

Spanning Tree

This chapter contains the following sections:

- STP Status and Global Settings, on page 1
- STP Interface Settings, on page 3
- RSTP Interface Settings, on page 4
- MSTP, on page 6
- PVST, on page 11

STP Status and Global Settings

Spanning Tree Protocol (STP) protects a Layer 2 Broadcast domain from Broadcast storms by selectively setting links to standby mode to prevent loops. In standby mode, these links temporarily stop transferring user data. After the topology changes so that the data transfer is made possible, the links are automatically reactivated.

STP provides a tree topology for any arrangement of switches and interconnecting links, by creating a unique path between end stations on a network, and thereby eliminating loops.

The STP Status and Global Settings page contain parameters for enabling the required STP mode. Use the STP Interface Settings page, RSTP Interface Settings page, and MSTP Properties page to configure each mode, respectively. To set the STP status and global settings, follow these steps:

Procedure

Step 1 Click **Spanning Tree** > **STP Status & Global Settings**.

Step 2 Enter the parameters.

Global Settings

Spanning Tree State	Select to enable on the device.
STP Loopback Guard	Select to enable Loopback Guard on the device.
STP Operation Mode	Select an STP mode.

BPDU Handling	Select how Bridge Protocol Data Unit (BPDU) packets are managed when STP is disabled. BPDUs are used to transmit spanning tree information. • Filtering-Filters BPDU packets when Spanning Tree is disabled on an interface. • Flooding-Floods BPDU packets when Spanning Tree is disabled on an interface.
Path Cost Default Values	Selects the method used to assign default path costs to the STP ports. The default path cost assigned to an interface varies according to the selected method. • Short-Specifies the range 1–65,535 for port path costs • Long-Specifies the range 1–200,000,000 for port path costs Bridge Settings:

Bridge Settings

Priority	Sets the bridge priority value. After exchanging BPDUs, the device with the lowest priority becomes the Root Bridge. In the case that all bridges use the same priority, then their MAC addresses are used to determine the Root Bridge. The bridge priority value is provided in increments of 4096. For example, 4096, 8192, 12288, and so on.
Hello Time	Set the interval (in seconds) that a Root Bridge waits between configuration messages.
Max Age	Set the interval (in seconds) that the device can wait without receiving a configuration message, before attempting to redefine its own configuration.
Forward Delay	Set the interval (in seconds) that a bridge remains in a learning state before forwarding packets. For more information, refer to STP Interface Settings, on page 3.

Designated Root

Note
The following fields are displayed.

Bridge ID	The bridge priority concatenated with the MAC address of the device.
Root Bridge ID	The Root Bridge priority concatenated with the MAC address of the Root Bridge.
Root Port	The port that offers the lowest cost path from this bridge to the Root Bridge.
Root Path Cost	The cost of the path from this bridge to the root.
Topology Changes Counts	The total number of STP topology changes that have occurred.
Last Topology Change	The time interval that elapsed since the last topology change occurred. The time appears in a days/hours/minutes/seconds format.

Step 3 Click **Apply**. The STP Global settings are written to the Running Configuration file.

STP Interface Settings

The STP Interface Settings page enables you to configure STP on a per-port basis, and to view the information learned by the protocol, such as the designated bridge.

The defined configuration entered is valid for all flavors of the STP protocol.

To configure STP on an interface, follow these steps:

Procedure

Step 1 Click **Spanning Tree** > **STP Interface Settings**.

Step 2 Select an interface and click **Edit**.

Step 3 Enter the parameters.

Interface	Select the Port or LAG on which the Spanning Tree is configured.
STP	Enables or disables STP on the port.
Edge Port	Enables or disables Fast Link on the port. If Fast Link mode is enabled on a port, the port is automatically set to Forwarding state when the port link is up. Fast Link optimizes the STP protocol convergence. The options are: • Enable—Enables Fast Link immediately. • Auto—Enables Fast Link a few seconds after the interface becomes active. This allows STP to resolve loops before enabling Fast Link. • Disable—Disables Fast Link **Note** It's recommended to set the value to Auto so that the device sets the port to fast link mode if a host is connected to it, or sets it as a regular STP port if connected to another device. This helps avoid loops. Edge Port isn't operational in MSTP mode.
BPDU Handling	Select how BPDU packets are managed when STP is disabled on the port or the device. BPDUs are used to transmit spanning tree information. • Use Global Settings—Select to use the settings defined in the STP Status and Global Settings, on page 1 page. • Filtering—Filters BPDU packets when Spanning Tree is disabled on an interface. • Flooding—Floods BPDU packets when Spanning Tree is disabled on an interface.
Path Cost	Set the port contribution to the root path cost by selecting Use Default (20000) or User Defined and enter a range 1–200000000.
Priority	Set the priority value of the port. The priority value influences the port choice when a bridge has two ports connected in a loop. The priority is a value 0–240, and must be a multiple of 16.

Port State	Displays the current STP state of a port. • Disabled—STP is currently disabled on the port. The port forwards traffic while learning MAC addresses. • Blocking—The port is currently blocked, and can't forward traffic (except for BPDU data) or learn MAC addresses. • Listening—The port is in Listening mode. The port can't forward traffic, and can't learn MAC addresses. • Learning—The port is in Learning mode. The port can't forward traffic, but it can learn new MAC addresses. • Forwarding—The port is in Forwarding mode. The port can forward traffic and learn new MAC addresses.
Designated Bridge ID	Displays the bridge priority and the MAC address of the designated bridge
Designated Port ID	Displays the priority and interface of the selected port.
Designated Cost	Displays the cost of the port participating in the STP topology. Ports with a lower cost are less likely to be blocked if STP detects loops.
Forward Transitions	Displays the number of times the port has changed from the Blocking state to the Forwarding state.
Speed	Displays the speed of the port.
LAG	Displays the LAG to which the port belongs. If a port is a member of a LAG, the LAG settings override the port settings.

Step 4 Click **Apply**. The interface settings are written to the Running Configuration file.

RSTP Interface Settings

Rapid Spanning Tree Protocol (RSTP) enables a faster STP convergence without creating forwarding loops.

The RSTP Interface Settings page enables you to configure RSTP per port. Any configuration that is done on this page is active when the global STP mode is set to RSTP.

To enter RSTP settings, proceed with the following steps:

Procedure

Step 1 Click **Spanning Tree** > **RSTP Interface Settings**.

Step 2 Select an entry no. and click **Activate Protocol Migration**.

Note

Activate Protocol Migration is only available after selecting the port that is connected to the bridge partner being tested. The activate protocol migration discovers whether the link partner using STP still exists, and if so whether it has migrated to RSTP or MSTP. If it still exists as an STP link, the device continues to communicate with it by using STP. Otherwise, if it has been migrated to RSTP or MSTP, the device communicates with it using RSTP or MSTP, respectively.

Step 3 If you wish to edit the settings on an existing interface, select the interface, and click **Edit**.

Step 4 Enter the parameters:

Interface	Set the interface, and specify the port or LAG where RSTP is to be configured.
Point to Point Administrative Status	Define the point-to-point link status. Ports defined as Full Duplex are considered Point-to-Point port links. • Enabled-This port is an RSTP edge port when this feature is enabled, and is brought to Forwarding mode quickly (usually within 2 seconds). • Disabled-The port isn't considered point-to-point for RSTP purposes, which means that STP works on it at regular speed, as opposed to high speed. • Auto-Automatically determines the device status by using RSTP BPDUs.
Point to Point Operational Status	Displays the Point-to-Point operational status if the Point to Point Administrative Status is set to Auto.
Role	Displays the role of the port that was assigned by STP to provide STP paths. The possible roles are: • Root-Lowest cost path to forward packets to the Root Bridge. • Designated-The interface through which the bridge is connected to the LAN, which provides the lowest cost path from the LAN to the Root Bridge. • Alternate-Provides an alternate path to the Root Bridge from the root port. • Backup-Provides a backup path to the designated port path toward the Spanning Tree leaves. This provides a configuration in which two ports are connected in a loop by a point-to-point link. Backup ports are also used when a LAN has two or more established connections to a shared segment. • Disabled-The port is not participating in Spanning Tree.
Mode	Displays the current Spanning Tree mode: Classic STP or RSTP.
Fast Link Operational Status	Displays whether the Fast Link (Edge Port) is enabled, disabled, or automatic for the interface. The values are: • Enabled-Fast Link is enabled. • Disabled-Fast Link is disabled. • Auto-Fast Link mode is enabled a few seconds after the interface becomes active.

Port Status	Displays the RSTP status on the specific port. • Disabled-STP is currently disabled on the port. • Discarding-The port is currently discarding/blocked, and it cannot forward traffic or learn MAC addresses. • Listening-The port is in Listening mode. The port cannot forward traffic, and cannot learn MAC addresses. • Learning-The port is in Learning mode. The port cannot forward traffic, however it can learn new MAC addresses. • Forwarding-The port is in Forwarding mode. The port can forward traffic and learn new MAC addresses.

Step 5 Click **Apply**. The Running Configuration file is updated.

MSTP



Note This feature and all of its subfeatures are visible only in the Advanced Mode view.

Multiple Spanning Tree Protocol (MSTP) is used to separate the spanning tree protocol (STP) port state between various domains (on different VLANs). For example, while port A is blocked in one STP instance due to a loop on VLAN A, the same port can be placed in the Forwarding State in another STP instance. The MSTP Properties page enables you to define the global MSTP settings.

Multiple STP (MSTP) - MSTP is based on RSTP. It detects Layer 2 loops, and attempts to mitigate them by preventing the involved port from transmitting traffic. Since loops exist on a per-Layer 2-domain basis, a situation can occur when a port is blocked to eliminate an STP loop. Traffic will be forwarded to the port that isn't blocked. No traffic will be forwarded to the port that is blocked. This isn't an efficient usage of bandwidth as the blocked port will always be unused. MSTP solves this problem by enabling several STP instances, so that it's possible to detect and mitigate loops separately in each instance. This enables a port to be blocked for one or more STP instances but non blocked for other STP instances. If different VLANs are associated with different STP instances, then their traffic is relayed based on the STP port state of their associated MST instances. Better bandwidth utilization results.

MSTP Properties

The global MSTP configures a separate Spanning Tree for each VLAN group and blocks all but one of the possible alternate paths within each spanning tree instance. MSTP enables formation of MST regions that can run multiple MST instances (MSTI). Multiple regions and other STP bridges are interconnected using one single common spanning tree (CST).

MSTP is fully compatible with RSTP bridges, in that an MSTP BPDU can be interpreted by an RSTP bridge as an RSTP BPDU. This not only enables compatibility with RSTP bridges without configuration changes, but also causes any RSTP bridges outside of an MSTP region to see the region as a single RSTP bridge,

regardless of the number of MSTP bridges inside the region itself. For two or more switches to be in the same MST region, they must have the same VLANs to MST instance mapping, configuration revision number, and region name. Switches intended to be in the same MST region are never separated by switches from another MST region. If they are separated, the region becomes two separate regions.

This mapping can be done in the MSTP Instance Settings, on page 7. Use this page if the system operates in MSTP mode.

To define MSTP, follow these steps:

Procedure

Step 1 Click **Spanning Tree** > **MSTP** > **MSTP Properties**.

Step 2 Enter the parameters.

- Region Name—Define an MSTP region name.
- Revision—Define an unsigned 16-bit number that identifies the revision of the current MST configuration. The field range is 0–65535.
- Max Hops—Set the total number of hops that occur in a specific region before the BPDU is discarded. Once the BPDU is discarded, the port information is aged out. The field range is 1–40.
- IST Master—Displays the active regions.

Step 3 Click **Apply**. The MSTP properties are defined, and the Running Configuration file is updated.

MSTP Instance Settings

The MSTP Instance Settings page enables you to configure and view parameters per MST instance. This is the per-instance equivalent to the Configuring STP Status and Global Settings.

Note No fields will be editable until VLAN to MSTP Instance mapping has been configured .

To enter the MSTP instance settings, proceed as follows:

Procedure

Step 1 Click **Spanning Tree** > **MSTP** >**MSTP Instance Settings**.

Step 2 Enter the parameters.

- MSTP Instance ID-Select an MST instance to be displayed and defined.
- Included VLAN-Displays the VLANs mapped to the selected instance. The default mapping is that all VLANs are mapped to the common and internal spanning tree (CIST) instance 0).
- Bridge Priority-Set the priority of this bridge for the selected MST instance.

- Designated Root Bridge ID-Displays the priority and MAC address of the Root Bridge for the MST instance.
- Root Port-Displays the root port of the selected instance.
- Root Path Cost-Displays the root path cost of the selected instance.
- Bridge ID-Displays the bridge priority and the MAC address of this device for the selected instance.
- Remaining Hops-Displays the number of hops remaining to the next destination.

Step 3 Click **Apply**. The MST Instance configuration is defined, and the Running Configuration file is updated.

MSTP Interface Settings

The MSTP Interface Settings page enables you to configure the port MSTP settings for every MST instance, and to view information that has currently been learned by the protocol, such as the designated bridge per MST instance.

To configure the ports in an MST instance, follow these steps:

Procedure

Step 1 Click **Spanning Tree** > **MSTP** > **MSTP Interface Settings**.

Step 2 Enter the parameters.

- Instance equals to—Select the MSTP instance to be configured.
- Interface Type equals to—Select whether to display the list of ports or LAGs.

Step 3 Click **Go**. The MSTP parameters for the interfaces on the instance are displayed.

Step 4 Select an interface, and click **Edit**.

Step 5 Enter the parameters.

Option	Description
Instance ID	Select the MST instance to be configured.
Interface	Select the interface for which the MSTI settings are to be defined.
Interface Priority	Set the port priority for the specified interface and MST instance.
Path Cost	Enter the port contribution to the root path cost in the User Defined textbox or select **Use Default** to use the default value.
Port State	Displays the MSTP status of the specific port on a specific MST instance. The parameters are defined as: • Disabled—STP is currently disabled. • Discarding—The port on this instance is currently discarding/blocked, and cannot forward traffic (with the exception of BPDU data) or learn MAC addresses.

Option	Description
	• Listening—The port on this instance is in Listening mode. The port cannot forward traffic, and cannot learn MAC addresses. • Learning—The port on this instance is in Learning mode. The port cannot forward traffic, but it can learn new MAC addresses. • Forwarding—The port on this instance is in Forwarding mode. The port can forward traffic and learn new MAC addresses. • Boundary—The port on this instance is a boundary port. It inherits its state from instance 0 and can be viewed on the STP Interface Settings, on page 3.
Port Role	Displays the port or LAG role, per port or LAG per instance, assigned by the MSTP algorithm to provide STP paths: • Root—Forwarding packets through this interface provides the lowest cost path for forwarding packets to the root device. • Designated Port—The interface through which the bridge is connected to the LAN, which provides the lowest root path cost from the LAN to the Root Bridge for the MST instance. • Alternate—The interface provides an alternate path to the Root Bridge from the root port. • Backup—The interface provides a backup path to the designated port path toward the Spanning Tree leaves. Backup ports occur when two ports are connected in a loop by a point-to-point link. Backup ports also occur when a LAN has two or more established connections to a shared segment. • Disabled—The interface does not participate in the Spanning Tree. • Boundary—The port on this instance is a boundary port. It inherits its state from instance 0 and can be viewed on the STP Interface Settings, on page 3.
Mode	Displays the current interface Spanning Tree mode. • If the link partner is using MSTP or RSTP, the displayed port mode is RSTP. • If the link partner is using STP, the displayed port mode is STP.
Type	Displays the MST type of the port. • Boundary—A Boundary port attaches MST bridges to a LAN in a remote region. If the port is a boundary port, it also indicates whether the device on the other side of the link is working in RSTP or STP mode. • Internal—The port is an internal port.
Designated Bridge ID	Displays the ID number of the bridge that connects the link or shared LAN to the root.
Designated Port ID	Displays the Port ID number on the designated bridge that connects the link or the shared LAN to the root.
Designated Cost	Displays the cost of the port participating in the STP topology. Ports with a lower cost are less likely to be blocked if STP detects loops.

Option	Description
Remain Hops	Displays the hops remaining to the next destination.
Forward Transitions	Displays the number of times the port has changed from the Forwarding state to the Discarding state.

Step 6 Click **Apply**. The Running Configuration file is updated.

VLAN to MSTP Instance

The VLAN to MSTP Instance page enables you to map each VLAN to a Multiple Spanning Tree Instance (MSTI). For devices to be in the same region, they must have the same mapping of VLANs to MSTIs.



Note The same MSTI can be mapped to more than one VLAN, but each VLAN can only have one MST instance attached to it. Configuration on this page (and all of the MSTP pages) applies if the system STP mode is MSTP. Up to 16 MST instances can be defined in addition to instance zero. For those VLANs that aren't explicitly mapped to one of the MST instances, the device automatically maps them to the CIST (Core and Internal Spanning Tree) instance. The CIST instance is MST instance 0.

To map VLANs to MST Instances, follow these steps:

Procedure

Step 1 Click **Spanning Tree** > **MSTP** > **VLAN to MSTP Instance**.

The VLAN to MSTP Instance page displays the following fields:

- MSTP Instance ID-All MST instances are displayed.
- VLANs-All VLANs belonging to the MST instance are displayed.

Step 2 Click **Add** to add a VLAN to an MSTP instance, or **Edit** to edit a VLAN to an MSTP instance.

Step 3 Enter the parameters:

- MSTP Instance ID-Select the MST instance.
- VLANs-Define the VLANs being mapped to this MST instance.

Step 4 Click **Apply**. The MSTP VLAN mappings are defined, and the Running Configuration file is updated.

PVST

Note This feature and all its subfeatures are visible only in the Advanced Mode view.

Per VLAN Spanning Tree (PVST) is a protocol running a separate instance of the 802.1Q STP standard protocol per each VLAN configured on the device. RSTP standard protocol per each VLAN configured on the device. The PVST protocol is a protocol that was designed to address the problem that exists with STP/ RSTP standard based implementation - that sometimes a port that is in blocking mode (for more than 1 VLAN) may create an efficient usage of bandwidth since it can't be used for any traffic forwarding.

PVST addresses this issue by assigning a separate spanning tree instance for each VLAN configured on the device. Up to 126 PVST instances are supported. This means that if more than 126 VLANs are configured on the device, PVST can't be enabled. Likewise, if PVST is enabled you can't configure more than 126 VLANs.

The device supports the PVST/RPVST Plus flavor of the protocols. This section refers to PVST to describe both PVST+ and RPVST+ feature behavior.

PVST VLAN Settings

To define the PVST VLAN settings, follow these steps:

Procedure

Step 1 Click **Spanning Tree > PVST > PVST VLAN Settings**.

The PVST VLAN Settings page enables you to configure PVST settings for each VLAN ID that is configured on the device, except the VLAN ID 1.

To configure the PVST parameters on an interface:

Step 2 Select a row in the table and click **Copy Settings** to create an new PVST VLAN based on the selected row, or click **Edit** to revise the selected row.

Note
VLAN entry 1 cannot be edited. Edit the values of the PVST VLAN as needed:

- VLAN ID—the VLAN ID of the PVST instance
- Priority—The PVST VLAN STP priority value.
- Address—The address of the VLAN
- Hello Time—The interval (in seconds) that a Root Bridge waits between configuration messages.
- Max Age—The interval (in seconds) that this VLAN STP instance can wait without receiving a configuration message, before attempting to redefine its own configuration.
- Forward Delay—The interval (in seconds) that this VLAN STP instance remains in a learning state before forwarding packets.

Step 3 Click **Apply**. The new/revised PVST VLAN is added/updated.

Step 4 Click **Details** to view the PVST VLAN details.

- VLAN ID—the VLAN ID of the PVST instance
- Root Priority—The PVST VLAN STP priority value.
- Root Hello Time—The interval (in seconds) that a Root Bridge waits between configuration messages.
- Root Max Age—The interval (in seconds) that this VLAN STP instance can wait without receiving a configuration message, before attempting to redefine its own configuration.
- Root Forward Delay—The interval (in seconds) that this VLAN STP instance remains in a learning state before forwarding packets.
- Root Port—The port that offers the lowest cost path on this VLAN from this bridge to the root.
- Root Path Cost—The cost, on this VLAN of the path from this bridge to the root.
- Root Bridge ID—The bridge ID of the root bridge in this VLAN.
- Bridge ID—The bridge ID of this device and VLAN.
- Topology Change Count—The total number of STP topology changes that have occurred on this VLAN last topology change.
- Last Topology Change— Details of when the last topology was changed.

PVST Interface Settings

The PVST Interface Settings page enables you to configure PVST on a per-port and VLAN basis, and to view the information learned by the protocol, such as the designated bridge.

To configure the PVST parameters on an interface, proceed as follows:

Procedure

Step 1 Click **Spanning Tree > PVST > PVST Interface Settings.**

Step 2 Using the filters, select the VLAN ID and Interface Type (Port or Lag) from the drop-down list and click **Go**. Then, the following PVST interface information will be displayed for each VLAN PVST.

Option	Description
Interface	The interface name.
Priority	The priority value of the port for this VLAN instance. The priority value influences the port choice when a bridge has two ports connected in a loop. The priority is a value 0–240, and must be a multiple of 16.
Port Cost	The port contribution, per VLAN instance, to the root path cost or use the default cost generated by the system.

Option	Description
State	Displays the current STP state of a port, per VLAN instance. • Disabled—PVST is currently disabled on the port. The port forwards traffic while learning MAC addresses. • Blocking—The port is blocked for this VLAN instance and can't forward traffic (except for BPDU data) or learn MAC addresses. • Listening—The port is in Listening state for this VLAN instance. The port can't forward traffic, and can't learn MAC addresses. • Learning—The port is in Learning state for this VLAN instance. The port can't forward traffic, but it can learn new MAC addresses. • Forwarding—The port is in Forwarding state for this VLAN instance. The port can forward traffic and learn new MAC addresses.
Role	Displays the PVST role, per PVST instance, assigned by the PVST algorithm to provide STP path. • Root—Forwarding packets through this interface provides the lowest cost path for forwarding packets to the root device. • Designated—The interface through which the bridge is connected to the LAN, which provides the lowest root path cost from the LAN to the Root Bridge for the PVST instance. • Alternate—The interface provides an alternate path to the root device from the root interface. • Backup—The interface provides a backup path to the designated port path toward the Spanning Tree leaves. Backup ports occur when two ports are connected in a loop by a point-to-point link. Backup ports also occur when a LAN has two or more established connections to a shared segment. • Disable—The interface doesn't participate in the Spanning Tree.
Mode	Displays the PVST mode. • RPVST—The port is running the RPVST+ flavor of PVST. • PVST—The port is running the PVST+ flavor of PVST.
Inconsistency	Displays the inconsistency.
Designated Bridge ID	Displays the bridge priority and the MAC address of the designated bridge for the current VLAN instance.
Designated Port ID	Displays the priority and interface of the selected port for the current VLAN instance.
Designated Cost	Displays the cost of the port participating in the STP topology for the current VLAN instance. Ports with a lower cost are less likely to be blocked if STP detects loops

Option	Description
Forward Transitions	Displays the number of times the port has changed from the Blocking state to Forwarding state for the current VLAN instance.

PVST Inconsistent Ports

The PVST Inconsistent Ports page displays the inconsistent PVST ports.

To view inconsistent PVST ports, follow these steps:

Procedure

Click **Spanning Tree > PVST > PVST Inconsistent Ports**.

This page displays details on ports that are in the PVST inconsistent state:

- VLAN ID—the VLAN ID of the PVST instance
- Interface Name—The interface ID
- Inconsistency—Displays the inconsistency state.