



CHAPTER 16

Configuring MSTP

This chapter describes how to configure the Cisco implementation of the IEEE 802.1s Multiple STP (MSTP) on the Catalyst 2960 switch.



Note

The multiple spanning-tree (MST) implementation in Cisco IOS Release 12.2(25)SED is based on the IEEE 802.1s standard. The MST implementations in earlier Cisco IOS releases are prestandard.

The MSTP enables multiple VLANs to be mapped to the same spanning-tree instance, reducing the number of spanning-tree instances needed to support a large number of VLANs. The MSTP provides for multiple forwarding paths for data traffic and enables load balancing. It improves the fault tolerance of the network because a failure in one instance (forwarding path) does not affect other instances (forwarding paths). The most common initial deployment of MSTP is in the backbone and distribution layers of a Layer 2 switched network. This deployment provides the highly available network required in a service-provider environment.

When the switch is in the MST mode, the Rapid Spanning Tree Protocol (RSTP), which is based on IEEE 802.1w, is automatically enabled. The RSTP provides rapid convergence of the spanning tree through explicit handshaking that eliminates the IEEE 802.1D forwarding delay and quickly transitions root ports and designated ports to the forwarding state.

Both MSTP and RSTP improve the spanning-tree operation and maintain backward compatibility with equipment that is based on the (original) IEEE 802.1D spanning tree, with existing Cisco-proprietary Multiple Instance STP (MISTP), and with existing Cisco per-VLAN spanning-tree plus (PVST+) and rapid per-VLAN spanning-tree plus (rapid PVST+). For information about PVST+ and rapid PVST+, see [Chapter 15, “Configuring STP.”](#) For information about other spanning-tree features such as Port Fast, UplinkFast, root guard, and so forth, see [Chapter 17, “Configuring Optional Spanning-Tree Features.”](#)



For complete syntax and usage information for the commands used in this chapter, see the command reference for this release.

This chapter consists of these sections:

- [Understanding MSTP, page 16-2](#)
- [Understanding RSTP, page 16-8](#)
- [Configuring MSTP Features, page 16-13](#)
 - [Displaying the MST Configuration and Status, page 16-26](#)

Understanding MSTP

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- [Hop Count, page 16-5](#)
- [Boundary Ports, page 16-6](#)
- [IEEE 802.1s Implementation, page 16-6](#)
- [Interoperability with IEEE 802.1D STP, page 16-8](#)

For configuration information, see the “Configuring MSTP Features” section on page 16-13.

Multiple Spanning-Tree Regions

[Figure 16-1 on page 16-4.](#)

The MST configuration controls to which MST region each switch belongs. The configuration includes the name of the region, the revision number, and the MST VLAN-to-instance assignment map. You configure the switch for a region by using the **spanning-tree mst configuration**

name	instance	revision
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IST, CIST, and CST

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An MST instance is local to the region; for example, MST instance 1 in region A is independent of MST instance 1 in region B, even if regions A and B are interconnected.

A common and internal spanning tree (CIST), which is a collection of the ISTs in each MST region, and the common spanning tree (CST) that interconnects the MST regions and single spanning trees.

The spanning tree computed in a 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 switches that support the IEEE 802.1w, IEEE 802.1s, and IEEE 802.1D standards. The CIST inside an MST region is the same as the CST outside a region.

For more information, see the [“Operations Within an MST Region”](#) section on page 16-3 and the [“Operations Between MST Regions”](#) section on page 16-3.



The implementation of the IEEE 802.1s standard, changes some of the terminology associated with MST implementations. For a summary of these changes, see [Table 15-1 on page 15-4](#).

Operations Within an MST Region

IST master

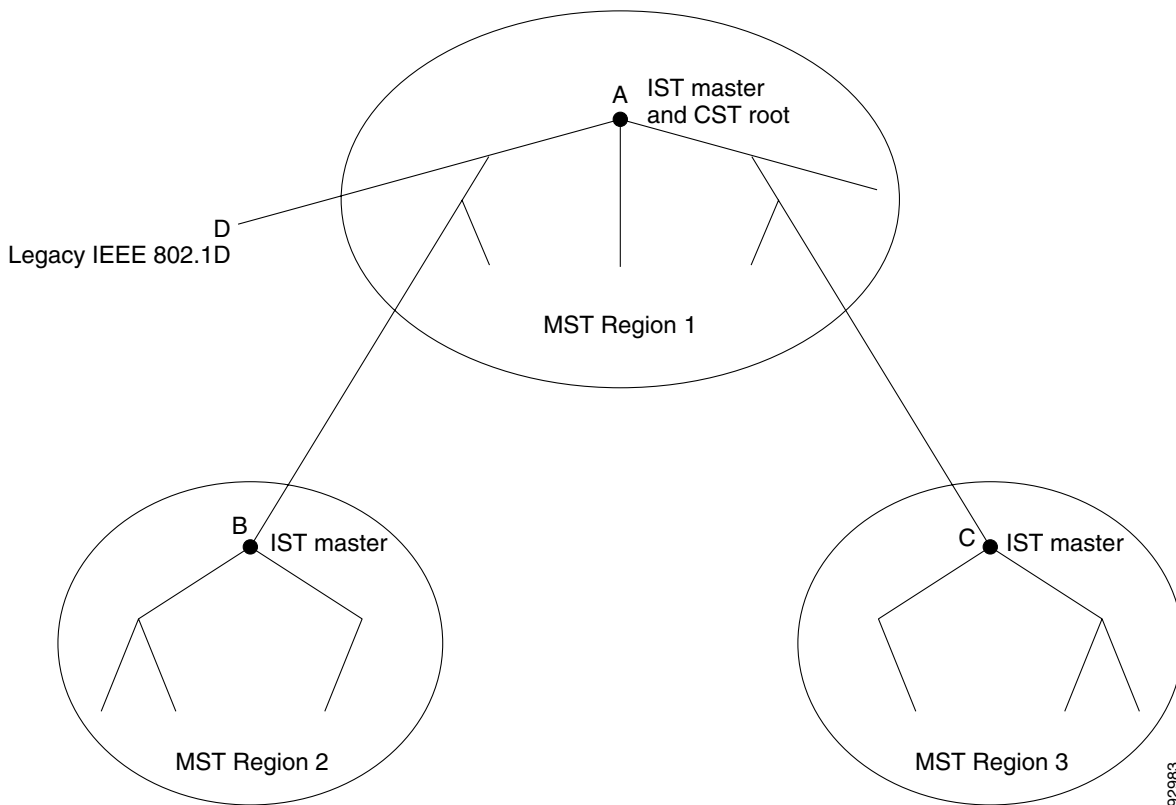
When an MSTP switch initializes, it sends BPDUs claiming itself as the root of the CIST and the CIST regional root, with both of the path costs to the CIST root and to the CIST regional root set to zero. The switch also initializes all of its MST instances and claims to be the root for all of them. If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

During initialization, a region might have many subregions, each with its own CIST regional root. As switches receive superior IST information, they leave their old subregions and join the new subregion that contains the true CIST regional root. Thus all subregions shrink, except for the one that contains the true CIST regional root.

For correct operation, all switches in the MST region must agree on the same CIST regional root. Therefore, any two switches in the region only synchronize their port roles for an MST instance if they converge to a common CIST regional root.

Operations Between MST Regions

Figure 16-1 MST Regions, CIST Masters, and CST Root



Only the CST instance sends and receives BPDUs, and MST instances add their spanning-tree information into the BPDUs to interact with neighboring switches and compute the final spanning-tree topology. Because of this, the spanning-tree parameters related to BPDU transmission (for example, hello time, forward time, max-age, and max-hops) are configured only on the CST instance but affect all MST instances. Parameters related to the spanning-tree topology (for example, switch priority, port VLAN cost, and port VLAN priority) can be configured on both the CST instance and the MST instance. MSTP switches use Version 3 RSTP BPDUs or IEEE 802.1D STP BPDUs to communicate with legacy IEEE 802.1D switches. MSTP switches use MSTP BPDUs to communicate with MSTP switches.

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IEEE 802.1s Terminology

Some MST naming conventions used in Cisco's prestandard implementation have been changed to identify some *internal* *regional*

Table 16-1 *Prestandard and Standard Terminology*

IEEE Standard	Cisco Prestandard	Cisco Standard

Hop Count

`spanning-tree mst max-hops`

Boundary Ports

There is no definition of a boundary port in the IEEE 802.1s standard. The IEEE 802.1Q-2002 standard identifies two kinds of messages that a port can receive: internal (coming from the same region) and external. When a message is external, it is received only by the CIST. If the CIST role is root or alternate, or if the external BPDU is a topology change, it could have an impact on the MST instances. When a message is internal, the CIST part is received by the CIST, and each MST instance receives its respective M-record. The Cisco prestandard implementation treats a port that receives an external message as a boundary port. This means a port cannot receive a mix of internal and external messages.

An MST region includes both switches and LANs. A segment belongs to the region of its designated port. Therefore, a port in a different region than the designated port for a segment is a boundary port. This definition allows two ports internal to a region to share a segment with a port belonging to a different region, creating the possibility of receiving both internal and external messages on a port.

The primary change from the Cisco prestandard implementation is that a designated port is not defined as boundary, unless it is running in an STP-compatible mode.



Note

If there is a legacy STP switch on the segment, messages are always considered external.

The other change from the prestandard implementation is that the CIST regional root switch ID field is now inserted where an RSTP or legacy IEEE 802.1Q switch has the sender switch ID. The whole region performs like a single virtual switch by sending a consistent sender switch ID to neighboring switches. In this example, switch C would receive a BPDU with the same consistent sender switch ID of root, whether or not A or B is designated for the segment.

IEEE 802.1s Implementation

Port Role Naming Change

- The boundary port is the root port of the CIST regional root—When the CIST instance port is proposed and is in sync, it can send back an agreement and move to the forwarding state only after all the corresponding MSTI ports are in sync (and thus forwarding). The MSTI ports now have a special role.

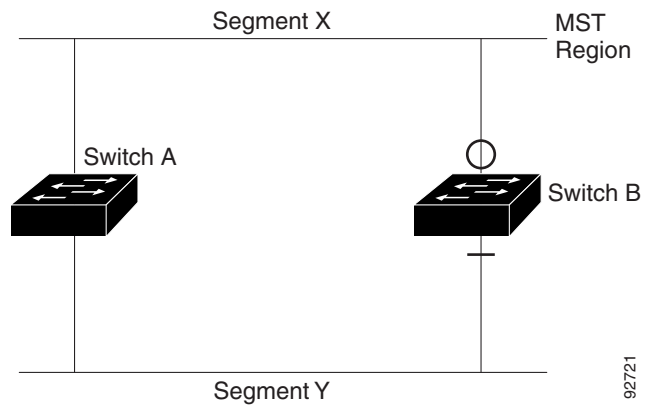
show

type

Interoperation Between Legacy and Standard Switches

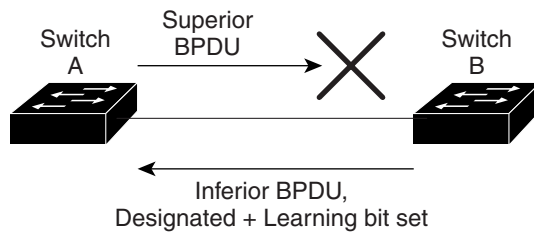
configured to be in the same region. A is the root switch for the CIST, and thus B has a root port (BX) on segment X and an alternate port (BY) on segment Y. If segment Y flaps, and the port on BY becomes the alternate before sending out a single prestandard BPDU, AY cannot detect that a prestandard switch is connected to Y and continues to send standard BPDUs. The port BY is thus fixed in a boundary, and no load balancing is possible between A and B. The same problem exists on segment X, but B might transmit topology changes.

Figure 16-2 Standard and Prestandard Switch Interoperation



Detecting Unidirectional Link Failure

Figure 16-3 *Detecting Unidirectional Link Failure*



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Interoperability with IEEE 802.1D STP

detected-protocols

clear spanning-tree

Understanding RSTP

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Port Roles and the Active Topology

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Operational Status	STP Port State (IEEE 802.1D)	RSTP Port State	Is Port Included in the Active Topology?

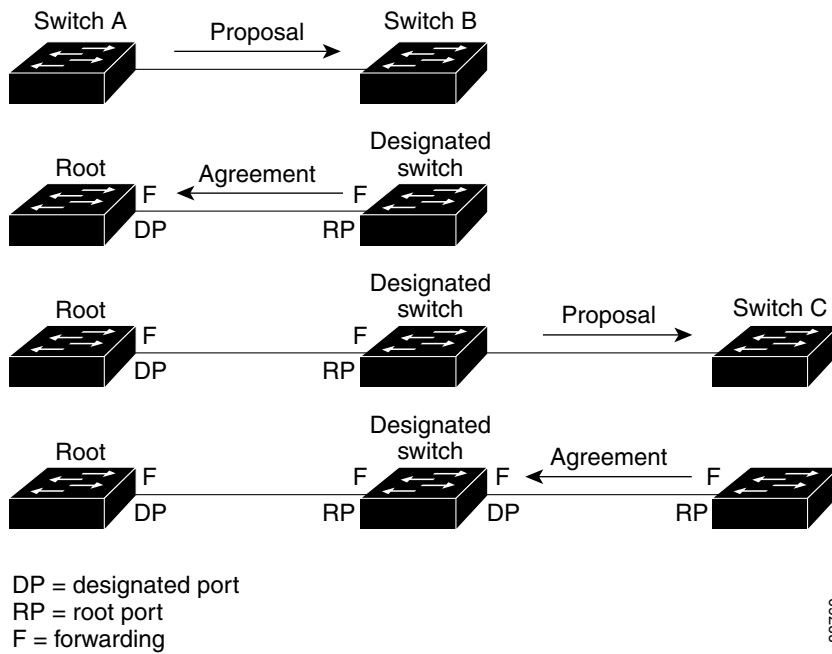
discarding

blocking

-
-

link-type

Figure 16-4 Proposal and Agreement Handshaking for Rapid Convergence

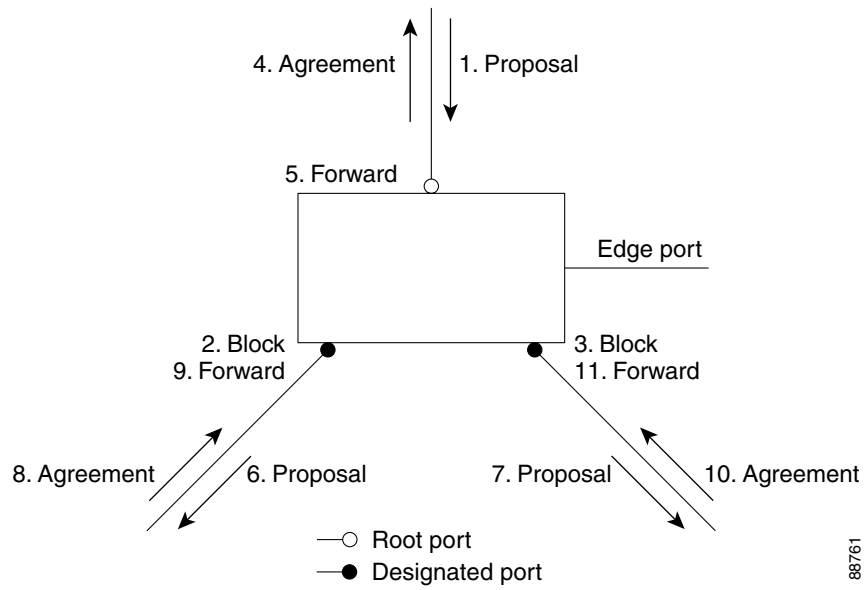


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Synchronization of Port Roles

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Figure 16-5 Sequence of Events During Rapid Convergence



Bridge Protocol Data Unit Format and Processing

RSTP BPDUs Flags

Bit	Function
2–3:	Port role:
00	Unknown
01	Alternate port
10	Root port
11	Designated port
4	Learning
5	Forwarding
6	Agreement
7	Topology change acknowledgement (TCA)

Processing Superior BPDUs Information

Processing Inferior BPDUs Information

Topology Changes

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Configuring MSTP Features


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- [MSTP Configuration Guidelines, page 16-14](#)
- [Specifying the MST Region Configuration and Enabling MSTP, page 16-15](#) (required)
- [Configuring the Root Switch, page 16-17](#) (optional)

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Specifying the MST Region Configuration and Enabling MSTP

	Command	Purpose
Step 1		
Step 2		

	Command	Purpose
Step 3		<ul style="list-style-type: none"> • • <p style="text-align: right;">instance 1 vlan</p> <p>1-63</p> <p>20, 30</p> <p style="text-align: right;">instance 1 vlan 10,</p>
Step 4	name	
Step 5		
Step 6		
Step 7		
Step 8		<div style="text-align: center;">  Caution </div> <hr/> <hr/>
Step 9		
Step 10		
Step 11		

[*vlan-range*] MST configuration command. To return to the default name, use the *instance-id* MST configuration command. To return to the default revision number, use the *instance-id* MST configuration command. To re-enable PVST+, use the *instance-id* or the *instance-id* global configuration command.

This example shows how to enter MST configuration mode, map VLANs 10 to 20 to MST instance 1, name the region *region1*

```
Switch(config)# spanning-tree mst configuration
Switch(config-mst)# instance 1 vlan 10-20
                    name region1
                    revision 1
                    show pending

Pending MST configuration
Name          [region1]
Revision      1
Instance      Vlans Mapped
-----      -
```



```
0          1-9,21-4094
1          10-20
-----
```

```
Switch(config-mst)# exit
Switch(config)#
```







<i>interface-id</i>	

<i>instance-id</i>	<i>priority</i>	<i>instance-id</i>
		<i>priority</i>
	<i>interface-id</i>	
<i>instance-id</i>		



interface-id

instance-id

<i>interface-id</i>	

<i>instance-id</i>	<i>cost</i>	
		<i>instance-id</i>
		<i>cost</i>
	<i>interface-id</i>	
	<i>instance-id</i>	



interface-id

instance-id



instance-id

instance-id

<i>instance-id</i>	<i>priority</i>	<i>instance-id</i>
		<i>priority</i>
<i>instance-id</i>		

instance-id

<i>seconds</i>		<i>seconds</i>

	Command	Purpose
Step 1		
Step 2		
Step 3		
Step 4		
Step 5		

Configuring the Maximum-Aging Time

	Command	Purpose
Step 1		
Step 2		
Step 3		
Step 4		
Step 5		

Configuring the Maximum-Hop Count

	Command	Purpose
Step 1		
Step 2	<i>hop-count</i>	<i>hop-count</i>

Specifying the Link Type to Ensure Rapid Transitions

<i>interface-id</i>	
<i>interface-id</i>	

Designating the Neighbor Type

	Command	Purpose
Step 1		
Step 2		
Step 3		
Step 4		
Step 5		
Step 6		

Restarting the Protocol Migration Process

Displaying the MST Configuration and Status

Command	Purpose