from the network.

- *The `/var/log/jnc/pcep_server.log` file does not contain any information. How can I get more verbose PCEP logging?*

1. From the NorthStar Controller CLI, run **pcep\_cli**.
2. Type **set log-level all**
3. Press CTRL-C to exit.

- Related Documentation**
- [NorthStar Controller Troubleshooting Guide on page 254](#)
  - [NorthStar Controller Troubleshooting Overview on page 253](#)



## Additional Troubleshooting Resources

- [Enabling the SNMP Daemon on NorthStar Controller on page 285](#)
- [Managing the Path Computation Server and Path Computation Element Services on the NorthStar Controller on page 289](#)

### Enabling the SNMP Daemon on NorthStar Controller

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The SNMP daemon (SNMPD) responds to SNMP request packets. This section describes and provides examples for enabling and running SNMPD on the NorthStar Controller. SNMPD is useful if you prefer to monitor the NorthStar server using your own monitoring system.

The following net-SNMP man page is a good resource for additional information and configuration help:

<http://www.net-snmp.org/docs/man/snmpd.conf.html>

Perform the steps that follow to enable SNMPD on the NorthStar server. Run all commands in this procedure as the root user on the NorthStar server.

1. Juniper Networks provides a sample **snmpd.conf** file in the NorthStar build in the following directory:

```
/opt/northstar/utls/examples/snmpd.conf
```

Copy the sample file to your local **/usr/share/snmp/** directory.

2. Modify the **/usr/share/snmp/snmpd.conf** file to include your company's settings.
3. Start the service:

```
#service snmpd start
```

4. Configure the service to turn on in the event of a reboot:

```
#chkconfig snmpd on
```

5. Confirm that your server is listening on port 161 (default snmpd):

```
#netstat -na | grep 161
```

6. Wait five minutes for trap collection, then check your SNMP collection device or host.

The sample **snmpd.conf** file included with the NorthStar build sends the following traps by default:

- Physical location
- Contact information
- Running processes (the supervisord process has been predefined)
- Mounted filesystems (/ and /home have been pre-established)
- System load on the machine, including memory and CPU

The trap2sink line in the sample configuration file tells the host the address of the traps receiver.

Sample **snmpd.conf** file included with the NorthStar build:

```
# snmpd.conf
#
#   - created by the snmpconf configuration program
#
#####
# SECTION: System Information Setup
#
#   This section defines some of the information reported in
#   the "system" mib group in the mibII tree.

# syslocation: The [typically physical] location of the system.
#   Note that setting this value here means that when trying to
#   perform an snmp SET operation to the syslocation.0 variable will make
#   the agent return the "notWritable" error code. IE, including
#   this token in the snmpd.conf file will disable write access to
#   the variable.
#   arguments:  location_string

syslocation Unknown (edit /etc/snmp/snmpd.conf)
syslocation Bridgewater

# syscontact: The contact information for the administrator
#   Note that setting this value here means that when trying to
#   perform an snmp SET operation to the sysContact.0 variable will make
#   the agent return the "notWritable" error code. IE, including
#   this token in the snmpd.conf file will disable write access to
#   the variable.
#   arguments:  contact_string

syscontact Root <root@localhost> (configure /etc/snmp/snmp.local.conf)
syscontact "John Doe"
syscontact "John Doe"

# syservices: The proper value for the sysServices object.
```



```

# arguments: sysservices_number

sysservices 78

#####
# SECTION: Extending the Agent
#
# You can extend the snmp agent to have it return information
# that you yourself define.

# pass_persist: Run a persistent process that interpretes the request for an
entire tree.
# The pass program defined here will get called for all
# requests below a certain point in the mib tree. It is then
# responsible for returning the right data beyond that point.
# The pass_persist scripts must be able to stay running and accept input
# from stdin.
#
# arguments: miboid program
#
# example: pass_persist .1.3.6.1.4.1.2021.255 /path/to/local/pass_persisttest
#
# See the snmpd.conf manual page for further information.

pass_persist

# dlmod: dynamically extend the agent using a shared-object
# arguments: module-name module-path

dlmod

#####
# SECTION: Monitor Various Aspects of the Running Host
#
# The following check up on various aspects of a host.

# proc: Check for processes that should be running.
# proc NAME [MAX=0] [MIN=0]
#
# NAME: the name of the process to check for. It must match
# exactly (ie, http will not find httpd processes).
# MAX: the maximum number allowed to be running. Defaults to 0.
# MIN: the minimum number to be running. Defaults to 0.
#
# The results are reported in the prTable section of the UCD-SNMP-MIB tree
# Special Case: When the min and max numbers are both 0, it assumes
# you want a max of infinity and a min of 1.
# The following line will be monitoring the supervisord process.

proc /opt/northstar/thirdparty/python/bin/supervisord 1 1

# disk: Check for disk space usage of a partition.
# The agent can check the amount of available disk space, and make
# sure it is above a set limit.
#
# disk PATH [MIN=100000]
#
# PATH: mount path to the disk in question.

```

```

# MIN: Disks with space below this value will have the Mib's errorFlag
set.
# Can be a raw integer value (units of kB) or a percentage followed
by the %
# symbol. Default value = 100000.
#
# The results are reported in the diskTable section of the UCD-SNMP-MIB tree
# The following will monitor the root and home filesystems.

disk /
disk /home

# load: Check for unreasonable load average values.
# Watch the load average levels on the machine.
#
# load [1MAX=12.0] [5MAX=12.0] [15MAX=12.0]
#
# 1MAX: If the 1 minute load average is above this limit at query
# time, the errorFlag will be set.
# 5MAX: Similar, but for 5 min average.
# 15MAX: Similar, but for 15 min average.
#
# The results are reported in the laTable section of the UCD-SNMP-MIB tree

load 5 5 5

# file: Check on the size of a file.
# Display a files size statistics.
# If it grows to be too large, report an error about it.
#
# file /path/to/file [maxsize_in_kilobytes]
#
# if maxsize is not specified, assume only size reporting is needed.
#
# The results are reported in the fileTable section of the UCD-SNMP-MIB tree

file

#####
# SECTION: Access Control Setup
#
# This section defines who is allowed to talk to your running
# snmp agent.

# rouser: a SNMPv3 read-only user
# arguments: user [noauth|auth|priv] [restriction_oid]

rouser northstar

# rocommunity: a SNMPv1/SNMPv2c read-only access community name
# arguments: community [default|hostname|network/bits] [oid]

rocommunity northstar

#####
# SECTION: Trap Destinations
#
# Here we define who the agent will send traps to.

```

```
# trap2sink: A SNMPv2c trap receiver
# arguments: host [community] [portnum]

trap2sink 192.168.1.161

#
# Unknown directives read in from other files by snmpconf
#
com2sec notConfigUser default public
group notConfigGroup v1 notConfigUser
group notConfigGroup v2c notConfigUser
view systemview included .1.3.6.1.2.1.1
view systemview included .1.3.6.1.2.1.25.1.1
access notConfigGroup "" any noauth exact systemview none none
dontLogTCPWrappersConnects yes
```

- Related Documentation**
- [Managing the Path Computation Server and Path Computation Element Services on the NorthStar Controller on page 289](#)

## Managing the Path Computation Server and Path Computation Element Services on the NorthStar Controller

To perform administrative tasks, you can run commands from the NorthStar Controller CLI to stop, start, or restart Path Computation Server (PCS) or Path Computation Element (PCE) services that run on the NorthStar Controller.

We recommend that you run the PCS restart command when encountering either of the following scenarios:

- If you suspect that the network model is out-of-sync—for example, when LSPs are still displayed from the UI but the LSPs are no longer on the router.
- If the admin status of LSPs appears to be stuck in “PENDING” when you attempt to provision LSPs—from the NorthStar Controller UI, the LSPs are displayed as PENDING and are not provisioned to router.

To manage services on the NorthStar Controller:

1. From the CLI, log in to the NorthStar Controller PCS, for example:

```
[northstar_manager-bash-4.1]$ ssh root@10.92.23.31
```

2. From the prompt, enter username **root** and password **northstar**.

- Related Documentation**
- [NorthStar Controller Troubleshooting Overview on page 253](#)
  - [FAQs for Troubleshooting the NorthStar Controller on page 281](#)
  - [NorthStar Controller Troubleshooting Guide on page 254](#)

