

Document Name: STP

Spanning Tree Protocol or STP prevents switching loops and defined in the IEEE 802.1d standard. The default port priority is 32768, but it ranges from 0 to 61440. If multiple switches have the same priority the switch with the lowest MAC address is elected as the root bridge. Otherwise, the switch with the lowest priority is elected as the root bridge. The root bridge will not have any root ports as it is the root bridge. Root ports will always be in forwarding mode, thus all ports on a root bridge will be in forwarding mode. Alternatively, ports will be in blocking mode. Enabling a port with portfast the switch will skip from the blocking state directly to the forwarding state.

Port Speed	Cost
10 Gigabit	2
1 Gigabit	4
100 Megabit	19
10 Megabit	100

- **Hello Time** - Defines how often the root bridge originates Hello BPDUs, default is 2 seconds.
- **Forward Delay** - Is the length of the listening and learning port stages, default of 15 seconds for each stage.
- **Maximum Age** - How long a switch retains the superior BPDUs content before discarding it, default is 20 seconds.
- **Root Path Cost** - Cumulative value that reflects the overall cost for the switch to reach the root.

Port States

- **Blocking** - Can't do anything except receive BPDUs.
- **Listening** - First step between blocking and forwarding, can only send and receive BPDUs allowing it to participate in the root bridge election. By default, a port is in the listening state for 15 seconds.
- **Learning** - Is not forwarding frames but is learning MAC addresses and continues to send and receive BPDUs.
- **Forwarding** - Is forwarding frames, learning MAC addresses and sending and receiving BPDUs.
- **Disabled** - Port is shutdown.

BPDUs

Bridge Protocol Data Units or BPDUs are used by switches to identify hierarchy and notify of changes in the topology. It uses destination MAC address 01:80:c2:00:00:00 there are two different types of BPDUs.

- **Configuration BPDUs** – Used to identify the root bridge, root ports, designated ports, and blocking ports. The configuration BPDU consists of the following fields:
 - STP type
 - Root path cost
 - Root bridge identifier
 - Local bridge identifier
 - Max age
 - Hello time
 - Forward delay
- **Topology Change Notification (TCN) BPDUs** – Used to communicate changes in the L2 topology to other switches. These are flooded to switches and they all their MAC address timer to the forwarding delay timer (default of 15 seconds). In doing so the MAC address table is flushed of

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MAC address that have not communicated in the timer window (last 15 seconds) but actively communicating devices are maintained in the MAC address table. The timer is then reset to its normal value of 300 seconds. TCNs are generated on a per VLAN basis.

Root guard is enabled on a port-by-port basis and will put a port in the errdisabled if a superior BPDU is received on that port. This is to prevent that port from becoming a root port.

BPDU guard is enabled globally on a switch and will shut down ports configured with portfast if a BPDU is received on that port.

UDLD

Unidirectional Link Detection allows for the bidirectional monitoring of fiber-optic cables. This works by transmitting packets to a neighbor device that includes the system id and port id of the interface transmitting the UDLD packet. The other device does the same thing and this continues indefinitely. There are two modes by which UDLD operates.

- Normal – in normal mode, if a frame is not acknowledged, the link is considered undetermined and the port remains active.
- Aggressive – in aggressive mode when a frame is not acknowledged, the switch send another eight packets in one second intervals. If those packets are not acknowledged the port is placed into an error state.

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Configuration

```
switch(config-if)# spanning bpduguard [enable | disable]
switch(config-if)# spanning guard root
switch(config)# spanning portfast default
switch(config)# spanning portfast bpduguard default
```

This will set the priority for a VLAN for PVST.

```
switch(config)# spanning-tree vlan [vlan ID] priority [priority]
```

This will configure the primary/secondary root bridge.

```
switch(config)# spanning-tree vlan [vlan ID] root [primary | secondary]
```

To modify a port's cost.

```
switch(config)#spanning-tree [vlan ID] cost
switch(config)# bandwidth [bps]
```

Modify the Bridge ID.

```
switch(config)# spanning-tree vlan [vlan ID] priority
```

Modify the Port ID.

```
switch(config)# spanning-tree vlan [vlan ID] port-priority
```

Enables UDLD and optionally into aggressive mode.

```
Switch(config)# udld enable [aggressive]
```

Show Commands

```
switch# show spanning-tree
switch# show spanning-tree root
switch# show spanning-tree vlan [vlan i.d. or range]
switch# show spanning-tree inconsistentports
```