

Spanning-Tree Protocols User Guide

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Spanning-Tree Protocols User Guide
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About This Guide

Spanning-tree protocols on routers and switches address provide link redundancy while simultaneously preventing undesirable loops.

1

CHAPTER

Overview

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Spanning-Tree Protocol Overview

IN THIS SECTION

- [How Spanning Tree Protocols Work | 2](#)
- [Choosing a Spanning Tree Protocol | 6](#)

How Spanning Tree Protocols Work

IN THIS SECTION

- [Benefits of Using Spanning Tree Protocols | 3](#)
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- [Port Roles Determine Participation in the Spanning Tree | 3](#)
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Ethernet networks are susceptible to broadcast storms if loops are introduced. However, an Ethernet network needs to include loops because they provide redundant paths in case of a link failure. Spanning-tree protocols address both of these issues because they provide link redundancy while simultaneously preventing undesirable loops.

Juniper Networks devices provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP), and VLAN Spanning Tree Protocol (VSTP). RSTP is the default spanning-tree protocol for preventing loops on Ethernet networks.

This topic describes:

Benefits of Using Spanning Tree Protocols

Spanning Tree protocols have the following benefits:

- Provide link redundancy while simultaneously preventing undesirable loops
- Prevent Broadcast Storms
- Connects to devices that are not STP-capable, such as PCs, servers, routers, or hubs that are not connected to other switches, by using edge ports

Spanning Tree Protocols Help Prevent Broadcast Storms

Spanning-tree protocols intelligently avoid loops in a network by creating a tree topology (spanning tree) of the entire bridged network with only one available path between the tree root and a leaf. All other paths are forced into a standby state. The tree *root* is a switch within the network elected by the STA (spanning-tree algorithm) to use when computing the best path between bridges throughout the network and the root bridge. Frames travel through the network to their destination—a *leaf* such as an end-user PC—along branches. A tree *branch* is a network segment, or link, between bridges. Switches that forward frames through an STP spanning tree are called *designated bridges*.

NOTE: If you are using Junos OS for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, you can force the original IEEE 802.1D Spanning Tree Protocol (STP) version to run in place of RSTP or VSTP by setting ["force-version" on page 279](#).

Port Roles Determine Participation in the Spanning Tree

Each port has both a role and a state. A port's *role* determines how it participates in the spanning tree. The five port roles used in RSTP are:

- Root port—The port closest to the root bridge (has the lowest path cost from a bridge). This is the only port that receives frames from and forwards frames to the root bridge.
- Designated port—The port that forwards traffic away from the root bridge toward a leaf. A designated bridge has one designated port for every link connection it serves. A root bridge forwards frames from all of its ports, which serve as designated ports.
- Alternate port—A port that provides an alternate path toward the root bridge if the root port fails and is placed in the discarding state. This port is not part of the active spanning tree, but if the root port fails, the alternate port immediately takes over.

- Backup port—A port that provides a backup path toward the leaves of the spanning tree if a designated port fails and is placed in the discarding state. A backup port can exist only where two or more bridge ports connect to the same LAN for which the bridge serves as the designated bridge. A backup port for a designated port immediately takes over if the port fails.
- Disabled port—The port is not part of the active spanning tree.

Port States Determine How a Port Processes a Frame

Each port has both a state and a role. A port's *state* determines how it processes a frame. RSTP places each port of a designated bridge in one of three states:

- Discarding—The port discards all BPDUs. A port in this state discards all frames it receives and does not learn MAC addresses.
- Learning—The port prepares to forward traffic by examining received frames for location information in order to build its MAC address table.
- Forwarding—The port filters and forwards frames. A port in the forwarding state is part of the active spanning tree.

Edge Ports Connect to Devices That Cannot Be Part of a Spanning Tree

Spanning Tree also defines the concept of an *edge port*, which is a designated port that connects to devices that are not STP-capable, such as PCs, servers, routers, or hubs that are not connected to other switches. Because edge ports connect directly to end stations, they cannot create network loops and can transition to the forwarding state immediately. You can manually configure edge ports, and a switch can also detect edge ports by noting the absence of communication from the end stations.

The edge ports themselves do send BPDUs to the spanning tree. If you have a good understanding of the implications on your network and want to modify RSTP on the edge port interface.

BPDUs Maintain the Spanning-Tree

Spanning-tree protocols use frames called bridge protocol data units (BPDUs) to create and maintain the spanning tree. A BPDU frame is a message sent from one switch to another to communicate information about itself, such as its bridge ID, root path costs, and port MAC addresses. The initial exchange of BPDUs between switches determines the root bridge. Simultaneously, BPDUs are used to communicate the cost of each link between branch devices, which is based upon port speed or user configuration. RSTP uses this path cost to determine the ideal route for data frames to travel from one leaf to another leaf and then blocks all other routes. If an edge port receives a BPDU, it automatically transitions to a regular RSTP port.

When the network is in a steady state, the spanning tree converges when the spanning-tree algorithm (STA) identifies both the root and designated bridges and all ports are in either a forwarding or blocking state. To maintain the tree, the root bridge continues to send BPDUs at a *hello time* interval (default 2 seconds). These BPDUs continue to communicate the current tree topology. When a port receives a hello BPDU, it compares the information to that already stored for the receiving port. One of three actions takes place when a switch receives a BPDU:

- If the BPDU data matches the existing entry in the MAC address table, the port resets a timer called *max age* to zero and then forwards a new BPDU with the current active topology information to the next port in the spanning tree.
- If the topology in the BPDU has been changed, the information is updated in the MAC address table, *max age* is again set to zero, and a new BPDU is forwarded with the current active topology information to the next port in the spanning tree.
- When a port does not receive a BPDU for three hello times, it reacts one of two ways. If the port is the root port, a complete rework of the spanning tree occurs—see *When an RSTP Root Bridge Fails*. If the bridge is any non-root bridge, RSTP detects that the connected device cannot send BPDUs and converts that port to an edge port.

When a Root Bridge Fails

When a link to the root port goes down, a flag called a topology change notification (TCN) is added to the BPDU. When this BPDU reaches the next port in the VLAN, the MAC address table is flushed and the BPDU is sent to the next bridge. Eventually, all ports in the VLAN have flushed their MAC address tables. Then, RSTP configures a new root port.

After a root port or a designated port fails, the alternate or backup port takes over after an exchange of BPDUs called the proposal-agreement handshake. RSTP propagates this handshake over *point-to-point links*, which are dedicated links between two network nodes, or switches, that connect one port to another. If a local port becomes a new root or designated port, it negotiates a rapid transition with the receiving port on the nearest neighboring switch by using the proposal-agreement handshake to ensure a loop-free topology.

Devices Must Relearn MAC Addresses After a Link Failure

Because a link failure causes all associated ports to flush their MAC address table, the network might be slower as it floods to relearn the MAC addresses. There is a way to speed up this relearning process. During TCN propagation, the Layer 2 forwarding table of switches is flushed, resulting in a flood of data packets. The Address Resolution Protocol (ARP) feature causes the switch to proactively send ARP requests for IP addresses in the ARP cache (present because of Layer 3 VLAN interface). With ARP on STP enabled, as the reply comes through, the switches build up the Layer 2 forwarding table, thus limiting the flooding later. Enabling ARP on STP is most useful to prevent excessive flooding in large Layer 2 networks using RVIs.

NOTE: The ARP feature is not available on Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style.

SEE ALSO

[Understanding STP | 23](#)

[Understanding MSTP | 87](#)

[Understanding RSTP | 27](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP | 32](#)

[Configuring RSTP on EX Series Switches \(CLI Procedure\) | 31](#)

Choosing a Spanning Tree Protocol

IN THIS SECTION

- [Comparison of Spanning Tree Features | 6](#)
- [Switch and Router Spanning Tree Support and Limitations | 12](#)

When selecting a spanning-tree protocol, consider two basic questions:

- What STP features do I need?
- What switch or router will be used?

Comparison of Spanning Tree Features

[Table 1 on page 7](#) describes differences between spanning-tree protocols STP, RSTP, MSTP and VSTP.

Table 1: Selecting a Spanning-Tree Protocol

Protocol	Advantages	Disadvantages
RSTP	<ul style="list-style-type: none"> • Rapid Spanning Tree Protocol is the default switch configuration and is recommended for most network configurations because it converges more quickly than STP after a failure. • Voice and video work better with RSTP than they do with STP. • RSTP is backward compatible with STP; therefore, switches do not all have to run RSTP. • RSTP supports more ports than MSTP or VSTP. • On MX and ACX routers, you can configure RSTP, MSTP, and VSTP instance interfaces as edge ports. 	<ul style="list-style-type: none"> • STP and RSTP are limited to a single instance on any physical interface. Use the <code>set rstp interface</code> statement to configure interfaces participating in the RSTP instance. • RSTP does not work with 802.1D 1998 bridges. Use STP instead—see "Forcing RSTP or VSTP to Run as IEEE 802.1D STP (CLI Procedure)" on page 86

TIP: Use the `set rstp interface` configuration statement to indicate which logical interfaces participate in RSTP. See

.

TIP: If RSTP has been forced to run as the original STP version, you can revert back to RSTP by ["Reverting to RSTP or VSTP from Forced IEEE 802.1D STP" on page 157](#).

Table 1: Selecting a Spanning-Tree Protocol *(Continued)*

Protocol	Advantages	Disadvantages
STP	<ul style="list-style-type: none"> Spanning Tree Protocol works with 802.1D 1998 bridges. RSTP is backward compatible with STP; therefore, you can run RSTP on some switches and STP on others with 802.1D 1998 bridges. 	<ul style="list-style-type: none"> STP and RSTP are limited to a single instance on any physical interface. Use the <code>set stp</code> interface statement to configure interfaces participating in the RSTP instance. STP is slower than RSTP. STP is not recommended for multiple VLAN networks because it is not VLAN--as a result, all VLANs within a LAN share the same spanning-tree. This limits the number of forwarding paths for data traffic. Use MSTP instead. Although STP provides basic loop prevention functionality, it does not provide fast network convergence when there are topology changes. The STP process to determine network state transitions is slower than the RSTP process because it is timer-based. RSTP converges faster because it uses a handshake mechanism based on point-to-point links instead of the timer-based process used by STP.

Table 1: Selecting a Spanning-Tree Protocol (*Continued*)

Protocol	Advantages	Disadvantages
		<ul style="list-style-type: none"> Edge ports are not supported when the original IEEE 802.1D STP is configured. If you specify edge at the [edit protocols stp] hierarchy level, the software ignores the option.

TIP: Use the `set stp interface` statement to configure interfaces to participate in the STP instance. See ["Configuring STP on EX Series Switches \(CLI Procedure\)" on page 25](#).

MSTP	<ul style="list-style-type: none"> Multiple Spanning Tree Protocol works with most VLANs. MSTP supports multiple instances on a single physical interface. On MX and ACX routers, you can configure RSTP, MSTP, and VSTP instance interfaces as edge ports. 	<ul style="list-style-type: none"> Some protocols require compatibility not provided by MSTP. In this case, use VSTP. MSTP supports a limited number of ports. An MSTP region supports up to 64 MSTIs with each instance supporting from 1 through 4094 VLANs MSTP uses more CPU than RSTP and does not converge as fast as RSTP.
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TIP: Use the `set mstp interface configuration` statement to indicate which logical interfaces participate in MSTP. See ["Configuring MSTP on Switches" on page 91](#).

Table 1: Selecting a Spanning-Tree Protocol *(Continued)*

Protocol	Advantages	Disadvantages
VSTP	<ul style="list-style-type: none"> • VSTP works with VLANs that require device compatibility. Enable VSTP on all VLANs that could receive VSTP bridge protocol data units (BPDUs). • VSTP and RSTP are the only spanning-tree protocols that can be configured concurrently on a switch. • For VSTP, interfaces can be configured at the global level or at the VLAN level. Interfaces configured at the global VSTP level will be enabled for all the configured VLANs. If an interface is configured at both the global and VLAN levels, the configuration at the VLAN level overrides the global configuration. • On MX and ACX routers, you can configure RSTP, MSTP, and VSTP instance interfaces as edge ports. 	<ul style="list-style-type: none"> • With VSTP, there can be only one STP instance per VLAN, where MSTP lets you combine multiple VLANs in one instance. • VSTP supports a limited number of ports compared to RSTP. • You can configure VSTP for a maximum of 509 VLANs. However, having a large number of VSTP and RSTP instances can cause continuous changes in the topology. As a performance workaround, reduce the number of VSTP instances to fewer than 190. • Using the same VLAN for RSTP and VSTP is not supported. For example, if you are configuring a VLAN under VSTP, configuring RSTP with an interface that contains the same VLAN is not supported. • If you configure VSTP and RSTP at the same time and the switch has more than 253 VLANs, VSTP is configured only for the first 253 VLANs. For the remaining

Table 1: Selecting a Spanning-Tree Protocol *(Continued)*

Protocol	Advantages	Disadvantages
		<p>VLANs, only RSTP is configured.</p> <ul style="list-style-type: none"> When you configure VSTP with the <code>set protocol vstp vlan vlan-id interface interface-name</code> command, the VLAN named default is excluded. You must manually configure a VLAN with the name default to run VSTP.

TIP: When using VSTP, we recommend that you enable VSTP on all VLANs that can receive VSTP bridge protocol data units (BPDUs).

TIP: When you configure VSTP with the `set protocol vstp vlan all` command, VLAN ID 1 is not set; it is excluded so that the configuration is compatible with Cisco PVST+. If you want VLAN ID 1 to be included in the VSTP configuration on your switch, you must set it separately with the `set protocol vstp vlan 1` command. For more information, see Knowledge Base articles KB15138 and KB18291 at <https://kb.juniper.net/InfoCenter/index>

TIP: The maximum number of VLANs supported by VSTP on a switch depends upon whether you are using Junos OS for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style or Junos OS that does not support ELS.

You can use Juniper Networks switches with VSTP and Cisco switches with PVST+ and Rapid-PVST+ in the same network. Cisco supports a proprietary Per-VLAN Spanning Tree (PVST) protocol, which maintains a separate spanning tree instance per each VLAN. One Spanning Tree per VLAN allows fine grain load balancing but requires more BPDUs CPU processing as the number of VLANs increases. PVST runs on Cisco proprietary ISL trunks which is not supported by Juniper. Juniper switches only inter-operate with PVST+ and Rapid-PVST+.

TIP: Spanning-tree protocols all generate their own BPDUs. User bridge applications running on a PC can also generate BPDUs. If these BPDUs are picked up by STP applications running on the switch, they can trigger STP miscalculations, and those miscalculations can lead to network outages. See [Configuring BPDUs Protection on Spanning Tree Interfaces](#).

NOTE: If you are configuring an interface for any spanning tree protocol (STP, MSTP, RSTP, and VSTP), the `interface all`, `vlan all`, and `vlan-group` options are not available when you configure an interface with the `flexible-vlan-tagging` family option.

Switch and Router Spanning Tree Support and Limitations

Not all switches and routers support the exact same features and configurations. Known differences are listed in [Table 2 on page 12](#).

Table 2: Spanning Tree Hardware Considerations

Router or Switch	Considerations
MX Series Routers	<p>Only MX Series routers can use the virtual-switch routing instance type to isolate a LAN segment with its spanning-tree instance and to separate its VLAN ID space. See "Configuring a Virtual Switch Routing Instance on MX Series Routers" on page 20</p> <p>Tracing and global tracing are available on ACX and MX routers with the global "traceoptions" on page 337 statement—see "Understanding Spanning-Tree Protocol Trace Options" on page 237.</p> <p>Beginning with Release 14.1R1, these STP log enhancements are supported on MX Series routers:</p> <ul style="list-style-type: none"> Logging of information in the internal ring buffer about events like Spanning Tree (such as STP, MSTP, RSTP, or VSTP) interface role or state change without having to configure STP traceoptions. Capturing information as to what triggered the spanning-tree role or state change. <p>On MX and ACX routers, you can configure RSTP, MSTP, and VSTP instance interfaces as edge ports for faster convergence than the original STP version. Edge ports transition directly to the forwarding state, and so the protocol does not need to wait for BPDUs to be received on edge ports.</p> <p>On an MX Series router running RSTP or MSTP in a provider network, you can enable provider bridge participation in the RSTP or MSTP instance—see Understanding Provider Bridge Participation in RSTP or MSTP Instances.</p>

Table 2: Spanning Tree Hardware Considerations *(Continued)*

Router or Switch	Considerations
<p>TIP: For 802.1ad provider bridge networks (stacked VLANs) on MX Series and M Series routers, single-tagged access ports and double-tagged trunk ports can co-exist in a single spanning tree context. In this mode, the VLAN Spanning Tree Protocol (VSTP) can send and receive untagged Rapid Spanning Tree Protocol (RSTP) bridge protocol data units (BPDUs) on Gigabit Ethernet (ge), 10 -Gigabit Ethernet (xe), and aggregated Ethernet (ae) interfaces. The untagged RSTP BPDUs interoperate with tagged VSTP BPDUs sent over the double-tagged trunk ports. Double-tagging can be useful for Internet service providers, allowing them to use VLANs internally while mixing traffic from clients that are already VLAN-tagged.</p>	
ACX Series Routers	<p>On MX and ACX routers, you can configure RSTP, MSTP, and VSTP instance interfaces as edge ports for faster convergence than the original STP version. Edge ports transition directly to the forwarding state, and so the protocol does not need to wait for BPDUs to be received on edge ports.</p> <p>Tracing and global tracing are available on ACX and MX routers with the global "traceoptions" on page 337 statement—see "Understanding Spanning-Tree Protocol Trace Options" on page 237.</p>

Table 2: Spanning Tree Hardware Considerations *(Continued)*

Router or Switch	Considerations
QFX Series Switches	<p>See Configuring STP.</p> <p>If your network includes IEEE 802.1D 1998 bridges, remove RSTP and explicitly configure STP—see "Forcing RSTP or VSTP to Run as IEEE 802.1D STP (CLI Procedure)" on page 86. When you explicitly configure STP, the QFX Series products use the IEEE 802.1D 2004 specification, force version 0. This configuration runs a version of RSTP that is compatible with the classic, basic STP. If you use virtual LANs (VLANs), you can enable VSTP on your network.</p> <p>The STP support provided for the QFX Series includes:</p> <ul style="list-style-type: none"> • IEEE 802.1d • 802.1w RSTP • 802.1s MSTP <p>Use Rapid Spanning Tree Protocol (RSTP) on the network side of the QFX Series to provide quicker convergence time than the base Spanning Tree Protocol (STP) does. RSTP identifies certain links as point to point. When a point-to-point link fails, the alternate link can transition to the forwarding state, which speeds up convergence.</p> <p>An interface can be configured for either root protection or loop protection, but not for both.</p> <p>On EX Series (except EX9200) and QFX Series switches running Junos OS that supports ELS—VSTP can support up to 510 VLANs.</p> <p>If your EX Series or QFX Series switch interoperates with a Cisco device running Rapid per VLAN Spanning Tree (Rapid PVST+), we recommend that you enable both VSTP and RSTP on the EX Series or QFX Series interface.</p>

Table 2: Spanning Tree Hardware Considerations *(Continued)*

Router or Switch	Considerations
EX Series Switches	<ul style="list-style-type: none"> • There are two versions of EX Series switches. Be sure to use the correct commands for each version. Some EX switches run the Juniper Networks Junos operating system (Junos OS) that supports the Enhanced Layer 2 Software (ELS) configuration (for example, EX4300, EX2300, EX3400 and EX4600 support ELS) and some do not support the ELS configuration. • EX Series switches configured to use STP actually run RSTP force version 0, which is compatible with STP. If you are using Junos OS for EX Series switches with support for ELS, you can force the original IEEE 802.1D Spanning Tree Protocol (STP) version to run in place of RSTP or VSTP. See "Forcing RSTP or VSTP to Run as IEEE 802.1D STP (CLI Procedure)" on page 86. • On EX Series (except EX9200) and QFX Series switches running Junos OS that supports ELS—VSTP can support up to 510 VLANs. However, on EX9200 switches, VSTP can support only up to 253 VLANs. • The EX Series switches EX4300, EX4600 and the QFX platforms QFX5100, QFX3500, QFX3600 support 510 Vlan on VSTP. • On EX9200 switches—VSTP can support up to 4000 VLANs. • On an EX Series switch running Junos OS that does not support ELS—VSTP can support up to 253 VLANs. • EX4300 switches can be configured for STP only by enabling RSTP and forcing it to act as STP. Select the Force STP check box from the RSTP configuration page. • An interface can be configured for either root protection or loop protection, but not for both. • If your EX Series or QFX Series switch interoperates with a Cisco device running Rapid per VLAN Spanning Tree (Rapid PVST+), we recommend that you enable both VSTP and RSTP on the EX Series or QFX Series interface. • The ARP feature is not available for EX Series switches supporting the Enhanced Layer 2 Software (ELS) configuration style.

Table 2: Spanning Tree Hardware Considerations *(Continued)*

Router or Switch	Considerations
	<p>TIP: EX Series switches can have a maximum of 253 VLANs on VSTP. Therefore, to have as many spanning-tree protocol VLANs as possible, use both VSTP and RSTP. RSTP will then be applied to VLANs that exceed the limit for VSTP. Because RSTP is enabled by default, you just need to additionally enable VSTP.</p>
QFabric	<p>Although there is no need to run STP in a QFabric system, you can connect a QFabric system to another Layer 2 device and use STP. STP traffic can only be processed on network Node groups. Other Node groups, such as redundant server Node groups and server Node groups, discard the STP bridge protocol data units (BPDUs) traffic and disable the interface automatically. Server Node groups only process host-facing protocols, whereas Network Node groups process all supported protocols.</p>
SRX Series devices	<ul style="list-style-type: none"> • Provide Layer 2 loop prevention through STP, RSTP, or MSTP only. VSTP is not supported on the SRX platform. • There are two versions of SRX Series devices. Be sure to use the correct commands for each version. Some SRX Series devices run the Juniper Networks Junos operating system (Junos OS) that supports the Enhanced Layer 2 Software (ELS) configuration and some do not support the ELS configuration. • Starting in Junos OS Release 15.1X49-D70, the Spanning Tree Protocol (STP) is supported on SRX300, SRX320, SRX340, SRX345, SRX550M, and SRX1500 devices. Spanning Tree Protocol (STP) is not supported from Junos OS Release 15.1X49-D40 to Junos OS Release 15.1X49-D60. • An interface can be configured for either root protection or loop protection, but not for both.

2

CHAPTER

Spanning-Tree Instances and Interfaces

Spanning Tree Instances and Interfaces | 18

Spanning Tree Instances and Interfaces

IN THIS SECTION

- [Understanding Spanning-Tree Instance Interfaces | 18](#)
- [Configuring a Virtual Switch Routing Instance on MX Series Routers | 20](#)
- [Configuring a Spanning-Tree Instance Interface as an Edge Port for Faster Convergence | 21](#)

Understanding Spanning-Tree Instance Interfaces

IN THIS SECTION

- [Benefits of Spanning-Tree Instance Interface Configuration | 18](#)
- [How Many Instances Do Spanning Tree Protocols Have? | 19](#)
- [Spanning-Tree Instance Interfaces Have Priorities | 19](#)
- [What is Spanning-Tree Instance Interface Cost? | 19](#)

An instance is analogous to one computer process. The 802.1Q standard defines one unique Spanning-Tree instance to be used by all VLANs in the network. STP runs on the Native VLAN so that it can communicate with both 802.1Q and non-802.1Q compatible switches. This single instance of STP is also referred to as 802.1Q Mono Spanning Tree or Common Spanning Tree (CST).

Benefits of Spanning-Tree Instance Interface Configuration

The interface mode allows RSTP, MSTP, and VSTP to converge faster than the original STP on point-to-point links. The protocol does not need to wait for timers on point-to-point links. Configure interfaces that have a point-to-point link to another Layer 2 bridge as **p2p**. This parameter is ignored if the STP is configured to run the original spanning-tree version.

If the ["interface \(Spanning Tree\)" on page 288](#) mode is configured at both the VSTP global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

How Many Instances Do Spanning Tree Protocols Have?

STP and RSTP are limited to a single instance on any physical interface. Use the ["interface \(Spanning Tree\)" on page 288](#) statement to configure interfaces to participate in the STP or RSTP instance.

MSTP supports multiple instances on a single physical interface. Again, use the ["interface \(Spanning Tree\)" on page 288](#) statement to configure which logical interfaces participate in MSTP.

For VSTP, interfaces can be configured at the global level or at the VLAN level. Interfaces configured at the global VSTP level will be enabled for all the configured VLANs. If an interface is configured at both the global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

Spanning-Tree Instance Interfaces Have Priorities

The reason that instances must have priorities is because a root port for a spanning tree is the interface on the nonroot bridge with the lowest path cost to the root bridge. When multiple interfaces have the same path cost to the root bridge, the interface with the lowest interface priority is selected as the root port.

If the interface ["priority" on page 314](#) is not configured and multiple interfaces have the same path cost to the root bridge, the interface with the lowest interface identifier is selected as the root port.

If the interface ["priority" on page 314](#) is configured under the MSTP protocol, this becomes the default value for all interfaces. If the interface priority is configured under the MSTI interface, the value overrides the default for that interface.

If the interface ["priority" on page 314](#) is configured at both the VSTP global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

What is Spanning-Tree Instance Interface Cost?

The path cost used to calculate the root path cost from any given LAN segment is determined by the total cost of each link in the path. By default, the link cost is determined by the speed of the link. The interface cost can be configured to override the default cost and control which bridge is the designated bridge and which port is the designated port. In MSTP the CIST external path cost is determined by the link speed and the number of hops.

If the interface ["cost" on page 264](#) is not configured, the cost is determined by the speed of the interface. For example, a 100-Mbps link has a default path cost of 19, a 1000-Mbps link has a default path cost of 4, and a 10-Gbps link has a default path cost of 2.

If the interface ["cost" on page 264](#) is configured under MSTP, this becomes the default value for all interfaces. If the interface cost is configured under the MSTI interface, the value overrides the default for that interface.

If the interface "[cost](#)" on [page 264](#) is configured at both the VSTP global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

TIP: The interface cost should be set the same for all interfaces connected to the same LAN segment.

Configuring a Virtual Switch Routing Instance on MX Series Routers

On MX Series routers only, use the `virtual-switch` routing instance type to isolate a LAN segment with its spanning-tree instance and to separate its VLAN ID space. A bridge domain consists of a set of ports that share the same flooding or broadcast characteristics. Each virtual switch represents a Layer 2 network. You can optionally configure a virtual switch to support Integrated Routing and Bridging (IRB), which facilitates simultaneous Layer 2 bridging and Layer 3 IP routing on the same interface. You can also configure Layer 2 control protocols to provide loop resolution. Protocols supported include the Spanning-Tree Protocol (STP), Rapid Spanning-Tree Protocols (RSTP), Multiple Spanning-Tree Protocol (MSTP), and VLAN Spanning-Tree Protocol (VSTP).

To create a routing instance for a virtual switch, include at least the following statements in the configuration:

```
[edit]
routing-instances {
  routing-instance-name
    instance-type virtual-switch;
    bridge-domains {
      bridge-domain-name {
        domain-type bridge;
        interface interface-name;
        vlan-id (all | none | number);
        vlan-tags outer number inner number;
      }
    }
    protocols {
      (rstp | mstp | vstp) {
        ...stp-configuration ...
      }
    }
  }
}
```

```
}
}
```

For more information about configuring virtual switches, see *Configuring a Layer 2 Virtual Switch*.

Configuring a Spanning-Tree Instance Interface as an Edge Port for Faster Convergence

RSTP, MSTP, and VSTP instance interfaces configured as *edge ports* enable the protocol to converge faster than the original IEEE 802.1D STP version. Edge ports transition directly to the forwarding state, and so the protocol does not need to wait for BPDUs to be received on edge ports.

The Junos OS supports automatic detection of edge ports as described in the RSTP standard. Layer 2 bridges do not expect to receive BPDUs for edge ports. If a BPDU is received for an edge port, the port becomes a non-edge port.

Keep the following guidelines in mind when configuring spanning-tree instance interfaces as edge ports:

- Do not configure a spanning-tree instance interface as an edge port if it is connected to any Layer 2 bridge. An instance interface connected to Layer 2 bridges but configured as an edge port can cause physical loops.
- If the spanning-tree protocol is configured to run the original IEEE 802.1D spanning-tree version, the edge-port option (if configured) is ignored.
- If edge ports are configured at both the VSTP global and VLAN levels, the configuration at the VLAN level overrides the global configuration.

SEE ALSO

Example: Configuring BPDU Protection on MX Edge Interfaces to Prevent STP Miscalculations

[Configuring Rapid Spanning Tree Protocol | 28](#)

[Configuring Multiple Spanning Tree Protocol | 95](#)

[Configuring VLAN Spanning Tree Protocol](#)

[edge | 274](#)

[interface \(Spanning Tree\) | 288](#)

[Configuring RSTP on EX Series Switches \(CLI Procedure\) | 31](#)

[Configuring MSTP on Switches | 91](#)

3

CHAPTER

Configuring Spanning-Tree Protocols

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Configuring STP Protocol

IN THIS SECTION

- [Understanding STP | 23](#)
- [Understanding System Identifiers for Bridges in STP or RSTP Instances | 25](#)
- [Configuring STP on EX Series Switches \(CLI Procedure\) | 25](#)

Understanding STP

IN THIS SECTION

- [Benefits of Using the Original STP | 23](#)
- [STP on MX Routers | 24](#)
- [STP on SRX Firewalls | 24](#)
- [STP on EX Series Switches | 24](#)
- [STP Operation Mode Commands | 24](#)

Spanning Tree Protocol (STP), defined in IEEE 802.1D, creates a tree of links in the Ethernet switched network. Links that cause loops in the network are disabled, thereby providing a single active link between any two devices.

Benefits of Using the Original STP

Some benefits of using the original STP are:

- Some legacy networks require the slower convergence times of basic STP.
- STP supports older 802.1D 1998 bridges.
- You can run RSTP on some switches and STP on others with 802.1D 1998 bridges. They are compatible.

STP on MX Routers

Beginning with Release 14.1R1, these enhancements are supported on STP logs in the MX Series support:

- Logging of information in the internal ring buffer about events like Spanning Tree (such as STP, MSTP, RSTP, or VSTP) interface role or state change without having to configure STP traceoptions.
- Capturing information as to what triggered the spanning-tree role or state change.

STP on SRX Firewalls

Spanning Tree Protocol (STP) is not supported on SRX devices from Junos Os Release 15.1X49-D40 to Junos OS Release 15.1X49-D60.

Starting in Junos OS Release 15.1X49-D70, the Spanning Tree Protocol (STP) is supported on SRX300, SRX320, SRX340, SRX345, SRX550M, and SRX1500 devices.

STP on EX Series Switches

EX Series switches configured to use STP actually run RSTP force version 0, which is compatible with STP. If you are using Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, you can force the original IEEE 802.1D Spanning Tree Protocol (STP) version to run in place of RSTP or VSTP by setting ["force-version" on page 279](#).

STP Operation Mode Commands

You can use the operational mode commands ["show spanning-tree statistics message-queues" on page 415](#), ["show spanning-tree stp-buffer see-all" on page 417](#), ["show spanning-tree statistics bridge" on page 410](#), and ["show spanning-tree statistics interface" on page 412](#) to get the information from ring-buffer, bridge, and port statistics. ["clear spanning-tree stp-buffer" on page 370](#) clears the stp-buffer, and ["clear spanning-tree statistics bridge" on page 368](#) clears the statistics of the bridge.

SEE ALSO

| *Understanding Layer 2 Protocol Tunneling*

Understanding System Identifiers for Bridges in STP or RSTP Instances

Spanning tree protocols work by creating bridges. A root bridge (switch) is a bridge at the top of a Spanning Tree. Ethernet connections branch out from the root switch, connecting to other switches in the Local Area Network (LAN). An extended system identifier is assigned to bridges in STP or RSTP routing instances—see ["extended-system-id" on page 278](#).

When you configure STP or RSTP, you specify the extended system identifier.

Configuring STP on EX Series Switches (CLI Procedure)

The default spanning-tree protocol for EX Series switches is Rapid Spanning Tree Protocol (RSTP). RSTP provides faster convergence times than the original Spanning Tree Protocol (STP). However, some legacy networks require the slower convergence times of basic STP that work with 802.1D 1998 bridges.

If your network includes 802.1D 1998 bridges, you can remove RSTP and explicitly configure STP. When you explicitly configure STP, the switches use the IEEE 802.1D 2004 specification, force version 0. This configuration runs a version of RSTP that is compatible with the classic, basic STP.

To configure STP:

1. Either delete RSTP on the entire switch or disable RSTP on specific interfaces:

- To delete RSTP on the entire switch:

```
[edit protocols]
user@switch# delete rstp
```

- To disable RSTP on a specific interface:

```
[edit protocols]
user@switch# set rstp interface interface-name disable
```

2. Enable STP either on all interfaces or on a specific interface:

- To enable STP on all interfaces:

```
[edit protocols]
user@switch# set stp interface all
```

- To enable STP on a specific interface:

```
[edit protocols]
user@switch# set stp interface interface-name
```

3. (Optional) Only if a routed VLAN interface (RVI) is configured, enable the Address Resolution Protocol (ARP) for faster MAC address recovery:

- To enable ARP on STP on all interfaces:

```
[edit protocols]
user@switch# set stp interface all arp-on-stp
```

- To enable ARP on STP on a specific interface:

```
[edit protocols]
user@switch# set stp interface interface-name arp-on-stp
```

RELATED DOCUMENTATION

Understanding Layer 2 Protocol Tunneling

Configuring RSTP Protocol

IN THIS SECTION

- [Understanding RSTP | 27](#)
- [Configuring Rapid Spanning Tree Protocol | 28](#)
- [Configuring RSTP on EX Series Switches \(CLI Procedure\) | 31](#)
- [Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP | 32](#)
- [Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)
- [Forcing RSTP or VSTP to Run as IEEE 802.1D STP \(CLI Procedure\) | 86](#)

Understanding RSTP

IN THIS SECTION

- [Benefits of Using RSTP | 27](#)
- [Why is RSTP the Default Spanning-Tree Protocol? | 27](#)

Juniper Networks products use Rapid Spanning Tree Protocol (RSTP) on the network side of devices by default to provide quicker convergence time than the base Spanning Tree Protocol (STP) does. RSTP identifies certain links as point to point. When a point-to-point link fails, the alternate link can transition to the forwarding state, which speeds up convergence.

Benefits of Using RSTP

Some benefits of using the original STP are:

- RSTP is faster than STP.
- Voice and video work better with RSTP than they do with STP.
- RSTP supports more ports than MSTP or VSTP.
- RSTP is backward compatible with STP; therefore, switches do not all have to run RSTP.
- On MX and ACX routers, you can configure RSTP, MSTP, and VSTP instance interfaces as edge ports.

Why is RSTP the Default Spanning-Tree Protocol?

RSTP evolved from the original STP IEEE 802.1D protocol to provide faster spanning-tree reconvergence after a switch port, switch, or LAN failure. Where STP took up to 50 seconds to respond to topology changes, RSTP responds to changes within the timeframe of three hello BPDUs (bridge protocol data units), or 6 seconds. This is the primary reason that RSTP is the default spanning-tree configuration.

TIP: EX Series switches configured to use STP actually run RSTP force version 0, which is compatible with STP.

Configuring Rapid Spanning Tree Protocol

You can configure Rapid Spanning Tree Protocol (RSTP) under the following hierarchy levels:

- [edit logical-systems *logical-system-name* protocols]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]
- [edit protocols]
- [edit routing-instances *routing-instance-name* protocols]

The routing instance type can be either **virtual-switch** or **layer2-control**.

To configure the Rapid Spanning Tree Protocol:

1. Enable RSTP as the version of spanning-tree protocol to be configured:

```
[edit]
user@host# edit ... protocols (STP Type) rstp
```

2. (Optional) For compatibility with older bridges that do not support RSTP, you can force RSTP to run as the original IEEE 802.1D Spanning Tree Protocol (STP) version:

```
[edit ... protocols rstp]
user@host# set force-version stp
```

NOTE: If RSTP has been forced to run as the original STP version, you can revert back to RSTP by first removing the `force-version` statement from the configuration and then entering the **clear spanning-tree protocol-migration** configuration mode command.

3. (Optional) Enable provider bridge participation in the RSTP instance:

```
[edit ... protocols rstp]
user@host# set bpdu-destination-mac-address provider-bridge-group
```

4. (Optional) Specify the extended system identifier used in identifiers bridges that participate in RSTP:

```
[edit ... protocols rstp]
user@host# set extended-system-id identifier
```

5. Configure the interfaces that participate in the RSTP instance.

- a. Enable configuration of the interface:

```
[edit ... protocols rstp]
user@host# edit interface interface-name
```

- b. Configure the interface priority:

```
[edit ... protocols rstp interface interface-name]
user@host# set priority interface-priority
```

- c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

```
[edit ... protocols rstp interface interface-name]
user@host# set cost interface-link-cost
```

- d. Configure the interface link mode to identify point-to-point links:

```
[edit ... protocols rstp interface interface-name]
user@host# set mode (p2p | shared)
```

Specify **p2p** if the link is point to point. Specify **shared** if the link is a shared media.

- e. (Optional) Configure the interface as an edge port:

```
[edit ... protocols rstp interface interface-name]
user@host# set edge
```

Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a non-edge port

You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see ["Checking the Status of Spanning-Tree Instance Interfaces" on page 236](#).

6. Configure the bridge priority:

```
[edit ... protocols rstp]
user@host# set bridge-priority bridge-priority
```

For more information, see ["Understanding Bridge Priority for Election of Root Bridge and Designated Bridge" on page 212](#).

7. Configure hello BPDUs:

- a. Configure the maximum expected arrival time of hello BPDUs:

```
[edit ... protocols rstp]
user@host# set max-age seconds
```

- b. Configure the time interval at which the root bridge transmits configuration BPDUs:

```
[edit ... protocols rstp]
user@host# set hello-time seconds
```

8. (Optional) By default, the bridge port remains in the listening and learning states for 15 seconds before transitioning to the forwarding state. You can specify a delay from 4 through 20 seconds instead:

```
[edit ... protocols rstp]
user@host# set forward-delay seconds
```

9. Verify the RSTP configuration:

```
[edit]
... { # Optional logical system and/or routing instance
  protocols (STP Type) {
    rstp {
      force-version stp; # Optional.
      bpd-destination-mac-address provider-bridge-group; # Optional
      extended-system-id identifier; # Optional.
      interface interface-name {
        priority interface-priority;
        cost interface-link-cost; # Optional.
        mode (p2p | shared);
        edge; # Optional.
```



```

    }
    bridge-priority bridge-priority;
    max-age seconds;
    hello-time seconds;
    forward-delay seconds; # Optional.
  }
}
}

```

Configuring RSTP on EX Series Switches (CLI Procedure)

The default spanning-tree protocol for EX Series switches is Rapid Spanning Tree Protocol (RSTP). RSTP provides faster convergence times than the original Spanning Tree Protocol (STP). Because RSTP is configured by default, you only need to use this procedure if another spanning-tree protocol has been configured. In that case, you can reconfigure RSTP.

To enable RSTP:

1. Disable the other configured spanning-tree protocol (MSTP):

- To disable MSTP:

```

[edit protocols]
user@switch# set mstp disable

```

2. Configure RSTP

- To enable RSTP on a specific interface:

```

[edit protocols]
user@switch# set rstp interface interface-name

```

- To disable RSTP on a specific interface:

```

[edit protocols]
user@switch# set rstp interface interface-name disable

```

- To enable RSTP on a range of interfaces:

```
[edit protocols]
user@switch# set rstp interface interface-range-name
```

- To enable RSTP on all interfaces:

```
[edit protocols]
user@switch# set rstp interface all
```

Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP

IN THIS SECTION

- Requirements | 33
- Overview and Topology | 33
- Configuring RSTP and Nonstop Bridging on Switch 1 | 36
- Configuring RSTP and Nonstop Bridging on Switch 2 | 41
- Configuring RSTP and Nonstop Bridging on Switch 3 | 46
- Configuring RSTP and Nonstop Bridging on Switch 4 | 51
- Verification | 55

NOTE: This example uses Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see ["Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches"](#) on page 59. For ELS details, see *Using the Enhanced Layer 2 Software CLI*.

EX Series switches use Rapid Spanning Tree Protocol (RSTP) by default to provide a loop-free topology.

When switches that support redundant Routing Engines use RSTP, it is important to keep RSTP synchronized on both Routing Engines so that no loss of service occurs after a Routing Engine switchover. Nonstop bridging protocol keeps Routing Engines synchronized.

This example describes how to configure RSTP and NSB on four EX Series switches:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 15.1 or later or later for EX Series switches
- Four EX Series switches

Before you configure the switches for RSTP, be sure you have:

- Installed and connected the four switches. See the hardware documentation for your switch.
- Performed the initial software configuration on all switches. See *Connecting and Configuring an EX Series Switch (CLI Procedure)*.

Overview and Topology

IN THIS SECTION

- [Topology | 36](#)

RSTP works by identifying certain links as point to point links and blocking other possible paths. When one of the point-to-point links fails, a designated alternate link transitions to the forwarding state and take over. Configuring nonstop bridging (NSB) on a switch with redundant Routing Engines keeps RSTP synchronized on both Routing Engines. This way, RSTP remains active immediately after a switchover because it is already synchronized to the backup Routing Engine. RSTP does not have to reconverge after a Routing Engine switchover when NSB is enabled because the neighbor devices do not detect an RSTP change on the switch. In this example, four EX Series switches are connected in the topology displayed in [Figure 1 on page 34](#) to create a loop-free topology with NSB applied to switches with dual Routing Engines.

Figure 1: Network Topology for RSTP

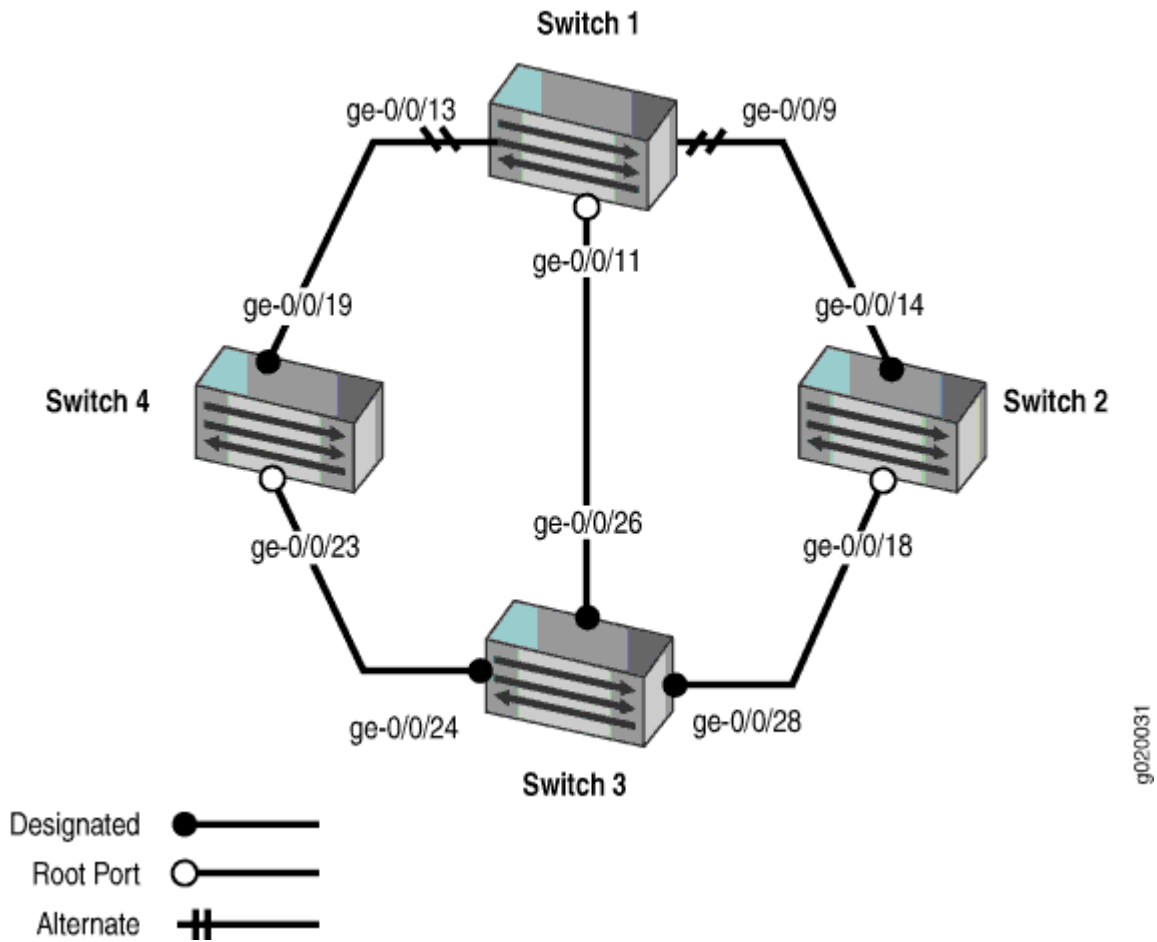


Table 3 on page 35 shows the components of the topology for this example.

NOTE: You can configure RSTP only on physical interfaces, not on logical interfaces.

Table 3: Components of the Topology for Configuring RSTP

Property	Settings
Switch 1	<p>The following interfaces on Switch 1 are connected in this way:</p> <ul style="list-style-type: none"> • <code>ge-0/0/9</code> is connected to Switch 2 • <code>ge-0/0/13</code> is connected to Switch 4 • <code>ge-0/0/11</code> is connected to Switch 3
Switch 2	<p>The following interfaces on Switch 2 are connected in this way:</p> <ul style="list-style-type: none"> • <code>ge-0/0/14</code> is connected to Switch 1 • <code>ge-0/0/18</code> is connected to Switch 3
Switch 3	<p>The following interfaces on Switch 3 are connected in this way:</p> <ul style="list-style-type: none"> • <code>ge-0/0/26</code> is connected to Switch 1 • <code>ge-0/0/28</code> is connected to Switch 2 • <code>ge-0/0/24</code> is connected to Switch 4
Switch 4	<p>The following interfaces on Switch 4 are connected in this way:</p> <ul style="list-style-type: none"> • <code>ge-0/0/19</code> is connected to Switch 1 • <code>ge-0/0/23</code> is connected to Switch 3
VLAN names and tag IDs	<p>voice-vlan, tag 10 employee-vlan, tag 20 guest-vlan, tag 30 camera-vlan, tag 40</p>

This configuration example creates a loop-free topology between four EX Series switches using RSTP.

An RSTP topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.

- The *designated port* forwards data to the downstream network segment or device.
- The *backup port* is a backup port for the designated port. When a designated port goes down, the backup port becomes the active designated port and starts forwarding data.

NOTE: You also can create a loop-free topology between the aggregation layer and the distribution layer using redundant trunk links. For more information about configuring redundant trunk links, see *Example: Configuring Redundant Trunk Links for Faster Recovery on Devices with ELS Support*.

Topology

Configuring RSTP and Nonstop Bridging on Switch 1

IN THIS SECTION

- [Procedure | 36](#)

Procedure

CLI Quick Configuration

To quickly configure RSTP and nonstop bridging on Switch 1, copy the following commands and paste them into the switch terminal window:

```
[edit]

set vlans voice-vlan description "Voice VLAN"
set vlans voice-vlan vlan-id 10
set vlans employee-vlan description "Employee VLAN"
set vlans employee-vlan vlan-id 20
set vlans guest-vlan description "Guest VLAN"
set vlans guest-vlan vlan-id 30
set vlans camera-vlan description "Camera VLAN"
set vlans camera-vlan vlan-id 40
set interfaces ge-0/0/13 unit 0 family ethernet-switching vlan members

[10 20 30 40]
```

```

[10 20 30 40]      set interfaces ge-0/0/9 unit 0 family ethernet-switching vlan members
[10 20 30 40]      set interfaces ge-0/0/11 unit 0 family ethernet-switching vlan members
mode trunk          set interfaces ge-0/0/13 unit 0 family ethernet-switching interface-
trunk               set interfaces ge-0/0/9 unit 0 family ethernet-switching interface-mode
mode trunk          set interfaces ge-0/0/11 unit 0 family ethernet-switching interface-
                    set protocols rstp bridge-priority 16k
                    set protocols rstp interface all cost 1000
                    set protocols rstp interface all mode point-to-point

```

If Switch 1 includes dual Routing Engines, configure NSB. To quickly configure nonstop bridging on Switch 1, copy the following commands and paste them into the switch terminal window:

```

set chassis redundancy graceful-switchover
set system commit synchronize
set protocols layer2-control nonstop-bridging

```

NOTE: NFX150 devices support only a single Routing Engine.

Step-by-Step Procedure

To configure RSTP and nonstop bridging on Switch 1:

1. Configure the VLANs **voice-vlan**, **employee-vlan**, **guest-vlan**, and **camera-vlan**:

```

[edit vlans]
user@switch1# set voice-vlan description "Voice VLAN"
user@switch1# set voice-vlan vlan-id 10
user@switch1# set employee-vlan description "Employee VLAN"
user@switch1# set employee-vlan vlan-id 20
user@switch1# set guest-vlan description "Guest VLAN"
user@switch1# set guest-vlan vlan-id 30
user@switch1# set camera-vlan description "Camera VLAN"

```

```
user@switch1# set camera-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch1# set ge-0/0/13 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch1# set ge-0/0/9 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch1# set ge-0/0/11 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch1# set ge-0/0/13 unit 0 family ethernet-switching interface-mode trunk
user@switch1# set ge-0/0/9 unit 0 family ethernet-switching interface-mode trunk
user@switch1# set ge-0/0/11 unit 0 family ethernet-switching interface-mode
trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]

user@switch1# rstp bridge-priority 16k
user@switch1# rstp interface all cost 1000
user@switch1# rstp interface all mode point-to-point
```

Step-by-Step Procedure

If Switch 1 includes dual Routing Engines, configure nonstop bridging. To configure NSB on Switch 1:

1. Enable graceful Routing Engine switchover (GRES):

```
[edit chassis redundancy]
user@switch1# set graceful-switchover
```


2. Configure the switch to always synchronize configuration changes between the Routing Engines:

```
[edit system]
user@switch1# set commit synchronize
```

If you try to commit a configuration in which nonstop bridging is configured but synchronization of configuration changes is not configured, the configuration is not committed.

3. Enable nonstop bridging:

```
[edit protocols layer2-control]
user@switch1# set nonstop-bridging
```

NOTE: This process enables NSB for all NSB-supported Layer 2 protocols on the switch, including RSTP.

Results

Check the results of the configuration:

```
user@switch1> show configuration
interfaces {
  ge-0/0/13 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
  ge-0/0/9 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
}
```

```

        }
    }
}
ge-0/0/11 {
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members [10 20 30 40];
            }
        }
    }
}
}
protocols {
    layer2-control {
        nonstop-bridging;
    }
    rstp {
        bridge-priority 16k;
        interface ge-0/0/13 {
            cost 1000;
            mode point-to-point;
        }
        interface ge-0/0/9 {
            cost 1000;
            mode point-to-point;
        }
        interface ge-0/0/11 {
            cost 1000;
            mode point-to-point;
        }
    }
}
}
vlangs {
    voice-vlan {
        vlan-id 10;
    }
    employee-vlan {
        vlan-id 20;
    }
}

```

```

    guest-vlan {
        vlan-id 30;
    }
    camera-vlan {
        vlan-id 40;
    }
}
system {
    commit synchronize;
}
chassis {
    redundancy {
        graceful-switchover;
    }
}

```

Configuring RSTP and Nonstop Bridging on Switch 2

IN THIS SECTION

- [Procedure | 41](#)

Procedure

CLI Quick Configuration

To quickly configure RSTP and nonstop bridging on Switch 2, copy the following commands and paste them into the switch terminal window:

```

[edit]

    set vlans voice-vlan description "Voice VLAN"
    set vlans voice-vlan vlan-id 10
    set vlans employee-vlan description "Employee VLAN"
    set vlans employee-vlan vlan-id 20
    set vlans guest-vlan description "Guest VLAN"
    set vlans guest-vlan vlan-id 30
    set vlans camera-vlan description "Camera VLAN"
    set vlans camera-vlan vlan-id 40
    set interfaces ge-0/0/14 unit 0 family ethernet-switching vlan members

```

```

[10 20 30 40]
set interfaces ge-0/0/18 unit 0 family ethernet-switching vlan members
[10 20 30 40]
set interfaces ge-0/0/14 unit 0 family ethernet-switching interface-
mode trunk
set interfaces ge-0/0/18 unit 0 family ethernet-switching interface-
mode trunk
set protocols rstp bridge-priority 32k
set protocols rstp interface ge-0/0/14 cost 1000
set protocols rstp interface ge-0/0/14 mode point-to-
point
set protocols rstp interface ge-0/0/18 cost 1000
set protocols rstp interface ge-0/0/18 mode point-to-
point

```

NOTE: Starting with Junos OS Release 15.1 for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, you can configure spanning tree parameters globally on all spanning tree interfaces. See ["Configuring RSTP on EX Series Switches \(CLI Procedure\)" on page 31](#) for additional information.

If Switch 2 includes dual Routing Engines, configure NSB. To quickly configure nonstop bridging on Switch 2, copy the following commands and paste them into the switch terminal window:

```

set chassis redundancy graceful-switchover
set system commit synchronize
set protocols layer2-control nonstop-bridging

```

Step-by-Step Procedure

To configure RSTP and nonstop bridging on Switch 2:

1. Configure the VLANs **voice-vlan**, **employee-vlan**, **guest-vlan**, and **camera-vlan**:

```

[edit vlans]
user@switch2# set voice-vlan description "Voice VLAN"
user@switch2# set voice-vlan vlan-id 10
user@switch2# set employee-vlan description "Employee VLAN"
user@switch2# set employee-vlan vlan-id 20
user@switch2# set guest-vlan description "Guest VLAN"

```

```

user@switch2# set guest-vlan vlan-id 30
user@switch2# set camera-vlan vlan-description "Camera VLAN"
user@switch2# set camera-vlan vlan-id 40

```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```

[edit interfaces]
user@switch2# set ge-0/0/14 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch2# set ge-0/0/18 unit 0 family ethernet-switching vlan members [10 20 30 40]

```

3. Configure the port mode for the interfaces:

```

[edit interfaces]
user@switch2# set ge-0/0/14 unit 0 family ethernet-switching interface-mode trunk
user@switch2# set ge-0/0/18 unit 0 family ethernet-switching interface-mode
trunk

```

4. Configure RSTP on the switch:

```

[edit protocols]
user@switch2# rstp bridge-priority 32k
user@switch2# rstp interface ge-0/0/14 cost 1000
user@switch2# rstp interface ge-0/0/14 mode point-to-point
user@switch2# rstp interface ge-0/0/18 cost 1000
user@switch2# rstp interface ge-0/0/18 mode point-to-point

```

Step-by-Step Procedure

If Switch 2 includes dual Routing Engines, configure nonstop bridging. To configure NSB on Switch 2:

1. Enable graceful Routing Engine switchover (GRES):

```

[edit chassis redundancy]
user@switch2# set graceful-switchover

```

2. Configure the switch to always synchronize configuration changes between the Routing Engines:

```
[edit system]
user@switch2# set commit synchronize
```

If you try to commit a configuration in which nonstop bridging is configured but synchronization of configuration changes is not configured, the configuration is not committed.

3. Enable nonstop bridging:

```
[edit protocols layer2-control]
user@switch2# set nonstop-bridging
```

NOTE: This process enables NSB for all NSB-supported Layer 2 protocols on the switch, including RSTP.

Results

Check the results of the configuration:

```
user@switch2> show configuration
interfaces {
  ge-0/0/14 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
  ge-0/0/18 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
}
```

```

    }
}

protocols {
    layer2-control {
        nonstop-bridging;
    }
    rstp {
        bridge-priority 32k;
        interface ge-0/0/14 {
            cost 1000;
            mode point-to-point;
        }
        interface ge-0/0/18 {
            cost 1000;
            mode point-to-point;
        }
    }
}

vpls {
    voice-vlan {
        vlan-id 10;
    }
    employee-vlan {
        vlan-id 20;
    }
    guest-vlan {
        vlan-id 30;
    }
    camera-vlan {
        vlan-id 40;
    }
}

system {
    commit synchronize;
}

chassis {
    redundancy {
```

```
    graceful-switchover;
}
```

Configuring RSTP and Nonstop Bridging on Switch 3

IN THIS SECTION

- [Procedure | 46](#)

Procedure

CLI Quick Configuration

To quickly configure RSTP and nonstop bridging on Switch 3, copy the following commands and paste them into the switch terminal window:

```
[edit]
    set vlans voice-vlan description "Voice VLAN"
    set vlans voice-vlan vlan-id 10
    set vlans employee-vlan description "Employee VLAN"
    set vlans employee-vlan vlan-id 20
    set vlans guest-vlan description "Guest VLAN"
    set vlans guest-vlan vlan-id 30
    set vlans camera-vlan description "Camera VLAN"
    set vlans camera-vlan vlan-id 40
    set interfaces ge-0/0/26 unit 0 family ethernet-switching vlan members
[10 20 30 40]
    set interfaces ge-0/0/28 unit 0 family ethernet-switching vlan members
[10 20 30 40]
    set interfaces ge-0/0/24 unit 0 family ethernet-switching vlan members
[10 20 30 40]
    set interfaces ge-0/0/26 unit 0 family ethernet-switching interface-
mode trunk
    set interfaces ge-0/0/28 unit 0 family ethernet-switching interface-
mode trunk
    set interfaces ge-0/0/24 unit 0 family ethernet-switching interface-
mode trunk
    set protocols rstp bridge-priority 8k
```



```

point
    set protocols rstp interface ge-0/0/26 cost 1000
    set protocols rstp interface ge-0/0/26 mode point-to-

point
    set protocols rstp interface ge-0/0/28 cost 1000
    set protocols rstp interface ge-0/0/28 mode point-to-

point
    set protocols rstp interface ge-0/0/24 cost 1000
    set protocols rstp interface ge-0/0/24 mode point-to-

```

If Switch 3 includes dual Routing Engines, configure NSB. To quickly configure nonstop bridging on Switch 3, copy the following commands and paste them into the switch terminal window:

```

set chassis redundancy graceful-switchover
set system commit synchronize
set protocols layer2-control nonstop-bridging

```

Step-by-Step Procedure

To configure RSTP and nonstop bridging on Switch 3:

1. Configure the VLANs **voice-vlan**, **employee-vlan**, **guest-vlan**, and **camera-vlan**:

```

[edit vlans]
user@switch3# set voice-vlan description "Voice VLAN"
user@switch3# set voice-vlan vlan-id 10
user@switch3# set employee-vlan description "Employee VLAN"
user@switch3# set employee-vlan vlan-id 20
user@switch3# set guest-vlan description "Guest VLAN"
user@switch3# set guest-vlan vlan-id 30
user@switch3# set camera-vlan description "Camera VLAN"
user@switch3# set camera-vlan vlan-id 40

```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```

[edit interfaces]
user@switch3# set ge-0/0/26 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch3# set ge-0/0/28 unit 0 family ethernet-switching vlan members [10 20 30 40]

```

```
user@switch3# set ge-0/0/24 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch3# set ge-0/0/26 unit 0 family ethernet-switching interface-mode trunk
user@switch3# set ge-0/0/28 unit 0 family ethernet-switching interface-mode trunk
user@switch3# set ge-0/0/24 unit 0 family ethernet-switching interface-mode
trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]
user@switch3# rstp bridge-priority 8k
user@switch3# rstp interface ge-0/0/26 cost 1000
user@switch3# rstp interface ge-0/0/26 mode point-to-point
user@switch3# rstp interface ge-0/0/28 cost 1000
user@switch3# rstp interface ge-0/0/28 mode point-to-point
user@switch3# rstp interface ge-0/0/24 cost 1000
user@switch3# rstp interface ge-0/0/24 mode point-to-point
```

Step-by-Step Procedure

If Switch 3 includes dual Routing Engines, configure nonstop bridging. To configure NSB on Switch 3:

1. Enable graceful Routing Engine switchover (GRES):

```
[edit chassis redundancy]
user@switch3# set graceful-switchover
```

2. Configure the switch to always synchronize configuration changes between the Routing Engines:

```
[edit system]
user@switch3# set commit synchronize
```

If you try to commit a configuration in which nonstop bridging is configured but synchronization of configuration changes is not configured, the configuration is not committed.

3. Enable nonstop bridging:

```
[edit protocols layer2-control]  
user@switch3# set nonstop-bridging
```

NOTE: This process enables NSB for all NSB-supported Layer 2 protocols on the switch, including RSTP.

Results

Check the results of the configuration:

```
user@switch3> show configuration  
interfaces {  
  ge-0/0/26 {  
    unit 0 {  
      family ethernet-switching {  
        interface-mode trunk;  
        vlan {  
          members [10 20 30 40];  
        }  
      }  
    }  
  }  
  ge-0/0/28 {  
    unit 0 {  
      family ethernet-switching {  
        interface-mode trunk;  
        vlan {  
          members [10 20 30 40];  
        }  
      }  
    }  
  }  
  ge-0/0/24 {  
    unit 0 {  
      family ethernet-switching {  
        interface-mode trunk;  
        vlan {
```



```

    }
}
system {
    commit synchronize;
}
chassis {
    redundancy {
        graceful-switchover;
    }
}

```

Configuring RSTP and Nonstop Bridging on Switch 4

IN THIS SECTION

- [Procedure | 51](#)

Procedure

CLI Quick Configuration

To quickly configure RSTP and nonstop bridging on Switch 4, copy the following commands and paste them into the switch terminal window:

```

[edit]
    set vlans voice-vlan description "Voice VLAN"
    set vlans voice-vlan vlan-id 10
    set vlans employee-vlan description "Employee VLAN"
    set vlans employee-vlan vlan-id 20
    set vlans guest-vlan description "Guest VLAN"
    set vlans guest-vlan vlan-id 30
    set vlans camera-vlan description "Camera VLAN"
    set vlans camera-vlan vlan-id 40
    set interfaces ge-0/0/23 unit 0 family ethernet-switching vlan members
[10 20 30 40]
    set interfaces ge-0/0/19 unit 0 family ethernet-switching vlan members
[10 20 30 40]
    set interfaces ge-0/0/23 unit 0 family ethernet-switching interface-
mode trunk

```

```

mode trunk
    set interfaces ge-0/0/19 unit 0 family ethernet-switching interface-
point
    set protocols rstp bridge-priority 16k
    set protocols rstp interface ge-0/0/23 cost 1000
    set protocols rstp interface ge-0/0/23 mode point-to-
point
    set protocols rstp interface ge-0/0/19 cost 1000
    set protocols rstp interface ge-0/0/19 mode point-to-
point

```

If Switch 4 includes dual Routing Engines, configure NSB. To quickly configure nonstop bridging on Switch 4, copy the following commands and paste them into the switch terminal window:

```

set chassis redundancy graceful-switchover
set system commit synchronize
set protocols layer2-control nonstop-bridging

```

Step-by-Step Procedure

To configure RSTP and nonstop bridging on Switch 4:

1. Configure the VLANs **voice-vlan**, **employee-vlan**, **guest-vlan**, and **camera-vlan**:

```

[edit vlans]
user@switch4# set voice-vlan description "Voice VLAN"
user@switch4# set voice-vlan vlan-id 10
user@switch4# set employee-vlan description "Employee VLAN"
user@switch4# set employee-vlan vlan-id 20
user@switch4# set guest-vlan description "Guest VLAN"
user@switch4# set guest-vlan vlan-id 30
user@switch4# set camera-vlan description "Camera VLAN"
user@switch4# set camera-vlan vlan-id 40

```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```

[edit interfaces]
user@switch4# set ge-0/0/23 unit 0 family ethernet-switching vlan members [10 20 30 40]

```

```
user@switch4# set ge-0/0/19 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch4# set ge-0/0/23 unit 0 family ethernet-switching interface-mode trunk
user@switch4# set ge-0/0/19 unit 0 family ethernet-switching interface-mode
trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]
user@switch4# rstp bridge-priority 16k
user@switch4# rstp interface ge-0/0/23 cost 1000
user@switch4# rstp interface ge-0/0/23 mode point-to-point
user@switch4# rstp interface ge-0/0/19 cost 1000
user@switch4# rstp interface ge-0/0/19 mode point-to-point
```

Step-by-Step Procedure

If Switch 4 includes dual Routing Engines, configure nonstop bridging. To configure NSB on Switch 4:

1. Enable graceful Routing Engine switchover (GRES):

```
[edit chassis redundancy]
user@switch4# set graceful-switchover
```

2. Configure the switch to always synchronize configuration changes between the Routing Engines:

```
[edit system]
user@switch4# set commit synchronize
```

If you try to commit a configuration in which nonstop bridging is configured but synchronization of configuration changes is not configured, the configuration is not committed.

3. Enable nonstop bridging:

```
[edit protocols layer2-control]  
user@switch4# set nonstop-bridging
```

NOTE: This process enables NSB for all NSB-supported Layer 2 protocols on the switch, including RSTP.

Results

Check the results of the configuration:

```
user@switch4> show configuration  
interfaces {  
  ge-0/0/23 {  
    unit 0 {  
      family ethernet-switching {  
        interface-mode trunk;  
        vlan {  
          members [10 20 30 40];  
        }  
      }  
    }  
  }  
  ge-0/0/19 {  
    unit 0 {  
      family ethernet-switching {  
        interface-mode trunk;  
        vlan {  
          members [10 20 30 40];  
        }  
      }  
    }  
  }  
}  
protocols {  
  layer2-control {  
    nonstop-bridging;  
  }  
}
```



```
rstp {
    bridge-priority 16k;
    interface ge-0/0/23 {
        cost 1000;
        mode point-to-point;
    }
    interface ge-0/0/19 {
        cost 1000;
        mode point-to-point;
    }
}
vpls {
    voice-vlan {
        vlan-id 10;
    }
    employee-vlan {
        vlan-id 20;
    }
    guest-vlan {
        vlan-id 30;
    }
    camera-vlan {
        vlan-id 40;
    }
}
system {
    commit synchronize;
}
chassis {
    redundancy {
        graceful-switchover;
    }
}
```

Verification

IN THIS SECTION



Verifying RSTP Configuration on Switch 1 | 56

- [Verifying RSTP Configuration on Switch 2 | 57](#)
- [Verifying RSTP Configuration on Switch 3 | 57](#)
- [Verifying RSTP Configuration on Switch 4 | 58](#)

To confirm that the configuration is working properly, perform these tasks on both Routing Engines:

Verifying RSTP Configuration on Switch 1

Purpose

Verify the RSTP configuration on Switch 1.

Action

Use the operational mode command:

```
user@switch1> show spanning-tree
interface

Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/13	128:526	128:526	16384.0019e25040e0	1000	BLK	ALT
ge-0/0/9	128:522	128:522	32768.0019e2503d20	1000	BLK	ALT
ge-0/0/11	128:524	128:524	8192.0019e25051e0	1000	FWD	ROOT

Meaning

The operational mode command `show spanning-tree interface` shows that **ge-0/0/13** is in a forwarding state. The other interfaces on Switch 1 are blocking.

Verifying RSTP Configuration on Switch 2

Purpose

Use this procedure to verify the RSTP configuration on both Switch 2 Routing Engines.

Action

Use the operational mode command:

```
user@switch2> show spanning-tree
interface

Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/14	128:527	128:527	32768.0019e2503d20	1000	FWD	DESG
ge-0/0/18	128:529	128:529	8192.0019e25051e0	1000	FWD	ROOT

Meaning

The operational mode command `show spanning-tree interface` shows that **ge-0/0/18** is in a forwarding state and is the root port.

Verifying RSTP Configuration on Switch 3

Purpose

Use this procedure to verify the RSTP configuration on both Switch 3 Routing Engines.

Action

Use the operational mode commands:

```
user@switch3> show spanning-tree
interface
```

Spanning tree interface parameters for instance 0

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/26	128:539	128:539	8192.0019e25051e0	1000	FWD	DESG
ge-0/0/28	128:541	128:541	8192.0019e25051e0	1000	FWD	DESG
ge-0/0/24	128:537	128:537	8192.0019e25051e0	1000	FWD	DESG

Meaning

The operational mode command `show spanning-tree interface` shows that no interface is the root interface.

Verifying RSTP Configuration on Switch 4

Purpose

Use this procedure to verify the RSTP configuration on both Switch 4 Routing Engines.

Action

Use the operational mode commands:

```
user@switch4> show spanning-tree
interface
Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/23	128:536	128:536	8192.0019e25051e0	1000	FWD	ROOT
ge-0/0/19	128:532	128:532	16384.0019e25040e0	1000	FWD	DESG

Meaning

The operational mode command `show spanning-tree interface` shows that interface **ge-0/0/23** is the root interface and forwarding.

Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches

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- Overview and Topology | 60
- Configuring RSTP and Nonstop Bridging on Switch 1 | 63
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EX Series switches use Rapid Spanning Tree Protocol (RSTP) by default to provide a loop-free topology.

When switches that support redundant Routing Engines use RSTP, it is important to keep RSTP synchronized on both Routing Engines so that no loss of service occurs after a Routing Engine switchover. Nonstop bridging protocol keeps Routing Engines synchronized.

This example describes how to configure RSTP and NSB on four EX Series switches:

Requirements

This example uses the following hardware and software components:

- Junos OS Release 11.3 or later for EX Series switches
- Four EX Series switches

Before you configure the switches for RSTP, be sure you have:

- Installed the four switches. See *Connecting and Configuring an EX Series Switch (J-Web Procedure)*.
- Performed the initial software configuration on all switches. See [Installing and Connecting an EX3200 Switch](#).

Overview and Topology

IN THIS SECTION

- [Topology | 63](#)

RSTP works by identifying certain links as point to point links and blocking other possible paths. When one of the point-to-point links fails, a designated alternate link transitions to the forwarding state and take over. Configuring nonstop bridging (NSB) on a switch with redundant Routing Engines keeps RSTP synchronized on both Routing Engines. This way, RSTP remains active immediately after a switchover because it is already synchronized to the backup Routing Engine. RSTP does not have to reconverge after a Routing Engine switchover when NSB is enabled because the neighbor devices do not detect an RSTP change on the switch. In this example, four EX Series switches are connected in the topology displayed in [Figure 2 on page 61](#) to create a loop-free topology with NSB applied to switches with dual Routing Engines.

Figure 2: Network Topology for RSTP

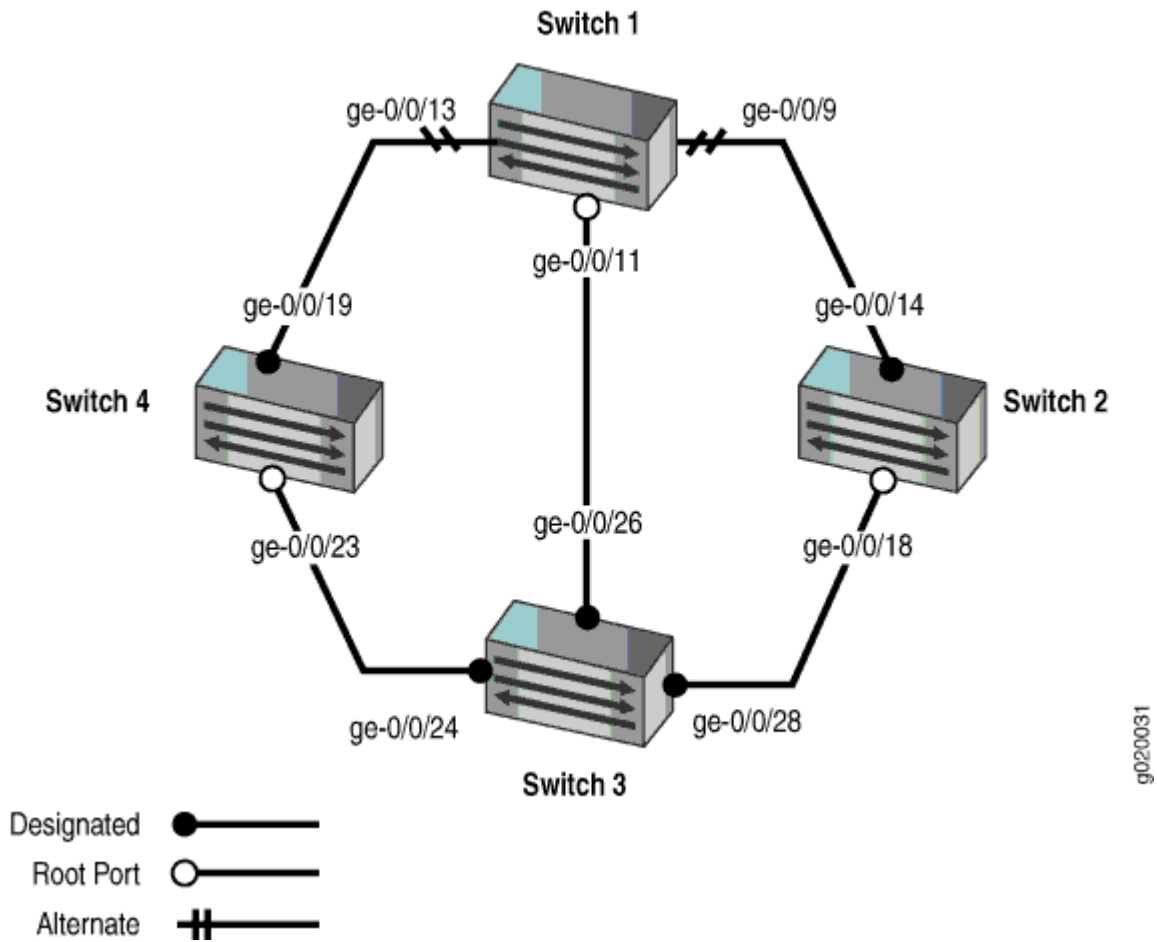


Table 4 on page 62 shows the components of the topology for this example.

NOTE: You can configure RSTP on logical or physical interfaces. This example shows RSTP configured on logical interfaces.

Table 4: Components of the Topology for Configuring RSTP

Property	Settings
Switch 1	<p>The following interfaces on Switch 1 are connected in this way:</p> <ul style="list-style-type: none"> • ge-0/0/9 is connected to Switch 2 • ge-0/0/13 is connected to Switch 4 • ge-0/0/11 is connected to Switch 3
Switch 2	<p>The following interfaces on Switch 2 are connected in this way:</p> <ul style="list-style-type: none"> • ge-0/0/14 is connected to Switch 1 • ge-0/0/18 is connected to Switch 3
Switch 3	<p>The following interfaces on Switch 3 are connected in this way:</p> <ul style="list-style-type: none"> • ge-0/0/26 is connected to Switch 1 • ge-0/0/28 is connected to Switch 2 • ge-0/0/24 is connected to Switch 4
Switch 4	<p>The following interfaces on Switch 4 are connected in this way:</p> <ul style="list-style-type: none"> • ge-0/0/19 is connected to Switch 1 • ge-0/0/23 is connected to Switch 3
VLAN names and tag IDs	<p>voice-vlan, tag 10 employee-vlan, tag 20 guest-vlan, tag 30 camera-vlan, tag 40</p>

This configuration example creates a loop-free topology between four EX Series switches using RSTP.

An RSTP topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.

- The *designated port* forwards data to the downstream network segment or device.
- The *backup port* is a backup port for the designated port. When a designated port goes down, the backup port becomes the active designated port and starts forwarding data.

NOTE: You also can create a loop-free topology between the aggregation layer and the distribution layer using redundant trunk links. For more information about configuring redundant trunk links, see *Example: Configuring Redundant Trunk Links for Faster Recovery on EX Series Switches*.

Topology

Configuring RSTP and Nonstop Bridging on Switch 1

IN THIS SECTION

- [Procedure | 63](#)

Procedure

CLI Quick Configuration

To quickly configure RSTP and nonstop bridging on Switch 1, copy the following commands and paste them into the switch terminal window:

```
[edit]

set vlans voice-vlan description "Voice VLAN"
set vlans voice-vlan vlan-id 10
set vlans employee-vlan description "Employee VLAN"
set vlans employee-vlan vlan-id 20
set vlans guest-vlan description "Guest VLAN"
set vlans guest-vlan vlan-id 30
set vlans camera-vlan description "Camera VLAN"
set vlans camera-vlan vlan-id 40
set interfaces ge-0/0/13 unit 0 family ethernet-switching vlan members

[10 20 30 40]
```

```

[10 20 30 40]      set interfaces ge-0/0/9 unit 0 family ethernet-switching vlan members
[10 20 30 40]      set interfaces ge-0/0/11 unit 0 family ethernet-switching vlan members
trunk              set interfaces ge-0/0/13 unit 0 family ethernet-switching port-mode
trunk              set interfaces ge-0/0/9 unit 0 family ethernet-switching port-mode
trunk              set interfaces ge-0/0/11 unit 0 family ethernet-switching port-mode

point              set protocols rstp bridge-priority 16k
                   set protocols rstp interface ge-0/0/13.0 cost 1000
                   set protocols rstp interface ge-0/0/13.0 mode point-to-

point              set protocols rstp interface ge-0/0/9.0 cost 1000
                   set protocols rstp interface ge-0/0/9.0 mode point-to-

point              set protocols rstp interface ge-0/0/11.0 cost 1000
                   set protocols rstp interface ge-0/0/11.0 mode point-to-

```

If Switch 1 includes dual Routing Engines, configure NSB. To quickly configure nonstop bridging on Switch 1, copy the following commands and paste them into the switch terminal window:

```

set chassis redundancy graceful-switchover
set system commit synchronize
set ethernet-switching-options nonstop-bridging

```

Step-by-Step Procedure

To configure RSTP and nonstop bridging on Switch 1:

1. Configure the VLANs **voice-vlan**, **employee-vlan**, **guest-vlan**, and **camera-vlan**:

```

[edit vlans]
user@switch1# set voice-vlan description "Voice VLAN"
user@switch1# set voice-vlan vlan-id 10
user@switch1# set employee-vlan description "Employee VLAN"
user@switch1# set employee-vlan vlan-id 20
user@switch1# set guest-vlan description "Guest VLAN"
user@switch1# set guest-vlan vlan-id 30

```

```
user@switch1# set camera-vlan description "Camera VLAN"
user@switch1# set camera-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch1# set ge-0/0/13 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch1# set ge-0/0/9 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch1# set ge-0/0/11 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch1# set ge-0/0/13 unit 0 family ethernet-switching port-mode trunk
user@switch1# set ge-0/0/9 unit 0 family ethernet-switching port-mode trunk
user@switch1# set ge-0/0/11 unit 0 family ethernet-switching port-mode
trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]

user@switch1# rstp bridge-priority 16k
user@switch1# rstp interface ge-0/0/13.0 cost 1000
user@switch1# rstp interface ge-0/0/13.0 mode point-to-point
user@switch1# rstp interface ge-0/0/9.0 cost 1000
user@switch1# rstp interface ge-0/0/9.0 mode point-to-point
user@switch1# rstp interface ge-0/0/11.0 cost 1000
user@switch1# rstp interface ge-0/0/11.0 mode point-to-point
```

Step-by-Step Procedure

If Switch 1 includes dual Routing Engines, configure nonstop bridging. To configure NSB on Switch 1:

1. Enable graceful Routing Engine switchover (GRES):

```
[edit chassis redundancy]
user@switch1# set graceful-switchover
```

2. Configure the switch to always synchronize configuration changes between the Routing Engines:

```
[edit system]
user@switch1# set commit synchronize
```

If you try to commit a configuration in which nonstop bridging is configured but synchronization of configuration changes is not configured, the configuration is not committed.

3. Enable nonstop bridging:

```
[edit ethernet-switching-options]
user@switch1# set nonstop-bridging
```

NOTE: This process enables NSB for all NSB-supported Layer 2 protocols on the switch, including RSTP.

Results

Check the results of the configuration:

```
user@switch1> show configuration
interfaces {
  ge-0/0/13 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
}
```

```

ge-0/0/9 {
    unit 0 {
        family ethernet-switching {
            port-mode trunk;
            vlan {
                members [10 20 30 40];
            }
        }
    }
}
ge-0/0/11 {
    unit 0 {
        family ethernet-switching {
            port-mode trunk;
            vlan {
                members [10 20 30 40];
            }
        }
    }
}
}
protocols {
    rstp {
        bridge-priority 16k;
        interface ge-0/0/13.0 {
            cost 1000;
            mode point-to-point;
        }
        interface ge-0/0/9.0 {
            cost 1000;
            mode point-to-point;
        }
        interface ge-0/0/11.0 {
            cost 1000;
            mode point-to-point;
        }
    }
}
}
vlangs {
    voice-vlan {
        vlan-id 10;
    }
}

```

```

employee-vlan {
    vlan-id 20;
}
guest-vlan {
    vlan-id 30;
}
camera-vlan {
    vlan-id 40;
}
}
system {
    commit synchronize;
}
chassis {
    redundancy {
        graceful-switchover;
    }
}
ethernet-switching-options {
    nonstop-bridging;
}

```

Configuring RSTP and Nonstop Bridging on Switch 2

IN THIS SECTION

- [Procedure | 68](#)

Procedure

CLI Quick Configuration

To quickly configure RSTP and nonstop bridging on Switch 2, copy the following commands and paste them into the switch terminal window:

```

[edit]

set vlans voice-vlan description "Voice VLAN"
set vlans voice-vlan vlan-id 10
set vlans employee-vlan description "Employee VLAN"

```

```

set vlans employee-vlan vlan-id 20
set vlans guest-vlan description "Guest VLAN"
set vlans guest-vlan vlan-id 30
set vlans camera-vlan description "Camera VLAN"
set vlans camera-vlan vlan-id 40
set interfaces ge-0/0/14 unit 0 family ethernet-switching vlan members
[10 20 30 40]
set interfaces ge-0/0/18 unit 0 family ethernet-switching vlan members
[10 20 30 40]
set interfaces ge-0/0/14 unit 0 family ethernet-switching port-mode
trunk
set interfaces ge-0/0/18 unit 0 family ethernet-switching port-mode
trunk
set protocols rstp bridge-priority 32k
set protocols rstp interface ge-0/0/14.0 cost 1000
set protocols rstp interface ge-0/0/14.0 mode point-to-
point
set protocols rstp interface ge-0/0/18.0 cost 1000
set protocols rstp interface ge-0/0/18.0 mode point-to-
point

```

If Switch 2 includes dual Routing Engines, configure NSB. To quickly configure nonstop bridging on Switch 2, copy the following commands and paste them into the switch terminal window:

```

set chassis redundancy graceful-switchover
set system commit synchronize
set ethernet-switching-options nonstop-bridging

```

Step-by-Step Procedure

To configure RSTP and nonstop bridging on Switch 2:

1. Configure the VLANs **voice-vlan**, **employee-vlan**, **guest-vlan**, and **camera-vlan**:

```

[edit vlans]
user@switch2# set voice-vlan description "Voice VLAN"
user@switch2# set voice-vlan vlan-id 10
user@switch2# set employee-vlan description "Employee VLAN"
user@switch2# set employee-vlan vlan-id 20
user@switch2# set guest-vlan description "Guest VLAN"
user@switch2# set guest-vlan vlan-id 30

```

```
user@switch2# set camera-vlan vlan-description "Camera VLAN"
user@switch2# set camera-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch2# set ge-0/0/14 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch2# set ge-0/0/18 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch2# set ge-0/0/14 unit 0 family ethernet-switching port-mode trunk
user@switch2# set ge-0/0/18 unit 0 family ethernet-switching port-mode
trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]
user@switch2# rstp bridge-priority 32k
user@switch2# rstp interface ge-0/0/14.0 cost 1000
user@switch2# rstp interface ge-0/0/14.0 mode point-to-point
user@switch2# rstp interface ge-0/0/18.0 cost 1000
user@switch2# rstp interface ge-0/0/18.0 mode point-to-point
```

Step-by-Step Procedure

If Switch 2 includes dual Routing Engines, configure nonstop bridging. To configure NSB on Switch 2:

1. Enable graceful Routing Engine switchover (GRES):

```
[edit chassis redundancy]
user@switch2# set graceful-switchover
```


2. Configure the switch to always synchronize configuration changes between the Routing Engines:

```
[edit system]
user@switch2# set commit synchronize
```

If you try to commit a configuration in which nonstop bridging is configured but synchronization of configuration changes is not configured, the configuration is not committed.

3. Enable nonstop bridging:

```
[edit ethernet-switching-options]
user@switch2# set nonstop-bridging
```

NOTE: This process enables NSB for all NSB-supported Layer 2 protocols on the switch, including RSTP.

Results

Check the results of the configuration:

```
user@switch2> show configuration
interfaces {
  ge-0/0/14 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
  ge-0/0/18 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
}
```

```

    }
  }
}

protocols {
  rstp {
    bridge-priority 32k;
    interface ge-0/0/14.0 {
      cost 1000;
      mode point-to-point;
    }
    interface ge-0/0/18.0 {
      cost 1000;
      mode point-to-point;
    }
  }
}

vpls {
  voice-vlan {
    vlan-id 10;
  }
  employee-vlan {
    vlan-id 20;
  }
  guest-vlan {
    vlan-id 30;
  }
  camera-vlan {
    vlan-id 40;
  }
}

system {
  commit synchronize;
}

chassis {
  redundancy {
    graceful-switchover;
  }
  ethernet-switching-options {

```

```
nonstop-bridging;
}
```

Configuring RSTP and Nonstop Bridging on Switch 3

IN THIS SECTION

- [Procedure | 73](#)

Procedure

CLI Quick Configuration

To quickly configure RSTP and nonstop bridging on Switch 3, copy the following commands and paste them into the switch terminal window:

```
[edit]
    set vlans voice-vlan description "Voice VLAN"
    set vlans voice-vlan vlan-id 10
    set vlans employee-vlan description "Employee VLAN"
    set vlans employee-vlan vlan-id 20
    set vlans guest-vlan description "Guest VLAN"
    set vlans guest-vlan vlan-id 30
    set vlans camera-vlan description "Camera VLAN"
    set vlans camera-vlan vlan-id 40
    set interfaces ge-0/0/26 unit 0 family ethernet-switching vlan members
[10 20 30 40]
    set interfaces ge-0/0/28 unit 0 family ethernet-switching vlan members
[10 20 30 40]
    set interfaces ge-0/0/24 unit 0 family ethernet-switching vlan members
[10 20 30 40]
    set interfaces ge-0/0/26 unit 0 family ethernet-switching port-mode
trunk
    set interfaces ge-0/0/28 unit 0 family ethernet-switching port-mode
trunk
    set interfaces ge-0/0/24 unit 0 family ethernet-switching port-mode
trunk
    set protocols rstp bridge-priority 8k
```

```

point
    set protocols rstp interface ge-0/0/26.0 cost 1000
    set protocols rstp interface ge-0/0/26.0 mode point-to-

point
    set protocols rstp interface ge-0/0/28.0 cost 1000
    set protocols rstp interface ge-0/0/28.0 mode point-to-

point
    set protocols rstp interface ge-0/0/24.0 cost 1000
    set protocols rstp interface ge-0/0/24.0 mode point-to-

```

If Switch 3 includes dual Routing Engines, configure NSB. To quickly configure nonstop bridging on Switch 3, copy the following commands and paste them into the switch terminal window:

```

set chassis redundancy graceful-switchover
set system commit synchronize
set ethernet-switching-options nonstop-bridging

```

Step-by-Step Procedure

To configure RSTP and nonstop bridging on Switch 3:

1. Configure the VLANs **voice-vlan**, **employee-vlan**, **guest-vlan**, and **camera-vlan**:

```

[edit vlans]
user@switch3# set voice-vlan description "Voice VLAN"
user@switch3# set voice-vlan vlan-id 10
user@switch3# set employee-vlan description "Employee VLAN"
user@switch3# set employee-vlan vlan-id 20
user@switch3# set guest-vlan description "Guest VLAN"
user@switch3# set guest-vlan vlan-id 30
user@switch3# set camera-vlan description "Camera VLAN"
user@switch3# set camera-vlan vlan-id 40

```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```

[edit interfaces]
user@switch3# set ge-0/0/26 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch3# set ge-0/0/28 unit 0 family ethernet-switching vlan members [10 20 30 40]

```

```
user@switch3# set ge-0/0/24 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch3# set ge-0/0/26 unit 0 family ethernet-switching port-mode trunk
user@switch3# set ge-0/0/28 unit 0 family ethernet-switching port-mode trunk
user@switch3# set ge-0/0/24 unit 0 family ethernet-switching port-mode
trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]
user@switch3# rstp bridge-priority 8k
user@switch3# rstp interface ge-0/0/26.0 cost 1000
user@switch3# rstp interface ge-0/0/26.0 mode point-to-point
user@switch3# rstp interface ge-0/0/28.0 cost 1000
user@switch3# rstp interface ge-0/0/28.0 mode point-to-point
user@switch3# rstp interface ge-0/0/24.0 cost 1000
user@switch3# rstp interface ge-0/0/24.0 mode point-to-point
```

Step-by-Step Procedure

If Switch 3 includes dual Routing Engines, configure nonstop bridging. To configure NSB on Switch 3:

1. Enable graceful Routing Engine switchover (GRES):

```
[edit chassis redundancy]
user@switch3# set graceful-switchover
```

2. Configure the switch to always synchronize configuration changes between the Routing Engines:

```
[edit system]
user@switch3# set commit synchronize
```

If you try to commit a configuration in which nonstop bridging is configured but synchronization of configuration changes is not configured, the configuration is not committed.

3. Enable nonstop bridging:

```
[edit ethernet-switching-options]  
user@switch3# set nonstop-bridging
```

NOTE: This process enables NSB for all NSB-supported Layer 2 protocols on the switch, including RSTP.

Results

Check the results of the configuration:

```
user@switch3> show configuration  
interfaces {  
  ge-0/0/26 {  
    unit 0 {  
      family ethernet-switching {  
        port-mode trunk;  
        vlan {  
          members [10 20 30 40];  
        }  
      }  
    }  
  }  
  ge-0/0/28 {  
    unit 0 {  
      family ethernet-switching {  
        port-mode trunk;  
        vlan {  
          members [10 20 30 40];  
        }  
      }  
    }  
  }  
  ge-0/0/24 {  
    unit 0 {  
      family ethernet-switching {  
        port-mode trunk;  
        vlan {
```



```

    commit synchronize;
}
chassis {
    redundancy {
        graceful-switchover;
    }
    ethernet-switching-options {
        nonstop-bridging;
    }
}

```

Configuring RSTP and Nonstop Bridging on Switch 4

IN THIS SECTION

- [Procedure | 78](#)

Procedure

CLI Quick Configuration

To quickly configure RSTP and nonstop bridging on Switch 4, copy the following commands and paste them into the switch terminal window:

```

[edit]

    set vlans voice-vlan description "Voice VLAN"
    set vlans voice-vlan vlan-id 10
    set vlans employee-vlan description "Employee VLAN"
    set vlans employee-vlan vlan-id 20
    set vlans guest-vlan description "Guest VLAN"
    set vlans guest-vlan vlan-id 30
    set vlans camera-vlan description "Camera VLAN"
    set vlans camera-vlan vlan-id 40
    set interfaces ge-0/0/23 unit 0 family ethernet-switching vlan members

[10 20 30 40]

    set interfaces ge-0/0/19 unit 0 family ethernet-switching vlan members

[10 20 30 40]

    set interfaces ge-0/0/23 unit 0 family ethernet-switching port-mode
trunk

```



```

trunk      set interfaces ge-0/0/19 unit 0 family ethernet-switching port-mode

            set protocols rstp bridge-priority 16k
            set protocols rstp interface ge-0/0/23.0 cost 1000
            set protocols rstp interface ge-0/0/23.0 mode point-to-

point      set protocols rstp interface ge-0/0/19.0 cost 1000
            set protocols rstp interface ge-0/0/19.0 mode point-to-

point

```

If Switch 4 includes dual Routing Engines, configure NSB. To quickly configure nonstop bridging on Switch 4, copy the following commands and paste them into the switch terminal window:

```

set chassis redundancy graceful-switchover
set system commit synchronize
set ethernet-switching-options nonstop-bridging

```

Step-by-Step Procedure

To configure RSTP and nonstop bridging on Switch 4:

1. Configure the VLANs **voice-vlan**, **employee-vlan**, **guest-vlan**, and **camera-vlan**:

```

[edit vlans]
user@switch4# set voice-vlan description "Voice VLAN"
user@switch4# set voice-vlan vlan-id 10
user@switch4# set employee-vlan description "Employee VLAN"
user@switch4# set employee-vlan vlan-id 20
user@switch4# set guest-vlan description "Guest VLAN"
user@switch4# set guest-vlan vlan-id 30
user@switch4# set camera-vlan description "Camera VLAN"
user@switch4# set camera-vlan vlan-id 40

```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```

[edit interfaces]
user@switch4# set ge-0/0/23 unit 0 family ethernet-switching vlan members [10 20 30 40]

```

```
user@switch4# set ge-0/0/19 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch4# set ge-0/0/23 unit 0 family ethernet-switching port-mode trunk
user@switch4# set ge-0/0/19 unit 0 family ethernet-switching port-mode
trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]
user@switch4# rstp bridge-priority 16k
user@switch4# rstp interface all cost 1000
user@switch4# rstp interface ge-0/0/23.0 cost 1000
user@switch4# rstp interface ge-0/0/23.0 mode point-to-point
user@switch4# rstp interface ge-0/0/19.0 cost 1000
user@switch4# rstp interface ge-0/0/19.0 mode point-to-point
```

Step-by-Step Procedure

If Switch 4 includes dual Routing Engines, configure nonstop bridging. To configure NSB on Switch 4:

1. Enable graceful Routing Engine switchover (GRES):

```
[edit chassis redundancy]
user@switch4# set graceful-switchover
```

2. Configure the switch to always synchronize configuration changes between the Routing Engines:

```
[edit system]
user@switch4# set commit synchronize
```

If you try to commit a configuration in which nonstop bridging is configured but synchronization of configuration changes is not configured, the configuration is not committed.

3. Enable nonstop bridging:

```
[edit ethernet-switching-options]  
user@switch4# set nonstop-bridging
```

NOTE: This process enables NSB for all NSB-supported Layer 2 protocols on the switch, including RSTP.

Results

Check the results of the configuration:

```
user@switch4> show configuration  
interfaces {  
  ge-0/0/23 {  
    unit 0 {  
      family ethernet-switching {  
        port-mode trunk;  
        vlan {  
          members [10 20 30 40];  
        }  
      }  
    }  
  }  
  ge-0/0/19 {  
    unit 0 {  
      family ethernet-switching {  
        port-mode trunk;  
        vlan {  
          members [10 20 30 40];  
        }  
      }  
    }  
  }  
}  
protocols {  
  rstp {  
    bridge-priority 16k;  
    interface ge-0/0/23.0 {
```


- [Verifying RSTP Configuration on Switch 2 | 84](#)
- [Verifying RSTP Configuration on Switch 3 | 84](#)
- [Verifying RSTP Configuration on Switch 4 | 85](#)

To confirm that the configuration is working properly, perform these tasks on both Routing Engines:

Verifying RSTP Configuration on Switch 1

Purpose

Verify the RSTP configuration on Switch 1.

Action

Use the operational mode command:

```
user@switch1> show spanning-tree
interface

Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/13.0	128:526	128:526	16384.0019e25040e0	1000	BLK	ALT
ge-0/0/9.0	128:522	128:522	32768.0019e2503d20	1000	BLK	ALT
ge-0/0/11.0	128:524	128:524	8192.0019e25051e0	1000	FWD	ROOT

Meaning

The operational mode command `show spanning-tree interface` shows that **ge-0/0/13.0** is in a forwarding state. The other interfaces on Switch 1 are blocking.

Verifying RSTP Configuration on Switch 2

Purpose

Use this procedure to verify the RSTP configuration on both Switch 2 Routing Engines.

Action

Use the operational mode command:

```
user@switch2> show spanning-tree
interface

Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/14.0	128:527	128:527	32768.0019e2503d20	1000	FWD	DESG
ge-0/0/18.0	128:529	128:529	8192.0019e25051e0	1000	FWD	ROOT

Meaning

The operational mode command `show spanning-tree interface` shows that **ge-0/0/18.0** is in a forwarding state and is the root port.

Verifying RSTP Configuration on Switch 3

Purpose

Use this procedure to verify the RSTP configuration on both Switch 3 Routing Engines.

Action

Use the operational mode commands:

```
user@switch3> show spanning-tree
interface
```

Spanning tree interface parameters for instance 0

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/26.0	128:539	128:539	8192.0019e25051e0	1000	FWD	DESG
ge-0/0/28.0	128:541	128:541	8192.0019e25051e0	1000	FWD	DESG
ge-0/0/24.0	128:537	128:537	8192.0019e25051e0	1000	FWD	DESG

Meaning

The operational mode command `show spanning-tree interface` shows that no interface is the root interface.

Verifying RSTP Configuration on Switch 4

Purpose

Use this procedure to verify the RSTP configuration on both Switch 4 Routing Engines.

Action

Use the operational mode commands:

```
user@switch4> show spanning-tree
interface
Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/23.0	128:536	128:536	8192.0019e25051e0	1000	FWD	ROOT
ge-0/0/19.0	128:532	128:532	16384.0019e25040e0	1000	FWD	DESG

Meaning

The operational mode command `show spanning-tree interface` shows that interface **ge-0/0/23.0** is the root interface and forwarding.

Forcing RSTP or VSTP to Run as IEEE 802.1D STP (CLI Procedure)

NOTE: This procedure uses Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style. For ELS details, see *Using the Enhanced Layer 2 Software CLI*.

On EX Series switches running Rapid Spanning Tree Protocol (RSTP) (the default) or VLAN Spanning Tree Protocol (VSTP), you can force the original IEEE 802.1D Spanning Tree Protocol (STP) version to run in place of RSTP or VSTP. Configure the **force-version stp** statement for compatibility with older bridges that do not support RSTP or VSTP.

To force the spanning-tree protocol version to be the original IEEE 802.1D STP:

Enable IEEE 802.1D STP:

```
[edit protocols]
user@switch# set (rstp | vstp) force-version stp
```

NOTE: After using the **force-version** statement to enable xSTP globally, apply the **force-version** statement for specific Layer 2 ports.

Release History Table

Release	Description
15.1	Starting with Junos OS Release 15.1 for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, you can configure spanning tree parameters globally on all spanning tree interfaces.

RELATED DOCUMENTATION

- Using the Enhanced Layer 2 Software CLI*
- Example: Configuring Redundant Trunk Links for Faster Recovery on Devices with ELS Support*

Configuring MSTP Protocol

IN THIS SECTION

- [Understanding MSTP | 87](#)
- [Configuring MSTP on Switches | 91](#)
- [Configuring Multiple Spanning Tree Protocol | 95](#)
- [Configuring MSTP Instances on a Physical Interface | 98](#)
- [Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)
- [Disabling MSTP | 133](#)

Multiple Spanning Tree Protocol (MSTP) maps multiple VLANs into a spanning tree instance, with each instance having a spanning tree topology independent of other spanning tree instances.

Understanding MSTP

IN THIS SECTION

- [Benefits of MSTP | 88](#)
- [MSTP Maps Multiple VLANs | 88](#)
- [Configuring MSTP Regions | 89](#)
- [Selecting a Spanning Tree Protocol | 89](#)

Ethernet networks are susceptible to broadcast storms if loops are introduced. However, an Ethernet network needs to include loops because they provide redundant paths in case of a link failure. Spanning-tree protocols address both of these issues because they provide link redundancy while simultaneously preventing undesirable loops.

Spanning-tree protocols intelligently avoid loops in a network by creating a tree topology (spanning tree) of the entire bridged network with only one available path between the tree root and a leaf. All other

paths are forced into a standby state. The tree *root* is a switch within the network elected by the STA (spanning-tree algorithm) to use when computing the best path between bridges throughout the network and the root bridge. Frames travel through the network to their destination— a *leaf*. A tree *branch* is a network segment, or link, between bridges. Switches that forward frames through an STP spanning-tree are called *designated bridges*.

Juniper Networks devices provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP), and VLAN Spanning Tree Protocol (VSTP). This topic explains MSTP.

NOTE: If you are using Junos OS for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, you can force the original IEEE 802.1D Spanning Tree Protocol (STP) version to run in place of RSTP or VSTP by setting "[force-version](#)" on [page 279](#).

This topic describes:

Benefits of MSTP

MSTP has the following benefits:

- Multiple Spanning Tree Protocol works with most VLANs.
- MSTP supports multiple instances on a single physical interface.
- On MX and ACX routers, you can configure RSTP, MSTP, and VSTP instance interfaces as edge ports.

MSTP Maps Multiple VLANs

MSTP is an extension of RSTP that maps multiple independent spanning-tree instances onto one physical topology. Each spanning-tree instance (STI) includes one or more VLANs. Unlike in STP and RSTP configurations, a port might belong to multiple VLANs and be dynamically blocked in one spanning-tree instance, but forwarding in another. This behavior significantly improves network resource utilization by load-balancing across the network and maintaining switch CPU loads at moderate levels. MSTP also leverages the fast reconvergence time of RSTP when a network, switch, or port failure occurs within a spanning-tree instance.

MSTP creates a common and internal spanning tree (CIST) to interconnect and manage all MSTP regions and even individual devices that run RSTP or STP, which are recognized as distinct spanning-tree regions by MSTP. The CIST views each MSTP region as a virtual bridge, regardless of the actual number of devices participating in the MSTP region, and enables multiple spanning-tree instances (MSTIs) to link to other regions. The CIST is a single topology that connects all switches (STP, RSTP, and MSTP devices) through an active topology, ensuring connectivity between LANs and devices within a bridged network.

This functionality provided by MSTP enables you to better utilize network resources while remaining backward-compatible with older network devices.

Configuring MSTP Regions

When enabling MSTP, you define one or more MSTP regions. An MSTP region defines a logical domain where multiple spanning-tree instances (MSTIs) can be administered independently of MSTIs in other regions, setting the boundary for bridge protocol data units (BPDUs) sent by one MSTI. An MSTP region is a group of switches that is defined by three parameters:

- Region name—User-defined alphanumeric name for the region.
- Revision level—User-defined value that identifies the region.
- Mapping table—Numerical digest of VLAN-to-instance mappings.

An MSTP region can support up to 64 MSTIs,, and each MSTI can support from 1 to 4094 VLANs. When you define a region, MSTP automatically creates an internal spanning-tree instance (IST instance 0) that provides the root switch for the region and includes all currently configured VLANs that are not specifically assigned to a user-defined MSTI. An MSTI includes all static VLANs that you specifically add to it. The switch places any dynamically created VLANs in the IST instance by default, unless you explicitly map them to another MSTI. Once you assign a VLAN to a user-defined MSTI, the switch removes the VLAN from the IST instance.

Selecting a Spanning Tree Protocol

The default factory configuration is RSTP, a faster version of STP. To determine which spanning-tree protocol is best for your situation, see [Table 5 on page 90](#) below.

Table 5: Selecting a Spanning Tree Protocol

Protocol	Advantages	Disadvantages
RSTP	<ul style="list-style-type: none"> • Rapid Spanning Tree Protocol is the default switch configuration and is recommended for most network configurations because it converges more quickly than STP after a failure. • Voice and video work better with RSTP than they do with STP. • RSTP is backward compatible with STP; therefore, switches do not all have to run RSTP. 	<ul style="list-style-type: none"> • RSTP does not work with 802.1D 1998 bridges.
STP	<ul style="list-style-type: none"> • Spanning Tree Protocol works with 802.1D 1998 bridges. • RSTP is backward compatible with STP; therefore, switches do not all have to run STP. 	<ul style="list-style-type: none"> • STP is slower than RSTP. • STP is not recommended for multiple VLAN networks because it is not VLAN-aware—as a result, all VLANs within a LAN share the same spanning-tree. This limits the number of forwarding paths for data traffic. • If you are using Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, you can force the original IEEE 802.1D Spanning Tree Protocol (STP) version to run in place of RSTP or VSTP by setting "force-version" on page 279. However, the CLI does not include <code>[edit protocols stp]</code>.
MSTP	<ul style="list-style-type: none"> • Multiple Spanning Tree Protocol works with most VLANs. • RSTP and STP are recognized as distinct spanning-tree regions by MSTP. 	<ul style="list-style-type: none"> • Some protocols require compatibility that is not provided by MSTP. In this case, use VSTP. • MSTP uses more CPU than RSTP and does not converge as fast as RSTP.

Table 5: Selecting a Spanning Tree Protocol (*Continued*)

Protocol	Advantages	Disadvantages
VSTP	<ul style="list-style-type: none"> • VLAN Spanning Tree Protocol works with VLANs that require device compatibility. • VSTP and RSTP are the only spanning-tree protocols that can be configured concurrently on a switch. 	<ul style="list-style-type: none"> • With VSTP there can be only STP instance per VLAN, whereas MSTP lets you combine multiple VLANs in one instance. • VSTP supports a limited number of ports compared to RSTP. • VSTP uses more CPU than RSTP and does not converge as fast as RSTP. • Having a large number of VSTP and RSTP instances can cause continuous changes in the topology. Ensure to check the scale limits before configuring large number of VSTP instances.

SEE ALSO
[Understanding RSTP | 27](#)
[Understanding VSTP](#)

Configuring MSTP on Switches

You can configure the Multiple Spanning Tree Protocol (MSTP) under [edit protocols].

To configure the Multiple Spanning Tree Protocol:

1. Enable MSTP as the version of spanning-tree protocol to be configured:

```
[edit]
user@switch@ edit ... protocols mstp
```

2. Configure the interfaces that participate in the MSTP instance for all interfaces at one time, or for configured interface ranges, or for specific interfaces individually:

- Enable MSTP on all the interfaces at one time, for switches that support this option (most switches):

```
[edit ... protocols mstp]
user@switch# set interface all
```

NOTE: You cannot disable MSTP on all the interfaces with one command. See the configuration steps for configuring MSTP on specific interfaces later in this topic for how to disable MSTP on interfaces individually.

For QFX5100 switches, which do not support the `interface all` option, you must configure interface ranges for the applicable interfaces on which you want to enable MSTP, and then issue the `set protocols mstp interface name` command for each *name* that you have configured as an interface range (described next).

- Enable MSTP on a range of interfaces, for switches such as QFX5100 switches that do not support the `interface all` option:
 - a. Configure interface ranges using the `interface-range` statement at the `[edit interfaces]` hierarchy level for the applicable interfaces on which you want to enable MSTP:

```
[edit interfaces]
user@switch# set interface-range interface-range-name member-range interface-name1 to
interface-name2
```

- b. Enable MSTP for each configured interface range *interface-range-name* at the `[edit ... protocols mstp]` hierarchy level:

```
[edit ... protocols mstp]
user@switch# set interface interface-range-name
```

- Configure a specific interface individually to enable MSTP and various MSTP options on that interface, or to disable MSTP on that interface:
 - a. Enable MSTP on the specified interface:

```
[edit ... protocols mstp]
user@switch# edit interface interface-name
```

- b. Configure the interface priority:

```
[edit ... protocols mstp interface interface-name]
user@switch# set priority interface-priority
```

- c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

```
[edit ... protocols mstp interface interface-name]
user@switch# set cost interface-link-cost
```

- d. Configure the interface link mode to identify point-to-point links:

```
[edit ... protocols mstp interface interface-name]
user@switch# set mode (p2p | shared)
```

Specify p2p if the link is point to point. Specify shared if the link is a shared media.

- e. (Optional) Configure the interface as an edge port:

```
[edit ... protocols mstp interface interface-name]
user@switch# set edge
```

Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a nonedge port

- f. (Optional) Disable MSTP on a specific interface:

```
[edit protocols mstp interface interface-name]
user@switch# set disable
```

You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see ["Checking the Status of Spanning-Tree Instance Interfaces" on page 236](#).

3. Configure the bridge priority

```
[edit ... protocols mstp]
user@switch# set bridge-priority bridge-priority
```

For more information, see ["Understanding Bridge Priority for Election of Root Bridge and Designated Bridge" on page 212](#).

4. Configure hello BPDUs.

- a. Configure the maximum expected arrival time of hello BPDUs:

```
[edit ... protocols mstp]
user@switch# set max-age seconds
```

- b. Configure the time interval at which the root bridge transmits configuration BPDUs:

```
[edit ... protocols mstp]
user@switch# set hello-time seconds
```

5. (Optional) By default, the bridge port remains in the listening and learning states for 15 seconds before transitioning to the forwarding state. You can specify a delay from 4 through 20 seconds instead:

```
[edit ... protocols mstp]
user@switch# set forward-delay seconds
```

6. Configure MSTP-specific options.

- a. Configure the MSTP region configuration name:

```
[edit ... protocols mstp]
user@switch# set configuration-name configuration-name
```

- b. Configure the MSTP revision level:

```
[edit ... protocols mstp]
user@switch# set revision-level revision-level
```


- c. Configure the maximum number of hops a BPDU can be forwarded in the MSTP region:

```
[edit ... protocols mstp]
user@switch# set max-hops hops
```

SEE ALSO

| [Configuring MSTP Instances on a Physical Interface](#) | 98

Configuring Multiple Spanning Tree Protocol

You can configure the Multiple Spanning Tree Protocol (MSTP) under the following hierarchy levels:

- [edit *logical-systems logical-system-name* "protocols" on page 322]
- [edit *logical-systems logical-system-name routing-instances routing-instance-name* "protocols" on page 322]
- [edit "protocols" on page 322]
- [edit *routing-instances routing-instance-name* "protocols" on page 322]

The routing instance type can be either virtual-switch or layer2-control.

To configure the Multiple Spanning Tree Protocol:

1. Enable MSTP as the version of spanning-tree protocol to be configured:

```
[edit]
user@host# edit ... protocols (STP Type) mstp
```

2. (Optional) Enable provider bridge participation in the MSTP instance:

```
[edit ... protocols mstp]
user@host# set bpd-destination-mac-address provider-bridge-group
```

3. Configure the interfaces that participate in the MSTP instance.

- a. Enable configuration of the interface:

```
[edit ... protocols mstp]
user@host# edit interface interface-name
```

- b. Configure the interface priority:

```
[edit ... protocols mstp interface interface-name]
user@host# set priority interface-priority
```

- c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

```
[edit ... protocols mstp interface interface-name]
user@host# set cost interface-link-cost
```

- d. Configure the interface link mode to identify point-to-point links:

```
[edit ... protocols mstp interface interface-name]
user@host# set mode (p2p | shared)
```

Specify p2p if the link is point to point. Specify shared if the link is a shared media.

- e. (Optional) Configure the interface as an edge port:

```
[edit ... protocols mstp interface interface-name]
user@host# set edge
```

Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a non-edge port

You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see ["Checking the Status of Spanning-Tree Instance Interfaces" on page 236](#).

4. Configure the bridge priority:

```
[edit ... protocols mstp]
user@host# set bridge-priority bridge-priority
```

For more information, see ["Understanding Bridge Priority for Election of Root Bridge and Designated Bridge" on page 212](#).

5. Configure hello BPDUs.

- a. Configure the maximum expected arrival time of hello BPDUs:

```
[edit ... protocols mstp]
user@host# set max-age seconds
```

- b. Configure the time interval at which the root bridge transmits configuration BPDUs:

```
[edit ... protocols mstp]
user@host# set hello-time seconds
```

6. (Optional) By default, the bridge port remains in the listening and learning states for 15 seconds before transitioning to the forwarding state. You can specify a delay from 4 through 20 seconds instead:

```
[edit ... protocols mstp]
user@host# set forward-delay seconds
```

7. Configure MSTP-specific options.

- a. Configure the MSTP region configuration name:

```
[edit ... protocols mstp]
user@host# set configuration-name configuration-name
```

- b. Configure the MSTP revision level:

```
[edit ... protocols mstp]
user@host# set revision-level revision-level
```

- c. Configure the maximum number of hops a BPDU can be forwarded in the MSTP region:

```
[edit ... protocols mstp]
user@host# set max-hops hops
```

8. Verify the MSTP configuration:

```
[edit]
... {          # Optional logical system and/or routing instance
  protocols (STP Type) {
    mstp {
      bpd-destination-mac-address          provider-bridge-group;          # Optional
      interface          interface-name {
        priority          interface-priority;
        cost          interface-link-cost; # Optional.
        mode          (p2p | shared);
        edge; # Optional.
      }
      bridge-priority bridge-priority;
      max-age seconds;
      hello-time seconds;
      forward-delay seconds; # Optional.
      configuration-name configuration-name; # MST region configuration name.
      revision-level revision-level; # MST revision number.
      max-hops hops; # MST maximum hops.
    }
  }
}
```

Configuring MSTP Instances on a Physical Interface

You can configure a Multiple Spanning Tree Instance (MSTI) under the following hierarchy levels:

- [edit logical-systems *logical-system-name* protocols mstp]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp]
- [edit protocols mstp]
- [edit routing-instances *routing-instance-name* protocols mstp]

The routing instance type can be either **virtual-switch** or **layer2-control**.

Before you begin, configure Multiple Spanning-Tree Protocol. For configuration details, see ["Configuring Multiple Spanning Tree Protocol" on page 95](#).

1. Enable configuration of an MST instance:

```
[edit]
user@host# edit ... protocols mstp msti msti-id
```

The *msti-id* value must be from **1** through **64**.

2. Configure the interfaces that participate in the MST instance.

- a. Enable configuration of the interface:

```
[edit ... protocols mstp msti msti-id]
user@host# edit interface interface-name
```

- b. Configure the interface priority:

```
[edit ... protocols mstp msti msti-id interface interface-name]
user@host# set priority interface-priority
```

- c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

```
[edit ... protocols mstp msti msti-id interface interface-name]
user@host# set cost interface-link-cost
```

- d. (Optional) Configure the interface as an edge port:

```
[edit ... protocols mstp msti msti-id interface interface-name]
user@host# set edge
```

Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a non-edge port

3. Configure the bridge priority:

```
[edit ... protocols mstp msti msti-id]
user@host# set bridge-priority bridge-priority
```

For more information, see ["Understanding Bridge Priority for Election of Root Bridge and Designated Bridge" on page 212](#).

4. (Optional) An MSTI can map to a range of VLANs just as a logical port can map to a range of VLANs. The MSTP VLAN specifies the VLAN or VLAN range to which this MSTI is mapped. The `vlan-id` is configured under the logical interface. Configure the VLAN or VLAN range of the MSTI instance:

```
[edit]
user@host# set vlan (vlan-id | vlan-id-range)
```

5. Verify the MST interface configuration.

```
[edit]
protocols {
  mstp {
    ...basic-mstp-configuration...

    msti msti-id { # Instance identifier 1 - 64.
      bridge-priority priority;
      vlan vlan-id; # Optional
      interface interface-name {
        cost cost;
        edge;
        priority interface-priority;
      }
    }
  }
}
```

Example: Configuring Network Regions for VLANs with MSTP on Switches

IN THIS SECTION

- [Requirements | 101](#)
- [Overview and Topology | 102](#)
- [Configuring MSTP on Switch 1 | 105](#)
- [Configuring MSTP on Switch 2 | 110](#)
- [Configuring MSTP on Switch 3 | 115](#)
- [Configuring MSTP on Switch 4 | 120](#)
- [Verification | 124](#)

NOTE: This example uses Junos OS for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style. The example also describes the configuration statement differences that can be substituted in the same configuration on EX Series switches that do not support ELS.

Multiple Spanning Tree Protocol (MSTP) is used to create a loop-free topology in networks using multiple spanning-tree regions in which each region contains multiple spanning-tree instances (MSTIs). MSTIs provide different paths for different VLANs. This functionality facilitates better load sharing across redundant links.

Up to 64 MSTIs can be created for an EX Series switch, and each MSTI can support up to 4094 VLANs.

This example describes how to configure MSTP on four EX Series switches:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 13.2X50-D10 or later for EX Series or QFX Series switches
- Four QFX Series switches

Before you configure the switches for MSTP, be sure you have:

- Installed and connected the four switches. See the hardware documentation for your switch.

- Performed the initial software configuration on all switches. See *Connecting and Configuring an EX Series Switch (CLI Procedure)* or *Connecting and Configuring an EX Series Switch (J-Web Procedure)*.

Overview and Topology

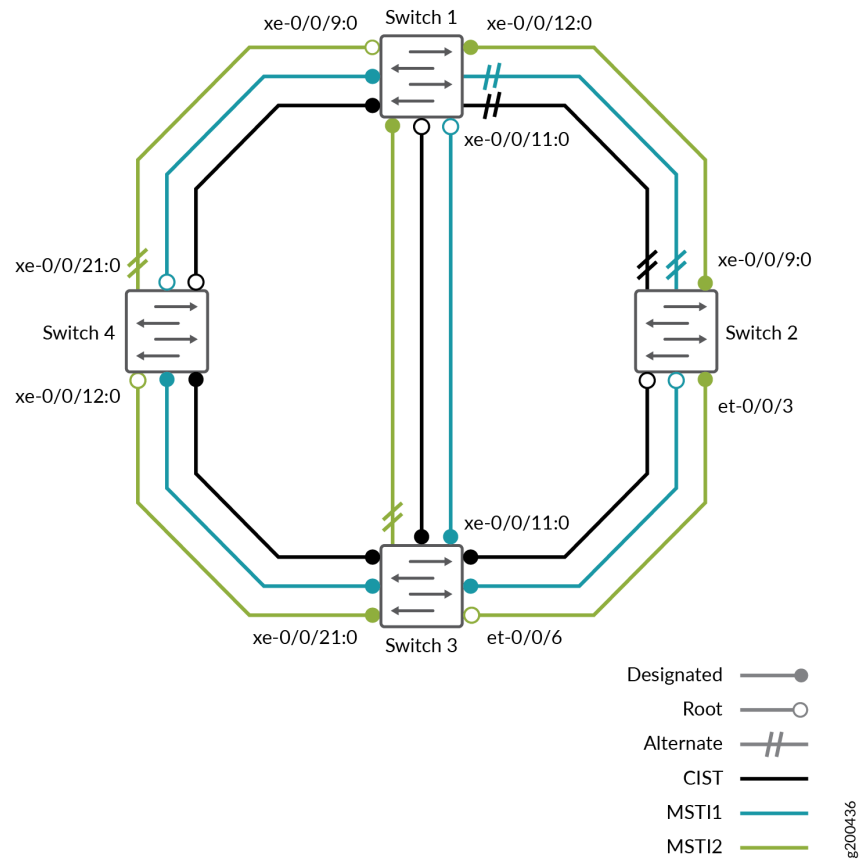
IN THIS SECTION

- [Topology](#) | 103

When the number of VLANs grows in a network, MSTP provides an efficient way of creating a loop-free topology by using MSTIs. Each MSTI in the spanning-tree domain maintains its own tree. Each tree can be mapped to different links, utilizing bandwidth that would be unavailable to a single tree. MSTIs reduce the demand on system resources.

Topology

Figure 3: Network Topology for MSTP



The interfaces shown in [Figure 3 on page 103](#) will be configured for MSTP.

Table 6: Components of the Topology for Configuring MSTP on EX Series Switches

Property	Settings
Switch 1	<p>The following interfaces on Switch 1 are connected in this way:</p> <ul style="list-style-type: none">• xe-0/0/12:0 is connected to Switch 2• xe-0/0/9:0 is connected to Switch 4• xe-0/0/11:0 is connected to Switch 3

Table 6: Components of the Topology for Configuring MSTP on EX Series Switches (*Continued*)

Property	Settings
Switch 2	<p>The following interfaces on Switch 2 are connected in this way:</p> <ul style="list-style-type: none"> • xe-0/0/9:0 is connected to Switch 1 • et-0/0/3 is connected to Switch 3
Switch 3	<p>The following interfaces on Switch 3 are connected in this way:</p> <ul style="list-style-type: none"> • xe-0/0/11:0 is connected to Switch 1 • et-0/0/6 is connected to Switch 2 • xe-0/0/21:0 is connected to Switch 4
Switch 4	<p>The following interfaces on Switch 4 are connected in this way:</p> <ul style="list-style-type: none"> • xe-0/0/21:0 is connected to Switch 1 • xe-0/0/12:0 is connected to Switch 3
VLAN names and tag IDs	<p>voice-vlan, tag 10</p> <p>employee-vlan, tag 20</p> <p>guest-vlan, tag 30</p> <p>camera-vlan, tag 40</p>
MSTIs	<p>1</p> <p>2</p>
MSTI region	region1

The topology in [Figure 3 on page 103](#) shows a common and internal spanning tree (CIST). The CIST is a single spanning tree connecting all devices in the network. The switch with the lowest bridge priority is elected as the root bridge of the CIST. You can control the election of the root bridge by configuring the bridge priority. Switch 3 is the root bridge of the CIST.

The ports in an MSTP topology have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.

- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.
- The *backup port* becomes the active designated port and starts forwarding data when the designated port goes down.

In this example, one MSTP region contains Switch 1, Switch 2, Switch 3, and Switch 4. Within the region, four VLANs are created:

- voice-vlan supports voice traffic and has the VLAN tag identifier of 10.
- employee-vlan supports data traffic and has the VLAN tag identifier of 20.
- guest-vlan supports guest VLAN traffic (for supplicants that fail authentication) and has the VLAN tag identifier of 30.
- camera-vlan supports video traffic and has the VLAN tag identifier of 40.

The VLANs are associated with specific interfaces on each of the four switches. Two MSTIs, 1 and 2, are then associated with the VLAN tag identifiers, and some MSTP parameters, such as cost, are configured on each switch.

Configuring MSTP on Switch 1

IN THIS SECTION

- [Procedure](#) | 105

Procedure

CLI Quick Configuration

To quickly configure interfaces and MSTP on Switch 1, for ELS switches, copy the following commands and paste them into the switch terminal window:

```
[edit]
set vlans voice-vlan description "Voice VLAN"
set vlans voice-vlan vlan-id 10
set vlans employee-vlan description "Employee VLAN"
set vlans employee-vlan vlan-id 20
```

```

set vlans guest-vlan description "Guest VLAN"
set vlans guest-vlan vlan-id 30
set vlans camera-vlan description "Camera VLAN"
set vlans camera-vlan vlan-id 40
set interfaces xe-0/0/9:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/12:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/11:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/9:0 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/12:0 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/11:0 unit 0 family ethernet-switching interface-mode trunk
set protocols mstp configuration-name region1
set protocols mstp bridge-priority 16k
set protocols mstp interface xe-0/0/9:0 cost 1000
set protocols mstp interface xe-0/0/9:0 mode point-to-point
set protocols mstp interface xe-0/0/12:0 cost 1000
set protocols mstp interface xe-0/0/12:0 mode point-to-point
set protocols mstp interface xe-0/0/11:0 cost 1000
set protocols mstp interface xe-0/0/11:0 mode point-to-point
set protocols mstp msti 1 bridge-priority 16k
set protocols mstp msti 1 vlan [10 20]
set protocols mstp msti 1 interface xe-0/0/11:0 cost 1000
set protocols mstp msti 2 bridge-priority 8k
set protocols mstp msti 2 vlan [30 40]

```

NOTE: For non-ELS switches, instead of the following command used above for ELS switches that sets an interface into trunk mode using the `interface-mode` statement:

```
set interfaces interface-name unit 0 family ethernet-switching interface-mode trunk
```

substitute the following command for those lines in the configuration, which uses the non-ELS `port-mode` statement to set an interface into trunk mode:

```
set interfaces interface-name unit 0 family ethernet-switching port-mode trunk
```

Step-by-Step Procedure

To configure interfaces and MSTP on Switch 1:

NOTE: Starting with Junos OS Release 15.1 for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, you can configure spanning tree parameters globally on all spanning tree interfaces. See ["Configuring MSTP on Switches" on page 91](#) for additional information.

1. Configure the VLANs voice-vlan, employee-vlan, guest-vlan, and camera-vlan:

```
[edit vlans]
user@switch1# set voice-vlan description "Voice VLAN"
user@switch1# set voice-vlan vlan-id 10
user@switch1# set employee-vlan description "Employee VLAN"
user@switch1# set employee-vlan vlan-id 20
user@switch1# set guest-vlan description "Guest VLAN"
user@switch1# set guest-vlan vlan-id 30
user@switch1# set camera-vlan description "Camera VLAN"
user@switch1# set guest-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet Switching protocol:

```
[edit interfaces]
user@switch1# set xe-0/0/9:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch1# set xe-0/0/12:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch1# set xe-0/0/11:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch1# set xe-0/0/9:0 unit 0 family ethernet-switching interface-mode trunk
user@switch1# set xe-0/0/12:0 unit 0 family ethernet-switching interface-mode trunk
user@switch1# set xe-0/0/11:0 unit 0 family ethernet-switching interface-mode trunk
```

NOTE: For non-ELS switches, instead of the following command used above for ELS switches that sets an interface into trunk mode using the interface-mode statement:

```
set interfaces interface-name unit 0 family ethernet-switching interface-mode trunk
```

substitute the following command for those lines in the configuration, which uses the non-ELS port-mode statement to set an interface into trunk mode:

```
set interfaces interface-name unit 0 family ethernet-switching port-mode trunk
```

4. Configure MSTP on the switch, including the two MSTIs:

```
[edit protocols]
user@switch1# mstp configuration-name region1
user@switch1# mstp bridge-priority 16k
user@switch1# mstp interface xe-0/0/9:0 cost 1000
user@switch1# mstp interface xe-0/0/9:0 mode point-to-point
user@switch1# mstp interface xe-0/0/12:0 cost 1000
user@switch1# mstp interface xe-0/0/12:0 mode point-to-point
user@switch1# mstp interface xe-0/0/11:0 cost 1000
user@switch1# mstp interface xe-0/0/11:0 mode point-to-point
user@switch1# mstp msti 1 bridge-priority 16k
user@switch1# mstp msti 1 vlan [10 20]
user@switch1# mstp msti 1 interface xe-0/0/11:0 cost 1000
user@switch1# mstp msti 2 bridge-priority 8k
user@switch1# mstp msti 2 vlan [30 40]
```

Results

Check the results of the configuration:

```
user@switch1> show configuration
interfaces {
  xe-0/0/9:0 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members 10;
          members 20;
```

```

        members 30;
        members 40;
    }
}
}
xe-0/0/12:0 {
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members 10;
                members 20;
                members 30;
                members 40;
            }
        }
    }
}
xe-0/0/11:0 {
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members 10;
                members 20;
                members 30;
                members 40;
            }
        }
    }
}
}
protocols {
    mstp {
        configuration-name region1;
        bridge-priority 16k;
        interface xe-0/0/9:0 {
            cost 1000;
            mode point-to-point;
        }
        interface xe-0/0/12:0 {
            cost 1000;

```

```

        mode point-to-point;
    }
    interface xe-0/0/11:0 {
        cost 1000;
        mode point-to-point;
    }
    msti 1 {
        bridge-priority 16k;
        vlan [ 10 20];
        interface xe-0/0/11:0 {
            cost 1000;
        }
    }
    msti 2 {
        bridge-priority 8k;
        vlan [ 30 40 ];
    }
}
vlangs {
    voice-vlan {
        vlan-id 10;
    }
    employee-vlan {
        vlan-id 20;
    }
    guest-vlan {
        vlan-id 30;
    }
    camera-vlan {
        vlan-id 40;
    }
}
}

```

Configuring MSTP on Switch 2

IN THIS SECTION

- [Procedure | 111](#)

Procedure

CLI Quick Configuration

To quickly configure interfaces and MSTP on Switch 2, copy the following commands and paste them into the switch terminal window:

```
[edit]
set vlans voice-vlan description "Voice VLAN"
set vlans voice-vlan vlan-id 10
set vlans employee-vlan description "Employee VLAN"
set vlans employee-vlan vlan-id 20
set vlans guest-vlan description "Guest VLAN"
set vlans guest-vlan vlan-id 30
set vlans camera-vlan description "Camera VLAN"
set vlans camera-vlan vlan-id 40
set interfaces xe-0/0/9:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces et-0/0/3 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/9:0 unit 0 family ethernet-switching interface-mode trunk
set interfaces et-0/0/3 unit 0 family ethernet-switching interface-mode trunk
set protocols mstp configuration-name region1
set protocols mstp bridge-priority 32k
set protocols mstp interface xe-0/0/9:0 cost 1000
set protocols mstp interface xe-0/0/9:0 mode point-to-point
set protocols mstp interface et-0/0/3 cost 1000
set protocols mstp interface et-0/0/3 mode point-to-point
set protocols mstp msti 1 bridge-priority 32k
set protocols mstp msti 1 vlan [10 20]
set protocols mstp msti 2 bridge-priority 4k
set protocols mstp msti 2 vlan [30 40]
```

NOTE: For non-ELS switches, instead of the following command used above for ELS switches that sets an interface into trunk mode using the `interface-mode` statement:

```
set interfaces interface-name unit 0 family ethernet-switching interface-mode trunk
```

substitute the following command for those lines in the configuration, which uses the non-ELS `port-mode` statement to set an interface into trunk mode:

```
set interfaces interface-name unit 0 family ethernet-switching port-mode trunk
```

Step-by-Step Procedure

To configure interfaces and MSTP on Switch 2:

1. Configure the VLANs voice-vlan, employee-vlan, guest-vlan, and camera-vlan:

```
[edit vlans]
user@switch2# set voice-vlan description "Voice VLAN"
user@switch2# set voice-vlan vlan-id 10
user@switch2# set employee-vlan description "Employee VLAN"
user@switch2# set employee-vlan vlan-id 20
user@switch2# set guest-vlan description "Guest VLAN"
user@switch2# set guest-vlan vlan-id 30
user@switch2# set camera-vlan vlan-description "Camera VLAN"
user@switch2# set guest-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet Switching protocol:

```
[edit interfaces]
user@switch2# set xe-0/0/9:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch2# set et-0/0/3 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch2# set xe-0/0/9:0 unit 0 family ethernet-switching interface-mode trunk
user@switch2# set et-0/0/3 unit 0 family ethernet-switching interface-mode trunk
```

NOTE: For non-ELS switches, instead of the following command used above for ELS switches that sets an interface into trunk mode using the `interface-mode` statement:

```
set interfaces interface-name unit 0 family ethernet-switching interface-mode trunk
```

substitute the following command for those lines in the configuration, which uses the non-ELS port-mode statement to set an interface into trunk mode:

```
set interfaces interface-name unit 0 family ethernet-switching port-mode trunk
```

4. Configure MSTP on the switch, including the two MSTIs:

```
[edit protocols]
user@switch2# mstp configuration-name region1
user@switch2# mstp bridge-priority 32k
user@switch2# mstp interface xe-0/0/9:0 cost 1000
user@switch2# mstp interface xe-0/0/9:0 mode point-to-point
user@switch2# mstp interface et-0/0/3 cost 1000
user@switch2# mstp interface et-0/0/3 mode point-to-point
user@switch2# mstp msti 1 bridge-priority 32k
user@switch2# mstp msti 1 vlan [10 20]
user@switch2# mstp msti 2 bridge-priority 4k
user@switch2# mstp msti 2 vlan [30 40]
```

Results

Check the results of the configuration:

```
user@switch2> show configuration
interfaces {
  xe-0/0/9:0 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members 10;
          members 20;
          members 30;
          members 40;
        }
      }
    }
  }
}
```

```

    }
  }
}
et-0/0/3 {
  unit 0 {
    family ethernet-switching {
      interface-mode trunk;
      vlan {
        members 10;
        members 20;
        members 30;
        members 40;
      }
    }
  }
}
}
protocols {
  mstp {
    configuration-name region1;
    bridge-priority 32k;
    interface xe-0/0/9:0 {
      cost 1000;
      mode point-to-point;
    }
    interface et-0/0/3 {
      cost 1000;
      mode point-to-point;
    }
    msti 1 {
      bridge-priority 32k;
      vlan [10 20];
    }
    msti 2 {
      bridge-priority 4k;
      vlan [30 40];
    }
  }
}
vlangs {
  voice-vlan {
    vlan-id 10;
  }
}

```

```

employee-vlan {
    vlan-id 20;
}
guest-vlan {
    vlan-id 30;
}
camera-vlan {
    vlan-id 40;
}
}

```

Configuring MSTP on Switch 3

IN THIS SECTION

- [Procedure | 115](#)

Procedure

CLI Quick Configuration

To quickly configure interfaces and MSTP on Switch 3, copy the following commands and paste them into the switch terminal window:

```

[edit]
set vlans voice-vlan description "Voice VLAN"
set vlans voice-vlan vlan-id 10
set vlans employee-vlan description "Employee VLAN"
set vlans employee-vlan vlan-id 20
set vlans guest-vlan description "Guest VLAN"
set vlans guest-vlan vlan-id 30
set vlans camera-vlan description "Camera VLAN"
set vlans camera-vlan vlan-id 40
set interfaces xe-0/0/11:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces et-0/0/6 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/21:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/11:0 unit 0 family ethernet-switching interface-mode trunk
set interfaces et-0/0/6 unit 0 family ethernet-switching interface-mode trunk

```

```

set interfaces xe-0/0/21:0 unit 0 family ethernet-switching interface-mode trunk
set protocols mstp configuration-name region1
set protocols mstp bridge-priority 8k
set protocols mstp interface xe-0/0/11:0 cost 1000
set protocols mstp interface xe-0/0/11:0 mode point-to-point
set protocols mstp interface et-0/0/6 cost 1000
set protocols mstp interface et-0/0/6 mode point-to-point
set protocols mstp interface xe-0/0/21:0 cost 1000
set protocols mstp interface xe-0/0/21:0 mode point-to-point
set protocols mstp msti 1 bridge-priority 4k
set protocols mstp msti 1 vlan [10 20]
set protocols mstp msti 2 bridge-priority 16k
set protocols mstp msti 2 vlan [30 40]

```

NOTE: For non-ELS switches, instead of the following command used above for ELS switches that sets an interface into trunk mode using the `interface-mode` statement:

```
set interfaces interface-name unit 0 family ethernet-switching interface-mode trunk
```

substitute the following command for those lines in the configuration, which uses the non-ELS `port-mode` statement to set an interface into trunk mode:

```
set interfaces interface-name unit 0 family ethernet-switching port-mode trunk
```

Step-by-Step Procedure

To configure interfaces and MSTP on Switch 3:

1. Configure the VLANs voice-vlan, employee-vlan, guest-vlan, and camera-vlan:

```

[edit vlans]
user@switch3# set voice-vlan description "Voice VLAN"
user@switch3# set voice-vlan vlan-id 10
user@switch3# set employee-vlan description "Employee VLAN"
user@switch3# set employee-vlan vlan-id 20
user@switch3# set guest-vlan description "Guest VLAN"
user@switch3# set guest-vlan vlan-id 30
user@switch3# set camera-vlan description "Camera VLAN"

```

```
user@switch3# set guest-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet Switching protocol:

```
[edit interfaces]
user@switch3# set xe-0/0/11:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch3# set et-0/0/6 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch3# set xe-0/0/21:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch3# set xe-0/0/11:0 unit 0 family ethernet-switching interface-mode trunk
user@switch3# set et-0/0/6 unit 0 family ethernet-switching interface-mode trunk
user@switch3# set xe-0/0/21:0 unit 0 family ethernet-switching interface-mode trunk
```

NOTE: For non-ELS switches, instead of the following command used above for ELS switches that sets an interface into trunk mode using the `interface-mode` statement:

```
set interfaces interface-name unit 0 family ethernet-switching interface-mode trunk
```

substitute the following command for those lines in the configuration, which uses the non-ELS `port-mode` statement to set an interface into trunk mode:

```
set interfaces interface-name unit 0 family ethernet-switching port-mode trunk
```

4. Configure MSTP on the switch, including the two MSTIs:

```
[edit protocols]
user@switch3# mstp configuration-name region1
user@switch3# mstp bridge-priority 8k
user@switch3# mstp interface xe-0/0/11:0 cost 1000
user@switch3# mstp interface xe-0/0/11:0 mode point-to-point
user@switch3# mstp interface et-0/0/6 cost 1000
user@switch3# mstp interface et-0/0/6 mode point-to-point
user@switch3# mstp interface xe-0/0/21:0 cost 1000
```

```

user@switch3# mstp interface xe-0/0/21:0 mode point-to-point
user@switch3# mstp msti 1 bridge-priority 4k
user@switch3# mstp msti 1 vlan [10 20]
user@switch3# mstp msti 2 bridge-priority 16k
user@switch3# mstp msti 2 vlan [30 40]

```

Results

Check the results of the configuration:

```

user@switch3> show configuration
  interfaces {
    xe-0/0/11:0 {
      unit 0 {
        family ethernet-switching {
          interface-mode trunk;
          vlan {
            members 10;
            members 20;
            members 30;
            members 40;
          }
        }
      }
    }
    et-0/0/6 {
      unit 0 {
        family ethernet-switching {
          interface-mode trunk;
          vlan {
            members 10;
            members 20;
            members 30;
            members 40;
          }
        }
      }
    }
    xe-0/0/21:0 {
      unit 0 {

```



```

        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members 10;
                members 20;
                members 30;
                members 40;
            }
        }
    }
}

protocols {
    mstp {
        configuration-name region1;
        bridge-priority 8k;
        interface xe-0/0/11:0 {
            cost 1000;
            mode point-to-point;
        }
        interface et-0/0/6 {
            cost 1000;
            mode point-to-point;
        }
        interface xe-0/0/21:0 {
            cost 1000;
            mode point-to-point;
        }
        msti 1 {
            bridge-priority 4k;
            vlan [10 20];
        }
        msti 2 {
            bridge-priority 16k;
            vlan [30 40];
        }
    }
}

vlangs {
    voice-vlan {
        vlan-id 10;
    }
}

```

```

employee-vlan {
    vlan-id 20;
}
guest-vlan {
    vlan-id 30;
}
camera-vlan {
    vlan-id 40;
}
}

```

Configuring MSTP on Switch 4

IN THIS SECTION

- [Procedure | 120](#)

Procedure

CLI Quick Configuration

To quickly configure interfaces and MSTP on Switch 4, copy the following commands and paste them into the switch terminal window:

```

[edit]
set vlans voice-vlan description "Voice VLAN"
set vlans voice-vlan vlan-id 10
set vlans employee-vlan description "Employee VLAN"
set vlans employee-vlan vlan-id 20
set vlans guest-vlan description "Guest VLAN"
set vlans guest-vlan vlan-id 30
set vlans camera-vlan description "Camera VLAN"
set vlans camera-vlan vlan-id 40
set interfaces xe-0/0/12:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/21:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/12:0 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/21:0 unit 0 family ethernet-switching interface-mode trunk
set protocols mstp configuration-name region1

```

```

set protocols mstp bridge-priority 16k
set protocols mstp interface xe-0/0/12:0 cost 1000
set protocols mstp interface xe-0/0/12:0 mode point-to-point
set protocols mstp interface xe-0/0/21:0 cost 1000
set protocols mstp interface xe-0/0/21:0 mode point-to-point
set protocols mstp msti 1 bridge-priority 16k
set protocols mstp msti 1 vlan [10 20]
set protocols mstp msti 2 bridge-priority 32k
set protocols mstp msti 2 vlan [30 40]

```

NOTE: For non-ELS switches, instead of the following command used above for ELS switches that sets an interface into trunk mode using the `interface-mode` statement:

```
set interfaces interface-name unit 0 family ethernet-switching interface-mode trunk
```

substitute the following command for those lines in the configuration, which uses the non-ELS `port-mode` statement to set an interface into trunk mode:

```
set interfaces interface-name unit 0 family ethernet-switching port-mode trunk
```

Step-by-Step Procedure

To configure interfaces and MSTP on Switch 4:

1. Configure the VLANs voice-vlan, employee-vlan, guest-vlan, and camera-vlan:

```

[edit vlans]
user@switch4# set voice-vlan description "Voice VLAN"
user@switch4# set voice-vlan vlan-id 10
user@switch4# set employee-vlan description "Employee VLAN"
user@switch4# set employee-vlan vlan-id 20
user@switch4# set guest-vlan description "Guest VLAN"
user@switch4# set guest-vlan vlan-id 30
user@switch4# set camera-vlan description "Camera VLAN"
user@switch4# set guest-vlan vlan-id 40

```

2. Configure the VLANs on the interfaces, including support for the Ethernet Switching protocol:

```
[edit interfaces]
user@switch4# set xe-0/0/12:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch4# set xe-0/0/21:0 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

```
[edit interfaces]
user@switch4# set xe-0/0/12:0 unit 0 family ethernet-switching interface-mode trunk
user@switch4# set xe-0/0/21:0 unit 0 family ethernet-switching interface-mode trunk
```

NOTE: For non-ELS switches, instead of the following command used above for ELS switches that sets an interface into trunk mode using the `interface-mode` statement:

```
set interfaces interface-name unit 0 family ethernet-switching interface-mode trunk
```

substitute the following command for those lines in the configuration, which uses the non-ELS `port-mode` statement to set an interface into trunk mode:

```
set interfaces interface-name unit 0 family ethernet-switching port-mode trunk
```

4. Configure MSTP on the switch, including the two MSTIs:

```
[edit protocols]
user@switch4# mstp configuration-name region1
user@switch4# mstp bridge-priority 16k
user@switch4# mstp interface xe-0/0/12:0 cost 1000
user@switch4# mstp interface xe-0/0/12:0 mode point-to-point
user@switch4# mstp interface xe-0/0/21:0 cost 1000
user@switch4# mstp interface xe-0/0/21:0 mode point-to-point
user@switch4# mstp msti 1 bridge-priority 16k
user@switch4# mstp msti 1 vlan [10 20]
user@switch4# mstp msti 2 bridge-priority 32k
user@switch4# mstp msti 2 vlan [30 40]
```

Results

Check the results of the configuration:

```
user@switch4> show configuration
interfaces {
  xe-0/0/12:0 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members 10;
          members 20;
          members 30;
          members 40;
        }
      }
    }
  }
  xe-0/0/21:0 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members 10;
          members 20;
          members 30;
          members 40;
        }
      }
    }
  }
}
protocols {
  mstp {
    configuration-name region1;
    bridge-priority 16k;
    interface xe-0/0/12:0 {
      cost 1000;
      mode point-to-point;
    }
    interface xe-0/0/21:0 {
```

```
        cost 1000;
        mode point-to-point;
    }
    msti 1 {
        bridge-priority 16k;
        vlan [10 20];
    }
    msti 2 {
        bridge-priority 32k;
        vlan [30 40];
    }
}
vllans {
    voice-vlan {
        vlan-id 10;
    }
    employee-vlan {
        vlan-id 20;
    }
    guest-vlan {
        vlan-id 30;
    }
    camera-vlan {
        vlan-id 40;
    }
}
```

Verification

IN THIS SECTION

- [Verifying MSTP Configuration on Switch 1 | 125](#)
- [Verifying MSTP Configuration on Switch 2 | 127](#)
- [Verifying MSTP Configuration on Switch 3 | 129](#)
- [Verifying MSTP Configuration on Switch 4 | 131](#)

To confirm that the configuration is working properly, perform these tasks:

Verifying MSTP Configuration on Switch 1

Purpose

Verify the MSTP configuration on Switch 1.

Action

Issue the operational mode commands **show spanning-tree interface** and **show spanning-tree bridge**:

```
user@switch1> show spanning-tree interface
```

Spanning tree interface parameters for instance 0

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-0/0/9:0	128:1010	128:1010	16384.544b8c432703	1000	FWD	DESG
xe-0/0/12:0	128:1011	128:1011	16384.40a677792303	1000	BLK	ALT
xe-0/0/11:0	128:1012	128:1010	8192.544b8c44c103	1000	FWD	ROOT

Spanning tree interface parameters for instance 1

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-0/0/9:0	128:1010	128:1010	16385.544b8c432703	1000	FWD	DESG
xe-0/0/12:0	128:1011	128:1011	16385.40a677792303	1000	BLK	ALT
xe-0/0/11:0	128:1012	128:1010	4097.544b8c44c103	1000	FWD	ROOT

Spanning tree interface parameters for instance 2

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-0/0/9:0	128:1010	128:1012	4098.88a25e8c7603	1000	FWD	ROOT
xe-0/0/12:0	128:1011	128:1011	8194.544b8c432703	1000	FWD	DESG
xe-0/0/11:0	128:1012	128:1012	8194.544b8c432703	1000	FWD	DESG

```
user@switch1> show spanning-tree bridge
```

STP bridge parameters

Routing instance name : GLOBAL

Context ID : 0

Enabled protocol : MSTP

STP bridge parameters for CIST

Root ID : 8192.54:4b:8c:44:c1:03
 Root cost : 0
 Root port : xe-0/0/11:0
 CIST regional root : 8192.54:4b:8c:44:c1:03
 CIST internal root cost : 1000
 Hello time : 2 seconds
 Maximum age : 20 seconds
 Forward delay : 15 seconds
 Hop count : 19
 Message age : 0
 Number of topology changes : 3
 Time since last topology change : 675 seconds
 Local parameters
 Bridge ID : 16384.54:4b:8c:43:27:03

STP bridge parameters for MSTI 1

MSTI regional root : 4097.54:4b:8c:44:c1:03
 Root cost : 1000
 Root port : xe-0/0/11:0
 Hello time : 2 seconds
 Maximum age : 20 seconds
 Forward delay : 15 seconds
 Hop count : 19
 Number of topology changes : 3
 Time since last topology change : 675 seconds
 Local parameters
 Bridge ID : 16385.54:4b:8c:43:27:03

STP bridge parameters for MSTI 2

MSTI regional root : 4098.88:a2:5e:8c:76:03
 Root cost : 1000
 Root port : xe-0/0/9:0
 Hello time : 2 seconds
 Maximum age : 20 seconds
 Forward delay : 15 seconds
 Hop count : 19
 Number of topology changes : 3
 Time since last topology change : 675 seconds
 Local parameters

Bridge ID	: 8194.54:4b:8c:43:27:03
-----------	--------------------------

Meaning

The operational mode command `show spanning-tree interface` displays spanning-tree domain information such as the designated port and the port roles.

The operational mode command `show spanning-tree bridge` displays the spanning-tree domain information at either the bridge level or the interface level. If the optional interface name is omitted, all interfaces in the spanning-tree domain are displayed.

Verifying MSTP Configuration on Switch 2

Purpose

Verify the MSTP configuration on Switch 2.

Action

Issue the operational mode commands **show spanning-tree interface** and **show spanning-tree bridge**:

```
user@switch2> show spanning-tree bridge
```

Spanning tree interface parameters for instance 0

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
et-0/0/3	128:1010	128:1011	8192.544b8c44c103	1000	FWD	ROOT
xe-0/0/9:0	128:1012	128:1010	16384.544b8c432703	1000	BLK	ALT

Spanning tree interface parameters for instance 1

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
et-0/0/3	128:1010	128:1011	4097.544b8c44c103	1000	FWD	ROOT
xe-0/0/9:0	128:1012	128:1010	16385.544b8c432703	1000	BLK	ALT

Spanning tree interface parameters for instance 2

Interface	Port ID	Designated	Designated	Port	State	Role
-----------	---------	------------	------------	------	-------	------

		port ID	bridge ID	Cost		
et-0/0/3	128:1010	128:1010	4098.88a25e8c7603	1000	FWD	DESG
xe-0/0/9:0	128:1012	128:1012	4098.88a25e8c7603	1000	FWD	DESG

user@switch2> **show spanning-tree bridge**

STP bridge parameters

Routing instance name : GLOBAL
Context ID : 0
Enabled protocol : MSTP

STP bridge parameters for CIST

Root ID : 8192.54:4b:8c:44:c1:03
Root cost : 0
Root port : et-0/0/3
CIST regional root : 8192.54:4b:8c:44:c1:03
CIST internal root cost : 1000
Hello time : 2 seconds
Maximum age : 20 seconds
Forward delay : 15 seconds
Hop count : 19
Message age : 0
Number of topology changes : 2
Time since last topology change : 659 seconds
Local parameters
Bridge ID : 32768.88:a2:5e:8c:76:03

STP bridge parameters for MSTI 1

MSTI regional root : 4097.54:4b:8c:44:c1:03
Root cost : 1000
Root port : et-0/0/3
Hello time : 2 seconds
Maximum age : 20 seconds
Forward delay : 15 seconds
Hop count : 19
Number of topology changes : 2
Time since last topology change : 659 seconds
Local parameters
Bridge ID : 32769.88:a2:5e:8c:76:03

STP bridge parameters for MSTI 2

MSTI regional root : 4098.88:a2:5e:8c:76:03

```

Hello time           : 2 seconds
Maximum age          : 20 seconds
Forward delay        : 15 seconds
Number of topology changes : 3
Time since last topology change : 655 seconds
Local parameters
  Bridge ID          : 4098.88:a2:5e:8c:76:03

```

Meaning

The operational mode command `show spanning-tree interface` displays spanning-tree domain information such as the designated port and the port roles. The spanning-tree interface parameters for instance 2 show that both ports are designated ports, which means Switch 2 is the root bridge for this instance.

The operational mode command `show spanning-tree bridge` displays the spanning-tree domain information at either the bridge level or interface level. If the optional interface name is omitted, all interfaces in the spanning-tree domain are displayed.

Verifying MSTP Configuration on Switch 3

Purpose

Verify the MSTP configuration on Switch 3.

Action

Issue the operational mode commands **show spanning-tree interface** and **show spanning-tree bridge**:

```
user@switch3> show spanning-tree interface
```

```
Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-0/0/11:0	128:1010	128:1010	8192.544b8c44c103	1000	FWD	DESG
et-0/0/6	128:1011	128:1011	8192.544b8c44c103	1000	FWD	DESG
xe-0/0/21:0	128:1012	128:1012	8192.544b8c44c103	1000	FWD	DESG

```
Spanning tree interface parameters for instance 1
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-0/0/11:0	128:1010	128:1010	4097.544b8c44c103	1000	FWD	DESG
et-0/0/6	128:1011	128:1011	4097.544b8c44c103	1000	FWD	DESG
xe-0/0/21:0	128:1012	128:1012	4097.544b8c44c103	1000	FWD	DESG

Spanning tree interface parameters for instance 2

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-0/0/11:0	128:1010	128:1012	8194.544b8c432703	1000	BLK	ALT
et-0/0/6	128:1011	128:1010	4098.88a25e8c7603	1000	FWD	ROOT
xe-0/0/21:0	128:1012	128:1012	16386.544b8c44c103	1000	FWD	DESG

user@switch3> **show spanning-tree bridge**

STP bridge parameters

```
Routing instance name      : GLOBAL
Context ID                : 0
Enabled protocol          : MSTP
```

STP bridge parameters for CIST

```
Root ID                   : 8192.54:4b:8c:44:c1:03
CIST regional root        : 8192.54:4b:8c:44:c1:03
CIST internal root cost   : 0
Hello time                 : 2 seconds
Maximum age                : 20 seconds
Forward delay              : 15 seconds
Number of topology changes : 2
Time since last topology change : 786 seconds
Local parameters
  Bridge ID                : 8192.54:4b:8c:44:c1:03
```

STP bridge parameters for MSTI 1

```
MSTI regional root        : 4097.54:4b:8c:44:c1:03
Hello time                 : 2 seconds
Maximum age                : 20 seconds
Forward delay              : 15 seconds
Number of topology changes : 1
Time since last topology change : 786 seconds
Local parameters
```

```
Bridge ID                : 4097.54:4b:8c:44:c1:03

STP bridge parameters for MSTI 2
MSTI regional root       : 4098.88:a2:5e:8c:76:03
Root cost                 : 1000
Root port                : et-0/0/6
Hello time               : 2 seconds
Maximum age               : 20 seconds
Forward delay            : 15 seconds
Hop count                : 19
Number of topology changes : 1
Time since last topology change : 786 seconds
Local parameters
  Bridge ID              : 16386.54:4b:8c:44:c1:03
```

Meaning

The operational mode command `show spanning-tree interface` displays spanning-tree domain information such as the designated port and the port roles. Switch 3 is the root bridge for instance 0, which is the CIST, as well as for instance 1. In both instances, all ports on Switch 3 are designated ports.

The operational mode command `show spanning-tree bridge` displays the spanning-tree domain information at either the bridge level or the interface level. If the optional interface name is omitted, all interfaces in the spanning-tree domain are displayed.

Verifying MSTP Configuration on Switch 4

Purpose

Verify the MSTP configuration on Switch 4.

Action

Issue the operational mode commands `show spanning-tree interface` and `show spanning-tree bridge`:

```
user@switch4> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface      Port ID  Designated      Designated      Port  State  Role
```

		port ID	bridge ID	Cost		
xe-0/0/12:0	128:1011	128:1011	16384.40a677792303	1000	FWD	DESG
xe-0/0/21:0	128:1012	128:1012	8192.544b8c44c103	1000	FWD	ROOT

Spanning tree interface parameters for instance 1

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-0/0/12:0	128:1011	128:1011	16385.40a677792303	1000	FWD	DESG
xe-0/0/21:0	128:1012	128:1012	4097.544b8c44c103	1000	FWD	ROOT

Spanning tree interface parameters for instance 2

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-0/0/12:0	128:1011	128:1011	8194.544b8c432703	1000	FWD	ROOT
xe-0/0/21:0	128:1012	128:1012	16386.544b8c44c103	1000	BLK	ALT

user@switch4> **show spanning-tree bridge**

STP bridge parameters

Routing instance name : GLOBAL
Context ID : 0
Enabled protocol : MSTP

STP bridge parameters for CIST

Root ID : 8192.54:4b:8c:44:c1:03
Root cost : 0
Root port : xe-0/0/21:0
CIST regional root : 8192.54:4b:8c:44:c1:03
CIST internal root cost : 1000
Hello time : 2 seconds
Maximum age : 20 seconds
Forward delay : 15 seconds
Hop count : 19
Message age : 0
Number of topology changes : 2
Time since last topology change : 823 seconds
Local parameters
Bridge ID : 16384.40:a6:77:79:23:03

STP bridge parameters for MSTI 1

```

MSTI regional root      : 4097.54:4b:8c:44:c1:03
Root cost               : 1000
Root port              : xe-0/0/21:0
Hello time              : 2 seconds
Maximum age             : 20 seconds
Forward delay           : 15 seconds
Hop count               : 19
Number of topology changes : 2
Time since last topology change : 823 seconds
Local parameters
  Bridge ID             : 16385.40:a6:77:79:23:03

```

STP bridge parameters for MSTI 2

```

MSTI regional root      : 4098.88:a2:5e:8c:76:03
Root cost               : 2000
Root port              : xe-0/0/12:0
Hello time              : 2 seconds
Maximum age             : 20 seconds
Forward delay           : 15 seconds
Hop count               : 18
Number of topology changes : 2
Time since last topology change : 823 seconds
Local parameters
  Bridge ID             : 32770.40:a6:77:79:23:03

```

Meaning

The operational mode command `show spanning-tree interface` displays spanning-tree domain information such as the designated port and the port roles.

The operational mode command `show spanning-tree bridge` displays the spanning-tree domain information at either the bridge level or the interface level. If the optional interface name is omitted, all interfaces in the spanning-tree domain are displayed.

Disabling MSTP

To disable the entire MSTP instance:

- Include the "disable" on page 267 statement. You can include this statement at the following hierarchy levels:
 - [edit logical-systems *logical-system-name* protocols mstp]
 - [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols mstp]
 - [edit protocols mstp]
 - [edit routing-instances *routing-instance-name* protocols mstp]

Release History Table

Release	Description
15.1	Starting with Junos OS Release 15.1 for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, you can configure spanning tree parameters globally on all spanning tree interfaces.

Configuring VSTP Protocol

IN THIS SECTION

- Understanding VSTP | 135
- Global and Specific VSTP Configurations for Switches | 136
- Example: Configuring VSTP on a Trunk Port with Tagged Traffic | 141
- Reverting to RSTP or VSTP from Forced IEEE 802.1D STP | 157

Virtual Spanning-Tree Protocol works with VLANs that require device compatibility.

Understanding VSTP

IN THIS SECTION

- [Benefits of VSTP | 135](#)
- [VSTP Restrictions | 135](#)
- [Recommended Uses of VSTP | 136](#)

When using VSTP, we recommend that you enable VSTP on all VLANs that can receive VSTP bridge protocol data units (BPDUs).

Benefits of VSTP

VSTP has the following benefits:

- Connects devices that are not part of the network
- Compatible with Cisco PVST+
- VSTP and RSTP are the only spanning-tree protocols that can be configured concurrently on a device.

VSTP Restrictions

VSTP has these restrictions:

- The EX Series switches EX4300, EX4600 and the QFX platforms QFX5100, QFX3500, QFX3600 support 510 Vlans on VSTP.
- VSTP is not supported on the SRX platform - just STP/RSTP/MSTP are supported on SRX Series.
- On EX Series (except EX9200) and QFX Series switches running Junos OS that supports ELS—VSTP can support up to 510 VLANs.
- On EX9200 switches—VSTP can support up to 4000 VLANs.
- On an EX Series switch running Junos OS that does not support ELS—VSTP can support up to 253 VLANs.

Recommended Uses of VSTP

You can use Juniper Networks switches with VSTP and Cisco switches with PVST+ and Rapid-PVST+ in the same network. Cisco supports a proprietary Per-VLAN Spanning Tree (PVST) protocol, which maintains a separate spanning tree instance per each VLAN. One Spanning Tree per VLAN allows fine grain load balancing but requires more BPDU CPU processing as the number of VLANs increases. PVST runs on Cisco proprietary ISL trunks which is not supported by Juniper. Juniper switches only inter-operate with PVST+ and Rapid-PVST+. For more information, see [VSTP and RPVST+ convergence on native-vlan 1 for EX Switches](#).

TIP: If your device interoperates with a Cisco device running Rapid per VLAN Spanning Tree (Rapid PVST+), we recommend that you enable both VSTP and RSTP on the EX Series or QFX Series interface.

VSTP and RSTP are the only spanning-tree protocols that can be configured concurrently on a device. The maximum number of VLANs that can be supported by VSTP on a switch depends upon whether you are using Junos OS for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style or Junos OS that does not support ELS. For ELS details, see *Using the Enhanced Layer 2 Software CLI*. For additional VLANs, use RSTP.

The maximum number of VLANs supported by VSTP on a switch depends upon whether you are using Junos OS for EX Series and QFX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style or Junos OS that does not support ELS.

Global and Specific VSTP Configurations for Switches

IN THIS SECTION

- [Where Can I Configure VSTP? | 137](#)
- [VSTP Commands to Configure All Interfaces | 138](#)
- [VSTP Commands to Configure Specific Interfaces | 139](#)
- [VSTP Commands to Disable Interfaces | 140](#)

Juniper Networks EX Series Ethernet Switches provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP), and VLAN

Spanning Tree Protocol (VSTP). The default factory configuration for EX Series switches uses RSTP. This topic describes options for configuring VSTP on an EX Series or QFX Series switch.

NOTE: On EX Series (other than EX9200) and QFX switches running Junos OS that supports ELS –VSTP can support up to 510 VLANs. However, on EX9200 switches, VSTP can support only up to 253 VLANs.

NOTE: When you configure VSTP, we recommend that you enable VSTP on all VLANs that can receive VSTP bridge protocol data units (BPDUs).

Where Can I Configure VSTP?

You can configure VSTP at the global level:

- For all interfaces on the switch
- For all interfaces within all VLANs
- For all interfaces within a specified VLAN
- For all interfaces within a specified VLAN group

You can configure or disable VSTP for specific interfaces:

- For a specific interface on the switch
- For a specific interface within all VLANs
- For a specific interface within a specified VLAN
- For a specific interface within a specified VLAN group

NOTE:

- If you configure VSTP on an interface at both the global and the specific VLAN level, the interface configuration that is defined at the specific VLAN level overrides the interface configuration that is defined at the global level.
- If you specify VSTP to be configured on an interface that is not configured to belong to the VLAN (or VLANs), an error message is displayed.

- On EX Series (other than EX9200) and QFX switches running Junos OS that supports ELS—VSTP can support up to 510 VLANs. However, on EX9200 switches, VSTP can support only up to 253 VLANs.
- When you configure VSTP, we recommend that you enable VSTP on all VLANs that can receive VSTP bridge protocol data units (BPDUs).

You must enable RSTP if you used the `set vstp vlan all` statement to enable VSTP and if the switch has more than 253 VLANs. If you use the `set vstp vlan all` statement to enable VSTP on a switch with more than 253 VLANs, the configuration cannot be committed.

VSTP Commands to Configure All Interfaces

Command to configure VSTP on an individual interface on a switch:

```
[edit protocols vstp]
user@switch@ set interface interface-name
```

Command to configure all VSTP interfaces on a switch:

```
[edit protocols vstp]
user@switch# set interface all
```

Command to configure all VSTP interfaces for all VLANs:

NOTE: When you issue the `set protocols vstp vlan all interface all` command, you might not receive an error message when you have exceed the limit of 5119 vports.

```
[edit protocols vstp]
user@switch# set vlan all interface all
```

Command to configure all VSTP interfaces within a specified VLAN:

```
[edit protocols vstp]
user@switch# set vlan (vlan-id | vlan-range | open-set-of-values) interface all interface all
```

NOTE: When you configure VSTP with the `set protocol vstp vlan vlan-id interface interface-name` command, the VLAN named default is excluded. You must manually configure a VLAN with the name default to run VSTP.

Command to configure all VSTP interfaces within a specified VLAN group:

```
[edit protocols vstp]
user@switch# set vlan-group vlan-group-name vlan (vlan-id | vlan-range | open-set-of-values)
interface all
```

VSTP Commands to Configure Specific Interfaces

Command to configure a specific interface on a switch:

```
[edit protocols vstp]
user@switch# set interface interface-name
```

Command to configure a specific interface within all VLANs:

```
[edit protocols vstp]
user@switch# set vlan all interface interface-name
```



CAUTION: Ensure that the interface is a member of all VLANs before you add the interface to the VSTP configuration. If the interface is not a member of all VLANs, this VSTP configuration will fail when you try to commit it.

Command to configure a specific interface within a specific VLAN:

```
[edit protocols vstp]
user@switch# set vlan vlan-id-or-vlan-range interface interface-name
```

Command to configure a specific interface within a specific VLAN group:

```
[edit protocols vstp]
user@switch# set vlan-group vlan-group-name vlan (vlan-id | vlan-range | open-set-of-values)
interface interface-name
```

VSTP Commands to Disable Interfaces

Command to disable VSTP on an individual interface on a switch:

```
[edit protocols vstp]
user@switch@ set interface interface-name disable
```

Command to disable VSTP on a specific interface within a specific VLAN on a switch:

```
[edit protocols vstp]
user@switch@ set vlan vlan-id interface interface-name disable
```

Command to disable one specific VSTP interface on all the VLANs on the switch:

```
[edit protocols vstp]
user@switch@ set vlan all interface interface-name disable
```

Command to disable a specific VSTP interface within a specific VLAN group:

```
[edit protocols vstp]
user@switch@ set vlan-group group group-name vlan (vlan-id | vlan-range | open-set-of-values)
interface interface-name disable
```

NOTE: You *cannot* disable the VSTP VLAN parameters for *all* VSTP interfaces.

Example: Configuring VSTP on a Trunk Port with Tagged Traffic

IN THIS SECTION

- [Requirements | 141](#)
- [Overview | 141](#)
- [Configuration | 142](#)
- [Verification | 154](#)

In 802.1ad provider bridge networks (stacked VLANs), single-tagged access ports and double-tagged trunk ports can co-exist in a single spanning tree context. In this mode, the VLAN Spanning Tree Protocol (VSTP) can send and receive untagged Rapid Spanning Tree Protocol (RSTP) bridge protocol data units (BPDUs) on Gigabit Ethernet (ge), 10 -Gigabit Ethernet (xe), and aggregated Ethernet (ae) interfaces. The untagged RSTP BPDUs interoperate with tagged VSTP BPDUs sent over the double-tagged trunk ports.

Double-tagging can be useful for Internet service providers, allowing them to use VLANs internally while mixing traffic from clients that are already VLAN-tagged.

This example shows how to configure the VSTP to send and receive standard untagged Rapid Spanning Tree Protocol (RSTP) bridge protocol data units (BPDUs) on access trunks that interoperate with tagged VSTP BPDUs sent over the double-tagged trunk ports.

Requirements

This example uses the following hardware and software components:

- Two CE devices (MX Series routers with DPCE or MPC cards)
- Two PE devices (MX Series routers with DPCE or MPC cards)
- Junos OS Release 12.3 or later running on the PE devices

Overview

IN THIS SECTION

- [Topology | 142](#)

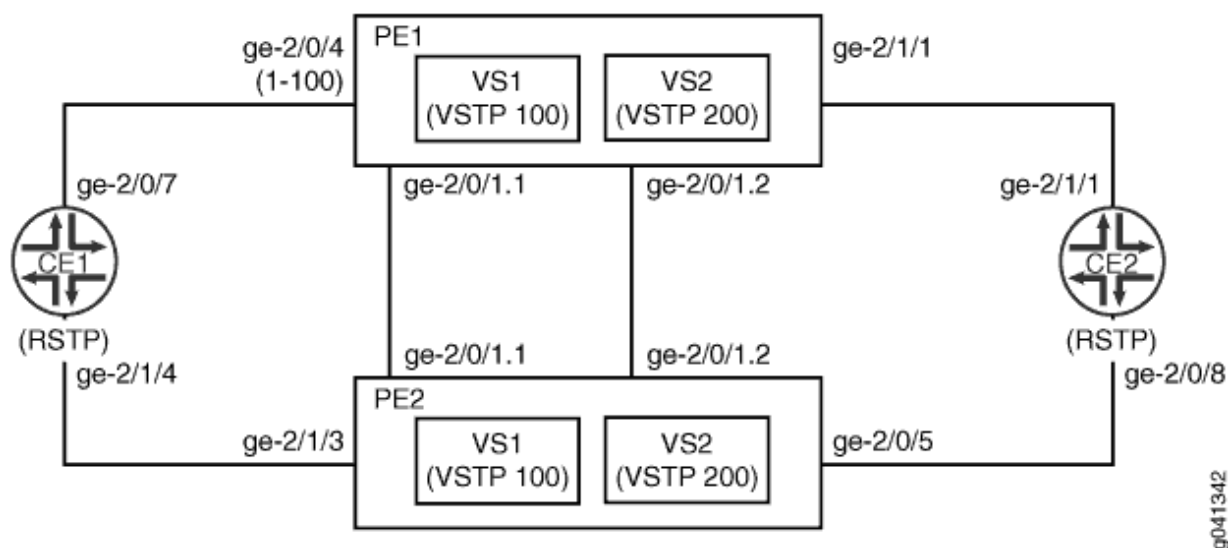
This example shows how to configure VSTP on a trunk port with tagged traffic.

Topology

Figure 4 on page 142 shows a sample topology in which two customer edge (CE) bridges are dual-homed to two provider edge (PE) devices. All of the PE-CE links are single-tagged trunks using C-VLANs 1-100. The core link between Devices PE1 and PE2 is a double-tagged trunk that carries traffic from both CE devices, using S-VLANs 100 and 200 to distinguish the CE traffic.

Two VSTP instances are created on the PE devices, one for each S-VLAN. The CE devices run the standard RSTP. The PE devices run VSTP on the core link while sending standard untagged RSTP BPDUs toward the CE devices.

Figure 4: Topology for VSTP Configured on a Trunk Port with Tagged Traffic



Configuration

IN THIS SECTION

- CLI Quick Configuration | 143
- Configuring PE1, PE2, CE1, and CE2 | 145
- Results | 148

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

Device PE1

```
set interfaces ge-2/0/1 flexible-vlan-tagging
set interfaces ge-2/0/1 encapsulation flexible-ethernet-services
set interfaces ge-2/0/1 unit 1 vlan-id 100
set interfaces ge-2/0/1 unit 1 family bridge interface-mode trunk
set interfaces ge-2/0/1 unit 1 family bridge inner-vlan-id-list 1-100
set interfaces ge-2/0/1 unit 2 vlan-id 200
set interfaces ge-2/0/1 unit 2 family bridge interface-mode trunk
set interfaces ge-2/0/1 unit 2 family bridge inner-vlan-id-list 1-100
set interfaces ge-2/0/4 encapsulation ethernet-vpls
set interfaces ge-2/0/4 unit 0 description to_CE1
set interfaces ge-2/0/4 unit 0 family bridge interface-mode trunk
set interfaces ge-2/0/4 unit 0 family bridge vlan-id-list 1-100
set interfaces ge-2/1/1 unit 0 description to_CE2
set interfaces ge-2/1/1 unit 0 family bridge interface-mode trunk
set interfaces ge-2/1/1 unit 0 family bridge vlan-id-list 1-100
set routing-instances vs1 instance-type virtual-switch
set routing-instances vs1 interface ge-2/0/1.1
set routing-instances vs1 interface ge-2/0/4.0
set routing-instances vs1 protocols vstp vlan 100 interface ge-2/0/1
set routing-instances vs1 protocols vstp vlan 100 interface ge-2/0/4 access-trunk
set routing-instances vs1 bridge-domains bd vlan-id-list 1-100
set routing-instances vs2 instance-type virtual-switch
set routing-instances vs2 interface ge-2/0/1.2
set routing-instances vs2 interface ge-2/1/1.0
set routing-instances vs2 protocols vstp vlan 200 interface ge-2/0/1
set routing-instances vs2 protocols vstp vlan 200 interface ge-2/1/1 access-trunk
set routing-instances vs2 bridge-domains bd vlan-id-list 1-100
```

Device PE2

```
set interfaces ge-2/0/1 flexible-vlan-tagging
set interfaces ge-2/0/1 encapsulation flexible-ethernet-services
set interfaces ge-2/0/1 unit 1 vlan-id 100
set interfaces ge-2/0/1 unit 1 family bridge interface-mode trunk
```

```

set interfaces ge-2/0/1 unit 1 family bridge inner-vlan-id-list 1-100
set interfaces ge-2/0/1 unit 2 vlan-id 200
set interfaces ge-2/0/1 unit 2 family bridge interface-mode trunk
set interfaces ge-2/0/1 unit 2 family bridge inner-vlan-id-list 1-100
set interfaces ge-2/1/3 description to_CE1
set interfaces ge-2/1/3 unit 0 family bridge interface-mode trunk
set interfaces ge-2/1/3 unit 0 family bridge vlan-id-list 1-100
set interfaces ge-2/0/5 description to_CE2
set interfaces ge-2/0/5 unit 0 family bridge interface-mode trunk
set interfaces ge-2/0/5 unit 0 family bridge vlan-id-list 1-100
set routing-instances vs1 instance-type virtual-switch
set routing-instances vs1 interface ge-2/0/1.1
set routing-instances vs1 interface ge-2/1/3.0
set routing-instances vs1 protocols vstp vlan 100 interface ge-2/0/1
set routing-instances vs1 protocols vstp vlan 100 interface ge-2/1/3 access-trunk
set routing-instances vs1 bridge-domains bd vlan-id-list 1-100
set routing-instances vs2 instance-type virtual-switch
set routing-instances vs2 interface ge-2/0/1.2
set routing-instances vs2 interface ge-2/0/5.0
set routing-instances vs2 protocols vstp vlan 200 interface ge-2/0/1
set routing-instances vs2 protocols vstp vlan 200 interface ge-2/0/5 access-trunk
set routing-instances vs2 bridge-domains bd vlan-id-list 1-100

```

Device CE1

```

set interfaces ge-2/0/7 unit 0 description to_PE1
set interfaces ge-2/0/7 unit 0 family bridge interface-mode trunk
set interfaces ge-2/0/7 unit 0 family bridge vlan-id-list 1-100
set interfaces ge-2/1/4 unit 0 description to_PE2
set interfaces ge-2/1/4 unit 0 family bridge interface-mode trunk
set interfaces ge-2/1/4 unit 0 family bridge vlan-id-list 1-100
set protocols rstp interface ge-2/0/7
set protocols rstp interface ge-2/1/4
set bridge-domains bd vlan-id-list 1-100

```

Device CE2

```

set interfaces ge-2/0/8 unit 0 description to_PE2
set interfaces ge-2/0/8 unit 0 family bridge interface-mode trunk
set interfaces ge-2/0/8 unit 0 family bridge vlan-id-list 1-100
set interfaces ge-2/1/1 unit 0 description to_PE1

```

```

set interfaces ge-2/1/1 unit 0 family bridge interface-mode trunk
set interfaces ge-2/1/1 unit 0 family bridge vlan-id-list 1-100
set protocols rstp interface ge-2/0/8
set protocols rstp interface ge-2/1/1
set bridge-domains bd vlan-id-list 1-100

```

Configuring PE1, PE2, CE1, and CE2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the [CLI User Guide](#).

To configure Device PE1:

1. Configure the network interfaces.

```

[edit interfaces]
user@PE1# set ge-2/0/1 flexible-vlan-tagging
user@PE1# set ge-2/0/1 encapsulation flexible-ethernet-services
user@PE1# set ge-2/0/1 unit 1 vlan-id 100
user@PE1# set ge-2/0/1 unit 1 family bridge interface-mode trunk
user@PE1# set ge-2/0/1 unit 1 family bridge inner-vlan-id-list 1-100
user@PE1# set ge-2/0/1 unit 2 vlan-id 200
user@PE1# set ge-2/0/1 unit 2 family bridge interface-mode trunk
user@PE1# set ge-2/0/1 unit 2 family bridge inner-vlan-id-list 1-100
user@PE1# set ge-2/0/4 encapsulation ethernet-vpls
user@PE1# set ge-2/0/4 unit 0 description to_CE1
user@PE1# set ge-2/0/4 unit 0 family bridge interface-mode trunk
user@PE1# set ge-2/0/4 unit 0 family bridge vlan-id-list 1-100
user@PE1# set ge-2/1/1 unit 0 description to_CE2
user@PE1# set ge-2/1/1 unit 0 family bridge interface-mode trunk
user@PE1# set ge-2/1/1 unit 0 family bridge vlan-id-list 1-100

```

2. Configure the routing instances.

```

[edit routing-instances]
user@PE1# set vs1 instance-type virtual-switch
user@PE1# set vs1 interface ge-2/0/1.1
user@PE1# set vs1 interface ge-2/0/4.0

```

```

user@PE1# set vs1 protocols vstp vlan 100 interface ge-2/0/1
user@PE1# set vs1 protocols vstp vlan 100 interface ge-2/0/4 access-trunk
user@PE1# set vs1 bridge-domains bd vlan-id-list 1-100
user@PE1# set vs2 instance-type virtual-switch
user@PE1# set vs2 interface ge-2/0/1.2
user@PE1# set vs2 interface ge-2/1/1.0
user@PE1# set vs2 protocols vstp vlan 200 interface ge-2/0/1
user@PE1# set vs2 protocols vstp vlan 200 interface ge-2/1/1 access-trunk
user@PE1# set vs2 bridge-domains bd vlan-id-list 1-100

```

Step-by-Step Procedure

To configure Device PE2:

1. Configure the interfaces.

```

[edit interfaces]
user@PE2# set ge-2/0/1 flexible-vlan-tagging
user@PE2# set ge-2/0/1 encapsulation flexible-ethernet-services
user@PE2# set ge-2/0/1 unit 1 vlan-id 100
user@PE2# set ge-2/0/1 unit 1 family bridge interface-mode trunk
user@PE2# set ge-2/0/1 unit 1 family bridge inner-vlan-id-list 1-100
user@PE2# set ge-2/0/1 unit 2 vlan-id 200
user@PE2# set ge-2/0/1 unit 2 family bridge interface-mode trunk
user@PE2# set ge-2/0/1 unit 2 family bridge inner-vlan-id-list 1-100
user@PE2# set ge-2/1/3 description to_CE1
user@PE2# set ge-2/1/3 unit 0 family bridge interface-mode trunk
user@PE2# set ge-2/1/3 unit 0 family bridge vlan-id-list 1-100
user@PE2# set ge-2/0/5 description to_CE2
user@PE2# set ge-2/0/5 unit 0 family bridge interface-mode trunk
user@PE2# set ge-2/0/5 unit 0 family bridge vlan-id-list 1-100

```

2. Configure the routing instances.

```

[edit routing-instances]
user@PE2# set vs1 instance-type virtual-switch
user@PE2# set vs1 interface ge-2/0/1.1
user@PE2# set vs1 interface ge-2/1/3.0
user@PE2# set vs1 protocols vstp vlan 100 interface ge-2/0/1
user@PE2# set vs1 protocols vstp vlan 100 interface ge-2/1/3 access-trunk
user@PE2# set vs1 bridge-domains bd vlan-id-list 1-100

```

```

user@PE2# set vs2 instance-type virtual-switch
user@PE2# set vs2 interface ge-2/0/1.2
user@PE2# set vs2 interface ge-2/0/5.0
user@PE2# set vs2 protocols vstp vlan 200 interface ge-2/0/1
user@PE2# set vs2 protocols vstp vlan 200 interface ge-2/0/5 access-trunk
user@PE2# set vs2 bridge-domains bd vlan-id-list 1-100

```

Step-by-Step Procedure

To configure CE1:

1. Configure the interfaces.

```

[edit interfaces]
user@CE1# set ge-2/0/7 unit 0 description to_PE1
user@CE1# set ge-2/0/7 unit 0 family bridge interface-mode trunk
user@CE1# set ge-2/0/7 unit 0 family bridge vlan-id-list 1-100
user@CE1# set ge-2/1/4 unit 0 description to_PE2
user@CE1# set ge-2/1/4 unit 0 family bridge interface-mode trunk
user@CE1# set ge-2/1/4 unit 0 family bridge vlan-id-list 1-100

```

2. Configure the protocols.

```

[edit protocols]
user@CE1# set rstp interface ge-2/0/7
user@CE1# set rstp interface ge-2/1/4

```

3. Configure the bridge domain.

```

[edit bridge-domains]
user@CE1# set bd vlan-id-list 1-100

```

Step-by-Step Procedure

To configure CE2:

1. Configure the interfaces.

```
[edit interfaces]
user@CE2# set ge-2/0/8 unit 0 description to_PE2
user@CE2# set ge-2/0/8 unit 0 family bridge interface-mode trunk
user@CE2# set ge-2/0/8 unit 0 family bridge vlan-id-list 1-100
user@CE2# set ge-2/1/1 unit 0 description to_PE1
user@CE2# set ge-2/1/1 unit 0 family bridge interface-mode trunk
user@CE2# set ge-2/1/1 unit 0 family bridge vlan-id-list 1-100
```

2. Configure the protocols.

```
[edit protocols]
user@CE2# set rstp interface ge-2/0/8
user@CE2# set rstp interface ge-2/1/1
```

3. Configure the bridge domain.

```
[edit bridge-domains]
user@CE2# set bd vlan-id-list 1-100
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show routing-instances**, **show protocols**, and **show bridge-domains** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device PE1

```
user@PE1# show interfaces
ge-2/0/1 {
  flexible-vlan-tagging;
  encapsulation flexible-ethernet-services;
  unit 1 {
    vlan-id 100;
    family bridge {
      interface-mode trunk;
      inner-vlan-id-list 1-100;
    }
  }
}
```

```

    }
    unit 2 {
        vlan-id 200;
        family bridge {
            interface-mode trunk;
            inner-vlan-id-list 1-100;
        }
    }
}
ge-2/0/4 {
    encapsulation ethernet-vpls;
    unit 0 {
        description to_CE1;
        family bridge {
            interface-mode trunk;
            vlan-id-list 1-100;
        }
    }
}
ge-2/1/1 {
    unit 0 {
        description to_CE2;
        family bridge {
            interface-mode trunk;
            vlan-id-list 1-100;
        }
    }
}
}

```

```

user@PE1# show routing-instances
vs1 {
    instance-type virtual-switch;
    interface ge-2/0/1.1;
    interface ge-2/0/4.0;
    protocols {
        vstp {
            vlan 100 {
                interface ge-2/0/1;
                interface ge-2/0/4 {
                    access-trunk;
                }
            }
        }
    }
}

```

```

    }
  }
}
bridge-domains {
  bd {
    vlan-id-list 1-100;
  }
}
}
vs2 {
  instance-type virtual-switch;
  interface ge-2/0/1.2;
  interface ge-2/0/1.0;
  protocols {
    vstp {
      vlan 200 {
        interface ge-2/0/1;
        interface ge-2/1/1 {
          access-trunk;
        }
      }
    }
  }
}
bridge-domains {
  bd {
    vlan-id-list 1-100;
  }
}
}
}

```

Device PE2

```

user@PE2# show interfaces
ge-2/0/1 {
  flexible-vlan-tagging;
  encapsulation flexible-ethernet-services;
  unit 1 {
    vlan-id 100;
    family bridge {
      interface-mode trunk;
      inner-vlan-id-list 1-100;
    }
  }
}

```



```

    }
    unit 2 {
        vlan-id 200;
        family bridge {
            interface-mode trunk;
            inner-vlan-id-list 1-100;
        }
    }
}
ge-2/0/5 {
    description to_CE2;
    unit 0 {
        family bridge {
            interface-mode trunk;
            vlan-id-list 1-100;
        }
    }
}
ge-2/1/3 {
    description to_CE1;
    unit 0 {
        family bridge {
            interface-mode trunk;
            vlan-id-list 1-100;
        }
    }
}
}

```

```

user@PE2# show routing-instances

```

```

vs1 {
    instance-type virtual-switch;
    interface ge-2/0/1.1;
    interface ge-2/1/3.0;
    protocols {
        vstp {
            vlan 100 {
                interface ge-2/0/1;
                interface ge-2/1/3 {
                    access-trunk;
                }
            }
        }
    }
}

```

```

    }
  }
  bridge-domains {
    bd {
      vlan-id-list 1-100;
    }
  }
}
vs2 {
  instance-type virtual-switch;
  interface ge-2/0/1.2;
  interface ge-2/0/5.0;
  protocols {
    vstp {
      vlan 200 {
        interface ge-2/0/1;
        interface ge-2/0/5 {
          access-trunk;
        }
      }
    }
  }
  bridge-domains {
    bd {
      vlan-id-list 1-100;
    }
  }
}
}

```

Device CE1

```

user@CE1# show interfaces
ge-2/0/7 {
  unit 0 {
    description to_PE1;
    family bridge {
      interface-mode trunk;
      vlan-id-list 1-100;
    }
  }
}
ge-2/1/4 {

```

```

    unit 0 {
        description to_PE2;
        family bridge {
            interface-mode trunk;
            vlan-id-list 1-100;
        }
    }
}

```

```

user@CE1# show protocols
rstp {
    interface ge-2/0/7;
    interface ge-2/1/4;
}

```

```

user@CE1# show bridge-domains
bd {
    vlan-id-list 1-100;
}

```

Device CE2

```

user@CE2 show interfaces
ge-2/0/8 {
    unit 0 {
        description to_PE2;
        family bridge {
            interface-mode trunk;
            vlan-id-list 1-100;
        }
    }
}
ge-2/1/1 {
    unit 0 {
        description to_PE1;
        family bridge {
            interface-mode trunk;
            vlan-id-list 1-100;
        }
    }
}

```

```
}  
}
```

```
user@CE2# show protocols  
rstp {  
    interface ge-2/0/8;  
    interface ge-2/1/1;  
}
```

```
user@CE2# show bridge-domains  
bd {  
    vlan-id-list 1-100;  
}
```

If you are done configuring the device, enter `commit` from configuration mode.

Verification

IN THIS SECTION

- [Verifying That the Interfaces Are Operational | 154](#)
- [Verifying the STP Bridge Parameters of the Routing Instances | 155](#)
- [Displaying STP Statistics for the Configured Bridge | 156](#)

Confirm that the configuration is working properly.

Verifying That the Interfaces Are Operational

Purpose

Verify that the interfaces are operational.

Action

From operational mode, enter the **show spanning-tree interface routing-instance** command.

```
user@PE1> show spanning-tree interface routing-instance vs1
```

Spanning tree interface parameters for VLAN 100

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-2/0/1	128:82	128:82	32868.0021590f37d0	20000	FWD	DESG
ge-2/0/4	128:85	128:85	32868.0021590f37d0	20000	FWD	DESG

Meaning

The output shows the status of the interfaces configured for VLAN 100.

Verifying the STP Bridge Parameters of the Routing Instances

Purpose

Verify the STP bridge parameters configured for the routing instances.

Action

From operational mode, enter the **show spanning-tree bridge routing-instance** command.

```
user@PE1> show spanning-tree bridge routing-instance vs1
```

STP bridge parameters

Routing instance name : vs1

Enabled protocol : RSTP

STP bridge parameters for VLAN 100

Root ID : 32868.00:21:59:0f:37:d0

Hello time : 2 seconds

Maximum age : 20 seconds

Forward delay : 15 seconds

Message age : 0

Number of topology changes : 2

Time since last topology change : 687 seconds

Local parameters

```

Bridge ID           : 32868.00:21:59:0f:37:d0
Extended system ID  : 100

```

Meaning

The output shows the status of the STP bridge parameters for routing instance vs1.

Displaying STP Statistics for the Configured Bridge

Purpose

Display spanning-tree statistics for the configured bridge.

Action

From operational mode, enter the **show spanning-tree statistics bridge** command.

```

user@PE1> show spanning-tree statistics bridge
STP Context  : default
STP Instance : 0
Number of Root Bridge Changes: 0
Number of Root Port Changes:  0

STP Context  : x/default
STP Instance : 0
Number of Root Bridge Changes: 0
Number of Root Port Changes:  0

STP Context  : vs1
STP Instance : 0
Number of Root Bridge Changes: 2          Last Changed: Thu Sep 20 15:12:18 2012
Number of Root Port Changes:  1          Last Changed: Thu Sep 20 15:01:13 2012
Recent TC Received: ge-2/0/1.1          Received   : Thu Sep 20 15:01:17 2012

STP Context  : vs2
STP Instance : 0
Number of Root Bridge Changes: 2          Last Changed: Thu Sep 20 15:10:25 2012
Number of Root Port Changes:  2          Last Changed: Thu Sep 20 15:10:25 2012
Recent TC Received: ge-2/1/1.0          Received   : Thu Sep 20 15:10:47 2012

STP Context  : CE1/default

```

```

STP Instance : 0
Number of Root Bridge Changes: 0
Number of Root Port Changes: 0
Recent TC Received: ge-2/1/4.0          Received : Thu Sep 20 15:12:15 2012

```

Meaning

The command output shows spanning-tree statistics for the configured bridge.

SEE ALSO

| [access-trunk](#) | [247](#)

Reverting to RSTP or VSTP from Forced IEEE 802.1D STP

On MX Series routers and EX Series and QFX Series switches on which Rapid Spanning Tree Protocol (RSTP) or VLAN Spanning Tree Protocol (VSTP) has been forced to run as the original IEEE 802.1D Spanning Tree Protocol (STP) version, you can revert back to RSTP or VSTP.

To revert from the forced instance of the original IEEE 802.1D STP version to the originally configured RSTP or VSTP version:

1. Remove the `force-version` statement from the following RSTP or VSTP configuration:

```

user@host# delete protocols rstp force-version stp
user@host# delete protocols vstp force-version stp

```

Include this statement at the following hierarchy levels:

- [edit logical-systems *routing-instance-name* protocols [rstp](#)]
- [edit protocols [rstp](#)]
- [edit protocols [vstp](#)]
- [edit routing-instances *routing-instance-name* protocols [rstp](#)]
- [edit routing-instances *routing-instance-name* protocols [vstp](#)]

2. Revert the forced IEEE 802.1D STP to run as the configured RSTP or VSTP:

```
user@host# clear spanning-tree protocol-migration <interface interface-name> <routing-  
instance routing-instance-name>
```

To revert the STP protocol globally, issue the statement without options (**clear spanning-tree protocol-migration**).

To revert the STP protocol for the specified interface only, specify the **interface *interface-name*** option.

To revert the STP protocol for a particular routing instance only, specify the **routing-instance *routing-instance-name*** option.

RELATED DOCUMENTATION

| [Connecting and Configuring an EX Series Switch \(CLI Procedure\)](#)

4

CHAPTER

BPDU Protection for Spanning-Tree Protocols

BPDU Protection for Spanning-Tree Protocols | 160

BPDU Protection for Spanning-Tree Protocols

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- [Configuring BPDU Protection for Edge Interfaces | 170](#)
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- [Example: Configuring BPDU Protection on Interfaces | 173](#)

Understanding BPDU Protection for Spanning-Tree Instance Interfaces

ACX Series routers, MX Series routers, PTX Series routers, EX Series switches, and QFX Series switches support spanning-tree protocols that prevent loops in a network by creating a tree topology (spanning-tree) of the entire bridged network. All spanning-tree protocols use a special type of frame called bridge protocol data units (BPDUs) to communicate with each other.

The Spanning Tree Protocol (STP) family is designed to break possible loops in a Layer 2 bridged network. Loop prevention avoids damaging broadcast storms that can potentially render the network useless. STP processes on bridges exchange BPDUs to determine the LAN topology, decide the root bridge, stop forwarding on some ports, and so on. However, a misbehaving user application or device can interfere with the operation of the STP protocols and cause network problems.

BPDU-block is a feature that defends the STP topology from a misbehaving user application or device or a threat. You must enable BPDU guard on the interfaces that are not supposed to receive any BPDUs.

If an interface is configured to be edge port, it will transition directly to the Forwarding state. Such ports are connected to end devices and are not expected to receive BPDUs. Therefore, to avoid loops, you must protect edge ports by enabling `bpdu-block-on-edge`.

On the routers and switches that support STP, you can configure BPDU protection to ignore BPDUs received on interfaces where none should be expected (for example, a LAN interface on a network edge with no other bridges present). If a BPDU is received on a protected interface, the interface is disabled and stops forwarding frames. By default, all BPDUs are accepted and processed on all interfaces.

You can achieve BPDU protection in several ways. By default, if `bpdu-block` is enabled on the interface, on receiving BPDU, the interface will be disabled and all traffic forwarding will stop on the interface. However, if you do not want to disable the interface and do not want that interface to take part in the STP calculation, you can configure `action drop`. If you configure `action drop`, the interface remains up and running and traffic continues to flow; however, BPDUs are dropped.

The edge ports do not support `action drop`. `BPDU-block-on-edge` disables the interface if the edge ports receive BPDUs. You must clear the error to bring the interface back up.

You can configure BPDU protection on interfaces with the following encapsulation types:

- **ethernet-bridge**
- **ethernet-vpls**
- **extended-vlan-bridge**
- **vlan-vpls**
- **vlan-bridge**
- **extended-vlan-vpls**

You can configure BPDU protection on individual interfaces or on all the edge ports of the bridge.

Enable BPDU protection on interfaces that are configured as edge ports by using the `bpdu-block-on-edge` command under the `set protocols (mstp|rstp|vstp)` hierarchy. If you have not configured a port as an edge port, you can still configure BPDU protection on the interface by using the `bpdu-block` command under the `set protocols layer2-control` hierarchy. You can also use the `bpdu-block` command to configure BPDU protection on interfaces configured for a spanning-tree.

SEE ALSO

[Understanding Root Protection for Spanning-Tree Instance Interfaces in a Layer 2 Switched Network | 212](#)

[Understanding VPLS Multihoming | 207](#)

Understanding BPDU Protection for STP, RSTP, and MSTP

IN THIS SECTION

- [Different Types of BPDUs | 162](#)

Networks frequently use multiple protocols simultaneously to achieve different goals and in some cases those protocols might conflict with each other. One such case is when spanning-tree protocols are active on the network, where a special type of switching frame called a bridge protocol data unit (BPDU) can conflict with BPDUs generated on other devices such as PCs. The different kinds of BPDUs are not compatible, but they can still be recognized by other devices that use BPDUs and cause network outages. You need to protect any device that recognizes BPDUs from picking up incompatible BPDUs.

Different Types of BPDUs

Spanning-tree protocols such as Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), and Multiple Spanning Tree Protocol (MSTP) generate their own BPDUs. These peer STP applications use their BPDUs to communicate, and ultimately, the exchange of BPDUs determines which interfaces block traffic and which interfaces become root ports. The root ports and designated ports forward traffic; the alternate and back up ports block the traffic.

Configuring BPDU Protection for Individual Spanning-Tree Instance Interfaces

To configure BPDU protection on one or more spanning-tree instance interfaces, include the `bpdu-block` statement:

```
bpdu-block {  
    interface interface-name;  
    disable-timeout seconds;  
}
```

NOTE: If you also include the optional `disable-timeout seconds` statement, *protected interfaces* are automatically cleared after the specified time interval unless the interval is 0.

Understanding BPDUs Used for Exchanging Information Among Bridges

In a Layer 2 bridge environment, spanning-tree protocols use data frames called Bridge Protocol Data Units (BPDUs) to exchange information among bridges.

Spanning-tree protocols on peer systems exchange BPDUs, which contain information about port roles, bridge IDs, and root path costs. On each router or switch, the spanning-tree protocol uses this information to elect a root bridge, identify root ports for each switch, identify designated ports for each physical LAN segment, and prune specific redundant links to create a loop-free tree topology. The resulting tree topology provides a single active Layer 2 data path between any two end stations.

NOTE: In discussions of spanning-tree protocols, the terms *bridge* and *switch* are often used interchangeably.

The transmission of BPDUs is controlled by the Layer 2 Control Protocol process (l2cpd) on MX Series 5G Universal Routing Platforms.

The transmission of periodic packets on behalf of the l2cpd process is carried out by periodic packet management (PPM), which, by default, is configured to run on the Packet Forwarding Engine. The ppm process on the Packet Forwarding Engine ensures that the BPDUs are transmitted even when the l2cpd is unavailable, and keeps the remote adjacencies alive during a unified in-service software upgrade (unified ISSU). However, if you want the distributed PPM (ppmd) process to run on the Routing Engine instead of the Packet Forwarding Engine, you can disable the ppm process on the Packet Forwarding Engine.

On routers and switches with redundant Routing Engines (two Routing Engines that are installed in the same router), you can configure nonstop bridging. Nonstop bridging enables the router to switch from a primary Routing Engine to a backup Routing Engine without losing Layer 2 Control Protocol (L2CP) information. Nonstop bridging uses the same infrastructure as graceful Routing Engine switchover (GRES) to preserve interface and kernel information. However, nonstop bridging also saves L2CP information by running the l2cpd process on the backup Routing Engine.

NOTE: To use nonstop bridging, you must first enable GRES.

Nonstop bridging is supported for the following Layer 2 control protocols:

- Spanning-Tree Protocol (STP)
- Rapid Spanning-Tree Protocol (RSTP)
- Multiple Spanning-Tree Protocol (MSTP)

Understanding BPDU Protection for EVPN-VXLAN

EVPN-VXLAN data center fabrics have a number of built-in Ethernet loop prevention mechanisms, such as split-horizon and designated forwarder and non-designated forwarder election. In some existing data center environments where a new IP EVPN fabric is being deployed, you might need to configure BPDU protection at the leaf-to-server interface in order to avoid network outages due to xSTP miscalculations. Incorrect cabling between the server and leaf interfaces, or any back-door layer 2 link between two or more ESI-LAG interfaces, might cause miscalculations and then result in Ethernet loops. Without BPDU protection, BPDUs might not be recognized and will be flooded as unknown Layer 2 packets on the VXLAN interfaces. With BPDU protection, when a BPDU is received on an edge port in an EVPN-VXLAN environment, the edge port is disabled and stops forwarding all traffic. You can also configure BPDU protection to drop BPDU traffic but have all other traffic forwarded on the interfaces without having to configure a spanning-tree protocol.

Configuring Interface for BPDU Protection With Port Shutdown Mode

To configure BPDU protection on an edge interface of a switch:

NOTE: Ensure that the switch is connected to an end device.

1. Configure any spanning-tree protocol on the switch if not configured already. RSTP is configured in this procedure.

```
[edit protocols]
user@switch# set rstp
```

2. Enable RSTP on a specific interface and set a priority for the interface—for example, **et-0/0/0.0**:

```
[edit protocols]
user@switch# set rstp interface et-0/0/0.0 priority 16
```

3. Enable BPDU protection on the **et-0/0/0.0** interface:

```
[edit protocols]
user@switch# set layer2-control bpdu-block interface et-0/0/0.0
```

4. Commit the configuration:

```
[edit]
user@switch# commit
```

5. Verify that BPDU protection is configured properly on the interface (**et-0/0/0.0**):
 - Run the `show ethernet-switching interfaces operational mode` command to see the state of STP configured on the interface:

```
user@switch> show ethernet-switching interface et-0/0/0
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                        LH - MAC limit hit, DN - interface down,
                        MMAS - Mac-move action shutdown, AS - Autostate-exclude enabled,
                        SCTL - shutdown by Storm-control, SL - Secure Learning,
                        MI - MAC+IP limit hit)

Logical      Vlan      TAG  MAC  MAC+IP STP      Logical
Tagging
interface    members
et-0/0/0.0   1007616 0
tagged
              default    1    1007616 0    Discarding
tagged
```

	vlan100	100	1007616 0	Discarding
tagged				

In this output, note that the **et-0/0/0.0** interface is in blocked state because it has received BPDUs from the end device.

- Run the `show spanning-tree interfaces operational mode` command to ensure that the **et-0/0/0.0** interface is blocked:

```
user@switch> show spanning-tree interface et-0/0/0
Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated	Designated	Port	State
Role		port ID	bridge ID	Cost	
et-0/0/0	128:58	128:58	32768.605f7e0507de	50	BLK
DIS (Bpdu-Incon)					

- Run the `show interfaces interface-name operational mode` command to verify that the interface is disabled:

```
user@switch> show interfaces et-0/0/0
Physical interface: et-0/0/0, Enabled, Physical link is Down
  Interface index: 1036, SNMP ifIndex: 521
  Link-level type: Ethernet, MTU: 1518, LAN-PHY mode, Speed: 400Gbps, BPDU Error:
Detected, Loop Detect PDU Error: None, Ethernet-Switching Error: None, MAC-REWRITE Error:
None, Loopback: Disabled, Source filtering: Disabled,
  Flow control: Disabled, Auto-negotiation: Disabled, Media type: Fiber
  Device flags   : Present Running Down
  Interface flags: Down SNMP-Traps Internal: 0x20
  CoS queues     : 8 supported, 8 maximum usable queues
  Current address: 60:5f:7e:05:00:28, Hardware address: 60:5f:7e:05:00:28
  Last flapped   : 2023-01-19 11:46:36 IST (00:02:03 ago)
  Input rate     : 248 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None
  PCS statistics
    Bit errors           Seconds
    Errored blocks       0
  PRBS Mode : Disabled
```



```

Interface transmit statistics: Disabled
Link Degradation :
  Link Monitoring          : Disable

Logical interface et-0/0/0.0 (Index 1005) (SNMP ifIndex 533)
  Flags: Device-Down SNMP-Traps Encapsulation: Ethernet-Bridge DF
  Input packets : 36590
  Output packets: 0
  Protocol ethernet-switching, MTU: 1518
  Flags: Trunk-Mode

```

The physical link is down and BPDU error is detected.

Configuring Interface for BPDU Protection With BPDU Drop Mode

For certain access switches, you might want interfaces on the switch not to shutdown on encountering incompatible BPDU packets; instead, only drop incompatible BPDU packets while allowing the remaining traffic to pass through. Such an interface must not have a spanning-tree protocol configured on it, so that packets that pass through the interface will not cause STP misconfiguration and consequent network outages.

To configure BPDU protection for an interface to only drop incompatible BPDU packets and to allow the remaining traffic to pass through, while retaining the interface status as up:

NOTE: Ensure that the switch on which you are configuring BPDU protection is connected to a peer device.

1. Delete or disable any spanning-tree protocol (for instance, RSTP as in this procedure) configured on the switch or on any interface.
 - To delete a spanning-tree protocol on the entire switch:

```

[edit]
user@switch# delete protocols rstp

```

Or,

```
[edit]
user@switch# set protocols rstp disable
```

- To delete a spanning-tree protocol on a specific interface (for example, **et-0/0/0.0**) on the switch:

```
[edit]
user@switch# set protocols rstp interface et-0/0/0.0 disable
```

2. Enable the BPDU protection on the interface (**et-0/0/0.0** in this procedure) to drop BPDU packets:

```
[edit]
user@switch set layer2-control bpdu-block interface et-0/0/0.0 drop
```

3. Commit the configuration:

```
[edit]
user@switch# commit
```

4. Verify that the BPDU protection action-drop is configured on the interface:

- Run the `show ethernet-switching interfaces operational mode` command to ensure that the BPDU protection is configured on the interface:

```
user@switch> show ethernet-switching interface et-0/0/0
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                        LH - MAC limit hit, DN - interface down,
                        MMAS - Mac-move action shutdown, AS - Autostate-exclude enabled,
                        SCTL - shutdown by Storm-control, SL - Secure Learning,
                        MI - MAC+IP limit hit)

Logical      Vlan      TAG  MAC  MAC+IP STP      Logical
Tagging
interface    members
et-0/0/0.0   limit limit state  interface flags
tagged                               1007616 0
                                1  1007616 0  Forwarding
                                default
tagged
```

	vlan100	100	1007616 0	Forwarding
tagged				

In this output, note that the **et-0/0/0.0** interface is up even though it has received incompatible BPDU packets because the **drop** feature is configured for this interface.

- Run the `show interfaces interface-name operational mode` command to ensure that the **et-0/0/0.0** interface is displayed in the output and that the **State** of the interface is **DIS**, which indicates that the interface discards all incompatible BPDUs:

```

user@switch> show interfaces et-0/0/0
Physical interface: et-0/0/0, Enabled, Physical link is Up
  Interface index: 1036, SNMP ifIndex: 521
  Link-level type: Ethernet, MTU: 1518, LAN-PHY mode, Speed: 400Gbps, BPDU Error: None,
  Loop Detect PDU Error: None, Ethernet-Switching Error: None, MAC-REWRITE Error: None,
  Loopback: Disabled, Source filtering: Disabled,
  Flow control: Disabled, Auto-negotiation: Disabled, Media type: Fiber
  Device flags   : Present Running Down
  Interface flags: Down SNMP-Traps Internal: 0x20
  CoS queues     : 8 supported, 8 maximum usable queues
  Current address: 60:5f:7e:05:00:28, Hardware address: 60:5f:7e:05:00:28
  Last flapped   : 2023-01-18 17:44:33 IST (00:00:01 ago)
  Input rate     : 744 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None
  PCS statistics
    Bit errors           Seconds
    Errored blocks       0
  PRBS Mode : Disabled
  Interface transmit statistics: Disabled
  Link Degrade :
    Link Monitoring      : Disable

Logical interface et-0/0/0.0 (Index 1005) (SNMP ifIndex 533)
  Flags: Device-Down SNMP-Traps Encapsulation: Ethernet-Bridge DF
  Input packets : 83
  Output packets: 0
  Protocol ethernet-switching, MTU: 1518
  Flags: Trunk-Mode

```

The physical link is up and there is no BPDU error.

Configuring BPDU Protection for Edge Interfaces

In a spanning-tree topology, if a switch is an access switch then interfaces on that switch will be connected to end devices such as PCs, servers, routers, or hubs, that are not connected to other switches. You configure these interfaces as edge interfaces because they directly connect to end devices.

Interfaces that are configured as edge interfaces can transition to a forwarding state immediately because they cannot create network loops. A switch detects edge ports by noting the absence of communication from the end stations. As edge ports are connected to end devices, it is imperative that you configure BPDU protection on edge ports to avoid loops. If BPDU protection is enabled on an edge interface, the interface shuts down on encountering a BPDU thereby preventing any traffic from passing through the interface. You can re-enable the interface by issuing the `clear error bpdu interface interface-name` operational mode command. The `clear error bpdu interface interface-name` command will only re-enable an interface but the BPDU configuration for the interface will continue to exist unless you explicitly remove the BPDU configuration.

To configure BPDU protection on an edge interface of a switch:

NOTE: Ensure that the switch is connected to an end device.

1. Configure any spanning-tree protocol on the switch if not configured already. RSTP is configured in this procedure.

```
[edit protocols]
user@switch# set rstp
```

2. Enable RSTP on a specific interface and set a priority for the interface—for example, **et-0/0/0.0**:

```
[edit protocols]
user@switch# set rstp interface et-0/0/0.0 priority 16
```

3. Configure the **et-0/0/0.0** interface as an edge interface and enable BPDU protection on that interface:

```
[edit protocols]
user@switch# set rstp bpdu-block-on-edge interface et-0/0/0.0 edge
```

4. Commit the configuration:

```
[edit]
user@switch# commit
```

5. Verify that BPDU protection is configured properly on the edge interface (et-0/0/0.0):

- Run the `show ethernet-switching interfaces operational mode` command to see the state of STP configured on the interface:

```
user@switch> show ethernet-switching interface et-0/0/0
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                        LH - MAC limit hit, DN - interface down,
                        MMAS - Mac-move action shutdown, AS - Autostate-exclude enabled,
                        SCTL - shutdown by Storm-control, SL - Secure Learning,
                        MI - MAC+IP limit hit, LP - Loop Protect Down)
Logical Interface flags (DL - disable learning, AD - packet action drop,
                        LH - MAC limit hit, DN - interface down,
                        MMAS - Mac-move action shutdown, AS - Autostate-exclude enabled,
                        SCTL - shutdown by Storm-control, SL - Secure Learning,
                        MI - MAC+IP limit hit, LP - Loop Protect Down)

Logical      Vlan      TAG  MAC  MAC+IP STP      Logical
Tagging
interface    members          limit limit state  interface flags
et-0/0/0.0   untagged          294912 0      Discarding  DN
untagged
              default    1      294912 0      Discarding
untagged
```

In this output, you note that the **et-0/0/0.0** interface is in blocked state because it has received BPDUs from the end device.

- Run the `show spanning-tree interfaces operational mode` command to ensure that the **et-0/0/0.0** interface is blocked:

```
user@switch> show spanning-tree interface et-0/0/0
Spanning tree interface parameters for instance 0

Interface      Port ID  Designated      Designated      Port  State
Role
```

		port ID	bridge ID	Cost	
et-0/0/0	128:58	128:58	32768.605f7e0507de	50	BLK
DIS (Bpdu-Incon)					

- Run the show interfaces **interface-name** operational mode command to verify that the interface is disabled:

```

user@switch> show interfaces et-0/0/0
Physical interface: et-0/0/0, Enabled, Physical link is Down
  Interface index: 1036, SNMP ifIndex: 521
  Link-level type: Ethernet, MTU: 1518, LAN-PHY mode, Speed: 400Gbps, BPDU Error:
Detected, Loop Detect PDU Error: None, Ethernet-Switching Error: None, MAC-REWRITE Error:
None, Loopback: Disabled, Source filtering: Disabled,
  Flow control: Disabled, Auto-negotiation: Disabled, Media type: Fiber
  Device flags   : Present Running Down
  Interface flags: Down SNMP-Traps Internal: 0x20
  CoS queues     : 8 supported, 8 maximum usable queues
  Current address: 60:5f:7e:05:00:28, Hardware address: 60:5f:7e:05:00:28
  Last flapped   : 2023-01-19 11:46:36 IST (00:02:03 ago)
  Input rate     : 248 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None
  PCS statistics
                                Seconds
    Bit errors                  0
    Errored blocks              0
  PRBS Mode : Disabled
  Interface transmit statistics: Disabled
  Link Degrade :
    Link Monitoring              : Disable

Logical interface et-0/0/0.0 (Index 1005) (SNMP ifIndex 533)
  Flags: Device-Down SNMP-Traps Encapsulation: Ethernet-Bridge DF
  Input packets : 36590
  Output packets: 0
  Protocol ethernet-switching, MTU: 1518
  Flags: Trunk-Mode

```

The physical link is down and BPDU error is detected.

Example: Blocking BPDUs on an Interface for 600 Seconds

The following example, when used with a full bridge configuration with aggregated Ethernet, blocks BPDUs on interface **ae0** for 10 minutes (600 seconds) before enabling the interface again:

```
[edit protocols layer2-control]
bpdu-block {
  interface ae0;
  disable-timeout 600;
}
```

SEE ALSO

[Understanding Root Protection for Spanning-Tree Instance Interfaces in a Layer 2 Switched Network | 212](#)

[Checking the Status of Spanning-Tree Instance Interfaces | 236](#)

Example: Configuring BPDU Protection on Interfaces

IN THIS SECTION

- [Requirements | 174](#)
- [Overview and Topology | 174](#)
- [Configuration | 177](#)

NOTE: This example uses Junos OS for EX Series switches without support for the Enhanced Layer 2 Software (ELS) configuration style. For ELS details, see *Using the Enhanced Layer 2 Software CLI*.

When BPDU protection is enabled, an interface shuts down or drops BPDU packets when any incompatible BPDU is encountered, thereby preventing the BPDUs generated by spanning-tree

protocols from reaching the switch. When an interface is configured to drop BPDU packets, all traffic except the incompatible BPDUs can pass through the interface.

NOTE: The BPDU drop feature can be specified only on interfaces on which no spanning-tree protocol is configured.

This example configures BPDU protection on STP switch downstream interfaces that connect to two PCs:

Requirements

This example uses the following hardware and software components:

- One EX Series switch in an RSTP topology
- One EX Series switch that is not in any spanning-tree topology
- Junos OS Release 9.1 or later for EX Series switches

Before you configure the interfaces on Switch 2 for BPDU protection, be sure you have:

- Ensured that RSTP is operating on Switch 1.
- Disabled or enabled RSTP on Switch 2 (depending on the configuration that you plan to implement.)

If you want to enable the BPDU shutdown feature, then it is optional to disable spanning-tree protocols on the interface.

NOTE: By default, RSTP is enabled on all EX Series switches.

Overview and Topology

IN THIS SECTION

- [Topology | 176](#)

This example explains how to configure BPDU protection on an interface.

[Figure 5 on page 176](#) shows the topology for this example. Switch 1 and Switch 2 are connected through a trunk interface. Switch 1 is configured for RSTP while Switch 2 has a spanning-tree protocol

configured on it for the first scenario, and does not have a spanning-tree protocol configured on it for the second scenario.

In the first scenario, this example configures downstream BPDU protection on Switch 2 interfaces **ge-0/0/5.0** and **ge-0/0/6.0** when the default spanning-tree protocol (RSTP) is not disabled on these interfaces. When BPDU protection is enabled, the `shutdown` statement is enabled by default, and the switch interfaces will shut down if BPDUs generated by the laptops attempt to access Switch 2.

In the second scenario, this example configures downstream BPDU protection on Switch 2 interfaces **ge-0/0/5.0** and **ge-0/0/6.0** when there is no spanning-tree protocol configured on these interfaces. When BPDU protection is enabled with the `drop` statement, the switch interfaces drop only the BPDUs while allowing remaining traffic to pass through and retaining their status as up if BPDUs generated by the laptops attempt to access Switch 2.



CAUTION: When configuring BPDU protection on an interface without spanning trees connected to a switch with spanning trees, be careful that you do not configure BPDU protection on **all** interfaces. Doing so could prevent BPDUs being received on switch interfaces (such as a trunk interface) that you intended to have receive BPDUs from a switch with spanning trees.

Topology

Figure 5: BPDU Protection Topology

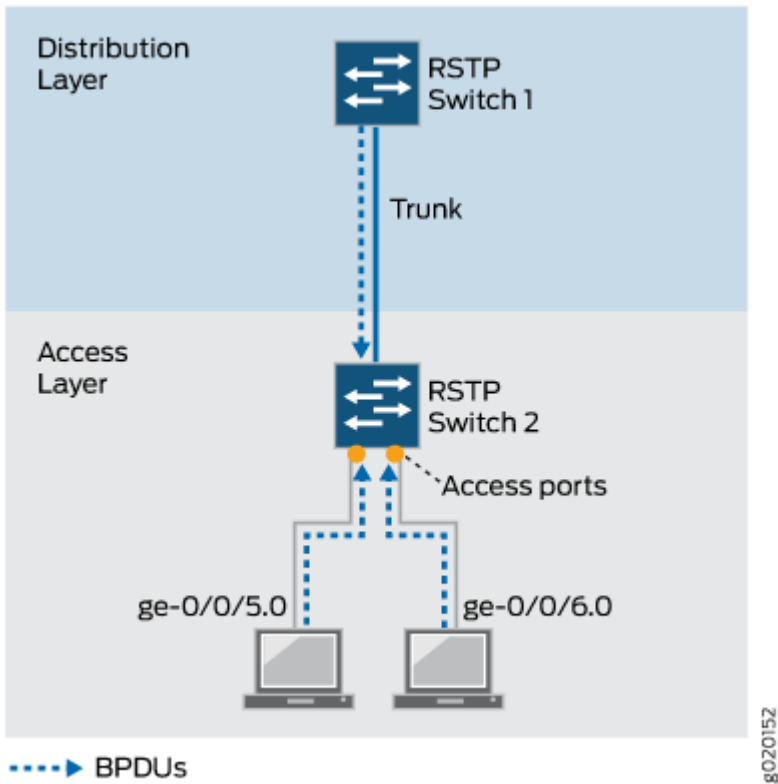


Table 7 on page 176 shows the components that will be configured for BPDU protection.

Table 7: Components of the Topology for Configuring BPDU Protection on EX Series Switches

Property	Settings
Switch 1 (Distribution Layer)	Switch 1 is connected to Switch 2 through a trunk interface. Switch 1 is configured for RSTP.
Switch 2 (Access Layer)	Switch 2 has two downstream access ports connected to laptops: <ul style="list-style-type: none">• ge-0/0/5.0• ge-0/0/6.0

Configuration

IN THIS SECTION

● Procedure | [177](#)

● Procedure | [178](#)

To configure BPDU protection on the interfaces:

Procedure

CLI Quick Configuration

This is the first scenario that explains configuration for the default BPDU block (action: shutdown). To quickly configure BPDU protection on Switch 2, copy the following commands and paste them into the switch terminal window:

```
[edit]

user@switch# set protocols layer2-control bpdu-block interface ge-0/0/5
[edit]

user@switch# set protocols layer2-control bpdu-block interface ge-0/0/6
```

Step-by-Step Procedure

To configure BPDU protection for the shutdown statement:

1. Configure the BPDU block (action: shutdown) on the downstream interface **ge-0/0/5** on Switch 2:

```
[edit protocols]
user@switch# set layer2-control bpdu-block interface ge-0/0/5
```

2. Configure the BPDU block (action: shutdown) on the downstream interface **ge-0/0/6** on Switch 2:

```
[edit protocols]
user@switch# set layer2-control bpdu-block interface ge-0/0/6
```

Results

Check the results of the configuration:

```
user@switch> show protocols layer2-control
bpdu-block {
  interface ge-0/0/5;
  interface ge-0/0/6;
}
```

Procedure

CLI Quick Configuration

This is the second scenario that explains configuration for the drop statement. To quickly configure BPDU protection on Switch 2 for the drop statement, copy the following commands and paste them into the switch terminal window:

```
[edit]

user@switch# set protocols layer2-control bpdu-block interface ge-0/0/5 drop
user@switch# set protocols layer2-control bpdu-block interface ge-0/0/6 drop
```

NOTE: If xSTP is enabled on the interface, you must disable it before configuring BPDU drop action: block. You can disable RSTP globally by using the `delete protocols rstp`, the `set protocols rstp disable`, or the `set protocols rstp interface all disable` command.

Step-by-Step Procedure

To configure BPDU protection for the drop statement:

1. Configure the BPDU drop statement on the downstream interface **ge-0/0/5** on Switch 2:

```
[edit protocols layer2-control]
user@switch# set bpdu-block interface ge-0/0/50 drop
```

2. Configure the BPDU drop statement on the downstream interface **ge-0/0/6** on Switch 2:

```
[edit protocols layer2-control]
user@switch# set bpdu-block interface ge-0/0/6 drop
```

Results

Check the results of the configuration:

```
user@switch> show configuration protocols layer2-control
bpdu-block {
  interface ge-0/0/5;
  interface ge-0/0/6;
}
```

5

CHAPTER

Loop Protection for Spanning-Tree Protocols

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Loop Protection for Spanning-Tree Protocols

IN THIS SECTION

- [Understanding Loop Protection for Spanning-Tree Instance Interfaces | 181](#)
- [Eliminating Bridge Loops in Ethernet LANs with Spanning Tree Protocol | 183](#)
- [Example: Enabling Loop Protection for Spanning-Tree Protocols | 191](#)
- [Configuring Loop Protection for a Spanning-Tree Instance Interface | 191](#)
- [Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on non-ELS EX Series Switches | 193](#)
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Understanding Loop Protection for Spanning-Tree Instance Interfaces

IN THIS SECTION

- [How Does Loop Protection Work? | 182](#)
- [Benefits of Loop Protection on STP Protocols | 182](#)
- [What Action Causes a Loop? | 182](#)
- [What Can Loop Protection Do When BPDUs Don't Arrive? | 182](#)
- [When Should I Use Loop Protection? | 183](#)
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Loop protection increases the efficiency of STP, RSTP, and MSTP by preventing ports from moving into a forwarding state that would result in a loop opening up in the network. Spanning-tree protocol loop protection enhances the normal checks that spanning-tree protocols perform on interfaces. Loop protection performs a specified action when BPDUs are not received on a nondesignated port interface. You can choose to block the interface or issue an alarm when bridge protocol data units (BPDUs) are not received on the port.

How Does Loop Protection Work?

A loop-free network in spanning-tree topologies is supported through the exchange of a special type of frame called bridge protocol data unit (BPDU). Peer STP applications running on the switch interfaces use BPDUs to communicate. Ultimately, the exchange of BPDUs determines which interfaces block traffic (preventing loops) and which interfaces become root ports and forward traffic.

However, a blocking interface can transition to the forwarding state in error if the interface stops receiving BPDUs from its designated port on the segment. Such a transition error can occur when there is a hardware error on the switch or software configuration error between the switch and its neighbor.

When loop protection is enabled, the spanning-tree topology detects root ports and blocked ports and makes sure both keep receiving BPDUs. If a loop-protection-enabled interface stops receiving BPDUs from its designated port, it reacts as it would react to a problem with the physical connection on this interface. It does not transition the interface to a forwarding state, but instead transitions it to a loop-inconsistent state. The interface recovers and then it transitions back to the spanning-tree blocking state as soon as it receives a BPDU.

Benefits of Loop Protection on STP Protocols

By default, a spanning-tree protocol interface that stops receiving bridge protocol data unit (BPDU) data frames will transition to the designated port (forwarding) state, creating a potential loop.

What Action Causes a Loop?

The spanning-tree protocol family is responsible for breaking loops in a network of bridges with redundant links. However, hardware failures can create forwarding loops (STP loops) and cause major network outages. Spanning-tree protocols break loops by blocking ports (interfaces). However, errors occur when a blocked port transitions erroneously to a forwarding state.

Ideally, a spanning-tree protocol bridge port remains blocked as long as a superior alternate path to the root bridge exists for a connected LAN segment. This designated port is determined by receiving superior BPDUs from a peer on that port. When other ports no longer receive BPDUs, the spanning-tree protocol considers the topology to be loop free. However, if a blocked or alternate port moves into a forwarding state, this creates a loop.

What Can Loop Protection Do When BPDUs Don't Arrive?

To prevent a spanning-tree instance interface from interpreting a lack of received BPDUs as a “false positive” condition for assuming the designated port role, you can configure one of the following loop protection options:

- Configure the router to raise an alarm condition if the spanning-tree instance interface has not received BPDUs during the timeout interval.
- Configure the router to block the spanning-tree instance interface if the interface has not received BPDUs during the timeout interval.

NOTE: Spanning-tree instance interface loop protection is enabled for all spanning-tree instances on the interface, but blocks or alarms only those instances that stop receiving BPDUs.

When Should I Use Loop Protection?

You can configure spanning-tree protocol loop protection to improve the stability of Layer 2 networks. We recommend you configure loop protection only on non-designated interfaces such as the root or alternate interfaces. Otherwise, if you configure loop protection on both sides of a designated link, then certain STP configuration events (such as setting the root bridge priority to an inferior value in a topology with many loops) can cause both interfaces to transition to blocking mode.

We recommend that you enable loop protection on all switch interfaces that have a chance of becoming root or designated ports. Loop protection is most effective when enabled in the entire switched network. When you enable loop protection, you must configure at least one action (log, block, or both).

NOTE: An interface can be configured for either loop protection or root protection, but not for both.

What Happens if I Do Not Use Loop Protection?

By default (that is, without spanning-tree protocol loop protection configured), an interface that stops receiving BPDUs will assume the designated port role and possibly result in a spanning-tree protocol loop.

Eliminating Bridge Loops in Ethernet LANs with Spanning Tree Protocol

IN THIS SECTION

● [Understanding Bridge Loops](#) | 184

- [How STP Helps Eliminate Loops | 187](#)
- [Types of Spanning-Tree Protocols Supported | 190](#)

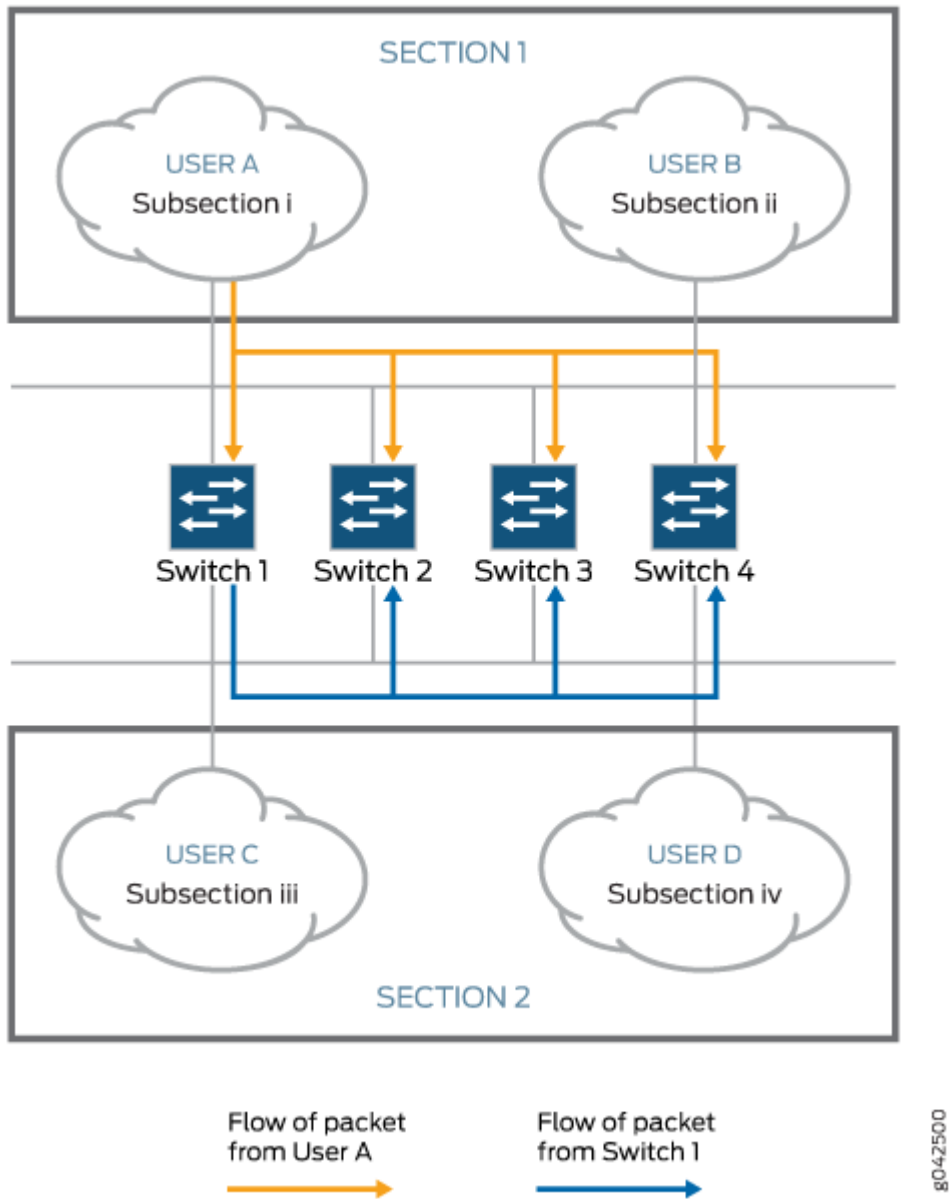
The Spanning Tree Protocol (STP) is a network protocol that is used to eliminate bridge loops in Ethernet LANs. STP prevents network loops and associated network outage by blocking redundant links or paths. The redundant paths can be used to keep the network operational if the primary link fails.

The sections describe bridge loops and how STP helps eliminate them.

Understanding Bridge Loops

To understand bridge loops, consider a scenario in which four switches (or bridges) are connected to four different subsections (Subsection i, ii, iii, and iv) where each subsection is a collection of network nodes (see [Figure 6 on page 185](#)). For simplicity, Subsection i and Subsection ii are combined to form Section 1. Similarly, Subsection iii and Subsection iv are combined to form Section 2.

Figure 6: Formation of Bridge Loops



When the switches are powered on, the bridge tables are empty. If User A in Subsection i tries to send a single packet Packet 1 to User D in Subsection iv, all the switches, which are in listening mode, receive the packet. The switches make an entry in their respective bridging tables, as shown in the following table:

Table 8: Switches Make Entries in Respective Bridging Tables

Bridge 1	Bridge 2	Bridge 3	Bridge 4
ID Port Facing Direction	ID Port Facing Direction	ID Port Facing Direction	ID Port Facing Direction
Packet 1 Section 1	Packet 1 Section 1	Packet 1 Section 1	Packet 1 Section 1

At this point, the switches do not know where Subsection iv is, and the packet is forwarded to all the ports except the source port (which results in flooding of the packet). In this example, after Subsection 1 sends the packet, the switches receive the packet on the ports facing Section 1. As a result, they start forwarding the packet through the ports facing Section 2. Which switch gets the first chance to send out the packet depends on the network configuration. In this example, suppose Switch 1 transmits the packet first. Because it received the packet from Section 1, it floods the packet toward Section 2. Similarly, Switches 2, 3, and 4, which are also in listening mode, receive the same packet from Switch 1 (originally sent from Section 1) on the ports facing Section 2. They readily update their bridging tables with incorrect information, as shown in the following table:

Table 9: Bridging Tables Updated with Incorrect Information

Bridge 1	Bridge 2	Bridge 3	Bridge 4
ID Port Facing Direction	ID Port Facing Direction	ID Port Facing Direction	ID Port Facing Direction
Packet 1 Section 1	Packet 1 Section 2	Packet 1 Section 2	Packet 1 Section 2

Thus, a loop is created as the same packet is received both from Section 1 and Section 2. As illustrated in [Figure 6 on page 185](#), Switch 1 has information that the packet came from Subsection i in Section 1, whereas all other switches have incorrect information that the same packet came from Section 2.

The entire process is repeated when Switch 2 gets the chance to transmit the original packet. Switch 2 receives the original packet from Section 1 and transmits the same packet to Section 2. Eventually, Switch 1, which still has no idea where Subsection iv is, updates its bridging table, as shown in the following table:

Table 10: Switch 1 Updates Its Bridging Table

Bridge 1	Bridge 2	Bridge 3	Bridge 4
ID Port Facing Direction	ID Port Facing Direction	ID Port Facing Direction	ID Port Facing Direction
Packet 1 Section 2	Packet 1 Section 2	Packet 1 Section 2	Packet 1 Section 2

In complex networks, this process can quickly lead to huge packet transmission cycles as the same packet is sent repeatedly.

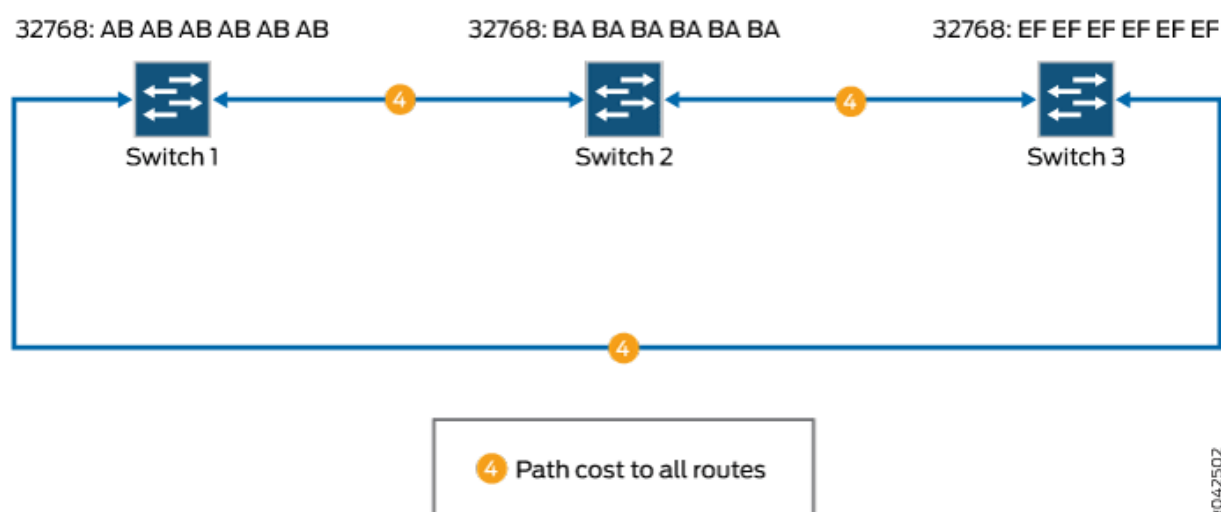
How STP Helps Eliminate Loops

Spanning Tree Protocol helps eliminate loops in a network by turning off additional routes that can create a loop. The blocked routes are enabled automatically if the primary path gets deactivated.

To understand the steps followed by STP in eliminating bridge loops, consider the following example where three switches are connected to form a simple network (see [Figure 7 on page 188](#)). To maintain redundancy, more than one path exists between each device. The switches communicate with each other by using Bridge Protocol Data Units (BPDUs) sent every 2 seconds.

NOTE: BPDUs are frames that consist of bridge ID, the bridge port where it originates, the priority of the bridge port, cost of the path and so on. BPDUs are sent as multicast MAC address 01:80:c2:00:00:00. BPDUs can be of three types: configuration BPDUs, topology change notification (TCN) BPDUs, and topology change acknowledgment (TCA) BPDUs.

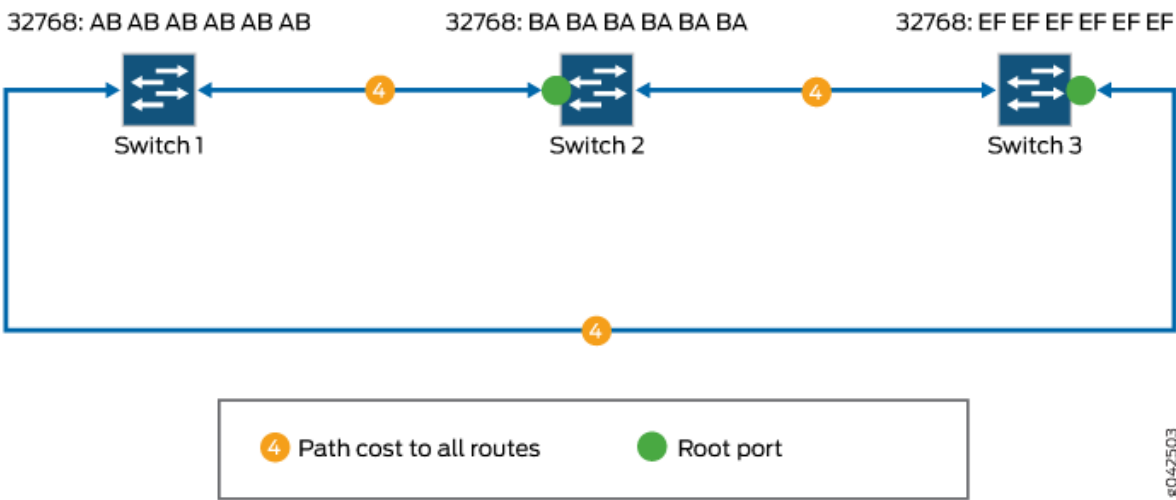
Figure 7: Simple Network with Redundant Links



To eliminate network loops, STP performs the following steps in this sample network:

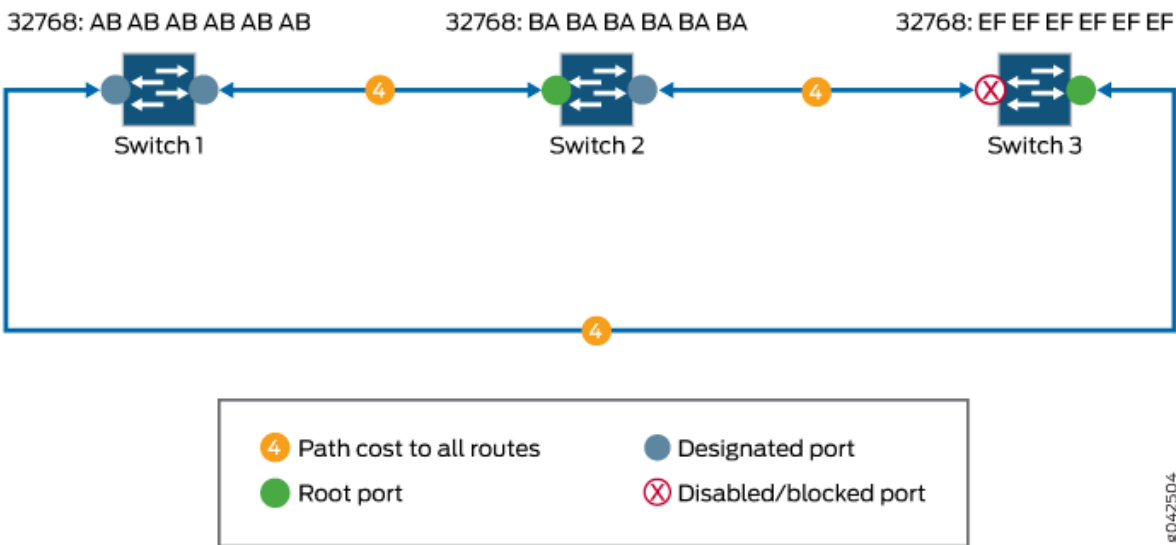
1. *Elects a root bridge (or switch).* To elect a root switch, STP uses the bridge ID. The bridge ID is 8 bytes in length and consists of two parts. The first part is 2 bytes of information known as bridge priority. The default bridge priority is 32,768. In this example, the default value is used for all the switches. The remaining 6 bytes consist of the MAC address of the switch. In this example, Switch 1 is elected as the root switch because it has the lowest MAC address.
2. *Elects the root ports.* Typically, root ports use the least-cost paths from one switch to the other. In this example, assume that all paths have similar costs. Therefore, the root port for Switch 2 is the port that receives packets through the direct path from Switch 1 (cost 4), because the other path is through Switch 3 (cost 4 + 4) as shown in [Figure 8 on page 189](#). Similarly, for Switch 3, the root port is the one that uses the direct path from Switch 1.

Figure 8: Electing Root Ports



3. *Selects the designated ports.* Designated ports are the only ports that can receive and forward frames on switches other than the root switch. They are generally the ports that use the least-cost paths. In [Figure 9 on page 189](#), the designated ports are marked.

Figure 9: Selecting Designated Ports and Blocking Redundant Paths



Because there is more than one path involved in the network and the root ports and designated ports are identified, STP can block the path between Switch 2 and Switch 3 temporarily, eliminating any Layer 2 loops.

Types of Spanning-Tree Protocols Supported

In a Layer 2 environment, you can configure various spanning-tree protocol versions to create a loop-free topology in Layer 2 networks.

A spanning-tree protocol is a Layer 2 control protocol (L2CP) that calculates the best path through a switched network containing redundant paths. A spanning-tree protocol uses bridge protocol data unit (BPDU) data frames to exchange information with other switches. A spanning-tree protocol uses the information provided by the BPDUs to elect a root bridge, identify root ports for each switch, identify designated ports for each physical LAN segment, and prune specific redundant links to create a loop-free tree topology. The resulting tree topology provides a single active Layer 2 data path between any two end stations.

NOTE: In discussions of spanning-tree protocols, the terms *bridge* and *switch* are often used interchangeably.

The Juniper Networks MX Series 5G Universal Routing Platforms and EX Series switches support STP, RSTP, MSTP, and VSTP.

- The original Spanning Tree Protocol (STP) is defined in the IEEE 802.1D 1998 specification. A newer version called Rapid Spanning Tree Protocol (RSTP) was originally defined in the IEEE 802.1w draft specification and later incorporated into the IEEE 802.1D-2004 specification. A recent version called Multiple Spanning Tree Protocol (MSTP) was originally defined in the IEEE 802.1s draft specification and later incorporated into the IEEE 802.1Q-2003 specification. The VLAN Spanning Tree Protocol (VSTP) is compatible with the Per-VLAN Spanning Tree Plus (PVST+) and Rapid-PVST+ protocols supported on Cisco Systems routers and switches.
- RSTP provides faster reconvergence time than the original STP by identifying certain links as point to point and by using protocol handshake messages rather than fixed timeouts. When a point-to-point link fails, the alternate link can transition to the forwarding state without waiting for any protocol timers to expire.
- MSTP provides the capability to logically divide a Layer 2 network into regions. Every region has a unique identifier and can contain multiple instances of spanning trees. All regions are bound together using a Common Instance Spanning Tree (CIST), which is responsible for creating a loop-free topology *across* regions, whereas the Multiple Spanning-Tree Instance (MSTI) controls topology *within* regions. MSTP uses RSTP as a converging algorithm and is fully interoperable with earlier versions of STP.

- VSTP maintains a separate spanning-tree instance for each VLAN. Different VLANs can use different spanning-tree paths. When different VLANs use different spanning-tree paths, the CPU processing resources being consumed increase as more VLANs are configured. VSTP BPDU packets are tagged with the corresponding VLAN identifier and are transmitted to the multicast destination media access control (MAC) address **01-00-0c-cc-cc-cd** with a protocol type of **0x010b**. VSTP BPDUs are tunneled by pure IEEE 802.1q bridges.

NOTE: All virtual switch routing instances configured on an MX Series router are supported using only one spanning-tree process. The Layer 2 control protocol process is named l2cpd.

Example: Enabling Loop Protection for Spanning-Tree Protocols

This example blocks and logs the non-designated RSTP port **ge-1/2/0** after the BPDU timeout interval expires:

```
[edit]
protocols {
  rstp {
    interface ge-1/2/0 {
      bpd- timeout-action block;
    }
  }
}
```

NOTE: This is not a complete configuration. You must also fully configure RSTP, including the **ge-1/2/0** interface.

Configuring Loop Protection for a Spanning-Tree Instance Interface

Before you begin, you must fully configure the spanning-tree protocol, including instance interfaces. You can configure RSTP, MSTP, or VSTP at the following hierarchy levels:

- [edit protocols]

- [edit routing-instances *routing-instance-name* protocols]

To configure enhanced loop protection:

1. Include the `bpdu-timeout-action` statement with either the **block** or **log** option for the spanning-tree protocol interface.

- For the STP or RSTP instance on a physical interface:

```
[edit]
protocols {
  rstp {
    interface interface-name {
      bpdu-timeout-action (log | block);
    }
  }
}
```

- For all MSTP instances on a physical interface:

```
[edit]
protocols {
  mstp {
    interface interface-name {
      bpdu-timeout-action (log | block);
    }
  }
}
```

- For all VSTP instances on a physical interface configured at the global level or a the VLAN level:

```
[edit]
protocols {
  vstp {
    interface interface-name {
      bpdu-timeout-action (log | block);
    }
    vlan vlan-id {
      interface interface-name {
        bpdu-timeout-action (log | block);
      }
    }
  }
}
```

```

    }
  }
}

```

2. To display the spanning-tree protocol loop protection characteristics on an interface, use the "[show spanning-tree interface](#)" on [page 390](#) operational command.

Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on non-ELS EX Series Switches

IN THIS SECTION

- [Requirements | 193](#)
- [Overview and Topology | 194](#)
- [Configuration | 196](#)
- [Verification | 197](#)

EX Series switches provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP). Loop protection increases the efficiency of STP, RSTP, and MSTP by preventing interfaces from moving into a forwarding state that would result in a loop opening up in the network.

This example describes how to configure loop protection for an interface on an EX Series switch in an RSTP topology:

Requirements

This example uses the following hardware and software components:

- Junos OS Release 9.1 or later for EX Series switches
- Three EX Series switches in an RSTP topology

Before you configure the interface for loop protection, be sure you have:

- RSTP operating on the switches.

NOTE: By default, RSTP is enabled on all EX Series switches.

Overview and Topology

IN THIS SECTION

- [Topology | 195](#)

A loop-free network in spanning-tree topologies is supported through the exchange of a special type of frame called bridge protocol data unit (BPDU). Peer STP applications running on the switch interfaces use BPDUs to communicate. Ultimately, the exchange of BPDUs determines which interfaces block traffic (preventing loops) and which interfaces become root ports and forward traffic.

A blocking interface can transition to the forwarding state in error if the interface stops receiving BPDUs from its designated port on the segment. Such a transition error can occur when there is a hardware error on the switch or software configuration error between the switch and its neighbor. When this happens, a loop opens up in the spanning tree. Loops in a Layer 2 topology cause broadcast, unicast, and multicast frames to continuously circle the looped network. As a switch processes a flood of frames in a looped network, its resources become depleted and the ultimate result is a network outage.



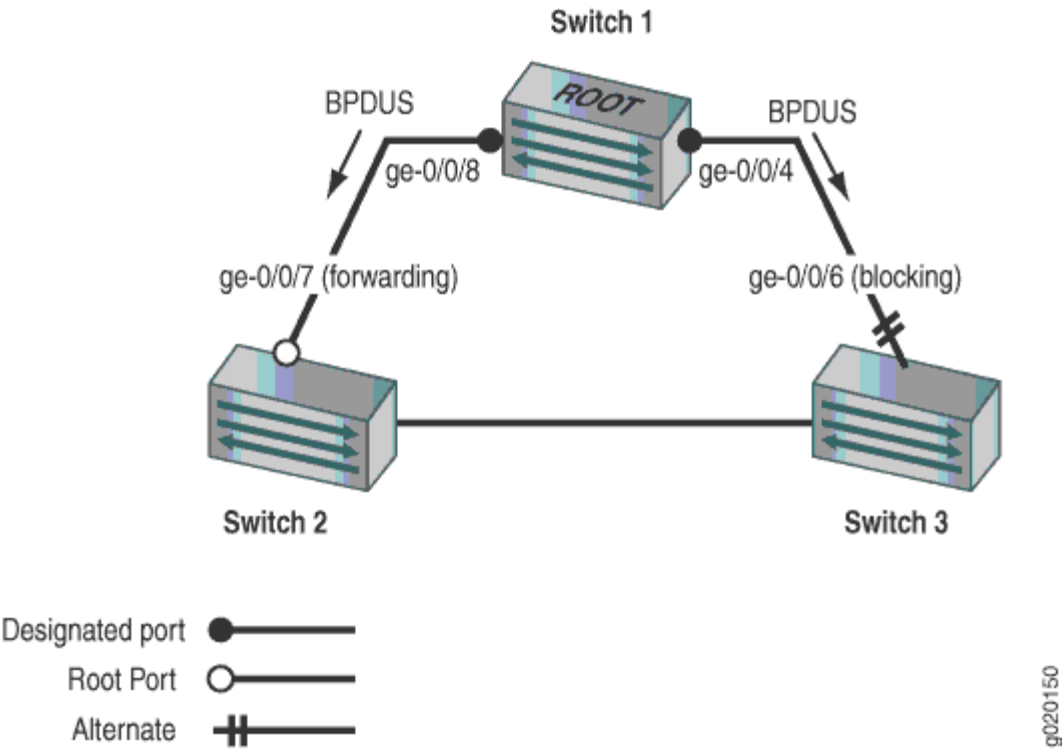
CAUTION: An interface can be configured for either loop protection or root protection, but not for both.

Three EX Series switches are displayed in [Figure 10 on page 195](#). In this example, they are configured for RSTP and create a loop-free topology. Interface **ge-0/0/6** is blocking traffic between Switch 3 and Switch 1; thus, traffic is forwarded through interface **ge-0/0/7** on Switch 2. BPDUs are being sent from the root bridge on Switch 1 to both of these interfaces.

This example shows how to configure loop protection on interface **ge-0/0/6** to prevent it from transitioning from a blocking state to a forwarding state and creating a loop in the spanning-tree topology.

Topology

Figure 10: Network Topology for Loop Protection



[Table 11 on page 195](#) shows the components that will be configured for loop protection.

Table 11: Components of the Topology for Configuring Loop Protection on EX Series Switches

Property	Settings
Switch 1	Switch 1 is the root bridge.
Switch 2	Switch 2 has the root port ge-0/0/7 .
Switch 3	Switch 3 is connected to Switch 1 through interface ge-0/0/6 .

A spanning-tree topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.

- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.

This configuration example uses an RSTP topology. However, you also can configure loop protection for STP or MSTP topologies at the `[edit protocols (mstp | stp)]` hierarchy level.

Configuration

IN THIS SECTION

- [Procedure | 196](#)

To configure loop protection on an interface:

Procedure

CLI Quick Configuration

To quickly configure loop protection on interface **ge-0/0/6**:

```
[edit]
    set protocols rstp interface ge-0/0/6 bpdu-timeout-action
block
```

Step-by-Step Procedure

To configure loop protection:

1. Configure interface **ge-0/0/6** on Switch 3:

```
[edit protocols rstp]
user@switch# set interface ge-0/0/6 bpdu-timeout-action block
```

Results

Check the results of the configuration:

```
user@switch> show configuration protocols rstp
interface ge-0/0/6.0 {
  bpdu-timeout-action {
    block;
  }
}
```

Verification

IN THIS SECTION

[Displaying the Interface State Before Loop Protection Is Triggered | 197](#)

[Verifying That Loop Protection Is Working on an Interface | 198](#)

To confirm that the configuration is working properly, perform these tasks:

Displaying the Interface State Before Loop Protection Is Triggered

Purpose

Before loop protection is triggered on interface **ge-0/0/6**, confirm that the interface is blocking.

Action

Use the operational mode command:

```
user@switch> show spanning-tree
interface

Spanning tree interface parameters for instance 0

Interface  Port ID  Designated  Designated  Port  State  Role
           port ID  port ID     bridge ID   Cost
```

```

ge-0/0/0.0    128:513    128:513    32768.0019e2503f00    20000    BLK    DIS
ge-0/0/1.0    128:514    128:514    32768.0019e2503f00    20000    BLK    DIS
ge-0/0/2.0    128:515    128:515    32768.0019e2503f00    20000    BLK    DIS
ge-0/0/3.0    128:516    128:516    32768.0019e2503f00    20000    FWD    DESG
ge-0/0/4.0    128:517    128:517    32768.0019e2503f00    20000    FWD    DESG
ge-0/0/5.0    128:518    128:518    32768.0019e2503f00    20000    FWD    DESG
ge-0/0/6.0    128:519    128:2      16384.00aabbcc0348    20000    BLK    ALT
[output truncated]

```

Meaning

The output from the operational mode command `show spanning-tree interface` shows that **ge-0/0/6.0** is the alternate port and in a blocking state.

Verifying That Loop Protection Is Working on an Interface

Purpose

Verify the loop protection configuration on interface **ge-0/0/6**. RSTP has been disabled on interface **ge-0/0/4** on Switch 1. This will stop BPDUs from being sent to interface **ge-0/0/6** and trigger loop protection on the interface.

Action

Use the operational mode command:

```

user@switch> show spanning-tree
interface

Spanning tree interface parameters for instance 0

```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/0.0	128:513	128:513	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/1.0	128:514	128:514	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/2.0	128:515	128:515	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/3.0	128:516	128:516	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/4.0	128:517	128:517	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/5.0	128:518	128:518	32768.0019e2503f00	20000	FWD	DESG


```
ge-0/0/6.0      128:519      128:519  32768.0019e2503f00      20000  BLK      DIS (Loop-Incon)
[output truncated]
```

Meaning

The operational mode command `show spanning-tree interface` shows that interface **ge-0/0/6.0** has detected that BPDUs are no longer being forwarded to it and has moved into a loop-inconsistent state. The loop-inconsistent state prevents the interface from transitioning to a forwarding state. The interface recovers and transitions back to its original state as soon as it receives BPDUs.

Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on EX Series Switches With ELS

IN THIS SECTION

- Requirements | 200
- Overview and Topology | 200
- Configuration | 202
- Verification | 203

NOTE: This example uses Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see ["Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on non-ELS EX Series Switches"](#) on page 181. For ELS details, see *Using the Enhanced Layer 2 Software CLI*.

EX Series switches provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP). Loop protection increases the efficiency of STP, RSTP, and MSTP by preventing interfaces from moving into a forwarding state that would result in a loop opening up in the network.

This example describes how to configure loop protection for an interface on an EX Series switch in an RSTP topology:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 13.2X50-D10 or later or later for EX Series switches
- Three EX Series switches in an RSTP topology

Before you configure the interface for loop protection, be sure you have:

- RSTP operating on the switches.

NOTE: By default, RSTP is enabled on all EX Series switches.

Overview and Topology

IN THIS SECTION

- [Topology | 201](#)

A loop-free network in spanning-tree topologies is supported through the exchange of a special type of frame called bridge protocol data unit (BPDU). Peer STP applications running on the switch interfaces use BPDUs to communicate. Ultimately, the exchange of BPDUs determines which interfaces block traffic (preventing loops) and which interfaces become root ports and forward traffic.

A blocking interface can transition to the forwarding state in error if the interface stops receiving BPDUs from its designated port on the segment. Such a transition error can occur when there is a hardware error on the switch or software configuration error between the switch and its neighbor. When this happens, a loop opens up in the spanning tree. Loops in a Layer 2 topology cause broadcast, unicast, and multicast frames to continuously circle the looped network. As a switch processes a flood of frames in a looped network, its resources become depleted and the ultimate result is a network outage.



CAUTION: An interface can be configured for either loop protection or root protection, but not for both.

Three EX Series switches are displayed in [Figure 11 on page 201](#). In this example, they are configured for RSTP and create a loop-free topology. Interface **ge-0/0/6** is blocking traffic between Switch 3 and

Switch 1; thus, traffic is forwarded through interface **ge-0/0/7** on Switch 2. BPDUs are being sent from the root bridge on Switch 1 to both of these interfaces.

This example shows how to configure loop protection on interface **ge-0/0/6** to prevent it from transitioning from a blocking state to a forwarding state and creating a loop in the spanning-tree topology.

Topology

Figure 11: Network Topology for Loop Protection

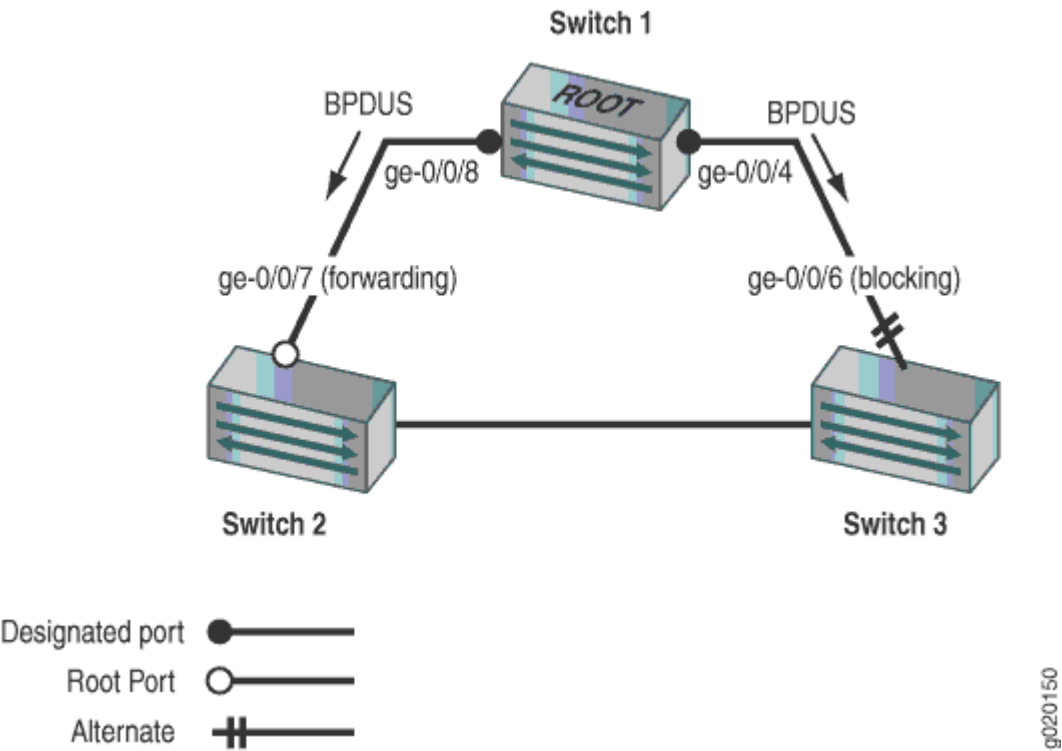


Table 12 on page 201 shows the components that will be configured for loop protection.

Table 12: Components of the Topology for Configuring Loop Protection on EX Series Switches

Property	Settings
Switch 1	Switch 1 is the root bridge.
Switch 2	Switch 2 has the root port ge-0/0/7 .

Table 12: Components of the Topology for Configuring Loop Protection on EX Series Switches
(Continued)

Property	Settings
Switch 3	Switch 3 is connected to Switch 1 through interface ge-0/0/6 .

A spanning-tree topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.

This configuration example uses an RSTP topology. However, you also can configure loop protection for MSTP topologies at the `[edit protocols mstp]` hierarchy level.

Configuration

IN THIS SECTION

[Procedure](#) | [202](#)

To configure loop protection on an interface:

Procedure

CLI Quick Configuration

To quickly configure loop protection on interface **ge-0/0/6**:

```
[edit]
set protocols rstp interface ge-0/0/6 bpdu-timeout-action
block
```

Step-by-Step Procedure

To configure loop protection:

1. Configure interface **ge-0/0/6** on Switch 3:

```
[edit protocols rstp]
user@switch# set interface ge-0/0/6 bpdu-timeout-action block
```

Results

Check the results of the configuration:

```
user@switch> show configuration protocols rstp
interface ge-0/0/6 {
  bpdu-timeout-action {
    block;
  }
}
```

Verification

IN THIS SECTION

- [Displaying the Interface State Before Loop Protection Is Triggered | 203](#)
- [Verifying That Loop Protection Is Working on an Interface | 204](#)

To confirm that the configuration is working properly, perform these tasks:

Displaying the Interface State Before Loop Protection Is Triggered

Purpose

Before loop protection is triggered on interface **ge-0/0/6**, confirm that the interface is blocking.

Action

Use the operational mode command:

```
user@switch> show spanning-tree
interface

Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/0	128:513	128:513	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/1	128:514	128:514	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/2	128:515	128:515	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/3	128:516	128:516	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/4	128:517	128:517	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/5	128:518	128:518	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/6	128:519	128:2	16384.00aabbcc0348	20000	BLK	ALT

[output truncated]

Meaning

The output from the operational mode command `show spanning-tree interface` shows that **ge-0/0/6** is the alternate port and in a blocking state.

Verifying That Loop Protection Is Working on an Interface

Purpose

Verify the loop protection configuration on interface **ge-0/0/6**. RSTP has been disabled on interface **ge-0/0/4** on Switch 1. This will stop BPDUs from being sent to interface **ge-0/0/6** and trigger loop protection on the interface.

Action

Use the operational mode command:

```
user@switch> show spanning-tree
interface
```

Spanning tree interface parameters for instance 0

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/0	128:513	128:513	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/1	128:514	128:514	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/2	128:515	128:515	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/3	128:516	128:516	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/4	128:517	128:517	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/5	128:518	128:518	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/6	128:519	128:519	32768.0019e2503f00	20000	BLK	DIS (Loop-Incon)
[output truncated]						

Meaning

The operational mode command `show spanning-tree interface` shows that interface **ge-0/0/6** has detected that BPDUs are no longer being forwarded to it and has moved into a loop-inconsistent state. The loop-inconsistent state prevents the interface from transitioning to a forwarding state. To clear the BPDU error, issue the operational mode command `clear error bpdu interface` on the switch. The interface recovers and transitions back to its original state as soon as it receives BPDUs.

SEE ALSO

[Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP](#) | 32

6

CHAPTER

Root Protection for VPLS Multihome Environments

Root Protection for VPLS Multihome Environments | 207

Root Protection for VPLS Multihome Environments

IN THIS SECTION

- [Understanding VPLS Multihoming | 207](#)
- [Understanding Bridge Priority for Election of Root Bridge and Designated Bridge | 212](#)
- [Understanding Root Protection for Spanning-Tree Instance Interfaces in a Layer 2 Switched Network | 212](#)
- [Example: Configuring VPLS Root Topology Change Actions | 214](#)
- [Enabling Root Protection for a Spanning-Tree Instance Interface | 214](#)
- [Configuring VPLS Root Protection Topology Change Actions to Control Individual VLAN Spanning-Tree Behavior | 215](#)
- [Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on non-ELS EX Series Switches | 217](#)
- [Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on EX Series Switches With ELS | 224](#)

Understanding VPLS Multihoming

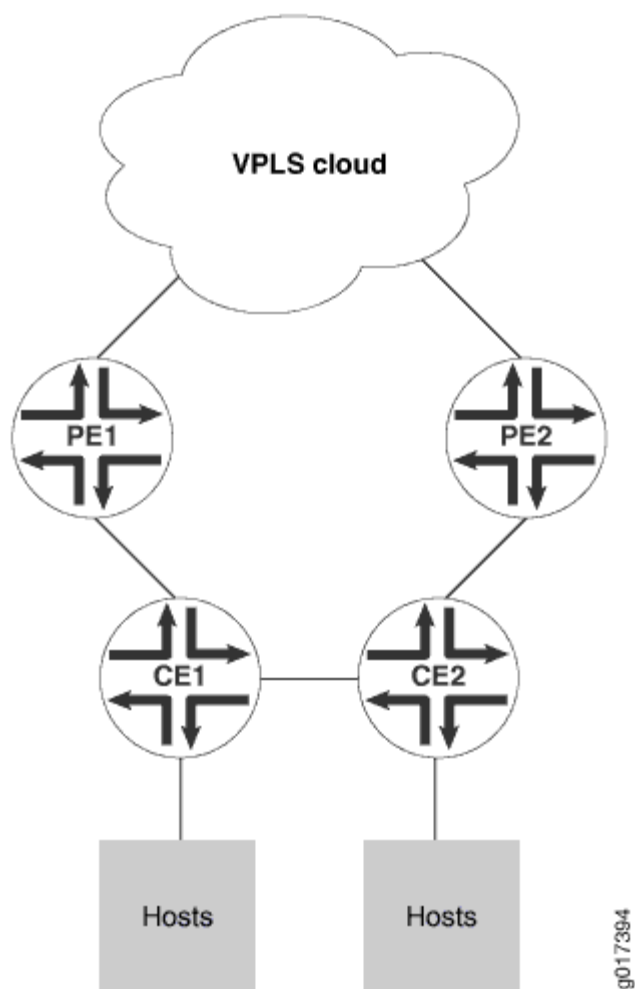
IN THIS SECTION

- [Benefits of Multihoming | 208](#)
- [How Does Multihoming Work? | 209](#)
- [VPLS Multihoming Hold Time Before Switching to Primary Priority | 209](#)
- [VPLS Multihoming Bridge Flush of MAC Cache on Topology Change | 210](#)
- [VPLS Multihoming System Identifiers for Bridges in the Ring | 211](#)
- [VPLS Multihoming Priority of the Backup Bridge | 211](#)

Redundancy is built into many networks through the use of alternate links and paths, which often take the shape of rings. When multiple hosts are attached to customer edge (CE) routers and provider edge (PE) routers to secure virtual private LAN service (VPLS), this technique is often called *multihoming*.

Figure 12 on page 208 shows hosts connected to CE routers and to a VPLS network through two PE routers. The CE routers are also connected, forming a kind of ring structure.

Figure 12: Layer 2 Ring and MPLS Infrastructure Topology



Benefits of Multihoming

Multihoming is basically giving your computing device or network a presence on more than one network. When both links are up, both links are fully utilized, increasing overall throughput. If one of the links fails, the other still carries traffic so you have redundancy.

Multihoming is used in network bridges, repeaters, range extenders, firewalls, proxy servers, gateways, and when using a virtual machine, configured to use network address translation (NAT).

How Does Multihoming Work?

The two PE routers have their own links to a VPLS network service as shown in [Figure 12 on page 208](#), but are not directly connected to each other. All four edge routers run some type of spanning-tree protocol with root protection enabled, and only one PE interface will be in the forwarding state, the other being blocked.

Assume this forwarding interface is through PE1. If the link between CE1 and CE2 fails, then the blocking PE2 interface must detect a root protection switch and move to the forwarding state. All of the MAC addresses learned by CE2 that connect to the VPLS network service through PE1 need to be flushed. In the same way, when the link between CE1 and CE2 is restored, PE2 again detects the root protection switch and begins blocking again. Now all of the MAC addresses learned by CE2 that connect through PE2 need to be flushed. All of this is controlled by configuring VPLS root protection topology change actions on the CE routers.

The Layer 2 ring connects to the multiprotocol link switching (MPLS) infrastructure through two PE routers. Link breaks on the ring are protected by running a version of the spanning-tree protocol with the root-protect option enabled.

The virtual private network (VPN) protocols at Layer 3, however, are not aware of the blocking state that results from this root protection setup (rings or loops are not permitted at Layer 2 because the Layer 2 protocols will not function properly).

Multiple hosts attach to CE routers, which are attached to each other as well as to the PE routers that access the VPLS network cloud. Any single link between the edge routers can fail without impacting the hosts' access to the VPLS services.

VPLS Multihoming Hold Time Before Switching to Primary Priority

At a global level, each type of spanning-tree protocol has a priority hold time associated with it. This is the number of seconds, in the range from 1 through 255 seconds, that the system waits to switch to the primary priority when the first core domain comes up. The default is 2 seconds. This allows the maximum number of core domains to come up, and some might be slower than others.

The default number of seconds to hold before switching to the primary priority when the first core domain comes up is 2 seconds.

When an MX Series router or an EX Series switch in a VPLS multihomed Layer 2 ring is running a spanning-tree protocol with root protection enabled, you can modify the default actions taken by the router or switch when the topology changes. To do this, configure the VPLS root protection topology change actions.

You can include the statement at the `[edit protocols (mstp | rstp | vstp)]` hierarchy level (to control global spanning-tree protocol behavior) or at the `[edit protocols vstp vlan vlan-id]` hierarchy level (to control a particular VLAN).

NOTE: VPLS root topology change actions are configured independently of VPLS, the spanning-tree protocol, or the spanning-tree protocol root protect option.

VPLS Multihoming Bridge Flush of MAC Cache on Topology Change

By default, if root protect is enabled and then the topology changes, the bridges do not flush the media access control (MAC) address cache of the MAC addresses learned when other interface ports were blocked.

To change the default behavior, you can use the statement `vpls-flush-on-topology-change`.

You can include the statement at the `[edit protocols (mstp | rstp | vstp)]` hierarchy level (to control global spanning-tree protocol behavior) or at the `[edit protocols vstp vlan vlan-id]` hierarchy level (to control a particular VLAN).

Specifically, MAC flush messages are sent from the blocked PE to LDP peers based on the mapping of system identifier to IP addresses as specified using the `system-id` statement.

NOTE: VPLS root topology change actions are configured independently of VPLS, the spanning-tree protocol, or the spanning-tree protocol root protect option.

However, to keep the Layer 2 ring functioning in a multihomed environment with link failures, the spanning-tree protocol running on the MX Series routers requires the following additional configuration:

The VPN protocols have to act on the blocking and unblocking of interfaces by the spanning-tree protocol. Specifically, media access control (MAC) flush messages need to be sent by the blocking PE router to LDP peers in order to flush the MAC addresses learned when other interface ports were blocked.

Also, if an active PE router with VPLS root protection bridging enabled loses VPLS connectivity, root protection requires that the bridge switch to the other PE router to maintain connectivity. The spanning-tree protocol needs to be aware of the status of the VPLS connectivity on the PE router. If the MAC address cache is not flushed when the topology changes, frames could be sent to the wrong device.

You can control the actions taken by the MX Series router when the topology changes in a multihomed Layer 2 ring VPLS environment using *VPLS root protection*.

VPLS Multihoming System Identifiers for Bridges in the Ring

When an MX Series router or an EX Series switch in a VPLS multihomed Layer 2 ring is running a spanning-tree protocol with root protection enabled, you can modify the default actions taken by the router or switch when the topology changes. To do this, configure the VPLS root protection topology change actions.

The system identifier for bridges in the ring is not configured by default.

You can include the statement at the `[edit protocols (mstp | rstp | vstp)]` hierarchy level (to control global spanning-tree protocol behavior) or at the `[edit protocols vstp vlan vlan-id]` hierarchy level (to control a particular VLAN).

NOTE: VPLS root topology change actions are configured independently of VPLS, the spanning-tree protocol, or the spanning-tree protocol root protect option.

VPLS Multihoming Priority of the Backup Bridge

When an MX Series router or EX Series switch in a VPLS multihomed Layer 2 ring is running a spanning-tree protocol with root protection enabled, you can modify the default actions taken by the router or switch when the topology changes. To do this, configure the VPLS root protection topology change actions.

The default value of the backup bridge is 32,768. You can set the backup bridge priority to a value from 0 through 61440, in increments of 4096.

To change the default value, you can use the following statement `backup-bridge-priority vpls-ring-backup-bridge-priority`

You can include the statement at the `[edit protocols (mstp | rstp | vstp)]` hierarchy level (to control global spanning-tree protocol behavior) or at the `[edit protocols vstp vlan vlan-id]` hierarchy level (to control a particular VLAN).

NOTE: VPLS root topology change actions are configured independently of VPLS, the spanning-tree protocol, or the spanning-tree protocol root protect option.

Understanding Bridge Priority for Election of Root Bridge and Designated Bridge

Use the bridge priority to control which bridge is elected as the root bridge and also to control which bridge is elected the root bridge when the initial root bridge fails.

The root bridge for each spanning-tree protocol instance is determined by the bridge ID. The bridge ID consists of a configurable bridge priority and the MAC address of the bridge. The bridge with the lowest bridge ID is elected as the root bridge. If the bridge priorities are equal or if the bridge priority is not configured, the bridge with the lowest MAC address is elected the root bridge.

The bridge priority can also be used to determine which bridge becomes the designated bridge for a LAN segment. If two bridges have the same path cost to the root bridge, the bridge with the lowest bridge ID becomes the designated bridge.

The bridge priority can be set only in increments of 4096.

Consider a sample scenario in which a dual-homed customer edge (CE) router is connected to two other provider edge (PE) routers, which function as the VPLS PE routers, with MSTP enabled on all these routers, and with the CE router operating as the root bridge. Integrated Routing and Bridging (IRB) interface is configured for the VPLS routing instances on the routers. In such a network, the MAC addresses that are learned in the VPLS domain continuously move between the LSI or virtual tunnel (VT) interfaces and the VPLS interfaces on both the PE routers. To avoid the continuous movement of the MAC addresses, you must configure root protection by including the `no-root-port` statement at the `[edit routing-instances routing-instance-name protocols mstp interface interface-name]` hierarchy level and configure the bridge priority as zero by including the `bridge priority 0` statement at the `[edit routing-instances routing-instance-name protocols mstp]` hierarchy level on the PE routers. This configuration on the PE routers is required to prevent the CE-side facing interfaces from becoming the root bridge.

Understanding Root Protection for Spanning-Tree Instance Interfaces in a Layer 2 Switched Network

IN THIS SECTION

- [Benefits of Spanning Tree Protocol Root Protection | 213](#)
- [How Root Protection Works | 213](#)
- [Where Should I Enable Root Protection? | 213](#)

Peer STP applications running on interfaces use BPDUs to communicate. Ultimately, the exchange of BPDUs determines which interfaces block traffic and which interfaces become root ports and forward traffic.

A root port elected through this process has the possibility of being wrongly elected. A user bridge application running on a PC can generate BPDUs, too, and interfere with root port election. This is when root protection is useful.

Benefits of Spanning Tree Protocol Root Protection

Root protection allows network administrators to manually enforce the root bridge placement in a Layer 2 switched network.

How Root Protection Works

When root protection is enabled on an interface, it is enabled for all the STP instances on that interface. If the bridge receives superior BPDUs on a port that has root protect enabled, that port transitions to a root-prevented STP state and the interface is blocked. This prevents a bridge that should not be the root bridge from being elected the root bridge. The interface is blocked only for instances for which it receives superior BPDUs. Otherwise, it participates in the spanning-tree topology.

After the bridge stops receiving superior BPDUs on the port with root protect enabled and the received BPDUs time out, that port transitions back to the STP-designated port state.

By default, root protect is disabled.

NOTE: An interface can be configured for either root protection or loop protection, but not for both.

Where Should I Enable Root Protection?

Enable root protection on interfaces that should not receive superior bridge protocol data units (BPDUs) from the root bridge and must not be elected as the root port.

Interfaces that become designated ports are typically located on an administrative boundary. If the bridge receives superior STP BPDUs on a port that has root protection enabled, that port transitions to a root-prevented STP state (inconsistency state) and the interface is blocked. This blocking prevents a bridge that should not be the root bridge from being elected the root bridge. After the bridge stops receiving superior STP BPDUs on the interface with root protection, the interface returns to a listening state, followed by a learning state, and ultimately back to a forwarding state. Recovery back to the forwarding state is automatic.

Example: Configuring VPLS Root Topology Change Actions

This example configures a bridge priority of **36k**, a backup bridge priority of **44k**, a priority hold time value of **60** seconds, a system identifier of **000203:040506** for IP address **10.1.1.1/32**, and sets the bridge to flush the MAC cache on a topology change for MSTP only.

```
[edit]
protocols {
  mstp {
    bridge-priority 36k;
    backup-bridge-priority 44k;
    priority-hold-time 60;
    system-id 000203:040506 {
      10.1.1.1/32;
    }
    vpls-flush-on-topology-change;
  }
}
```

NOTE: This is not a complete configuration.

Enabling Root Protection for a Spanning-Tree Instance Interface

To enable root protect for a spanning-tree instance interface:

1. Enable configuration of the spanning-tree protocol:

```
[edit]
user@host# edit protocols (mstp | rstp | vstp <vlan <vlan-id>)
```

2. Enable configuration of the spanning-tree instance interface:

```
[edit ... protocols (mstp | rstp | vstp <vlan <vlan-id>)]
user@host# edit interface <interface-name>
```


3. Enable root protection on the interface:

```
[edit ... protocols (mstp | rstp | vstp <vlan vlan-id>) interface interface-name]
user@host# set no-root-port
```

4. Verify the configuration of root protect for the spanning-tree instance interface:

```
[edit ... protocols (mstp | rstp | vstp <vlan vlan-id>) interface interface-name]
user@host# top
user@host# show ... protocols

...
(mstp | rstp | vstp <vlan vlan-id>) {
  interface interface-name {
    no-root-port;
  }
}
```

NOTE: This is not a complete configuration.

Configuring VPLS Root Protection Topology Change Actions to Control Individual VLAN Spanning-Tree Behavior

To configure VPLS root protection topology change actions to control a particular VLAN:

1. Enable configuration of the spanning-tree protocol VLAN:

```
[edit]
user@host# edit protocols (STP Type) vstp vlan vlan-id
```

2. (Optional) Change the priority of the backup bridge in a VPLS multihomed Layer 2 ring with MPLS infrastructure:

```
[edit protocols vstp vlan vlan-id]
user@host# set backup-bridge-priority vpls-ring-backup-bridge-priority
```

3. (Optional) Change the hold time before switching to the primary priority when the first core domain comes up:

```
[edit protocols vstp vlan vlan-id]
user@host# set priority-hold-time seconds
```

4. Configure the system identifier for bridges in the ring:

```
[edit protocols vstp vlan vlan-id]
user@host# set system-id system-id-value bridge-host-ip-address(es)
```

The ***system-id-value*** is configured in the format ***nnnnnnn.nnnnnnn***, where ***n*** = any digit from **0** to **9**.

Each ***bridge-host-ip-address*** is a valid host IP address with a **/32** mask.

NOTE: There are no default values for the system identifier or host IP addresses.

5. Configure bridges to flush the MAC address cache (of the MAC addresses learned when other interfaces ports were blocked) when the spanning-tree topology changes:

```
[edit protocols vstp vlan vlan-id]
user@host# set vpls-flush-on-topology-change
```

6. Verify the configuration of VPLS root protection topology change actions to control a particular VLAN:

```
[edit]
protocols {
  vstp {
    vlan vlan-id {
      backup-bridge-priority priority; # Default is 32,768.
      priority-hold-time seconds; # Default is 2 seconds.
      system-id system-id-value {
        ip-address;
      }
      vpls-flush-on-topology-change;
    }
  }
}
```

Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on non-ELS EX Series Switches

IN THIS SECTION

- [Requirements | 217](#)
- [Overview and Topology | 217](#)
- [Configuration | 220](#)
- [Verification | 221](#)

EX Series switches provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP). Root protection increases the efficiency of STP, RSTP, and MSTP by allowing network administrators to manually enforce the root bridge placement in the network.

This example describes how to configure root protection on an interface on an EX Series switch:

Requirements

This example uses the following hardware and software components:

- Junos OS Release 9.1 or later for EX Series switches
- Four EX Series switches in an RSTP topology

Before you configure the interface for root protection, be sure you have:

- RSTP operating on the switches.

NOTE: By default, RSTP is enabled on all EX Series switches.

Overview and Topology

IN THIS SECTION

- [Topology | 220](#)

Peer STP applications running on switch interfaces exchange a special type of frame called a bridge protocol data unit (BPDU). Switches communicate interface information using BPDUs to create a loop-free topology that ultimately determines the root bridge and which interfaces block or forward traffic in the spanning tree.

However, a root port elected through this process has the possibility of being wrongly elected. A user bridge application running on a PC can generate BPDUs, too, and interfere with root port election.

To prevent this from happening, enable root protection on interfaces that should not receive superior BPDUs from the root bridge and should not be elected as the root port. These interfaces are typically located on an administrative boundary and are designated ports.

When root protection is enabled on an interface:

- The interface is blocked from becoming the root port.
- Root protection is enabled for all STP instances on that interface.
- The interface is blocked only for instances for which it receives superior BPDUs. Otherwise, it participates in the spanning-tree topology.



CAUTION: An interface can be configured for either root protection or loop protection, but not for both.

Four EX Series switches are displayed in [Figure 13 on page 219](#). In this example, they are configured for RSTP and create a loop-free topology. Interface **ge-0/0/7** on Switch 1 is a designated port on an administrative boundary. It connects to Switch 4. Switch 3 is the root bridge. Interface **ge-0/0/6** on Switch 1 is the root port.

This example shows how to configure root protection on interface **ge-0/0/7** to prevent it from transitioning to become the root port.

Figure 13: Network Topology for Root Protection

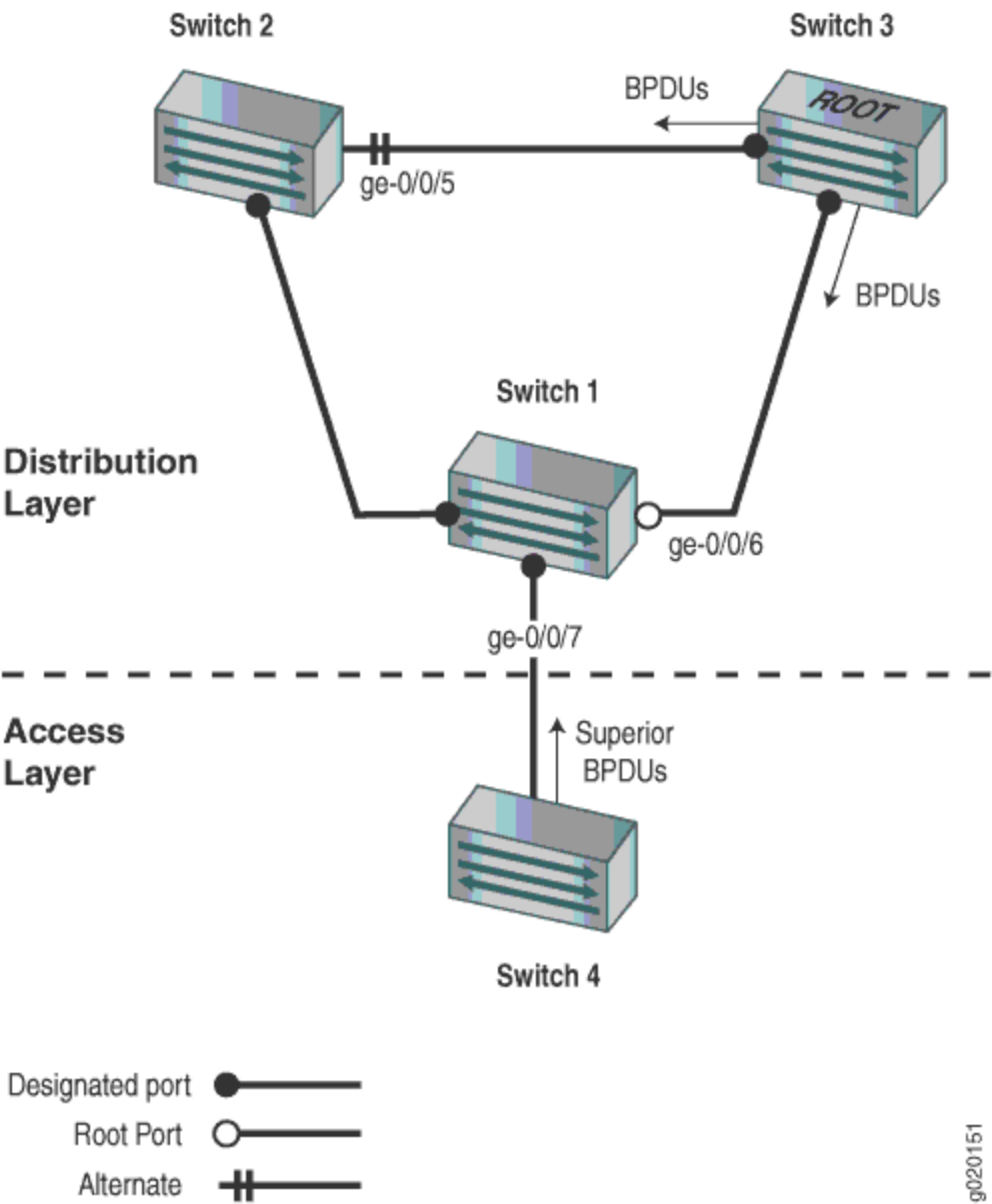


Table 13 on page 219 shows the components that will be configured for root protection.

Table 13: Components of the Topology for Configuring Root Protection on EX Series Switches

Property	Settings
Switch 1	Switch 1 is connected to Switch 4 through interface ge-0/0/7 .

Table 13: Components of the Topology for Configuring Root Protection on EX Series Switches
(Continued)

Property	Settings
Switch 2	Switch 2 is connected to Switch 1 and Switch 3. Interface ge-0/0/4 is the alternate port in the RSTP topology.
Switch 3	Switch 3 is the root bridge and is connected to Switch 1 and Switch 2.
Switch 4	Switch 4 is connected to Switch 1. After root protection is configured on interface ge-0/0/7 , Switch 4 will send superior BPDUs that will trigger root protection on interface ge-0/0/7 .

A spanning tree topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.

This configuration example uses an RSTP topology. However, you also can configure root protection for STP or MSTP topologies at the **[edit protocols (mstp | stp)]** hierarchy level.

Topology

Configuration

IN THIS SECTION

- [Procedure | 221](#)

To configure root protection on an interface:

Procedure

CLI Quick Configuration

To quickly configure root protection on interface **ge-0/0/7**, copy the following command and paste it into the switch terminal window:

```
[edit]  
  
set protocols rstp interface ge-0/0/7 no-root-port
```

Step-by-Step Procedure

To configure root protection:

1. Configure interface **ge-0/0/7**:

```
[edit protocols rstp]  
user@switch#  
  
set interface ge-0/0/7 no-root-  
port
```

Results

Check the results of the configuration:

```
user@switch> show configuration protocols rstp  
interface ge-0/0/7.0 {  
    no-root-port;  
}
```

Verification

IN THIS SECTION

- [Displaying the Interface State Before Root Protection Is Triggered | 222](#)
- [Verifying That Root Protection Is Working on the Interface | 223](#)

To confirm that the configuration is working properly:

Displaying the Interface State Before Root Protection Is Triggered

Purpose

Before root protection is triggered on interface **ge-0/0/7**, confirm the interface state.

Action

Use the operational mode command:

```

user@switch> show spanning-tree
interface

Spanning tree interface parameters for instance 0

Interface    Port ID    Designated    Designated    Port    State    Role
              port ID      port ID      bridge ID      Cost
ge-0/0/0.0    128:513     128:513     32768.0019e2503f00    20000    BLK      DIS
ge-0/0/1.0    128:514     128:514     32768.0019e2503f00    20000    BLK      DIS
ge-0/0/2.0    128:515     128:515     32768.0019e2503f00    20000    BLK      DIS
ge-0/0/3.0    128:516     128:516     32768.0019e2503f00    20000    FWD      DESG
ge-0/0/4.0    128:517     128:517     32768.0019e2503f00    20000    FWD      DESG
ge-0/0/5.0    128:518       128:2     16384.00aabbcc0348    20000    BLK      ALT
ge-0/0/6.0    128:519       128:1     16384.00aabbcc0348    20000    FWD      ROOT
ge-0/0/7.0    128:520     128:520     32768.0019e2503f00    20000    FWD      DESG
[output truncated]

```

Meaning

The output from the operational mode command `show spanning-tree interface` shows that **ge-0/0/7.0** is a designated port in a forwarding state.

Verifying That Root Protection Is Working on the Interface

Purpose

A configuration change takes place on Switch 4. A smaller bridge priority on the Switch 4 causes it to send superior BPDUs to interface **ge-0/0/7**. Receipt of superior BPDUs on interface **ge-0/0/7** will trigger root protection. Verify that root protection is operating on interface **ge-0/0/7**.

Action

Use the operational mode command:

```
user@switch> show spanning-tree
interface

Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/0.0	128:513	128:513	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/1.0	128:514	128:514	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/2.0	128:515	128:515	32768.0019e2503f00	20000	BLK	DIS
ge-0/0/3.0	128:516	128:516	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/4.0	128:517	128:517	32768.0019e2503f00	20000	FWD	DESG
ge-0/0/5.0	128:518	128:2	16384.00aabbcc0348	20000	BLK	ALT
ge-0/0/6.0	128:519	128:1	16384.00aabbcc0348	20000	FWD	ROOT
ge-0/0/7.0	128:520	128:520	32768.0019e2503f00	20000	BLK	DIS (Root-Incon)

[output truncated]

Meaning

The operational mode command **show spanning-tree interface** shows that interface **ge-0/0/7.0** has transitioned to a root inconsistent state. The root inconsistent state makes the interface block, discarding any received BPDUs, and prevents the interface from becoming a candidate for the root port. When the root bridge no longer receives superior STP BPDUs from the interface, the interface will recover and transition back to a forwarding state. Recovery is automatic.

Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on EX Series Switches With ELS

IN THIS SECTION

- [Requirements | 224](#)
- [Overview and Topology | 225](#)
- [Configuration | 227](#)
- [Verification | 228](#)

NOTE: This example uses Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style. For ELS details, see *Using the Enhanced Layer 2 Software CLI*.

EX Series switches provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP). Root protection increases the efficiency of STP, RSTP, and MSTP by allowing network administrators to manually enforce the root bridge placement in the network.

This example describes how to configure root protection on an interface on an EX Series switch:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 13.2X50-D10 or later or later for EX Series switches
- Four EX Series switches in an RSTP topology

Before you configure the interface for root protection, be sure you have:

- RSTP operating on the switches.

NOTE: By default, RSTP is enabled on all EX Series switches.

Overview and Topology

IN THIS SECTION

- [Topology](#) | 227

Peer STP applications running on switch interfaces exchange a special type of frame called a bridge protocol data unit (BPDU). Switches communicate interface information using BPDUs to create a loop-free topology that ultimately determines the root bridge and which interfaces block or forward traffic in the spanning tree.

However, a root port elected through this process has the possibility of being wrongly elected. A user bridge application running on a PC can generate BPDUs, too, and interfere with root port election.

To prevent this from happening, enable root protection on interfaces that must not receive superior BPDUs from the root bridge and must not be elected as the root port. These interfaces are typically located on an administrative boundary and are designated ports.

When root protection is enabled on an interface:

- The interface is blocked from becoming the root port.
- Root protection is enabled for all STP instances on that interface.
- The interface is blocked only for instances for which it receives superior BPDUs. Otherwise, it participates in the spanning-tree topology.



CAUTION: An interface can be configured for either root protection or loop protection, but not for both.

Four EX Series switches are displayed in [Figure 14 on page 226](#). In this example, they are configured for RSTP and create a loop-free topology. Interface `ge-0/0/7` on Switch 1 is a designated port on an administrative boundary. It connects to Switch 4. Switch 3 is the root bridge. Interface `ge-0/0/6` on Switch 1 is the root port.

This example shows how to configure root protection on interface `ge-0/0/7` to prevent it from transitioning to become the root port.

Figure 14: Network Topology for Root Protection

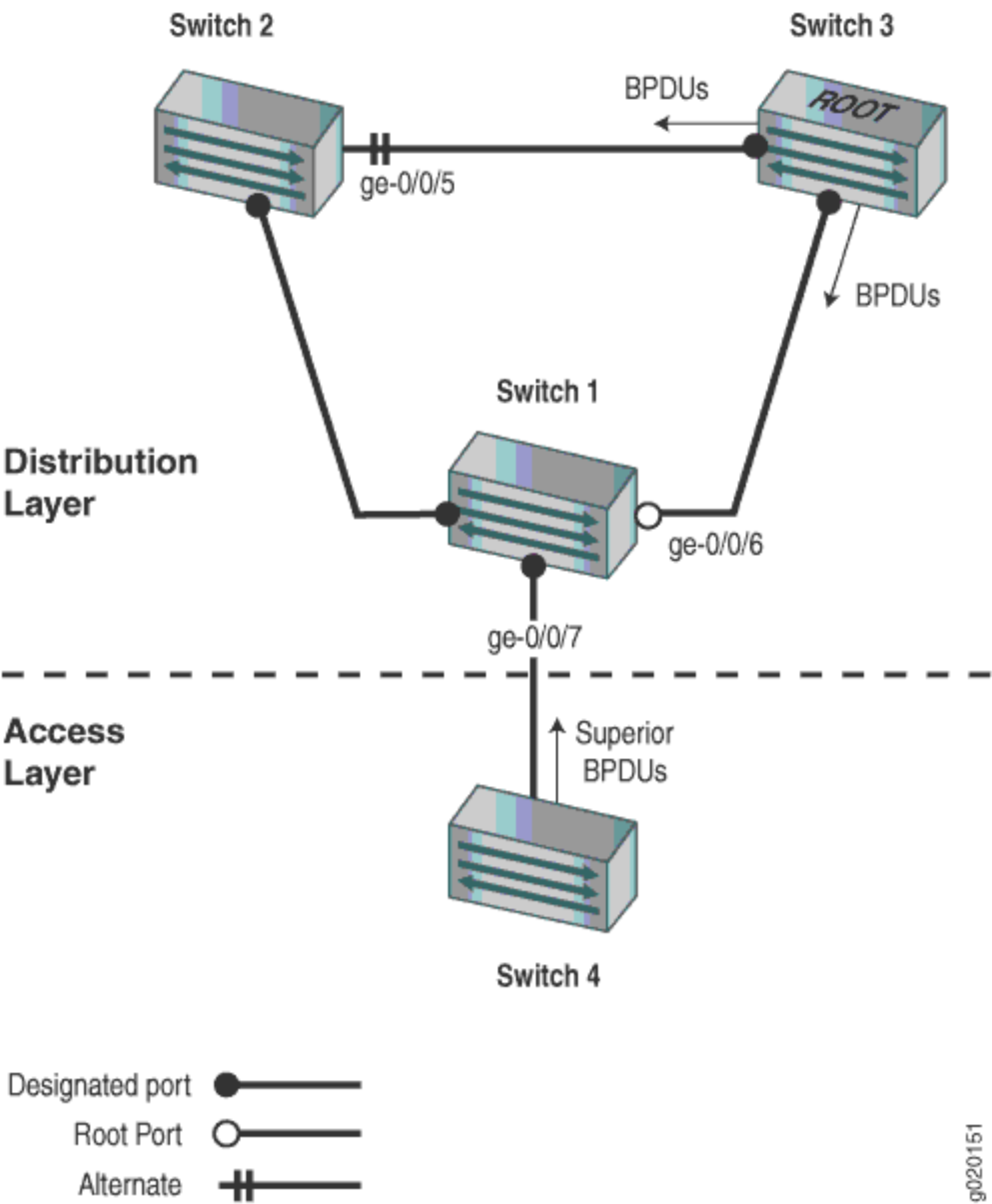


Table 14 on page 226 shows the components that will be configured for root protection.

Table 14: Components of the Topology for Configuring Root Protection on EX Series Switches

Property	Settings
Switch 1	Switch 1 is connected to Switch 4 through interface <code>ge-0/0/7</code> .

Table 14: Components of the Topology for Configuring Root Protection on EX Series Switches
(Continued)

Property	Settings
Switch 2	Switch 2 is connected to Switch 1 and Switch 3. Interface ge-0/0/4 is the alternate port in the RSTP topology.
Switch 3	Switch 3 is the root bridge and is connected to Switch 1 and Switch 2.
Switch 4	Switch 4 is connected to Switch 1. After root protection is configured on interface ge-0/0/7, Switch 4 will send superior BPDUs that will trigger root protection on interface ge-0/0/7.

A spanning tree topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.

This configuration example uses an RSTP topology. However, you also can configure root protection for STP or MSTP topologies at the [edit protocols mstp] hierarchy level.

Topology

Configuration

IN THIS SECTION

- [Procedure | 228](#)

To configure root protection on an interface:

Procedure

CLI Quick Configuration

To quickly configure root protection on interface ge-0/0/7, copy the following command and paste it into the switch terminal window:

```
[edit]
set protocols rstp interface ge-0/0/7 no-root-port
```

Step-by-Step Procedure

To configure root protection:

1. Configure interface ge-0/0/7:

```
[edit protocols rstp]
user@switch#
set interface ge-0/0/7 no-root-port
```

Results

Check the results of the configuration:

```
user@switch> show configuration protocols          rstp
interface ge-0/0/7 {
  no-root-port;
}
```

Verification

IN THIS SECTION

- [Displaying the Interface State Before Root Protection Is Triggered | 229](#)
- [Verifying That Root Protection Is Working on the Interface | 230](#)

To confirm that the configuration is working properly:

Displaying the Interface State Before Root Protection Is Triggered

Purpose

Before root protection is triggered on interface ge-0/0/7, confirm the interface state.

Action

Use the operational mode command:

```
user@switch> show spanning-tree
interface

Spanning tree interface parameters for instance 0
Role      Interface  Port ID  Designated  Designated  Port  State
port ID   bridge ID  Cost
ge-0/0/0  128:513    128:513  32768.0019e2503f00  20000  BLK
DIS
ge-0/0/1  128:514    128:514  32768.0019e2503f00  20000  BLK
DIS
ge-0/0/2  128:515    128:515  32768.0019e2503f00  20000  BLK
DIS
ge-0/0/3  128:516    128:516  32768.0019e2503f00  20000  FWD
DESG
ge-0/0/4  128:517    128:517  32768.0019e2503f00  20000  FWD
DESG
ge-0/0/5  128:518    128:2    16384.00aabbcc0348  20000  BLK
ALT
ge-0/0/6  128:519    128:1    16384.00aabbcc0348  20000  FWD
ROOT
ge-0/0/7  128:520    128:520  32768.0019e2503f00  20000  FWD
DESG

[output truncated]
```

Spanning tree interface parameters for instance 0					
Interface	Port ID	Designated	Designated	Port	State
port ID	bridge ID	Cost			
ge-0/0/0	128:513	128:513	32768.0019e2503f00	20000	BLK
ge-0/0/1	128:514	128:514	32768.0019e2503f00	20000	BLK
ge-0/0/2	128:515	128:515	32768.0019e2503f00	20000	BLK
ge-0/0/3	128:516	128:516	32768.0019e2503f00	20000	FWD
ge-0/0/4	128:517	128:517	32768.0019e2503f00	20000	FWD
ge-0/0/5	128:518	128:2	16384.00aabbcc0348	20000	BLK
ge-0/0/6	128:519	128:1	16384.00aabbcc0348	20000	FWD
ge-0/0/7	128:520	128:520	32768.0019e2503f00	20000	BLK

[output truncated]

Meaning

The operational mode command `show spanning-tree interface` shows that interface `ge-0/0/7` has transitioned to a root inconsistent state. The root inconsistent state makes the interface block, discarding any received BPDUs, and prevents the interface from becoming a candidate for the root port. When the root bridge no longer receives superior STP BPDUs from the interface, the interface will recover and transition back to a forwarding state. Recovery is automatic.

7

CHAPTER

Monitoring and Troubleshooting

Monitoring and Troubleshooting Spanning Tree Protocols | 233

Monitoring and Troubleshooting Spanning Tree Protocols

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Monitoring Spanning Tree Protocols on Switches

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Purpose

NOTE: This topic applies only to the J-Web Application package.

Use the monitoring feature to view status and information about the spanning-tree protocol parameters on your EX Series switch.

Action

To display spanning-tree protocol parameter details in the J-Web interface, select **Monitor > Switching > STP**.

To display spanning-tree protocol parameter details in the CLI, enter the following commands:

- show spanning-tree interface
- show spanning-tree bridge

Meaning

[Table 15 on page 234](#) summarizes the spanning-tree protocol parameters.

Table 15: Summary of Spanning Tree Protocols Output Fields

Field	Values
Bridge Parameters	
Context ID	An internally generated identifier.
Enabled Protocol	Spanning-tree protocol type enabled.
Root ID	Bridge ID of the elected spanning-tree root bridge. The bridge ID consists of a configurable bridge priority and the MAC address of the bridge.
Root cost	Calculated cost to reach the root bridge from the bridge where the command is entered.

Table 15: Summary of Spanning Tree Protocols Output Fields *(Continued)*

Field	Values
Root port	Interface that is the current elected root port for this bridge.
Bridge ID	Locally configured bridge ID.
Hello time	The time for which the bridge interface remains in the listening or learning state.
Forward delay	The time for which the bridge interface remains in the listening or learning state before transitioning to the forwarding state.
Extended System ID	The system ID.
Inter Instance ID	An internally generated instance identifier.
Maximum age	Maximum age of received bridge protocol data units (BPDUs).
Number of topology changes	Total number of spanning-tree protocol topology changes detected since the switch last booted.

Spanning Tree Interface Details

Interface Name	Interface configured to participate in the spanning-tree protocol instance.
Port ID	Logical interface identifier configured to participate in the spanning-tree protocol instance.
Designated Port ID	Port ID of the designated port for the LAN segment to which the interface is attached.
Designated Bridge ID	ID of the designated bridge to which the interface is attached.
Port Cost	Configured cost for the interface.

Table 15: Summary of Spanning Tree Protocols Output Fields (*Continued*)

Field	Values
Port State	Spanning-tree protocol port state: <ul style="list-style-type: none"> • Forwarding (FWD) • Blocking (BLK) • Listening • Learning • Disabled
Role	MSTP or RSTP port role, Designated (DESG), backup (BKUP), alternate (ALT), or root.

Spanning Tree Statistics of Interface	
Interface	Interface for which statistics is being displayed.
BPDUs Sent	Total number of BPDUs sent.
BPDUs Received	Total number of BPDUs received.
Next BPDU Transmission	Number of seconds until the next BPDU is scheduled to be sent.

Checking the Status of Spanning-Tree Instance Interfaces

On an MX Series router with a spanning-tree protocol enabled, the detection of a possible bridging loop from spanning-tree protocol operation can raise a bridge protocol data unit (BPDU) error condition on the affected spanning-tree instance interface.

To check whether a spanning-tree instance interface is blocked due to a BPDU error condition:

1. To check the status of spanning-tree instance interface, use the `show interfaces` command:

```
user@host> show interfaces interface-name
```

2. You can determine the status of the interface as follows:

- If the **BPDU Error** field is **none**, the interface is enabled.
- If the **BPDU Error** field is **Detected** and the link is **down**, the interface is blocked.

TIP: If an interface is blocked, see Troubleshooting section.

Understanding Spanning-Tree Protocol Trace Options

In order to trace spanning-tree protocol operations, you can set spanning-tree protocol-specific trace options in the spanning-tree protocol configuration.

For general information about tracing and global tracing options, see the statement summary for the `global traceoptions` statement in the Junos OS Routing Protocols Library for Routing Devices.

Configuring Tracing Spanning-Tree Operations

You can enable global routing protocol tracing options at the `[edit routing-options]` Hierarchy Level. For general information about tracing and global tracing options, see the statement summary for the `global traceoptions` statement in the [Junos OS Routing Protocols Library for Routing Devices](#).

In addition, you can enable STP-specific trace options at the following hierarchy levels:

- `[edit logical-systems logical-system-name protocols (mstp | rstp | vstp)]`
- `[edit logical-systems logical-system-name routing-instances routing-instance-name protocols (mstp | rstp | vstp)]`
- `[edit protocols (mstp | rstp | vstp)]`
- `[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp)]`

The routing instance type can be either **virtual-switch** or **layer2-control**.

To enable tracing of spanning-tree protocol operations:

1. Enable configuration of the spanning-tree protocol whose operations are to be traced:

```
[edit]
user@host# edit ... protocols (mstp | rstp | vstp)
```

2. Enable configuration of spanning-tree protocol-specific trace options:

```
[edit ... protocols (mstp | rstp | vstp)]
user@host# edit traceoptions
```

3. Configure the files that contain trace logging information:

```
[edit ... protocols (mstp | rstp | vstp)]
user@host# set file filename <files number> <size bytes> <world-readable | no-world-readable>
```

4. Configure spanning-tree protocol-specific options.

- a. To enable a spanning-tree protocol-specific option, include the `flag` statement:

```
[edit ... protocols (mstp | rstp | vstp)]
user@host# set flag flag <flag-modifier> <disable>
```

You can specify the following spanning-tree protocol-specific *flag* options:

- **all**—Trace all operations.
- **all-failures**—Trace all failure conditions.
- **bpdu**—Trace BPDU reception and transmission.
- **bridge-detection-state-machine**—Trace the bridge detection state machine.
- **events**—Trace events of the protocol state machine.
- **port-information-state-machine**—Trace the port information state machine.
- **port-migration-state-machine**—Trace the port migration state machine.
- **port-receive-state-machine**—Trace the port receive state machine.
- **port-role-transit-state-machine**—Trace the port role transit state machine.
- **port-role-select-state-machine**—Trace the port role selection state machine.
- **port-transmit-state-machine**—Trace the port transmit state machine.

- **port-state-transit-state-machine**—Trace the port state transit state machine.
- **ppmd**—Trace the state and events for the ppmmd process.
- **state-machine-variables**—Trace when the state machine variables change.
- **timers**—Trace protocol timers.
- **topology-change-state-machine**—Trace the topology change state machine.

NOTE: Use the trace flag **all** with caution. This flag may cause the CPU to become very busy.

- To disable an individual spanning-tree protocol-specific option, include the **disable** option with the flag statement.

5. Verify the spanning-tree protocol-specific trace options:

```
[edit]
...
  routing-options {
    traceoptions {
      ...global-trace-options-configuration...
    }
  }
}
protocols {
  (mstp | rstp | vstp) {
    traceoptions { # Spanning-tree protocol-specific.
      file filename <files number> <size bytes> <world-readable | no-world-
readable>;
      flag flag <flag-modifier> <disable>;
    }
  }
}
...
```

Example: Tracing Spanning-Tree Protocol Operations

Trace only unusual or abnormal operations to `/var/log/stp-log`:

```
[edit]
routing-options {
  traceoptions {
    file routing-log size 10m world-readable;
    flag all;
  }
}
protocols {
  rstp {
    traceoptions {
      file rstp-log size 10m world-readable;
      flag all;
    }
  }
}
```

Unblocking a Switch Interface That Receives BPDUs in Error (CLI Procedure)

EX Series and QFX Series switches use bridge protocol data unit (BPDU) protection on interfaces to prevent them from receiving BPDUs that could trigger a spanning-tree misconfiguration. If BPDUs are received on a BPDU-protected interface, the interface either shuts down or transitions to a blocking state and stops forwarding frames. In the latter scenario, after the misconfiguration that triggered the BPDUs being sent to an interface is fixed in the topology, the interface can be unblocked and returned to service.

NOTE: This topic applies to Junos OS for EX Series and QFX switches with support for the Enhanced Layer 2 Software (ELS) configuration style. For switches that do not support ELS, see ["Unblocking an Interface on non-ELS EX Series Switches That Receives BPDUs in Error \(CLI Procedure\)" on page 241](#). For ELS details, see *Using the Enhanced Layer 2 Software CLI*.

To unblock an interface and return it to service using the CLI:

- Automatically unblock an interface by configuring a timer that expires:

```
[edit protocol layer 2]
user@switch# set protocols layer2-control bpdv-block disable-timeout 30
```

All interfaces on the switch will be reenabled (unblocked) after the timer expires. However, once an interface on the switch receives a new spanning-tree protocol BPDV, the interface returns to the blocked state.

- Manually unblock an interface using the operational mode command:

```
user@switch> clear error bpdv interface ge-0/0/6
```

This command will only reenable an interface but the BPDV configuration for the interface will continue to exist unless you remove the BPDV configuration explicitly.

Unblocking an Interface on non-ELS EX Series Switches That Receives BPDUs in Error (CLI Procedure)

EX Series switches use bridge protocol data unit (BPDV) protection on interfaces to prevent them from receiving BPDUs that could trigger a spanning-tree misconfiguration. If BPDUs are received on a BPDV-protected interface, the interface either shuts down or transitions to a blocking state and stops forwarding frames. In the latter scenario, after the misconfiguration that triggered the BPDUs being sent to an interface is fixed in the topology, the interface can be unblocked and returned to service.

To unblock an interface and return it to service using the CLI:

- Automatically unblock an interface by configuring a timer that expires:

```
[edit ethernet-switching-options]
user@switch# set bpdv-block disable-timeout 30
```

All interfaces on the switch will be re-enabled (unblocked) after the timer expires. However, once an interface on the switch receives a new spanning-tree protocol BPDV, the interface returns to the blocked state.

- Manually unblock an interface using the operational mode command:

```
user@switch> clear ethernet-switching bpd-error
interface ge-0/0/6.0
```

This command will only re-enable an interface but the BPDU configuration for the interface will continue to exist unless you remove the BPDU configuration explicitly.

Clearing the Blocked Status of a Spanning-Tree Instance Interface

To clear the blocked status of a spanning-tree instance interface on routers or on switches running Junos OS with support for the Enhanced Layer 2 Software (ELS) configuration style:

- Use the `clear error bpd interface` operational mode command:

```
user@host> clear error bpd interface interface-name
```

- To clear the blocked status of a spanning-tree instance interface on switches running Junos OS that does not support ELS, use the ["clear ethernet-switching bpd-error interface" on page 363](#) command. See ["Unblocking an Interface on non-ELS EX Series Switches That Receives BPDUs in Error \(CLI Procedure\)" on page 241](#) for details.

NOTE: When you configure BPDU protection on individual interfaces (as opposed to on all the edge ports of the bridge), you can use the `disable-timeout seconds` option to specify that a blocked interface is automatically cleared after the specified time interval elapses (unless the interval is 0).

Checking for a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface

To check whether an interface or a spanning-tree instance interface is blocked due to a MAC rewrite error condition:

1. Use the **show interfaces** operational mode command:

```
user@host> show interfaces interface-name
```

2. You can determine the status of the interface as follows:

- If the value in the **Physical interface** includes **Enabled, Physical link is Up** and the value of the **BPDU Error** field is **None**, the interface is enabled
- If the value in the **Physical interface** field is **Enabled, Physical link is Down** and the value in the **BPDU Error** field is **Detected**, the interface is blocked.

Clearing a MAC Rewrite Error Condition Blocking a Spanning-Tree Instance Interface

To clear the blocked status of a spanning-tree instance interface:

- Use the **clear error bpdu** operational mode command:

```
user@host> clear error bpdu interface interface-name
```

Clearing a MAC Rewrite Error on an Interface with Layer 2 Protocol Tunneling

On devices with Layer 2 protocol tunneling (L2PT) configured, customer-facing ports should not receive packets with the L2PT MAC address as the destination address unless you have a network topology or configuration error. Under these conditions, when an interface with L2PT enabled receives an L2PT packet, the interface state becomes disabled due to a MAC rewrite error, and you must subsequently re-enable it to continue operation.

1. To check whether an interface with L2PT enabled has become disabled due to a MAC rewrite error condition, use the **show interfaces** operational command:

```
user@switch> show interfaces interface-name
```

If the interface status includes **Disabled, Physical link is Down** or **Enabled, Physical link is Down** and the **MAC-REWRITE Error** field is **Detected**, then the device detected a MAC rewrite error that contributed to the

interface being down. When the device did not detect any MAC rewrite errors, the MAC-REWRITE Error field is None.

For example, the following output shows the device detected a MAC rewrite error on the given interface:

```
user@switch> show interfaces ge-0/0/2
Physical interface: ge-0/0/2, Disabled, Physical link is Down
  Interface index: 150, SNMP ifIndex: 531
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 1000mbps, BPDU Error: None,
  Loop Detect PDU Error: None, Ethernet-Switching Error: None, Source filtering: Disabled
  Ethernet-Switching Error: None, MAC-REWRITE Error: Detected, Loopback: Disabled,
  Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online, Media type: Fiber
  Device flags      : Present Running
```

2. On routers, QFX Series switches, and EX Series switches that use the Enhanced Layer 2 Software configuration style, you can clear a MAC rewrite error from the Junos CLI.

To clear a MAC rewrite error from an interface that has L2PT enabled, use the `clear error mac-rewrite` operational command:

```
user@switch> clear error mac-rewrite interface-name
```

Understanding Forward Delay Before Ports Transition to Forwarding State

The forwarding delay timer specifies the length of time a spanning-tree protocol bridge port remains in the listening and learning states before transitioning to the forwarding state. Setting the interval too short could cause unnecessary spanning-tree reconvergence. Before changing this parameter, you should have a thorough understanding of spanning-tree protocols.

8

CHAPTER

Configuration Statements

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access-trunk

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Syntax

access-trunk;

Hierarchy Level

```
[edit logical-systems logical-system-name protocols vstp],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
vstp],  
[edit protocols vstp vlan vlan-identifier interface interface-name],  
[edit routing-instances routing-instance-name instance-type (layer2-control | virtual-switch)]
```

Description

Enable untagged RTSP BDPUs to be sent and received on the interface.

Required Privilege Level

routing—To view this statement in the configuration.

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

arp-on-stp

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Syntax

```
arp-on-stp;
```

Hierarchy Level

```
[edit protocols mstp interface (all | interface-name)],  
[edit protocols rstp interface (all | interface-name)],  
[edit protocols stp interface (all | interface-name)],  
[edit protocols vstp (all | vlan--id | vlan--name) interface (all | interface-name)]
```

Description

Configure the Address Resolution Protocol (ARP) in a spanning-tree network so that when a spanning-tree protocol topology change notification (TCN) is issued, the VLAN with a broken link can relearn MAC addresses from another, redundant VLAN in the network. The network must include a routed VLAN interface (RVI).

When a link fails in a spanning-tree network (RSTP, STP, MSTP, or VSTP), a message called a TCN is issued that causes all affected Ethernet switching table entries to be flushed. The network must then relearn the MAC addresses using flooding. If you have configured an RVI on the network, you have the option of having the VLAN with the broken link relearn MAC addresses from another VLAN using ARP, thereby avoiding excessive flooding on the VLAN with the broken link.

Default

ARP on STP is disabled.

Required Privilege Level

system—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 11.2.

RELATED DOCUMENTATION

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backup-bridge-priority

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Syntax

```
backup-bridge-priority priority;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id],
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan vlan-id],
[edit routing-instances routing-instance-name protocols (mstp | rstp)],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id]
```

Description

Determine the priority of the backup bridge in a VPLS multihomed Layer 2 ring with MPLS infrastructure.

Options

priority—The backup bridge priority can be set only in increments of 4096.

- **Range:** 0 through 61,440
- **Default:** 32,768

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 10.0.

RELATED DOCUMENTATION

[Understanding VPLS Multihoming | 207](#)

[Configuring VPLS Root Protection Topology Change Actions to Control Individual VLAN Spanning-Tree Behavior | 215](#)

block (Spanning Trees)

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Syntax

```
block;
```

Hierarchy Level

```
[edit protocols mstp interface (all | interface-name) bpdu-timeout-action],  
[edit protocols rstp interface (all | interface-name) bpdu-timeout-action],  
[edit protocols stp interface (all | interface-name) bpdu-timeout-action],  
[edit protocols vstp vlan vlan-id interface (all | interface-name) bpdu-timeout-action]
```

Description

Configures loop protection on a specific interface.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.1.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

RELATED DOCUMENTATION

[Understanding Loop Protection for STP, RSTP, VSTP, and MSTP](#)

[Understanding VSTP](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[Example: Configuring Faster Convergence and Improving Network Stability with RSTP](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree](#)

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bpdu-destination-mac-address (Spanning Tree)

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● [Description | 254](#)

- [Default | 254](#)
- [Options | 255](#)
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Syntax

```
bpdu-destination-mac-address provider-bridge-group;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],
[edit logical-systems logical-system-name routing-instances routing-instance-name
 protocols (mstp | rstp)],
[edit protocols (mstp | rstp)],
[edit routing-instances routing-instance-name protocols (mstp | rstp)]
```

Description

Enable MX Series router to participate in the provider Rapid Spanning Tree Protocol (RSTP) instance or a provider Multiple Spanning Tree Protocol (MSTP) instance.

Default

If the `bpdu-destination-mac-address` statement is not configured, the bridge participates in the customer RSTP instance, transmitting and receiving standard RSTP BPDU packets.

Options

provider-bridge-group—The destination MAC address of the BPDU packets transmitted is the provider bridge group address **01:80:c2:00:00:08**. Received BPDU packets with this destination MAC address are accepted and passed to the Routing Engine.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.2.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding BPDUs Used for Exchanging Information Among Bridges | 163](#)

[Understanding Provider Bridge Participation in RSTP or MSTP Instances](#)

[Configuring Rapid Spanning Tree Protocol | 28](#)

[Configuring Multiple Spanning Tree Protocol | 95](#)

bpdu-block

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Syntax

```
bpdu-block {  
    interface (interface-name disable | all);  
    disable-timeout seconds;  
}
```

Hierarchy Level

```
[edit protocols layer2-control ]
```

```
[edit ethernet-switching-options]
```

Description

Configures bridge protocol data unit (BPDU) protection on a specified interface or on all interfaces. If the interface receives incompatible BPDUs, it is disabled.

If the `disable-timeout` statement is included in the BPDU configuration, the interface is automatically reenabled after the timer expires. Otherwise, you must use the operational mode command `clear ethernet-switching bpu-error interface` to unblock and reenale the interface.

The remaining statements are explained separately. See [CLI Explorer](#).

Required Privilege Level

interface—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.1.

RELATED DOCUMENTATION

[Understanding BPDU Protection for Spanning-Tree Instance Interfaces | 160](#)

[Configuring BPDU Protection for Individual Spanning-Tree Instance Interfaces | 162](#)

[Understanding BPDU Protection for STP, RSTP, and MSTP | 162](#)

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bpdu-block-on-edge

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Syntax

```
bpdu-block-on-edge;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp | vstp)],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
(mstp | rstp | vstp)],  
[edit protocols ( mstp | rstp| vstp )],  
[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp)]
```

Description

Configure bridge protocol data unit (BPDU) protection on all edge ports of a switch. When the `bpdu-block-on-edge` statement is configured and the interface encounters an incompatible BPDU, the interface shuts down.

If the `disable-timeout` statement is included in the BPDU configuration, the interface is automatically reenabled after the timer expires. Otherwise, you must use the operational mode command `clear ethernet-switching bpdu-error interface` to unblock and reenabale the interface.

Default

Not enabled.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.1.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support. Statement updated in Junos OS Release 11.1 for EX Series switches to change blocking behavior to port shutdown.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding BPDU Protection for Spanning-Tree Instance Interfaces | 160](#)

[Understanding BPDU Protection for STP, RSTP, and MSTP | 162](#)

BPDU Protection on All Edge Ports of the Bridge

Configuring BPDU Protection on ACX Router, EX Switch and MX Router Edge Ports

Configuring BPDU Protection on Switch Spanning Tree Interfaces

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

Example: Configuring BPDU Protection on Edge Interfaces to Prevent STP Miscalculations on non-ELS EX Series Switches

[rstp | 326](#)

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bridge-priority

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Syntax

```
bridge-priority priority;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],  
[edit logical-systems logical-system-name protocols mstp msti msti-id],  
[edit logical-systems logical-system-name protocols vstp vlan vlan-id],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
(mstp | rstp)],  
[edit logical-systems logical-system-name routing-instances routing-instance-name  
protocols mstp msti msti-id],
```

```
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
vstp vlan vlan-id],
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp)],
[edit routing-instances routing-instance-name protocols mstp msti msti-id],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id]
```

```
[edit protocols mstp],
[edit protocols mstp msti msti-id],
[edit protocols rstp],
[edit protocols stp],
[edit protocols vstp vlan vlan-id]
```

Description

Configures the bridge priority, which determines which bridge is elected as the root bridge. If two bridges have the same path cost to the root bridge, the bridge priority determines which bridge becomes the designated bridge for a LAN segment.

Default

32,768

Options

priority—The bridge priority can be set only in increments of 4096.

- **Range:** 0 through 61,440
- **Default:** 32,768

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding MSTP | 87](#)

[Understanding VSTP](#)

[Understanding Bridge Priority for Election of Root Bridge and Designated Bridge | 212](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[show spanning-tree bridge | 382](#)

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configuration-name

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- [Hierarchy Level | 263](#)
- [Description | 263](#)
- [Required Privilege Level | 263](#)
- [Release Information | 263](#)

Syntax

```
configuration-name configuration-name;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols mstp],  
[edit logical-systems logical-system-name routing-instances routing-instance-name  
protocols mstp],
```

```
[edit protocols mstp],
```

```
[edit routing-instances routing-instance-name protocols mstp]
```

Description

Specify the configuration name, which is the MSTP region name carried in the MSTP BPDUs.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

Understanding MSTP 87
Understanding BPDUs Used for Exchanging Information Among Bridges 163
Configuring Multiple Spanning Tree Protocol 95
Configuring MSTP on Switches 91
Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches 59
show spanning-tree bridge 382
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Example: Configuring Network Regions for VLANs with MSTP on Switches 101
Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP 32
Understanding MSTP 87

cost

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- [Default | 265](#)
- [Options | 266](#)
- [Required Privilege Level | 266](#)
- [Release Information | 266](#)

Syntax

```
cost cost;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp | vstp) interface interface-name],
[edit logical-systems logical-system-name protocols mstp msti msti-id interface interface-name],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp | vstp) interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name
protocols mstp msti msti-id interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id interface interface-name],
```

```
[edit protocols (mstp | rstp | vstp) interface interface-name],
[edit protocols mstp msti msti-id interface interface-name],
[edit protocols vstp vlan vlan-id interface interface-name],
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp) interface interface-
name],
[edit routing-instances routing-instance-name protocols mstp msti msti-id interface interface-
name],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id interface interface-name]
```

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), configure the link cost to control which bridge is the designated bridge and which interface is the designated interface.

Default

The link cost is determined by the link speed.

Options

cost—(Optional) Link cost associated with the port.

- **Range:** 1 through 200,000,000

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding Spanning-Tree Instance Interfaces | 18](#)

[Understanding STP | 23](#)

[Understanding RSTP | 27](#)

[Understanding MSTP | 87](#)

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disable

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- [Hierarchy Level | 267](#)
- [Description | 268](#)
- [Default | 268](#)
- [Required Privilege Level | 268](#)
- [Release Information | 269](#)

Syntax

```
disable;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols mstp],
[edit logical-systems logical-system-name routing-instances routing-instance-name
protocols mstp],
```

```
[edit protocols mpls],
[edit protocols mpls interface (all | interface-name)],
```

```
[edit protocols mstp],
[edit protocols mstp (all | interface-name)],
[edit protocols mstp (all | interface-name) arp-on-stp],
[edit protocols mstp msti msti-id vlan (vlan-id | vlan-name) interface (all | interface-name)],
[edit protocols mstp msti msti-id vlan (vlan-id | vlan-name) interface interface-name arp-on-stp],
```

```
[edit protocols rstp],
[edit protocols rstp interface (all | interface-name)],
[edit protocols rstp interface (all | interface-name) arp-on-stp],
[edit protocols stp],
[edit protocols stp interface (all | interface-name)],
[edit protocols stp interface (all | interface-name) arp-on-stp],
[edit protocols vstp],
[edit protocols vstp vlan vlan-id interface (all | interface-name)]
[edit protocols vstp vlan vlan-id interface (all | interface-name) arp-on-stp]
[edit protocols mstp interface interface-name,
[edit protocols mstp msti msti-id vlan (all vlan-id | vlan-name) interface interface-name],
[edit protocols rstp interface interface-name],
[edit protocols vstp vlan vlan-id interface interface-name]
```

```
[edit routing-instances routing-instance-name protocols mstp]
```

```
[edit ethernet-switching-options bpdu-block interface]
```

Description

Disable the entire MSTP, RSTP, or VSTP instance on a specific interface.

NOTE: You cannot disable spanning tree parameters for all interfaces.

Default

Not enabled

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.0.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

Statement updated in Junos OS Release 15.1 for EX Series switches.

RELATED DOCUMENTATION

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Configuring Multiple Spanning Tree Protocol	 95
Configuring RSTP on EX Series Switches (CLI Procedure)	 31
Configuring MSTP on Switches	 91
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Example: Configuring BPDU Protection on Interfaces	 173
Example: Configuring Network Regions for VLANs with MSTP on Switches	 101
Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP	 32
interface (BPDU Blocking)	 286
show spanning-tree bridge	 382
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disable-timeout

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- [Syntax](#) | [270](#)
- [Hierarchy Level](#) | [270](#)

- [Description | 270](#)
- [Default | 270](#)
- [Options | 271](#)
- [Required Privilege Level | 271](#)
- [Release Information | 271](#)

Syntax

```
disable-timeout seconds;
```

Hierarchy Level

```
[edit protocols layer2-control bpdu-block]
```

```
[edit ethernet-switching-options bpdu-block]
```

Description

For interfaces configured for BPDU protection, specify the amount of time an interface receiving BPDUs is disabled.

Configure the timeout value to periodically check to see if an interface is still disabled with BPDU blocking. If this option is not configured, the interface is not periodically checked and remains disabled.

Default

The disable timeout is not enabled.

Options

seconds—Amount of time, in seconds, the interface receiving BPDUs is disabled. Once the timeout expires, the interface is brought back into service.

- **Range:** 10 through 3600
- **Default:** If this option is not configured, the interface is not periodically checked and remains disabled.

Required Privilege Level

routing—To view this statement in the configuration.

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

system—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.1.

RELATED DOCUMENTATION

[Understanding BPDU Protection for Spanning-Tree Instance Interfaces | 160](#)

[Understanding BPDU Protection for STP, RSTP, and MSTP | 162](#)

[Configuring BPDU Protection for Individual Spanning-Tree Instance Interfaces | 162](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[Example: Configuring BPDU Protection on Interfaces | 173](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

Example: Configuring BPDU Protection on Switch Edge Interfaces With ELS to Prevent STP Miscalculations

[show spanning-tree bridge | 382](#)

[show spanning-tree interface | 390](#)

drop (BPDU Block)

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- [Syntax | 272](#)
- [Hierarchy Level | 272](#)
- [Description | 272](#)
- [Default | 273](#)
- [Required Privilege Level | 273](#)
- [Release Information | 273](#)

Syntax

```
drop;
```

Hierarchy Level

```
[edit ethernet-switching-options bpdu-block bpdu-block (all | [interface-name])]
```

Description

Drop bridge protocol data units (BPDUs) that enter any interface or a specified interface, but do not disable the interface. Configure the drop statement *only* on interfaces on which no spanning-tree protocol (STP, MSTP, or RSTP) is configured.

NOTE: Do not configure drop on any interface on which a spanning-tree protocol has been configured. Doing so could cause STP misconfiguration and consequent network outages.

Default

Not enabled.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

[Understanding BPDU Protection for STP, RSTP, and MSTP | 162](#)

Example: Configuring BPDU Protection on Edge Interfaces to Prevent STP Miscalculations on non-ELS EX Series Switches

[Example: Configuring BPDU Protection on Interfaces | 173](#)

[bpdu-block-on-edge | 257](#)

edge

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- [Hierarchy Level | 274](#)
- [Description | 275](#)
- [Default | 275](#)
- [Required Privilege Level | 275](#)
- [Release Information | 276](#)

Syntax

```
edge;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp | vstp) interface interface-name],  
[edit logical-systems logical-system-name protocols mstp msti msti-id interface interface-name],  
[edit logical-systems logical-system-name protocols vstp vlan vlan-id interface interface-name],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
(mstp | rstp | vstp) interface interface-name],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols mstp  
msti msti-id interface interface-name],
```

```
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id interface interface-name],
```

```
[edit protocols (mstp | rstp | vstp) interface (all | interface-name)], )arp-on-stp],
[edit protocols mstp msti msti-id interface (all | interface-name)], )arp-on-stp],
[edit protocols vstp vlan vlan-id interface (all | interface-name)], )arp-on-stp],
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp) interface interface-
name]
[edit routing-instances routing-instance-name protocols mstp msti msti-id interface interface-
name],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id interface interface-name]
```

Description

For Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), configure interfaces as edge ports or edge interfaces. Edge ports do not expect to receive BPDUs. If a BPDU is received, the port becomes a nonedge port and the Edge interfaces immediately transition to a forwarding state.

NOTE: Although the edge configuration statement appears in the [edit protocols stp interface (all | *interface-name*)] or [edit protocols rstp force-version stp interface (all | *interface-name*)] hierarchy on the switch, this statement has no effect on the switch operation if you configure it.

Default

Edge interfaces are not enabled.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding STP | 23](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[show spanning-tree bridge | 382](#)

[show spanning-tree interface | 390](#)

enable-all-ifl

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- [Syntax | 276](#)
- [Hierarchy Level | 277](#)
- [Description | 277](#)
- [Required Privilege Level | 277](#)
- [Release Information | 277](#)

Syntax

```
enable-all-ifl;
```

Hierarchy Level

```
[edit protocols layer2-control mac-rewrite interface interface-name]
```

Description

Enable tunneling for STP, VTP, CDP, and other supported protocols on all logical interfaces (VLANs) configured on the interface.

NOTE: Tunneling on all logical interfaces is enabled automatically for PVST/PVST+.

Required Privilege Level

interface—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 13.3.

RELATED DOCUMENTATION

Understanding Layer 2 Protocol Tunneling
protocol

extended-system-id

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- [Hierarchy Level | 278](#)
- [Description | 278](#)
- [Options | 279](#)
- [Required Privilege Level | 279](#)
- [Release Information | 279](#)

Syntax

```
extended-system-id identifier;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols rstp],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
rstp],  
[edit protocols rstp],  
[edit routing-instances routing-instance-name protocols rstp]
```

Description

The extended system ID is used to specify different bridge identifiers for different RSTP or STP routing instances.

Options

identifier—Specify the system identifier to use for the RSTP or STP instance.

- **Range:** 0 through 4095

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.3.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Configuring Rapid Spanning Tree Protocol | 28](#)

[Configuring RSTP on EX Series Switches \(CLI Procedure\) | 31](#)

[Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP | 32](#)

[Understanding RSTP | 27](#)

force-version (IEEE 802.1D STP)

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● [Hierarchy Level | 280](#)

- [Description | 280](#)
- [Required Privilege Level | 280](#)
- [Release Information | 281](#)

Syntax

```
force-version stp;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (rstp | vstp)],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
(rstp | vstp)],
```

```
[edit protocols (rstp | vstp)],  
[edit routing-instances routing-instance-name protocols (rstp | vstp)]
```

Description

Forces the spanning-tree version to be the original IEEE 803.1D STP protocol.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Support for logical systems added in Junos OS Release 9.6.

Support for logical systems added in Junos OS Release 9.6.

forward-delay

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- [Hierarchy Level | 281](#)
- [Description | 282](#)
- [Options | 282](#)
- [Required Privilege Level | 282](#)
- [Release Information | 282](#)

Syntax

```
forward-delay seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp)],
```

```
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id],
```

```
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan vlan-id],
[edit routing-instances routing-instance-name protocols (mstp | rstp)],
```

```
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id]
```

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), specifies the length of time an STP bridge port remains in the listening and learning states before transitioning to the forwarding state.

Options

seconds—(Optional) Number of seconds the bridge port remains in the listening and learning states.

- **Range:** 4 through 30
- **Default:** 15 seconds

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

Understanding Forward Delay Before Ports Transition to Forwarding State	 244
Understanding STP	 23
Understanding MSTP	 87
Understanding VSTP	
Example: Configuring Network Regions for VLANs with MSTP on Switches	 101
Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP	 32
Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches	 59
show spanning-tree bridge	 382
show spanning-tree interface	 390

hello-time

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- [Hierarchy Level](#) | [284](#)
- [Description](#) | [284](#)
- [Default](#) | [284](#)
- [Options](#) | [285](#)
- [Required Privilege Level](#) | [285](#)
- [Release Information](#) | [285](#)

Syntax

```
hello-time seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id],
```

```
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan vlan-id],
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp)],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id]
```

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), specifies the number of seconds between transmissions of configuration BPDUs by the root bridge.

Default

2 seconds

Options

seconds—(Optional) Number of seconds between transmissions of configuration BPDUs.

- **Range:** 1 through 10
- **Default:** 2 seconds

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding MSTP | 87](#)

[Understanding VSTP](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP | 32](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[show spanning-tree bridge | 382](#)

[show spanning-tree interface | 390](#)

interface (BPDU Blocking)

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- [Syntax | 286](#)
- [Hierarchy Level | 286](#)
- [Description | 286](#)
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- [Required Privilege Level | 287](#)
- [Release Information | 288](#)

Syntax

```
interface (all | [interface-name]);
```

Hierarchy Level

```
[edit protocols layer2-control bpdu-block]
```

```
[edit ethernet-switching-options bpdu-block]
```

Description

Applies Bridge Protocol Data Unit (BPDU) protection on all interfaces or on one or more specified interfaces.

Spanning Tree Protocol (STP), Rapid Spanning Tree protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP) provide Layer 2 loop prevention for EX Series switches. The spanning-tree protocols use BPDU

frames to communicate. Through their exchange, spanning-tree topologies determine which interfaces block traffic and which interfaces become root ports and forward traffic. User bridge applications running on a PC can also generate BPDUs. If these BPDUs are picked up by STP applications running on the switch, they can trigger STP miscalculations that can lead to network outages.

To block outside BPDUs from reaching a switch interface connected to devices that are not part of a spanning-tree topology, configure BPDU protection on interfaces in the topology.



CAUTION: When configuring BPDU protection on an interface without spanning trees connected to a switch with spanning trees, be careful that you do not configure BPDU protection on all interfaces. Doing so could prevent BPDUs being received on switch interfaces (such as a trunk interface) that you intended to have receive BPDUs from a switch with spanning trees.

NOTE: Interfaces that are configured as edge interfaces can transition to a forwarding state immediately because they cannot create network loops. As edge ports are connected to end devices, it is imperative that you configure BPDU protection on edge ports to protect the switch from outside BPDUs. When BPDU protection is enabled on an edge interface, the interface shuts down on encountering an outside BPDU thereby preventing any traffic from passing through the interface.

Options

all—All interfaces.

[interface-name]—One or more Ethernet interface names.

The remaining statements are explained separately. See [CLI Explorer](#).

Required Privilege Level

system—To view this statement in the configuration.

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

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.1.

RELATED DOCUMENTATION

Understanding BPDU Protection for STP, RSTP, and MSTP	 162
Understanding BPDU Protection for Spanning-Tree Instance Interfaces	 160
Configuring BPDU Protection for Individual Spanning-Tree Instance Interfaces	 162
Example: Configuring Network Regions for VLANs with MSTP on Switches	 101
Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches	 59
Example: Configuring BPDU Protection on Interfaces	 173
show spanning-tree bridge	 382
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interface (Spanning Tree)

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- [Required Privilege Level](#) | [290](#)
- [Release Information](#) | [291](#)

Syntax

```
interface interface-name {
    bpdu-timeout-action {
        alarm;
        block;
    }
    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
}
```

Syntax

```
interface interface-name {
    arp-on-stp;
    bpdu-timeout-action
        block;
        log;
    cost cost;
    disable;
    edge;
    mode mode;
    no-root-port;
    priority priority;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp | vstp)],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp | vstp)],
```

```
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id],
```

```
[edit protocols (mstp | rstp | vstp)],
[edit protocols vstp vlan vlan-id],
```

```
[edit protocols (mstp | rstp | vstp)],
[edit protocols vstp vlan vlan-id],
[edit protocols vstp vlan-group group group-name vlan (vlan-id | vlan-range | open-set-of-values)
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp)],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id]
```

Description

Configures the interface to participate in the RSTP, MSTP, or VSTP instance.

The **edge**, **mode**, and **no-root-port** options are not available at the `[edit protocols mstp msti msti-id]` hierarchy level.

Options

interface-name—Name of a Gigabit Ethernet or 10-Gigabit Ethernet interface.

The remaining statements are explained separately. See [CLI Explorer](#).

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

Statement updated in Junos OS Release 15.1 for EX Series switches to support configuration of spanning tree parameters globally on all interfaces.

NOTE: You cannot disable spanning tree parameters globally on all interfaces.

RELATED DOCUMENTATION

[Understanding Spanning-Tree Instance Interfaces | 18](#)

[Understanding RSTP | 27](#)

[Understanding MSTP | 87](#)

[Understanding VSTP](#)

[Configuring RSTP on EX Series Switches \(CLI Procedure\) | 31](#)

[Configuring MSTP on Switches | 91](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[show spanning-tree bridge | 382](#)

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layer2-control

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[Hierarchy Level | 292](#)

- [Description | 293](#)
- [Required Privilege Level | 293](#)
- [Release Information | 293](#)

Syntax

```

layer2-control {
    bpdu-block {
        disable-timeout seconds;
        interface interface-name;
    }
    mac-rewrite {
        interface interface-name {
            enable-all-ifl;
            protocol protocol-name;
        }
        tunnel-destination-mac <destination mac address>;
    }nonstop-bridging;
    traceoptions {
        file filename <files number> <size maximum-file-size> <world-readable | no-world-
readable>;
        flag flag <disable>;
    }
}

```

Hierarchy Level

[edit protocols]

Description

Configure Layer 2 control protocols to enable features such as Layer 2 protocol tunneling or nonstop bridging.

You can configure destination MAC address using `tunnel-destination-mac <destination mac address>`.

The remaining statements are explained separately. See [CLI Explorer](#).

NOTE: For a detailed description of configuring the `nonstop-bridging` statement, see the [Junos OS High Availability User Guide](#). When you configure this statement on routing platforms with two Routing Engines, a primary Routing Engine switches over gracefully to a backup Routing Engine and preserves Layer 2 Control Protocol (L2CP) information.

Required Privilege Level

`interface`—To view this statement in the configuration.

`interface-control`—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 8.4.

`bpdv-block` statement added in Junos OS Release 9.4.

`enable-all-if` statement added in Junos OS Release 13.3.

Statement introduced in Junos OS Release 14.1X53-D10 for EX4300 switches.

`tunnel-destination-mac` statement added in Junos OS Evolved Release 21.3R1.

RELATED DOCUMENTATION

Understanding Layer 2 Protocol Tunneling

Configuring Layer 2 Protocol Tunneling

instance-type

log (Spanning Trees)

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- [Syntax | 294](#)
- [Hierarchy Level | 294](#)
- [Description | 294](#)
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Syntax

```
log;
```

Hierarchy Level

```
[edit protocols mstp interface (all | interface-name) bpdu-timeout-action],  
[edit protocols rstp interface (all | interface-name) bpdu-timeout-action],  
[edit protocols stp interface (all | interface-name) bpdu-timeout-action],  
[edit protocols vstp vlan vlan-id interface (all | interface-name) bpdu-timeout-action]
```

Description

For interfaces configured for loop protection, configure the software to generate a message to be sent to the system log file `/var/log/messages` to record the loop-protection event.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.1.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

RELATED DOCUMENTATION

[show spanning-tree bridge | 382](#)

[show spanning-tree interface | 390](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[Loop Protection for Spanning-Tree Protocols | 181](#)

mac-rewrite

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- [Hierarchy Level | 296](#)
- [Description | 296](#)
- [Required Privilege Level | 297](#)
- [Release Information | 297](#)

Syntax

```
mac-rewrite {  
    interface interface-name {  
        enable-all-ifl;  
        protocol protocol-name;  
    }  
}
```

Hierarchy Level

```
[edit protocols layer2-control]
```

Description

Enable rewriting of the MAC address for Layer 2 protocol tunneling (L2PT).

When a service provider edge port configured for L2PT receives a control packet for a supported protocol, the device rewrites the multicast destination MAC address with the predefined multicast tunneling MAC address 01:00:0c:cd:cd:d0 and sends the packet on the Q-in-Q tunnel interface. The packet travels across the provider network transparently to the other end of the tunnel, and the destination device restores the original multicast destination MAC address to deliver the packet at its destination.

Refer to *protocol* for the list of protocols that you can configure for L2PT on different devices.

To see the protocols for which you enabled L2PT on an interface, enter the *show mac-rewrite interface* command.

To see the MAC addresses installed by L2PT on products except MX Series routers, see [No Link Title](#). To see the MAC addresses installed by L2PT on MX Series routers, see ["show bridge mac-table" on page 371](#).

On MX Series and ACX Series routers and EX9200 switches with L2PT configured, customer-facing ports should not receive packets with the L2PT MAC address as the destination address unless there is a

network topology or configuration error. Any such interface receiving an L2PT packet becomes “Disabled”, and you must subsequently re-enable it using the *clear error mac-rewrite* command.

The remaining statements are explained separately. See [CLI Explorer](#).

Required Privilege Level

interface—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.1.

enable-all-if statement added in Junos OS Release 13.3.

Support for PVSTP protocol introduced in Junos OS Release 13.3 for MX Series routers and EX9200 switches.

Statement introduced in Junos OS Release 14.1X53-D10 and 17.3R1 for EX4300 switches.

RELATED DOCUMENTATION

Understanding Layer 2 Protocol Tunneling

Configuring Layer 2 Protocol Tunneling

show mac-rewrite interface

clear error mac-rewrite

max-age

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- [Hierarchy Level | 298](#)
- [Description | 299](#)
- [Default | 299](#)
- [Options | 299](#)
- [Required Privilege Level | 299](#)
- [Release Information | 300](#)

Syntax

```
max-age seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],  
[edit logical-systems logical-system-name protocols vstp vlan vlan-id],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
(mstp | rstp)],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp  
vlan vlan-id],
```

```
[edit protocols mstp],  
[edit protocols rstp],
```

```
[edit protocols stp],
[edit protocols vstp vlan vlan-id]
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp)],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id]
```

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), specifies the maximum expected arrival time of hello BPDUs.

Default

20 seconds

Options

seconds—(Optional) Number of seconds expected between hello BPDUs.

seconds—The maximum age of received protocol BPDUs.

- **Range:** 6 through 40
- **Default:** 20 seconds

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding STP | 23](#)

[Understanding MSTP | 87](#)

[Understanding VSTP](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP | 32](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[show spanning-tree bridge | 382](#)

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max-hops

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Syntax

```
max-hops hops;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols mstp],  
[edit logical-systems logical-system-name routing-instances routing-instance-name  
protocols mstp],
```

```
[edit protocols mstp],
```

```
[edit routing-instances routing-instance-name protocols mstp]
```

Description

Configure the maximum number of hops a BPDU can be forwarded in the MSTP region.

Options

hops—(Optional) Number of hops the BPDU can be forwarded.

- **Range:** 1 through 255
- **Default:** 19 hops

20 hops

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

Understanding MSTP 87
Configuring Multiple Spanning Tree Protocol 95
Configuring MSTP on Switches 91
Example: Configuring Network Regions for VLANs with MSTP on Switches 101
Understanding MSTP 87
show spanning-tree bridge 382
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mode

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- [Hierarchy Level | 303](#)
- [Description | 304](#)
- [Default | 304](#)
- [Options | 304](#)
- [Required Privilege Level | 304](#)

Syntax

```
mode (p2p | shared);
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp | vstp) interface interface-name],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp | vstp) interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id interface interface-name],
```

```
[edit protocols (mstp | rstp | vstp) interface interface-name],
[edit protocols vstp vlan vlan-id interface interface-name],
[edit protocols mstp interface (all | interface-name) arp-on-stp],
[edit protocols mstpmsti msti-id interface interface-name arp-on-stp],
[edit protocols rstp interface (all | interface-name) arp-on-stp],
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp) interface interface-
name],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id interface interface-name]
[edit protocols stp interface (all | (all | interface-name))],
[edit protocols stp interface (all | interface-name) arp-on-stp],
[edit protocols vstp vlan vlan-id interface (all | interface-name) arp-on-stp]
```

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), configures the link mode to identify point-to-point links.

NOTE: For EX4300 switches, the interfaces operate in full-duplex mode only.

Default

When the link is configured as full-duplex, the default link mode is **p2p**. When the link is configured half-duplex, the default link mode is **shared**.

Options

p2p—The link is point to point.

shared—The link is shared media.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding Spanning-Tree Instance Interfaces | 18](#)

[Understanding STP | 23](#)

[Understanding VSTP](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[Example: Configuring Faster Convergence and Network Stability on ELS Switches with RSTP | 32](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[show spanning-tree bridge | 382](#)

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msti

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- [Syntax | 306](#)
- [Hierarchy Level | 306](#)
- [Description | 306](#)
- [Default | 307](#)
- [Options | 307](#)
- [Required Privilege Level | 307](#)
- [Release Information | 307](#)

Syntax

```
msti msti-id {
    bridge-priority priority;
    vlan (vlan-id | vlan-range|open-set-of-values);
    interface (interface-name | all) {
        cost cost;
```

```

        edge;
        priority interface-priority;
    }
}

```

Syntax

```

msti msti-id {
    vlan (vlan-id | vlan-name);
    interface interface-name {
        disable-timeout;
        cost cost;
        priority priority;
    }
}

```

Hierarchy Level

```

[edit logical-systems logical-system-name protocols mstp],
[edit logical-systems logical-system-name routing-instances routing-instance-name
protocols mstp],

```

```

[edit protocols mstp],

```

```

[edit routing-instances routing-instance-name protocols mstp]

```

Description

Configures the Multiple Spanning Tree Instance (MSTI) identifier for Multiple Spanning Tree Protocol (MSTP). MSTI IDs are local to each region, so you can reuse the same MSTI ID in different regions.

Default

MSTI is disabled.

Options

msti-id—MSTI instance identifier.

- **Range:** 1 through 64
- **Range:** 1 through 4094. The Common Instance Spanning Tree (CIST) is always MSTI 0.

The remaining statements are explained separately. See [CLI Explorer](#).

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Support for logical systems added in Junos OS Release 9.6.

Statement updated in Junos OS Release 15.1 for EX Series switches to support configuration of spanning tree parameters globally on all interfaces.

NOTE: You cannot disable spanning tree parameters globally on all interfaces.

RELATED DOCUMENTATION

[Understanding MSTP | 87](#)

[Configuring Multiple Spanning Tree Protocol | 95](#)

Configuring MSTP on Switches	91
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mstp

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- MX Series, QFX Series, EX Series (Enhanced Layer 2 Software (ELS) Configuration Style) | 308
- EX Series (Without Enhanced Layer 2 Software (ELS) Configuration Style) | 309
- Hierarchy Level | 310
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- Required Privilege Level | 311
- Release Information | 311

MX Series, QFX Series, EX Series (Enhanced Layer 2 Software (ELS) Configuration Style)

```
mstp {
    backup-bridge-priority priority;
    bpdu-block-on-edge;
    bpdu-destination-mac-address provider-bridge-group;
    bridge-priority priority;
    configuration-name configuration-name;
    disable;
    forward-delay seconds;
    hello-time seconds;
    interface ( all | interface-name ) {
        bpdu-timeout-action {
```

```

        alarm;
        block;
    }
    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
}
max-age seconds;
max-hops hops;
msti msti-id {
    backup-bridge-priority priority;
    bridge-priority priority;
    interface interface-name {
        cost cost;
        priority interface-priority;
    }
    vlan vlan-id;
}
priority-hold-time seconds;
revision-level revision-level;
system-id system-id-value {
    ip-address(es);
}
traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
vpls-flush-on-topology-change;
}

```

EX Series (Without Enhanced Layer 2 Software (ELS) Configuration Style)

```

mstp {
    bpdu-block-on-edge;
    bridge-priority priority;
    configuration-name name;
    disable;
}

```

```

        forward-delay                seconds;
        hello-time                    seconds;
        interface ( all | interface-name ){
            bpdu-timeout-action {
                block;
                log;
            }

            cost                        cost;
            disable;
            edge;
            mode                        mode;
            no-root-port;
            priority                    priority;
        }

        max-age                       seconds;
        max-hops                       hops;
        msti                           msti-id {
            bridge-priority priority;
            interface interface-name {
                cost cost;
                disable;
                priority priority;
            }
            vlan (vlan-id | vlan-name);
        }
        revision-level                revision-level;
        traceoptions {
            file filename <files number > <size size> <no-stamp | world-readable | no-world-
readable>;
            flag flag;
        }
    }
}

```

Hierarchy Level

```

[edit logical-systems logical-system-name protocols],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols],
[edit protocols],
[edit routing-instances routing-instance-name protocols]

```


Description

Configures Multiple Spanning Tree Protocol (MSTP). MSTP is defined in the IEEE 802.1Q-2003 specification and is used to create a loop-free topology in networks with multiple spanning tree regions.

NOTE: MX Series routers and QFX5100 switches do not support the `interface all` statement to enable MSTP on all interfaces with one command.

On MX Series routers, you must enable MSTP on interfaces individually using the `set ... protocols mstp interface interface-name` statement.

On QFX5100 switches, to apply MSTP configuration to more than one interface, you must first configure one or more interface ranges for the interfaces on which you want to configure MSTP, and then issue the `set protocols mstp interface interface-name` command using each interface range as the *interface-name* parameter.

The remaining statements are explained separately. See [CLI Explorer](#).

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

`bpd-block-on-edge` statement added in Junos OS Release 9.4.

`bpd-timeout-action` statement added in Junos OS Release 9.4.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding MSTP | 87](#)

[Configuring Multiple Spanning Tree Protocol | 95](#)

[Configuring MSTP on Switches | 91](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[show spanning-tree bridge | 382](#)

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no-root-port

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Syntax

```
no-root-port;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp | vstp) interface interface-name],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp | vstp) interface interface-name],
```

```
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id interface interface-name],
```

```
[edit protocols (mstp | rstp | vstp) interface interface-name],
[edit protocols vstp vlan vlan-id interface interface-name],
[edit protocols mstp interface (all | interface-name) arp-on-stp],
[edit protocols rstp interface (all | interface-name) arp-on-stp],
[edit protocols stp interface (all | interface-name) arp-on-stp],
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp) interface interface-
name],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id interface interface-name]
[edit protocols vstp vlan vlan-id interface (all | interface-name) arp-on-stp]
```

Description

Configures an interface to be a spanning-tree designated port. If the bridge receives superior STP bridge protocol data units (BPDUs) on a root-protected interface, that interface transitions to a root-prevented STP state (inconsistency state) and the interface is blocked. This blocking prevents a bridge from being elected the root bridge. When the bridge stops receiving superior STP BPDUs on the root-protected interface, interface traffic is no longer blocked.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.1.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

Understanding VSTP
Understanding Root Protection for Spanning-Tree Instance Interfaces in a Layer 2 Switched Network 212
Enabling Root Protection for a Spanning-Tree Instance Interface 214
Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on non-ELS EX Series Switches 217
Example: Configuring Network Regions for VLANs with MSTP on Switches 101
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priority (Protocols STP)

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Syntax

```
priority interface-priority;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp | vstp) interface interface-name],
[edit logical-systems logical-system-name protocols mstp msti msti-id interface interface-name],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp | vstp) interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name
protocols mstp msti msti-id interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id interface interface-name],
```

```
[edit protocols (mstp | rstp | vstp) interface interface-name],
[edit protocols mstp msti msti-id interface interface-name],
[edit protocols vstp vlan-id interface interface-name],
[edit protocols mstp ;interface (all | interface-name) arp-on-stp],
[edit protocols mstpmsti msti-id interface interface-name arp-on-stp],
[edit protocols rstp interface (all | interface-name) arp-on-stp],
[edit protocols stp interface (all | interface-name) arp-on-stp],
[edit protocols vstp vlan vlan-id interface (all | interface-name) arp-on-stp]
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp) interface interface-
name],
[edit routing-instances routing-instance-name protocols mstp msti msti-id interface interface-
name],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id interface interface-name]
```

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), specifies the interface priority to control which interface is elected as the root port. The interface priority must be set in increments of 16.

Default

The default value is 128.

Options

priority—(Optional) Interface priority. The interface priority must be set in increments of 16.

- **Range:** 0 through 240

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding STP | 23](#)

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priority-hold-time

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Syntax

```
priority-hold-time seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
(mstp | rstp)],  
[edit protocols (mstp | rstp)],  
[edit routing-instances routing-instance-name protocols (mstp | rstp)],
```

Description

Specify the number of seconds to hold before switching to the primary priority when the first core domain comes up.

Options

seconds—Number of seconds to hold before switching to primary priority.

- **Range:** 1 through 255
- **Default:** 2 seconds

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 10.0.

protocol

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Syntax (ACX Series Routers)

```
protocol (cdp | elmi | ieee8021x | ieee8023ah | lacp | lldp | mmrp | mvrp | stp | vtp);
```

Syntax (MX Series Routers)

```
protocol (cdp | pvstp | stp | vtp);
```

Syntax (QFX Series Switches)

```
protocol (cdp | elmi | gvrp | ieee8021x | ieee8023ah | lacp | lldp | mmrp | mvrp | stp | udld |  
vstp | vtp);
```

Syntax (EX Series Switches)

Syntax (EX2300 Multigigabit Model Switches)

```
protocol (cdp | gvrp | ieee8023ah | lacp | lldp | mvrp | stp | vstp | vtp);
```

Syntax (EX2300, EX3400, EX4300, EX4300 Multigigabit Model, EX4600, and EX4650 Switches)

```
protocol (cdp | elmi | gvrp | ieee8021x | ieee8023ah | lacp | lldp | mmrp | mvrp | stp | udld |  
vstp | vtp);
```

Syntax (EX4100, EX4300-MP, and EX4400 Switches)

```
protocol (all | cdp | elmi | gvrp | ieee8021x | ieee8023ah | lacp | lldp | mmrp | mvrp | stp |
udld | vstp | vtp);
```

Syntax (EX9200 Switches)

```
protocol (cdp | elmi | gvrp | ieee8021x | ieee8023ah | lacp | lldp | mmrp | mvrp | pvstp | stp |
udld | vtp);
```

Hierarchy Level

```
[edit logical-systems name protocols layer2-control mac-rewrite          interface interface-
name],
[edit protocols layer2-control mac-rewrite interface interface-name]
```

Description

Configure the protocol to be tunneled on an interface using Layer 2 protocol tunneling (L2PT). To enable tunneling multiple protocols, include multiple protocol statements.

You can tunnel different protocols listed in the Options section on different types of devices. The Syntax and Release Information sections list the available options for the protocols that different devices can tunnel as of a particular Junos OS release (for devices that support L2PT).

When a service provider edge (PE) port configured for L2PT receives a control packet for a supported protocol, the device rewrites the multicast destination MAC address with the predefined multicast tunneling MAC address 01:00:0c:cd:cd:d0. The packet travels across the provider network transparently to the other end of the tunnel, and the destination device restores the original multicast destination MAC address to deliver the packet at its destination.

Options

`all`—Tunnel all supported Layer 2 control protocols.

`cdp`—Tunnel the Cisco Discovery Protocol (CDP).

`elmi`—Tunnel Ethernet Local Management Interface (E-LMI) packets.

`gvrp`—Tunnel Generic Attribute Registration Protocol (GARP) VLAN Registration Protocol (GVRP) packets.

`ieee8021x`—Tunnel IEEE 802.1X authentication packets.

`ieee8023ah`—Tunnel IEEE 802.3AH Operation, Administration, and Maintenance (OAM) link fault management (LFM) packets.

`lACP`—Tunnel Link Aggregation Control Protocol (LACP) packets.

`lldp`—Tunnel Link Layer Discovery Protocol (LLDP) packets.

`mmrp`—Tunnel Multiple MAC Registration Protocol (MMRP) packets.

`mvrp`—Tunnel Multiple VLAN Registration Protocol (MVRP) packets.

`pvstp`—Tunnel VLAN Spanning Tree Protocol (VSTP), Per-VLAN Spanning Tree (PVST), and Per-VLAN Spanning Tree Plus (PVST+) Protocol packets.

`stp`—Tunnel packets for all versions of Spanning-Tree Protocols.

`udld`—Tunnel Unidirectional Link Detection (UDLD) packets.

`vstp`—Tunnel VLAN Spanning Tree Protocol (VSTP) packets.

`vtp`—Tunnel VLAN Trunking Protocol (VTP) packets.

Required Privilege Level

`interface`—To view this statement in the configuration.

`interface-control`—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 9.1.

Support for PVST/PVST+ introduced in Junos OS Release 13.3 for MX Series routers and EX9200 switches.

Support for E-LMI, IEEE 802.1X, MMRP, and UDLD introduced in Junos OS Release 17.3R1 for EX4300 switches.

Support for E-LMI, GVRP, IEEE 802.1x, IEEE 802.3AH, LACP, LLDP, MMRP, MVRP, and UDLD introduced in Junos OS Release 17.3R1 for EX9200 switches.

Support for E-LMI, IEEE 802.1X, MMRP, and UDLD introduced in Junos OS Release 18.2R1 for EX2300 and EX3400 switches.

all option added in Junos OS Release 22.3R1.

RELATED DOCUMENTATION

Understanding Layer 2 Protocol Tunneling

Configuring Layer 2 Protocol Tunneling

protocols (STP Type)

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Syntax

```
protocols {  
  mstp { ... }  
}
```

```

    rstp { ... }
    vstp { ... }
}

```

Hierarchy Level

```
[edit],
```

```

[edit logical-systems logical-system-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name],

```

```
[edit routing-instances routing-instance-name]
```

Description

Configure the Spanning Tree Protocol type as MSTP, RSTP, or VSTP.

Options

mstp—Configure the protocol as Multiple Spanning Tree.

rstp—Configure the protocol as Rapid Spanning Tree.

vstp—Configure the protocol as VLAN Spanning Tree.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Configuring RSTP on EX Series Switches \(CLI Procedure\) | 31](#)

[Configuring MSTP on Switches | 91](#)

[Configuring MSTP Instances on a Physical Interface | 98](#)

[Configuring Rapid Spanning Tree Protocol | 28](#)

[Configuring Multiple Spanning Tree Protocol | 95](#)

[Configuring VLAN Spanning Tree Protocol](#)

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revision-level

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Syntax

```
revision-level revision-level;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols mstp],
[edit logical-systems logical-system-name routing-instances routing-instance-name
 protocols mstp],
```

```
[edit protocols mstp],
[edit routing-instances routing-instance-name protocols mstp]
```

Description

For Multiple Spanning Tree Protocol (MSTP), set the revision number of the MSTP configuration.

Options

revision-level—Configure the revision number of the MSTP region configuration.

- **Range:** 0 through 65,535

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding MSTP | 87](#)

[Configuring Multiple Spanning Tree Protocol | 95](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

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rstp

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MX Series

```
rstp {
  bpdu-block-on-edge;
  bpdu-destination-mac-address provider-bridge-group;
  bridge-priority priority;
  extended-system-id;
  force-version stp;
  forward-delay seconds;
  hello-time seconds;
  max-age seconds;
```



```

interface interface-name {
    bpdu-timeout-action {
        alarm;
        block;
    }
    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
}
priority-hold-time seconds;
traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
}

```

EX Series

```

rstp {
    bpdu-block-on-edge;
    bridge-priority priority;
    disable;
    forward-delay seconds;
    hello-time seconds;
    interface (all | interface-name) {
        arp-on-stp;
        bpdu-timeout-action {
            block;
            log;
        }
        cost cost;
        edge;
        mode mode;
        no-root-port;
        priority priority;
    }
}

```

```

                                max-age                seconds;
                                traceoptions {
    file filename <files number > <size size> <no-stamp | no-world-
readable | world-readable>;
    flag flag;
    }
}

```

ELS Versions: EX Series, QFX Series, NFX Series

```

rstp {
    bpdu-block-on-edge;
    bpdu-destination-mac-address provider-bridge-group;
    bridge-priority priority;
    disable;
    extended-system-id;
    force-version stp;
    forward-delay seconds;
    hello-time seconds;
    max-age seconds;
    priority-hold-time seconds;
    traceoptions {
        file filename <files number> <size size> <world-readable | no-world-readable>;
        flag flag <flag-modifier> <disable>;
    }
}

```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols],
```

```
[edit protocols],
```

```
[edit routing-instances routing-instance-name protocols]
```

Description

Configure Rapid Spanning Tree Protocol (RSTP). RSTP is defined in the IEEE 802.1D-2004 specification and is used to prevent loops in Layer 2 networks, which results in shorter convergence times than those provided by basic Spanning Tree Protocol (STP).

VSTP and RSTP can be configured concurrently. You can selectively configure up to 253 VLANs using VSTP; the remaining VLANs will be configured using RSTP. VSTP and RSTP are the only spanning-tree protocols that can be configured concurrently on the switch.

BEST PRACTICE: Configure RSTP when you configure VSTP. RSTP overhead is minimal and this configuration ensures that a spanning-tree protocol is running on all VLANs on your switch, even when your switch is supporting more than 253 VLANs.

The remaining statements are explained separately. See [CLI Explorer](#).

Default

RSTP is enabled on all Ethernet switching interfaces.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

bpdu-block-on-edge statement added in Junos OS Release 9.4.

bpdu-timeout-action statement added in Junos OS Release 9.4.

Support for logic systems added in Junos OS Release 9.6.

Statement updated in Junos OS Release 15.1 for EX Series and QFX Series switches to support configuration of spanning tree parameters globally on all interfaces.

NOTE: You cannot disable spanning tree parameters globally on all interfaces.

RELATED DOCUMENTATION

[Configuring Rapid Spanning Tree Protocol | 28](#)

[Understanding RSTP | 27](#)

[Configuring RSTP on EX Series Switches \(CLI Procedure\) | 31](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[show spanning-tree bridge | 382](#)

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shutdown (BPDU Block)

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Syntax

```
shutdown;
```

Hierarchy Level

```
[edit ethernet-switching-options bpdu-block interface (all | [interface-name])]
```

Description

Shut down all or specified interfaces to prevent spanning-tree protocol BPDUs (for STP, MSTP, RSTP, and VSTP) from entering the interfaces on which BPDU protection is configured.

Default

Not enabled

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

[Understanding BPDU Protection for STP, RSTP, and MSTP | 162](#)

[Unblocking an Interface on non-ELS EX Series Switches That Receives BPDUs in Error \(CLI Procedure\) | 241](#)

stp

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Syntax

```

stp {
    disable;
    bridge-priority                priority;
    forward-delay                  seconds;
    hello-time                     seconds;
    interface (all | interface-name) {
        disable;
        bpdu-timeout-action {
            block;
            alarm;
        }
        cost                       cost;
        edge;
        mode                       mode;
        no-root-port;
        priority                   priority;
    }
    max-age                       seconds;
    traceoptions {
        file name <replace> <size size> <files number> <no-stamp>
            <(world-readable | no-world-readable)>;
        flag flag <flag-modifier> <disable>;
    }
}

```

Syntax (EX Series)

```

stp {
    bpdu-block-on-edge            ;
    bridge-priority                priority;
    disable;
    forward-delay                  seconds;
    hello-time                     seconds;
    interface (all | interface-name) {
        arp-on-stp;
        bpdu-timeout-action {

```

```

        block;

        log;
    }

    cost
    disable;
    mode
    no-root-port;
    priority

    cost;
    mode;
    priority;

    max-age
    seconds;

    traceoptions {
        file filename <files number > <size size> <no-stamp | world-readable | no-world-
readable>;
        flag flag;
    }
}

```

Hierarchy Level

```

[edit protocols],
[edit protocols rstp force-version]

```

Description

When you explicitly configure STP, a switch uses the IEEE 802.1D 2004 specification, force version 0. This configuration runs a version of RSTP that is compatible with the classic, basic STP (defined in the IEEE 802.1D 1998 specification).

The remaining statements are explained separately. See [CLI Explorer](#).

NOTE: Although the edge configuration statement appears in the CLI on the switch, this statement has no effect on the switch operation if you configure it.

Default

STP is disabled; by default, RSTP is enabled on all Ethernet switching ports.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.0.

RELATED DOCUMENTATION

[Overview of Spanning-Tree Protocols](#)

[Understanding STP | 23](#)

[Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations](#)

Example: Configuring BPDU Protection on Edge Interfaces to Prevent STP Miscalculations on non-ELS EX Series Switches

[Configuring STP on EX Series Switches \(CLI Procedure\) | 25](#)

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system-id

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- [Description | 336](#)
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Syntax

```
system-id system-id-value {
    ip-address(es);
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],
[edit logical-systems logical-system-name protocols vstp vlan vlan-id],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp
vlan vlan-id],
[edit protocols (mstp | rstp)],
[edit protocols vstp vlan vlan-id],
[edit routing-instances routing-instance-name protocols (mstp | rstp)],
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id]
```

Description

Determine the system identifier value for bridges in a VPLS multihomed Layer 2 ring with MPLS infrastructure.

Options

system-id-value—System identifier in the format *nnnnnnn.nnnnnnn*, where *n* = any digit from 0 through 9.

- **Range:** Any valid value
- **Default:** None

ip-address(es)—Valid IP host addresses in the format *ip-address/32*.

- **Range:** Any valid IP address
- **Default:** None

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 10.0.

RELATED DOCUMENTATION

| [Understanding VPLS Multihoming](#) | 207

traceoptions (Spanning Tree)

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Syntax

```
traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp | vstp)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
(mstp | rstp | vstp)],
```

```
[edit protocols (mstp | rstp | vstp | vstp vlan vlan-id)],
```

```
[edit routing-instances routing-instance-name protocols (mstp | rstp | vstp)]
```

Description

Sets protocol-level tracing options for for spanning-tree protocols MPLS, MVRP, STP, RSTP, MSTP, and VSTP.

Default

The default STP protocol-level trace options are inherited from the global `traceoptions` statement. Traceoptions is disabled.

Options

disable—(Optional) Disable the tracing operation. One use of this option is to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks. We recommend that you place STP tracing output in the file `/var/log/stp-log`.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file.0***, then ***trace-file.1***, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

- **Range:** 2 through 1000 files
- **Default:** 1 trace file only

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. The following are the STP-specific tracing options:

- **all**—Trace all operations.
- **all-failures**—Trace all failure conditions.
- **bpdu**—Trace BPDU reception and transmission.
- **bridge-detection-state-machine**—Trace the bridge detection state machine.
- **error**—Trace all failure conditions.
- **events**—Trace events of the protocol state machine.
- **pdu**—Trace PDUs that were received and sent.
- **port-information-state-machine**—Trace the port information state machine.
- **port-migration-state-machine**—Trace the port migration state machine.
- **port-receive-state-machine**—Trace the port receive state machine.

- **port-role-transit-state-machine**—Trace the port role transit state machine.
- **port-role-select-state-machine**—Trace the port role selection state machine.
- **port-state-transit-state-machine**—Trace the port state transit state machine.
- **port-transmit-state-machine**—Trace the port transmit state machine.
- **ppmd**—Trace the state and events for the ppm process.
- **socket**—Trace socket activity.
- **state-machine**—Trace state machine information.
- **state-machine-variables**—Trace when the state machine variables change.
- **timers**—Trace protocol timers.
- **topology-change-state-machine**—Trace the topology change state machine.

The following are the global tracing options:

- **all**—All tracing operations.
- **config-internal**—Trace configuration internals.
- **general**—Trace general events.
- **normal**—All normal events.
- **Default**: If you do not specify this option, only unusual or abnormal operations are traced.
- **parse**—Trace configuration parsing.
- **policy**—Trace policy operations and actions.
- **regex-parse**—Trace regular-expression parsing.
- **route**—Trace routing table changes.
- **state**—Trace state transitions.
- **task**—Trace protocol task processing.
- **timer**—Trace protocol task timer processing.

no-world-readable—(Optional) Prevent any user from reading the log file.

replace—(Optional) Replace an existing trace file if there is one.

- **Default**: If you do not include this option, tracing output is appended to an existing trace file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB) or megabytes (MB). When a trace file named *trace-file* reaches this size, it is renamed *trace-file.0*. When the *trace-file* again reaches its maximum size, *trace-file.0* is renamed *trace-file.1* and *trace-file* is renamed *trace-file.0*. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the `files` option.

- **Syntax:** *xk* to specify KB, *xm* to specify MB, or *xg* to specify GB
- **Range:** 10 KB through the maximum file size supported on your system
- **Default:** 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding RSTP | 27](#)

[Understanding STP | 23](#)

[Understanding VSTP](#)

[Understanding Multiple VLAN Registration Protocol \(MVRP\)](#)

[Understanding Spanning-Tree Protocol Trace Options | 237](#)

[Configuring Tracing Spanning-Tree Operations | 237](#)

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[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches | 59](#)

[Example: Tracing Spanning-Tree Protocol Operations | 240](#)

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vlan (MSTP)

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Syntax

```
vlan vlan-id;
```

EX Series

```
vlan (all | vlan-id | vlan-name) {  
    bridge-priority priority;  
    forward-delay seconds;
```



```

hello-time seconds;
interface interface-name {
    bpdu-timeout-action {
        block;
        log;
    }
    cost cost;
    disable;
    edge;
    mode mode;
    no-root-port;
    priority priority;
}
max-age seconds;
traceoptions {
    file filename <files number > <size size> <no-stamp | world-readable | no-world-
readable>;
    flag flag;
}
}

```

Hierarchy Level

```

[edit logical-systems logical-system-name protocols mstp msti msti-id],
[edit logical-systems logical-system-name routing-instances routing-instance-name
protocols mstp msti msti-id],

```

```

[edit protocols mstp msti msti-id],
[edit protocols mstpmsti msti-id]
[edit protocols vstp]

```

```

[edit routing-instances routing-instance-name protocols mstp msti msti-id]

```

Description

Configure the VLANs for a Multiple Spanning Tree Instance (MSTI) or VSTP instance.

NOTE: When you configure VSTP with the `set protocol vstp vlan all` command, `vlan-id 1` is excluded to be compatible with Cisco PVST+. If you want `vlan-id 1` to be included in VSTP, you must set it separately with the `set protocol vstp vlan 1` command.

TIP: To display a list of all configured VLANs on the system, including VLANs that are configured but not committed, type `?` after **vlan** or **vlangs** in your configuration mode command line. Note that only one VLAN is displayed for a VLAN range.

Options

vlan-name—Name of the VLAN.

vlan-id—The VLAN identifier associated with the MSTI.

vlan-id-range—Range of VLAN identifiers associated with the MSTI in the form *minimum-vlan-id-maximum-vlan-id*. VLAN identifier ranges are not supported for VSTP.

- **Range:** 1 through 4096

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 8.4.

Statement updated with enhanced ? (CLI completion feature) functionality in Junos OS Release 9.5 for EX Series switches.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding MSTP | 87](#)

[Understanding VSTP](#)

[Configuring Multiple Spanning Tree Protocol | 95](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

vlan (VSTP)

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- [Hierarchy Level | 347](#)
- [Description | 347](#)
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- [Required Privilege Level | 347](#)
- [Release Information | 348](#)

Syntax

```
vlan vlan-id {  
    bridge-priority priority;  
    forward-delay seconds;  
    hello-time seconds;  
    max-age seconds;  
    interface interface-name {
```

```

    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
  }
}

```

EX Series

```

    vlan (all | vlan-id | vlan-name) {
        bridge-priority priority;
        forward-delay seconds;
        hello-time seconds;
        interface (all | interface-name) {
            bpdutimeout-action {
                block;
                log;
            }
            cost cost;
            disable;
            edge;
            mode mode;
            no-root-port;
            priority priority;
        }
        max-age seconds;
        traceoptions {
            file filename <files number > <size size> <no-stamp | world-readable | no-world-
readable>;
            flag flag;
        }
    }
}

```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols vstp],
[edit protocols vstp]
```

Description

Configure VSTP VLAN parameters.

TIP: To display a list of all configured VLANs on the system, including VLANs that are configured but not committed, type ? after **vlan** or **vlangs** in your configuration mode command line. Note that only one VLAN is displayed for a VLAN range.

Options

all	All VLANs.
<i>vlan-id</i>	Numeric VLAN identifier.
<i>vlan-range</i>	Name of the VLAN range.

The remaining statements are explained separately. See [CLI Explorer](#).

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.0.

Support for logical systems added in Junos OS Release 9.6.

RELATED DOCUMENTATION

[Understanding VSTP](#)

[Configuring VLAN Spanning Tree Protocol](#)

vlan-group

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- [Description | 349](#)
- [Required Privilege Level | 349](#)
- [Release Information | 349](#)

Syntax

```
vlan-group group group-name {  
  vlan (vlan-id |vlan-group |all) {  
  }
```

Hierarchy Level

```
[edit protocols vstp]
```

Description

Configure VLAN group for Spanning Tree Protocol (VSTP). VSTP is used to prevent loops in Layer 2 networks on a per-VLAN basis.

BEST PRACTICE: Configure RSTP when you configure VSTP. RSTP overhead is minimal and this configuration ensures that a spanning-tree protocol is running on all VLANs on your switch, even when your switch is supporting more than the maximum number of allowed VSTP VLANs.

The remaining statements are explained separately. See [CLI Explorer](#).

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 15.1.

RELATED DOCUMENTATION

[vstp](#) | [351](#)

[show spanning-tree bridge](#) | [382](#)

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vpls-flush-on-topology-change

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- [Release Information | 351](#)

Syntax

```
vpls-flush-on-topology-change;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols (mstp | rstp)],  
[edit logical-systems logical-system-name protocols vstp vlan vlan-id],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols  
(mstp | rstp)],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vstp  
vlan vlan-id],  
[edit protocols (mstp | rstp)],  
[edit protocols vstp vlan vlan-id],  
[edit routing-instances routing-instance-name protocols (mstp | rstp)],  
[edit routing-instances routing-instance-name protocols vstp vlan vlan-id]
```


Description

Determine the action the bridge should take when the topology of a multihomed Layer 2 ring with MPLS infrastructure changes: flush the media access control (MAC) cache or not. By default, the bridge does not flush the cache when the topology changes.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 10.0.

vstp

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MX Series

```
vstp {
    bpdu-block-on-edge;
    force-version stp;
    interface interface-name {
        bpdu-timeout-action {
            alarm;
            block;
        }
        cost cost;
        edge;
        mode (p2p | shared);
        no-root-port;
        priority interface-priority;
    }
    priority-hold-time seconds;
    vlan vlan-id {
        bridge-priority priority;
        forward-delay seconds;
        hello-time seconds;
        max-age seconds;
        interface interface-name {
            access-trunk
            bpdu-timeout-action {
                alarm;
                block;
            }
            cost cost;
            edge;
            mode (p2p | shared);
            no-root-port;
            priority interface-priority;
        }
    }
}
traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
}
```

EX Series, QFX Series, QFabric

```
vstp {
    bpdu-block-on-edge;
    disable;
    force-version stp;
    vlan (all | vlan-id | vlan-name) {
        bridge-priority priority;
        forward-delay seconds;
        hello-time seconds;
        interface (all | interface-name) {
            arp-on-stp;
            bpdu-timeout-action {
                block;
                log;
            }
            cost cost;
            disable;
            edge;
            mode mode;
            no-root-port;
            priority priority;
        }
        max-age seconds;
        traceoptions {
            file filename <files number > <size size> <no-stamp | no-world-readable | world-
readable>;
            flag flag;
        }
    }
}
```

ELS versions: EX Series, QFX Series, NFX Series

```
vstp {
    bpdu-block-on-edge;
    disable;
    force-version stp;
```

```

interface (interface-name disable | interface-range-name | all ){
    bpdu-timeout-action {
        alarm;
        block;
    }
    cost cost;
    edge;
    mode (p2p | shared);
    no-root-port;
    priority interface-priority;
}
priority-hold-time seconds;
vlan (vlan-id | all){
    bridge-priority priority;
    forward-delay seconds;
    hello-time seconds;
    max-age seconds;
    interface (interface-name disable | interface-range-name | all ){
        bpdu-timeout-action {
            alarm;
            block;
        }
        cost cost;
        edge;
        mode (p2p | shared);
        no-root-port;
        priority interface-priority;
    }
}
traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
vlan-group group group-name {
    vlans vlan-name (vlan-id |vlan-range | open-set-of-values) {
        interface all;
        interface interface-name {
            disable;
        }
    }
}
}

```

Hierarchy Level

```
[edit protocols]
```

```
[edit logical-systems logical-system-name protocols],  
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols],
```

```
[edit protocols],
```

```
[edit routing-instances routing-instance-name protocols]
```

Description

Configures VLAN Spanning Tree Protocol (VSTP). VSTP is used to prevent loops in Layer 2 networks on a per-VLAN basis.

You can have a maximum of 253 VSTP VLANs per switch.

If the number of VLANs on your switch exceeds the VSTP VLAN limit, you must use the [vlan](#) statement to specify which VLANs or VLAN groups use VSTP. You also cannot use the **vlan all** option to configure VSTP when your switch has more than the maximum allowed VSTP VLANs. To ensure all VLANs are running a spanning-tree protocol, run RSTP for networks with large numbers of VLANs .

NOTE: When you configure VSTP with the `set protocol vstp vlan all` command, VLAN ID 1 is not set; it is excluded so that the configuration is compatible with Cisco PVST+. If you want VLAN ID 1 to be included in the VSTP configuration on your switch, you must set it separately with the `set protocol vstp vlan 1` command.

NOTE: Option `vlan all` is not supported in Junos OS Release 13.2X50.

BEST PRACTICE: Configure RSTP when you configure VSTP. RSTP overhead is minimal and this configuration ensures that some spanning tree protocol is running on all VLANs on your switch, even when your switch has more than the maximum number of allowed VSTP VLANs.

The remaining statements are explained separately. See [CLI Explorer](#).

Default

VSTP is not enabled by default.

Required Privilege Level

routing—To view this statement in the configuration.

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

Release Information

Statement introduced in Junos OS Release 9.0.

bpdu-block-on-edge statement added in Junos OS Release 9.4.

bpdu-timeout-action statement added in Junos OS Release 9.4.

Support for logical systems added in Junos OS Release 9.6.

Statement updated in Junos OS Release 15.1 for EX Series switches to support configuration of spanning tree parameters globally on all interfaces.

NOTE: You cannot disable spanning tree parameters globally on all interfaces.

RELATED DOCUMENTATION

Understanding VSTP
Configuring VLAN Spanning Tree Protocol
Configuring VSTP (CLI Procedure)
Example: Configuring VSTP on QFX Series Switches and EX4600 Switches
show spanning-tree bridge 382
show spanning-tree interface 390

9

CHAPTER

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clear error bpdu interface

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MX Series

```
clear error bpdu interface interface-name
```

QFX Series, EX Series, NFX Series

```
clear error bpdu interface (all | interface-name)
```

Description

Clear a bridge protocol data unit (BPDU) error condition caused by the detection of a possible bridging loop from Spanning Tree Protocol (STP) operation.

Required Privilege Level

clear

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear error bpdu interface ge-1/1/1

```
user@host> clear error bpdu interface ge-1/1/1
```

Release Information

Command introduced in Junos OS Release 9.4.

Command supports all option in Junos OS Release 15.1 for EX Series switches.

RELATED DOCUMENTATION

Configuring BPDU Protection on ACX Router, EX Switch and MX Router Edge Ports

[Unblocking a Switch Interface That Receives BPDUs in Error \(CLI Procedure\) | 240](#)

clear error mac-rewrite

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Syntax

```
clear error mac-rewrite  
<interface interface-name>
```

Description

Clear a MAC rewrite error condition on an interface receiving tunneled Layer 2 protocol packets.

On interfaces with L2PT configured, customer-facing ports should not receive packets with the L2PT MAC address as the destination address unless there is a network topology or configuration error. The device sets the status of such interfaces to “Disabled”. Use this command to clear the error and re-enable the interface.

Options

interface *interface-name* (Optional) Clear the MAC rewrite error condition for the specified interface.

Required Privilege Level

clear

Output Fields

When you enter this command, the device returns feedback on the status of the request.

Sample Output

clear error mac-rewrite interface

```
user@host> clear error mac-rewrite interface ge-1/0/1
```

Release Information

Command introduced in Junos OS Release 9.1.

RELATED DOCUMENTATION

Configuring Layer 2 Protocol Tunneling

Clearing a MAC Rewrite Error on an Interface with Layer 2 Protocol Tunneling

show mac-rewrite interface

clear ethernet-switching bpdu-error interface

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Syntax

```
clear ethernet-switching bpdu-error interface interface-name
```

Description

Clear bridge protocol data unit (BPDU) errors from an interface and bring up the interface.

NOTE: This command is only available on switches running Junos OS without support for the Enhanced Layer 2 Software (ELS) configuration style. To clear BPDU errors from switches that support ELS, see ["clear error bpdu interface" on page 359](#).

Options

interface-name Clear BPDU errors on the specified interface.

Required Privilege Level

clear

Sample Output

clear ethernet-switching bpdu-error interface

```
user@switch> clear ethernet-switching bpdu-error interface xe-0/0/1.0
```

Release Information

Command introduced in Junos OS Release 9.1.

Command updated in Junos OS Release 11.1 for EX Series switches—a BPDU error shuts down the interface and this command brings the interface back up.

RELATED DOCUMENTATION

[show spanning-tree interface](#) | 390

clear spanning-tree protocol-migration

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- [Sample Output | 366](#)
- [Release Information | 366](#)

Syntax

```
clear spanning-tree protocol-migration
<interface interface-name>
<routing-instance routing-instance-name>
```

Description

Revert from the original IEEE 802.1D Spanning Tree Protocol (STP) back to the Rapid Spanning Tree Protocol after the `force-version` statement has been removed from the configuration.

Options

none	Reset the STP protocol for all interfaces and all routing instances.
interface <i>interface-name</i>	(Optional) Reset the STP protocol for the specified interface only.
routing-instance <i>routing-instance-name</i>	(Optional) Reset the STP protocol for a particular routing instance.

Additional Information

For information about the `force-version` statement, see the *Junos Routing Protocols Configuration Guide*.

Required Privilege Level

clear

Sample Output

clear spanning-tree protocol-migration

```
user@host> clear spanning-tree protocol-migration
```

Release Information

Command introduced in Junos OS Release 9.0.

clear spanning-tree statistics

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Syntax

```
clear spanning-tree statistics
<interface interface-name>
<logical-system logical-system-name>
```

Syntax (EX Series Switches and the QFX Series)

```
clear spanning-tree statistics
<interface interface-name>
```

Description

Clear Spanning Tree Protocol statistics for all interfaces or a specified interface.

Options

none	Reset STP counters for all interfaces for all routing instances.
interface <i>interface-name</i>	(Optional) Clear STP statistics for the specified interface only.
logical-system <i>logical-system-name</i>	(Optional) Clear STP statistics on a particular logical system.

NOTE: The **logical-system** option is not available on QFabric systems.

Required Privilege Level

clear

Output Fields

This command produces no output.

Sample Output

clear spanning-tree statistics

```
user@switch> clear spanning-tree statistics
```

Release Information

Command introduced in Junos OS Release 8.4.

RELATED DOCUMENTATION

[Understanding STP | 23](#)

[show spanning-tree statistics | 407](#)

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clear spanning-tree statistics bridge

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Syntax

```
clear spanning-tree statistics bridge
```

Description

Clear the statistics of the bridge.

Required Privilege Level

clear

Sample Output

clear spanning-tree statistics bridge (MX Series)

command-name

```
user@host> clear spanning-tree statistics bridge
```

Release Information

Command introduced in Junos OS Release 14.1.

clear spanning-tree stp-buffer

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Syntax

```
clear spanning-tree stp-buffer
```

Description

Clear the stp-buffer.

Required Privilege Level

clear

Sample Output

clear spanning-tree stp-buffer (MX Series)

command-name

```
user@host> clear spanning-tree stp-buffer
```

Release Information

Command introduced in Junos OS Release 14.1.

show bridge mac-table

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- [Additional Information | 373](#)
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- [Output Fields | 373](#)
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Syntax

```
show bridge mac-table  
<age>  
<brief | count | detail | extensive>  
<bridge-domain (all | bridge-domain-name)>  
<global-count>  
<instance instance-name>
```

```
<interface interface-name>
<mac-address>
<instance instance-name>
<vlan-id (all-vlan | vlan-id)>
```

Description

(MX Series routers only) Display Layer 2 MAC address information.

Options

none	Display all learned Layer 2 MAC address information.
age	(Optional) Display age of a single mac-address.
brief count detail extensive	(Optional) Display the specified level of output.
bridge-domain (all <i>bridge-domain-name</i>)	(Optional) Display learned Layer 2 MAC addresses for all bridging domains or for the specified bridging domain.
global-count	(Optional) Display the total number of learned Layer 2 MAC addresses on the system.
instance <i>instance-name</i>	(Optional) Display learned Layer 2 MAC addresses for the specified routing instance.
interface <i>interface-name</i>	(Optional) Display learned Layer 2 MAC addresses for the specified interface.
<i>mac-address</i>	(Optional) Display the specified learned Layer 2 MAC address information.
vlan-id (all-vlan <i>vlan-id</i>)	(Optional) Display learned Layer 2 MAC addresses for all VLANs or for the specified VLAN.

Additional Information

When Layer 2 protocol tunneling is enabled, the tunneling MAC address 01:00:0c:cd:cd:d0 is installed in the MAC table. When the Cisco Discovery Protocol (CDP), Spanning Tree Protocol (STP), or VLAN Trunk Protocol (VTP) is configured for Layer 2 protocol tunneling on an interface, the corresponding protocol MAC address is installed in the MAC table.

Required Privilege Level

view

Output Fields

[Table 16 on page 373](#) describes the output fields for the `show bridge mac-table` command. Output fields are listed in the approximate order in which they appear.

Table 16: show bridge mac-table Output Fields

Field Name	Field Description
Age	Age of a single mac-address.
Routing instance	Name of the routing instance.
Bridging domain	Name of the bridging domain.
MAC address	MAC address or addresses learned on a logical interface.

Table 16: show bridge mac-table Output Fields (Continued)

Field Name	Field Description
MAC flags	<p>Status of MAC address learning properties for each interface:</p> <ul style="list-style-type: none"> • S—Static MAC address is configured. • D—Dynamic MAC address is configured. • L—Locally learned MAC address is configured. • C—Control MAC address is configured. • SE—MAC accounting is enabled. • NM—Non-configured MAC. • R—Remote PE MAC address is configured. • P—MAC Pinned interface is configured
Logical interface	Name of the logical interface.
MAC count	Number of MAC addresses learned on the specific routing instance or interface.
Learning interface	Name of the logical interface on which the MAC address was learned.
Learning VLAN	VLAN ID of the routing instance or bridge domain in which the MAC address was learned.
VXLAN ID/VXLAN	VXLAN Network Identifier (VNI).
Layer 2 flags	Debugging flags signifying that the MAC address is present in various lists.
Epoch	Spanning Tree Protocol epoch number identifying when the MAC address was learned. Used for debugging.
Sequence number	Sequence number assigned to this MAC address. Used for debugging.

Table 16: show bridge mac-table Output Fields (Continued)

Field Name	Field Description
Learning mask	Mask of the Packet Forwarding Engines where this MAC address was learned. Used for debugging.
IPC generation	Creation time of the logical interface when this MAC address was learned. Used for debugging.

Sample Output

show bridge mac-table

```

user@host> show bridge mac-table
MAC flags (S -static MAC, D -dynamic MAC, L -locally learned, C -Control MAC
          SE -Statistics enabled, NM -Non configured MAC, R -Remote PE MAC)

Routing instance : default-switch
Bridging domain : test1, VLAN : 1
  MAC          MAC    Logical      NH      RTR
  address      flags   interface   Index   ID
  01:00:0c:cc:cc:cc S,NM    NULL
  01:00:0c:cc:cc:cd S,NM    NULL
  01:00:0c:cd:cd:d0 S,NM    NULL
  64:87:88:6a:17:d0 D        ae0.1
  64:87:88:6a:17:f0 D        ae0.1

```

show bridge mac-table (with Layer 2 Services over GRE Interfaces)

```

user@host> show bridge mac-table
MAC flags (S -static MAC, D -dynamic MAC, L -locally learned
          SE -Statistics enabled, NM -Non configured MAC, R -Remote PE MAC)

Routing instance : default-switch

```

```

Bridging domain : vlan-1, VLAN : 1
  MAC          MAC      Logical
  address      flags    interface
  00:01:01:00:01:f7 D,SE   gr-1/2/10.0
  00:03:00:32:01:f7 D,SE   gr-1/2/10.0
  00:00:21:11:11:10 DL      ge-1/0/0.0
  00:00:21:11:11:11 DL      ge-1/1/0.0

```

```

Routing instance : default-switch
Bridging domain : vlan-2, VLAN : 2
  MAC          MAC      Logical
  address      flags    interface
  00:02:01:33:01:f7 D,SE   gr-1/2/10.1
  00:00:21:11:21:10 DL      ge-1/0/0.1
  00:00:21:11:21:11 DL      ge-1/1/0.1

```

show bridge mac-table (with VXLAN enabled)

```

user@host> show bridge mac-table
MAC flags (S -static MAC, D -dynamic MAC, L -locally learned
          SE -Statistics enabled, NM -Non configured MAC, R -Remote PE MAC)

Routing instance : default-switch
Bridging domain : vlan-1, VLAN : 1
VXLAN: Id : 100, Multicast group: 233.252.0.1
  MAC          MAC      Logical
  address      flags    interface
  00:01:01:00:01:f7 D,SE   vtep.1052010
  00:03:00:32:01:f7 D,SE   vtep.1052011
  00:00:21:11:11:10 DL      ge-1/0/0.0
  00:00:21:11:11:11 DL      ge-1/1/0.0

Routing instance : default-switch
Bridging domain : vlan-2, VLAN : 2, VXLAN : 200
VXLAN: Id : 200, Multicast group: 233.252.0.2
  MAC          MAC      Logical
  address      flags    interface
  00:02:01:33:01:f7 D,SE   vtep.1052010

```

```
00:04:00:14:01:f7  D,SE    vtep.1052011
00:00:21:11:21:10  DL      ge-1/0/0.1
00:00:21:11:21:11  DL      ge-1/1/0.1
```

show bridge mac-table age (for GE interface)

```
user@host> show vpls mac-table age 00:02:03:aa:bb:1a instance vpls_instance_1
MAC Entry Age information
Current Age: 4 seconds
```

show bridge mac-table age (for AE interface)

```
user@host> show vpls mac-table age 00:02:03:aa:bb:1a instance vpls_instance_1
MAC Entry Age information
Current Age on FPC1: 102 seconds
Current Age on FPC2: 94 seconds
```

show bridge mac-table count

```
user@host> show bridge mac-table count
2 MAC address learned in routing instance vs1 bridge domain vlan100
```

MAC address count per interface within routing instance:

Logical interface	MAC count
ge-11/0/3.0	1
ge-11/1/4.100	0
ge-11/1/1.100	0
ge-11/1/0.100	0
xe-10/2/0.100	1
xe-10/0/0.100	0

MAC address count per learn VLAN within routing instance:

Learn VLAN ID	MAC count
0	2

```
0 MAC address learned in routing instance vs1 bridge domain vlan200
```

MAC address count per interface within routing instance:

Logical interface	MAC count
ge-11/1/0.200	0
ge-11/1/1.200	0
ge-11/1/4.200	0
xe-10/0/0.200	0
xe-10/2/0.200	0

MAC address count per learn VLAN within routing instance:

Learn VLAN ID	MAC count
0	0

show bridge mac-table detail

```
user@host> show bridge mac-table detail
```

MAC address: 00:00:00:19:1c:db

Routing instance: vs1

Bridging domain: vlan100

Learning interface: ge-11/0/3.0 Learning VLAN: 0

Layer 2 flags: in_ifd, in_ifl, in_vlan, kernel

Epoch: 4 Sequence number: 0

Learning mask: 0x800 IPC generation: 0

MAC address: 00:00:00:59:3a:2f

Routing instance: vs1

Bridging domain: vlan100

Learning interface: xe-10/2/0.100 Learning VLAN: 0

Layer 2 flags: in_ifd, in_ifl, in_vlan, kernel

Epoch: 7 Sequence number: 0

Learning mask: 0x400 IPC generation: 0

show bridge mac-table instance pbb-evpn

```
user@host> show bridge mac-table instance pbb-evpn
```

Routing instance : pbb-evpn

Bridging domain : isid-bd10000, ISID : 10000

MAC	MAC	Logical	NH	RTR
address	flags	interface	Index	ID
00:19:e2:b0:76:eb	D	cbp.1000		

aa:bb:cc:dd:ee:f2	DC	1048576	1048576
aa:bb:cc:dd:ee:f3	DC	1048575	1048575

show bridge mac-table

```
user@host>run show bridge mac-table
MAC flags (S -static MAC, D -dynamic MAC, L -locally learned, C -Control MAC
O -OVSDb MAC, SE -Statistics enabled, NM -Non configured MAC, R -Remote PE MAC, P -Pinned MAC)

Routing instance : VS-541
Bridging domain : 541, VLAN : 541
MAC MAC Logical NH RTR
address flags interface Index ID
00:00:01:00:00:01 DPRC xe-0/0/3.0
00:00:02:00:00:01 DP xe-0/0/3.0
```

Release Information

Command introduced in Junos OS Release 8.4.

Support for PBB-EVPN instance added in Junos OS Release 16.1

MAC Flag P to indicate a MAC Pinned interface introduced in Junos OS 16.2

show mac-rewrite interface

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Syntax

```
show mac-rewrite interface  
  
<brief | detail>  
<interface-name>
```

Description

Display Layer 2 protocol tunneling (L2PT) information.

Options

- | | |
|--|--|
| brief detail | (Optional) Display the specified level of output. |
| interface <i>interface-name</i> | (Optional) Display L2PT information for the specified interface. |

Required Privilege Level

view

Output Fields

[Table 17 on page 381](#) lists the output fields for the `show mac-rewrite interface` command. Output fields are listed in the approximate order in which they appear.

Table 17: show mac-rewrite interface Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the interface on which L2PT is configured.	brief detail
Tunnel destination MAC address	Name of the configured Layer 2 multicast MAC address	brief detail
Protocols	<p>Layer 2 protocols being tunneled on this interface.</p> <p>All devices that support L2PT can tunnel the following protocols: Cisco Discovery Protocol (CDP), Spanning Tree Protocol (STP), or VLAN Trunk Protocol (VTP).</p> <p>The following Layer 2 protocols can also be tunneled on some devices that support L2PT: E-LMI, GVRP, IEEE 802.1X, IEEE 802.3AH, LACP, LLDP, MMRP, MVRP, PVSTP+, UDLD, or VSTP. See <i>protocol</i> for more information on the supported protocols for tunneling on different devices.</p>	brief detail

Sample Output

show mac-rewrite interface

```

user@host> show mac-rewrite interface
Tunnel dest mac      : 01:00:0C:CD:CD:D0
Interface      Protocols

et-0/0/0        STP 8021X 8023AH ELMI LACP LLDP MMRP MVRP VTP CDP

```

show mac-rewrite interface (EX Series Switches)

```

user@switch> show mac-rewrite interface
Interface      Protocols

```

ge-0/0/1 802.3AH LLDP STP

Release Information

Command introduced in Junos OS Release 9.1.

Command introduced in Junos OS Release 14.1X53-D10 and 17.3R1 for EX4300 switches.

Command introduced in Junos OS Release 15.1X53-D55 and 18.2R1 for EX2300 and EX3400 switches.

RELATED DOCUMENTATION

layer2-control

mac-rewrite

protocol

Understanding Layer 2 Protocol Tunneling

Configuring Layer 2 Protocol Tunneling

show spanning-tree bridge

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Syntax

```
show spanning-tree bridge
<brief | detail>
<msti msti-id>
<routing-instance routing-instance-name>
<vlan-id vlan-id>
```

Syntax (QFX Series and EX Series)

```
show spanning-tree bridge
<brief | detail>
<msti msti-id>
<vlan-id vlan-id>
```

Description

Displays the configured or calculated spanning-tree protocol (can be either STP, RSTP, MSTP, or VSTP) parameters.

Options

none	(Optional) Display brief STP bridge information for all multiple spanning-tree instances (MSTIs).
brief detail	(Optional) Display the specified level of output.
msti <i>msti-id</i>	(Optional) Display spanning-tree protocol bridge information for the specified MSTI or Common and Internal Spanning Tree (CIST). Specify 0 for CIST. Specify a value from 1 through 4094 for an MSTI.
routing-instance <i>routing-instance-name</i>	(Optional) Display STP bridge information for the specified routing instance.

vlan-id *vlan-id* (Optional) Display spanning-tree protocol bridge information for the specified VLAN. Specify a VLAN tag identifier from **1** through **4094**.

Required Privilege Level

view

Output Fields

Table 18 on page 384 lists the output fields for the `show spanning-tree bridge` command. Output fields are listed in the approximate order in which they appear.

Table 18: show spanning-tree bridge Output Fields

Field Name	Field Description
Routing instance name	Name of the routing instance under which the bridge is configured.
Enabled protocol	Spanning Tree Protocol type enabled.
Root ID	Bridge ID of the elected spanning-tree root bridge. The bridge ID consists of a configurable bridge priority and the MAC address of the bridge.
Root cost	Calculated cost to reach the root bridge from the bridge where the command is entered.
Root port	Interface that is the current elected root port for this bridge.
CIST regional root	Bridge ID of the elected MSTP regional root bridge.
CIST internal root cost	Calculated cost to reach the regional root bridge from the bridge where the command is entered.

Table 18: show spanning-tree bridge Output Fields (Continued)

Field Name	Field Description
Hello time	Configured number of seconds between transmissions of configuration BPDUs.
Maximum age	Configured maximum expected arrival time of hello bridge protocol data units (BPDUs).
Forward delay	How long an STP bridge port remains in the listening and learning states before transitioning to the forwarding state.
Hop count	Configured maximum number of hops a BPDU can be forwarded in the MSTP region.
Message age	Number of elapsed seconds since the most recent BPDU was received.
Number of topology changes	Total number of STP topology changes detected since the routing device last booted.
Time since last topology change	Number of elapsed seconds since the most recent topology change.
Bridge ID (Local)	Locally configured bridge ID. The bridge ID consists of a configurable bridge priority and the MAC address of the bridge.
Extended system ID	System identifier.
MSTI regional root	Bridge ID of the elected MSTP regional root bridge.

Sample Output

show spanning-tree bridge routing-instance

```
user@host> show spanning-tree bridge routing-instance vs1 detail
```

STP bridge parameters

```
Routing instance name      : vs1
Enabled protocol           : MSTP
```

STP bridge parameters for CIST

```
Root ID                    : 32768.00:13:c3:9e:c8:80
Root cost                  : 0
Root port                  : ge-10/2/0
CIST regional root        : 32768.00:13:c3:9e:c8:80
CIST internal root cost   : 22000
Hello time                 : 2 seconds
Maximum age                : 20 seconds
Forward delay              : 15 seconds
Hop count                  : 18
Message age                : 0
Number of topology changes : 1
Time since last topology change : 1191 seconds
Local parameters
  Bridge ID                : 32768.00:90:69:0b:7f:d1
  Extended system ID       : 1
```

STP bridge parameters for MSTI 1

```
MSTI regional root        : 32769.00:13:c3:9e:c8:80
Root cost                  : 22000
Root port                  : ge-10/2/0
Hello time                 : 2 seconds
Maximum age                : 20 seconds
Forward delay              : 15 seconds
Hop count                  : 18
Number of topology changes : 1
Time since last topology change : 1191 seconds
Local parameters
  Bridge ID                : 32769.00:90:69:0b:7f:d1
  Extended system ID       : 1
```

STP bridge parameters for MSTI 2

```

MSTI regional root      : 32770.00:13:c3:9e:c8:80
Root cost                : 22000
Root port               : ge-10/2/0
Hello time              : 2 seconds
Maximum age              : 20 seconds
Forward delay            : 15 seconds
Hop count                : 18
Number of topology changes : 1
Time since last topology change : 1191 seconds
Local parameters
  Bridge ID              : 32770.00:90:69:0b:7f:d1
  Extended system ID     : 1

```

show spanning-tree bridge msti

```
user@host> show spanning-tree bridge msti 1 routing-instance vs1 detail
```

STP bridge parameters

```

Routing instance name      : vs1
Enabled protocol           : MSTP

```

STP bridge parameters for MSTI 1

```

MSTI regional root      : 32769.00:13:c3:9e:c8:80
Root cost                : 22000
Root port               : xe-10/2/0
Hello time              : 2 seconds
Maximum age              : 20 seconds
Forward delay            : 15 seconds
Hop count                : 18
Number of topology changes : 1
Time since last topology change : 1191 seconds
Local parameters
  Bridge ID              : 32769.00:90:69:0b:7f:d1
  Extended system ID     : 1

```

show spanning-tree bridge vlan-id (MSTP)

```
user@host> show spanning-tree bridge vlan-id 1 101 routing-instance vs1 detail
```

STP bridge parameters

```

Routing instance name      : vs1
Enabled protocol           : MSTP

```

STP bridge parameters for CIST

```

Root ID                : 32768.00:13:c3:9e:c8:80
Root cost               : 0
Root port              : xe-10/2/0
CIST regional root     : 32768.00:13:c3:9e:c8:80
CIST internal root cost : 22000
Hello time              : 2 seconds
Maximum age             : 20 seconds
Forward delay           : 15 seconds
Hop count               : 18
Message age             : 0
Number of topology changes : 0

Local parameters
  Bridge ID             : 32768.00:90:69:0b:7f:d1
  Extended system ID    : 1
  Hello time            : 2 seconds
  Maximum age           : 20 seconds
  Forward delay         : 15 seconds
  Path cost method      : 32 bit
  Maximum hop count     : 20

```

show spanning-tree bridge (RSTP)

```
user@host> show spanning-tree bridge
```

STP bridge parameters

```

Routing instance name   : GLOBAL
Enabled protocol        : RSTP
Root ID                 : 28672.00:90:69:0b:3f:d0
Hello time              : 2 seconds
Maximum age             : 20 seconds
Forward delay           : 15 seconds
Message age             : 0
Number of topology changes : 58
Time since last topology change : 14127 seconds

```

Local parameters

```

  Bridge ID             : 28672.00:90:69:0b:3f:d0
  Extended system ID    : 0

```

STP bridge parameters for bridge VLAN 10

```

Root ID                : 28672.00:90:69:0b:3f:d0

```

```

Hello time           : 2 seconds
Maximum age          : 20 seconds
Forward delay        : 15 seconds
Message age          : 0
Number of topology changes : 58
Time since last topology change : 14127 seconds
Local parameters
  Bridge ID           : 28672.00:90:69:0b:3f:d0
  Extended system ID  : 0

```

STP bridge parameters for bridge VLAN 20

```

Root ID              : 28672.00:90:69:0b:3f:d0
Hello time           : 2 seconds
Maximum age          : 20 seconds
Forward delay        : 15 seconds
Message age          : 0
Number of topology changes : 58
Time since last topology change : 14127 seconds
Local parameters
  Bridge ID           : 28672.00:90:69:0b:3f:d0
  Extended system ID  : 0

```

show spanning-tree bridge vlan-id (RSTP)

```

user@host> show spanning-tree bridge vlan-id 10
STP bridge parameters
Routing instance name      : GLOBAL
Enabled protocol           : RSTP

STP bridge parameters for VLAN 10
Root ID                    : 28672.00:90:69:0b:3f:d0
Hello time                 : 2 seconds
Maximum age                : 20 seconds
Forward delay              : 15 seconds
Message age                : 0
Number of topology changes : 58
Time since last topology change : 14127 seconds
Local parameters
  Bridge ID                 : 28672.00:90:69:0b:3f:d0
  Extended system ID        : 0

```

Release Information

Command introduced in Junos OS Release 8.4.

RELATED DOCUMENTATION

[Understanding STP | 23](#)

[Understanding RSTP | 27](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[show spanning-tree interface | 390](#)

show spanning-tree interface

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Syntax

```
show spanning-tree interface  
<brief | detail>  
<msti msti-id>
```



```
<routing-instance routing-instance-name>
<vlan-id vlan-id>
```

Syntax (EX Series Switches and QFX Series Switches)

```
show spanning-tree interface
<brief | detail>
<msti msti-id>
<vlan-id vlan-id>
```

Syntax (EX Series Switches)

```
show spanning-tree interface
<brief | detail>
<interface-name interface-name>
<msti msti-id>
<vlan-id vlan-id>
```

Description

Display the configured or calculated interface-level spanning-tree protocol (can be either STP, RSTP, or MSTP) parameters. In **brief** mode, will not display interfaces that are administratively disabled or do not have a physical link.

Options

none	Display brief STP interface information.
brief detail	(Optional) Display the specified level of output.

interface-name <i>interface-name</i>	(Optional) Name of an interface.
msti <i>msti-id</i>	(Optional) Display STP interface information for the specified MST instance.
routing-instance <i>routing-instance-name</i>	(Optional) Display STP interface information for the specified routing instance.
vlan-id <i>vlan-id</i>	(Optional) Display STP interface information for the specified VLAN.

Required Privilege Level

view

Output Fields

Table 19 on page 392 lists the output fields for the `show spanning-tree interface` command. Output fields are listed in the approximate order in which they appear.

Table 19: show spanning-tree Interface Output Fields

Field Name	Field Description
Interface name	Interface configured to participate in the STP, RSTP, VSTP, or MSTP instance.
Port ID	Logical interface identifier configured to participate in the MSTP or VSTP instance.
Designated port ID	Port ID of the designated port for the LAN segment to which this interface is attached.
Designated bridge ID	Bridge ID of the designated bridge for the LAN segment to which this interface is attached.
Port Cost	Configured cost for the interface.

Table 19: show spanning-tree Interface Output Fields *(Continued)*

Field Name	Field Description
Port State	STP port state: forwarding (FWD), blocking (BLK), listening, learning, or disabled.
Port Role	MSTP, VSTP, or RSTP port role: designated (DESG), backup (BKUP), alternate (ALT), (ROOT), or Root Prevented (Root-Prev).
Link type	MSTP, VSTP, or RSTP link type. Shared or point-to-point (pt-pt) and edge or nonedge.
Alternate	Identifies the interface as an MSTP, VSTP, or RSTP alternate root port (Yes) or nonalternate root port (No).
Boundary Port	Identifies the interface as an MSTP regional boundary port (Yes) or nonboundary port (No).
Edge delay while expiry count	Number of times the edge delay timer expired on that interface.
Rcvd info while expiry count	Number of times the rcvd info timer expired on that interface.

Sample Output

show spanning-tree interface

```
user@host> show spanning-tree interface routing-instance vs1 detail
```

```
Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ae1	128:1	128:1	32768.0090690b47d1	1000	FWD	DESG
ge-2/1/2	128:2	128:2	32768.0090690b47d1	20000	FWD	DESG
ge-2/1/5	128:3	128:3	32768.0090690b47d1	29999	FWD	DESG
ge-2/2/1	128:4	128:26	32768.0013c39ec880	20000	FWD	ROOT

```

xe-9/2/0      128:5      128:5  32768.0090690b47d1    2000 FWD  DESG
xe-9/3/0      128:6      128:6  32768.0090690b47d1    2000 FWD  DESG

```

Spanning tree interface parameters for instance 1

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ae1	128:1	128:1	32769.0090690b47d1	1000	FWD	DESG
ge-2/1/2	128:2	128:2	32769.0090690b47d1	20000	FWD	DESG
ge-2/1/5	128:3	128:3	32769.0090690b47d1	29999	FWD	DESG
ge-2/2/1	128:4	128:26	32769.0013c39ec880	20000	FWD	ROOT
xe-9/2/0	128:5	128:5	32769.0090690b47d1	2000	FWD	DESG
xe-9/3/0	128:6	128:6	32769.0090690b47d1	2000	FWD	DESG

Spanning tree interface parameters for instance 2

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ae1	128:1	128:1	32770.0090690b47d1	1000	FWD	DESG
ge-2/1/2	128:2	128:2	32770.0090690b47d1	20000	FWD	DESG
ge-2/1/5	128:3	128:3	32770.0090690b47d1	29999	FWD	DESG
ge-2/2/1	128:4	128:26	32770.0013c39ec880	20000	FWD	ROOT
xe-9/2/0	128:5	128:5	32770.0090690b47d1	2000	FWD	DESG
xe-9/3/0	128:6	128:6	32770.0090690b47d1	2000	FWD	DESG

show spanning-tree interface (QFX Series)

```

user@host> show spanning-tree interface routing-instance vs1 detail

```

Spanning tree interface parameters for instance 0

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ae1	128:1	128:1	32768.0090690b47d1	1000	FWD	DESG
ge-2/1/2	128:2	128:2	32768.0090690b47d1	20000	FWD	DESG
ge-2/1/5	128:3	128:3	32768.0090690b47d1	29999	FWD	DESG
ge-2/2/1	128:4	128:26	32768.0013c39ec880	20000	FWD	ROOT
xe-9/2/0	128:5	128:5	32768.0090690b47d1	2000	FWD	DESG
xe-9/3/0	128:6	128:6	32768.0090690b47d1	2000	FWD	DESG

Spanning tree interface parameters for instance 1

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ae1	128:1	128:1	32769.0090690b47d1	1000	FWD	DESG
ge-2/1/2	128:2	128:2	32769.0090690b47d1	20000	FWD	DESG
ge-2/1/5	128:3	128:3	32769.0090690b47d1	29999	FWD	DESG
ge-2/2/1	128:4	128:26	32769.0013c39ec880	20000	FWD	ROOT
xe-9/2/0	128:5	128:5	32769.0090690b47d1	2000	FWD	DESG
xe-9/3/0	128:6	128:6	32769.0090690b47d1	2000	FWD	DESG

Spanning tree interface parameters for instance 2

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ae1	128:1	128:1	32770.0090690b47d1	1000	FWD	DESG
ge-2/1/2	128:2	128:2	32770.0090690b47d1	20000	FWD	DESG
ge-2/1/5	128:3	128:3	32770.0090690b47d1	29999	FWD	DESG
ge-2/2/1	128:4	128:26	32770.0013c39ec880	20000	FWD	ROOT
xe-9/2/0	128:5	128:5	32770.0090690b47d1	2000	FWD	DESG
xe-9/3/0	128:6	128:6	32770.0090690b47d1	2000	FWD	DESG

show spanning-tree interface (EX Series)

```
user@switch> show spanning-tree interface
```

Spanning tree interface parameters for instance 0

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/0.0	128:513	128:513	8192.0019e2500340	1000	FWD	DESG
ge-0/0/2.0	128:515	128:515	8192.0019e2500340	1000	BLK	DIS
ge-0/0/4.0	128:517	128:517	8192.0019e2500340	1000	FWD	DESG
ge-0/0/23.0	128:536	128:536	8192.0019e2500340	1000	FWD	DESG

Spanning tree interface parameters for instance 1

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/0.0	128:513	128:513	8193.0019e2500340	1000	FWD	DESG
ge-0/0/2.0	128:515	128:515	8193.0019e2500340	1000	BLK	DIS
ge-0/0/4.0	128:517	128:517	8193.0019e2500340	1000	FWD	DESG

```
ge-0/0/23.0 128:536 128:536 8193.0019e2500340 1000 FWD DESG
```

Spanning tree interface parameters for instance 2

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-0/0/0.0	128:513	128:1	8194.001b549fd000	1000	FWD	ROOT
ge-0/0/2.0	128:515	128:515	32770.0019e2500340	4000	BLK	DIS
ge-0/0/4.0	128:517	128:1	16386.001b54013080	1000	BLK	ALT
ge-0/0/23.0	128:536	128:536	32770.0019e2500340	1000	FWD	DESG

show spanning-tree interface detail

```
user@host> show spanning-tree interface routing-instance vs1 detail
```

Spanning tree interface parameters for instance 0

```
Interface name           : ae1
Port identifier          : 128.1
Designated port ID       : 128.1
Port cost                 : 1000
Port state               : Forwarding
Designated bridge ID      : 32768.00:90:69:0b:47:d1
Port role                 : Designated
Link type                 : Pt-Pt/NONEDGE
Boundary port            : No
```

```
Interface name           : ge-2/1/2
Port identifier          : 128.2
Designated port ID       : 128.2
Port cost                 : 20000
Port state               : Forwarding
Designated bridge ID      : 32768.00:90:69:0b:47:d1
Port role                 : Designated
Link type                 : Pt-Pt/NONEDGE
Boundary port            : No
```

```
Interface name           : ge-2/1/5
Port identifier          : 128.3
Designated port ID       : 128.3
Port cost                 : 29999
```

```

Port state           : Forwarding
Designated bridge ID : 32768.00:90:69:0b:47:d1
Port role            : Designated
Link type             : Pt-Pt/NONEDGE
Boundary port         : No

```

```

Interface name       : ge-2/2/1
Port identifier       : 128.4
Designated port ID    : 128.26
Port cost             : 20000
Port state           : Forwarding
Designated bridge ID  : 32768.00:13:c3:9e:c8:80
Port role            : Root
Link type             : Pt-Pt/NONEDGE
Boundary port         : No

```

```

Interface name       : xe-9/2/0
Port identifier       : 128.5
Designated port ID    : 128.5
Port cost             : 2000
Port state           : Forwarding
Designated bridge ID  : 32768.00:90:69:0b:47:d1
Port role            : Designated
Link type             : Pt-Pt/NONEDGE
Boundary port         : No

```

```

Interface name       : xe-9/3/0
Port identifier       : 128.6
Designated port ID    : 128.6
Port cost             : 2000
Port state           : Forwarding
Designated bridge ID  : 32768.00:90:69:0b:47:d1
Port role            : Designated
Link type             : Pt-Pt/NONEDGE
Boundary port         : No

```

Spanning tree interface parameters for instance 1

```

Interface name       : ae1
Port identifier       : 128.1
Designated port ID    : 128.1
Port cost             : 1000

```

```

Port state           : Forwarding
Designated bridge ID : 32768.00:90:69:0b:47:d1
Port role            : Designated
Link type            : Pt-Pt/NONEDGE
Boundary port        : No

```

```

Interface name       : ge-2/1/2
Port identifier       : 128.2
Designated port ID   : 128.2
Port cost             : 20000
Port state           : Forwarding
Designated bridge ID : 32768.00:90:69:0b:47:d1
Port role            : Designated
Link type            : Pt-Pt/NONEDGE
Boundary port        : No

```

```

Interface name       : ge-2/1/5
Port identifier       : 128.3
Designated port ID   : 128.3
Port cost             : 29999
Port state           : Forwarding
Designated bridge ID : 32768.00:90:69:0b:47:d1
Port role            : Designated
Link type            : Pt-Pt/NONEDGE
Boundary port        : No

```

```

Interface name       : ge-2/2/1
Port identifier       : 128.4
Designated port ID   : 128.26
Port cost             : 20000
Port state           : Forwarding
Designated bridge ID : 32768.00:13:c3:9e:c8:80
Port role            : Root
Link type            : Pt-Pt/NONEDGE
Boundary port        : No

```

```
...
```


show spanning-tree interface detail (EX Series)

```
user@switch> show spanning-tree interface detail
Spanning tree interface parameters for instance 0
```

```
Interface name      : ge-1/0/0.0
Port identifier     : 128.625
Designated port ID  : 128.625
Port cost           : 20000
Port state          : Blocking
Designated bridge ID : 32768.00:19:e2:50:95:a0
Port role           : Disabled
Link type           : Pt-Pt/EDGE
Boundary port       : NA
Edge delay while expiry count : 0
Rcvd info while expiry count  : 0
```

```
Interface name      : ge-1/0/1.0
Port identifier     : 128.626
Designated port ID  : 128.626
Port cost           : 20000
Port state          : Blocking
Designated bridge ID : 32768.00:19:e2:50:95:a0
Port role           : Disabled
Link type           : Pt-Pt/NONEDGE
Boundary port       : NA
Edge delay while expiry count : 0
Rcvd info while expiry count  : 0
```

```
Interface name      : ge-1/0/2.0
Port identifier     : 128.627
Designated port ID  : 128.627
Port cost           : 20000
Port state          : Blocking
Designated bridge ID : 32768.00:19:e2:50:95:a0
Port role           : Disabled
Link type           : Pt-Pt/NONEDGE
Boundary port       : NA
Edge delay while expiry count : 0
Rcvd info while expiry count  : 0
```

```
Interface name      : ge-1/0/10.0
```

```

Port identifier      : 128.635
Designated port ID   : 128.635
Port cost            : 20000
Port state           : Blocking
Designated bridge ID : 32768.00:19:e2:50:95:a0
Port role             : Disabled
Link type            : Pt-Pt/NONEDGE
Boundary port        : NA
Edge delay while expiry count : 0
Rvcd info while expiry count   : 0

```

```

Interface name       : ge-1/0/20.0
Port identifier      : 128.645
Designated port ID   : 128.645
Port cost            : 20000
Port state           : Blocking
Designated bridge ID : 32768.00:19:e2:50:95:a0
Port role             : Disabled
Link type            : Pt-Pt/NONEDGE
Boundary port        : NA
Edge delay while expiry count : 0
Rvcd info while expiry count   : 0
[output truncated]

```

show spanning-tree interface msti

```

user@host> show spanning-tree interface msti 1 routing-instance vs1 detail
Spanning tree interface parameters for instance 1

```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
xe-7/0/0	128:1	128:1	32769.0090690b4fd1	2000	FWD	DESG
ge-5/1/0	128:2	128:2	32769.0090690b4fd1	20000	FWD	DESG
ge-5/1/1	128:3	128:3	32769.0090690b4fd1	20000	FWD	DESG
ae1	128:4	128:1	32769.0090690b47d1	10000	BLK	ALT
ge-5/1/4	128:5	128:3	32769.0090690b47d1	20000	BLK	ALT
xe-7/2/0	128:6	128:6	32769.0090690b47d1	2000	FWD	ROOT

show spanning-tree interface vlan-id

```
user@host> show spanning-tree interface vlan-id 101 routing-instance vs1 detail
Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Port Cost	State	Role
ge-11/0/5	128:1	128:1	32768.0090690b7fd1	20000	FWD	DESG
ge-11/0/6	128:2	128:1	32768.0090690b7fd1	20000	BLK	BKUP
ge-11/1/0	128:3	128:2	32768.0090690b4fd1	20000	BLK	ALT
ge-11/1/1	128:4	128:3	32768.0090690b4fd1	20000	BLK	ALT
ge-11/1/4	128:5	128:1	32768.0090690b47d1	20000	BLK	ALT
xe-10/0/0	128:6	128:5	32768.0090690b4fd1	2000	BLK	ALT
xe-10/2/0	128:7	128:4	32768.0090690b47d1	2000	FWD	ROOT

show spanning-tree interface (VSTP)

```
user@host> show spanning-tree interface
Spanning tree interface parameters for instance 0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Cost	State	Role
ge-1/0/1	128:1	128:1	28672.0090690b3fe0	20000	FWD	DESG
ge-1/0/2	128:2	128:2	28672.0090690b3fe0	20000	FWD	DESG

```
Spanning tree interface parameters for VLAN 10
```

Interface	Port ID	Designated port ID	Designated bridge ID	Cost	State	Role
ge-1/0/1	128:1	128:1	28672.0090690b3fe0	20000	FWD	DESG
ge-1/0/2	128:2	128:2	28672.0090690b3fe0	20000	FWD	DESG

```
Spanning tree interface parameters for VLAN 20
```

Interface	Port ID	Designated port ID	Designated bridge ID	Cost	State	Role
ge-1/0/1	128:1	128:1	28672.0090690b3fe0	20000	FWD	DESG
ge-1/0/2	128:2	128:2	28672.0090690b3fe0	20000	FWD	DESG

show spanning-tree interface vlan-id (VSTP)

```
user@host> show spanning-tree interface vlan-id 10
```

Spanning tree interface parameters for VLAN 10

Interface	Port ID	Designated port ID	Designated bridge ID	Cost	State	Role
ge-1/0/1	128:1	128:1	28672.0090690b3fe0	20000	FWD	DESG
ge-1/0/2	128:2	128:2	28672.0090690b3fe0	20000	FWD	DESG

show spanning-tree interface brief (EX Series)

```
user@switch> show spanning-tree interface brief
```

Spanning tree interface parameters for instance 0

Interface	Port ID	Designated port ID	Designated bridge ID	Cost	Port	State	Role
ge-1/0/0.0	128:625	128:625	32768.0019e25095a0	20000	BLK	DIS	
ge-1/0/1.0	128:626	128:626	32768.0019e25095a0	20000	BLK	DIS	
ge-1/0/2.0	128:627	128:627	32768.0019e25095a0	20000	BLK	DIS	
ge-1/0/10.0	128:635	128:635	32768.0019e25095a0	20000	BLK	DIS	
ge-1/0/20.0	128:645	128:645	32768.0019e25095a0	20000	BLK	DIS	
ge-1/0/30.0	128:655	128:655	32768.0019e25095a0	20000	BLK	DIS	

show spanning-tree interface ge-1/0/0 (EX Series)

```
user@switch> show spanning-tree interface ge-1/0/0
```

Interface	Port ID	Designated port ID	Designated bridge ID	Cost	Port	State	Role
ge-1/0/0.0	128:625	128:625	32768.0019e25095a0	20000	BLK	DIS	

Release Information

Command introduced in Junos OS Release 8.4.

RELATED DOCUMENTATION

[show spanning-tree bridge](#) | [382](#)

[Example: Configuring Network Regions for VLANs with MSTP on Switches](#) | [101](#)

[Understanding STP](#) | [23](#)

[Understanding RSTP](#) | [27](#)

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show spanning-tree mstp configuration

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Syntax

```
show spanning-tree mstp configuration  
<brief | detail>  
<routing-instance routing-instance-name>
```

Syntax (EX Series Switch and the QFX Series)

```
show spanning-tree mstp configuration
<brief | detail>
```

Description

Display the MSTP configuration.

Options

none	Display MSTP configuration information.
brief detail	(Optional) Display the specified level of output.
routing-instance <i>routing-instance-name</i>	(Optional) Display MSTP configuration information for the specified routing instance.

Required Privilege Level

view

Output Fields

[Table 20 on page 405](#) lists the output fields for the `show spanning-tree mstp configuration` command. Output fields are listed in the approximate order in which they appear.

Table 20: show spanning-tree mstp configuration Output Fields

Field Name	Field Description
Context id	Internally generated identifier.
Region name	MSTP region name carried in the MSTP BPDUs.
Revision	Revision number of the MSTP configuration.
Configuration digest	Numerical value derived from the VLAN-to-instance mapping table.
MSTI	MST instance identifier.
Member VLANs	VLAN identifiers associated with the MSTI.

Sample Output

show spanning-tree mstp configuration detail

```

user@host> show spanning-tree mstp configuration routing-instance vs1 detail
MSTP configuration information
Context identifier      : 1
Region name            : henry
Revision                : 3
Configuration digest    : 0x6da4b5c4fd587757eef35675365e1

MSTI      Member VLANs
  0 0-99,101-199,201-4094
  1 100
  2 200

```

show spanning-tree mstp configuration detail (QFX Series)

```
user@lf0> show spanning-tree mstp configuration routing-instance vs1 detail
MSTP configuration information
Context identifier      : 1
Region name            : henry
Revision               : 3
Configuration digest    : 0x6da4b5c4fd587757eef35675365e1

MSTI      Member VLANs
  0 0-99,101-199,201-4094
  1 100
  2 200
```

show spanning-tree mstp configuration (EX Series)

```
user@host> show spanning-tree mstp configuration
MSTP configuration information
Context identifier      : 0
Region name            : region1
Revision               : 0
Configuration digest    : 0xc92e7af9febb44d8df928b87f16b

MSTI      Member VLANs
  0 0-100,105-4094
  1 101-102
  2 103-104
```

Release Information

Command introduced in Junos OS Release 8.4.

RELATED DOCUMENTATION

[Understanding MSTP](#) | 87

[Example: Configuring Network Regions for VLANs with MSTP on Switches | 101](#)

[show spanning-tree bridge | 382](#)

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show spanning-tree statistics

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Syntax

```
show spanning-tree statistics  
<brief | detail>  
<interface interface-name>  
<routing-instance routing-instance-name>
```

Syntax (EX Series and QFX Series)

```
show spanning-tree statistics
<brief | detail>
<interface interface-name | vlan vlan-id>
```

Syntax (EX Series)

```
show spanning-tree statistics
interface interface-name
vlan vlan-id
<brief | detail>
```

Description

Display STP statistics.

Options

none	Display brief STP statistics.
brief detail	(Optional) Display the specified level of output.
interface <i>interface-name</i>	(Optional) Display STP statistics for the specified interface.
routing-instance <i>routing-instance-name</i>	(Optional) Display STP statistics for the specified routing instance.

Required Privilege Level

view

Output Fields

Table 21 on page 409 lists the output fields for the `show spanning-tree statistics` command. Output fields are listed in the approximate order in which they appear.

Table 21: show spanning-tree statistics Output Fields

Field Name	Field Description
Message type	Type of message being counted.
BPDUs sent	Total number of BPDUs sent.
BPDUs received	Total number of BPDUs received.
BPDUs sent in last interval	Number of BPDUs sent within a specified interval.
BPDUs received in last interval	Number of BPDUs received within a specified interval.
Interface	Interface for which the statistics are being displayed.
Next BDU transmission	Number of seconds until the next BDU is scheduled to be sent.

Sample Output

show spanning-tree statistics routing-instance

```

user@host> show spanning-tree statistics routing-instance vs1 detail
Routing instance level STP statistics
Message type           : bpdus
BPDUs sent              : 1396
BPDUs received          : 1027
BPDUs sent in last interval : 5      (duration: 4 sec)
BPDUs received in last interval: 4    (duration: 4 sec)

```

show spanning-tree statistics interface routing-instance detail

```
user@host> show spanning-tree statistics interface ge-11/1/4 routing-instance vs1 detail
```

Interface	BPDUs sent	BPDUs received	Next BDU transmission
ge-11/1/4	7	190	0

Release Information

Command introduced in Junos OS Release 8.4.

show spanning-tree statistics bridge

IN THIS SECTION

- [Syntax | 410](#)
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- [Required Privilege Level | 411](#)
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Syntax

```
show spanning-tree statistics bridge
```

Description

Display the STP statistics of the bridge.

Required Privilege Level

view

Output Fields

[Table 22 on page 411](#) describes the output fields for the **show spanning-tree statistics bridge** command. Output fields are listed in the approximate order in which they appear.

Table 22: show spanning-tree statistics bridge Output Fields

Field Name	Field Description
STP Context	Context of STP instances saved for each routing instance. All STP instances in the same routing instances have same context.
STP Instance	Instance number that uniquely identifies each STP session per routing instance.
Number of Root Bridge Changes	Counts the number of Root Bridge change events.
Number of Root Port Changes	Counts the number of Root Port change events.
Recent TC Received	Details about the last topology change received.

Sample Output

show spanning-tree statistics bridge (MX Series)

```
user@host> show spanning-tree statistics bridge
STP Context : default
STP Instance : 0
Number of Root Bridge Changes: 1          Last Changed: Wed Oct 23 07:10:05 2013
Number of Root Port Changes: 2          Last Changed: Wed Oct 23 07:10:05 2013
Recent TC Received: ge-3/1/4.32767      Received : Wed Oct 23 07:10:07 2013
```

Release Information

Command introduced in Junos OS Release 14.1.

show spanning-tree statistics interface

IN THIS SECTION

- [Syntax | 413](#)
- [Description | 413](#)
- [Required Privilege Level | 413](#)
- [Output Fields | 413](#)
- [Sample Output | 414](#)
- [Release Information | 414](#)

Syntax

```
show spanning-tree statistics interface
```

Description

Display the STP statistics related to the interface.

Required Privilege Level

view

Output Fields

[Table 23 on page 413](#) describes the output fields for the **show spanning-tree statistics interface** command. Output fields are listed in the approximate order in which they appear.

Table 23: show spanning-tree statistics interface Output Fields

Field Name	Field Description
Interface	Interface name.
BPDUs sent	Total number of BPDUs sent from the bridge on the interface.
BPDUs received	Total number of BPDUs received by the bridge on the interface.
Next BPDU Transmission	Time after which the next BPDU is sent by the bridge on the interface.
TC Tx/Rx	Total number of Topology Change BPDUs sent or received on the interface.

Table 23: show spanning-tree statistics interface Output Fields (Continued)

Field Name	Field Description
Proposal Tx/Rx	Total number of Proposal BPDUs sent or received on the interface.
Agreement Tx/Rx	Total number of Agreement BPDUs sent or received on the interface.

Sample Output

show spanning-tree statistics interface (MX Series)

```
user@host> show spanning-tree statistics interface
```

Interface	BPDUs Sent	BPDUs Received	Next BDU Transmission	TCs Tx/Rx	Proposal Tx/Rx	Agreement Tx/Rx
xe-0/0/0	49	3	1	5/2	0/2	1/0
ge-1/0/0	48	1	1	5/1	0/1	1/1

Release Information

Command introduced in Junos OS Release 14.1.

show spanning-tree statistics message-queues

IN THIS SECTION

- [Syntax | 415](#)
- [Description | 415](#)
- [Required Privilege Level | 415](#)
- [Output Fields | 415](#)
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Syntax

```
show spanning-tree statistics message-queues
```

Description

Display the STP message queues-related statistics.

Required Privilege Level

view

Output Fields

[Table 24 on page 416](#) describes the output fields for the **show spanning-tree statistics message-queues** command. Output fields are listed in the approximate order in which they appear.

Table 24: show spanning-tree statistics message-queues Output Fields

Field Name	Field Description
Queue	PPMD name.
Current size	Number of packets currently present in the queue.
High-watermark	Maximum number of packets present in the queue at any time.
max/avg wait time	Maximum or average time packet waiting to be consumed.

Sample Output

show spanning-tree statistics message-queues (MX Series)

```
user@host> show spanning-tree statistics message-queues
```

Queue	Current size	High-watermark	max/avg wait time
PPMD-TX	15	142	17636884/17636884
PPMD-RX	18	83	18866272/18866272

Release Information

Command introduced in Junos OS Release 14.1.

show spanning-tree stp-buffer see-all

IN THIS SECTION

- [Syntax | 417](#)
- [Description | 417](#)
- [Options | 417](#)
- [Required Privilege Level | 418](#)
- [Output Fields | 418](#)
- [Sample Output | 420](#)
- [Release Information | 423](#)

Syntax

```
show spanning-tree stp-buffer see-all  
<stp-instance stp-instance-id routing-instance instance-name>  
<vlan vlan-id routing-instance instance-name>
```

Description

Display the configured STP (RSTP, MSTP, VSTP) interface parameters.

Options

none

Display STP (RSTP, MSTP, VSTP) interface role/state changes that are logged into internal memory called the buffer. Entries in the buffer depend on the user configuration.

stp-instance <i>stp-instance-id</i> routing-instance <i>instance-name</i>	(Optional) Display the STP buffer for the specified stp-instance and routing instance.
vlan <i>vlan-id</i> routing-instance <i>instance-name</i>	(Optional) Display the STP buffer for the specified vlan id and routing instance.

Required Privilege Level

view

Output Fields

Table 25 on page 418 describes the output fields for the **show spanning-tree stp-buffer see-all** command. Output fields are listed in the approximate order in which they appear.

Table 25: show spanning-tree stp-buffer see-all Output Fields

Field Name	Field Description	Level of Output
Global Events	Displays events when PPMD RX/TX queues reach 70 % of their maximum queue size. The following indicates received queue status: <ul style="list-style-type: none"> • GT — Greater than 70 % of their maximum queue size. • LT — Less than 70 % of their maximum queue size. 	none, stp-instance, vlan
Per STP instance Information	Information about every STP instance.	none, stp-instance, vlan
Routing Inst	Routing instance to which the STP instance belongs.	none, stp-instance, vlan

Table 25: show spanning-tree stp-buffer see-all Output Fields (Continued)

Field Name	Field Description	Level of Output
STP Instance	Instance number that uniquely identifies each STP session per routing-instance.	none, stp-instance
Root Bridge	Bridge priority and bridge ID of ROOT bridge in the topology.	none, vlan
Root Port	Information about ROOT port, if any, on the local bridge at the displayed timestamp.	none, vlan
TC Received	Time at which topology change was received and on which port.	none, stp-instance, vlan
TC Generated	Time at which topology change occurred and on which port.	none, stp-instance, vlan
Port	The interface where the event is occurring.	none, stp-instance, vlan
State	<p>STP state of the port. The following are the types of state:</p> <ul style="list-style-type: none"> • Forwarding — Port forwards the traffic and is included in active topology and learns MAC addresses. • Blocking — Port does not forward traffic and is not included in active topology. Does not learn MAC addresses. 	none, vlan

Table 25: show spanning-tree stp-buffer see-all Output Fields (Continued)

Field Name	Field Description	Level of Output
Role	<p>Role of the port. The following are the types of ports:</p> <ul style="list-style-type: none"> • Root — Port closest to the Root bridge. • Designated — Port sends the best BPDU on the connected segment. • Alternate — Port blocked for receiving more useful BPDUs from another bridge. • Disabled — Port is disabled. Cannot send or receive BPDUs. 	none, stp-instance, vlan

Sample Output

show spanning-tree stp-buffer see-all (MX Series)

```

user@host> show spanning-tree stp-buffer see-all
1. Global Events:
Time at which different Queue's reached 70% of the Maximum Q-size
Mar 18 13:18:04 RCV_Q GT
Mar 18 13:18:57 RCV_Q LT
Mar 18 13:19:33 XMIT_Q GT

2. Per STP Instance Information :
Routing Inst    : default
STP Instance   : 02
Root Bridge    : 12288.00:23:9c:f0:17:d0 Mar 18 13:18:04
STP Instance   : 03
Root Port      : ge-0/1/2 Mar 18 13:18:38
STP Instance   : 03
TC Received    : ge-0/0/2 Mar 18 15:12:12

```

```
STP Instance : 03
TC Generated: ge-0/2/2 Mar 18 15:13:27
```

3. This section will print the time stamp for per Instance - port event changes.

```
STP Instance : 02
Port          : ge-1/0/0 Mar 22 13:35:02
State         : FWD S
Role          : DESG
```

```
STP Instance : 00
Port          : ge-0/0/3 Mar 22 14:03:46
State         : BLK
Role          : ALT R
```

```
STP Instance : 00
Port          : ge-1/0/0 Mar 28 02:03:49
State         : BLK S
Role          : ALT
```

show spanning-tree stp-buffer see-all stp-instance stp-instance-id routing-instance instance-name (MX Series)

```
user@host> show spanning-tree stp-buffer see-all stp-instance 0 routing-instance mstp_inst
```

1. Global Events:

Time at which different Queue's reached 70% of the Maximum Q-size

No Entry So far

2. Per STP Instance Information :

```
Routing Inst :
mstp_inst
```

```
STP Instance : 0
TC Generated : ge-3/0/5.32767 Tue Dec 17 06:00:50 2013
STP Instance : 0
TC Generated : ge-3/1/1.32767 Tue Dec 17 06:00:50 2013
STP Instance : 0
TC Received : ge-3/0/5.32767 Tue Dec 17 06:00:50 2013
STP Instance : 0
```

```

TC Received : ge-3/0/5.32767 Tue Dec 17 06:00:50 2013
STP Instance : 0
TC Received : ge-3/0/5.32767 Tue Dec 17 06:00:51 2013
STP Instance : 0
TC Received : ge-3/0/5.32767 Tue Dec 17 06:00:53 2013

```

3. This section will print the time stamp for per Instance, Port Event changes.

```

STP Instance : 0
Port          : ge-3/0/5.32767 Tue Dec 17 06:00:49 2013
State         : BLK S
Role          : DIS

```

```

STP Instance : 0
Port          : ge-3/0/5.32767 Tue Dec 17 06:00:49 2013
State         : BLK
Role          : DESG R

```

```

STP Instance : 0
Port          : ge-3/1/1.32767 Tue Dec 17 06:00:49 2013
State         : BLK S
Role          : DIS

```

```

STP Instance : 0
Port          : ge-3/1/1.32767 Tue Dec 17 06:00:49 2013
State         : BLK
Role          : DESG R

```

```

STP Instance : 0
Port          : ge-3/0/5.32767 Tue Dec 17 06:00:50 2013
State         : FWD S
Role          : DESG

```

```

STP Instance : 0
Port          : ge-3/1/1.32767 Tue Dec 17 06:00:50 2013
State         : FWD S
Role          : DESG

```


show spanning-tree stp buffer see-all vlan vlan-id routing-instance instance-name (MX Series)

```
user@host> show spanning-tree stp-buffer see-all vlan 10 routing-instance vstp_inst
```

1. Global Events:

Time at which different Queue's reached 70% of the Maximum Q-size

Mar 18 13:18:04 RCV_Q GT

Mar 18 13:18:57 RCV_Q LT

Mar 18 13:19:33 XMIT_Q GT

2. Per STP Instance Information :

Routing Inst : default

VLAN ID : 02

Root Bridge : 12288.00:23:9c:f0:17:d0 Mar 18 13:18:04

VLAN ID : 03

Root Port : ge-0/1/2 Mar 18 13:18:38

VLAN ID : 03

TC Received : ge-0/0/2 Mar 18 15:12:12

VLAN ID : 03

TC Generated: ge-0/2/2 Mar 18 15:13:27

3. This section will print the time stamp for per Instance - port event changes.

VLAN ID : 02

Port : ge-1/0/0 Mar 22 13:35:02

State : FWD S

Role : DESG

VLAN ID : 00

Port : ge-0/0/3 Mar 22 14:03:46

State : BLK

Role : ALT R

VLAN ID : 00

Port : ge-1/0/0 Mar 28 02:03:49

State : BLK S

Role : ALT

Release Information

Command introduced in Junos OS Release 14.1.