



# CHAPTER 23

## Configuring Optional STP Features

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This chapter describes the Spanning Tree Protocol (STP) features supported on the Catalyst 4500 series switch. It also provides guidelines, procedures, and configuration examples.

This chapter includes the following major sections:

- [About Root Guard, page 23-2](#)
- [Enabling Root Guard, page 23-2](#)
- [About Loop Guard, page 23-3](#)
- [Enabling Loop Guard, page 23-4](#)
- [About EtherChannel Guard, page 23-6](#)
- [Enabling EtherChannel Guard \(Optional\), page 23-6](#)
- [About PortFast, page 23-6](#)
- [Enabling PortFast, page 23-7](#)
- [About BPDU Guard, page 23-8](#)
- [Enabling BackboneFast, page 23-15](#)
- [About PortFast BPDU Filtering, page 23-9](#)
- [Enabling BackboneFast, page 23-15](#)
- [About UplinkFast, page 23-11](#)
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**Note** For information on configuring STP, see [Chapter 20, “Configuring STP and MST.”](#)

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**Note** For complete syntax and usage information for the switch commands used in this chapter, first look at the *Cisco Catalyst 4500 Series Switch Command Reference* and related publications at this location:

<http://www.cisco.com/en/US/products/hw/switches/ps4324/index.html>

If the command is not found in the Catalyst 4500 Series Switch Command Reference, it will be found in the larger Cisco IOS library. Refer to the *Cisco IOS Command Reference* and related publications at this

location:

<http://www.cisco.com/en/US/products/ps6350/index.html>

## About Root Guard

Spanning Tree root guard forces an interface to become a designated port, to protect the current root status and prevent surrounding switches from becoming the root switch.

When you enable root guard on a per-port basis, it is automatically applied to all of the active VLANs to which that port belongs. When you disable root guard, it is disabled for the specified port and the port automatically goes into the listening state.

When a switch that has ports with root guard enabled detects a new root, the ports enter the root-inconsistent state. The switch no longer detects a new root and its ports automatically go into the listening state.

## Enabling Root Guard

To enable root guard on a Layer 2 access port (to force it to become a designated port), perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>interface</b> {{fastethernet   gigabitethernet   tengigabitethernet} slot/port}	Specifies an interface to configure.
Step 2	Switch(config-if)# [no] <b>spanning-tree guard root</b>	Enables root guard. Use the <b>no</b> keyword to disable root guard.
Step 3	Switch(config-if)# <b>end</b>	Exits configuration mode.
Step 4	Switch# <b>show spanning-tree</b>	Verifies the configuration.

This example shows how to enable root guard on Fast Ethernet interface 5/8:

```
Switch(config)# interface fastethernet 5/8
Switch(config-if)# spanning-tree guard root
Switch(config-if)# end
Switch#
```

This example shows how to verify the configuration:

```
Switch# show running-config interface fastethernet 5/8
Building configuration...

Current configuration: 67 bytes
!
interface FastEthernet5/8
 switchport mode access
 spanning-tree guard root
end

Switch#
```

This example shows how to determine whether any ports are in root inconsistent state:

```
Switch# show spanning-tree inconsistentports
```

Name	Interface	Inconsistency
VLAN0001	FastEthernet3/1	Root Inconsistent
VLAN0001	FastEthernet3/2	Root Inconsistent
VLAN1002	FastEthernet3/1	Root Inconsistent
VLAN1002	FastEthernet3/2	Root Inconsistent
VLAN1003	FastEthernet3/1	Root Inconsistent
VLAN1003	FastEthernet3/2	Root Inconsistent
VLAN1004	FastEthernet3/1	Root Inconsistent
VLAN1004	FastEthernet3/2	Root Inconsistent
VLAN1005	FastEthernet3/1	Root Inconsistent
VLAN1005	FastEthernet3/2	Root Inconsistent

```
Number of inconsistent ports (segments) in the system :10
```

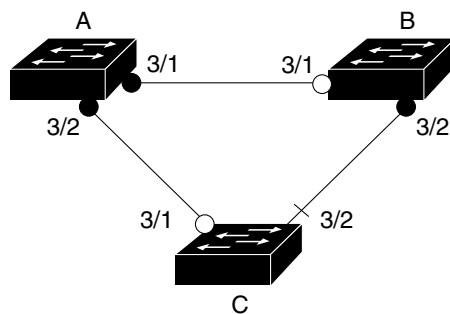
## About Loop Guard

Loop guard helps prevent bridging loops that could occur because of a unidirectional link failure on a point-to-point link. When enabled globally, loop guard applies to all point-to-point ports on the system. Loop guard detects root ports and blocked ports and ensures that they keep receiving BPDUs from their designated port on the segment. If a loop-guard-enabled root or blocked port stop receiving BPDUs from its designated port, it transitions to the blocking state, assuming there is a physical link error on this port. The port recovers from this state as soon as it receives a BPDU.

You can enable loop guard on a per-port basis. When you enable loop guard, it is automatically applied to all of the active instances or VLANs to which that port belongs. When you disable loop guard, it is disabled for the specified ports. Disabling loop guard moves all loop-inconsistent ports to the listening state.

If you enable loop guard on a channel and the first link becomes unidirectional, loop guard blocks the entire channel until the affected port is removed from the channel. [Figure 23-1](#) shows loop guard in a triangular switch configuration.

**Figure 23-1** Triangular Switch Configuration with Loop Guard



- Designated port
- Root port
- + Alternate port

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Figure 23-1 illustrates the following configuration:

- Switches A and B are distribution switches.
- Switch C is an access switch.
- Loop guard is enabled on ports 3/1 and 3/2 on Switches A, B, and C.

Enabling loop guard on a root switch has no effect but provides protection when a root switch becomes a nonroot switch.

Follow these guidelines when using loop guard:

- Do not enable loop guard on PortFast-enabled or dynamic VLAN ports.
- Do not enable loop guard if root guard is enabled.

Loop guard interacts with other features as follows:

- Loop guard does not affect the functionality of UplinkFast or BackboneFast.
- Enabling loop guard on ports that are not connected to a point-to-point link does not work.
- Root guard forces a port to always be the root port. Loop guard is effective only if the port is a root port or an alternate port. You cannot enable loop guard and root guard on a port at the same time.
- Loop guard uses the ports known to spanning tree. Loop guard can take advantage of logical ports provided by the Port Aggregation Protocol (PAgP). However, to form a channel, all the physical ports grouped in the channel must have compatible configurations. PAgP enforces uniform configurations of root guard or loop guard on all the physical ports to form a channel.
  - Spanning tree always chooses the first operational port in the channel to send the BPDUs. If that link becomes unidirectional, loop guard blocks the channel, even if other links in the channel are functioning properly.
  - If a set of ports that are already blocked by loop guard are grouped together to form a channel, spanning tree loses all the state information for those ports and the new channel port may obtain the forwarding state with a designated role.
  - If a channel is blocked by loop guard and the channel breaks, spanning tree loses all the state information. The individual physical ports may obtain the forwarding state with the designated role, even if one or more of the links that formed the channel are unidirectional.



**Note**

You can enable UniDirectional Link Detection (UDLD) to help isolate the link failure. A loop may occur until UDLD detects the failure, but loop guard is not able to detect it.

- Loop guard has no effect on a disabled spanning tree instance or a VLAN.

## Enabling Loop Guard

You can enable loop guard globally or per-port.

To enable loop guard globally on the switch, perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>spanning-tree loopguard default</b>	Enables loop guard globally on the switch.

	Command	Purpose
Step 2	Switch(config)# <b>end</b>	Exits configuration mode.
Step 3	Switch# <b>show spanning tree interface 4/4 detail</b>	Verifies the configuration impact on a port.

This example shows how to enable loop guard globally:

```
Switch(config)# spanning-tree loopguard default
Switch(config)# Ctrl-Z
```

This example shows how to verify the previous configuration of port 4/4:

```
Switch# show spanning-tree interface fastEthernet 4/4 detail
Port 196 (FastEthernet4/4) of VLAN0010 is forwarding
  Port path cost 1000, Port priority 160, Port Identifier 160.196.
  Designated root has priority 32768, address 00d0.00b8.140a
  Designated bridge has priority 32768, address 00d0.00b8.140a
  Designated port id is 160.196, designated path cost 0
  Timers:message age 0, forward delay 0, hold 0
  Number of transitions to forwarding state:1
  The port is in the portfast mode by portfast trunk configuration
  Link type is point-to-point by default
  Bpdu filter is enabled
  Loop guard is enabled by default on the port
  BPDU:sent 0, received 0
```

To enable loop guard on an interface, perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>interface</b> {type slot/port}   {port-channel port_channel_number}	Selects an interface to configure.
Step 2	Switch(config-if)# <b>spanning-tree guard loop</b>	Configures loop guard.
Step 3	Switch(config)# <b>end</b>	Exits configuration mode.
Step 4	Switch# <b>show spanning tree interface 4/4 detail</b>	Verifies the configuration impact on that port.

This example shows how to enable loop guard on port 4/4:

```
Switch(config)# interface fastEthernet 4/4
Switch(config-if)# spanning-tree guard loop
Switch(config-if)# ^Z
```

This example shows how to verify the configuration impact on port 4/4:

```
Switch# show spanning-tree interface fastEthernet 4/4 detail
Port 196 (FastEthernet4/4) of VLAN0010 is forwarding
  Port path cost 1000, Port priority 160, Port Identifier 160.196.
  Designated root has priority 32768, address 00d0.00b8.140a
  Designated bridge has priority 32768, address 00d0.00b8.140a
  Designated port id is 160.196, designated path cost 0
  Timers:message age 0, forward delay 0, hold 0
  Number of transitions to forwarding state:1
  The port is in the portfast mode by portfast trunk configuration
  Link type is point-to-point by default
  Bpdu filter is enabled
  Loop guard is enabled on the port
  BPDU:sent 0, received 0
Switch#
```

## About EtherChannel Guard

EtherChannel guard allows you to detect an EtherChannel misconfiguration between the switch and a connected device. A misconfiguration can occur if the interfaces of a switch are manually configured in an EtherChannel, and one or more interfaces on the other device are not. For EtherChannel configuration guidelines, see the “[EtherChannel Configuration Guidelines and Restrictions](#)” section on page 24-5.



### Note

EtherChannel guard applies only to EtherChannels in forced mode (that is, manually configured) rather than through PAgP or LACP.

If the switch detects a misconfiguration on the other device, EtherChannel guard error-disables all interfaces in the EtherChannel bundle, and displays an error message.

You can enable this feature with the **spanning-tree etherchannel guard misconfig** global configuration command.

## Enabling EtherChannel Guard (Optional)

You can enable EtherChannel guard to detect an EtherChannel misconfiguration if your switch is running PVST+, rapid PVST+, or MSTP.

To enable EtherChannel guard, perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>configure terminal</b>	Enters global configuration mode.
Step 2	Switch(config)# <b>spanning-tree etherchannel guard misconfig</b>	Enables EtherChannel guard.
Step 3	Switch(config)# <b>end</b>	Returns to privileged EXEC mode.
Step 4	Switch(config)# <b>show spanning-tree summary</b>	Verifies your entries.
Step 5	Switch(config)# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

To disable the EtherChannel guard feature, use the **no spanning-tree etherchannel guard misconfig** global configuration command.

Use the **show interfaces status err-disabled** privileged EXEC command to show which switch ports are disabled because of an EtherChannel misconfiguration. On the remote device, you can enter the **show etherchannel summary** privileged EXEC command to verify the EtherChannel configuration.

After the configuration is corrected, enter the **shutdown** and **no shutdown** interface configuration commands on the port-channel interfaces that were misconfigured.

## About PortFast

Spanning Tree PortFast causes an interface configured as a Layer 2 access port to enter the forwarding state immediately, bypassing the listening and learning states. Use PortFast on Layer 2 access ports connected to a single workstation or server to allow those devices to connect to the network immediately, rather than waiting for spanning tree to converge. Even if the interface receives a bridge protocol data

unit (BPDU), spanning tree does not place the port into the blocking state. Spanning tree sets the port's operating state to *non-port fast* even if the configured state remains *port fast* and starts participating in the topology change.

**Note**

Because the purpose of PortFast is to minimize the time that access ports must wait for spanning tree to converge, it is most effective when used on access ports. If you enable PortFast on a port connecting to another switch, you risk creating a spanning tree loop.

## Enabling PortFast

**Caution**

Use PortFast *only* when connecting a single end station to a Layer 2 access port. Otherwise, you might create a network loop.

To enable PortFast on a Layer 2 access port to force it to enter the forwarding state immediately, perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>interface</b> {{fastethernet   gigabitethernet   tengigabitethernet} slot/port}   {port-channel port_channel_number}	Specifies an interface to configure.
Step 2	Switch(config-if)# [no] <b>spanning-tree portfast</b>	Enables PortFast on a Layer 2 access port connected to a single workstation or server. Use the <b>no</b> keyword to disable PortFast.
Step 3	Switch(config-if)# <b>end</b>	Exits configuration mode.
Step 4	Switch# <b>show running interface</b> {{fastethernet   gigabitethernet   tengigabitethernet} slot/port}   {port-channel port_channel_number}	Verifies the configuration.

This example shows how to enable PortFast on Fast Ethernet interface 5/8:

```
Switch(config)# interface fastethernet 5/8
Switch(config-if)# spanning-tree portfast
Switch(config-if)# end
Switch#
```

This example shows how to verify the configuration:

```
Switch# show running-config interface fastethernet 5/8
Building configuration...

Current configuration:
!
interface FastEthernet5/8
 no ip address
 switchport
 switchport access vlan 200
 switchport mode access
 spanning-tree portfast
end

Switch#
```

## About BPDU Guard

Spanning Tree BPDU guard shuts down PortFast-configured interfaces that receive BPDUs, rather than putting them into the spanning tree blocking state. In a valid configuration, PortFast-configured interfaces do not receive BPDUs. Reception of a BPDU by a PortFast-configured interface signals an invalid configuration, such as connection of an unauthorized device. BPDU guard provides a secure response to invalid configurations, because the administrator must manually put the interface back in service.



### Note

When the BPDU guard feature is enabled, spanning tree applies the BPDU guard feature to all PortFast-configured interfaces.



### Note

To prevent the port from shutting down, use the **errdisable detect cause bpduguard shutdown vlan** global configuration command to shut down only the offending VLAN on the port where the violation occurred.

## Enabling BPDU Guard

To enable BPDU guard to shut down PortFast-configured interfaces that receive BPDUs, perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>[no] spanning-tree portfast bpduguard</b>	Enables BPDU guard on all the switch's PortFast-configured interfaces.  Use the <b>no</b> keyword to disable BPDU guard.
Step 2	Switch(config)# <b>end</b>	Exits configuration mode.
Step 3	Switch# <b>show spanning-tree summary totals</b>	Verifies the BPDU configuration.

This example shows how to enable BPDU guard:

```
Switch(config)# spanning-tree portfast bpduguard
Switch(config)# end
Switch#
```

This example shows how to verify the BPDU configuration:

```
Switch# show spanning-tree summary totals
```

```
Root bridge for: none.
PortFast BPDU Guard is enabled
Etherchannel misconfiguration guard is enabled
UplinkFast is disabled
BackboneFast is disabled
Default pathcost method used is short
```

```
Name                               Blocking Listening Learning Forwarding STP Active
-----
34 VLANs 0                         0             0             36           36
Switch#
```



## About PortFast BPDUs Filtering

Cisco IOS Release 12.2(25)EW and later support PortFast BPDUs filtering, which allows the administrator to prevent the system from sending or even receiving BPDUs on specified ports.

When configured globally, PortFast BPDUs filtering applies to all operational PortFast ports. Ports in an operational PortFast state are supposed to be connected to hosts that typically drop BPDUs. If an operational PortFast port receives a BPDUs, it immediately loses its operational PortFast status. In that case, PortFast BPDUs filtering is disabled on this port and STP resumes sending BPDUs on this port.

PortFast BPDUs filtering can also be configured on a per-port basis. When PortFast BPDUs filtering is explicitly configured on a port, it does not send any BPDUs and drops all BPDUs it receives.



### Caution

Explicitly configuring PortFast BPDUs filtering on a port that is not connected to a host can result in bridging loops, because the port ignores any BPDUs it receives and goes to the forwarding state.

When you enable PortFast BPDUs filtering globally and set the port configuration as the default for PortFast BPDUs filtering (see the “[Enabling BackboneFast](#)” section on page 23-15), PortFast enables or disables PortFast BPDUs filtering.

If the port configuration is not set to default, then the PortFast configuration does not affect PortFast BPDUs filtering. [Table 23-1](#) lists all the possible PortFast BPDUs filtering combinations. PortFast BPDUs filtering allows access ports to move directly to the forwarding state as soon as the end hosts are connected.

**Table 23-1 PortFast BPDUs Filtering Port Configurations**

Per-Port Configuration	Global Configuration	PortFast State	PortFast BPDUs Filtering State
Default	Enable	Enable	Enable <sup>1</sup>
Default	Enable	Disable	Disable
Default	Disable	Not applicable	Disable
Disable	Not applicable	Not applicable	Disable
Enable	Not applicable	Not applicable	Enable

1. The port transmits at least 10 BPDUs. If this port receives any BPDUs, then PortFast and PortFast BPDUs filtering are disabled.

## Enabling PortFast BPDUs Filtering

To enable PortFast BPDUs filtering globally, perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>spanning-tree portfast bpdudfilter default</b>	Enables BPDUs filtering globally on the switch.
Step 2	Switch# <b>show spanning-tree summary totals</b>	Verifies the BPDUs configuration.

This example shows how to enable PortFast BPDUs filtering on a port:

```
Switch(config)# spanning-tree portfast bpdudfilter default
```

```
Switch(config)# Ctrl-Z
```

This example shows how to verify the BPDU configuration in PVST+ mode:

```
Switch# show spanning-tree summary totals
Root bridge for:VLAN0010
EtherChannel misconfiguration guard is enabled
Extended system ID is disabled
Portfast is enabled by default
PortFast BPDU Guard is disabled by default
Portfast BPDU Filter is enabled by default
Loopguard is disabled by default
UplinkFast is disabled
BackboneFast is disabled
Pathcost method used is long

Name                               Blocking Listening Learning Forwarding STP Active
-----
2 vlans                            0           0           0           3           3

Switch#
```

**Note**

For PVST+ information, see [Chapter 20, “Configuring STP and MST.”](#)

To enable PortFast BPDU filtering, perform this task:

	Command	Purpose
<b>Step 1</b>	Switch(config)# <b>interface fastEthernet 4/4</b>	Selects the interface to configure.
<b>Step 2</b>	Switch(config-if)# <b>spanning-tree bpdupfilter enable</b>	Enables BPDU filtering.
<b>Step 3</b>	Switch# <b>show spanning-tree interface fastethernet 4/4</b>	Verifies the configuration.

This example shows how to enable PortFast BPDU filtering on port 4/4:

```
Switch(config)# interface fastethernet 4/4
Switch(config-if)# spanning-tree bpdupfilter enable
Switch(config-if)# ^Z
```

This example shows how to verify that PortFast BPDU filtering is enabled:

```
Switch# show spanning-tree interface fastethernet 4/4

Vlan          Role Sts Cost      Prio.Nbr Status
-----
VLAN0010      Desg FWD 1000     160.196 Edge P2p
```

This example shows more detail on the port:

```
Switch# show spanning-tree interface fastEthernet 4/4 detail
Port 196 (FastEthernet4/4) of VLAN0010 is forwarding
  Port path cost 1000, Port priority 160, Port Identifier 160.196.
  Designated root has priority 32768, address 00d0.00b8.140a
  Designated bridge has priority 32768, address 00d0.00b8.140a
  Designated port id is 160.196, designated path cost 0
  Timers:message age 0, forward delay 0, hold 0
  Number of transitions to forwarding state:1
  The port is in the portfast mode by portfast trunk configuration
  Link type is point-to-point by default
  Bpdu filter is enabled
  BPDU:sent 0, received 0
```

Switch#

## About UplinkFast



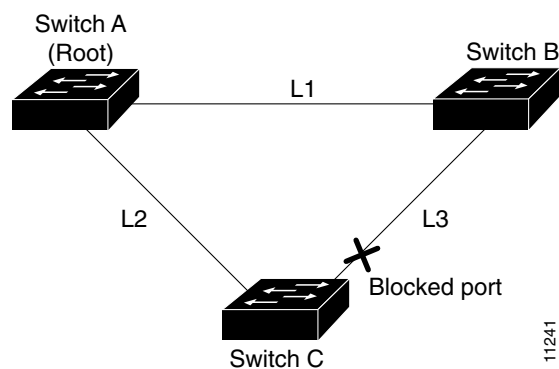
### Note

UplinkFast is most useful in wiring-closet switches. This feature might not be useful for other types of applications.

Spanning Tree UplinkFast provides fast convergence after a direct link failure and uses uplink groups to achieve load balancing between redundant Layer 2 links. Convergence is the speed and ability of a group of internetworking devices running a specific routing protocol to agree on the topology of an internetwork after a change in that topology. An uplink group is a set of Layer 2 interfaces (per VLAN), only one of which is forwarding at any given time. Specifically, an uplink group consists of the root port (which is forwarding) and a set of blocked ports, except for self-looping ports. The uplink group provides an alternate path in case the currently forwarding link fails.

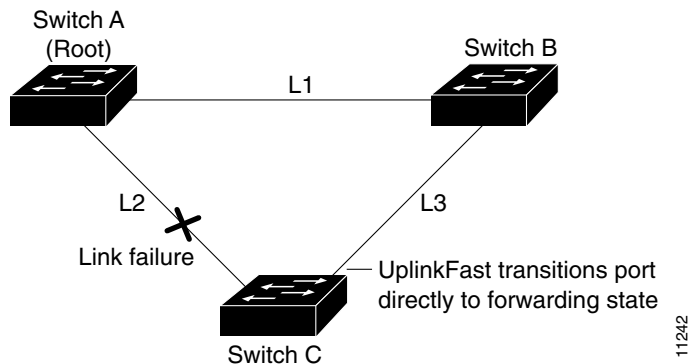
Figure 23-2 shows an example of a topology with no link failures. Switch A, the root switch, is connected directly to Switch B over link L1 and to Switch C over link L2. The Layer 2 interface on Switch C that is connected directly to Switch B is in the blocking state.

**Figure 23-2 UplinkFast Before Direct Link Failure**



If Switch C detects a link failure on the currently active link L2 on the root port (a direct link failure), UplinkFast unblocks the blocked port on Switch C and transitions it to the forwarding state without going through the listening and learning states, as shown in Figure 23-3. This switchover takes approximately one to five seconds.

Figure 23-3 UplinkFast After Direct Link Failure



## Enabling UplinkFast

UplinkFast increases the bridge priority to 49,152 and adds 3000 to the spanning tree port cost of all interfaces on the switch, making it unlikely that the switch becomes the root switch. The *max\_update\_rate* value represents the number of multicast packets transmitted per second (the default is 150 packets per second [pps]).

UplinkFast cannot be enabled on VLANs that have been configured for bridge priority. To enable UplinkFast on a VLAN with bridge priority configured, restore the bridge priority on the VLAN to the default value by entering a **no spanning-tree vlan *vlan\_ID* priority** command in global configuration mode.



### Note

When you enable UplinkFast, it affects all VLANs on the switch. You cannot configure UplinkFast on an individual VLAN.

To enable UplinkFast, perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>[no] spanning-tree uplinkfast</b> <b>[max-update-rate max_update_rate]</b>	Enables UplinkFast. Use the <b>no</b> keyword to disable UplinkFast and restore the default rate, use the command.
Step 2	Switch(config)# <b>end</b>	Exits configuration mode.
Step 3	Switch# <b>show spanning-tree vlan <i>vlan_ID</i></b>	Verifies that UplinkFast is enabled on that VLAN.

This example shows how to enable UplinkFast with a maximum update rate of 400 pps:

```
Switch(config)# spanning-tree uplinkfast max-update-rate 400
Switch(config)# exit
Switch#
```

This example shows how to verify which VLANs have UplinkFast enabled:

```
Switch# show spanning-tree uplinkfast
UplinkFast is enabled
```

```

Station update rate set to 150 packets/sec.

UplinkFast statistics
-----
Number of transitions via uplinkFast (all VLANs)           :14
Number of proxy multicast addresses transmitted (all VLANs) :5308

Name                Interface List
-----
VLAN1                Fa6/9(fwd) , Gi5/7
VLAN2                Gi5/7(fwd)
VLAN3                Gi5/7(fwd)
VLAN4
VLAN5
VLAN6
VLAN7
VLAN8
VLAN10
VLAN15
VLAN1002            Gi5/7(fwd)
VLAN1003            Gi5/7(fwd)
VLAN1004            Gi5/7(fwd)
VLAN1005            Gi5/7(fwd)
Switch#

```

## About BackboneFast

BackboneFast is a complementary technology to UplinkFast. UplinkFast is designed to quickly respond to failures on links directly connected to leaf-node switches, but it does not help with indirect failures in the backbone core. BackboneFast optimizes the topology based on the Max Age setting. It allows the default convergence time for indirect failures to be reduced from 50 seconds to 30 seconds. However, it never eliminates forward delays and offers no assistance for direct failures.



### Note

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BackboneFast should be enabled on every switch in your network.

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Sometimes a switch receives a BPDU from a designated switch that identifies the root bridge and the designated bridge as the same switch. Because this should not happen, the BPDU is considered inferior.

BPDUs are considered inferior when a link from the designated switch has lost its link to the root bridge. The designated switch transmits the BPDUs with the information that it is now the root bridge as well as the designated bridge. The receiving switch ignores the inferior BPDU for the time defined by the Max Age setting.

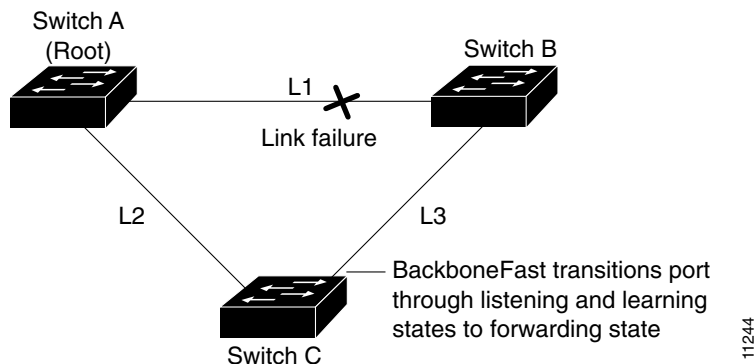
After receiving inferior BPDUs, the receiving switch tries to determine if there is an alternate path to the root bridge.

- If the port that the inferior BPDUs are received on is already in blocking mode, then the root port and other blocked ports on the switch become alternate paths to the root bridge.
- If the inferior BPDUs are received on a root port, then all presently blocking ports become the alternate paths to the root bridge. Also, if the inferior BPDUs are received on a root port and no other blocking ports exist on the switch, the receiving switch assumes that the link to the root bridge is down and the time defined by the Max Age setting expires, which turns the switch into the root switch.

If the switch finds an alternate path to the root bridge, it uses this new alternate path. This new path, and any other alternate paths, are used to send a Root Link Query (RLQ) BPDU. When BackboneFast is enabled, the RLQ BPDUs are sent out as soon as an inferior BPDU is received. This process can enable faster convergence in the event of a backbone link failure.

Figure 23-4 shows an example of a topology with no link failures. Switch A, the root switch, connects directly to Switch B over link L1 and to Switch C over link L2. In this example, because switch B has a lower priority than A but higher than C, switch B becomes the designated bridge for L3. Consequently, the Layer 2 interface on Switch C that connects directly to Switch B must be in the blocking state.

**Figure 23-4 BackboneFast Before Indirect Link Failure**



Next, assume that L1 fails. Switch A and Switch B, the switches directly connected to this segment, instantly know that the link is down. The blocking interface on Switch C must enter the forwarding state for the network to recover. However, because L1 is not directly connected to Switch C, Switch C does not start sending any BPDUs on L3 under the normal rules of STP until the time defined by the Max Age setting has expired.

In an STP environment without BackboneFast, if L1 should fail, Switch C cannot detect this failure because it is not connected directly to link L1. However, because Switch B is directly connected to the root switch over L1, Switch B detects the failure and elects itself the root. Switch B begins sending configuration BPDUs to Switch C, listing itself as the root.

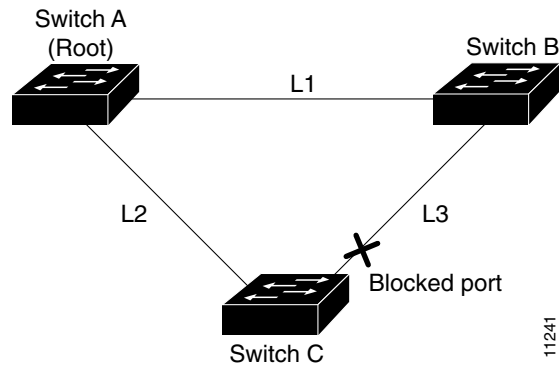
The following actions also occur when you use BackboneFast to eliminate the time defined by the Max Age setting (20-second) delay:

1. When Switch C receives the inferior configuration BPDUs from Switch B, Switch C infers that an indirect failure has occurred.
2. Switch C then sends out an RLQ.
3. Switch A receives the RLQ. Because Switch A is the root bridge, it replies with an RLQ response, listing itself as the root bridge.
4. When Switch C receives the RLQ response on its existing root port, it knows that it still has a stable connection to the root bridge. Because Switch C originated the RLQ request, it does not need to forward the RLQ response on to other switches.
5. BackboneFast allows the blocked port on Switch C to move immediately to the listening state without waiting for the time defined by the Max Age setting for the port to expire.
6. BackboneFast transitions the Layer 2 interface on Switch C to the forwarding state, providing a path from Switch B to Switch A.

This switchover takes approximately 30 seconds, twice the Forward Delay time if the default forward delay time of 15 seconds is set.

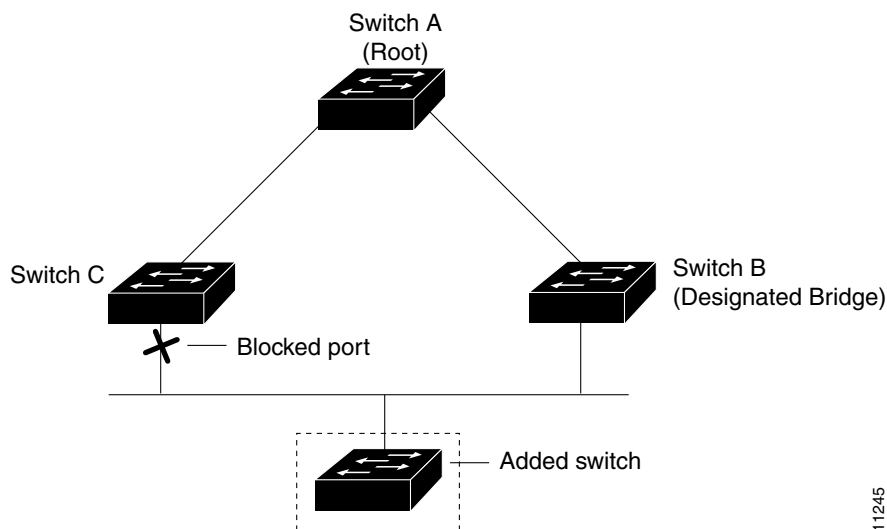
Figure 23-5 shows how BackboneFast reconfigures the topology to account for the failure of link L1.

Figure 23-5 BackboneFast after Indirect Link Failure



If a new switch is introduced into a shared-medium topology as shown in Figure 23-6, BackboneFast is not activated, because the inferior BPDUs did not come from the recognized designated bridge (Switch B). The new switch begins sending inferior BPDUs that say it is the root switch. However, the other switches ignore these inferior BPDUs, and the new switch learns that Switch B is the designated bridge to Switch A, the root switch.

Figure 23-6 Adding a Switch in a Shared-Medium Topology



## Enabling BackboneFast



### Note

For BackboneFast to work, you must enable it on all switches in the network. BackboneFast is supported for use with third-party switches but it is not supported on Token Ring VLANs.

To enable BackboneFast, perform this task:

	Command	Purpose
Step 1	Switch(config)# <b>[no] spanning-tree backbonefast</b>	Enables BackboneFast. Use You can use the <b>no</b> keyword to disable BackboneFast.
Step 2	Switch(config)# <b>end</b>	Exits configuration mode.
Step 3	Switch# <b>show spanning-tree backbonefast</b>	Verifies that BackboneFast is enabled.

This example shows how to enable BackboneFast:

```
Switch(config)# spanning-tree backbonefast
Switch(config)# end
Switch#
```

This example shows how to verify that BackboneFast is enabled:

```
Switch# show spanning-tree backbonefast
BackboneFast is enabled

BackboneFast statistics
-----
Number of transition via backboneFast (all VLANs) : 0
Number of inferior BPDUs received (all VLANs)    : 0
Number of RLQ request PDUs received (all VLANs)  : 0
Number of RLQ response PDUs received (all VLANs) : 0
Number of RLQ request PDUs sent (all VLANs)      : 0
Number of RLQ response PDUs sent (all VLANs)     : 0
Switch#
```

This example shows how to display a summary of port states:

```
Switch#show spanning-tree summary
Root bridge for:VLAN0001, VLAN1002-VLAN1005
Extended system ID is disabled
Portfast is enabled by default
PortFast BPDU Guard is disabled by default
Portfast BPDU Filter is enabled by default
Loopguard is disabled by default
EtherChannel misconfiguration guard is enabled
UplinkFast is enabled
BackboneFast is enabled
Pathcost method used is short

Name                Blocking Listening Learning Forwarding STP Active
-----
VLAN0001            0          0          0          3          3
VLAN1002            0          0          0          2          2
VLAN1003            0          0          0          2          2
VLAN1004            0          0          0          2          2
VLAN1005            0          0          0          2          2
-----
5 vlans              0          0          0          11         11

BackboneFast statistics
-----
Number of transition via backboneFast (all VLANs) :0
Number of inferior BPDUs received (all VLANs)    :0
Number of RLQ request PDUs received (all VLANs)  :0
Number of RLQ response PDUs received (all VLANs) :0
Number of RLQ request PDUs sent (all VLANs)      :0
```



```
Number of RLQ response PDUs sent (all VLANs)          :0
Switch#
```

This example shows how to display the total lines of the spanning tree state section:

```
Switch# show spanning-tree summary totals
Root bridge for:VLAN0001, VLAN1002-VLAN1005
Extended system ID   is disabled
Portfast              is enabled by default
PortFast BPDU Guard  is disabled by default
Portfast BPDU Filter is enabled by default
Loopguard             is disabled by default
EtherChannel misconfiguration guard is enabled
UplinkFast           is enabled
BackboneFast          is enabled
Pathcost method used is short

Name                    Blocking Listening Learning Forwarding STP Active
-----
5 vlans                  0          0          0          11          11

BackboneFast statistics
-----
Number of transition via backboneFast (all VLANs)      :0
Number of inferior BPDUs received (all VLANs)         :0
Number of RLQ request PDUs received (all VLANs)       :0
Number of RLQ response PDUs received (all VLANs)      :0
Number of RLQ request PDUs sent (all VLANs)           :0
Number of RLQ response PDUs sent (all VLANs)          :0
Switch#
```

