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As for BPDU Guard, the **spanning-tree bpduguard enable** interface subcommand applies BPDU Guard logic to the port regardless of whether operating as an access or trunk port and regardless of whether PortFast is used. Once enabled, BPDU Guard uses the following trigger, action, and recovery steps:

- **Trigger:** Any BPDU arrives in a port that has BPDU Guard enabled.
- **Actions:**
  - IOS places the interface into an error disabled (err-disabled) interface state.
  - STP removes the interface from the STP instance because the interface fails—that it, it is no longer up (connected).
- **Recovery:**
  - By default, the interface must be configured first with a **shutdown** command and then with a **no shutdown** command.
  - Alternately, and not discussed here, you can configure error disable recovery parameters to automatically recover the port after some time.

Example 10-8 shows a before-and-after example. It begins with switch SW1 port G1/0/1 as configured in Example 10-7, with both PortFast and BPDU Guard enabled. Example 10-8 begins with port G1/0/1 in an STP port role of Desg (designated) and a port state of FWD (forwarding), as consistent with a port in PortFast mode. It also reveals an interface state of connected. Also, in that first command's output, the highlighted port type of "P2p Edge" has great importance: the word "Edge" appears only if PortFast is both configured and enabled, so it confirms that the port uses PortFast.

Example 10-8 *Example of BPDU Guard Disabling a Port*

```
SW1# show spanning-tree interface g1/0/1
Vlan                Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
VLAN0009            Desg FWD 4         128.1    P2p Edge

SW1# show interfaces g1/0/1 status

Port          Name              Status       Vlan       Duplex  Speed Type
Gi1/0/1       Host A            connected    9          a-full a-1000
10/100/1000BaseTX
SW1#
SW1# ! The cable was removed from the PC and connected to a LAN switch.
SW1#
*Jan 30 17:08:19.024: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEther-
net1/0/1, changed state to down
*Jan 30 17:08:20.024: %LINK-3-UPDOWN: Interface GigabitEthernet1/0/1, changed state
to down
*Jan 30 17:08:30.364: %SPANTREE-2-BLOCK_BPDUGUARD: Received BPDU on port Gi1/0/1
with BPDU Guard enabled. Disabling port.
```

```
*Jan 30 17:08:30.364: %PM-4-ERR_DISABLE: bpduguard error detected on Gi1/0/1, put-
ting Gi1/0/1 in err-disable state
SW1#
SW1# show spanning-tree interface g1/0/1
no spanning tree info available for GigabitEthernet1/0/1

SW1# show interfaces g1/0/1 status

Port          Name               Status       Vlan       Duplex  Speed Type
Gi1/0/1       Host A             err-disabled 9            auto    auto
10/100/1000BaseTX
```

In the middle of the example we replaced the attached PC with a switch. The log messages reveal SW1's port G1/0/1 failing and recovering. As soon as the port came up again, BPDU Guard noticed the incoming BPDUs from the neighboring switch—and disabled the port, as seen in the highlighted log messages.

The bottom of the example repeats the same two **show** commands as the top of the example, revealing the actions taken. The interface state of err-disabled (error disabled) confirms BPDU Guard disabled the interface due to errors. The response from the **show spanning tree interface g1/0/1** command no longer lists information about this port, implying that the interface is no longer part of that spanning tree.

PortFast on VLAN Trunks and Voice Pseudo-Trunks

Cisco IOS also supports PortFast on trunk ports. You should not use PortFast on trunk ports connected to other switches, but you can use it on trunk ports connected to endpoints, as seen in the center of Figure 10-8. You can also use it on the pseudo-trunk created for voice ports connected to IP phones, as seen in port G1/0/3 in the figure. (For a review of voice VLAN configuration, refer to Chapter 8's section titled "Data and Voice VLAN Configuration and Verification.")

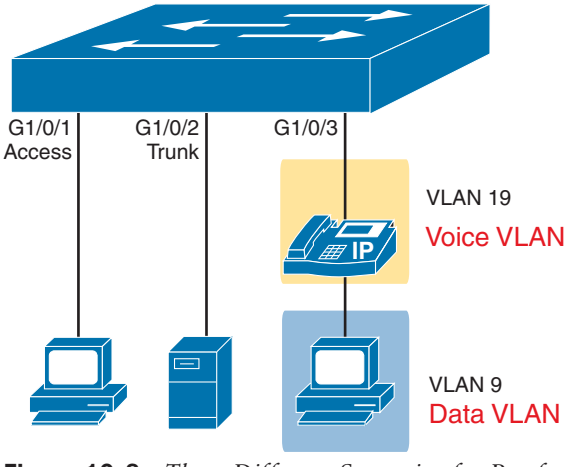

Figure 10-8 *Three Different Scenarios for Portfast and BPDU Guard*

The PortFast configuration for the voice port looks identical to the access ports. The only small difference happens with IOS automatically adding the **spanning-tree portfast** interface subcommand when you first configure the voice VLAN using the **switchport voice vlan** *vlan-id* interface subcommand.

Note that the **spanning-tree portfast** interface subcommand requires IOS to decide whether to apply PortFast logic or not, based on whether the command does or does not include the **trunk** keyword. The logic is:

spanning-tree portfast: Use PortFast if the port operates as an access port.

spanning-tree portfast trunk: Use PortFast if the port operates as a trunk.

Example 10-9 shows the configuration for switch SW1 port G1/0/2, attached via a trunk to a server. Note the different warning message in Example 10-9 versus Example 10-7's sample configuration.

Example 10-9 *Configuring Portfast and BPDU Guard on a Trunk*

```
SW1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SW1(config)# interface g1/0/2
SW1(config-if)# switchport mode trunk
SW1(config-if)# spanning-tree portfast trunk
%Warning: portfast should only be enabled on ports connected to a single
 host. Connecting hubs, concentrators, switches, bridges, etc... to this
 interface  when portfast is enabled, can cause temporary bridging loops.
 Use with CAUTION
SW1(config-if)# spanning-tree bpduguard enable
SW1(config-if)#
```

You must be ready to discover whether IOS decided to apply PortFast logic to a port. To do so, use the **show spanning-tree** command (without the **interface** keyword) as seen in Example 10-10. The lower part of the command output lists one line per interface for all interfaces active in that spanning tree, including both access and trunk links. The value under the Type heading in the **show spanning-tree** command output reveals whether PortFast is being used:

- **P2p Edge:** Port operates with PortFast logic
- **P2p (without "Edge"):** Port does not use PortFast logic

Example 10-10 *Confirming Portfast with Port Type Edge*

```
SW1# show spanning-tree vlan 9 | begin Interface
Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Gi1/0/1             Desg FWD 4         128.1    P2p Edge
Gi1/0/2             Desg FWD 4         128.2    P2p Edge
Gi1/0/3             Desg FWD 4         128.3    P2p Edge
Gi1/0/23            Desg FWD 4         128.23   P2p
Te1/1/1             Desg FWD 2         128.25   P2p
```

Global Configuration of PortFast and BPDU Guard

The configuration examples so far use interface subcommands that override any global settings. IOS defaults to global settings whose values disable both features per port; however, you can enable each feature globally. For interfaces with no related subcommands, IOS enables the feature on the interface. Then, you should identify the interfaces for which the feature should be disabled and use another interface subcommand to disable the feature per interface, as needed.

For example, consider an access layer switch with 48 access ports connected to endpoints, plus two trunk ports connected to other switches. You probably want to enable both PortFast and BPDU Guard on all 48 access ports. Rather than requiring the interface subcommands on all 48 of those ports, enable both the features globally, and then disable them on the uplink ports.

First, consider PortFast. Configuring the **spanning-tree portfast bpduguard default** global command tells IOS to apply PortFast to some ports, based on the following conditions:

- Enable PortFast on ports operating as access ports only.
- Ignore ports configured to disable PortFast with the **spanning-tree portfast disable** interface subcommand.

To see that logic in action, work through the examples in Figure 10-9. The switch uses the global command **spanning-tree portfast default**. Port G1/0/11 has no **spanning-tree portfast** subcommands and is configured to be an access port, so IOS applies PortFast to that port. However, port G1/0/12 has a **spanning-tree portfast disable** subcommand, so IOS does not apply PortFast. Port G1/0/13 fails to meet the required conditions because it uses trunking.

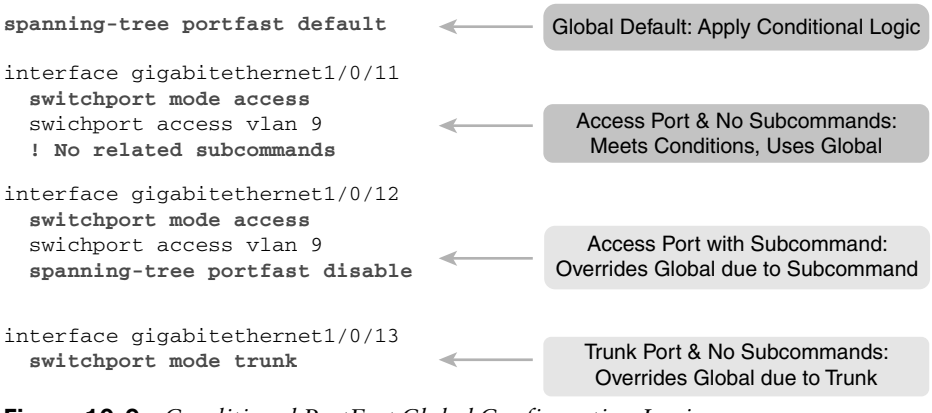

Figure 10-9 *Conditional PortFast Global Configuration Logic*

IOS also supports a similar configuration process for BPDU Guard, but with this configuration, BPDU Guard is tied to PortFast. You configure the **spanning-tree portfast bpduguard default** global command. Doing so asks IOS to enable BPDU Guard under these conditions:

- Enable BPDU Guard on ports that currently use PortFast.
- Ignore ports configured to disable BPDU Guard with the **spanning-tree bpduguard disable** interface subcommand.

For the exam, interpreting **show** command output might be more important than the intricacies of the configuration. For example, exam topic 2.5, the only one that mentions STP features, uses the verb *interpret* rather than *configure* or *verify*. So, be ready to interpret **show** command output and even predict the related configuration.

As an example of determining the configuration from the **show** commands, consider interfaces G1/0/7 and G1/0/8 on switch SW1. The configuration (not shown) uses this convention:

- **G1/0/7:** Uses interface subcommands **spanning-tree portfast** and **spanning-tree bpduguard enable**, not relying on the global configuration commands.
- **G1/0/8:** Uses no relevant interface subcommands, instead relying on the global configuration commands **spanning-tree portfast default** and **spanning-tree portfast bpduguard default**.

Example 10-11 shows truncated output from the **show spanning-tree interface** command for both interfaces. Compare the highlighted lines about PortFast and BPDU Guard to see the different information. On port G1/0/8, the phrase "by default" confirms that G1/0/8 uses the default setting per the global command. The absence of "by default" in the output for port G1/0/7 means those settings come from interface subcommands.

Example 10-11 *Interpreting the Source of PortFast and BPDU Guard Configuration*

```
SW1# show spanning-tree interface g1/0/7 detail | begin portfast
   The port is in the portfast mode
   Link type is point-to-point by default
   Bpdu guard is enabled
   BPDU: sent 387, received 0

SW1# show spanning-tree interface g1/0/8 detail | begin portfast
   The port is in the portfast mode by default
   Link type is point-to-point by default
   Bpdu guard is enabled by default
   BPDU: sent 774, received 0
```

BPDU Filter

In Chapter 9's section about this same topic, also titled "BPDU Filter," you learned about the two different logic branches of this feature. To review:

1. Using a global configuration command, enable BPDU Filter, after which IOS applies BPDU Filter on PortFast ports only. While applied, it monitors for incoming BPDUs. When incoming BPDUs occur, BPDU Filter disables PortFast logic, so that the port then uses normal STP logic on the port.
2. Using an interface subcommand, enable BPDU filter on the port. BPDU Filter discards all outgoing and incoming BPDUs on the port, effectively disabling STP on the port.

This section examines both logic branches in order.

Conditional BPDU Filtering with Global Configuration

To enable the conditional logic of BPDU Filter, you must toggle from the default global setting of **no spanning-tree portfast bpdufilter default** to the same command without the **no** option: the **spanning-tree portfast bpdufilter default** global command.

Similar to the effect of the **spanning-tree portfast bpduguard default** global command, the **spanning-tree portfast bpdufilter default** global command asks IOS to enable BPDU Filter under these conditions:

- Enable BPDU Filter on ports that currently use PortFast.
- Ignore ports configured to disable BPDU Filter with the **spanning-tree bpdufilter disable** interface subcommand.

Example 10-12 shows a straightforward scenario on switch SW1 port G1/0/23. It shows a classic access port, in VLAN 9, with PortFast enabled with an interface subcommand—along with conditional BPDU Filter enabled globally.

Example 10-12 *BPDU Filter as Global Default, Applied to Port G1/0/23*

```
spanning-tree portfast bpdufilter default
!
interface GigabitEthernet1/0/23
  switchport mode access
  switchport access vlan 9
  spanning-tree portfast
  ! No BPDU Filter subcommands present
```

You should be ready to think about the configuration and understand the rules IOS applies—and to also see the evidence of the choices in IOS command output. First, to review how IOS interprets and applies the configuration:

- The combination of port G1/0/23 as an access port (from the **switchport mode access** subcommand), with the command to enable PortFast on access ports (the **spanning-tree portfast** subcommand without the **trunk** keyword), enables PortFast.
- The one global command tells IOS to find current PortFast ports (no matter whether access or trunk port) and enable BPDU Filter conditional logic.

Example 10-13 shows evidence of these listed results, while an endpoint connects to the port rather than a rogue switch. Look for the following:

1. The first command, **show spanning-tree**, lists interfaces in the tree for that VLAN. It lists the port type for G1/0/23 as P2p Edge—the word Edge confirms that the port currently uses Portfast.
2. The final command, in the final line, lists a counter of 11 sent BPDUs and 0 received. That confirms the switch sent 11 Hellos before BPDU Filter stopped sending them after 20 seconds. If nothing changes, the received BPDU counter remains at 0 because the attached endpoint device does not send BPDUs to the switch.