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Spanning Tree Port States

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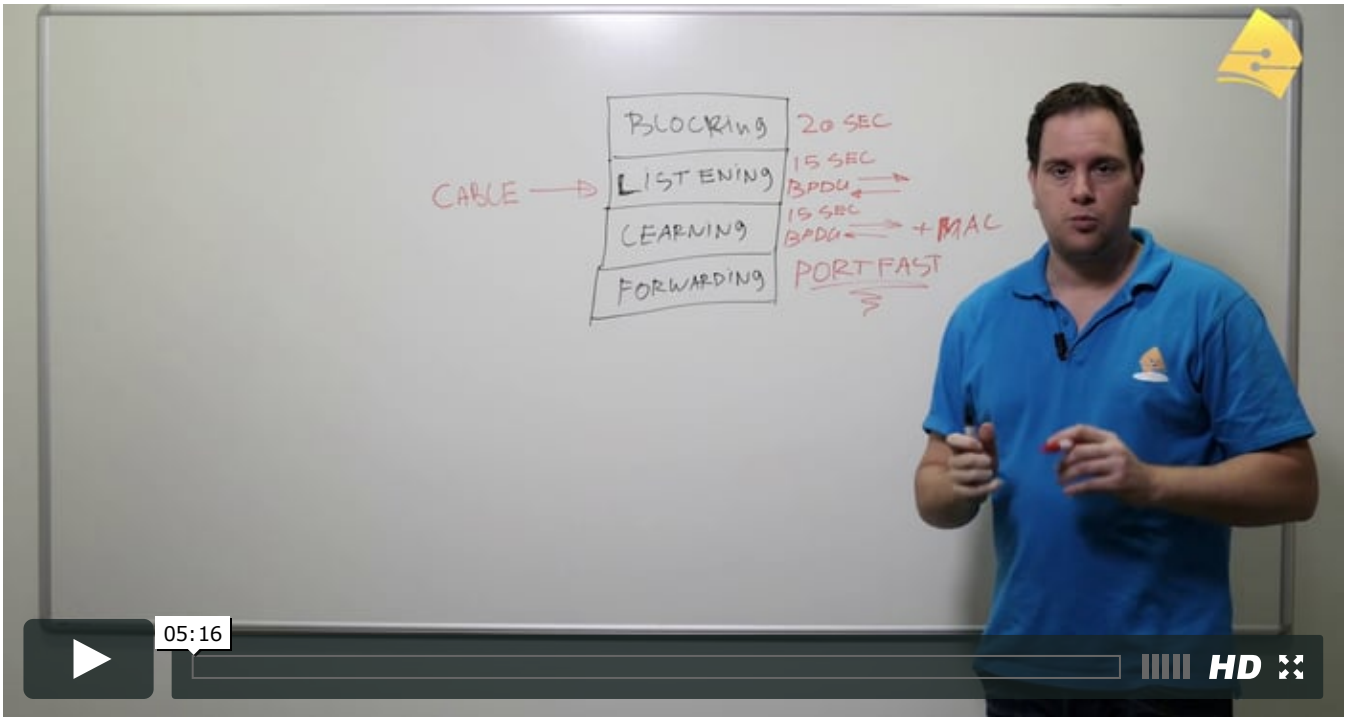
If you have played with some Cisco switches before you might have noticed that every time you plug in a cable the led above the interface was orange and after a while became green. What is happening at this moment is that spanning tree is determining the state of the interface.

This is what happens as soon as you plug in a cable:



- **Listening state**: Only a root or designated port will move to the listening state. The non-designated port will stay in the blocking state.No data transmission occurs at this state for 15 seconds just to make sure the topology doesn't change in the meantime. After the listening state we move to the learning state.
- **Learning state:** At this moment the interface will process Ethernet frames by looking at the source MAC address to fill the mac-address-table. Ethernet frames however are not forwarded to the destination. It takes 15 seconds to move to the next state called the forwarding state.
- **Forwarding state:** This is the final state of the interface and finally the interface will forward Ethernet frames so that we have data transmission!

When a port is not a designated or root port it will be in **blocking mode**.

This means it takes 30 seconds in total to move from listening to forwarding...that's not really fast right? This will happen on **all interfaces** on the switch.

When an interface is in blocking mode and the topology changes, it's possible that an interface that is currently in blocking mode has to move to the forwarding state. When this is the case, the blocking mode will last for 20 seconds before it moves to the listening state. This means that it takes 20 (blocking) + 15 (listening) + 15 (learning) = 50 seconds before the interface is in the forwarding state.

30 seconds is a long time right? Any modern PC with a SSD drive boots faster than that. Here's an overview of the different port states:

State	Forward Frames	Learn MAC Addresses	Duration
Blocking	No	No	20 seconds
Listening	No	No	15 seconds
Learning	No	Yes	15 seconds
Forwarding	Yes	Yes	–

So what does this look like on an actual Cisco switch? Let me show you an example of an interface that is connected to a router. I just unplugged and plugged the cable (or do a"shut" and "no shut") and the first time we run the show command it looks like this:

```
SW1#show spanning-tree vlan

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0019.569d.5700
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0019.569d.5700
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
--
Fa0/1               Desg LIS 19        128.4    P2p
```

You can see that the role of the port is designated and the status is listening. Keep refreshing this show command and after ~ 15 seconds it looks like this:

```
SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0019.569d.5700
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0019.569d.5700
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
--
Fa0/1               Desg LRN 19        128.4    P2p
```

It has moved to the learning state and after another ~ 15 seconds it looks like this:

```
SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0019.569d.5700
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0019.569d.5700
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
--
```

```
Fa0/1               Desg FWD 19        128.4    P2p
```

Very nice, you just witnessed an interface moving through the different spanning tree port states. A better method to see the changes is by enabling a debug:

```
SW1#debug spanning-tree events
Spanning Tree event debugging is on
```

When we disable and enable the interface again you can see it moving through the spanning tree port states in realtime:

```
SW1#
00:14:57: STP: VLAN0001 Fa0/1 -> listening
00:15:12: STP: VLAN0001 Fa0/1 -> learning
00:15:27: STP: VLAN0001 Fa0/1 -> forwarding
```

That's pretty neat right? I hope this tutorial has helped you to understand the spanning tree port states! If you have any questions, feel free to leave a comment.

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- November 9, 2014 at 08:15 #11698 Reply

Veerender K
Member
When we connect a cable on Switch which runs STP on a unused port, will whole switch run STP on all ports and all ports move from Listening — Learning–Forwarding mode?

Is the whole switch operation affected? or the port we just connected?

Regards,
Veerender

November 9, 2014 at 11:06 #11699 Reply

Rene Molenaar
Keymaster
Hi Veerender,

It's done per interface, not for all interfaces on the switch.

Rene

May 10, 2015 at 17:53 #11700 Reply

francesco r
Participant
Hello, Rene
if we suppose that we have 3 switch..we power on them...after booting,
the port of each switch connected each other goes into listening ,because they need to do an election...(in this 15 seconds a port is learning if it will be root port,designated port , or non designated port. Once understood, if it wiil be non designated goes into blocking state otherwise it's going into learning and then forwarding).Now the switch network will be converged....If now I focus at the port in blocking state ,it receive BPDU by a peer designatet port,every 2 sec, and store that bpdu value (here now we can speak of the value of MaxAge-MessageAge..20 sec)..At one time the blocking port doesn't receive bpdu from it's designated

switch, this one send a TCN to root bridge out it's root-port, but my blocking port has to wait 20 second(MaxAge-messageAge) before going into listening state and can send out BPDu frame... Meanwhile this switch with this blocking port has to lower the aging time??? But I don't understand who say to switch ..lower the aging time

May 11, 2015 at 13:13 #11701 Reply

Rene Molenaar
Keymaster
Hi Francesco,

The TCN is the trigger to set the aging time, the originating switch will reduce its aging the time and other switches will as soon as they receive the TCN.

Rene

September 2, 2015 at 14:05 #11702 Reply

christopher c
Participant
That was very good, I would also like to see the same output from a non root switch, and see at which point it changes from designated to root or non-designated. I guess the whole point of this is I can set it up myself and watch what happens.

Chris

September 2, 2015 at 15:46 #11703 Reply

Rene Molenaar
Keymaster
Hi Chris,

The output of a non-root bridge will be the same if you connect a new cable, it will go through the listening > learning > forwarding states. It might be interesting though to look at an interface that is currently in blocking mode.

Just take two switches, enable the debug I did and take a look...good exercise 🙂

Rene

May 6, 2016 at 10:24 #23881 Reply

Ravi J
Participant
Hi Rene,
In blocking port state,switch not able to receive and transmit any BPDUs,then How blocking port state move to listening state.

–Ravi

May 6, 2016 at 14:11 #23887 Reply

Andrew P
Moderator
Ravi,
In a Blocking state, the switch does receive BPDUs. In fact, it is the act of receiving inferior BPDUs that keeps the state as Blocking. Should an interface stop receiving BPDUs, then it will transition into a Listening-Learning-Forwarding state.

May 7, 2016 at 16:00 #23897 Reply

Ravi J
Participant
Hi Andrew,
Thanks for clearing concept.

-Ravi

May 8, 2016 at 15:51 #23905 Reply

Mohammad Hasanuz Z
Participant
Hlw Rene,

Root Port , Designated port will send & Receive BPDU right ??

Alternate Port will send and receive BPDU ????

How a Alternate port know , It have to move Listening, Learning , Forwording after Root port down as per attached Topology on switchC.

br/
zaman

May 8, 2016 at 23:45 #23916 Reply

Andrew P
Moderator
Mohammad,
The concept of an Alternate port was introduced with Rapid Spanning Tree. This feature takes over what the traditional (802.1 D) spanning-tree enhancement of “uplink-fast” used to do. The Alternate port serves as a “hot-standby” for a switch’s Root Port, but Alternate Port is considered to be in a Discarding state (Discarding is the RSTP term for Blocking, Listening, and Disabled for spanning-tree).

This means that an Alternate port can receive BPDUs but will not send them. As soon as a Root Port fails, the Alternate Port will immediately transition to forwarding, skipping the Learning state (there is no such thing as “Listening” in Rapid Spanning Tree).

You are correct that Root and Designated ports both send and receive BPDUs.

June 4, 2016 at 16:38 #24717 Reply

Gagan c
Participant
OMG,This is the easiest way to understand the stp concept and ports state.

June 11, 2016 at 20:21 #24821 Reply

sze jie k
Participant
Hi Rene,

q1) What is the difference between a port in BLOCK and LISTEN state ? LISTEN does send and receive but BLOCK only receives BPDUs ?

q2) I saw an amber light on a port in BLOCK state, but if we have PVST and we configure different root bridges, how does the switch
reflect a ND port that is BLOCK in 1 VLAN but not BLOCK in another VLAN ?

q3) “Only a root or designated port will move to the listening state”
what is the state for the interfaces/ports before everything (e.g. root bridge, root port, designated port) are determined ? — still listening ?

Regards,
Alan

June 15, 2016 at 21:02 #25668 Reply

Rene Molenaar
Keymaster
Hi Alan,

1. In the blocking state, the switch only receives BPDUs but does not send them. In the listening state, we send and receive BPDUs.
2. If it’s an access interface then it will be amber. Trunk interfaces will always have a green led (since you can have more than one VLAN).
3. When you first enable the interface, it will start in the listening state.

Rene

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