

STP Optional Characteristic Configuration

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Chapter 1 Configuring STP Optional Characteristic

1.1 STP Optional Characteristic Introduction

The spanning tree protocol module of the switch supports seven additional features (the so-called optional features). These features are not configured by default. The supported condition of various spanning tree protocol modes towards the optional characteristics is as follows:

Optional Characteristic	Single STP	PVST	RSTP	MSTP
Port Fast	Yes	Yes	No	No
BPDU Guard	Yes	Yes	Yes	Yes
BPDU Filter	Yes	Yes	No	No
Uplink Fast	Yes	Yes	No	No
Backbone Fast	Yes	Yes	No	No
Root Guard	Yes	Yes	Yes	Yes
Loop Guard	Yes	Yes	Yes	Yes

1.1.1 Port Fast

Port Fast immediately brings an interface configured as an access or trunk port to the forwarding state from a blocking state, bypassing the listening and learning states. You can use Port Fast on interfaces connected to a single workstation or server, to allow those devices to immediately connect to the network, rather than waiting for the spanning tree to converge.

Interfaces connected to a single workstation or server should not receive bridge protocol data units (BPDUs). An interface with Port Fast enabled goes through the normal cycle of spanning-tree status changes when the switch is restarted. If Port Fast is configured on a Port connected to a switch, it is possible to create a loop.

The Port Fast feature can be set in either global or Port configuration mode. If configured in global mode, all ports will be considered as Port Fast ports and will quickly enter the Forwarding state. It's also easier to create loops. To prevent network loops from being created by configuring the Port Fast function, you can use the BPDU Guard or BPDU Filter features to protect the ports.

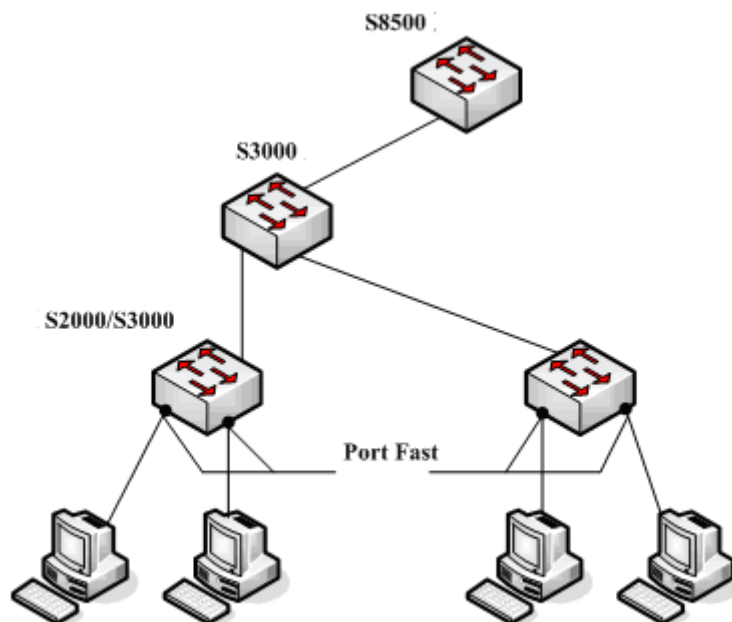


Figure 1.1 Port Fast

Note:

For the rapid convergent spanning tree protocol, RSTP and MSTP, can immediately bring an interface to the forwarding state, and therefore there is no need to use Port Fast feature.

1.1.2 BPDU Guard

If a Port Fast-enabled port receives a BPDU, it can be attributed to a bad network configuration. The BPDU Guard feature passively protects the port after it receives a BPDU.

BPDU Guard behaves differently under different spanning tree protocols. In SSTP/PVST mode, a Port Fast-enabled port that is also configured with the BPDU Guard is forced to shutdown once receiving the BPDU, after which the user can only manually configure it to recover. In RSTP/MSTP mode, a normal port configured with BPDU Guard will be set to a Blocking state for a period of time if it receives a BPDU.

The BPDU Guard feature can be configured independently without Port Fast. In all spanning tree protocol modes, a port configured with the BPDU Guard feature will still send the BPDU, and also receive and process the BPDU. In RSTP/MSTP mode, configuring the BPDU Guard on the port can prevent these devices connected to the switch from receiving BPDU.

The BPDU Guard feature can be configured in global or port mode. In global mode, using the **spanning tree portfast bpduguard** command will not prevent a port from sending BPDU. It is important to note that in a more complex network, improper use of the BPDU Guard function can result in loops.

1.1.3 BPDU Filter

The BPDU filtering feature can be globally enabled on the switch or can be enabled per interface, but the feature operates with some differences.

In SSTP/PVST mode, if a **Port Fast** port with BPDU filter configured receives the BPDU, the features BPDU Filter and Port Fast at the port will be automatically disabled, resuming the port as a normal port. Before entering the **Forwarding** state, the port must be in the **Listening** state and **Learning** state.

The BPDU Filter feature can be configured in global configuration mode or in port configuration mode. In global configuration mode, run the command **spanning-tree portfast bpdufilter** to block all ports to send BPDU out. The port, however, can still receive and process BPDU.

1.1.4 Uplink Fast

The feature **Uplink Fast** enables new root ports to rapidly enter the **Forwarding** state when the connection between the switch and the root bridge is disconnected.

A complex network always contains multiple layers of devices, as shown in figure 1.2. Both aggregation layer and the access layer of the switch have redundancy connections with the upper layer. These redundancy connections are normally blocked by the STP to avoid loops.

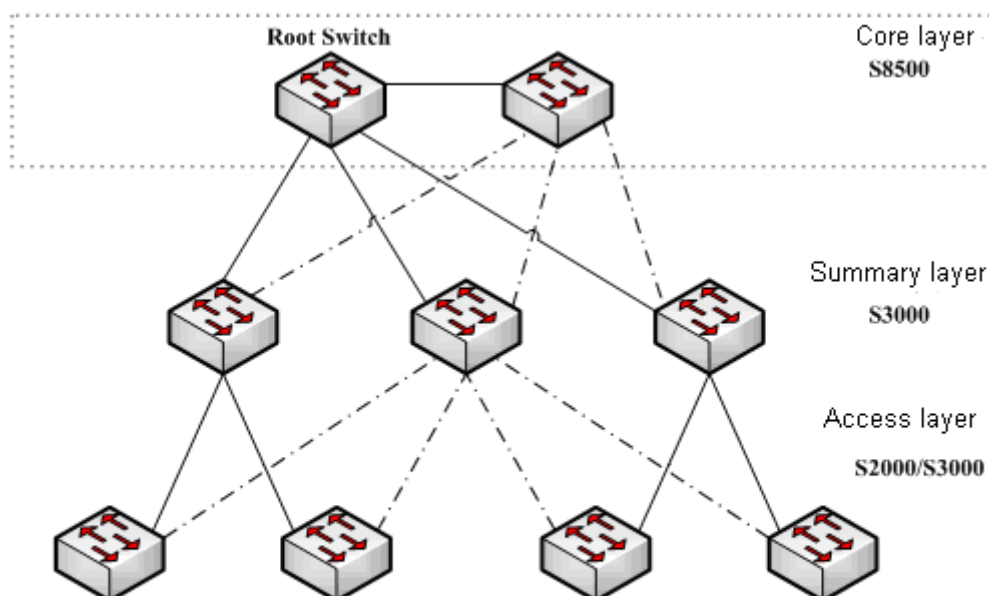


Figure 1.2 Switching network topology

Suppose the connection between a switch and the upper layer is disconnected (called as Direct Link Failure), the STP chooses the Alternate port on the redundancy line as the root port. Before entering the **Forwarding** state, the

Alternate port must be in the **Listening** state and **Learning** state. If the **Uplink Fast** feature is configured by running the command **spanning-tree uplinkfast** in global configuration mode, new root port can directly enter the forwarding state, resuming the connection between the switch and the upper layer.

Figure 1.3 shows the working principle of the **Uplink Fast** feature. The port for switch C to connect switch B is the standby port when the port is in the original state. When the connection between switch C and root switch A is disconnected, the previous **Alternate** port is selected as new root port and immediately starts forwarding.

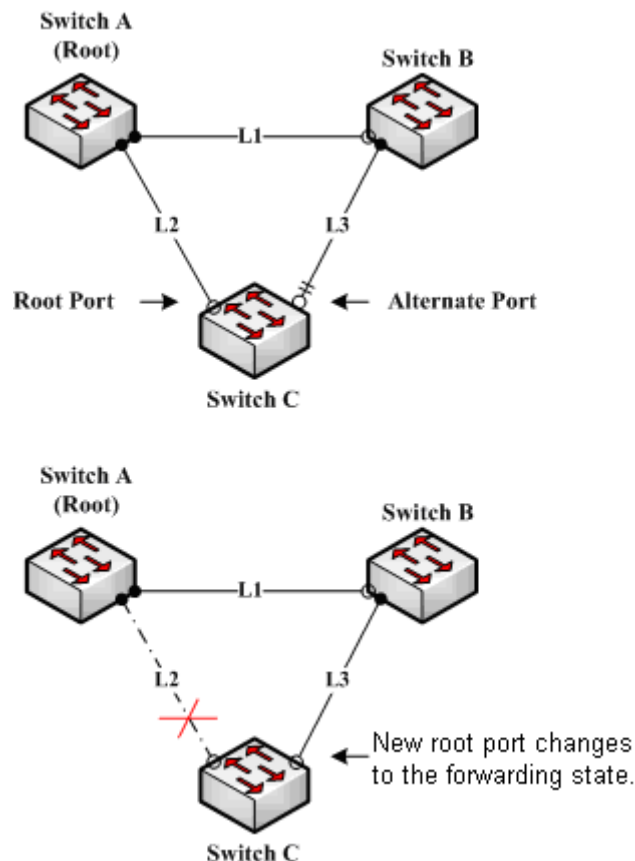


Figure 1.3 Uplink Fast

Note:

The **Uplink Fast** feature adjusts to the slowly convergent SSTP and PVST. In RSTP and MSTP mode, new root port can rapidly enter the Forwarding state without the **Uplink Fast** function.

1.1.5 Backbone Fast

The **Backbone Fast** feature is a supplement of the **Uplink Fast** technology. The **Uplink Fast** technology makes the redundancy line rapidly work in case the direct connection to the designated switch is disconnected, while the **Backbone Fast** technology detects the indirect-link network blackout in the upper-layer network and boosts the change of the port state.

In figure 1.3, Connection L2 between switch C and switch A is called as the direct link between switch C and root switch A. If the connection is disconnected, the

Uplink Fast function can solve the problem. Connection L1 between switches A and B is called as the indirect link of switch C. The disconnected indirect link is called as indirect failure, which is handled by the **Backbone Fast** function.

The working principle of the Backbone Fast function is shown in Figure 1.4.

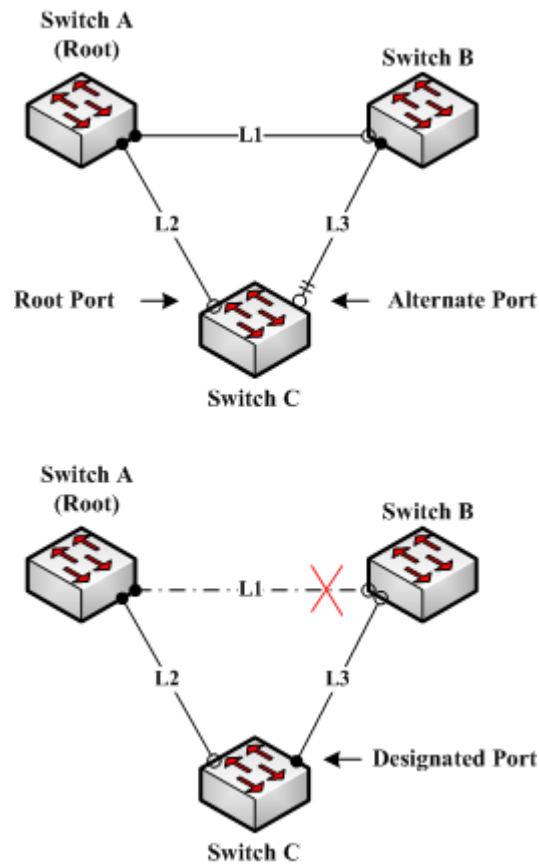


Figure 1.4 Backbone Fast

Suppose the bridge priority of switch C is higher than that of switch B. When L1 is disconnected, switch B is selected to send BPDU to switch C because the bridge priority is used as root priority. To switch C, the information contained by BPDU is not prior to information contained by its own. When Backbone Fast is not enabled, the port between switch C and switch B ages when awaiting the bridge information and then turns to be the designated port. The aging normally takes a few seconds. After the function is configured in global configuration mode by running the command **spanning-tree backbonefast**, when the Alternate port of switch C receives a BPDU with lower priority, switch C thinks that an indirect-link and root-switch-reachable connection on the port is disconnected. Switch C then promptly update the port as the designated port without waiting the aging information.

After the Backbone Fast function is enabled, if BPDU with low priority is received at different ports, the switch will perform different actions. If the Alternate port receives the message, the port is updated to the designated port. If the root port receives the low-priority message and there is no other standby port, the switch turns to be the root switch.

Note that the Backbone Fast feature just omits the time of information aging. New designated port still needs to follow the state change order: the listening state, then the learning state and finally the forwarding state.

Note:

Similar to Uplink Fast, the Backbone Fast feature is effective in SSTP and PVST modes.

1.1.6 Root Guard

The Root Guard feature prevents a port from turning into a root port because of receiving high-priority BPDU.

The Layer 2 network of a service provider (SP) can include many connections to switches that are not owned by the SP. In such a topology, the spanning tree can reconfigure itself and select a customer switch as the root switch, as shown in Figure 17-8. You can avoid this situation by enabling root guard on SP switch interfaces that connect to switches in your customer's network. If spanning-tree calculations cause an interface in the customer network to be selected as the root port, root guard then places the interface in the root-inconsistent (blocked) state to prevent the customer's switch from becoming the root switch or being in the path to the root.

If a switch outside the SP network becomes the root switch, the interface is blocked (root-inconsistent state), and spanning tree selects a new root switch. The customer's switch does not become the root switch and is not in the path to the root.

If the switch is operating in multiple spanning-tree (MST) modes, root guard forces the interface to be a designated port. If a boundary port is blocked in an internal spanning-tree (IST) instance because of root guard, the interface also is blocked in all MST instances. A boundary port is an interface that connects to a LAN, the designated switch of which is either an IEEE 802.1D switch or a switch with a different MST region configuration.

Root guard enabled on an interface applies to all the VLANs to which the interface belongs. VLANs can be grouped and mapped to an MST instance.

You can enable this feature by using the spanning-tree guard root interface configuration command.

Note:

Root Guard feature acts differently somehow in SSTP/PVST and RSTP/MSTP. In SSTP/PVST mode, Root port is always blocked by Root Guard. In RSTP/MSTP mode, Root port won't be blocked until receiving higher level BPDU. A port which formerly plays the Root role will not be blocked.

1.1.7 Loop Guard

You can use loop guard to prevent alternate or root ports from becoming designated ports because of a failure that leads to a unidirectional link. This feature is most effective when it is enabled on the entire switched network. Loop guard prevents alternate and root ports from becoming designated ports, and spanning tree does not send BPDUs on root or alternate ports.

You can enable this feature by using the **spanning-tree loopguard default** global configuration command.

When the switch is operating in PVST+ or rapid-PVST+ mode, loop guard prevents alternate and root ports from becoming designated ports, and spanning tree does not send BPDUs on root or alternate ports.

When the switch is operating in MST mode, BPDUs are not sent on nonboundary ports only if loop guard in all MST instances blocks the interface. On a boundary port, loop guard blocks the interface in all MST instances.

Note:

Loop Guard feature acts differently somehow in SSTP/PVST and RSTP/MSTP. In SSTP/PVST mode, the designated port is always be blocked by Loop Guard. In RSTP/MSTP mode, the port will be blocked only when it changes into the designated port because of inaccessibility to receiving BPDU. Loop Guard will not block a port, which is provided with the designated role due to receiving the lower level BPDU.

1.2 Configuring STP Optional Characteristic

1.2.1 STP Optional Characteristic Configuration Task

- Configuring Port Fast
- Configuring BPDU Guard
- Configuring BPDU Filter
- Configuring Uplink Fast
- Configuring Backbone Fast
- Configuring Root Guard
- Configuring Loop Guard
- Configuring Port Fast
- Configuring Address Table Aging Protection
- Configuring Port Fast
- Configuring Port FastBPDU Terminal

1.2.2 Configuring Port Fast

An interface with the Port Fast feature enabled is moved directly to the spanning-tree forwarding state without waiting for the standard forward-time delay. This function is not valid in other spanning tree modes.

Use the following command to configure the port fast feature in the global configuration mode:

command	purpose
spanning-tree port fast default	Globally enables port fast feature. It is valid to all interfaces.

no spanning-tree portfast default	Globally disables port fast feature. It has no effect on the interface configuration.
--	---

Note:

The port fast feature only applies to the interface that connects to the host. The BPDU Guard or BPDU Filter must be configured at the same time when the port fast feature is configured globally.

Use the following command to configure the port fast feature in the interface configuration mode:

command	purpose
spanning-tree portfast	Enables port fast feature on the interface.
no spanning-tree portfast	Disables port fast feature on the interface. It has no effect on the global configuration.

1.2.3 Configuring BPDU Guard

The BPDU Guard feature passively protects the port after it receives a BPDU, and the port still send BPDU.

BPDU Guard behaves differently under different spanning tree protocols. In SSTP/PVST mode, a Port Fast-enabled port that is also configured with the BPDU Guard is forced to shut down once receiving the BPDU, after which the user can only manually configure it to recover. In RSTP/MSTP mode, a normal port configured with BPDU Guard will be set to a Blocking state for a period of time if it receives a BPDU.

Follow these steps to globally enable the BPDU guard feature:

command	purpose
spanning-tree portfast bpduguard	Globally enables bpu guard feature. It is valid to all interfaces.
no spanning-tree portfast bpduguard	Globally disables bpu guard feature.

Instruction:

Globally enabling port fast feature may result in broadcast storm. The BPDU Guard or BPDU Filter should be configured for protection sake.

Follow these steps to enable the BPDU guard feature in interface configuration mode:

Command	Purpose
spanning-tree bpduguard enable	Enables bpu guard feature on the interface.
spanning-tree bpduguard disable	Disables bpu guard feature on the interface. It has no effect on the global configuration.
no spanning-tree bpduguard	Disables bpu guard feature on the interface. It has no effect on the global configuration.

1.2.4 Configuring BPDU Filter

You should enable BPDU filtering in SSTP/PVST mode so that the interface do not send BPDUs, which is also another protection method for the Port Fast port.

Follow these steps to globally enable the BPDU filter feature.:

Command	Purpose
spanning-tree portfast bpdupfilter	Globally enables bpdu filter feature. It is valid to all interfaces.
no spanning-tree portfast bpdupfilter	Globally disables bpdu filter feature.

Instruction:

Globally enabling port fast feature may result in broadcast storm. The BPDU Guard or BPDU Filter should be configured for protection sake.

Follow these steps to enable the BPDU filter feature in the interface configuration mode :

Command	Purpose
spanning-tree bpdupfilter enable	Enables bpdu filter feature on the interface.
spanning-tree bpdupfilter disable	Disables bpdu filter feature. It has no effect on the global configuration.
no spanning-tree bpdupfilter	Disables bpdu filter feature. It has no influence on the global configuration.

1.2.5 Configuring Uplink Fast

The Uplink Fast feature enables the new root port to quickly enter the Forwarding state when the connection between the switch and the network root bridge is interrupted.

Uplink Fast feature is only valid in SSTP/PVST mode.

Follow these steps to globally enable UplinkFast.:

Command	Purpose
spanning-tree uplinkfast	Enables uplink fast feature.
no spanning-tree uplinkfast	Disables uplink fast feature.

1.2.6 Configuring Backbone Fast

Backbone Fast feature is complementary to Uplink Fast technology. Uplink Fast enables redundant lines to start working quickly when the direct connection to the designated switch is interrupted. Backbone Fast can detect non-directly-connected network interruptions in the upper-layer network and speed up port status changes

Backbone fast feature is only valid in SSTP/PVST mode.

Follow these steps to globally enable BackboneFast.:

Command	Purpose
spanning-tree backbonefast	Enables backbone fast feature.
no spanning-tree backbonefast	Disables backbone fast feature.

1.2.7 Configuring Root Guard

Root Guard feature can prevent a port with a high-priority BPDU from becoming a Root port.

Root Guard feature acts differently somehow in SSTP/PVST and RSTP/MSTP. In SSTP/PVST mode, Root port is always blocked by Root Guard. In RSTP/MSTP mode, Root port won't be blocked until receiving higher level BPDU. A port which formerly plays the Root role will not be blocked.

Follow these steps to enable root guard on an interface:

Command	Purpose
spanning-tree guard root	Enables root guard feature on the interface.
no spanning-tree guard	Disables root guard and loop guard features on the interface.
spanning-tree guard none	Disables root guard and loop guard features on the interface.

1.2.8 Configuring Loop Guard

The Loop Guard feature protects a Root Port or Alternate Port after it becomes a Designated Port. It prevents the port from loops caused by not receiving BPDUs.

Loop Guard feature acts differently somehow in SSTP/PVST. In SSTP/PVST mode, the designated port is always blocked by Loop Guard. In RSTP/MSTP, the designated port is always blocked by Loop Guard. In RSTP/MSTP mode, the port will be blocked only when it changes into the designated port because of inaccessibility to receiving BPDU. A port which is provided with the designated role due to receiving the lower level BPDU will not be blocked by Loop Guard.

Follow these steps to enable loop guard in global configuration mode:

Command	Purpose
spanning-tree loopguard default	Globally enables loop guard feature. It is valid to all interfaces.
no spanning-tree loopguard default	Globally disables loop guard.

Follow these steps to enable loop guard in the interface configuration mode:

Command	Purpose
spanning-tree guard loop	Enables loop guard feature on the interface.
no spanning-tree guard	Disables root guard and loop guard feature on the interface.
spanning-tree guard none	Disables root guard and loop guard on the interface.

1.2.9 Configuring Loop Fast

Notice:

Please use this chapter's configuration command under the technical engineer's instruction.

Loop Fast feature is applied to improve network's convergence performance limitedly under special network environment. For example, this feature is enabled on every port which composes the ring network which is made up of dozens of switches.

Use the following command to configure Loop Fast on all ports under global configuration mode:

Command	Purpose
spanning-tree loopfast	Enabling Loop Fast feature for all ports under global configuration mode
no spanning-tree loopfast	Shutting down Loop Fast under global configuration mode

Use the following commands to configure Loop Fast under port configuration mode:

Command	Purpose
spanning-tree loopfast	Enabling port's Loop Fast Feature
no spanning-tree loopfast	Cancelling all port's Loop Fast Configuration. If configuring global Loop Fast, the feature is still valid on ports.
spanning-tree loopfast disable	Disabling port's Loop Fast

1.2.10 Configuring Address Table Aging Protection

Under the condition of network topology's frequent change, configuring address table aging protection could avoid communication impacted because spanning tree protocol updates MAC address table frequently.

Spanning tree protocol with Fast convergence, like RSTP and MSTP, when detects the change of spanning tree's topology, would do elimination operation on switch's MAC address table, which is deleting old MAC address and accelerating MAC address's update to guarantee the communication could recover rapidly. Under default configuration, our's switch finishes elimination operation by the way of MAC address table's fast aging. For most models of switches, address table's fast aging could finish in one second and have rare effect on CPU's function.

After address table's aging protection function is enabled, STP protocol would initiate timer protection after the first aging. Before timer is overtime (default is 15 seconds), aging would not be processed. If network topology changes within 15 seconds, the protocol would operate the second aging after timer is overtime.

Notice:

STP protocol executive address's aging could be disabled completely by the command **no spanning-tree fast-aging**. Before operating this configuration, please confirm network does not have loop. Otherwise, after network topology changes, terminal devices might need 5 minutes or longer time to regain communication with each other.

Use the following commands to configure address table's aging protection function under global configuration mode:

Command	Purpose
spanning-tree fast-aging	Enabling/disabling address table's aging function.
spanning-tree fast-aging protection	Enabling/disabling address table's aging protection function.
spanning-tree fast-aging protection time	Configuring address table's aging protection time. Within the time, spanning tree can only execute one time of address table's aging. The default is 15 seconds.

Adding no on the above commands can disable the relative configuration.

1.2.11 Configuring FDB-Flush

Notice:

Please use this chapter's configuration command under our's technical engineer's instruction.

OUR'S Switch's rapid spanning tree protocol (RSTP and MSTP) eliminates old MAC address by using the address table's fast aging method not FDB-Flush way under default configuration.

Use the following commands to configure FDB-Flush under global configuration mode:

Command	Purpose
spanning-tree fast-aging flush-fdb	Enabling FDB-Flush
no spanning-tree fast-aging flush-fdb	Disabling FDB-Flush

To be noticed is that FDB-Flush is independent with fast aging function. FDB-Flush could be configured when configuring **no spanning-tree fast-aging**. But fast aging protection function is not valid for FDB-Flush.

1.2.12 Configuring BPDU Terminal

By default, OUR'S's switch will forward the BPDU received when no spanning tree is running. The BPDU Terminal function can disable the forwarding of BPDU when no spanning tree is running.

Use the following commands to configure BPDU Terminal under global configuration mode:

Command	Purpose
spanning-tree bpdu-terminal	Enabling BPDU Terminal.
no spanning-tree bpdu-terminal	Disabling BPDU Terminal.