

Rapid Spanning Tree Protocol (RSTP):

Rapid Spanning Tree Protocol (RSTP) is the successor and enhanced version of the Spanning Tree Protocol (STP). The purpose of RSTP is to provide significantly faster convergence while still backward compatible with spanning tree protocol (802.1d). Rapid Spanning Tree Protocol (RSTP) is a networking protocol that significantly improves the speed and stability of the Spanning Tree Protocol (STP). RSTP achieves this by adding additional features that allow switches to converge on stable network topology more quickly. RSTP is used to create a loop-free network topology, similar to STP but faster. It provides faster convergence and better security while being backward compatible with STP. While standard STP takes 50 seconds to converge, RSTP can achieve sub-second convergence. RSTP is faster than STP because an RSTP port does not wait for the forward delay timer to expire.

Similarities between STP and RSTP:

- o The switch with the lowest bridge priority will be the root bridge.
- o If there is a tie, the switch with the lowest MAC address is selected same like in STP.
- o BPDUs are forwarded between switches in both STP and RSTP.
- o Roots and designated ports are elected in the same way that they are in STP.

- 1- Elect a Root Bridge in the network topology.
- 2- Place root interfaces into a Forwarding State.
- 3- Each non-root switch selects its Root Port.
- 4- Remaining links choose a designated Port.
- 5- All other ports are put in to a Blocking State.

RSTP Port Roles:

Root Port:

Similar to Spanning Tree and is the port on a switch that is the Lowest Cost to the Root Bridge.

Designated Port:

It is also the same as Spanning Tree and is the port that can send the best BPDU on its segment. All ports on the root switch are designated ports facing downwards away from the root switch.

Alternate Port:

An alternate port is a discarding port in a blocked state with an alternate path to the root bridge if the root port fails. It is the backup of Root Port.

Backup Port:

Because it has an inferior port path cost, it is a discarding port on the same ethernet segment as the designated port. Therefore, it is the backup of the Designated Port.

RSTP Port States:

RSTP can be described by three port states: Discarding, Learning, and Forwarding. The Disabled, Blocking, and Listening states described by STP have been combined into the Discarding state in RSTP. The functionality is similar. In RSTP, the Alternate port and Backup port are allowed to directly enter the forwarding state which allows the convergence time of the network to be reduced significantly. In STP, the port must wait for the network to converge (40-50 seconds) before entering the forwarding state. This is a major advantage of RSTP over STP.

STP State (802.1d)	RSTP State (802.1w)
Disabled	Discarding
Blocking	Discarding
Listening	Discarding
Learning	Learning
Forwarding	Forwarding

Discarding Port State:

The discarding state is when a device is connected, and the port will first enter the state. No MAC addresses are learned for incoming data frames; they are dropped. It combines the disabled, blocking, and listening states of 802.1D (STP).

Learning Port State:

In this state, incoming data frames will be dropped, but MAC addresses are learned.

Forwarding Port State:

The forwarding state is when the port is actively forwarding traffic. Incoming data frames are transmitted according to learned MAC addresses.

STP	RSTP
Disabled	Discarding
Blocking	
Listening	
Learning	Learning
Forwarding	Forwarding

RSTP BPDUs:

RSTP uses type 2 BPDUs similar to Spanning Tree, making it easy to detect legacy STP switches in the network. RSTP generates BPDUs at every hello interval (default 2 seconds) and uses them as keepalives between bridges. RSTP BPDUs age faster. The max-age timer expires when three consecutive hellos ($2 \times 3 = 6$ seconds) from a neighbor are missed.

STP BPDUs - 35 Bytes, RSTP BPDUs - 36 Bytes

Protocol ID	Version	Message type	Flag	Root ID	Root path cost	Bridge ID	Port ID	Message Age	Max Time	Hello time	Forward Delay	Version Length
2 bytes	1 byte	1 byte	1 byte	8 bytes	4 bytes	8 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	1 byte
0x 0000	STP- 0x 00 RSTP- 0x 02	0x 00-C- BPDUs 0x 80- TCN-BPDUs 0x 02- RSTP										In RSTP BPDUs only

Bit	STP (802.1D)	RSTP (802.1w)
7	TC	Topology Change
6	unused	Proposal
5	unused	Port role: 00-unknown, 01-Alternate, 10- Root port, 11 -Designated port
4	unused	
3	unused	Learning
2	unused	Forwarding
1	unused	Agreement
0	TCA	Topology Change Acknowledgement

Fields without a Change:

1. The Protocol ID field is a 2-byte field set as 0x0000 for both STP and RSTP.
2. Root ID is the identifier of the root bridge, an 8-byte field.
3. The root path cost field shows the cost of the path from the bridge to the root bridge.
4. The bridge ID is an 8-byte field signifies the ID of the switch originating the BPDUs.
5. Port ID is a 2-byte field, the port ID for the wired link is 128, by default.
6. The message age field is set to zero by the originating switch. Each switch in-route will add 1 to this value. The receiving device will come to know number of devices in the path.
7. Max time is the time that indicates the validity of BPDUs. In STP, it is 20 secs, and in RSTP, it is 6 secs by default.
8. The hello-time is 2 secs for both the protocols, by default.
9. Forward delay signifies the period the switch should wait for the transition to the next state.

Fields with a Change:

1. The second is the version, which is a one-byte field. It has the value 0x00 for STP; and 0x02 for the version-2 BPDU in RSTP.
2. The third field is a message type field, which can have values 0x00 for the Configuration-BPDU and 0x80 for Topology Change Notification- BPDU in 802.1D. In 802.w value 0x02.
3. Flag is 1-byte field, STP uses only two bits of them. In RSTP makes use of all eight bits.
4. The version length is an additional one byte is in RSTP BPDU. It has a value 0 in RSTP, indicating that no version one protocol information is present.

RSTP Timers:

In RSTP, all switches generate their BPDU in every hello-time even if they don't receive it from the root bridge. The aging time is now three hello-time unlike 802.1D where it was ten times of hello-time. If a switch misses three consecutive BPDUs, it will consider that it lost the link. The fast aging allows the switch to detect the fault in less time.

