Spanning Tree Protocol

Spanning Tree Protocols prevent bridging loops in Layer 2 Ethernet networks. Arista switches support Rapid Spanning Tree, Multiple Spanning Tree, and Rapid-Per VLAN Spanning Tree protocols. These sections describe the Arista Spanning Tree Protocol implementation.

- Section 25.1: Introduction to Spanning Tree Protocols
- Section 25.2: Spanning Tree Overview
- Section 25.3: Configuring a Spanning Tree
- Section 25.4: STP Commands

25.1 Introduction to Spanning Tree Protocols

Arista Switches support the leading spanning tree protocols: RSTP, MST and Rapid-PVST. This variety of options simplifies integration into existing networks without compromising network reliability, scalability or performance.

25.2 Spanning Tree Overview

An Ethernet network functions properly when only one active path exists between any two stations. A spanning tree is a loop-free subset of a network topology. STP is a L2 network protocol that ensures a loop-free topology for any bridged Ethernet LAN. STP allows a network to include spare links as automatic backup paths that are available when an active link fails without creating loops or requiring manual intervention. The original STP is standardized as IEEE 802.1D.

Several variations to the original STP improve performance and add capacity. Arista switches support these STP versions:

- Rapid Spanning Tree (RSTP)
- Multiple Spanning Tree (MSTP)
- Rapid Per-VLAN Spanning Tree (Rapid-PVST)

The Overview contains the following sections:

- Section 25.2.1: Spanning Tree Protocol Versions
- Section 25.2.2: Structure of a Spanning Tree Instance
- Section 25.2.3: BPDUs

25.2.1 Spanning Tree Protocol Versions

STP versions supported by Arista switches address two limitations of the original Spanning Tree protocol that was standardized as IEEE 802.1D:
- Slow convergence to the new spanning tree topology after a network change
- The entire network is covered by one spanning tree instance.

The following sections describe the supported STP versions, compatibility issues in networks containing switches running different STP versions, and supported alternatives to spanning tree.

25.2.1.1 Rapid Spanning Tree Protocol (RSTP)

RSTP is specified in 802.1w and supersedes STP. RSTP provides rapid convergence after network topology changes. RSTP provides a single spanning tree instance for the entire network, similar to STP. Standard 802.1D-2004 incorporates RSTP and obsoletes STP.

The RSTP instance is the base unit of MST and Rapid-PVST spanning trees.

25.2.1.2 Rapid Per-VLAN Spanning Tree Protocol (Rapid-PVST)

Rapid Per-VLAN Spanning Tree (PVST) extends the original STP to support a spanning tree instance on each VLAN in the network. The quantity of PVST instances in a network equals the number of configured VLANs, up to a maximum of 4094 instances. PVST can load balance layer-2 traffic without creating a loop because it handles each VLAN as a separate network. However, PVST does not address slow network convergence after a network topology change.

Arista switches support Rapid-PVST, which is a variation of PVST based on RSTP instances. Rapid-PVST provides rapid connectivity recovery after the failure of a bridge, port, or LAN. Rapid-PVST can be enabled or disabled on individual VLANs.

25.2.1.3 Multiple Spanning Tree Protocol (MSTP)

MST extends rapid spanning tree protocol (RSTP) to support multiple spanning tree instances on a network, but is still compatible with RSTP. By default, Arista switches use MSTP.

MST supports multiple spanning tree instances, similar to Rapid PVST. However, MST associates an instance with multiple VLANs. This architecture supports load balancing by providing multiple forwarding paths for data traffic. Network fault tolerance is improved because failures in one instance do not affect other instances.

**MST Regions**

An *MST region* is a group of connected switches with identical MST configuration. Each region can support a maximum of 65 spanning-tree instances. MST regions are identified by a version number, name, and VLAN-to-instance map; these parameters must be configured identically on all switches in the region. Only MST region members participate with the MST instances defined in the region. A VLAN can only be assigned to one spanning-tree instance at a time. MST does not specify the maximum number of regions that a network can contain.

**MST Instances**

Each MST instance is identified by an instance number that ranges from 0 to 4094 and is associated with a set of VLANs. An MST region contains two types of spanning tree instances: an internal spanning tree instance (IST) and multiple spanning tree instances (MSTI).

- The *Internal Spanning Tree Instance* (IST) is the default spanning tree instance in an MST region and is always instance 0. It gives the root switch for the region and contains all VLANs configured on the switch that are not assigned to a MST instance.
Multiple Spanning Tree instances (MSTIs) consist of VLANs that are assigned through MST configuration statements. VLANs assigned to an MSTI are removed from the IST instance. VLANs in an MSTI operate as a part of a single Spanning Tree topology. Because each VLAN can belong to only one instance, MST instances (and the IST) are topologically independent.

25.2.1.4 Version Interoperability

A network can contain switches running different spanning tree versions. The common spanning tree (CST) is a single forwarding path the switch calculates for STP, RSTP, MSTP, and Rapid-PVST topologies in networks containing multiple spanning tree variations.

In multi-instance topologies, the following instances correspond to the CST:

- **Rapid-PVST**: VLAN 1
- **MST**: IST (instance 0)

RSTP and MSTP are compatible with other spanning tree versions:

- An RSTP bridge sends 802.1D (original STP) BPDUs on ports connected to an STP bridge.
- RSTP bridges operating in 802.1D mode remain in 802.1D mode even after all STP bridges are removed from their links.
- An MST bridge detects a port is at a region boundary when it receives an STP BPDU or an MST BPDU from a different region.
- MST ports assume they are boundary ports when the bridges to which they connect join the same region.

The `clear spanning-tree detected-protocols` command forces MST ports to renegotiate with their neighbors.

25.2.1.5 Switchport Interface Pairs

Switchport interface pairs associate two interfaces in a primary-backup configuration. When the primary interface is functioning, the backup interface remains dormant in standby mode. When the primary interface stops functioning, the backup interface handles the traffic.

An alternative implementation balances traffic between the primary and backup interfaces. If either interface shuts down, the other handles traffic addressed to the pair.

The following guidelines apply to switchport interface pairs.

- Ethernet and Port Channels can be primary interfaces.
- Ethernet, Port Channel, Management, Loopback, and VLAN interfaces can be backup interfaces.
- The primary and backup interfaces can be different interface types.
- Interface pairs should be similarly configured to ensure consistent behavior.
- An interface can be associated with a maximum of one backup interface.
- An interface can back up a maximum of one interface.
- Any Ethernet interface configured in an interface pair cannot be a port channel member.
- STP is disabled on ports configured as primary or backup interfaces.
- Static MAC addresses should be configured after primary-backup pairs are established.
Disabling Spanning Tree

When spanning tree is disabled and switchport interface pairs are not configured, all interfaces forward packets as specified by their configuration. STP packets are not generated and inbound STP packets are forwarded on the VLAN where they are received as normal multicast data packets.

Important! Disabling all Spanning Tree Protocols on the switch is strongly discouraged.

Structure of a Spanning Tree Instance

A layer 2 network consists of bridges and network segments. A loop exists when multiple active paths connect two components. Spanning tree protocols allow only one active path between any two network components. Loops are removed by blocking selected ports that connect bridges to network segments.

Ports are assigned cost values that reflect their transmission speed and any other criteria selected by the administrator. Ports with faster transmission speeds and other desirable characteristics are assigned lower costs. High cost ports are blocked in deference to lower cost ports.

A network topology defines multiple possible spanning trees. Network bridges collectively compute and implement one spanning tree to maintain connectivity between all network components while blocking ports that could result in loops. Administrators improve network performance by adjusting parameter settings to select the most efficient spanning tree.

Spanning tree bridges continuously transmit topology information to notify all other bridges on the network when topology changes are required, such as when a link fails. Bridge Protocol Data Units (BPDUs) are STP information packets that bridges exchange.

The following sections describe spanning tree configuration parameters.

Root and Designated Bridges

The root bridge is the center of the STP topology. A spanning tree instance has one root bridge. Spanning tree bases path calculations on each network component’s distance from the root bridge.

All other network bridges calculate paths to the root bridge when selecting spanning tree links. STP calculates the distance to the root bridge to build a loop-free topology that features the shortest distance between devices among all possible paths.

Each switch is assigned a unique bridge ID number for each instance. All network switches collectively elect the root bridge by comparing bridge IDs. The root bridge is the switch with the lowest bridge ID.

The bridge ID contains the following eight bytes, in order of decreasing significance:

- Port priority (four bits)
- Instance number (12 bits): VLAN number (Rapid-PVST); instance number (MST); 0 (RST)
- MAC address of switch (six bytes)

A designated bridge is defined for each network segment as the switch that provides the segment’s shortest path to the root bridge. A designated bridge is selected for each segment after a root bridge is selected; a switch can be a designated bridge for multiple segments.

The following network calculations in Figure 25-1 assume that each path has the same cost:

- Switch B is the root bridge – its bridge ID is lowest because it has the smallest port priority.
- Switch A is the designated bridge for VLAN 11.
- Switch B is the designated bridge for VLAN 10, VLAN 13, VLAN 16, VLAN 18, VLAN 19.
- Switch C is the designated bridge for VLAN 25.
Switch D is the designated bridge for VLAN 21, VLAN 23.

Figure 25-1: Spanning Tree Network Example

25.2.2.2 Port Roles

Messages from connected devices to the root bridge traverse a least-cost path, which has the smallest cost among all possible paths to the root bridge. The cost of a path is the sum of the costs of all path segments, as defined through port cost settings.

Active ports in a least-cost-path fulfill one of two possible roles: root port and designated port. STP blocks all other network ports. STP also defines alternate and backup ports to handle traffic when an active port is inaccessible.

- **Root port (RP) accesses the bridge’s least-cost path to the root bridge.** Each bridge selects its root port after calculating the cost of each possible path to the root bridge.

  The following ports in Figure 25-1 are root ports:
  - **Switch A**: port 2
  - **Switch C**: port 1
  - **Switch D**: port 3

- **Designated port (DP) accesses a network segment’s designated bridge.** Each segment defines one DP. Switches can provide DPs for multiple segments. All ports on the root bridge are DPs.

  The following ports in Figure 25-1 are designated ports:
  - **Switch A**: port 4 (VLAN 11)
  - **Switch B**: port 2 (VLAN 13), port 4 (VLAN 18), port 5 (VLAN 10), port 6 (VLAN 19), port 8 (VLAN 16)
  - **Switch C**: port 2 (VLAN 25)
  - **Switch D**: port 2 (VLAN 23), port 6 (VLAN 21)
• **Alternate ports** provide backup paths from their bridges to the root bridge. An alternate port is blocked until a network change transforms it into a root port.

• **Backup ports** provide alternative paths from VLANs to their designated bridges. A backup port is blocked until a network change transforms it into a designated port.

### 25.2.2.3 Port Activity States

A port’s activity state defines its current STP activity level. STP monitors BPDUs for network changes that require an activity state transition.

STP defines three port activity states:

• **Forwarding**: The port receives and sends data. Root ports and designated ports are either in, or transitioning to, this state.

• **Discarding**: The port does not receive or send data. Blocked ports receive BPDU packets. All ports except RPs and DPs are blocked, including alternate and backup ports.

• **Learning**: The transitional post-discarding state where the port prepares to forward frames by adding source addresses from inbound data packets to the switching database.

### 25.2.2.4 Port Types

Port type is a configurable parameter that reflects the type of network segment that is connected to the port. Proper port type configuration results in rapid convergence after network topology changes. RSTP port types include normal, network, and edge ports. **Normal** is the default port type.

- **Normal** ports have an unspecified topology.
- **Network** ports connect only to switches or bridges.
  
  RSTP immediately transitions network ports to the discarding state.

- **Edge** ports connect directly to end stations.
  
  Edge ports transition directly to forwarding state because they do not create loops. An edge port becomes a normal port when it receives a BPDU.

### 25.2.2.5 Link Types

Link type is a configurable parameter that determines candidates for RSTP fast state transition.

- the default link type for full-duplex ports is **point-to-point**.
- the default link type for half-duplex ports is **shared**.

Fast state transitions are allowed on point-to-point links that connect bridges. Fast state transitions are not allowed on shared ports regardless of the duplex setting.

### 25.2.3 BPDUs

Spanning tree rules specify a root bridge, select designated bridges, and assign roles to ports. STP rule implementation requires that network topology information is available to each switch. Switches exchange topology information through bridge protocol data units (BPDUs). Information provided by BPDU packets include bridge IDs and root path costs.

#### 25.2.3.1 BPDU Types

STP defines three BPDU types:

- **Configuration BPDU** (CBPDU), used for computing the spanning tree.
• Topology Change Notification (TCN) BPDU, announces network topology changes.
• Topology Change Notification Acknowledgment (TCA), acknowledges topology changes.

Bridges enter the following addresses in outbound BPDU frames:
• source address: outbound port’s MAC address.
• destination address: STP multicast address 01:80:C2:00:00:00.

Bridges regularly exchange BPDUs to track network changes that trigger STP recomputations and port activity state transitions. The **hello timer** specifies the period between consecutive BPDU messages; the default is two seconds.

### 25.2.3.2 Bridge Timers

Bridge timers specify parameter values that the switch includes in BPDU packets that it sends as a root bridge. Bridge timers include:

• **hello-time**: transmission interval between consecutive BPDU packets.
• **forward-time**: the period that ports remain in learning state.
• **max-age**: the period that BPDU data remains valid after it is received.
• **max-hop**: the number of bridges in an MST region that a BPDU can traverse before it is discarded.

The switch recomputes the spanning tree topology if it does not receive another BPDU before the max-age timer expires. When **edge** ports and **point-to-point** links are properly configured, RSTP network convergence does not require forward-delay and max-age timers.

### 25.2.3.3 MSTP BPDUs

MSTP BPDUs are targeted at a single instance and provide STP information for the entire region. MSTP encodes a standard BPDU for the IST, then adds region information and MST instance messages for all configured instances, where each message conveys spanning tree data for an instance. Frames assigned to VLANs operate in the instance to which the VLAN is assigned. Bridges enter an MD5 digest of the VLAN-to-instance map table in BPDUs to avoid including the entire table in each BPDU. Recipients use this digest and other administratively configured values to identify bridges in the same MST region.

MSTP BPDUs are compatible with RSTP. RSTP bridges view an MST region as a single-hop RSTP bridge regardless of the number of bridges inside the region because:

• RSTP bridges interpret MSTP BPDUs as RSTP BPDUs.
• RSTP bridges increment the **message age timer** only once while data flows through an MST region; MSTP measures **time to live** with a **remaining hops** variable, instead of the **message age timer**.

Ports at the edge of an MST region connecting to a bridge (RSTP or STP) or to an endpoint are **boundary ports**.
25.3 Configuring a Spanning Tree

These sections describe the following configuration processes:

- **Section 25.3.1: Version Configuration and Instance Creation**
- **Section 25.3.2: Spanning Tree Instance Configuration**
- **Section 25.3.3: Port Roles and Rapid Convergence**
- **Section 25.3.4: Configuring BPDU Transmissions**

### 25.3.1 Version Configuration and Instance Creation

The switch supports three STP versions and switchport backup interface pairs. Disabling spanning tree is also supported but not recommended.

The `spanning-tree mode` global configuration command specifies the spanning tree version the switch runs. This section describes command options that enable and configure STP versions.

#### 25.3.1.1 Multiple Spanning Tree (MST)

Multiple Spanning Tree is enabled by the `spanning-tree mode` command with the `mstp` option. MSTP is the default STP version.

**Example**

- This command enables Multiple Spanning Tree.

  ```
  switch(config)# spanning-tree mode mstp
  switch(config)#
  ```

**Configuring MST Regions**

All switches in an MST region must have the same name, revision, and VLAN-to-instance map. MST configuration mode commands sets the region parameters. MST configuration mode is a group-change mode where changes are saved by exiting the mode.

**Example**

- The `spanning-tree mst configuration` command places the switch in MST configuration mode.

  ```
  switch(config)# spanning-tree mst configuration
  switch(config-mst)#
  ```

The `instance` command assigns VLANs to MST instances. The `name (mst-configuration mode)` and `revision (mst-configuration mode)` commands configure the MST region name and revision.

**Examples**

- These commands assign VLANs 4-7 and 9 to instance 8 and remove VLAN 6 from instance 10.

  ```
  switch(config-mst)# instance 8 vlans 4-7,9
  switch(config-mst)# no instance 10 vlans 6
  switch(config-mst)#
  ```

- These commands assign the name (`corporate_1`) and revision (`3`) to the switch.

  ```
  switch(config-mst)# name corporate_1
  switch(config-mst)# revision 3
  switch(config-mst)#
  ```

The `exit (mst-configuration mode)` command transitions the switch out of MST configuration mode and saves all pending changes. The `abort (mst-configuration mode)` command exits MST configuration mode without saving the pending changes.
Example

- This command exits MST configuration mode and saves all pending changes.

  switch(config-mst)#exit
  switch(config)#

Configuring MST Instances

These STP commands provide an optional MST instance parameter. These commands apply to instance 0 when the optional parameter is not included.

- spanning-tree priority
- spanning-tree root
- spanning-tree port-priority

Examples

- This command configures priority for MST instance 4.

  switch(config)#spanning-tree mst 4 priority 4096
  switch(config)#

- Each of these commands configure priority for MST instance 0.

  switch(config)#spanning-tree mst 0 priority 4096
  or
  switch(config)#spanning-tree priority 4096

25.3.1.2 Rapid Spanning Tree (RST)

Rapid spanning tree is enabled through the `spanning-tree mode` command with the `rstp` option.

Example

- This command enables Rapid Spanning Tree.

  switch(config)#spanning-tree mode rstp
  switch(config)#

These STP commands, when they do not include an optional MST or VLAN parameter, apply to RSTP. Commands that configure MSTP instance 0 also apply to the RSTP instance.

- spanning-tree priority
- spanning-tree root
- spanning-tree port-priority

Examples

- These commands apply to the RST instance.

  switch(config)#spanning-tree priority 4096
  and
  switch(config)#spanning-tree mst 0 priority 4096

- These commands do not apply to the RST instance.

  switch(config)#spanning-tree mst 4 priority 4096
  and
  switch(config)#spanning-tree vlan-id 3 priority 4096
Show commands (such as `show spanning-tree`) displays the RSTP instance as MST0 (MST instance 0).

Example

- This command, while the switch is in RST mode, displays RST instance information.

  ```
  switch(config)#show spanning-tree
  MST0
  Spanning tree enabled protocol rstp<br>
  Root ID  Priority    32768<br>
  Address     001c.730c.1867<br>
  This bridge is the root<br>
  Bridge ID  Priority    32768  (priority 32768 sys-id-ext 0)<br>
  Address     001c.730c.1867<br>
  Hello Time  2.000 sec  Max Age 20 sec  Forward Delay 15 sec<br>
  Interface        Role       State      Cost      Prio.Nbr Type<br>
  ---------------- ---------- ---------- --------- -------- --------------------
  Et51             designated forwarding 2000      128.51   P2p
  ```

25.3.1.3 Rapid Per-VLAN Spanning Tree (Rapid-PVST)

Rapid-PVST mode is enabled by the `spanning-tree mode` command with the `rapid-pvst` option.

Example

- This command enables Rapid Per-VLAN Spanning Tree.

  ```
  switch(config)#spanning-tree mode rapid-pvst
  switch(config)#
  ```

These commands provide an optional VLAN parameter for configuring Rapid-PVST instances.

- `spanning-tree priority`
- `spanning-tree root`
- `spanning-tree port-priority`

Example

- This command configures bridge priority for VLAN 4.

  ```
  switch(config)#spanning-tree vlan-id 4 priority 4096
  switch(config)#
  ```

25.3.1.4 Switchport Backup Mode

Switchport backup interface pairs are enabled through the `spanning-tree mode` command with the `backup` option. Enabling switchport backup disables all spanning-tree modes. For loop avoidance under switchport backup mode, use the Loop Protection feature.

Example

- This command enables switchport backup.

  ```
  switch(config)#spanning-tree mode backup
  switch(config)#
  ```
The **switchport backup-link** command establishes an interface pair between the command mode interface (primary) and the interface specified by the command (backup).

**Examples**

- These commands establish Ethernet interface 7 as the backup port for Ethernet interface 1.

```plaintext
switch(config)#interface ethernet 1
switch(config-if-Et1)#switchport backup-link ethernet 7
switch(config-if-Et1)#
```

The **prefer** option of the **switchport backup-link** command establishes a peer relationship between the primary and backup interfaces and specifies VLAN traffic that the backup interface normally carries. If either interface goes down, the other interface carries traffic normally handled by both interfaces.

**Examples**

These steps perform the following:

- configures Ethernet interface 1 as a trunk port that handles VLANs 4 through 9 traffic.
- configures Ethernet interface 2 as the backup interface.
- assigns Ethernet 2 as the preferred interface for VLANs 7 through 9.

**Step 1** Enter configuration mode for the primary interface

```plaintext
switch(config)#interface ethernet 1
```

**Step 2** Configure the primary interface as a trunk port that services VLANs 4-9

```plaintext
switch(config-if-Et1)#switchport mode trunk
switch(config-if-Et1)#switchport trunk allowed vlan 4-9
```

**Step 3** Configure the backup interface and specify the VLANs that it normally services.

```plaintext
switch(config-if-Et1)#switchport backup-link Ethernet 2 prefer vlan 7-9
switch(config-if-Et1)#
```
25.3.1.5 Loop Protection

Loop protection is a loop detection and prevention method which is independent of STP and is not disabled when the switch is in switchport backup mode. When loop protection is active on an interface, that interface periodically sends out loop-detection frames; if one is received that originated on the switch, the receiving port is errdisables until a timeout period has passed or it is manually reset.

Loop protection is configured and enabled per VLAN, but individual ports in a VLAN can be configured to disable loop protection.

Note

Loop protection cannot be enabled on an MLAG peer link.

This feature is disabled by default. To enable it, use the `monitor loop-protection` command to enter loop-protection configuration mode, then use the `no shutdown (Loop-protection)` command to enable the feature. To enable loop protection on a VLAN, use the `protect vlan` command. To exclude a port from loop protection, use the `no loop-protection` command.

The feature is configured with the following additional commands:

- `transmit-interval`
- `disabled-time`
- `rate-limit`

Examples

- This command enters loop protection configuration mode.
  ```
  switch(config)#monitor loop-protection
  switch(config-monitor-loop-protect)#
  ```

- These commands enable loop protection on VLANs 1025-2000.
  ```
  switch(config)#monitor loop-protection
  switch(config-monitor-loop-protect)#no shutdown
  switch(config-monitor-loop-protect)#protect vlan 1025-2000
  switch(config-monitor-loop-protect)#
  ```

- These commands exclude Ethernet interface 38 from loop protection.
  ```
  switch(config)#interface ethernet 38
  switch(config-if-Et38)#no loop-protection
  switch(config-if-Et38)#
  ```

- These commands configure loop protection with a transmission interval of 10 seconds, a disabled time of two days, and a maximum rate of 500 loop detection frames per second.
  ```
  switch(config-monitor-loop-protect)#transmit-interval 10
  switch(config-monitor-loop-protect)#disabled-time 172800
  switch(config-monitor-loop-protect)#rate-limit 500
  switch(config-monitor-loop-protect)#
  ```

25.3.1.6 Disabling Spanning Tree

Spanning tree is disabled by the `spanning-tree mode` command with the `none` option. The switch does not generate STP packets. Switchport interfaces forward packets when connected to other ports. The switch forwards inbound STP packets as multicast data packets on the VLAN where they are received.
Examples

- This command disables all STP functions.
  ```
  switch(config)#spanning-tree mode none
  switch(config)#
  ```

25.3.2 Spanning Tree Instance Configuration

A network performs these steps to set up an STP instance:

**Step 1** The bridge with the lowest ID is elected root bridge.

**Step 2** Root ports (RP) are selected on all other bridges.

**Step 3** Designated bridges are selected for each network segment.

**Step 4** Designated ports (DP) are selected on each designated bridge.

**Step 5** Networks begin forwarding data through RPs and DPs. All other ports are blocked.

25.3.2.1 Root Bridge Parameters

STPs use bridge IDs for electing the root bridge. Switches denote a bridge ID for each configured Spanning Tree instance. The bridge ID composition is

- **Priority (four bits)**
  
  Priority is expressed as a multiple of 4096 because it is stored as the four most significant bits of a two-byte number.

- **Protocol Dependent (twelve bits)**
  - Rapid-PVST: VLAN number
  - MST: Instance number
  - RST: 0

- **MAC address of switch (six bytes)**

Example

- The switch defines bridge IDs for three MST instances:
  - MST 0: 32768 (Priority (32768)+Instance number(0)) and 001c.7301.23de (MAC address)
  - MST101: 32869 (Priority (32768)+Instance number(101)) and 001c.7301.23de (MAC address)
  - MST102: 32870 (Priority (32768)+Instance number(102)) and 001c.7301.23de (MAC address)

This command displays a table of root bridge information.

```
switch>show spanning-tree root

<table>
<thead>
<tr>
<th>Instance</th>
<th>Root ID</th>
<th>MAC addr</th>
<th>Root Cost</th>
<th>Hello Time</th>
<th>Max Age</th>
<th>Fwd Dly</th>
<th>Root Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>MST0</td>
<td>32768</td>
<td>001c.7301.23de</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Po937</td>
</tr>
<tr>
<td>MST101</td>
<td>32869</td>
<td>001c.7301.23de</td>
<td>3998</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Po909</td>
</tr>
<tr>
<td>MST102</td>
<td>32870</td>
<td>001c.7301.23de</td>
<td>3998</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Po911</td>
</tr>
</tbody>
</table>
```

The switch provides two commands that configure the switch priority: **spanning-tree priority** and **spanning-tree root**. The commands differ in the available parameter options:
• **spanning-tree priority** options are integer multiples of 4096 between 0 and 61440.
• **spanning-tree root** options are *primary* and *secondary*.
• *primary* assigns a priority of 8192.
• *secondary* assigns a priority of 16384.

The default priority value is 32768.

The following examples configure bridge IDs with both commands.

**Examples**

• These commands configure MST instance bridge priorities with the **root** command:

  switch(config)#spanning-tree mst 0 root primary
  switch(config)#spanning-tree mst 1 root secondary

  switch>show spanning-tree root

<table>
<thead>
<tr>
<th>Instance</th>
<th>Root ID</th>
<th>MAC addr</th>
<th>Cost</th>
<th>Hello</th>
<th>Max</th>
<th>Fwd</th>
<th>Root Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>MST0</td>
<td>8192</td>
<td>001c.7301.6017</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>None</td>
</tr>
<tr>
<td>MST1</td>
<td>16385</td>
<td>001c.7301.6017</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>MST2</td>
<td>32770</td>
<td>001c.7301.6017</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>None</td>
</tr>
</tbody>
</table>

  • Instance 0 root priority is 8192: primary priority plus the instance number of 0.
  • Instance 1 root priority is 16385: secondary priority plus the instance number of 1.
  • Instance 2 root priority is 32770: default priority plus the instance number of 2.

  These priority settings normally program the switch to be the primary root bridge for instance 0, the secondary root bridge for instance 1, and a normal bridge for instance 2. Primary and secondary root bridge elections also depend on the configuration of other network bridges.

• These priority commands configure Rapid-PVST VLAN bridge priorities:

  switch(config)#spanning-tree vlan-id 1 priority 8192
  switch(config)#spanning-tree vlan-id 2 priority 16384
  switch(config)#spanning-tree vlan-id 3 priority 8192
  switch(config)#no spanning-tree vlan-id 4 priority

  switch(config)#show spanning-tree root

<table>
<thead>
<tr>
<th>Instance</th>
<th>Root ID</th>
<th>MAC addr</th>
<th>Cost</th>
<th>Hello</th>
<th>Max</th>
<th>Fwd</th>
<th>Root Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL1</td>
<td>8193</td>
<td>001c.7301.6017</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>None</td>
</tr>
<tr>
<td>VL2</td>
<td>16386</td>
<td>001c.7301.6017</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>None</td>
</tr>
<tr>
<td>VL3</td>
<td>8195</td>
<td>001c.7301.6017</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>None</td>
</tr>
<tr>
<td>VL4</td>
<td>32788</td>
<td>001c.7301.6017</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>None</td>
</tr>
</tbody>
</table>

  • VLAN 1 root priority is 8193: configured priority plus the VLAN number of 1.
  • VLAN 2 root priority is 16386: configured priority plus the VLAN number of 2.
  • VLAN 3 root priority is 8195: configured priority plus the VLAN number of 3.
  • VLAN 4 root priority is 32788: default priority plus the VLAN number of 4.

  These priority settings normally program the switch to be the primary root bridge for VLANs 1 and 3, the secondary root bridge for VLAN2, and a normal bridge for VLAN 4. Primary and secondary root bridge elections also depend on the configuration of other network bridges.
25.3.2.2 Path Cost

Spanning tree calculates the costs of all possible paths from each component to the root bridge. The path cost is equal to the sum of the cost assigned to each port in the path. Ports are assigned a cost by default or through CLI commands. Cost values range from 1 to 200000000 (200 million).

The default cost is a function of the interface speed:

- 1 gigabit interfaces have a default cost of 20000.
- 10 gigabit interfaces have a default cost of 2000.

The `spanning-tree cost` command configures the path cost of the configuration mode interface. Costs can be specified for Ethernet and port channel interfaces. The command provides a mode parameter for assigning multiple costs to a port for MST instances or Rapid-PVST VLANs.

Examples

- These commands configure a port cost of 25000 to Ethernet interface 5. This cost is valid for RSTP or MSTP instance 0.

  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree cost 25000
  ```

- This command configures a path cost of 300000 to Ethernet interface 5 in MST instance 200.

  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree mst 200 cost 300000
  ```

- This command configures a path cost of 10000 to Ethernet interface 5 in Rapid-PVST VLAN 200-220.

  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree vlan-id 200-220 cost 10000
  ```

25.3.2.3 Port Priority

STP uses the port priority interface parameter to select ports when resolving loops. The port with the lower port priority numerical value is placed in forwarding mode. When multiple ports are assigned equal port priority numbers, the port with the lower interface number is placed in forwarding mode. Valid port-priority numbers are multiples of 16 between 0 and 240; the default is 128.

The `spanning-tree port-priority` command configures the port-priority number for the configuration mode interface. The command provides a mode option for assigning different priority numbers to a port for multiple MST instances or Rapid-PVST VLANs. Port-priority can be specified for Ethernet and port channel interfaces.

Examples

- This command sets the access port priority of 144 for Ethernet 5 interface.

  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree port-priority 144
  ```

- This command sets the access port priority of 144 for Ethernet 5 interface in MST instance 10.

  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree mst 10 port-priority 144
  ```
25.3.3 Port Roles and Rapid Convergence

Spanning Tree provides the following options for controlling port configuration and operation:

- **PortFast**: Allows ports to skip learning state before entering the forwarding state.
- **Port type** and **link type**: Designates ports for rapid transitions to the forwarding state.
- **Root guard**: Ensures that a port will not become the root port.
- **Loop guard**: Prevents loops resulting from unidirectional failure of links.
- **Bridge assurance**: Prevents loops caused by unidirectional links or a malfunctioning switch.

25.3.3.1 PortFast

PortFast allows devices to gain immediate network access before convergence of the spanning tree. Enabling PortFast on ports connected to another switch can create loops.

A *portfast* port that receives a BPDU sets its operating state to *non-portfast* while remaining in *portfast* configured state. In this state, the port is subject to topology changes and can enter the discarding state.

The `spanning-tree portfast` command programs access ports to immediately enter the forwarding state. PortFast connects devices attached to an access port, such as a single workstation, to the network immediately without waiting for STP convergence. PortFast can also be enabled on trunk ports.

**Example**

- This command unconditionally enables portfast on Ethernet 5 interface.

```
switch(config)#interface ethernet 5
switch(config-if-Et5)#spanning-tree portfast
switch(config-if-Et5)#
```

25.3.3.2 Port Type and Link Type Configuration

RSTP only achieves rapid transition to forwarding state on edge ports and point-to-point links.

**Port Type**

Edge ports are directly connected to end stations. Because edge ports do not create loops, they transition directly to forwarding state when a link is established.

The `spanning-tree portfast <port type>` command sets the configuration mode interface’s port type. Spanning tree ports can be configured as *edge* ports, *network* ports, or *normal* ports. The default port type is *normal*.

- **Edge ports** connect to a host (end station). Configuring a port that connects to a bridge as an edge port may create a loop. Edge ports that receive a BPDU become a normal spanning tree port.
- **Network ports** connect only to a Layer 2 switch or bridge. Configuring a port connected to a host as a network port transitions the port to the discarding state.
- **Normal ports** have an unspecified topology.

**Example**

- This command configures Ethernet 5 interface as a network port.

```
switch(config)#interface ethernet 5
switch(config-if-Et5)#spanning-tree portfast network
switch(config-if-Et5)#
```
Auto-edge detection converts ports into edge ports when they do not receive a new BPDU before the current BPDU expires, as measured by the max-age timer. The `spanning-tree portfast auto` command enables auto-edge detection on the configuration mode interface, superseding the `spanning-tree portfast` command. Auto-edge detection is enabled by default.

**Example**

- This command enables auto-edge detection on Ethernet interface 5.
  
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree portfast auto
  switch(config-if-Et5)#
  ```

**Link Type**

The switch derives a port's default link type from its duplex mode:

- full-duplex ports are **point-to-point**.
- half-duplex ports are **shared**.

The `spanning-tree link-type` command specifies the configuration mode interface's link-type. RSTP fast transition is not allowed on **shared link** ports, regardless of their duplex setting. Because the ports are full-duplex by default, the default link-type setting is **point-to-point**.

**Example**

- This command configures Ethernet 5 interface as a shared port.
  
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree link-type shared
  switch(config-if-Et5)#
  ```

25.3.3.3 **Root Guard and Loop Guard**

**Root guard** stops a port from becoming a root port, which stops connected switches from becoming root bridges. When a switch detects a new root bridge, its root-guard-enabled ports enter blocked (root-inconsistent) state. When the switch no longer detects a new root, these ports enter learning state.

Root guard is enabled on a per-port basis. The setting applies to all STP instances. Disabling root guard places the port in learning state.

The `spanning-tree guard` command, with the root option, enables root guard on the configuration mode interface.

**Example**

- This command enables root guard on Ethernet 5 interface.
  
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree guard root
  switch(config-if-Et5)#
  ```

**Loop guard** prevents loops resulting from unidirectional failure of point-to-point links by verifying that non-designated ports (root, blocked, and alternate) are receiving BPDUs from their designated ports. A loop-guard-enabled root or blocked port that stops receiving BPDUs transitions to the discarding (loop-inconsistent) state. The port recovers from this state when it receives a BPDU.

Loop guard, when enabled globally, applies to all point-to-point ports. Loop guard is configurable on individual ports and applies to all STP instances of an enabled port. Loop-inconsistent ports transition to learning state when loop guard is disabled.
If loop guard is enabled on a root switch, it takes effect only if the switch becomes a nonroot switch.

When using loop guard:

- Do not enable loop guard on portfast-enabled ports.
- Loop guard is not functional on ports not connected to point-to-point links.
- Loop guard has no effect on disabled spanning tree instances.

Loop guard aspects on port channels include:

- BPDUs are sent over the channel’s first operational port. Loop guard blocks the channel if that link becomes unidirectional even when other channel links function properly.
- Creating a new channel destroys state information for its component ports; new channels with loop-guard-enabled ports can enter forwarding state as a DP.
- Dissembling a channel destroys its state information; component ports from a blocked channel can enter the forwarding state as DPs, even if the channel contained unidirectional links.
- If a link on any port of the channel becomes unidirectional, the channel is blocked. Transmission resumes if the port is removed from the channel or the bidirectional communication is restored.

Loop guard configuration commands include:

- `spanning-tree guard loop default` command enables loop guard as a default on all switch ports.
- `spanning-tree guard` control the loop guard setting on the configuration mode interface. This command overrides the default command for the specified interface.

**Examples**

- This command enables loop guard as the default on all switch ports.
  ```
  switch(config)#spanning-tree guard loop default
  switch(config)#
  ```
- This command enables loop guard on Ethernet 6 interface.
  ```
  switch(config)#interface ethernet 6
  switch(config-if-Et6)#spanning-tree guard loop
  switch(config-if-Et6)#
  ```

### 25.3.3.4 Bridge Assurance

Bridge assurance protects against unidirectional link failures, other software failures, and devices that continue forwarding data traffic after they quit running spanning tree.

Bridge assurance programs the switch to send BPDUs at each hello time period through all bridge assurance-enabled ports (i.e., network ports). Bridge assurance operates only on network ports with point-to-point links, ideally with bridge assurance enabled on each side of the link. Bridge assurance-enabled ports will not necessarily be blocked when they link to a port where bridge assurance is not enabled.

Ports not receiving a BPDU packet within a hello time period enter inconsistent (blocking) state. In this case, the `show spanning-tree transmit active` command will show a bridge assurance status of “inconsistent” for the port. If the other side of the link has bridge assurance enabled, or if the other switch is the root bridge, it will send periodic BPDUs, preventing an “inconsistent” blocking state.

Bridge assurance is globally enabled by default, but must also be enabled on a per-port basis by designating the port as a network port with the `spanning-tree portfast <port type>` command. The `no spanning-tree transmit active` command disables bridge assurance globally.
Example

- These commands enable bridge assurance on the switch, then enable bridge assurance on Ethernet port 5 by designating it a network port.

```
switch(config)#spanning-tree transmit active
switch(config)#interface ethernet 5
switch(config-if-Et5)#spanning-tree portfast network
switch(config-if-Et5)#
```

25.3.4 Configuring BPDU Transmissions

The following sections describe instructions that configure BPDU packet contents and transmissions.

25.3.4.1 Bridge Timers

Bridge timers configure parameter values that the switch includes in BPDU packets that it sends as a root bridge. Bridge timers include:

- **hello-time**: the transmission interval between consecutive outbound BPDU packets.
- **forward-time**: the period that ports are in learning state prior to forwarding packets.
- **max-age**: the period that BPDU data remains valid after it is received. The switch recomputes the spanning tree topology if it does not receive another BPDU packet before the timer expires.
- **max-hop**: the number of bridges in an MST region that a BPDU can traverse before it is discarded.

In standard STP, ports passively wait for **forward_delay** and **max_age** periods before entering the forwarding state. RSTP achieves faster convergence by relying on edge port and link type definitions to start forwarding traffic. When edge ports and link types are properly configured, bridge timers are used in RSTP as backup or when interacting with networks running standard STP.

The `spanning-tree hello-time` command configures the hello time.

```
switch(config)##spanning-tree hello-time 1000
switch(config)#
```

The `spanning-tree max-hops` command specifies the max hop setting that the switch inserts into BPDUs that it sends out as the root bridge.

Example

- This command sets the max hop value to 40.

```
switch(config)##spanning-tree max-hops 40
switch(config)#
```

The `spanning-tree forward-time` command configures the forward delay setting that the switch inserts into BPDUs that it sends out as the root bridge.

Example

- This command sets the forward delay timer value to 25 seconds.

```
switch(config)##spanning-tree forward-time 25
switch(config)#
```

The `spanning-tree max-age` command configures the max age setting that the switch inserts into BPDUs that it sends out as the root bridge.
Example

- This command sets the max age timer value to 25 seconds.

  `switch(config)#spanning-tree max-age 25
  switch(config)#`

25.3.4.2 BPDU Transmit Hold-Count

The `spanning-tree bpdu tx hold-count` command specifies the maximum number of BPDUs per second that the switch can send from an interface. Valid settings range from 1 to 10 BPDUs with a default of 6 BPDUs.

Higher hold-count settings can significantly impact CPU utilization, especially in Rapid-PVST mode. Smaller values can slow convergence in some configurations.

Example

- This command configures a transmit hold-count of 8 BPDUs.

  `switch(config)#spanning-tree bpdu tx hold-count 8
  switch(config)#`

25.3.4.3 BPDU Guard

PortFast interfaces do not receive BPDUs in a valid configuration. BPDU Guard provides a secure response to invalid configurations by disabling ports when they receive a BPDU. Disabled ports differ from blocked ports in that they are re-enabled only through manual intervention.

- When configured globally, BPDU Guard is enabled on ports in the operational portfast state.
- When configured on an individual interface, BPDU Guard disables the port when it receives a BPDU, regardless of the port's portfast state.

The `spanning-tree edge-port bpduguard default` global configuration command enables BPDU guard by default on all portfast ports. BPDU guard is disabled on all ports by default.

The `spanning-tree bpduguard` interface configuration command controls BPDU guard on the configuration mode interface. This command takes precedence over the default setting configured by `spanning-tree edge-port bpduguard default`.

- `spanning-tree bpduguard` enables BPDU guard on the configuration mode interface.
- `spanning-tree bpduguard disable` disables BPDU guard on the configuration mode interface.
- `no spanning-tree bpduguard` reverts the configuration mode interface to the default BPDU guard setting.

Example

- These commands enable BPDU guard by default on all portfast ports, then disable BPDU guard on Ethernet 5.

  `switch(config)#spanning-tree edge-port bpduguard default
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree bpduguard disable
  switch(config-if-Et5)#`

25.3.4.4 BPDU Filter

BPDU filtering prevents the switch from sending or receiving BPDUs on specified ports. BPDU filtering is configurable on Ethernet and port channel interfaces.
Ports with BPDU filtering enabled do not send BPDUs and drops inbound BPDUs. Enabling BPDU filtering on a port not connected to a host can result in loops as the port continues forwarding data while ignoring inbound BPDU packets.

The **spanning-tree bpdufilter** command controls BPDU filtering on the configuration mode interface. BPDU filtering is disabled by default.

**Example**

- These commands enable BPDU filtering on Ethernet 5.

```
switch(config)#interface ethernet 5
switch(config-if-Et5)#spanning-tree bpdufilter enable
```

### 25.3.4.5 BPDU Rate Limit

BPDU input rate limiting restricts the number of BPDUs that a port with BPDU guard and BPDU filter disabled, can process during a specified interval. The port discards all BPDUs that it receives in excess of the specified limit. Configuring the rate limiter requires two steps:

- Establishing the rate limit threshold
- Enabling rate limiting

#### Establishing the Rate Limit Threshold

The **spanning-tree bpduguard rate-limit count (interface)** command specifies the BPDU reception rate (quantity per interval) that triggers the discarding of BPDUs. The command is available in global and interface configuration modes.

- The **spanning-tree bpduguard rate-limit count** global command specifies the maximum reception rate for ports that are not covered by interface rate limit count commands. The global command specifies the default limit.

**Note**

Arista Networks recommends to retain the default values of rate limit. In the PVST mode, when the VLAN membership of a port is changed by a significant margin, it is advisable to disable interface BPDU rate limit on both ends of a port. For example, if three VLANs are present on a port initially, the operator must first add 300 more VLANs on one side of the port and then add the same 300 VLANs on the other side of the port. In this case, if the VLANs are increased towards the root bridge first, then the other side can cross the rate-limit threshold.

- The **spanning-tree bpduguard rate-limit count** interface command defines the maximum BPDU reception rate for ports in the configuration mode interface.

#### Examples

- This command configures the global limit of 5000 BPDUs over a four second interval.

```
switch(config)#spanning-tree bpduguard rate-limit count 5000 interval 4
```

- These commands configure a limit of 7500 BPDUs over an 8 second interval on the Ethernet interface 2.

```
switch(config)#interface ethernet 2
switch(config-if-Et2)#spanning-tree bpduguard rate-limit count 7500 interval 8
```
Enabling Rate Limiting

BPDU rate limiting is enabled globally or on individual ports:

- `spanning-tree bpdu-guard rate-limit default` enables rate limiting on all ports that are not covered by the interface rate limiting command. The default setting is `enabled`.
- `spanning-tree bpdu-guard rate-limit enable / disable` interface command enables or disables BPDU rate limiting on the configuration mode interface. This command has precedence over the global command.

Examples

- This command enables rate limiting on ports that are not covered by interface rate limit commands.

  ```
  switch(config)#spanning-tree bpdu-guard rate-limit default
  switch(config)#
  ```

- These commands enable rate limiting on the Ethernet interface 15.

  ```
  switch(config)#interface ethernet 15
  switch(config-if-Et15)#spanning-tree bpdu-guard rate-limit enable
  switch(config-if-Et15)#
  ```
25.4 STP Commands

Spanning Tree Commands: Global Configuration
- spanning-tree bpdu tx hold-count
- spanning-tree bpduguard rate-limit default
- spanning-tree bpduguard rate-limit count (global)
- spanning-tree edge-port bpdufilter default
- spanning-tree edge-port bpduguard default
- spanning-tree forward-time
- spanning-tree guard loop default
- spanning-tree hello-time
- spanning-tree max-age
- spanning-tree max-hops
- spanning-tree mode
- spanning-tree mst configuration
- spanning-tree portchannel guard misconfig
- spanning-tree priority
- spanning-tree root
- spanning-tree transmit active
- spanning-tree vlan-id

Loop Protection Commands
- disabled-time
- loop-protection
- monitor loop-protection
- protect vlan
- rate-limit
- shutdown (Loop-protection)
- transmit-interval

Spanning Tree Commands: Interface Configuration Mode
- spanning-tree bpdufilter
- spanning-tree bpduguard
- spanning-tree bpduguard rate-limit count (interface)
- spanning-tree bpduguard rate-limit enable / disable
- spanning-tree cost
- spanning-tree guard
- spanning-tree link-type
- spanning-tree port-priority
- spanning-tree portfast
- spanning-tree portfast auto
- spanning-tree portfast <port type>
- switchport backup-link

MST Configuration Commands
- abort (mst-configuration mode)
- exit (mst-configuration mode)
- instance
- name (mst-configuration mode)
- revision (mst-configuration mode)
- show (mst-configuration mode)
Display Commands

- show spanning-tree
- show spanning-tree blockedports
- show spanning-tree counters
- show spanning-tree instance
- show spanning-tree interface
- show spanning-tree mst
- show spanning-tree mst configuration
- show spanning-tree mst interface
- show spanning-tree mst test information
- show spanning-tree root
- show spanning-tree topology status
- show spanning-tree transmit active

Clear Commands

- clear spanning-tree counters
- clear spanning-tree counters session
- clear spanning-tree detected-protocols
**abort (mst-configuration mode)**

The `abort` command, in MST-configuration mode, discards pending changes to the MST region configuration, then returns the switch to global configuration mode.

The `exit (mst-configuration mode)` command saves MST region changes to `running-config` before returning the switch to global configuration mode.

**Command Mode**
- MST-configuration

**Command Syntax**
- `abort`

**Examples**
- This command discards changes to the MST region, then returns the switch to global configuration mode.

```
switch(config-mst)#abort
switch(config)#
```
clear spanning-tree counters

The clear spanning-tree counters command resets the BPDU counters for the specified interfaces to zero in all CLI sessions.

Command Mode
Privileged EXEC

Command Syntax
```
clear spanning-tree counters [INT_NAME]
```

Parameters
- **INT_NAME** Interface type and number. Options include:
  - <no parameter> resets counters for all interfaces.
  - `interface ethernet e_num` Ethernet interface specified by `e_num`.
  - `interface loopback l_num` Loopback interface specified by `l_num`.
  - `interface management m_num` Management interface specified by `m_num`.
  - `interface port-channel p_num` Port-Channel Interface specified by `p_num`.
  - `interface vlan v_num` VLAN interface specified by `v_num`.

Examples
- This command resets the BPDU counters on Ethernet 15 interface.

  ```
  switch#show spanning-tree counters
  +-----------------+-------+---------+-------+---------+-------+
  | Port            | Sent  | Received| Tagged| Other   | Error |
  +-----------------+-------+---------+-------+---------+-------+
  | Ethernet15      | 32721 |         | 0     | 0       | 0     |
  | Port-Channel10  | 8487  |         | 0     | 0       | 0     |
  +-----------------+-------+---------+-------+---------+-------+
  switch#clear spanning-tree counters interface ethernet 15
  switch#show spanning-tree counters
  +-----------------+-------+---------+-------+---------+-------+
  | Port            | Sent  | Received| Tagged| Other   | Error |
  +-----------------+-------+---------+-------+---------+-------+
  | Ethernet15      | 11    |         | 0     | 0       | 0     |
  | Port-Channel10  | 8494  |         | 2     | 6       | 0     |
  +-----------------+-------+---------+-------+---------+-------+
  ```
clear spanning-tree counters session

The `clear spanning-tree counters session` command resets the BPDU counters to zero on all interfaces in the current CLI session. Counters in other CLI sessions are not affected.

**Command Mode**
Privileged EXEC

**Command Syntax**
```
clear spanning-tree counters session
```

**Examples**
- This command resets the BPDU counters in the current CLI session.

```
switch# show spanning-tree counters
-----------------------------------
Port       Sent       Received     Tagged Error Other Error
-----------------------------------
  Ethernet15      32721             0                  0              0
  Port-Channel10       8487             0                  0              0
switch# clear spanning-tree counters session
switch# show spanning-tree counters
-----------------------------------
Port       Sent       Received     Tagged Error Other Error
-----------------------------------
  Ethernet15        11              0                  0              0
  Port-Channel10         7              2                  6              0
switch#
```
clear spanning-tree detected-protocols

The clear spanning-tree detected-protocols command restarts the spanning tree protocol (STP) migration state machine on the specified interfaces. The switch is reset to running rapid spanning tree protocol on an interface where it previously detected a bridge running an old version of the protocol.

Command Mode
Privileged EXEC

Command Syntax

clear spanning-tree detected-protocols [INT_NAME]

Parameters

- **INT_NAME**  Interface type and number. Values include:
  - <no parameter>  all interfaces.
  - ethernet e_num  Ethernet interface specified by e_num.
  - loopback l_num  Loopback interface specified by l_num.
  - management m_num  Management interface specified by m_num.
  - port-channel p_num  Port-Channel Interface specified by p_num.
  - vlan v_num  VLAN interface specified by v_num.

Examples

- This command restarts the STP migration machine on all switch interfaces.
  
  switch#clear spanning-tree detected-protocols
  
  switch#
disabled-time

The disabled-time command sets the time for which the port remains disabled after a loop is detected by loop protection. The no disabled-time and default disabled-time commands reset the disabled time to the default of 604800 seconds (seven days).

Note

If this value is changed, interfaces that are already disabled by loop protection will remain disabled for the previously configured period.

Command Mode

Loop-protection Configuration

Command Syntax

disabled-time period
no disabled-time [period]
default disabled-time [period]

Parameters

- **period**  Time in seconds for which the port remains disabled. Values range from 0 to 604800 (seven days). Default is 604800. A value of 0 disables the interface until it is manually reset, even if the disabled time is later set to a non-zero value. To restore the port manually, shut it down and then re-enable it.

Example

- This command configures loop protection to disable a port on which a loop is detected for a period of two days (172800 seconds).

```
switch(config-monitor-loop-protect)#disabled-time 172800
switch(config-monitor-loop-protect)#
```
exit (mst-configuration mode)

The `exit` command, in MST-configuration mode, saves changes to the MST region configuration, then returns the switch to global configuration mode. MST region configuration changes are also saved by entering a different configuration mode.

**Command Mode**
- MST-configuration

**Command Syntax**
- `exit`

**Examples**
- This command saves changes to the MST region, then returns the switch to global configuration mode.
  
  ```
  switch(config-mst)#exit
  switch(config)#
  ```

- This command saves changes to the MST region, then places the switch in Interface-Ethernet mode.

  ```
  switch(config-mst)#interface ethernet 3
  switch(config-if-Et3)#
  ```
instance

The instance command inserts an entry into the VLAN-to-instance map that associates a set of VLANs to an MST instance. In addition to defining the MST topology, the VLAN-to-instance map is one of three parameters, along with the MST name and revision number, that identifies the switch’s MST region.

The no instance command removes specified entries from the VLAN-to-instance map. If the command does not provide a VLAN list, all entries are removed for the specified instance. The no instance and default instance commands function identically.

Command Mode
MST-Configuration

Command Syntax

```
instance mst_inst vlans v_range
no instance mst_inst [vlans v_range]
no default instance mst_inst [vlans v_range]
```

Parameters
- **mst_inst**  MST instance number. Value of mst_inst ranges from 0 to 4094.
- **v_range**  VLAN list. Formats include a number, number range, or comma-delimited list of numbers and ranges.

Examples
- This command maps VLANs 20-39 to MST instance 2
  ```
  switch(config)#spanning-tree mst configuration
  switch(config-mst)#instance 2 vlans 20-39
  switch(config-mst)#
  ```
- This command removes all VLAN mappings to MST instance 10.
  ```
  switch(config-mst)#no instance 10
  switch(config-mst)#
  ```
loop-protection

The loop-protection command enables loop protection on the configuration mode interface. All interfaces in a VLAN under loop protection have loop protection enabled by default. The no loop-protection and default loop-protection commands disable loop protection on the interface.

When loop protection is disabled (at the VLAN or interface level), the computed state of the interface is forgotten and packets queued to be sent are dropped. If an interface is err-disabled by loop protection, disabling loop protection removes the err-disable.

Command Mode
   Interface-Ethernet Configuration

Command Syntax
   loop-protection
   no loop-protection
   default loop-protection

Example
   • These commands disable loop protection on Ethernet interface 2/4. If the interface is currently err-disabled by loop protection, the err-disable will be removed.

   switch(config)#interface ethernet 2/4
   switch(config-if-Et2/4)#no loop-protection
   switch(config-if-Et2/4)#
**monitor loop-protection**

The *monitor loop-protection* command places the switch in loop-protection configuration mode.

**Command Mode**

Global Configuration

**Command Syntax**

```bash
monitor loop-protection
```

**Commands available in loop-protection configuration mode:**

- `shutdown (Loop-protection)`
- `protect vlan`
- `transmit-interval`
- `disabled-time`
- `rate-limit`

**Example**

- This command places the switch in loop-protection configuration mode.

```
switch(config)#monitor loop-protection
switch(config-monitor-loop-protect)#
```
name (mst-configuration mode)

The **name** command configures the MST region name. The name is one of three parameters, along with the MST revision number and VLAN-to-instance map, that identifies the switch's MST region.

The name has up to 32 characters. The default name is an empty string. The name string accepts all characters except the space.

The **no name** and **default name** commands restore the default name by removing the **name** command from **running-config**.

**Command Mode**
- MST-Configuration

**Command Syntax**

- `name label_text`
- `no name`
- `default name`

**Parameters**
- **label_text** character string assigned to name attribute. Maximum 32 characters. The space character is not permitted in the name string.

**Example**
- This command assigns corporate_100 as the MST region name.

  ```
  switch(config)#spanning-tree mst configuration
  switch(config-mst)#name corporate_100
  switch(config-mst)#show pending
  Active MST configuration
  Name      [corporate_100]
  Revision  0    Instances configured 1
  
  Instance  Vlans mapped
  -------  -----------------------------------------------
  0        1-4094
  -----------------------------------------------
  ```
**protect vlan**

The `protect vlan` command specifies which VLANs will participate in loop protection. The `no protect vlan` and `default protect vlan` commands remove loop protection from the specified VLANs.

**Command Mode**
Loop-protection Configuration

**Command Syntax**

`protect vlan vlan-range`

**Parameters**

- `vlan-range` List of VLANs (number, range, comma-delimited list of numbers and ranges). Numbers range from 1 to 4094.

**Example**

- This command enables loop protection on VLANs 1025-2000.

```
switch(config-monitor-loop-protect)#protect vlan 1025-2000
switch(config-monitor-loop-protect)#
```
rate-limit

The rate-limit command sets the maximum number of loop detection frames which can be sent by the switch per second. The no rate-limit and default rate-limit commands return the rate limit to the default value of 1000.

Command Mode

Loop-protection Configuration

Command Syntax

```
rate-limit frames
no rate-limit [frames]
default rate-limit [frames]
```

Parameters

- **frames** Maximum number of frames sent per second. Values range from 0-1000, default is 1000. A value of zero disables throttling.

Example

- This command sets the maximum number of loop detection frames to 500 per second.

```
switch(config-monitor-loop-protect)#rate-limit 500
switch(config-monitor-loop-protect)#
```
revision (mst-configuration mode)

The `revision` command configures the MST revision number. The revision number is one of three parameters, along with the MST name and VLAN-to-instance map, that identifies the switch’s MST region. Revision numbers range from 0 to 65535. The default revision number is 0.

The `no revision` and `default revision` commands restore the revision number to its default value by removing the revision command from `running-config`.

Command Mode

MST-Configuration

Command Syntax

```
revision rev_number
no revision
default revision
```

Parameters

- `rev_number` revision number. Possible ranges from 0 to 65535 with a default of 0.

Examples

- This command sets the revision number to 15.

```
switch(config)# spanning-tree mst configuration
switch(config-mst)# revision 15
```

Active MST configuration

Name []
Revision 15 Instances configured 1

<table>
<thead>
<tr>
<th>Instance</th>
<th>Vlans mapped</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1-4094</td>
</tr>
</tbody>
</table>

---
show (mst-configuration mode)

The `show` command displays the current and pending MST configuration:
Exiting MST configuration mode stores all pending configuration changes to `running-config`.

**Command Mode**

MST-Configuration

**Command Syntax**

```
show [EDIT_VERSION]
```

**Parameters**

- `EDIT_VERSION` specifies configuration version that the command displays. Options include:
  - `<no parameter>` command displays pending MST configuration.
  - `active` command displays MST configuration stored in `running-config`.
  - `current` command displays MST configuration stored in `running-config`.
  - `pending` command displays pending MST configuration.
Example

- These commands contrast the difference between the active and pending configuration by adding MST configuration commands, then showing the configurations.

```plaintext
switch(config-mst)#show pending
Active MST configuration
Name       [ ]
Revision 0  Instances configured 1

Instance Vlans mapped
--------
---------
0        1-4094
---------
-
```

```plaintext
switch(config-mst)#instance 2 vlan 20-29,102
switch(config-mst)#revision 2
switch(config-mst)#name baseline
switch(config-mst)#show pending
Pending MST configuration
Name       [baseline]
Revision 2  Instances configured 2

Instance Vlans mapped
--------
---------
0        1-19,30-101,103-4094
2        20-29,102
---------
-
```

```plaintext
switch(config-mst)#show active
Active MST configuration
Name       [ ]
Revision 0  Instances configured 1

Instance Vlans mapped
--------
---------
0        1-4094
---------
-
```
show loop-protection

The `show loop-protection` command displays loop protection status.

**Command Syntax**

`show loop-protection [detail]`

**Examples**

- This command displays basic loop protection information.
  
  ```
  switch>show loop-protection
  Loop protection is enabled
  Transmit interval: 5
  Disable Time: 604800 (or Permanent)
  Packets Transmitted rate: 12/second (or Unthrottled)
  Total: 3 Vlans enabled.
  switch>
  ```

- This command displays detailed information about loop protection.
  
  ```
  switch>show loop-protection detail
  Loop protection is enabled
  Transmit interval: 5
  Disable Time: 604800
  Packets Transmitted rate: 12/second
  Total: 3 Vlans enabled.
  Destination address: ffff.ffff.ffff
  Ethernet type: 0x88b7
  Receive action: Interface Disable

<table>
<thead>
<tr>
<th>Vlan</th>
<th>Loop Detected</th>
<th>Disabled Intfs</th>
<th>Total</th>
<th>Latest Disabled Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>Et1-2</td>
<td>20</td>
<td>18:01</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td></td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td></td>
<td>20</td>
<td>-</td>
</tr>
</tbody>
</table>
  switch>
  ```

- This command displays loop protection information for the interfaces in VLANS 3-4.
  
  ```
  switch>show loop-protection vlan 3-4
  Vlan  Intf  LP Enabled State  LP  Disabled  Bring Disabled at  up at
  ----- ----- ---------- -------- -------- ------- ------ ------ -----
  3    Et1  Yes  shutdown  Yes  17:21  18:21
  3    Et2  Yes  shutdown  No   -       -       -       -
  3    Et3  Yes  enabled  No   -       -       -       -
  3    Et4  No   -         -   -       -       -       -
  4    -    No   -         -   -       -       -       -
  switch>
  ```
This command displays the number of loop detection packets sent and received.

```
switch>show loop-protection counters
VLAN    Tx    Rx    Rx-Other
------- ---- --- -------
 2       200  0     100
 3       200  1     0

Intfs   Tx    Rx    Rx-Other
------- ---- --- -------
 Et1     200  0     100
 Et2     200  1     0
```

switch>
show spanning-tree

The show spanning-tree command displays spanning tree protocol (STP) data, organized by instance.

Command Mode
EXEC

Command Syntax
show spanning-tree [VLAN_ID] [INFO_LEVEL]

Parameters
- **VLAN_ID** specifies the VLANs for which the command displays information. Formats include:
  - <no parameter> displays information for all VLANs.
  - vlan displays data for instances containing the first VLAN listed in running-config.
  - vlan v_range displays data for instances containing a VLAN in the specified range.
- **INFO_LEVEL** specifies level of information detail provided by the command.
  - <no parameter> displays table for each instance listing status, configuration, and history.
  - detail displays data blocks for each instance and all ports on each instance.

Display Values
- **Root ID** Displays information on the ROOT ID (elected spanning tree root bridge ID):
  - **Priority**: Priority of the bridge. Default value is 32768.
  - **Address**: MAC address of the bridge.
- **Bridge ID** bridge status and configuration information for the locally configured bridge:
  - **Priority**: Priority of the bridge. The default priority is 32768.
  - **Address**: MAC address of the bridge.
  - **Hello Time**: Interval (seconds) between bridge protocol data units (BPDUs) transmissions.
  - **Max Age**: Maximum time that a BPDU is saved.
  - **Forward Delay**: Time (in seconds) that is spent in the learning state.
- **Interface** STP configuration participants. Link-down interfaces are not shown.
- **Role** Role of the port as one of the following:
  - **Root**: The best port for a bridge to a root bridge used for forwarding.
  - **Designated**: A forwarding port for a LAN segment.
  - **Alternate**: A port acting as an alternate path to the root bridge.
  - **Backup**: A port acting as a redundant path to another bridge port.
- **State** Displays the interface STP state as one of the following:
  - Learning
  - Discarding
  - Forwarding
- **Cost** STP port path cost value.
- **Prio. Nbr.** STP port priority. Values range from 0 to 240. Default is 128.
- **Type** The link type of the interface (automatically derived from the duplex mode of an interface):
  - **P2p Peer (STP)** Point to point full duplex port running standard STP.
- **shr Peer (STP)** Shared half duplex port running standard STP.

**Examples**

- This command displays STP data, including a table of port parameters.

  ```
  switch>show spanning-tree vlan 1000
  MST0
  Spanning tree enabled protocol rstp
  Root ID  Priority  32768
  Address  001c.7301.07b9
  Cost     1999 (Ext) 0 (Int)
  Port     101 (Port-Channel12)
  Hello Time 2.000 sec Max Age 20 sec Forward Delay 15 sec

  Bridge ID  Priority  32768 (priority 32768 sys-id-ext 0)
  Address  001c.7304.195b
  Hello Time 2.000 sec Max Age 20 sec Forward Delay 15 sec

  Interface        Role       State      Cost      Prio.Nbr Type
  ---------------- ---------- ---------- --------- -------- -------------------
  Et4              designated forwarding 20000     128.4    P2p
  Et5              designated forwarding 20000     128.5    P2p
  Et6              designated forwarding 20000     128.6    P2p
  Et23             designated forwarding 20000     128.23   P2p
  Et26             designated forwarding 20000     128.26   P2p
  Et32             designated forwarding 2000      128.32   P2p

  switch>
  This command displays output from the show spanning-tree command:

  Switch#show spanning-tree
  MST0
  Spanning tree enabled protocol mstp
  Root ID  Priority  32768
  Address  0011.2201.0301
  This bridge is the root

  Bridge ID  Priority  32768 (priority 32768 sys-id-ext 0)
  Address  0011.2201.0301
  Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

  Interface        Role       State      Cost      Prio.Nbr Type
  ---------------- ---------- ---------- --------- -------- -------------------
  Et4              designated forwarding 2000      128.4    P2p
  Et5              designated forwarding 2000      128.5    P2p
  ...              ...                    ...        ...      ...
  PEt4             designated forwarding 2000      128.31   P2p
  PEt5             designated forwarding 2000      128.44   P2p
  ...              ...                    ...        ...      ...
  Po3              designated forwarding 1999      128.1003 P2p
  ```
This command displays STP data, including an information block for each interface running STP.

```
switch>show spanning-tree vlan 1000 detail
MST0 is executing the rstp Spanning Tree protocol
  Bridge Identifier has priority 32768, sysid 0, address 001c.7304.195b
  Configured hello time 2.000, max age 20, forward delay 15, transmit hold-count 6
  Current root has priority 32768, address 001c.7301.07b9
  Root port is 101 (Port-Channel2), cost of root path is  1999 (Ext) 0 (Int)
  Number of topology changes 4109 last change occurred 1292651 seconds ago
    from Ethernet13

Port 4 (Ethernet4) of MST0 is designated forwarding
  Port path cost 20000, Port priority 128, Port Identifier 128.4.
  Designated root has priority 32768, address 001c.7301.07b9
  Designated bridge has priority 32768, address 001c.7304.195b
  Designated port id is 128.4, designated path cost 1999 (Ext) 0 (Int)
  Timers: message age 1, forward delay 15, hold 20
  Number of transitions to forwarding state: 1
  Link type is point-to-point by default, Internal
  BPDU: sent 452252, received 0, taggedErr 0, otherErr 0, rateLimiterCount 0
  Rate-Limiter: enabled, Window: 10 sec, Max-BPDU: 400

Port 5 (Ethernet5) of MST0 is designated forwarding
  Port path cost 20000, Port priority 128, Port Identifier 128.5.
  Designated root has priority 32768, address 001c.7301.07b9
  Designated bridge has priority 32768, address 001c.7304.195b
  Designated port id is 128.5, designated path cost 1999 (Ext) 0 (Int)
  Timers: message age 1, forward delay 15, hold 20
  Number of transitions to forwarding state: 1
  Link type is point-to-point by default, Internal
  BPDU: sent 1006266, received 0, taggedErr 0, otherErr 0, rateLimiterCount 0
  Rate-Limiter: enabled, Window: 10 sec, Max-BPDU: 400

<-------OUTPUT OMITTED FROM EXAMPLE-------->
```

switch>
show spanning-tree blockedports

The **show spanning-tree blockedports** command displays the list of blocked (discarding) ports.

**Command Mode**

EXEC

**Command Syntax**

```plaintext
show spanning-tree blockedports
```

**Example**

- This command shows the ports that are in discarding state.

```
switch>show spanning-tree blockedports
Name    Blocked Interfaces List
--------
MST0    Po903, Po905, Po907, Po909, Po911, Po913, Po915, Po917, Po919, Po921,
        Po923
        Po925, Po927, Po929, Po931, Po933, Po935, Po939, Po941, Po943, Po945,
        Po947

Number of blocked ports (segments) in the system : 22
switch>
```
show spanning-tree counters

The `show spanning-tree counters` command displays the number of BPDU transactions on each interface running spanning tree.

**Command Mode**

EXEC

**Command Syntax**

`show spanning-tree counters`

**Example**

- This command displays the BPDU counter status on each interface running spanning tree.

```
switch>show spanning-tree counters

                      Port      Sent   Received   Tagged Error   Other Error  sinceTimer
----------------------------------------------------------------------------
        Ethernet2   1008399          0              0             0           0           0
         Ethernet3   1008554          0              0             0           0           0
          Ethernet4    454542          0              0             0           0           0
           Ethernet5   1008556          0              0             0           0           0
           Ethernet6    827133          0              0             0           0           0
           Ethernet7   1008566          0              0             0           0           0
           Ethernet10    390732          0              0             0           0           0
           Ethernet11   1008559          0              0             0           0           0
          Ethernet15    391379          0              0             0           0           0
           Ethernet17    621253          0              0             0           0           0
           Ethernet19    330855          0              0             0           0           0
          Ethernet23    245243          0              0             0           0           0
          Ethernet25    591695          0              0             0           0           0
          Ethernet26    1007903          0              0             0           0           0
          Ethernet32    1010429          8              0             0           0           0
          Ethernet33    510227          0              0             0           0           0
          Ethernet34    827136          0              0             0           0           0
          Ethernet38    1008397          0              0             0           0           0
        Ethernet39    1008564          0              0             0           0           0
        Ethernet40    1008185          0              0             0           0           0
        Ethernet41    1007467          0              0             0           0           0
          Ethernet42    829255          0              0             0           0           0
     Port-Channel1   1008551          0              0             0           0           0
     Port-Channel2    334854  678589              0             0           3
     Port-Channel3    1010420          4              0             0           0           0

switch>
```
show spanning-tree instance

The **show spanning-tree instance** command displays spanning tree protocol bridge configuration settings for each instance on the switch. The display includes Bridge ID, Hello Time, Max Age, and Forward Delay times.

The command also displays the restartability of the STP agent when the **detail** option is selected. A switch can continue support of MLAG operation when its peer is offline and the STP agent is unavailable.

**Command Mode**

EXEC

**Command Syntax**

```
show spanning-tree instance [INFO_LEVEL]
```

**Parameters**

- **INFO_LEVEL** specifies level of information detail provided by the command.
  - `<no parameter>` command displays information in a data table.
  - `detail` command displays bridge information in data blocks for each instance.

**Examples**

- **This command displays a bridge data table.**
  
  ```
  switch>show spanning-tree instance
  Bridge ID Priority      MAC addr       Hello  Max  Fwd
  Instance--------------------------------------------------     -----  ---  ---
  MST0             32768(32768, sys-id 0 ) 001c.7302.2f98      2000    20   15
  MST101           32869(32768, sys-id 101 ) 001c.7302.2f98      2000    20   15
  MST102           32870(32768, sys-id 102 ) 001c.7302.2f98      2000    20   15
  switch>
  ```

- **This command displays bridge data blocks.**
  
  ```
  switch>show spanning-tree instance detail
  Stp Detailed Status:
  Stp agent restartable : True
  MST-PVST interoperation : Disabled
  Stp heartbeat timeout : 2.0
  Last local heartbeat timeout : 0:04:07 ago
  Local heartbeat timeout since reboot : 1
  MST0
  Bridge ID Priority      32768 (priority 32768 sys-id-ext 0)
  Address 001c.7302.2f98
  Hello Time 2.000 sec Max Age 20 sec Forward Delay 15 sec
  MST101
  Bridge ID Priority      32869 (priority 32768 sys-id-ext 101)
  Address 001c.7302.2f98
  Hello Time 2.000 sec Max Age 20 sec Forward Delay 15 sec
  MST102
  Bridge ID Priority      32870 (priority 32768 sys-id-ext 102)
  Address 001c.7302.2f98
  Hello Time 2.000 sec Max Age 20 sec Forward Delay 15 sec
  switch>
  ```
show spanning-tree interface

The show spanning-tree interface command displays spanning tree protocol information for the specified interface.

Command Mode
EXEC

Command Syntax

show spanning-tree interface INT_NAME [INFO_LEVEL]

Parameters

- **INT_NAME** Interface type and number. Values include:
  - ethernet e_num Ethernet interface specified by e_num.
  - peerethernet e_num Ethernet interface specified by e_num.
  - port-channel p_num Port-Channel Interface specified by p_num.
  - peerport-channel p_num Port-Channel Interface specified by p_num.
- **INFO_LEVEL** specifies level of detail provided by the output. Options include:
  - <no parameter> command displays a table of STP data for the specified interface.
  - detail command displays a data block for the specified interface.

Examples

- This command displays an STP table for Ethernet interface 5.

  switch> show spanning-tree interface ethernet 5
  Instance         Role       State      Cost      Prio.Nbr Type
  ---------------- ---------- ---------- --------- -------- -------------------
  MST0             designated forwarding 20000     128.5    P2p
  switch>

- This command displays a data block for Ethernet interface 5.

  switch> show spanning-tree interface ethernet 5 detail
  Port 5 (Ethernet5) of MST0 is designated forwarding
  Port path cost 20000, Port priority 128, Port Identifier 128.5.
  Designated root has priority 32768, address 001c.7301.07b9
  Designated bridge has priority 32768, address 001c.7304.195b
  Designated port id is 128.5, designated path cost 1999 (Ext) 0 (Int)
  Timers: message age 1, forward delay 15, hold 20
  Number of transitions to forwarding state: 1
  Link type is point-to-point by default, Internal
  BPDU: sent 1008766, received 0, taggedErr 0, otherErr 0, rateLimiterCount 0
  Rate-Limiter: enabled, Window: 10 sec, Max-BPDU: 400
  switch>
show spanning-tree mst

The `show spanning-tree mst` command displays configuration and state information for Multiple Spanning Tree Protocol (MST) instances.

**Command Mode**

EXEC

**Command Syntax**

```
show spanning-tree mst [INSTANCE] [INFO_LEVEL]
```

**Parameters**

- **INSTANCE** – MST instance for which the command displays information. Options include:
  - `<no parameter>` all MST instances.
  - `mst_inst` MST instance number. Value of `mst_inst` ranges from 0 to 4094.

- **INFO_LEVEL** – type and amount of information in the output. Options include:
  - `<no parameter>` output is interface data in tabular format.
  - `detail` output is a data block for each interface.

**Examples**

- This command displays interface data blocks for MST instance 3.

```
switch>show spanning-tree mst 3 detail
##### MST3    vlans mapped:    3
Bridge        address 0011.2233.4402  priority      32771 (32768 sysid 3)
Root          address 0011.2233.4401  priority      32771 (32768 sysid 3)
Ethernet1 of MST3 is root forwarding
Port info             port id          128.1  priority    128  cost       2000
Designated root       address 0011.2233.4401  priority  32768  cost          0
Designated bridge     address 0011.2233.4401  priority  32768  port id   128.1

Ethernet2 of MST3 is alternate discarding
Port info             port id          128.2  priority    128  cost       2000
Designated root       address 0011.2233.4401  priority  32768  cost          0
Designated bridge     address 0011.2233.4401  priority  32768  port id   128.2

Ethernet3 of MST3 is designated forwarding
Port info             port id          128.3  priority    128  cost       2000
Designated root       address 0011.2233.4401  priority  32768  cost       2000
Designated bridge     address 0011.2233.4402  priority  32768  port id   128.3
```
This command displays interface tables for all MST instances.

```
switch>show spanning-tree mst

### MST0 vlans mapped: 1,4-4094
Bridge     address 0011.2233.4402     priority     32768 (32768 sysid 0)
Root       address 0011.2233.4401     priority     32768 (32768 sysid 0)
Regional Root address 0011.2233.4401 priority     32768 (32768 sysid 0)

<table>
<thead>
<tr>
<th>Interface</th>
<th>Role</th>
<th>State</th>
<th>Cost</th>
<th>Prio.Nbr</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Et1</td>
<td>root</td>
<td>forwarding</td>
<td>2000</td>
<td>128.1</td>
<td>P2p</td>
</tr>
<tr>
<td>Et2</td>
<td>alternate</td>
<td>discarding</td>
<td>2000</td>
<td>128.2</td>
<td>P2p</td>
</tr>
<tr>
<td>Et3</td>
<td>designated</td>
<td>forwarding</td>
<td>2000</td>
<td>128.3</td>
<td>P2p</td>
</tr>
<tr>
<td>Et4</td>
<td>designated</td>
<td>forwarding</td>
<td>2000</td>
<td>128.4</td>
<td>P2p</td>
</tr>
</tbody>
</table>

### MST2 vlans mapped: 2
Bridge     address 0011.2233.4402     priority     8194 (8192 sysid 2)
Root       this switch for MST2

<table>
<thead>
<tr>
<th>Interface</th>
<th>Role</th>
<th>State</th>
<th>Cost</th>
<th>Prio.Nbr</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Et1</td>
<td>designated</td>
<td>forwarding</td>
<td>2000</td>
<td>128.1</td>
<td>P2p</td>
</tr>
<tr>
<td>Et2</td>
<td>designated</td>
<td>forwarding</td>
<td>2000</td>
<td>128.2</td>
<td>P2p</td>
</tr>
<tr>
<td>Et3</td>
<td>designated</td>
<td>forwarding</td>
<td>2000</td>
<td>128.3</td>
<td>P2p</td>
</tr>
<tr>
<td>Et4</td>
<td>designated</td>
<td>forwarding</td>
<td>2000</td>
<td>128.4</td>
<td>P2p</td>
</tr>
</tbody>
</table>

### MST3 vlans mapped: 3
Bridge     address 0011.2233.4402     priority     32771 (32768 sysid 3)
Root       address 0011.2233.4401     priority     32771 (32768 sysid 3)

<table>
<thead>
<tr>
<th>Interface</th>
<th>Role</th>
<th>State</th>
<th>Cost</th>
<th>Prio.Nbr</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Et1</td>
<td>root</td>
<td>forwarding</td>
<td>2000</td>
<td>128.1</td>
<td>P2p</td>
</tr>
<tr>
<td>Et2</td>
<td>alternate</td>
<td>discarding</td>
<td>2000</td>
<td>128.2</td>
<td>P2p</td>
</tr>
<tr>
<td>Et3</td>
<td>designated</td>
<td>forwarding</td>
<td>2000</td>
<td>128.3</td>
<td>P2p</td>
</tr>
<tr>
<td>Et4</td>
<td>designated</td>
<td>forwarding</td>
<td>2000</td>
<td>128.4</td>
<td>P2p</td>
</tr>
</tbody>
</table>
show spanning-tree mst configuration

The `show spanning-tree mst configuration` command displays information about the MST region’s VLAN-to-instance mapping. The command provides two display options:

- **default** displays a table that lists the instance to VLAN map.
- **digest** displays the configuration digest.

The configuration digest is a 16-byte hex string calculated from the md5 encoding of the VLAN-to-instance mapping table. Switches with identical mappings have identical digests.

**Command Mode**
EXEC

**Command Syntax**

```
show spanning-tree mst configuration [INFO_LEVEL]
```

**Parameters**

- **INFO_LEVEL** specifies data provided by the output. Options include:
  - `<no parameter>` command displays VLAN-to-instance map.
  - **digest** command displays the MST configuration digest.

**Examples**

- This command displays the MST region’s VLAN-to-instance map.

```
switch>show spanning-tree mst configuration
Name       []
Revision 0  Instances configured 3

Instance  Vlans mapped
--------  -----------------------------------------------
0         1,4-4094
2         2
3         3
-----------------------------------------------
switch>
```

- This command displays the MST region’s configuration digest.

```
switch>show spanning-tree mst configuration digest
Name       []
Revision 0  Instances configured 1
Digest     0xAC36177F50283CD4B83821D8AB26DE62
switch>
```
**show spanning-tree mst interface**

The `show spanning-tree mst interface` command displays Multiple Spanning Tree Protocol (MSTP) information for a specified interface on the specified MST instances.

**Command Mode**

EXEC

**Command Syntax**

```
show spanning-tree mst [INSTANCE] interface INT_NAME [INFO_LEVEL]
```

**Parameters**

- **INSTANCE** MST instance for which the command displays information. Options include:
  - `<no parameter>` all MST instances.
  - `mst_inst` denotes a single MST instance. Value of `mst_inst` ranges from 0 to 4094.

- **INT_NAME** Interface type and number. Values include:
  - `ethernet e_num` Ethernet interface specified by `e_num`.
  - `peerethernet e_num` Ethernet interface specified by `e_num`.
  - `port-channel p_num` Port-channel interface specified by `p_num`.
  - `peerport-channel p_num` Port-channel interface specified by `p_num`.

- **INFO_LEVEL** specifies level of detail provided by the output. Options include:
  - `<no parameter>` command displays a table of STP instance data for the specified interface
  - `detail` command displays a data block for all specified instance-interface combinations.

**Examples**

- This command displays a table of STP instance data for Ethernet 1 interface:
  
  switch>show spanning-tree mst interface ethernet 1
  Ethernet1 of MST0 is root forwarding
  Edge port: no                                bpdu guard: disabled
  Link type: point-to-point
  Boundary : Internal
  Bpdus sent 2120, received 2164, taggedErr 0, otherErr 0

  Instance Role Sts Cost     Prio.Nbr Vlans mapped
  -------- ---- --- --------- -------- -------------------------------
  0        Root FWD 2000      128.1   1,4-4094
  2        Desg FWD 2000      128.1   2
  3        Root FWD 2000      128.1   3

- This command displays blocks of STP instance information for Ethernet 1 interface.
  
  switch>show spanning-tree mst 3 interface ethernet 1 detail
  Ethernet1 of MST3 is root forwarding
  Vlans mapped to MST3
  Port info             port id      priority 128 cost 2000
  Designated root      address 0011.2233.4401 priority 32768 cost 0
  Designated bridge    address 0011.2233.4401 priority 32768 port id 128.1
show spanning-tree mst test information

The `show spanning-tree mst test information` displays diagnostic spanning tree protocol information.

**Command Mode**

EXEC

**Command Syntax**

`show spanning-tree mst test information`

**Examples**

- This command displays diagnostic STP information.

```python
switch>show spanning-tree mst test information
bi = MstInfo.BridgeInfo( "dut" )
bi.stpVersion = "rstp"
bi.mstpRegionId = ""
bi.bridgeAddr = "00:1c:73:01:60:17"
si = MstInfo.BridgeStpiInfo( "Mst" )
bi.stpiInfoIs( "Mst", si )
si.cistRoot = Tac.Value( "Stp::BridgeId", priority=32768, systemId=0,
address='00:1c:73:01:60:17' )
si.cistPathCost = 0
bmi = MstInfo.BridgeMstiInfo( "Mst0" )
bmi.bridgeId = Tac.Value( "Stp::BridgeId", priority=32768, systemId=0,
address='00:1c:73:01:60:17' )
bmi.designatedRoot = Tac.Value( "Stp::BridgeId", priority=32768, systemId=0,
address='00:1c:73:01:60:17' )
si.mstiInfoIs( "Mst0", bmi )
bmii = MstInfo.BridgeMstiIntfInfo( "Mst0", "Ethernet15" )
bmii.portId = Tac.Value( "Stp::PortId",
portPriority=128, portNumber=15 )
bmii.role = "designated"
bmii.operIntPathCost = 2000
bmii.fdbFlush = 1
bmii.mstiIntfInfoIs( "Ethernet15", bmii )
bii = MstInfo.BridgeIntfInfo( "Ethernet15" )
bii.operExtPathCost = 2000
si.intfInfoIs( "Ethernet15", bi )
bmii = MstInfo.BridgeMstiIntfInfo( "Mst0", "Port-Channel10" )
bmii.portId = Tac.Value( "Stp::PortId",
portPriority=128, portNumber=101 )
bmii.role = "designated"
bmii.operIntPathCost = 1999
bmii.fdbFlush = 1
bmii.mstiIntfInfoIs( "Port-Channel10", bmii )
bii = MstInfo.BridgeIntfInfo( "Port-Channel10" )
bii.operExtPathCost = 1999
si.intfInfoIs( "Port-Channel10", bi )
switch>
```
**show spanning-tree root**

The **show spanning-tree root** command displays the Bridge-ID, cost to the root bridge, root port, and the root bridge timer settings for all instances.

**Command Mode**

EXEC

**Command Syntax**

```
  show spanning-tree root [INFO_LEVEL]
```

**Parameters**

- **INFO_LEVEL** specifies output format. Options include:
  - <no parameter> output displays data in tabular format.
  - **detail** output displays a data block for each instance.

**Examples**

- This command displays a table of root bridge information.
  
  ```
  switch>show spanning-tree root
  Instance    Root ID          Root    Hello  Max  Fwd
  ----------   -------------------- --------- -----  ---  ---  ------------
  MST0         32768 001c.7301.23de         0    2    20  15   Po937
  MST101       32869 001c.7301.23de      3998    0     0   0   Po909
  MST102       32870 001c.7301.23de      3998    0     0   0   Po911
  switch>
  ```

- This command displays root bridge data blocks for each MSTP instance.
  
  ```
  switch>show spanning-tree root detail
  MST0
  MST0
  Root ID    Priority    32768
  Address     001c.7301.23de
  Cost        0 (Ext) 3998 (Int)
  Port        100 (Port-Channel937)
  Hello Time  2.000 sec  Max Age 20 sec  Forward Delay 15 sec
  ```
  
  ```
  MST101
  Root ID    Priority    32869
  Address     001c.7301.23de
  Cost        3998
  Port        107 (Port-Channel909)
  Hello Time  0.000 sec  Max Age 0 sec  Forward Delay 15 sec
  ```
  
  ```
  MST102
  Root ID    Priority    32870
  Address     001c.7301.23de
  Cost        3998
  Port        104 (Port-Channel911)
  Hello Time  0.000 sec  Max Age 0 sec  Forward Delay 0 sec
  ```
  ```
  switch>
  ```
show spanning-tree topology status

The `show spanning-tree topology status` command displays the forwarding state of ports on the specified VLANs.

**Command Mode**

EXEC

**Command Syntax**

```
show spanning-tree topology [VLAN_NAME] status [INFO_LEVEL]
```

**Parameters**

- **VLAN_NAME** specifies the VLANs that the output displays. Options include:
  - `<no parameter>` output includes all VLANs.
  - `vlan` output includes all VLANs.
  - `vlan v_num` command includes specified VLAN; `v_num` ranges from 1 to 4094.

- **INFO_LEVEL** specifies information provided by output. Options include:
  - `<no parameter>` output lists forwarding state of interfaces.
  - `detail` output lists forwarding state and change history of interfaces.

**Examples**

- This command displays forwarding state for ports mapped to all VLANs.
  ```shell
  switch>show spanning-tree topology status
  Topology: Cist
  Mapped Vlans: 1-4,666,1000-1001,1004-1005
  Cpu:               forwarding
  Ethernet2:         forwarding
  Ethernet3:         forwarding
  Ethernet4:         forwarding
  Ethernet5:         forwarding
  Ethernet6:         forwarding
  Ethernet8:         forwarding
  Ethernet10:        forwarding
  Port-Channel1:     forwarding
  Port-Channel2:     forwarding
  Port-Channel3:     forwarding
  ```
  
  switch>

- This command displays forwarding state and history for ports mapped to VLAN 1000.
  ```shell
  switch>show spanning-tree topology vlan 1000 status detail
  Topology: Cist
  Mapped Vlans: 1000
  Cpu:               forwarding (1 changes, last 23 days, 22:54:43 ago)
  Ethernet2:         forwarding (3 changes, last 23 days, 22:48:59 ago)
  Ethernet4:         forwarding (3 changes, last 19 days, 15:49:10 ago)
  Ethernet5:         forwarding (3 changes, last 23 days, 22:54:38 ago)
  Ethernet6:         forwarding (3 changes, last 19 days, 15:49:10 ago)
  Ethernet10:        forwarding (3 changes, last 9 days, 7:37:05 ago)
  Port-Channel1:     forwarding (3 changes, last 23 days, 22:54:34 ago)
  Port-Channel3:     forwarding (5 changes, last 21 days, 4:56:41 ago)
  ```
  
  switch>
The `show spanning-tree transmit active` command displays spanning tree protocol bridge assurance information for network ports or for all ports. Bridge assurance-enabled ports will not necessarily be blocked when they link to a port where bridge assurance is not enabled, but if they do not receive periodic BPDUs from the other side of the link the `show spanning-tree transmit active` command will show a bridge assurance status of “inconsistent” (blocking) for that port.

**Command Mode**

EXEC

**Command Syntax**

```
show spanning-tree transmit active INFO_LEVEL
```

**Parameters**

- `INFO_LEVEL` specifies level of information detail provided by the command.
  - `<no parameter>` command displays bridge assurance information for network ports.
  - `detail` command displays bridge assurance information for all ports.

**Examples**

- This command displays the bridge assurance status of network ports.
  ```
  switch>show spanning-tree transmit active
  Name                Bridge Assurance Status
  ------------------- -----------------------------
  VL1            Et5/1              consistent
  
  Number of bridge assurance inconsistent ports in the system : 0
  switch>
  ```
**shutdown (Loop-protection)**

The `shutdown (Loop-protection)` command disables loop protection globally. The feature is disabled by default, and is enabled by using the `no shutdown (Loop-protection)` command.

**Note**

To function, loop protection must also be enabled on a per-VLAN basis using the `protect vlan` command.

**Command Mode**

Loop-protection Configuration

**Command Syntax**

```
shutdown
no shutdown
```

**Example**

- This command enables loop protection globally on the switch.
  
  ```
  switch(config-monitor-loop-protect)#no shutdown
  switch(config-monitor-loop-protect)#
  ```
**spanning-tree bpdu tx hold-count**

The `spanning-tree bpdu tx hold-count` command specifies the maximum number of BPDUs per second that the switch can send from an interface. Valid settings range from 1 to 10 BPDUs with a default of 6 BPDUs.

The `no spanning-tree bpdu tx hold-count` and `default spanning-tree bpdu tx hold-count` commands restore the transmit hold count default of 6 BPDUs by removing the `spanning-tree bpdu tx hold-count` command from `running-config`.

**Command Mode**
- Global Configuration

**Command Syntax**

```
spanning-tree bpdu tx hold-count max_bpdu
no spanning-tree bpdu tx hold-count
default spanning-tree bpdu tx hold-count
```

**Parameters**
- `max_bpdu` BPDU packets. Value ranges from 1 to 10. Default is 6.

**Examples**
- This command configures a transmit hold-count of 8 BPDUs.
  
  switch(config)#spanning-tree bpdu tx hold-count 8
  
  switch(config)#
spanning-tree bpdufilter

The `spanning-tree bpdufilter` command controls bridge protocol data unit (BPDU) filtering on the configuration mode interface. BPDU filtering is disabled by default.

- `spanning-tree bpdufilter enabled` enables BPDU filtering.
- `spanning-tree bpdufilter disabled` disables BPDU filtering by removing the `spanning-tree bpdufilter` command from `running-config`.

The BPDU filter default setting for portfast ports is configured by the `spanning-tree edge-port bpdufilter default` command; BPDU filter is disabled by default on all non-portfast ports.

The `no spanning-tree bpdufilter` and `default spanning-tree bpdufilter` commands restore the global BPDU filter setting on the configuration mode interface by removing the corresponding `spanning-tree bpdufilter` command from `running-config`.

**Command Mode**

- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**

```
spanning-tree bpdufilter FILTER_STATUS
no spanning-tree bpdufilter
default spanning-tree bpdufilter
```

**Parameters**

- `FILTER_STATUS` BPDU filtering status. Options include:
  - `enabled` BPDU filter is enabled on the interface.
  - `disabled` BPDU filter is disabled on the interface.

**Examples**

- This command enables BPDU filtering on Ethernet 5 interface.

  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree bpdufilter enabled
  switch(config-if-Et5)#
  ```
spanning-tree bpduguard

The `spanning-tree bpduguard` command controls BPDU guard on the configuration mode interface. A BPDU guard-enabled port is disabled when it receives a BPDU packet.

The BPDU guard default setting for portfast ports is configured by the `spanning-tree edge-port bpduguard default` command; BPDU guard is disabled by default on all non-portfast ports.

The `no spanning-tree bpduguard` and `default spanning-tree bpduguard` commands restore the global BPDU guard setting on the configuration mode interface by removing the corresponding `spanning-tree bpduguard` command from `running-config`.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**
- `spanning-tree bpduguard GUARD_ACTION`
- `no spanning-tree bpduguard`
- `default spanning-tree bpduguard`

**Parameters**
- **GUARD_ACTION**  
  - `disable`  
    Disable bpduguard
  - `enable`  
    Enable bpduguard
  - `rate-limit`  
    BPDU Input Rate Limiter options

**Examples**
- These commands enable BPDU guard on Ethernet interface 5.
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree bpduguard enabled
  switch(config-if-Et5)
  ```

---

**spanning-tree bpduguard**

The `spanning-tree bpduguard` command controls BPDU guard on the configuration mode interface. A BPDU guard-enabled port is disabled when it receives a BPDU packet.

The BPDU guard default setting for portfast ports is configured by the `spanning-tree edge-port bpduguard default` command; BPDU guard is disabled by default on all non-portfast ports.

The `no spanning-tree bpduguard` and `default spanning-tree bpduguard` commands restore the global BPDU guard setting on the configuration mode interface by removing the corresponding `spanning-tree bpduguard` command from `running-config`.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**
- `spanning-tree bpduguard GUARD_ACTION`
- `no spanning-tree bpduguard`
- `default spanning-tree bpduguard`

**Parameters**
- **GUARD_ACTION**  
  - `disable`  
    Disable bpduguard
  - `enable`  
    Enable bpduguard
  - `rate-limit`  
    BPDU Input Rate Limiter options

**Examples**
- These commands enable BPDU guard on Ethernet interface 5.
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree bpduguard enabled
  switch(config-if-Et5)
  ```
spanning-tree bpduguard rate-limit count (global)

The `spanning-tree bpduguard rate-limit count` command sets the maximum BPDU reception rate (quantity per interval) for ports that are not covered by a `spanning-tree bpduguard rate-limit count (interface)` command.

BPDU rate limiting restricts the number of BPDUs that ports with BPDU guard or BPDU filter disabled can process during a specified interval. Ports discard BPDUs they receive in excess of the specified limit. BPDU rate limiting is enabled or disabled by `spanning-tree bpduguard rate-limit enable` or `disable` commands.

The `no spanning-tree bpduguard rate-limit count` and `default spanning-tree bpduguard rate-limit count` commands restore the global setting to its default value by removing the `spanning-tree bpduguard rate-limit count` command from `running-config`.

Command Mode
- Global Configuration

Command Syntax

```
spanning-tree bpduguard rate-limit count max_bpdu [interval period]
no spanning-tree bpduguard rate-limit count
default spanning-tree bpduguard rate-limit count
```

Parameters
- `max_bpdu` configures the maximum number of BPDUs per timer interval. The value of `BPDU quantity` ranges from 1 to 20000.
- `interval period` configures the timer interval in seconds. The value of `period` ranges from 1 to 15.

Guidelines
Arista Networks recommends to retain the default values of rate limit.

In the PVST mode, when the VLAN membership of a port is changed by a significant margin, it is advisable to disable interface BPDU rate limit on both ends of a port. For example, if three VLANs are present on a port initially, the operator must first add 300 more VLANs on one side of the port and then add the same 300 VLANs on the other side of the port. In this case, if the VLANs are increased towards the root bridge first, then the other side can cross the rate-limit threshold.

Example
- This command configures the global rate limit as 5000 BPDUs per four second period.

```
switch(config)#spanning-tree bpduguard rate-limit count 5000 interval 4
switch(config)#
```
spanning-tree bpduguard rate-limit count (interface)

The `spanning-tree bpduguard rate-limit count` command configures the maximum BPDU reception rate for the configuration mode interface. The default rate limit is specified by the `spanning-tree bpduguard rate-limit count (global)` command.

BPDU rate limiting restricts the number of BPDUs that ports with BPDU guard or BPDU filter disabled can process during a specified interval. Ports discard BPDUs it receives in excess of the specified limit. BPDU rate limiting is enabled or disabled by `spanning-tree bpduguard rate-limit enable / disable` commands.

The `no spanning-tree bpduguard rate-limit count` and `default spanning-tree bpduguard rate-limit count` commands restore the interface value to the global setting by removing the corresponding `spanning-tree bpduguard rate-limit count` command from `running-config`.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**
```
spanning-tree bpduguard rate-limit count max_bpdu [TIMER]
no spanning-tree bpduguard rate-limit count
default spanning-tree bpduguard rate-limit count
```

**Parameters**
- `max_bpdu` BPDU quantity. Value ranges from 1 to 20,000.
- `TIMER` BPDU reception interval (seconds). Options include:
  - `<no parameter>` reception interval defaults to `hello-time`.
  - `interval period` Value of `period` ranges from 1 to 15.

**Example**
- These commands configure rate limit as 7500 BPDUs per 8 second period on Ethernet 2.
```
switch(config)#interface ethernet 2
switch(config-if-Et2)#spanning-tree bpduguard rate-limit count 7500 interval 8
switch(config-if-Et2)#
```
spanning-tree bpduguard rate-limit default

The `spanning-tree bpduguard rate-limit default` command configures the global BPDU rate limit setting. The global BPDU rate limit setting provides the default for individual ports whose configuration does not include a `spanning-tree bpduguard rate-limit enable / disable` command. The default global setting is `enabled`.

BPDU rate limiting restricts the number of BPDUs that ports with BPDU guard or BPDU filter disabled can process during a specified interval. Ports discard BPDUs it receives in excess of the specified limit. BPDU rate limits are established by `spanning-tree bpduguard rate-limit count (global)` commands.

The `no spanning-tree bpduguard rate-limit default` sets the global BPDU rate limit setting to `disabled`. The `spanning-tree bpduguard rate-limit default` and `default spanning-tree bpduguard rate-limit default` commands restore the default global rate limit setting to `enabled` by removing the `no spanning-tree bpduguard rate-limit default` command from `running-config`.

**Command Mode**

Global Configuration

**Command Syntax**

- `spanning-tree bpduguard rate-limit default`
- `no spanning-tree bpduguard rate-limit default`
- `default spanning-tree bpduguard rate-limit default`

**Example**

- This command enables rate limiting on all ports not covered by an interface rate limit command.

  ```
  switch(config)#spanning-tree bpduguard rate-limit default
  switch(config)#
  ```
spanning-tree bpduguard rate-limit enable / disable

These commands enable and disable BPDU rate limiting on the configuration mode interface:

- **spanning-tree bpduguard rate-limit enable** enables BPDU rate limiting.
- **spanning-tree bpduguard rate-limit disable** disables BPDU rate limiting.

The **spanning-tree bpduguard rate-limit default** command enables BPDU rate limiting on all ports not configured with a **spanning-tree bpduguard rate-limit** command.

BPDU rate limiting restricts the number of BPDUs that ports with BPDU guard or BPDU filter disabled can process during a specified interval. Ports discard BPDUs it receives in excess of the specified limit. BPDU rate limits are established by **spanning-tree bpduguard rate-limit count (interface)** commands.

The **no spanning-tree bpduguard rate-limit** and **default spanning-tree bpduguard rate-limit** commands restore the global rate limit setting on the configuration mode interface by removing the corresponding **spanning-tree bpduguard rate-limit** command from *running-config*.

**Command Mode**

- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**

- `spanning-tree bpduguard rate-limit enable`
- `spanning-tree bpduguard rate-limit disable`
- `no spanning-tree bpduguard rate-limit`
- `default spanning-tree bpduguard rate-limit`

**Example**

- These commands enable rate limiting on Ethernet 15.
  
  ```
  switch(config)#interface ethernet 15
  switch(config-if-Et15)#spanning-tree bpduguard rate-limit enable
  switch(config-if-Et15)#
  ```
spanning-tree cost

The `spanning-tree cost` command configures the path cost of the configuration mode interface. Cost values range from 1 to 200000000 (200 million). The default cost depends on the interface speed:

- 1 gigabit interface: cost = 20000
- 10 gigabit interface: cost = 2000

The `spanning-tree cost` command provides a mode option:

- RST instance cost is configured by not including a mode.
- MST instance 0 cost is configured by not including a mode or with the `mst` mode option.
- MST instance cost is configured with the `mst` mode option.
- Rapid-PVST VLAN cost is configured with the `vlan` mode option.

The `no spanning-tree cost` and `default spanning-tree cost` commands restore the default cost on the configuration mode interface by removing the corresponding `spanning-tree cost` command from `running-config`.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**

```
spanning-tree MODE cost value
no spanning-tree MODE cost
default spanning-tree MODE cost
```

**Parameters**
- `MODE` specifies the spanning tree instances for which the cost is configured. Values include:
  - `<no parameter>` RST instance, MST instance 0, or all Rapid-PVST instances permitted on the interface.
  - `mst m_range` specified MST instances. `m_range` formats include a number, number range, or comma-delimited list of numbers and ranges. Instance numbers range from 0 to 4094.
  - `vlan v_range` specified Rapid-PVST instances. `v_range` formats include a number, number range, or comma-delimited list of numbers and ranges. VLAN numbers range from 1 to 4094.
  - `value` path cost assigned to interface. Values range from 1 to 200000000 (200 million). Default values are 20000 (1 G interfaces) or 2000 (10 G interfaces).

**Examples**
- These commands configure a port cost of 25000 for Ethernet interface 5 when configured as an RST port, as a port in MST instance 0, or all unconfigured Rapid-PVST instances that are not explicitly configured.
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning tree cost 25000
  ```
- This command configures a port cost of 30000 for Ethernet interface 5 when configured as a port in MST instance 200.
  ```
  switch(config-if-Et5)#spanning tree mst 200 cost 30000
  ```
This command configures a port cost of 100000 for Ethernet interface 5 when configured as a port in VLANs 200-220.

switch(config-if-Et5)#spanning tree vlan 200-220 cost 100000
switch(config-if-Et5)#
**spanning-tree edge-port bpdufilter default**

The `spanning-tree edge-port bpdufilter default` command configures the global BPDU filter setting as *enabled*. Ports not covered by a `spanning-tree bpdufilter` command use the global BPDU filter setting.

**Command Mode**

Global Configuration

**Command Syntax**

```
spanning-tree edge-port bpdufilter default
no spanning-tree edge-port bpdufilter default
default spanning-tree edge-port bpdufilter default
```

**Example**

- This command configures the BPDU filter global setting to *enabled*.

  ```
  switch(config)#spanning-tree edge-port bpdufilter default
  switch(config)#
  ```
spanning-tree edge-port bpduguard default

The `spanning-tree edge-port bpduguard default` command sets the global BPDU guard setting as **enabled**. Ports not covered by a `spanning-tree bpduguard` command use the global BPDU guard setting.

**Command Mode**
- Global Configuration

**Command Syntax**

```
spanning-tree edge-port bpduguard default
no spanning-tree edge-port bpduguard default
default spanning-tree edge-port bpduguard default
```

**Example**

- This command configures the global BPDU guard setting to **enabled**.

  ```
  switch(config)#spanning-tree edge-port bpduguard default
  switch(config)#
  ```
spanning-tree forward-time

The `spanning-tree forward-time` command configures the forward delay timer. Forward delay is the time that a port is in learning state before it begins forwarding data packets.

The switch inserts the forward delay timer value in BPDU packets it sends as the root bridge. The forward delay value ranges from 4 to 30 seconds with a default of 15 seconds.

The `no spanning-tree forward-time` and `default spanning-tree forward-time` commands restore the forward delay timer default of 15 seconds by removing the `spanning-tree forward-time` command from `running-config`.

**Command Mode**
- Global Configuration

**Command Syntax**

```
spanning-tree forward-time period
no spanning-tree forward-time
default spanning-tree forward-time
```

**Parameters**
- `period` forward delay timer (seconds). Value ranges from 4 to 30. Default is 15.

**Examples**
- This command sets the forward delay timer value to 25 seconds.
  ```
  switch(config)#spanning-tree forward-time 25
  switch(config)#
  ```
spanning-tree guard

The `spanning-tree guard` command enables root guard or loop guard on the configuration mode interface. The `spanning-tree guard loop default` command configures the global loop guard setting.

- Root guard prevents a port from becoming a root or blocked port. A root guard port that receives a superior BPDU transitions to the root-inconsistent (blocked) state.
- Loop guard protects against loops resulting from unidirectional link failures on point-to-point links by preventing non-designated ports from becoming designated ports. When loop guard is enabled, a root or blocked port transitions to loop-inconsistent (blocked) state if it stops receiving BPDUs from its designated port. The port returns to its prior state when it receives a BPDU.

The `no spanning-tree guard` and `default spanning-tree guard` commands sets the configuration mode interface to the global loop guard mode by removing the `spanning-tree guard` statement from `running-config`. The `spanning-tree guard none` command disables loop guard and root guard on the interface, overriding the global setting.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**
```
spanning-tree guard PORT_MODE
no spanning-tree guard
default spanning-tree guard
```

**Parameters**
- `PORT_MODE` the port mode. Options include:
  - `loop` enables loop guard on the interface.
  - `root` enables root guard on the interface.
  - `none` disables root guard and loop guard.

**Examples**
- This command enables root guard on Ethernet 5 interface.
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree guard root
  switch(config-if-Et5)#
  ```
spanning-tree guard loop default

The spanning-tree guard loop default command configures the global loop guard setting as enabled. Ports not covered by a spanning-tree guard command use the global loop guard setting. Loop guard prevents blocked or root ports from becoming a designated port due to failures resulting in a unidirectional link. The spanning-tree guard interface configuration statement overrides the global setting for a specified interface. The default global loop guard setting is disabled.

The no spanning-tree guard loop default and default spanning-tree guard loop default commands restore the global loop guard setting of disabled by removing the spanning-tree guard loop default command from running-config.

Command Mode
Global Configuration

Command Syntax
   spanning-tree guard loop default
   no spanning-tree guard loop default
   default spanning-tree guard loop default

Examples
   • This command enables loop guard as the default on all switch ports.

     switch(config)#spanning-tree guard loop default
     switch(config)#
spanning-tree hello-time

The `spanning-tree hello-time` command configures the hello time, which specifies the transmission interval between consecutive bridge protocol data units (BPDU) that the switch sends as a root bridge. The hello time is also inserted in outbound BPDUs.

This hello time ranges from 0.2 seconds to 10 seconds with a default of 2 seconds.

The `no spanning-tree hello-time` and `default spanning-tree hello-time` commands restore the hello time default of 2 seconds by removing the `spanning-tree hello-time` command from `running-config`.

**Command Mode**
- Global Configuration

**Command Syntax**

```plaintext
spanning-tree hello-time period
no spanning-tree hello-time
default spanning-tree hello-time
```

**Parameters**
- `period` hello-time (milliseconds). Value ranges from 200 to 10000. Default is 2000.

**Examples**
- This command configures a hello-time of one second.
  
  ```
  switch(config)#spanning-tree hello-time 1000
  switch(config)#
  ```
spanning-tree link-type

The `spanning-tree link-type` command specifies the configuration mode interface's link type, which is normally derived from the port's duplex setting. The default setting depends on a port's duplex mode:

- full-duplex ports are `point-to-point`.
- half-duplex ports are `shared`.

The `no spanning-tree link-type` and `default spanning-tree link-type` commands restore the default link type on the configuration mode interface by removing the corresponding `spanning-tree link-type` command from `running-config`.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**

```
spanning-tree link-type TYPE
no spanning-tree link-type
default spanning-tree link-type
```

**Parameters**

- `TYPE`  
  Link type of the configuration mode interface. Options include:
  - `point-to-point`
  - `shared`

**Examples**

- This command configures Ethernet 5 interface as a shared port.

```
switch(config)#interface ethernet 5
switch(config-if-Et5)#spanning-tree link-type shared
switch(config-if-Et5)#
```
spanning-tree max-age

The **spanning-tree max-age** command configures the switch's max age timer, which specifies the max age value that the switch inserts in outbound BPDU packets it sends as a root bridge. The max-age time value ranges from 6 to 40 seconds with a default of 20 seconds.

Max age is the interval, specified in the BPDU, that BPDU data remains valid after its reception. The bridge recomputes the spanning tree topology if it does not receive a new BPDU before max age expiry.

The **no spanning-tree max-age** and **default spanning-tree max-age** commands restore the max-age default of 20 seconds by removing the **spanning-tree max-age** command from **running-config**.

**Command Mode**

Global Configuration

**Command Syntax**

```
spanning-tree max-age period
no spanning-tree max-age
default spanning-tree max-age
```

**Parameters**

- **period** max age period (seconds). Value ranges from 6 to 40. Default is 20.

**Examples**

- This command sets the max age timer value to 25 seconds.

  ```
  switch(config)#spanning-tree max-age 25
  switch(config)#
  ```
spanning-tree max-hops

The `spanning-tree max-hops` command specifies the max hop setting that the switch inserts into BPDUs that it sends out as the root bridge. The max hop setting determines the number of bridges in an MST region that a BPDU can traverse before it is discarded. The max-hop value ranges from 1 to 40 with a default of 20.

The `no spanning-tree max-hops` and `default spanning-tree max-hops` commands restore the max-hops setting to its default value of 20 by removing the `spanning-tree max-hops` command from `running-config`.

**Command Mode**
Global Configuration

**Command Syntax**
- `spanning-tree max-hops ports`
- `no spanning-tree max-hops`
- `default spanning-tree max-hops`

**Parameters**
- `ports` max hops (bridges). Value ranges from 1 to 40. Default is 20.

**Example**
- This command sets the max hop value to 40.
  ```
  switch(config)#spanning-tree max-hop 40
  switch(config)#
  ```
**spanning-tree mode**

The `spanning-tree mode` command specifies the spanning tree protocol version that the switch runs. The default mode is Multiple Spanning Tree (mstp).

The `no spanning-tree mode` and `default spanning-tree mode` commands restore the default spanning tree protocol version.

**Caution**

The `spanning-tree mode` command may disrupt user traffic. When the switch starts a different STP version, all spanning-tree instances are stopped, then restarted in the new mode.

**Command Mode**

Global Configuration

**Command Syntax**

```
spanning-tree mode VERSION
no spanning-tree mode
default spanning-tree mode
```

**Parameters**

- **VERSION**  
  spanning tree version that the switch runs. Options include:
  - `mstp` multiple spanning tree protocol described in the IEEE 802.1Q-2005 specification and originally specified in the IEEE 802.1s specification.
  - `rstp` rapid spanning tree protocol described in the IEEE 802.1D-2004 specification and originally specified in the IEEE 802.1w specification.
  - `rapid-pvst` rapid per-VLAN spanning tree protocol described in the IEEE 802.1D-2004 specification and originally specified in the IEEE 802.1w specification.
  - `backup` disables STP and enables switchport interface pairs configured with the `switchport backup-link` command.
  - `none` disables STP. The switch does not generate STP packets. Each switchport interface forwards data packets to all connected ports and forwards STP packets as multicast data packets on the VLAN where they are received.

**Guidelines**

Backup mode is not available on Trident platform switches.

**Example**

- This command configures the switch to run multiple spanning tree protocol.

```
switch(config)#spanning-tree mode mstp
switch(config)#
```
spanning-tree mst configuration

The `spanning-tree mst configuration` command places the switch in MST-configuration mode, which is the group change mode where MST region parameters are configured. Changes made in a group change mode are saved by leaving the mode through the `exit` command or by entering another configuration mode. To discard changes from the current edit session, leave the mode with the `abort` command.

These commands are available in MST-configuration mode:

- `abort (mst-configuration mode)`
- `exit (mst-configuration mode)`
- `instance`
- `name (mst-configuration mode)`
- `revision (mst-configuration mode)`
- `show (mst-configuration mode)`

The `no spanning-tree mst configuration` and `default spanning-tree mst configuration` commands restore the MST default configuration.

**Command Mode**

Global Configuration

**Command Syntax**

```
spanning-tree mst configuration
no spanning-tree mst configuration
default spanning-tree mst configuration
```

**Examples**

- This command enters MST configuration mode.
  ```
  switch(config)#spanning-tree mst configuration
  switch(config-mst)#
  ```

- This command exits MST configuration mode, saving MST region configuration changes to `running-config`.
  ```
  switch(config-mst)#exit
  switch(config)#
  ```

- This command exits MST configuration mode without saving MST region configuration changes to `running-config`.
  ```
  switch(config-mst)#abort
  switch(config)#
  ```
spanning-tree portchannel guard misconfig

The `spanning-tree portchannel guard misconfig` command enables the switch to detect misconfigured port channels that may cause network loops by monitoring inbound BPDUs. When a port channel receives 75 inconsistent BPDUs within 30 seconds, the switch error disables the port. When a port channel receives 5 BPDUs with the same source BPDU during the 30 second measurement interval, the error counter is reset and the port continues normal port channel operation. Misconfigured port channel detection is disabled by default.

The `no spanning-tree portchannel guard misconfig` and `default spanning-tree portchannel guard misconfig` commands disables the detection of misconfigured port channels by removing the `spanning-tree portchannel guard misconfig` statement from `running-config`.

**Command Mode**

Global Configuration

**Command Syntax**

```plaintext
spanning-tree portchannel guard misconfig
no spanning-tree portchannel guard misconfig
default spanning-tree portchannel guard misconfig

spanning-tree etherchannel guard misconfig
no spanning-tree etherchannel guard misconfig
default spanning-tree etherchannel guard misconfig
```

**Guidelines**

The `spanning-tree portchannel guard misconfig` and `spanning-tree etherchannel guard misconfig` commands are equivalent.

**Examples**

- This command enables port channel misconfiguration detection on the switch.

```plaintext
switch(config)#spanning-tree portchannel guard misconfig
switch(config)#show running-config

! spanning-tree mode mstp
spanning-tree portchannel guard misconfig
!

<------OUTPUT OMITTED FROM EXAMPLE--------->

!
end
switch(config)#
```

- This command disables port channel misconfiguration detection on the switch.

```plaintext
switch(config)#no spanning-tree portchannel guard misconfig
switch(config)#show running-config

<------OUTPUT OMITTED FROM EXAMPLE--------->

!
spanning-tree mode mstp
!

<------OUTPUT OMITTED FROM EXAMPLE--------->

!
end
switch(config)#
```
spanning-tree portfast

The `spanning-tree portfast` command programs configuration mode ports to immediately enter forwarding state when they establish a link. PortFast ports are included in spanning tree topology calculations and can enter discarding state. This command overrides the `spanning-tree portfast auto` command.

The `no spanning-tree portfast` and `default spanning-tree portfast` commands remove the corresponding `spanning-tree portfast` command from `running-config`.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**
- `spanning-tree portfast`
- `no spanning-tree portfast`
- `default spanning-tree portfast`

**Example**
- This command unconditionally enables portfast on Ethernet 5.
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree portfast
  switch(config-if-Et5)#
  ```
**spanning-tree portfast auto**

The `spanning-tree portfast auto` command enables auto-edge detection on the configuration mode interface. When auto-edge detection is enabled, the port is configured as an edge port if it does not receive a new BPDU before the current BPDU expires. Auto-edge detection is enabled by default. The `spanning-tree portfast` command, when configured, has priority over this command.

The `no spanning-tree portfast auto` command disables auto-edge port detection. This command is removed from `running-config` with the `spanning-tree portfast auto` and `default spanning-tree portfast auto` commands.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**
- `spanning-tree portfast auto`
- `no spanning-tree portfast auto`
- `default spanning-tree portfast auto`

**Example**
- This command enables auto-edge detection on Ethernet interface 5.
  ```
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree portfast auto
  switch(config-if-Et5)#
  ```
spanning-tree portfast <port type>

The **spanning-tree portfast <port-type>** command specifies the STP port mode for the configuration mode interface. Default port mode is **normal**.

Port modes include:

- **Edge**: Edge ports connect to hosts and transition to the forwarding state when the link is established. An edge port that receives a BPDU becomes a normal port.
- **Network**: Network ports connect only to switches or bridges and support bridge assurance. Network ports that connect to hosts or other edge devices transition to the discarding state.
- **Normal**: Normal ports function as normal STP ports and can connect to any type of device.

The **no spanning-tree portfast <port-type>** and **default spanning-tree portfast <port-type>** commands restore the default port mode of normal by removing the corresponding **spanning-tree portfast <port-type>** command from **running-config**.

**Command Mode**

- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**

```plaintext
spanning-tree portfast PORT_MODE
no spanning-tree portfast PORT_MODE
default spanning-tree portfast PORT_MODE
```

**Parameters**

- **PORT_MODE**  STP port mode. Options include:
  - edge
  - network
  - normal

  The **normal** option is not available for the **no** and **default** commands.

**Related Commands**

The **spanning-tree portfast <port-type>** command also affects the **spanning-tree portfast auto** and **spanning-tree portfast** configuration for the configuration mode interface:

- **spanning-tree portfast normal**: **spanning-tree portfast auto** is enabled.
- **spanning-tree portfast edge**: **spanning-tree portfast** is enabled.
- **spanning-tree portfast network**: **spanning-tree portfast auto** is disabled.

**Example**

- This command configures Ethernet 5 interface as a network port.

```plaintext
switch(config)#interface ethernet 5
switch(config-if-Et5)#spanning-tree portfast network
switch(config-if-Et5)#
```
spanning-tree port-priority

The **spanning-tree port-priority** command specifies the configuration mode interface’s port-priority number. The switch uses this number to determine which interface it places into forwarding mode when resolving a loop. Valid settings are all multiples of 16 between 0 and 240. Default value is 128. Ports with lower numerical priority values are selected over other ports.

The **no spanning-tree port-priority** and default spanning-tree port-priority commands restore the default of 128 for the configuration mode interface by removing the **spanning-tree port-priority** command from **running-config**.

The **spanning-tree port-priority** command provides a mode option:

- RST instance port-priority is configured by not including a mode.
- MST instance 0 port-priority is configured by not including a mode or with the **mst** mode option.
- MST instance port-priority is configured with the **mst** mode option.
- Rapid-PVST VLAN port-priority is configured with the **vlan** mode option.

**Command Mode**

- Interface-Ethernet Configuration
- Interface-Port-Channel Configuration

**Command Syntax**

```plaintext
spanning-tree [MODE] port-priority value
no spanning-tree [MODE] port-priority
default spanning-tree [MODE] port-priority
```

**Parameters**

- **MODE** specifies the spanning tree instances for which the cost is configured. Values include:
  - <no parameter> RST instance or MST instance 0.
  - **mst m_range** specified MST instances. **m_range** formats include a number, number range, or comma-delimited list of numbers and ranges. Instance numbers range from 0 to 4094.
  - **vlan v_range** specified Rapid-PVST instances. **v_range** formats include a number, number range, or comma-delimited list of numbers and ranges. VLAN numbers range from 1 to 4094.
  - **value** bridge priority number. Values range from 0 to 240 and must be a multiple of 16.

**Example**

- This command sets the port priority of Ethernet 5 interface to 144.

  ```plaintext
  switch(config)#interface ethernet 5
  switch(config-if-Et5)#spanning-tree port-priority 144
  switch(config-if-Et5)#
  ```
spanning-tree priority

The `spanning-tree priority` command configures the bridge priority number. The bridge priority is the four most significant digits of the bridge ID, which is used by spanning tree algorithms to select the root bridge and choose among redundant links. Bridge ID numbers range from 0 to 65535 (16 bits); bridges with smaller bridge IDs are elected over other bridges.

Because bridge priority sets the four most significant bits of the bridge ID, valid settings include all multiples of 4096 between 0 and 61440. Default value is 32768.

The `spanning-tree priority` command provides a mode option:

- RST instance priority is configured by not including a mode.
- MST instance 0 priority is configured by not including a mode or with the `mst` mode option.
- MST instance priority is configured with the `mst` mode option.
- Rapid-PVST VLAN priority is configured with the `vlan` mode option.

The `no spanning-tree priority` and `default spanning-tree priority` commands restore the bridge priority default of 32768 for the specified mode by removing the corresponding `spanning-tree priority` command from `running-config`.

Another method of adding `spanning-tree priority` commands to the configuration is through the `spanning-tree root` command. Similarly, the `no spanning-tree root` command removes the corresponding `spanning-tree priority` command from `running-config`.

Command Mode

Global Configuration

Command Syntax

```
spanning-tree [MODE] priority level
no spanning-tree [MODE] priority
default spanning-tree [MODE] priority
```

Parameters

- **MODE** spanning tree instances for which the command configures priority. Options include:
  - `<no parameter>` RST instance or MST instance 0.
  - `mst m_range` specified MST instances. `m_range` formats include a number, number range, or comma-delimited list of numbers and ranges. Instance numbers range from 0 to 4094.
  - `vlan v_range` specified Rapid-PVST instances. `v_range` formats include a number, number range, or comma-delimited list of numbers and ranges. VLAN numbers range from 1 to 4094.
- **level** priority number. Values include multiples of 4096 between 0 and 61440. Default is 32768.

Examples

- This command configures a bridge priority value of 20480 for Rapid-PVST VLANs 20, 24, 28, and 32.
  ```
  switch(config)#spanning-tree vlan-id 20,24,28,32 priority 20480
  switch(config)#
  ```
- This command configures a bridge priority value of 36864 for the RST instance. When MST is enabled, this command configures a priority of 36864 for MST instance 0.
  ```
  switch(config)#spanning-tree priority 36864
  switch(config)#
  ```
spanning-tree root

The `spanning-tree root` command configures the bridge priority number by adding a `spanning-tree priority` command to the configuration. Parameter settings set the following priority values:

- `primary` sets the bridge priority to 8192.
- `secondary` sets the bridge priority to 16384.

The bridge priority is the four most significant digits of the bridge ID, which is used by spanning tree algorithms to select the root bridge and choose among redundant links. Bridge ID numbers range from 0 to 65535 (16 bits); bridges with smaller bridge IDs are elected over other bridges.

When no other switch in the network is similarly configured, assigning the primary value to the switch facilitates its selection as the root switch. Assigning the secondary value to the switch facilitates its selection as the backup root in a network that contains one switch with a smaller priority number.

The `spanning-tree root` command provides a mode option:

- RST instance priority is configured by not including a mode.
- MST instance 0 priority is configured by not including a mode or with the `mst` mode option.
- MST instance priority is configured with the `mst` mode option.
- Rapid-PVST VLAN priority is configured with the `vlan` mode option.

The `no spanning-tree root` and `default spanning-tree root` commands restore the bridge priority default of 32768 by removing the corresponding `spanning-tree priority` command from `running-config`. The `no spanning-tree root`, `no spanning-tree priority`, `default spanning-tree root` and `default spanning-tree priority` commands perform the same function.

Command Mode

Global Configuration

Command Syntax

```
spanning-tree [MODE] root TYPE
no spanning-tree [MODE] root
default spanning-tree [MODE] root
```

Parameters

- `MODE` specifies the spanning tree instances for which priority is configured. Values include:
  - `<no parameter>` RST instance or MST instance 0.
  - `mst m_range` specified MST instances. `m_range` formats include a number, number range, or comma-delimited list of numbers and ranges. Instance numbers range from 0 to 4094.
  - `vlan v_range` specified Rapid-PVST instances. `v_range` formats include a number, number range, or comma-delimited list of numbers and ranges. VLAN numbers range from 1 to 4094.

- `TYPE` sets the bridge priority number. Values include:
  - `primary` sets the bridge priority to 8192.
  - `secondary` sets the bridge priority to 16384.
Examples

- This command configures a bridge priority value of 8192 for Rapid-PVST VLANs 20-36.
  
  `switch(config)#spanning-tree vlan-id 20-36 root primary`

- This command configures a bridge priority value of 16384 for the RSTP instance and MST instance 0.

  `switch(config)#spanning-tree root secondary`
spanning-tree transmit active

The `spanning-tree transmit active` command enables bridge assurance globally, which enables bridge assurance on all ports with a port type of `network`. Bridge assurance protects against unidirectional link failure, other software failure, and devices that quit running a spanning tree algorithm.

Bridge assurance is available only on point-to-point links on spanning tree `network` ports. Both ends of the link should ideally have bridge assurance enabled. Bridge assurance-enabled ports will not necessarily be blocked when they link to a port where bridge assurance is not enabled, but if they do not receive periodic BPDUs from the other side of the link the `show spanning-tree transmit active` command will show a bridge assurance status of “inconsistent” (blocking) for that port.

The `no spanning-tree transmit active` command disables bridge assurance.

The `spanning-tree transmit active` and `default spanning-tree transmit active` commands restore the default behavior by removing the `no spanning-tree transmit active` command from `running-config`.

**Command Mode**
Global Configuration

**Command Syntax**

```
spanning-tree transmit active
no spanning-tree transmit active
default spanning-tree transmit active
```

**Example**

- This command enables bridge assurance on the switch.

```
switch(config)#spanning-tree transmit active
switch(config)#
```
spanning-tree vlan-id

The `spanning-tree vlan-id` command enables Spanning Tree Protocol (STP) on specified VLANs by removing any corresponding `no spanning-tree vlan-id` statements from `running-config`. Spanning-tree is enabled on all VLANs by default.

The `no spanning-tree vlan-id` command disables STP on the specified interfaces. The `default spanning-tree vlan-id` enables STP on the specified interfaces.

**Warning**
Disabling STP is not recommended, even in topologies free of physical loops; STP guards against configuration mistakes and cabling errors. When disabling STP, ensure that there are no physical loops in the VLAN.

**Important!**
When disabling STP on a VLAN, ensure that all switches and bridges in the network disable STP for the same VLAN. Disabling STP on a subset of switches and bridges in a VLAN may have unexpected results because switches and bridges running STP will have incomplete information regarding the network's physical topology.

The following STP global configuration commands provide a `vlan` option for configuring Rapid-PVST VLAN instances:

- `spanning-tree priority`
- `spanning-tree root`

**Command Mode**
Global Configuration

**Command Syntax**
```plaintext
spanning-tree vlan-id v_range
no spanning-tree vlan-id v_range
default spanning-tree vlan-id v_range
```

**Parameters**
- `v_range` VLAN list. Formats include a number, number range, or comma-delimited list of numbers and ranges. VLAN numbers range from 1 to 4094.

**Examples**
- This command disables STP on VLANs 200-205
  ```plaintext
  switch(config)#no spanning-tree vlan-id 200-205
  switch(config)#
  ```
- This command enables STP on VLAN 203
  ```plaintext
  switch(config)#spanning-tree vlan-id 203
  switch(config)#
  ```
**switchport backup-link**

The `switchport backup-link` command establishes a primary-backup configuration for forwarding VLAN traffic between the command mode interface and a specified interface. The `show interfaces switchport backup` command displays the state of backup interface pairs on the switch:

- the primary interface is the command mode interface.
- the backup interface is the interface specified in the command.

The following guidelines apply to primary and backup interfaces:

- Ethernet and Port Channels can be primary interfaces.
- Ethernet, Port Channel, Management, Loopback, and VLANs can be backup interfaces.
- The primary and backup interfaces can be different interface types.
- Interface pairs should be similarly configured to ensure consistent behavior.
- An interface can be associated with a maximum of one backup interface.
- An interface can back up a maximum of one interface.
- Any Ethernet interface configured in an interface pair cannot be a port channel member.
- The STP mode is backup.
- Static MAC addresses should be configured after primary-backup pairs are established.

When load balancing is not enabled, the primary and backup interfaces cannot simultaneously forward VLAN traffic. When the primary interface is forwarding VLAN traffic, the backup interface drops all traffic. If the primary interface fails, the backup interface forwards VLAN traffic until the primary interface is functional.

The `prefer vlan` option balances the load across the primary and backup interfaces. When the command includes the `prefer vlan` option, each interface is the primary for a subset of the vlans carried by the pair. When both interfaces are up, prefer option vlans are forwarded on the backup interface and all other configured vlans are carried by the primary interface.

The `no switchport backup-link` and `default switchport backup-link` commands remove the primary-backup configuration for the configuration mode interface.

**Command Mode**
- Interface-Ethernet Configuration
- Interface-Port Channel Configuration

**Command Syntax**

```
switchport backup-link INT_NAME [BALANCE]
no switchport backup-link
default switchport backup-link
```

**Parameters**

- `INT_NAME` the backup interface. Options include:
  - `ethernet e_num` Ethernet interface specified by `e_num`.
  - `loopback l_num` Loopback interface specified by `l_num`.
  - `management m_num` Management interface specified by `m_num`.
  - `port-channel p_num` Channel group interface specified by `p_num`.
  - `vlan v_num` VLAN interface specified by `v_num`.
  - `vxlan vx_num` VXLAN interface specified by `vx_num`.
- `BALANCE` VLANs whose traffic is normally handled on the backup interfaces. Values include:
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- **<no parameter>** backup interface handles no traffic if the primary interface is operating.
- **prefer vlan v_range** list of VLANs whose traffic is handled by backup interface.

**Examples**

- These commands establish Ethernet interface 7 as the backup port for Ethernet interface 1.
  
  ```
  switch(config)#interface ethernet 1
  switch(config-if-Et1)#switchport backup-link ethernet 7
  switch(config-if-Et1)#
  ```

- These commands configure the following:
  - Ethernet interface 1 as a trunk port that handles VLAN 4 through 9 traffic.
  - Ethernet interface 2 as its backup interface.
  - Ethernet 2 as the preferred interface for VLANs 7 through 9.
  
  ```
  switch(config-if-Et1)#switchport mode trunk
  switch(config-if-Et1)#switchport trunk allowed vlan 4-9
  switch(config-if-Et1)#switchport backup-link Ethernet 2 prefer vlan 7-9
  switch(config-if-Et1)#
  ```
transmit-interval

The transmit-interval command sets the interval at which loop detection packets are transmitted. The no transmit-interval and default transmit-interval commands restore the transmission interval to the default of 5 seconds.

Command Mode
Loop-protection Configuration

Command Syntax
transmit-interval interval

Parameters
- interval Interval in seconds at which loop-detection packets are transmitted. Values range from 1 to 10; default is 5.

Example
- This command sets the loop detection packet transmission interval to 10 seconds.

switch(config-monitor-loop-protect)#transmit-interval 10
switch(config-monitor-loop-protect)#