T108: Lab-1 STP Modifications and Tuning (Student version)

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S1

**Cat 3850**

Lab 1 (T113)



S2

**Cat 3850**

Gig1/0/3

Gig1/0/3

Gig1/0/1

Gig1/0/2

Gig1/0/1

Gig1/0/2

Gig1/0/4

Gig1/0/3

Gig1/0/2

Gig1/0/1

S3

**Cat 2960**

**or Cat3850**

All links between Switches are 802.1Q trunks

# Topology

**NOTE:**

**Always Check on Cat3850 the interface numbering (x/0/x) and adjust the switches base configurations as needed, i.e. Switch D1 or D2 may have interface numbering different than what is shown in topology, this depends on stack number for the switch, so do:**

1. **“show ip interface brief” on each Cat3850 switches and adjust interface numbering in base configuration below as needed**
2. **“show cdp neighbors” on all devices to ensure that you have proper cabling/connections**

**Objectives**

**Part 1: Build the Network and Configure Basic Device Settings and Interface Addressing Part 2: Implement and Observe Various Topology Tuning Methods**

# Background / Scenario

Although spanning tree works “out of the box”, the default values used in the decisions it makes may lead to logical topologies that, although loop-free, do not align to what you need for your network. In addition, spanning tree “out of the box” is vulnerable to several different scenarios where the root bridge status could be taken over, or a loop could be introduced in the network. In this lab you will configure and observe various ways of bending the logical spanning tree topology to meet your requirements, as well as the different topology protection mechanism that are available. The terms "switch" and "bridge" will be used interchangeably throughout the lab.

**Note:** This lab is an exercise in deploying and verifying various STP mechanisms and does not reflect networking best practices.

**Instructions**

**Part 1: Build the Network and Configure Basic Device Settings and Interface Addressing**

In Part 1, you will set up the network topology.

## Step 0: Cable network devices and erase any leftover configurations.

Ensure all devices have been properly cabled and no configs are leftover. Delete VLAN.dat a shown below:

* (S1 is shown below as an example):

**S1#delete vlan.dat**

**Delete filename [vlan.dat]?**

**Delete flash:/vlan.dat? [confirm]**

**S1#**

## Step 1: Configure basic settings for each switch.

1. Console into each switch, enter global configuration mode, and apply the basic settings and interface addressing. The startup configuration is provided below for each switch in the topology.

### Switch S1 (Catalyst 3850)

!

hostname S1

spanning-tree mode rapid-pvst

vtp version 2

vtp mode server

!

line con 0

exec-timeout 0 0

logging synchronous

exit

!

line vty 0 4

privilege level 15

password cisco

login

transport input all

!

interface range Gig1/0/1-3

switchport mode trunk

no shutdown

exit

!

vlan 2

name SecondVLAN

exit

!

interface vlan 1

ip address 10.0.0.1 255.0.0.0

no shut

exit

### Switch S2 (Catalyst 3850)

!

hostname S2

spanning-tree mode rapid-pvst

vtp version 2

vtp mode server

!

line con 0

exec-timeout 0 0

logging synchronous

exit

!

line vty 0 4

privilege level 15

password cisco

login

transport input all

!

interface range Gig1/0/1-3

switchport mode trunk

no shutdown

exit

!

vlan 2

name SecondVLAN

exit

!

interface vlan 1

ip address 10.0.0.2 255.0.0.0

no shut

exit

### Switch S3 (Catalyst 2960)

!

hostname S3

spanning-tree mode rapid-pvst

vtp version 2

vtp mode server

!

line con 0

exec-timeout 0 0

logging synchronous

exit

!

!

line vty 0 4

privilege level 15

password cisco

login

transport input all

!

interface range Gig1/0/1-4

switchport mode trunk

no shutdown

exit

!

vlan 2

name SecondVLAN

exit

!

interface vlan 1

ip address 10.0.0.3 255.0.0.0

no shut

exit

1. Verify that trunking and VLANs are propagated to all switches also you can ping between VLAN 1

**S3# ping 10.0.0.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/4/9 ms

**S3# ping 10.0.0.2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/5/9 ms

Sherif-S3#

## Step 2: Discover your default spanning tree.

Your switches have been configured with a basic configuration with **Rapid Spanning Tree** enabled. Once enabled on all three switches, RSTP (IEEE 802.1w) converged onto a loop-free logical network within a few seconds.

Before proceeding with the lab, you need to know how the current STP loop-free topology looks like. For each VLAN, you need to know which:

* + Switch became the root bridge
  + Ports became root, designated, and alternate ports

It can be helpful to draw this logical Layer 2 STP topology. The spanning tree topology is the same for both VLAN 1 and VLAN 2.

**Note**: Outputs and Spanning Tree topologies highlighted in this lab will/may be different than what you observe using your own equipment.

1. On **S1,S2,S3** enter the **show spanning-tree vlan 1** command.

Compare the output generated by each switch and refer to the topology diagram.

1. Based on the output generated below, S3 switch was selected the root switch **(Your output may/will be different from the one shown below, i.e. your Root Switch will/may be different that S3 that is shown below:)**

**S3#sh spanning-tree vlan 1**

VLAN0001

Spanning tree enabled protocol rstp

Root ID Priority 32769

Address 001b.2ae8.ec80

**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 001b.2ae8.ec80**

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 300 sec

**S1#sh spanning-tree vlan 1 (your result may/will be different)**

VLAN0001

Spanning tree enabled protocol rstp

Root ID Priority 32769

**Address 001b.2ae8.ec80===🡺 MAC address of Root switch “S3”**

**S2#sh spanning-tree vlan 1 (your result may/will be different)**

VLAN0001

Spanning tree enabled protocol rstp

Root ID Priority 32769

**Address 001b.2ae8.ec80===🡺 MAC address of Root switch “S3”**

**Part 2: Implement and Observe Various Topology Tuning Methods**

In Part 2, you will implement various topology tuning methods.

## Step 1: Controlling the Root Bridge.

The current root bridge was elected based on the **lowest Bridge ID (consisting of the Priority, extended system ID equal to the VLAN ID, and base MAC address values).**

With the priority and extended system IDs being identical, the root bridge's MAC is numerically smaller than the local bridge’s MAC. The result is that in a completely un-configured network, one single switch will be elected as the root bridge. The resulting choice of switch may or may not be desirable.

There are two basic ways to manipulate the configuration to control the location of the root bridge:

* + The **spanning-tree vlan** *vlan-id* **priority** *value* command can be used to manually set a priority value
  + The **spanning-tree vlan** *vlan-id* **root** { **primary** | **secondary** } command can be used to automatically set a priority value.

The difference between the two is that the **priority** command will set a specific number (multiple of 4096) as the priority. This number must be an increment of 4096. **The root primary command will set the local bridge's priority to 24,576 (if the local bridge MAC is lower than the current root bridge's MAC) or 4096 lower than the current root's priority (if the local bridge MAC is higher than the current root bridge's MAC). Notice that 24,576 is the sixth increment of 4096.**

The logic behind this operation is straight-forward. The **root primary** command tries to lower the priority only as much as is needed to win the root election, while leaving priorities between **24576 and the default 32768** for use by secondary bridges. The command always takes the entire Bridge ID into account when computing the resulting priority value.

**The spanning-tree vlan *vlan-id* root secondary command will statically set the local bridge’s priority to 28,672. In an otherwise unconfigured network where all switch priorities default to 32,768, the root primary command will set the priority on the switch to 24,576 (two 4096 increments lower than the default priority) while the root secondary command will set the priority on the secondary root to the 28,672 (one 4096 increment lower than the default priority).**

1. Configure **S1** the primary root bridge for VLAN 1 and the secondary root bridge for VLAN 2 as shown.

S1(config)#**spanning-tree vlan 1 root primary**

S1(config)#**spanning-tree vlan 2 root secondary**

1. Configure **S2** the primary root bridge for VLAN 2 and the secondary root bridge for VLAN 1:

S2(config)#**spanning-tree vlan 2 root primary**

S2(config)#**spanning-tree vlan 1 root secondary**

RSTP should quickly converge within seconds.

1. On **S3**, issue the command **show spanning-tree root**.

**S3# sh spanning-tree root**

Root Hello Max Fwd

Vlan Root ID Cost Time Age Dly Root Port

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**VLAN0001**  24577 c471.fefd.ac80 4 2 20 15 **Gig1/0/1**

**VLAN0002**  24578 a493.4cc5.f980 4 2 20 15 **Gig1/0/3**

From the above output, you can see that the root port for VLAN 1 is Gig1/0/1 and the root port for VLAN 2 is Gig1/0/3.

## Step 2: Adjust port cost on Switch “S3” values to impact root and designated port selection.

As the network is implemented right now, there are two direct paths between switch “S3” and the root bridge for each VLAN. Path and port costs are evaluated to determine the shortest path to the root bridge. In the case where there are multiple equal cost paths to the root bridge, additional attributes must be evaluated. In our case, the lower interface number (for example, Gig1/0/1) is chosen as the Root Port, and the higher interface number (for example, Gig1/0/2) is put into a spanning tree Discarding state.

You can see which ports are blocked with the **show spanning-tree** *vlan-id* command or the **show spanning-tree blockedports** command. For now, examine VLAN 1 on S1.

1. On S3, issue the commands **show spanning-tree vlan 1** and **show spanning-tree blockedports**.

**S3#** **show spanning-tree vlan 1**

**VLAN0001**

Spanning tree enabled protocol rstp Root ID Priority 24577

Address c471.fefd.ac80 Cost 4

Port 3 (GigabitEthernet1/0/1)

Hello Time **2** sec Max Age **20** sec Forward Delay **15** sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1) Address 001b.2ae8.ec80

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec Aging Time 300 sec

Interface Role Sts Cost Prio.Nbr Type

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Gig1/0/1 Root FWD | 4 |  | 128.1 |  | P2p |
| Gig1/0/2 Altn BLK | 4 |  | 128.2 |  | P2p |
| Gig1/0/3 Altn BLK | 4 |  | 128.3 |  | P2p |
| Gig1/0/4 Altn BLK | 4 |  | 128.4 |  | P2p |

As you can see, VLAN 1 has its Root Port **on Gig1/0/1**. Gig1/0/2, Gig1/0/3, and Gig1/0/4 are Alternate Blocking Ports.

To manipulate which port becomes the Root Port on **non-root bridges**, change the **port cost on the local switch or port priority** **value on the upstream switch.** Remember that this change could have an impact on downstream switches as well.

**Note**: The changes you are about to implement are considered topology changes and *could* have a significant impact on the overall structure of the spanning tree in your switch network. **Do not** make these changes in a production network without careful planning and prior coordination.

1. On **S3**, shutdown interfaces Gig1/0/1 and Gig1/0/2, assign a new port cost to Gig1/0/2, and then issue **no shutdown** to the ports.

S3(config)#**interface range gig1/0/1-2**

S3(config-if-range)#**shutdown** S3(config-if-range)#**exit**

!

S3(config)#**interface gig1/0/2**

S3(config-if)#**spanning-tree cost 2**

S3(config-if)#**exit**

S3(config)#**interface range gig1/0/1-2**

S3(config-if-range)#**no shutdown** S3(config-if-range)#**exit** S3(config)#**end**

1. Now verify that this impacts root port selection.

On **S3**, use the **show spanning-tree vlan 1**

S3# **show spanning-tree vlan 1**

VLAN0001

Spanning tree enabled protocol rstp Root ID Priority 24577

Address c471.fefd.ac80 Cost 2

**Port 2 (Gig1/0/2)**

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1) Address 001b.2ae8.ec80

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec Aging Time 300 sec

Interface Role Sts Cost Prio.Nbr Type

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Gi1/0/1 Altn BLK 4 128.1 P2p

**Gi1/0/2 Root FWD 2 128.2 P2p**

Gi1/0/3 Desg FWD 4 128.3 P2p

Gi1/0/4 Desg FWD 4 128.4 P2p

S3#

From the output you can see that the root port selected by S3 for VLAN 1 is now interface **Gig1/0/2** and the port (and root) cost is now 2.

## Step 3: Adjust port priority value on the upstream Switch “S2” to impact root port selection.

The next method to impact root port selection is configured on the **Root bridge** itself. In our current network topology, S3 has two connections to the root bridge for VLAN 2, switch S2. The **root port** has been selected, in this case based on the lowest port ID. Port ID is made up of two values, labeled as Prio (Priority) and Nbr (Number).

**Note**: The port number is not necessarily equal to the interface ID. A switch may use any port number for STP purposes if they are unique for each port on the switch.

The **port priority** can be any value between 0 and 240, in increments of 16 (older switches may allow setting the priority in different increments).

1. On **S3**, issue the command **show spanning-tree vlan 2** and take note of the port ID values listed.

### S3# show spanning-tree vlan 2 | begin Interface

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Interface |  | Role |  | Sts |  | Cost |  | Prio.Nbr |  | Type |
| Gig1/0/1 |  | Altn |  | BLK |  | 4 |  | 128.1 |  | P2p |
| Gig1/0/2 |  | Altn |  | BLK |  | 2 |  | 128.2 |  | P2p |
| **Gig1/0/3** |  | **Root** |  | **FWD** |  | **4** |  | **128.3** |  | **P2p** |
| Gig1/0/4 |  | Altn |  | BLK |  | 4 |  | 128.4 |  | P2p |

As expected with two equal-cost paths to the root bridge (using G1/0/3 and G1/0/4), the lower port ID (128.3) was selected as the root port.

1. On **S2**, modify the port priority of interface Fa0/2 so that it becomes the preferred port.

S2(config)#**int range gig1/0/1-2** S2(config-if-range)#**shutdown** S2(config-if-range)#**exit** S2(config)# **int gig1/0/2**

S2(config-if)#**spanning-tree port-priority 64**

S2(config-if)#**exit**

S2(config)#**int range gig1/0/1-2** S2(config-if-range)#**no shutdown** S2(config-if-range)#

1. On **S3**, issue the **show spanning-tree vlan 2** command and you will see that Gig1/0/4 is now the selected root port. This selection is based on the lower priority value of S2 interface Gig1/0/2. Notice that the lower priority value does not appear in any S3 output.

**S3# show spanning-tree vlan 2**

VLAN0002

Spanning tree enabled protocol rstp Root ID Priority 24578

Address a493.4cc5.f980 Cost 4

**Port 4 (GigabitEthernet1/0/4)**

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32770 (priority 32768 sys-id-ext 2) Address 001b.2ae8.ec80

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec Aging Time 300 sec

Interface Role Sts Cost Prio.Nbr Type

Gig1/0/1 Altn BLK 4 128.1 P2p

Gig1/0/2 Altn BLK 2 128.2 P2p

Gig1/0/3 Altn BLK 4 128.3 P2p

**Gig1/0/4 Root FWD 4 128.4 P2p**

S3#

**Part 3: Lab DEMO and lab document submission**

# Copy and paste into a text document or Screen Shots output from your Setup to the Table below and Demo it to your Instructor

# Submit your Lab document to BrighTSpace with ALL the names of your team members

|  |  |  |
| --- | --- | --- |
| Node | Show or ping command | Paste below a Screen shot from your setup |
| S3  (5 points) | **show spanning-tree vlan 1** |  |
| S3  (5 points) | **show spanning-tree vlan 2** |  |