

Configuring MST Using Cisco NX-OS

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Information About MST

Note See the *Cisco Nexus® 3550-T Interfaces Configuration* section, for information on creating Layer 2 interfaces.

MST, which is the IEEE 802.1s standard, allows you to assign two or more VLANs to a spanning tree instance. MST is not the default spanning tree mode; Rapid per VLAN Spanning Tree (Rapid PVST+) is the default mode. MST instances with the same name, revision number, and VLAN-to-instance mapping combine to form an MST region. The MST region appears as a single bridge to spanning tree configurations outside the region. MST forms a boundary to that interface when it receives an IEEE 802.1D Spanning Tree Protocol (STP) message from a neighboring device.

Note Spanning tree is used to refer to IEEE 802.1w and IEEE 802.1s. If the IEEE 802.1D Spanning Tree Protocol is discussed in this publication, 802.1D is stated specifically.

MST Overview

Note RSTP (Rapid Spanning Tree Protocol) is the default spanning tree mode.

MST maps multiple VLANs into a spanning tree instance, with each instance having a spanning tree topology independent of other spanning tree instances. This architecture provides multiple forwarding paths for data traffic, enables load balancing, and reduces the number of STP instances required to support a large number of VLANs. MST improves the fault tolerance of the network because a failure in one instance (forwarding path) does not affect other instances (forwarding paths).

MST provides rapid convergence through explicit handshaking because each MST instance uses the IEEE 802.1w standard, which eliminates the 802.1D forwarding delay and quickly transitions root bridge ports and designated ports to the forwarding state.

MAC address reduction is always enabled on the device. You cannot disable this feature.

MST improves spanning tree operation and maintains backward compatibility with original 802.1D spanning tree STP versions:

Note

- IEEE 802.1 was defined in the Rapid Spanning Tree Protocol (RSTP) and was incorporated into IEEE 802.1D.
- IEEE 802.1 was defined in MST and was incorporated into IEEE 802.1Q

  .

MST Regions

To allow devices to participate in MST instances, you must consistently configure the devices with the same MST configuration information.

A collection of interconnected devices that have the same MST configuration is an MST region. An MST region is a linked group of MST bridges with the same MST configuration.

The MST configuration controls the MST region to which each device belongs. The configuration includes the name of the region, the revision number, and the VLAN-to-MST instance assignment mapping.

A region can have one or multiple members with the same MST configuration. Each member must be capable of processing 802.1w bridge protocol data units (BPDUs). There is no limit to the number of MST regions in a network.

Each device can support only single MST instance (Instance 0), in a single MST region. You can assign a VLAN to only one MST instance at a time.

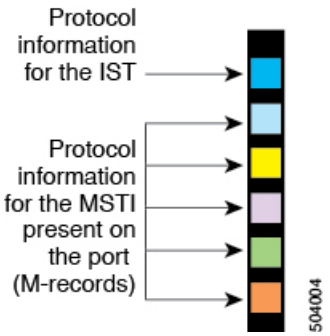
The MST region appears as a single bridge to adjacent MST regions and to other 802.1D spanning tree protocols.

Note We do not recommend that you partition the network into a large number of regions.

MST BPDUs

Each device has only one MST BPDU per interface, and that BPDU carries an M-record for each MSTI on the device. Only the IST sends BPDUs for the MST region; all M-records are encapsulated in that one BPDU that the IST sends. Because the MST BPDU carries information for all instances, the number of BPDUs that need to be processed to support MST is significantly reduced.

Figure 1: MST BPDU with M-Records for MSTIs



MST Configuration Information

The MST configuration that must be identical on all devices within a single MST region is configured by the user.

You can configure the three parameters of the MST configuration as follows:

- Name—32-character string, null padded and null terminated, identifying the MST region
- Revision number—Unsigned 16-bit number that identifies the revision of the current MST configuration

Note You must set the revision number when required as part of the MST configuration. The revision number is not incremented automatically each time that the MST configuration is committed.

- VLAN-to-MST instance mapping—4096-element table that associates each of the potential VLANs supported to a given instance with the first (0) and last element (4095) set to 0. The value of element number X represents the instance to which VLAN X is mapped.

Note When you change the VLAN-to-MSTI mapping, the system reconverges MST.

MST BPDUs contain these three configuration parameters. An MST bridge accepts an MST BPDU into its own region only if these three configuration parameters match exactly. If one configuration attribute differs, the MST bridge considers the BPDU to be from another MST region.

IST, CIST, and CST

IST, CIST, and CST Overview

MST establishes and maintains IST, CIST, and CST spanning trees, as follows:

- An IST is the spanning tree that runs in an MST region.
- MST establishes and maintains additional spanning trees within each MST region; these spanning trees are called multiple spanning tree instances (MSTIs).
- Instance 0 is a special instance for a region, known as the IST. The IST always exists on all ports; you cannot delete the IST, or Instance 0. By default, all VLANs are assigned to the IST. All other MST instances are numbered from 1 to 4094.
- The IST is the only STP instance that sends and receives BPDUs. All of the other MSTI information is contained in MST records (M-records), which are encapsulated within MST BPDUs.
- All MSTIs within the same region share the same protocol timers, but each MSTI has its own topology parameters, such as the root bridge ID, the root path cost, and so forth.
- An MSTI is local to the region; for example, MSTI 9 in region A is independent of MSTI 9 in region B, even if regions A and B are interconnected. Only CST information crosses region boundaries.
- The CST interconnects the MST regions and any instance of 802.1D and 802.1w STP that may be running on the network. The CST is the one STP instance for the entire bridged network and encompasses all MST regions and 802.1w and 802.1D instances.
- A CIST is a collection of the ISTs in each MST region. The CIST is the same as an IST inside an MST region, and the same as a CST outside an MST region.

The spanning tree computed in an MST region appears as a subtree in the CST that encompasses the entire switched domain. The CIST is formed by the spanning tree algorithm running among devices that support the 802.1w, 802.1s, and 802.1D standards. The CIST inside an MST region is the same as the CST outside a region.

Spanning Tree Operation Within an MST Region

The IST connects all the MSTdevices in a region. When the IST converges, the root of the IST becomes the CIST regional root. The CIST regional root is also the CIST root if there is only one region in the network. If the CIST root is outside the region, the protocol selects one of the MST devices at the boundary of the region as the CIST regional root.

When an MST device initializes, it sends BPDUs that identify itself as the root of the CIST and the CIST regional root, with both the path costs to the CIST root and to the CIST regional root set to zero. The device also initializes all of its MSTIs and claims to be the root for all of them. If the device receives superior MSTI root information (lower switch ID, lower path cost, and so forth) than the information that is currently stored for the port, it relinquishes its claim as the CIST regional root.

During initialization, an MST region might have many subregions, each with its own CIST regional root. As devices receive superior IST information from a neighbor in the same region, they leave their old subregions and join the new subregion that contains the true CIST regional root. This action causes all subregions to shrink except for the subregion that contains the true CIST regional root.

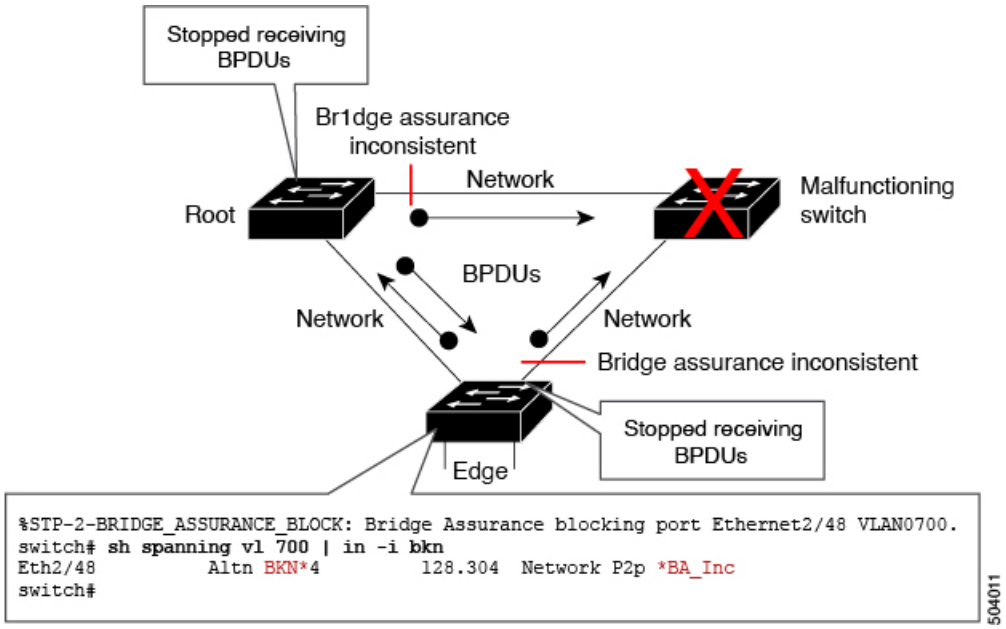
All devices in the MST region must agree on the same CIST regional root. Any two devices in the region will only synchronize their port roles for an MSTI if they converge to a common CIST regional root.

Spanning Tree Operations Between MST Regions

If you have multiple regions or 802.1 w or 802.1D STP instances within a network, MST establishes and maintains the CST, which includes all MST regions and all 802.1w and 802.1D STP devices in the network. The MSTIs combine with the IST at the boundary of the region to become the CST.

The IST connects all the MST devices in the region and appears as a subtree in the CIST that encompasses the entire switched domain. The root of the subtree is the CIST regional root. The MST region appears as a virtual device to adjacent STP devices and MST regions.

Figure 2: MST Regions, CIST Regional Roots, and CST Root



Only the CST instance sends and receives BPDUs. MSTIs add their spanning tree information into the BPDUs (as M-records) to interact with neighboring devices within the same MST region and compute the final spanning tree topology. The spanning tree parameters related to the BPDU transmission (for example, hello time, forward time, max-age, and max-hops) are configured only on the CST instance but affect all MSTIs. You can configure the parameters related to the spanning tree topology (for example, the switch priority, the port VLAN cost, and the port VLAN priority) on both the CST instance and the MSTI.

MST devices use Version 3 BPDUs. If the MST device falls back to 802.1D STP, the device uses only 802.1D BPDUs to communicate with 802.1D-only devices. MST devices use MST BPDUs to communicate with MST devices.

MST Terminology

MST naming conventions include identification of some internal or regional parameters. These parameters are used only within an MST region, compared to external parameters that are used throughout the whole network. Because the CIST is the only spanning tree instance that spans the whole network, only the CIST parameters require the external qualifiers and not the internal or regional qualifiers. The MST terminology is as follows:

- The CIST root is the root bridge for the CIST, which is the unique instance that spans the whole network.

- The CIST external root path cost is the cost to the CIST root. This cost is left unchanged within an MST region. An MST region looks like a single device to the CIST. The CIST external root path cost is the root path cost calculated between these virtual devices and devices that do not belong to any region.
- If the CIST root is in the region, the CIST regional root is the CIST root. Otherwise, the CIST regional root is the closest device to the CIST root in the region. The CIST regional root acts as a root bridge for the IST.
- The CIST internal root path cost is the cost to the CIST regional root in a region. This cost is only relevant to the IST, instance 0.

Hop Count

MST does not use the message-age and maximum-age information in the configuration BPDU to compute the STP topology inside the MST region. Instead, the protocol uses the path cost to the root and a hop-count mechanism similar to the IP time-to-live (TTL) mechanism.

By using the **spanning-tree mst max-hops** global configuration command, you can configure the maximum hops inside the region and apply it to the IST and all MST instances in that region.

The hop count achieves the same result as the message-age information (triggers a reconfiguration). The root bridge of the instance always sends a BPDU (or M-record) with a cost of 0 and the hop count set to the maximum value. When a device receives this BPDU, it decrements the received remaining hop count by one and propagates this value as the remaining hop count in the BPDUs that it generates. When the count reaches zero, the device discards the BPDU and ages the information held for the port.

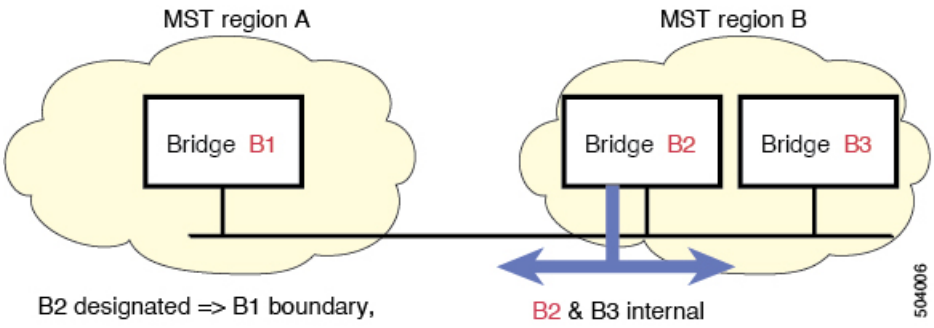
The message-age and maximum-age information in the 802.1w portion of the BPDU remain the same throughout the region (only on the IST), and the same values are propagated by the region-designated ports at the boundary.

You configure a maximum aging time as the number of seconds that a device waits without receiving spanning tree configuration messages before attempting a reconfiguration.

Boundary Ports

A boundary port is a port that connects to a LAN, the designated bridge of a bridge with a different MST configuration (and so, a separate MST region) 802.1D STP bridge. A designated port knows that it is on the boundary if it detects an STP bridge or receives an agreement proposal from an MST bridge with a different configuration. This definition allows two ports that are internal to a region to share a segment with a port that belongs to a different region, creating the possibility of receiving both internal and external messages on a port.

Figure 3: MST Boundary Ports



At the boundary, the roles of MST ports do not matter; the system forces their state to be the same as the IST port state. If the boundary flag is set for the port, the MST port-role selection process assigns a port role to the boundary and assigns the same state as the state of the IST port. The IST port at the boundary can take up any port role except a backup port role.

Port Cost and Port Priority

Spanning tree uses port costs to break a tie for the designated port. Lower values indicate lower port costs, and spanning tree chooses the least costly path. Default port costs are taken from the bandwidth of the interface, as follows:

- 1 Gigabit Ethernet—20,000
- 10 Gigabit Ethernet—2,000
- 40 Gigabit Ethernet—500

You can configure the port costs in order to influence which port is chosen.



Note MST always uses the long path-cost calculation method, so the range of valid values is between 1 and 200,000,000.

The system uses port priorities to break ties among ports with the same cost. A lower number indicates a higher priority. The default port priority is 128. You can configure the priority to values between 0 and 224, in increments of 32.

Interoperability with IEEE 802.1D

A device that runs MST supports a built-in protocol migration feature that enables it to interoperate with 802.1D STP devices. If this device receives an 802.1D configuration BPDU (a BPDU with the protocol version set to 0), it sends only 802.1D BPDUs on that port. In addition, an MST device can detect that a port is at the boundary of a region when it receives an 802.1D BPDU, an MST BPDU (Version 3) associated with a different region, or an 802.1w BPDU (Version 2).

However, the device does not automatically revert to the MST mode if it no longer receives 802.1D BPDUs because it cannot detect whether the 802.1D device has been removed from the link unless the 802.1D device is the designated device. A device might also continue to assign a boundary role to a port when the device to which this device is connected has joined the region.

To restart the protocol migration process (force the renegotiation with neighboring devices), enter the **clear spanning-tree detected-protocols** command.

All 8021.D STP switches on the link can process MST BPDUs as if they are 802.1w BPDUs. MST devices can send either Version 0 configuration and topology change notification (TCN) BPDUs or Version 3 MST BPDUs on a boundary port. A boundary port connects to a LAN, the designated device of which is either a single spanning tree device or a device with a different MST configuration.

MST interoperates with the Cisco prestandard MSTP whenever it receives prestandard MSTP on an MST port; no explicit configuration is necessary.

You can also configure the interface to proactively send prestandard MSTP messages.

Prerequisites for MST

MST has the following prerequisites:

- You must be logged onto the device.

Guidelines and Limitations for Configuring MST



Note When you change the VLAN-to-MSTI mapping, the system reconverges MST.

MST has the following configuration guidelines and limitations:

- For MST configuration limits, see the *Cisco Nexus® 3550-T Verified Scalability Guide*.
- **show** commands with the **internal** keyword are not supported.
- Beginning with Cisco NX-OS Release 10.2(3t), RSTP (Rapid Spanning Tree Protocol) is the default spanning tree mode.
- You can assign a VLAN to only one MST instance in Cisco Nexus® 3550-T switches.
- By default, all VLANs are mapped to MSTI 0 or the IST.
- You can load balance only within the MST region.
- Ensure that trunks within an MST region carry all of the VLANs that are mapped to an MSTI or exclude all those VLANs that are mapped to an MSTI.
- Always leave STP enabled.
- Do not change timers because you can adversely affect your network stability.
- Keep user traffic off the management VLAN; keep the management VLAN separate from user data.
- Choose the distribution and core layers as the location of the primary and secondary root switches.
- Port channeling—The port channel bundle is considered as a single port. The port cost is the aggregation of all the configured port costs assigned to that channel.
- When you map a VLAN to an MSTI, the system automatically removes that VLAN from its previous MSTI.
- You can map any number of VLANs to an MSTI.
- Do not partition the network into a large number of regions. However, if this situation is unavoidable, we recommend that you partition the switched LAN into smaller LANs interconnected by non-Layer 2 devices.
- When you are in the MST configuration submode, the following guidelines apply:
  - Each command reference line creates its pending regional configuration.
  - The pending region configuration starts with the current region configuration.

- To leave the MST configuration submode without committing any changes, enter the **abort** command.
- To leave the MST configuration submode and commit all the changes that you made before you left the submode, enter the **exit** or **end** commands, or press **Ctrl + Z**.

Default Settings for MST

This table lists the default settings for MST parameters.

Table 1: Default MST Parameters

Parameters	Default
Spanning tree	Enabled
Name	Empty string
VLAN mapping	All VLANs mapped to a CIST instance
Revision	0
Instance ID	Instance 0; VLANs 1 to 3967 are mapped to Instance 0 by default
MSTI per MST region	Only single instance of MST is permitted in the Cisco Nexus® 3550-T switches
Bridge priority (configurable per CIST port)	32768
Spanning tree port priority (configurable per CIST port)	128
Spanning tree port cost (configurable per CIST port)	Auto The default port cost is determined by the port speed as follows: • 1 Gigabit Ethernet: 20,000 • 10 Gigabit Ethernet: 2,000 • 40 Gigabit Ethernet: 500
Hello time	2 seconds
Forward-delay time	15 seconds
Maximum-aging time	20 seconds
Maximum hop count	20 hops

Parameters	Default
Link type	Auto The default link type is determined by the duplex, as follows: • Full duplex: point-to-point link • Half duplex: shared link

Configuring MST

Note If you are familiar with the Cisco IOS CLI, be aware that the Cisco software commands for this feature might differ from the Cisco IOS commands that you would use.

Enabling MST - CLI Version

Note When you change the spanning tree mode, traffic is disrupted because all spanning tree instances are stopped for the previous mode and started for the new mode.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mode mst** or **no spanning-tree mode mst**. **Example:** `switch(config)# spanning-tree mode mst`	• **spanning-tree mode mst** Enables MST on the device. • **no spanning-tree mode mst** Disables MST on the device.

Step 3	**exit**
	Example:
	`switch(config)# exit`
	`switch#`
		Exits configuration mode.

	Command or Action	Purpose
Step 4	(Optional) **show running-config spanning-tree all** **Example:** `switch# show running-config spanning-tree all`	Displays the currently running STP configuration.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to enable MST on the device:

```
switch# config t
switch(config)# spanning-tree mode mst
switch(config)# exit
switch#
```

Entering MST Configuration Mode

You enter MST configuration mode to configure the MST name, VLAN-to-instance mapping, and MST revision number on the device.

If two or more devices are in the same MST region, they must have the identical MST name, VLAN-to-instance mapping, and MST revision number.

Note Each command reference line creates its pending regional configuration in MST configuration mode. In addition, the pending region configuration starts with the current region configuration.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst configuration** or **no spanning-tree mst configuration** **Example:**	• **spanning-tree mst configuration** Enters MST configuration submode on the system. You must be in the MST

	Command or Action	Purpose
	`switch(config)# spanning-tree mst configuration` `switch(config-mst)#`	configuration submode to assign the MST configuration parameters, as follows: • MST name • VLAN-to-MST instance mapping • MST revision number • **no spanning-tree mst configuration** Returns the MST region configuration to the following default values: • The region name is an empty string. • No VLANs are mapped to any MST instance (all VLANs are mapped to the CIST instance). • The revision number is 0.

Step 3	**exit** or **abort**
	Example:
	`switch(config-mst)# exit`
	`switch(config)#`
		• **exit**
		Commits all the changes and exits MST configuration submode.
		• **abort**
		Exits the MST configuration submode without committing any of the changes.

Step 4	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to enter the MST configuration submode on the device:

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

Specifying the MST Name

You can configure a region name on the bridge. If two or more bridges are in the same MST region, they must have the identical MST name, VLAN-to-instance mapping, and MST revision number.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst configuration**
	Example:
	`switch(config)# spanning-tree mst configuration`
	`switch(config-mst)#`
		Enters MST configuration submode.

Step 3	**name** *name* **Example:** `switch(config-mst)# name accounting`	Specifies the name for the MST region. The *name* string has a maximum length of 32 characters and is case sensitive. The default is an empty string.

Step 4	**exit** or **abort**
	Example:
	`switch(config-mst)# exit`
	`switch(config)#`
		• **exit**
		Commits all the changes and exits MST configuration submode.
		• **abort**
		Exits the MST configuration submode without committing any of the changes.

Step 5	(Optional) **show spanning-tree mst configuration** **Example:** `switch# show spanning-tree mst configuration`	Displays the MST configuration.
Step 6	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to set the name of the MST region:

```
switch# config t
switch(config)#  spanning-tree mst configuration
switch(config-mst)# name accounting
switch(config-mst)# exit
switch(config)#
```

Specifying the MST Configuration Revision Number

You configure the revision number on the bridge. If two or more bridges are in the same MST region, they must have the identical MST name, VLAN-to-instance mapping, and MST revision number.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst configuration**
	Example:
	`switch(config)# spanning-tree mst configuration`
	`switch(config-mst)#`
		Enters MST configuration submode.

Step 3	**revision** *version* **Example:** `switch(config-mst)# revision 5`	Specifies the revision number for the MST region. The range is from 0 to 65535, and the default value is 0.

Step 4	**exit** or **abort**
	Example:
	`switch(config-mst)# exit`
	`switch(config)#`
		• **exit**
		Commits all the changes and exits MST configuration submode.
		• **abort**
		Exits the MST configuration submode without committing any of the changes.

Step 5	(Optional) **show spanning-tree mst configuration** **Example:** `switch# show spanning-tree mst configuration`	Displays the MST configuration.
Step 6	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to configure the revision number of the MSTI region to 5:

```
switch# config t
switch(config)# spanning-tree mst configuration
switch(config-mst)# revision 5
switch(config-mst)#
```

Configuring the Root Bridge

You can configure the device to become the MST root bridge.

The **spanning-tree vlan** *vlan_ID* **primary root** command fails if the value required to be the root bridge is less than 4096. If the software cannot lower the bridge priority any lower, the device returns the following message:

```
Error: Failed to set root bridge for VLAN 1
It may be possible to make the bridge root by setting the priority
for some (or all) of these instances to zero.
```



Note The root bridge for each MSTI should be a backbone or distribution device. Do not configure an access device as the spanning tree primary root bridge.

Enter the **diameter** keyword, which is available only for MSTI 0 (or the IST), to specify the Layer 2 network diameter (that is, the maximum number of Layer 2 hops between any two end stations in the Layer 2 network). When you specify the network diameter, the device automatically sets an optimal hello time, forward-delay time, and maximum-age time for a network of that diameter, which can significantly reduce the convergence time. You can enter the **hello** keyword to override the automatically calculated hello time.



Note With the device configured as the root bridge, do not manually configure the hello time, forward-delay time, and maximum-age time using the **spanning-tree mst hello-timespanning-tree mst forward-time**, and **spanning-tree mst max-age** global configuration commands.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst** *instance-id* **root** {**primary** | **secondary**} [**diameter** *dia* [**hello-time** *hello-time*]] or **no spanning-tree mst** *instance-id* **root** **Example:** `switch(config)# spanning-tree mst 5 root primary`	• **spanning-tree mst** *instance-id* **root** {**primary** | **secondary**} [**diameter** *dia* [**hello-time** *hello-time*]] Configures a device as the root bridge as follows: • For *instance-id*, specify a single instance, a range of instances

	Command or Action	Purpose
		separated by a hyphen, or a series of instances separated by a comma. The range is from 1 to 4094. • For **diameter** *net-diameter*, specify the maximum number of Layer 2 hops between any two end stations. The default is 7. This keyword is available only for MST instance 0. • For **hello-time** *seconds*, specify the interval in seconds between the generation of configuration messages by the root bridge. The range is from 1 to 10 seconds; the default is 2 seconds. • **no spanning-tree mst** *instance-id* **root** Returns the switch priority, diameter, and hello time to default values.

Step 3	**exit** or **abort**
	Example:
	`switch(config)# exit`
	`switch#`
		• **exit**
		Commits all the changes and exits MST configuration submode.
		• **abort**
		Exits the MST configuration submode without committing any of the changes.

Step 4	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to configure the device as the root switch for MSTI 5:

```
switch# config t
switch(config)# spanning-tree mst 5 root primary
switch(config)# exit
switch(config)#
```

Configuring an MST Secondary Root Bridge

You use this command on more than one device to configure multiple backup root bridges. Enter the same network diameter and hello-time values that you used when you configured the primary root bridge with the **spanning-tree mst root primary** global configuration command.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst** *instance-id* **root** {**primary** | **secondary**} [**diameter** *dia*[**hello-time** *hello-time*]] or **no spanning-tree mst** *instance-id* **root** **Example:** `switch(config)# spanning-tree mst 0 root secondary`	• **spanning-tree mst** *instance-id* **root** {**primary** | **secondary**} [**diameter** *dia*[**hello-time** *hello-time*]] Configures a device as the secondary root bridge as follows: • For *instance-id*, specify the single MSTI ID. • For **diameter** *net-diameter*, specify the maximum number of Layer 2 hops between any two end stations. The default is 7. This keyword is available only for MST instance 0. • For **hello-time** *seconds*, specify the interval in seconds between the generation of configuration messages by the root bridge. The range is from 1 to 10 seconds; the default is 2 seconds. • **no spanning-tree mst** *instance-id* **root** Returns the switch priority, diameter, and hello-time to default values.

Step 3	**exit**
	Example:
	`switch# exit`
	`switch(config)#`
		Exits configuration mode.

Step 4	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.

	Command or Action	Purpose
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to configure the device as the secondary root switch for MSTI 0:

```
switch# config t
switch(config)# spanning-tree mst 0 root secondary
switch(config)# exit
switch#
```

Configuring the MST Switch Priority

You can configure the switch priority for an MST instance so that it is more likely that the specified device is chosen as the root bridge.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst** *instance-id* **priority** *priority-value* **Example:** `switch(config)# spanning-tree mst 0 priority 4096`	Configures a device priority as follows: • For *instance-id*, specify the single MSTI ID. • For *priority-value* the range is from 0 to 61440 in increments of 4096; the default is 32768. A lower number indicates that the device will most likely be chosen as the root bridge. Priority values are 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, and 61440. The system rejects all other values.
Step 3	**exit** **Example:**	Exits configuration mode.

	Command or Action	Purpose
	`switch(config)# exit` `switch#`	
Step 4	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to configure the priority of the bridge to 4096 for MSTI 0:

```
switch# config t
switch(config)# spanning-tree mst 0 priority 4096
switch(config)# exit
switch#
```

Configuring the MST Port Priority

If a loop occurs, MST uses the port priority when selecting an interface to put into the forwarding state. You can assign lower priority values to interfaces that you want selected first and higher priority values to the interface that you want selected last. If all interfaces have the same priority value, MST puts the interface with the lowest interface number in the forwarding state and blocks the other interfaces.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**interface** {{*type slot/port*} | {**port-channel** *number*}}
	Example:
	`switch(config)# interface ethernet 1/1`
	`switch(config-if)#`
		Specifies an interface to configure, and enters interface configuration mode.

Step 3	**spanning-tree mst** *instance-id* **port-priority** *priority* **Example:**	Configures the port priority as follows: • For *instance-id*, specify the single MSTI ID.

	Command or Action	Purpose
	`switch(config-if)# spanning-tree mst 3 port-priority 64`	• For *priority*, the range is from 0 to 224 in increments of 32. The default is 128. A lower number indicates a higher priority. The priority values are 0, 32, 64, 96, 128, 160, 192, and 224. The system rejects all other values.

Step 4	**exit**
	Example:
	`switch(config-if)# exit`
	`switch(config)#`
		Exits interface mode.

Step 5	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 6	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to set the MST interface port priority for MSTI 0 on Ethernet port 1/1 to 64:

```
switch# config t
switch(config)# interface ethernet 1/1
switch(config-if)# spanning-tree mst 0 port-priority 64
switch(config-if)# exit
switch(config)#
```

Configuring the MST Port Cost

The MST port cost default value is derived from the media speed of an interface. If a loop occurs, MST uses the cost when selecting an interface to put in the forwarding state. You can assign lower cost values to interfaces that you want selected first and higher cost to interfaces values that you want selected last. If all interfaces have the same cost value, MST puts the interface with the lowest interface number in the forwarding state and blocks the other interfaces.

Note MST uses the long path-cost calculation method.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**interface** {{*type slot/port*} | {**port-channel** *number*}}
	Example:
	`switch# config t`
	`switch(config)# interface ethernet 1/1`
	`switch(config-if)#`
		Specifies an interface to configure, and enters interface configuration mode.

Step 3	**spanning-tree mst** *instance-id* **cost** {*cost* | *auto*} **Example:** `switch(config-if)# spanning-tree mst 4 cost 17031970`	Configures the cost. If a loop occurs, MST uses the path cost when selecting an interface to place into the forwarding state. A lower path cost represents higher-speed transmission as follows: • For *instance-id*, specify the single MSTI ID. • For *cost*, the range is from 1 to 200000000. The default value is **auto**, which is derived from the media speed of the interface.

Step 4	**exit**
	Example:
	`switch(config-if)# exit`
	`switch(config)#`
		Exits interface mode.

Step 5	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 6	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to set the MST interface port cost on Ethernet 1/1 for MSTI 0:

```
switch# config t
switch(config)# interface ethernet 1/1
switch(config-if)# spanning-tree mst 0 cost 17031970
switch(config-if)# exit
switch(config)#
```

Configuring the MST Hello Time

You can configure the interval between the generation of configuration messages by the root bridge for all instances on the device by changing the hello time.

Note Be careful when using the **spanning-tree mst hello-time** command. For most situations, we recommend that you enter the **spanning-tree mst** *instance-id* **root primary** and the **spanning-tree mst** *instance-id* **root secondary** global configuration commands to modify the hello time.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst hello-time** *seconds* **Example:** `switch(config)# spanning-tree mst hello-time 1`	Configures the hello time for the MST instance. The hello time is the interval between the generation of configuration messages by the root bridge. These messages mean that the device is alive. For *seconds*, the range is from 1 to 10, and the default is 2 seconds.

Step 3	**exit**
	Example:
	`switch(config)# exit`
	`switch#`
		Exits configuration mode.

Step 4	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to configure the hello time of the device to 1 second:

```
switch# config t
switch(config)# spanning-tree mst hello-time 1
switch(config)# exit
switch#
```

Configuring the MST Forwarding-Delay Time

You can set the forward delay timer for the MST instance on the device with one command.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst forward-time** *seconds* **Example:** `switch(config)# spanning-tree mst forward-time 10`	Configures the forward time for the MST instance. The forward delay is the number of seconds that a port waits before changing from its spanning tree blocking and learning states to the forwarding state. For *seconds*, the range is from 4 to 30, and the default is 15 seconds.

Step 3	**exit**
	Example:
	`switch(config)# exit`
	`switch#`
		Exits configuration mode.

Step 4	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to configure the forward-delay time of the device to 10 seconds:

```
switch# config t
switch(config)# spanning-time mst forward-time 10
switch(config)# exit
switch#
```

Configuring the MST Maximum-Aging Time

You can set the maximum-aging timer for the MST instance on the device with one command (the maximum age time only applies to the IST).

The maximum-aging timer is the number of seconds that a device waits without receiving spanning tree configuration messages before attempting a reconfiguration.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst max-age** *seconds* **Example:** `switch(config)# spanning-tree mst max-age 40`	Configures the maximum-aging time for the MST instance. The maximum-aging time is the number of seconds that a device waits without receiving spanning tree configuration messages before attempting a reconfiguration. For *seconds*, the range is from 6 to 40, and the default is 20 seconds.

Step 3	**exit**
	Example:
	`switch(config)# exit`
	`switch#`
		Exits configuration mode.

Step 4	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to configure the maximum-aging timer of the device to 40 seconds:

```
switch# config t
switch(config)# spanning-tree mst max-age 40
switch(config)# exit
switch#
```

Configuring the MST Maximum-Hop Count

You can configure the maximum hops inside the region and apply it to the IST and the MST instance in that region. MST uses the path cost to the IST regional root and a hop-count mechanism similar to the IP time-to-live (TTL) mechanism. The hop count achieves the same result as the message-age information (triggers a reconfiguration).

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**spanning-tree mst max-hops** *hop-count* **Example:** `switch(config)# spanning-tree mst max-hops 40`	Specifies the number of hops in a region before the BPDU is discarded and the information held for a port is aged. For *hop-count*, the range is from 1 to 255, and the default value is 20 hops.

Step 3	**exit**
	Example:
	`switch(config-mst)# exit`
	`switch#`
		Exits configuration mode.

Step 4	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to set the maximum hops to 40:

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

Configuring an Interface to Proactively Send Prestandard MSTP Messages - CLI Version

By default, interfaces on a device running MST send prestandard, rather than standard, MSTP messages after they receive a prestandard MSTP message from another interface. You can configure the interface to proactively send prestandard MSTP messages. That is, the specified interface would not have to wait to receive a prestandard MSTP message; the interface with this configuration always sends prestandard MSTP messages.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**interface** *type slot/port*
	Example:
	`switch(config)# interface ethernet 1/4`
	`switch(config-if)#`
		Specifies the interface to configure and enters the interface configuration mode.

Step 3	**spanning-tree mst pre-standard** **Example:** `switch(config-if)# spanning-tree mst pre-standard`	Specifies that the interface always sends MSTP messages in the prestandard format, rather than in the MSTP standard format.

Step 4	**exit**
	Example:
	`switch(config-if)# exit`
	`switch(config)#`
		Exits interface mode.

Step 5	(Optional) **show spanning-tree mst** **Example:** `switch# show spanning-tree mst`	Displays the MST configuration.
Step 6	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to set the MST interface so that it always sends MSTP messages in the prestandard format:

```
switch# config t
switch (config)# interface ethernet 1/4
switch(config-if)# spanning-tree mst pre-standard
switch(config-if)# exit
switch(config)#
```

Specifying the Link Type for MST - CLI Version

Rapid connectivity (802.1w standard) is established only on point-to-point links. By default, the link type is controlled from the duplex mode of the interface. A full-duplex port is considered to have a point-to-point connection; a half-duplex port is considered to have a shared connection.

If you have a half-duplex link physically connected point to point to a single port on a remote device, you can override the default setting on the link type and enable rapid transitions.

If you set the link to shared, STP falls back to 802.1D.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**interface** *type slot/port*
	Example:
	`switch(config)# interface ethernet 1/4`
	`switch(config-if)#`
		Specifies the interface to configure and enters the interface configuration mode.

Step 3	**spanning-tree link-type** {*auto* | *point-to-point* | *shared*} **Example:** `switch(config-if)# spanning-tree link-type point-to-point`	Configures the link type to be either a point-to-point link or shared link. The system reads the default value from the device connection, as follows: half duplex links are shared and full-duplex links are point to point. If the link type is shared, the STP falls back to 802.1D. The default is auto, which sets the link type based on the duplex setting of the interface.

Step 4	**exit**
	Example:
	`switch(config-if)# exit`
	`switch(config)#`
		Exits interface mode.

Step 5	(Optional) **show spanning-tree** **Example:** `switch# show spanning-tree`	Displays the STP configuration.

	Command or Action	Purpose
Step 6	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to configure the link type as a point-to-point link:

```
switch# config t
switch (config)# interface ethernet 1/4
switch(config-if)# spanning-tree link-type point-to-point
switch(config-if)# exit
switch(config)#
```

Reinitializing the Protocol for MST

An MST bridge can detect that a port is at the boundary of a region when it receives a legacy BPDU or an MST BPDU that is associated with a different region. However, the STP protocol migration cannot determine whether the legacy device, which is a device that runs only IEEE 802.1D, has been removed from the link unless the legacy device is the designated switch. Enter this command to reinitialize the protocol negotiation (force the renegotiation with neighboring devices) on the entire device or on specified interfaces.

Procedure

	Command or Action	Purpose
Step 1	**clear spanning-tree detected-protocol** [**interface** *interface* [*interface-num* | *port-channel*]] **Example:** `switch# clear spanning-tree detected-protocol`	Reintializes MST on an entire device or specified interfaces.

Example

This example shows how to reinitialize MST on the Ethernet interface on slot 1, port 8:

```
switch# clear spanning-tree detected-protocol interface ethernet 1/8
```

Verifying the MST Configuration

To display MST configuration information, perform one of the following tasks:

Command	Purpose
show running-config spanning-tree [**all**]	Displays STP information.
show spanning-tree mst configuration	Displays MST information.
show spanning-tree mst [**detail**]	Displays information about MST instances.
show spanning-tree mst *instance-id* [**detail**]	Displays information about the specified MST instance.
show spanning-tree mst *instance-id* **interface** {**ethernet** *slot/port* | **port-channel** *channel-number*} [**detail**]	Displays MST information for the specified interface and instance.
show spanning-tree summary	Displays summary STP information.
show spanning-tree detail	Displays detailed STP information.
show spanning-tree {**vlan** *vlan-id* | **interface** {[**ethernet** *slot/port*] | [**port-channel** *channel-number*]}} [**detail**]	Displays STP information per VLAN and interface.
show spanning-tree vlan *vlan-id* **bridge**	Displays information on the STP bridge.

Displaying and Clearing MST Statistics -- CLI Version

To display MST configuration information, perform one of the following tasks:

Command	Purpose
clear spanning-tree counters [**interface** *type slot/port* | **vlan***vlan-id*]	Clears the counters for STP.
show spanning-tree {**vlan** *vlan-id* | **interface** {[**ethernet** *slot/port*] | [**port-channel***channel-number*]}} **detail**	Displays information about STP by interface or VLAN including BPDUs sent and received.

MST Example Configuration

The following example shows how to configure MST:

```
switch# configure terminal
switch(config)# spanning-tree mode mst
switch(config)# spanning-tree port type edge bpduguard default
switch(config)# spanning-tree port type edge bpdufilter default
switch(config)# spanning-tree port type network default
switch(config)# spanning-tree mst 0-64 priority 24576
```

```
switch(config)# spanning-tree mst configuration
switch(config-mst)# name cisco_region_1
switch(config-mst)# revision 2
switch(config-mst)# instance 1 vlan 1-21
```

Additional References for MST -- CLI Version

Related Documents

Related Topic	Document Title
Layer 2 interfaces	*Cisco Nexus® 3550-T Interfaces Configuration Guide*
System management	*Cisco Nexus® 3550-T System Management Configuration Guide*

Standards

Standards	Title
IEEE 802.1Q-2006 (formerly known as IEEE 802.1s), IEEE 802.1D-2004 (formerly known as IEEE 802.1w), IEEE 802.1D, IEEE 802.1t	—