

1-4(D). Rapid Spanning Tree

R A P I D S P A N N I N G T R E E P U R P O S E

RSTP (Rapid Spanning Tree Protocol) decreases convergence time and renames the “blocking” state to “discarding.” It can interoperate with normal spanning tree switches. RSTP provides

- Reduced MaxAge timer, now 3x hello rate instead of 10x (6 seconds instead of 20)—Useful when your own port is still up, but stops receiving BPDUs
- New mechanism to replace a root port and immediately start forwarding (sometimes)
- New mechanism to replace a designated port and immediately start forwarding (sometimes)
- Reduced wait times when waits are necessary

RSTP was originally defined in 802.1w (“W” as in kWick or Wapid), but has since been folded into the current 802.1D -2004 definition (“D” was always the definition of normal spanning tree).

Compared to normal STP, RSTP adds roles and reduces states.

Port Roles—Alternate and Backup roles added

ROLE	DESCRIPTION
Root	Lowest cost path to root switch (on a non-root switch)
Alternate	Could replace the root port during a failure
Designated	Chosen to forward frames to and from a network segment (collision domain)
Backup	Could replace a designated port from the same switch—probably made more sense with coax cable daisy-chain topologies
Disabled	Administratively down (interface shutdown command)

Port States—Disabled and blocking are combined and renamed “Discarding” because RSTP really doesn't care whether the port was blocked by it or shut down by an administrator. Either way, it doesn't send packets there. The “Listening” state is abandoned as unnecessary.

802.1D	802.1W	STABLE	LEARN MACS	FORWARD FRAMES
Disabled	Discarding	•		
Blocking	Discarding	•		
Listening	—			
Learning	Learning		•	
Forwarding	Forwarding	•	•	•

You can remember the 3 RSTP states (Forwarding, Listening, and Discarding) as FLD, short for “flood,” which is what switches do with frames headed to an unknown MAC. They are “states,” not “roles,” because “states” (the intranational boundary type) get “flooded” during storms, and “packet storms” are the reason we use STP at all. Yeah, I know that all of this is a stream of horrible puns, but [get ready...] any port in a storm.

Only 41 more chapters to go.

A L T E R N A T E P O R T

After choosing a root port, any other ports that receive BPDUs naming the same root switch are marked as alternates. When BPDUs stop arriving on the root port, it is immediately (after MaxAge) changed to role=disabled and state=discarding (called blocking in normal STP) and the alternate port is immediately changed to role=root and state=forwarding. There is no waiting in intermediate states, like “learning.”

- The root port stops receiving BPDUs
- The switch exchanges RSTP messages with the neighboring (upstream) switch over the alternate port, causing the neighboring switch to flush (now incorrect) MAC address table entries.

Because the MAC flush is in the same message as the topology change, there's no reason for normal STP's 15 second wait state to make sure the MAC table on the other switch is ready.

- The old root port becomes role=disabled and the alternate becomes role=root
- The alternate port is immediately changed to state=forwarding because RSTP knows that this cannot create a loop—no learning state (no listening state either because it doesn't exist)

B A C K U P (D E S I G N A T E D) P O R T S

Only happens where >1 port of the same switch is connected to the same collision domain (hub). If the designated port fails, the backup can be immediately used, moving from discarding state to forwarding with no timers.

P O R T (L I N K) T Y P E S

TYPE	DESCRIPTION
Point-to-Point	Normal crossover cable between two switches
Point-to-Point Edge	Connects switchport to host
Shared	Connects switchport to a hub.

All half-duplex switchports are treated as shared ports and converge more slowly.

I M P L E M E N T A T I O N

Set and Identify STP Mode—The exam expects you to "configure, verify, and troubleshoot" the STP mode between per-VLAN spanning tree and rapid per-VLAN spanning tree. MST can be safely ignored. The table below translates between the terminology on the exam, the keyword when you set the mode on a switch and what the second line of a "show spanning-tree" command displays.

EXAM TERM	MODE COMMAND	SHOW COMMAND OUTPUT	USES RAPID	DESCRIPTION
PVST+	pvst	ieee		(default) One STP instance per VLAN
RPVST+	rapid-pvst	rstp	•	One RSTP instance per VLAN
	mst	mst	•	Multiple RSTP instances, each can serve >1 VLAN

```
S2(config)# spanning-tree mode { pvst | rapid-pvst | mst }
```

```
S2# show spanning-tree
```

```
VLAN0001
```

```
Spanning tree enabled protocol ieee
```

This would show "rstp" if we were using rapid-pvst

```
Root ID    Priority    32769
Address    000c.85ca.e280
Cost       19
Port       1 (FastEthernet0/1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
```

```
Bridge ID  Priority    32769 (priority 32768 sys-id-ext 1)
Address    000d.29a1.8680
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	LRN	19	128.1	P2p
Fa0/2	Altn	BLK	19	128.2	P2p
Fa0/3	Altn	BLK	19	128.3	P2p
Fa0/4	Altn	BLK	19	128.4	P2p

NOTE: presence of "alternate" ports does NOT mean it's running rapid spanning-tree. Also, in RSTP, the discarding state is still called "BLK."

```
S1# show spanning-tree bridge
```

Vlan	Bridge ID	Hello Time	Max Age	Fwd Dly	Protocol
VLAN0001	32769 (32768, 1) 000c.85ca.e280	2	20	15	ieee

Port Types—Automatically determined based on duplex and portfast. Half-duplex = shared; Full Duplex = Point-to-point; Portfast = edge. Cisco recommends against half-duplex portfast (shared edge) for fear of loops.

	FULL DUPLEX	HALF DUPLEX
NO PORTFAST	Point-to-Point	Shared
PORTFAST	Point-to-Point Edge	Shared Edge

S2# **show spanning-tree**

VLAN0001

Spanning tree enabled protocol ieee

Root ID Priority 32769
 Address 000c.85ca.e280
 Cost 19
 Port 1 (FastEthernet0/1)
 Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
 Address 000d.29a1.8680
 Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
 Aging Time 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	LRN	19	128.1	P2p
Fa0/2	Altn	BLK	19	128.2	Shr
Fa0/3	Altn	FWD	19	128.3	P2p Edge
Fa0/4	Altn	BLK	19	128.4	P2p