Networking Academy

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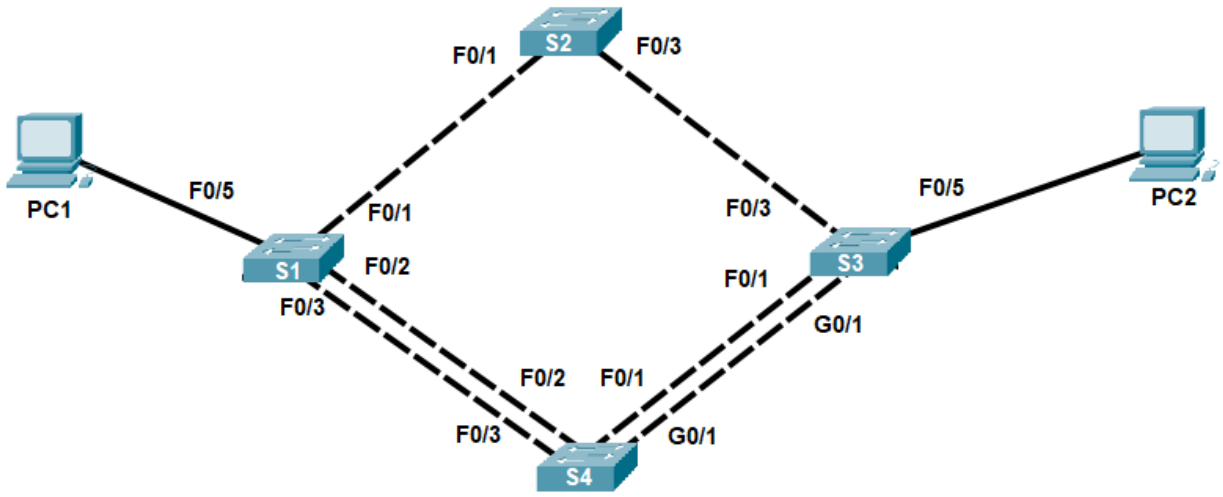
Lab 2.2 – Observing STP (Packet Tracer)

Topology

This activity comes with an accompanying Packet Tracer file with a partially configured network. Make sure to download the Packet Tracer file from the Animospace assignment page.



Addressing Table

Device	Interface	IP Address	Subnet Mask
PC1	NIC	192.168.1.1	255.255.255.0
PC2	NIC	192.168.1.2	255.255.255.0

Objectives

Part 1: Determine the Root Bridge and Port Roles

Part 2: Observe STP Port Selection Based on Path Cost

Part 3: Observe STP Port Selection Based on Port Priority

Background / Scenario

Redundancy increases the availability of devices in the network topology by protecting the network from a single point of failure. Redundancy in a switched network is accomplished through the use of multiple switches or multiple links between switches. When physical redundancy is introduced into a network design, loops and duplicate frames can occur.

The Spanning Tree Protocol (STP) was developed as a Layer 2 loop-avoidance mechanism for redundant links in a switched network. STP ensures that there is only one logical path between all destinations on the network by intentionally blocking redundant paths that could cause a loop.

Part 1: Determine the Root Bridge

Every spanning-tree instance (switched LAN or broadcast domain) has a switch designated as the root bridge. The root bridge serves as a reference point for all spanning-tree calculations to determine which redundant paths to block.

An election process determines which switch becomes the root bridge. The switch with the lowest bridge identifier (BID) becomes the root bridge. The BID is made up of a bridge priority value and the MAC address of the switch.

Step 1: Temporarily disable selected ports on the switches.

Temporarily deactivate ports F0/2 and G0/1 on **S4**.

```
S4(config)# interface f0/2
S4(config-if)# shutdown
S4(config-if)# interface g0/1
S4(config-if)# shutdown
S4(config-if)# end
```

Step 2: Display spanning tree information.

a. Issue the **show spanning-tree** command on S1. The Bridge ID Priority is calculated by adding the priority value and the extended system ID. The extended system ID is always the VLAN number. Currently, all four switches have equal Bridge ID Priority values (32769 = 32768 + 1, where default priority = 32768, VLAN number = 1); therefore, the switch with the lowest MAC address becomes the root bridge. The root bridge is identified by the switch in the command output under the Root ID section

```
S1# show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    32769
              Address     0001.64C4.1250
              Cost        38
              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     000B.BEBB.35C4
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20
Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Fa0/1               Root FWD 19        128.1    P2p
Fa0/3               Altn FWD 19        128.3    P2p
Fa0/5               Desg FWD 19        128.5    P2p
```

b. Use the **show spanning-tree** command on the rest of switches to gather information about the spanning tree status of each switch. Complete the table.

Switch	Port	Port Role (Root, Desg, Altn)	Status (FWD, BLK…)
S1	F0/1	Root	LSN
	F0/3	Altn	BLK
S2	F0/1	Desg	FWD
	F0/3	Root	FWD
S3	F0/1	Desg	FWD
	F0/3	Desg	FWD
S4	F0/1	Root	FWD
	F0/3	Desg	FWD

Based on the output from your switches, answer the following questions.

Which switch is the root bridge?	S3

Why did spanning tree select this switch as the root bridge?

It has the lowest bridge address (0005.5E62.0442)

Notice that Packet Tracer uses a different color for the link light on one of the connections between the switches. What do you think does this link light mean?

The orange light represents a blocked port.

Why did the spanning tree algorithm select this port as the non-designated (blocked) port?

It has a higher path cost than S4's Fa0/3, and S4's Fa0/3 is already designated.

Given the resulting spanning tree, what path do data frames take to go from PC1 to PC2?

PC1 -> S1 -> S2 -> S3 -> PC2

Part 2: Observe STP Port Selection Based on Path Cost

The spanning tree algorithm (STA) uses the root bridge as the reference point and then determines which ports to block, based on path cost. The port with the lower path cost is preferred. If path costs are equal, then spanning tree compares BIDs. If the BIDs are equal, then the port priorities are used to break the tie. Lower values are always preferred. In Part 2, you will change the path cost to control which port is blocked by spanning tree.

Step 1: Determine current path cost.

With the current topology, all switches are linked using Fast Ethernet connections which use a default link cost of 19. The spanning tree algorithm aggregates the cost of each individual link to determine the overall path costs which is used as basis to select the least cost path to the root bridge.

Issue the **show spanning-tree** command on S1. The Root ID section indicates the total cost of the least cost path calculated by the switch to reach the root bridge.

```
S1# show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    32769
              Address     0001.64C4.1250
              Cost        38
              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     000B.BEBB.35C4
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20
Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Fa0/1               Root FWD 19        128.1    P2p
Fa0/3               Altn FWD 19        128.3    P2p
Fa0/5               Desg FWD 19        128.5    P2p
Fa0/6               Desg FWD 19        128.6    P2p
```

Notice that the cost is currently 38. This is because to reach the root bridge (S3) through S2, S1 crosses two Fast Ethernet links with a cost of 19 each.

What would have been the path cost of S1 to S3 if going through S4?	23 (assuming it is not blocked and not shutdown)

Step 2: Change path cost.

You will now change the cost of the path going through S4 to influence the path of S1 to the root bridge by swapping the Fast Ethernet connection from S4 to the root bridge with a Gigabit connection. Deactivate F0/1 on **S4** and activate G0/1 instead.

```
S4(config)# interface f0/1
S4(config-if)# shutdown
S4(config-if)# interface g0/1
S4(config-if)# no shutdown
```

Step 3: Observe spanning tree changes.

Wait 30 seconds for the spanning-tree to adjust to the new topology (or you may click on the fast-forward button of Packet Tracer). Re-issue the **show spanning-tree** command **S1**. Observe that the path cost to root has now changed and the spanning tree is now blocking the port connected to S2.

```
S1# show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
```

```
  Root ID    Priority    32769
             Address     0001.64C4.1250
             Cost        23
             Port        3(FastEthernet0/3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000B.BEBB.35C4
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Fa0/1               Altn FWD 19        128.1    P2p
Fa0/3               Root FWD 19        128.3    P2p
Fa0/5               Desg FWD 19        128.5    P2p
Fa0/6               Desg FWD 19        128.6    P2p
```

Why did spanning tree change the previously blocked port to a root port, and block the port that was a root port on the other S2?

> Because the previously blocked port now has a lower cost.

How did the swapping of connection types between S4 and S3 affect the cost of the path? Hint: Observe the cost of the G0/1 port using **show spanning-tree** command on S4.

> The G0/1 port, being a gigabit ethernet port, costs less than a fast ethernet port. Thus, swapping the connection types made the path cost less than the previous path.

Part 3: Observe STP Port Selection Based on Port Priority

If path costs are equal, then spanning tree compares BIDs. If the BIDs are equal, then the port priorities are used to break the tie. The default port priority value is **128**. STP aggregates the port priority with the port number / port ID to break ties. Lower values are always preferred. In Part 3, you will activate the redundant paths between S4 and S3 to observe how STP selects a port using the port priority.

a. Activate the redundant link between S1 and S4 by enabling F0/2 on S4.

```
S4(config)# interface f0/2
S4(config-if)# no shutdown
S4(config-if)# end
```

b. Wait 30 seconds for STP to complete the port transition process (or you may click on the fast-forward button of Packet Tracer), and then issue the **show spanning-tree** command on S1. Observe that the root port has moved to the lower numbered port linked to the upstream switch and blocked the previous root port.

```
S1# show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
```

```
              Address     0001.64C4.1250
              Cost        23
              Port        2(FastEthernet0/2)
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     000B.BEBB.35C4
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Altn BLK 19        128.1    P2p
Fa0/2            Root FWD 19        128.2    P2p
Fa0/3            Altn BLK 19        128.3    P2p
Fa0/5            Desg FWD 19        128.5    P2p
Fa0/6            Desg FWD 19        128.6    P2p
```

What port did STP select as the root port on S1?	Fa0/2

Why did STP select this port as the root port on S1?

Because Fa0/2 has a lower port priority number (128.2) than Fa0/3 (128.3).

c. Adjust the port priority of the upstream switch **S4** to influence the selection of the root port on S1 by issuing the interface **spanning-tree vlan port-priority** command. Port priorities are set at 128 by default and may be adjusted in increments of 16.

```
S4(config)# interface f0/3
S4(config-if)# spanning-tree vlan 1 port-priority 112
```

d. Wait for the spanning tree to adjust to the new topology (or you may click on the fast-forward button of Packet Tracer) then issue the **show spanning-tree** command on **S4**. Confirm that the port priority has now changed for F0/3.

```
S4# show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    32769
              Address     0001.64C4.1250
              Cost        4
              Port        25(GigabitEthernet0/1)
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     0030.F250.0126
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20
```

```
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/3            Desg FWD 19        112.3    P2p
Gi0/1            Root FWD 4         128.25   P2p
```

e. Issue the **show spanning-tree** command on S1. Observe that the root port has again moved back to F0/3 from F0/2.

```
S1# show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.64C4.1250
             Cost        23
             Port        3(FastEthernet0/3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000B.BEBB.35C4
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Altn BLK 19        128.1    P2p
Fa0/2            Altn BLK 19        128.2    P2p
Fa0/3            Root FWD 19        128.3    P2p
Fa0/5            Desg FWD 19        128.5    P2p
Fa0/6            Desg FWD 19        128.6    P2p
```

Reflection

1. What is the advantage of having redundant paths in a switched network?

Redundant paths in a switched network offer advantages such as increased reliability, fault tolerance, load balancing, quick recovery, scalability, enhanced performance, fault isolation, and improved network availability.

2. Based on your tests and observations, in what order does a switch prioritize the following factors when selecting which among its ports to assign as the root port? (1= first, 4= last)

2	Lowest upstream switch BID
4	Lowest upstream switch interface ID
1	Lowest path cost
3	Lowest upstream switch interface priority