

# Spanning Tree Protocol Timers

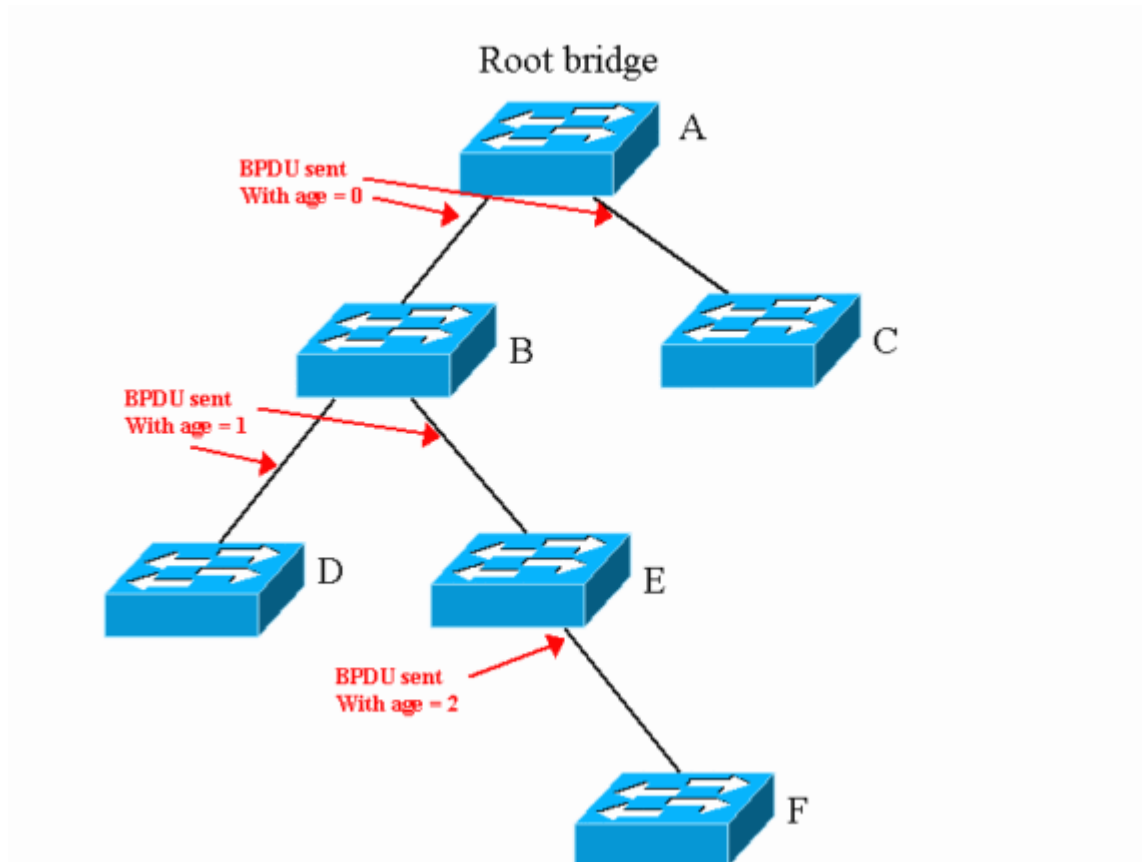
[http://www.cisco.com/en/US/tech/tk389/tk621/technologies\\_tech\\_note09186a0080094954.shtml#stp\\_timers](http://www.cisco.com/en/US/tech/tk389/tk621/technologies_tech_note09186a0080094954.shtml#stp_timers)

This is an excerpt from the Cisco manual above. I thought this would help you understand the calculation I've asked about in Lab 1

There are several STP timers, as this list shows:

- **hello**—The hello time is the time between each bridge protocol data unit (BPDU) that is sent on a port. This time is equal to 2 seconds (sec) by default, but you can tune the time to be between 1 and 10 sec.
- **forward delay**—The forward delay is the time that is spent in the listening and learning state. This time is equal to 15 sec by default, but you can tune the time to be between 4 and 30 sec.
- **max age**—The max age timer controls the maximum length of time that passes before a bridge port saves its configuration BPDU information. This time is 20 sec by default, but you can tune the time to be between 6 and 40 sec.

Each configuration BPDU contains these three parameters. In addition, each BPDU configuration contains another time-related parameter that is known as the message age. The message age is not a fixed value. The message age contains the length of time that has passed since the root bridge initially originated the BPDU. The root bridge sends all its BPDUs with a message age value of 0, and all subsequent switches add 1 to this value. Effectively, this value contains the information on how far you are from the root bridge when you receive a BPDU. This diagram illustrates the concept:



When a new configuration BPDU is received that is equal to or better than the recorded information on the port, all the BPDU information is stored. The age timer begins to run. The age timer starts at the message age that is received in that configuration BPDU. If this age timer reaches max age before another BPDU is received that refreshes the timer, the information is aged out for that port.

Here is an example that applies to the diagram in this section:

- Switches B and C receive a configuration BPDU from switch A with a message age of 0. On the port that goes to A, the information ages out in (max age – 0) sec. This time is 20 sec by default.
- Switches D and E receive the BPDU from switch B with a message age of 1. On the port that goes to A, the information ages out in (max age – 1) sec. This time is 19 sec by default.
- Switch F receives the BPDU from switch E with a message age of 2. On the port that goes to E, the information ages out in (max age – 2) sec. This time is 18 sec by default.

## Other Parameters of the Spanning Tree Protocol

IEEE 802.1D defines STP. In addition to the timers that the [Spanning Tree Protocol Timers](#) section describes, IEEE also defines these parameters that relate to STP:

- **diameter of the STP domain (dia)**—This value is the maximum number of bridges between any two points of attachment of end stations. The IEEE recommendation is to consider a maximum diameter of seven bridges for the default STP timers.
- **bridge transit delay (transit delay)**—This value is the time that elapsed between the reception and the transmission of the same frame by the bridge. This is logically the latency through the bridge. The IEEE recommendation is to consider 1 sec as the maximum bridge transit delay.
- **BPDU transmission delay (bpdu\_delay)**—This value is the delay between the time that a BPDU is received on a port and the time that the configuration BPDU is effectively transmitted to another port. The IEEE recommends 1 sec as the maximum BPDU transmission delay.
- **message age increment overestimate (msg\_overestimate)**—This value is the increment that each bridge adds to the message age before forwarding a BPDU. As the [Spanning Tree Protocol Timers](#) section states, Cisco switches (and probably all switches) add 1 sec to the message age before the switches forward a BPDU.
- **lost message (lost\_msg)**—This value is the number of BPDUs that can be lost as a BPDU moves from one end of the bridged network to the other end. The IEEE recommendation is to use three as the number of BPDUs that can be lost.
- **transmit halt delay (Tx\_halt\_delay)**—This value is the maximum amount of time that is necessary for a bridge to effectively move a port into the blocking state after the determination that the port needs to be blocked. The IEEE recommendation is to use 1 sec for this parameter.
- **medium access delay (med\_access\_delay)**—This value is the time that is necessary for a device to gain access to the media for initial transmission. It is the time between the CPU decision to send a frame and the moment when the frame effectively begins to leave the bridge. The IEEE recommendation is to use 0.5 sec as the maximum time.

From these parameters, you can calculate other values. This list provides the additional parameters and the calculations. The calculations assume that you use the default recommended IEEE values for all parameters.

- **End-to-end BPDU propagation delay**—This value is the amount of time that is necessary for a BPDU to travel from one end of the network to the other end. Assume a diameter of seven hops, three BPDUs that can be lost, and a hello time of 2 sec. In this case, the formula is:
  - $\text{End-to-end\_BPDU\_propa\_delay}$
  - $= ((\text{lost\_msg} + 1) \times \text{hello}) + (\text{BPDU\_Delay} \times (\text{dia} - 1))$
  - $= ((3 + 1) \times \text{hello}) + ((1 \times (\text{dia} - 1))$
  - $= 4 \times \text{hello} + \text{dia} - 1$
  - $= 4 \times 2 + 6$
  - $= 14 \text{ sec}$

- **Message age overestimate**—The purpose of this parameter is to account for the age of the BPDU since origination. Assume that each bridge increases the BPDU message age by 1 sec. The formula is:
  - `Message_age_overestimate`
  - $= (\text{dia} - 1) \times \text{overestimate\_per\_bridge}$
  - $= \text{dia} - 1$
  - $= 6$
- **Maximum frame lifetime**—This value is the maximum time that a frame that previously was sent to the bridge network remains in the network before the frame reaches that destination. The formula is:
  - `Maximum_frame_lifetime`
  - $= \text{dia} \times \text{transit\_delay} + \text{med\_access\_delay}$
  - $= \text{dia} + 0.5$
  - $= 7.5$
  - $= 8 \text{ (rounded)}$
- **Maximum transmission halt delay**—This value is the time that is necessary in order to effectively block a port, after the decision to block is made. The IEEE counts 1 sec as the maximum for this event. The formula is:
  - `Maximum_transmission_halt_delay`
  - $= 1$

## Default Values of Spanning Tree Protocol Timers

This section details how to reach the default value for max age and forward delay if you use the recommended value for each parameter. The recommended values are a diameter of seven and a hello time of 2 sec.

### max age

The max age takes into account the fact that the switch that is at the periphery of the network does not time out the root information under stable conditions (that is, if the root is still alive). The max age value needs to take into account the total BPDU propagation delay and the message age overestimate. Therefore, the formula for max age is:

```
max_age
= End-to-end_BPDU_propa_delay + Message_age_overestimate
= 14 + 6
= 20 sec
```

This calculation shows how the IEEE reaches the default recommended value for max age.

### forward delay

The movement of a port into the listening state indicates that there is a change in the active STP topology and that a port will go from blocking to forwarding. So the listening and learning periods during which the forward delay runs must cover this consecutive period:

- Time from when the first bridge port enters the listening state (and stays there through the subsequent reconfiguration) to when the last bridge in the bridged LAN hears of the change in the active topology

In addition, you need to count the same delay that you use to calculate max age (message age overestimate and BPDU propagation delay).

- Time for the last bridge to stop forwarding frames that are received on the previous topology (maximum transmission halt delay), until the last frame that is forwarded on the previous topology disappears (maximum frame lifetime)

This amount of time is necessary in order to be sure that you do not get duplicated frames.

Therefore, twice the time of the forward delay (listening time + learning time) contains all these parameters. The formula is:

$$\begin{aligned} & 2 \times \text{forward\_delay} \\ &= \text{end-to-end\_BPDU\_propagation\_delay} + \text{Message\_age\_overestimate} + \\ & \quad \text{Maximum\_frame\_lifetime} + \text{Maximum\_transmission\_halt\_delay} \\ &= 14 + 6 + 7.5 + 1 = 28.5 \end{aligned}$$

$$\begin{aligned} \text{forward\_delay} \\ &= 28.5 / 2 \\ &= 15 \text{ (rounded)} \end{aligned}$$