

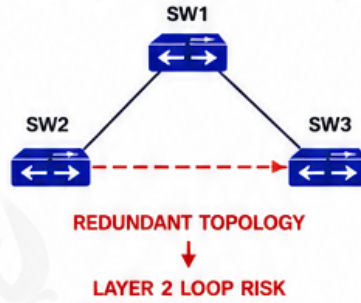
STP QUICK FACTS

Full Name	Spanning Tree Protocol
Standard	IEEE 802.1D
Purpose	Prevent Layer 2 Loops
Algorithm	Spanning Tree Algorithm
Control Message	BPDU
Root Selection	Lowest Bridge ID
Redundant Links	Blocked When Needed

★ STP = LOOP-FREE LAYER 2 TOPOLOGY

WHY STP?

Redundant Layer 2 links can create switching loops.

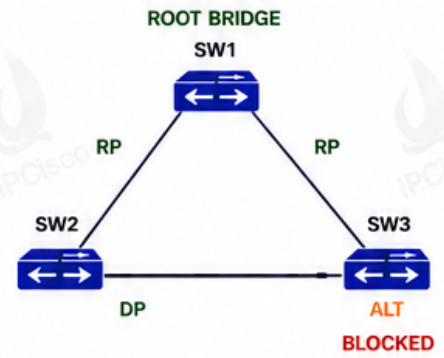


Possible Problems:

- Broadcast Storms
- MAC Table Instability
- Duplicate Frames

★ STP CREATES A LOOP-FREE TOPOLOGY

STP TOPOLOGY



STP builds its topology around the:

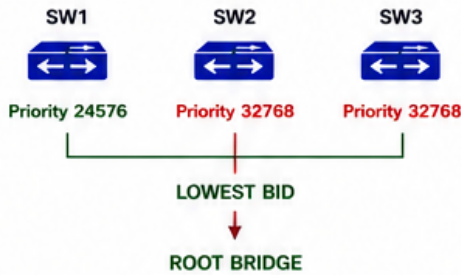
ROOT BRIDGE

★ ROOT BRIDGE IS THE CENTER OF THE TREE

ROOT BRIDGE ELECTION

Every switch has a Bridge ID (BID).

BRIDGE ID =
PRIORITY + SYSTEM ID EXTENSION + MAC ADDRESS

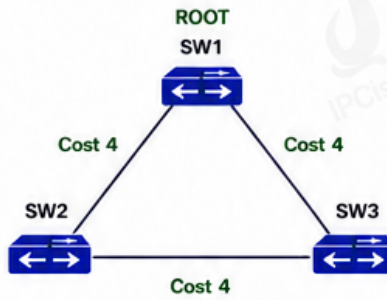


★ LOWEST BRIDGE ID WINS

If priorities are equal, the lower MAC address breaks the tie.

STP PATH COST

Each link has an STP cost.



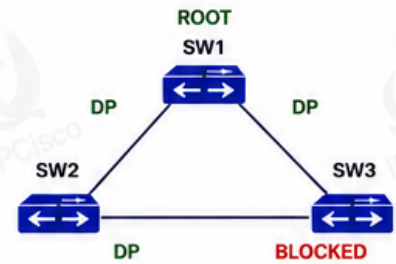
Each non-root switch selects the path with the lowest total Root Path Cost.

★ LOWEST ROOT PATH COST = BEST PATH

Exact cost values depend on the STP path-cost method.

STP PORT ROLES

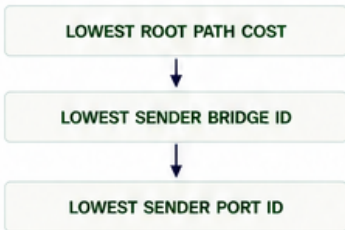
Role	Purpose	Forwarding?
Root Port (RP)	Best Path Toward Root	Yes
Designated Port (DP)	Best Port for a Segment	Yes
Non-Designated (ALT)	Redundant Path	No



★ ROOT BRIDGE HAS NO ROOT PORT

ROOT PORT SELECTION

A non-root switch selects one Root Port.



★ ONE ROOT PORT PER NON-ROOT SWITCH

CLASSIC STP PORT STATES

	State	Learn MACs?	Forward Data?
BLOCKING	Blocking	No	No
LISTENING	Listening	No	No
LEARNING	Learning	Yes	No
FORWARDING	Forwarding	Yes	Yes
DISABLED	Disabled	No	No

★ BLOCK → LISTEN → LEARN → FORWARD

BPDU

BPDU = Bridge Protocol Data Unit



- ROOT INFORMATION
- PATH COST
- BRIDGE ID
- PORT INFORMATION

BPDU's help switches determine:
Root Bridge
↓
Best Paths
↓
Port Roles

★ BPDUs BUILD AND MAINTAIN THE SPANNING TREE

ROOT BRIDGE CONFIGURATION

Make a switch the preferred root:

```
spanning-tree vlan 10 root primary
```

Backup root:

```
spanning-tree vlan 10 root secondary
```

Manual priority:

```
spanning-tree vlan 10 priority 24576
```

★ LOWER PRIORITY → MORE LIKELY TO BECOME ROOT

STP VERIFICATION

Check:

```
show spanning-tree  
show spanning-tree vlan 10  
show spanning-tree root
```



★ ROOT → COST → PORT ROLE → PORT STATE

RSTP

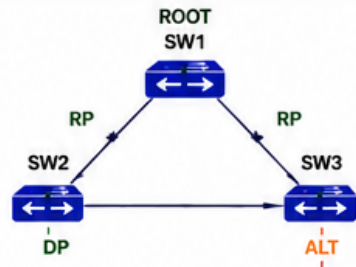
RSTP = Rapid Spanning Tree Protocol

Feature	STP (802.1D)	RSTP (802.1w)
Standard	802.1D	802.1w
Convergence	Slower	Faster
Port States	5 Traditional States	3 States
Alternate Role	Not Explicit	Yes



★ RSTP = FASTER STP CONVERGENCE

RSTP PORT ROLES



- RP** Root Port: Best path toward Root Bridge
- DP** Designated Port: Best port for a segment
- ALT** Alternate Port: Alternate path toward Root
- BKP** Backup Port: Backup for a DP on same segment (uncommon in modern networks)

★ ROOT BRIDGE HAS NO ROOT PORT

RSTP PORT STATES



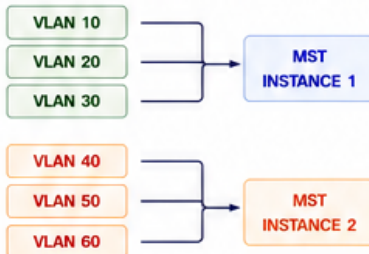
State	Learn MACs?	Forward Data?
Discarding	No	No
Learning	Yes	No
Forwarding	Yes	Yes

Faster transitions (proposal/agreement handshake) minimize topology change delays.

★ RSTP: 3 STATES

MST

MST = Multiple Spanning Tree



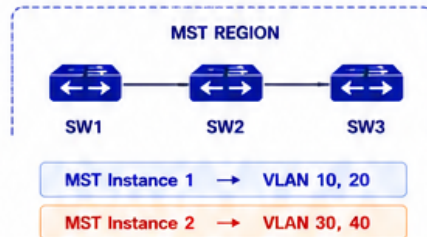
Instead of a separate spanning tree for every VLAN, MST maps multiple VLANs to fewer instances.

★ MULTIPLE VLANs → ONE MST INSTANCE

MST REGION

Switches are in the same MST region when these parameters match:

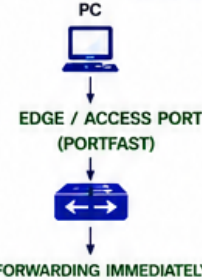
- ✓ Region Name
- ✓ Revision Number
- ✓ VLAN-to-Instance Mapping



★ SAME REGION = SAME MST CONFIGURATION

PORTFAST

PortFast allows an edge/access port to transition rapidly to forwarding.



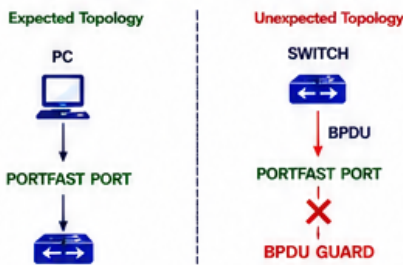
interface
GigabitEthernet0/1
spanning-tree
portfast

⚠ Use only on edge ports connected to end devices. Do not enable on links where loops could form.

★ PORTFAST = EDGE PORT FAST FORWARDING

BPDU GUARD

Protects edge ports from unexpected BPDUs.



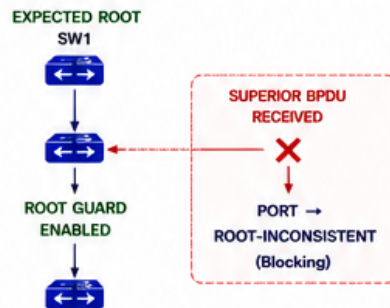
✗ BPDU RECEIVED → PORT ERROR-DISABLED

interface GigabitEthernet0/1
spanning-tree bpduguard enable

★ PORTFAST + BPDU GUARD = COMMON EDGE PROTECTION

ROOT GUARD

Prevents an unexpected switch from becoming the Root.

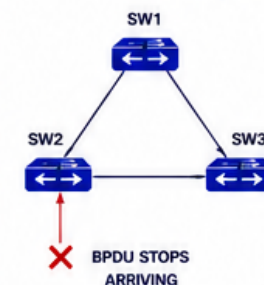


The port recovers automatically after the superior BPDUs stop.

★ ROOT GUARD = PROTECT ROOT PLACEMENT

LOOP GUARD

Protects against certain STP failures caused by loss of expected BPDUs.



LOOP GUARD
DETECTS LOSS
→ PORT
LOOP-INCONSISTENT
(Blocking)

★ LOOP GUARD = PROTECT AGAINST LOST BPDUs

STP PROTECTION COMPARISON

Feature	Protects Against	Typical Placement
BPDU Guard	Unexpected Switch / BPDU	Edge / PortFast
Root Guard	Unexpected Root Bridge	Where Root Must Not Appear
Loop Guard	Loss of Expected BPDUs (Unidirectional Failure)	Redundant Network Links

- ✓ **BPDU GUARD:** Unexpected BPDU → Block / Err-disable
- ✓ **ROOT GUARD:** Superior BPDU → Root-Inconsistent
- ✓ **LOOP GUARD:** Expected BPDU Stops → Loop-Inconsistent

★ BPDU GUARD → EDGE • ROOT GUARD → ROOT CONTROL
LOOP GUARD → LOOP PROTECTION

RAPID PVST+ & MST CONFIGURATION

Rapid PVST+

```
spanning-tree mode rapid-pvst
```

MST

```
spanning-tree mode mst
```

```
spanning-tree mst configuration
name IPCISCO
revision 1
instance 1 vlan 10,20
instance 2 vlan 30,40
```

★ CONFIGURE THE RIGHT STP MODE & INSTANCES

VERIFICATION

Useful Commands

```
show spanning-tree
show spanning-tree vlan 10
show spanning-tree mst
show spanning-tree inconsistentports
```

Troubleshooting Flow



★ ROOT → PORT ROLE → PORT STATE → BPDU → GUARD FEATURE