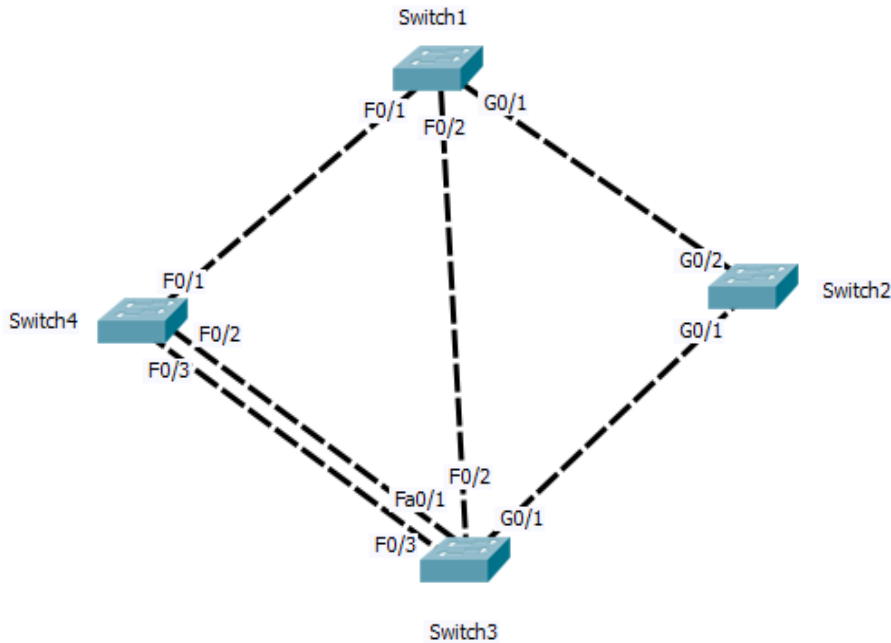## Lab 4: Configuring and verifying Spanning Tree Protocol

Activities:

1. *Use Cisco 2960 switches to create the topology shown below. Exactly use the indicated interface numbers to interconnect the switches.*

2. *Change hostnames to Switch1, Switch2, Switch3 and Switch4 as shown in the topology*

   Click on the respective Switch and click on CLI tab to access the command line interface of the switch.

   On Switch1:

   ```
   Switch>
   Switch>enable
   Switch#conf t
   Switch(config)#hostname Switch1
   Switch1(config)#exit
   Switch1#
   ```

   On Switch2:

   ```
   Switch>
   Switch>enable
   Switch#conf t
   Switch(config)#hostname Switch2
   Switch2(config)#exit
   Switch2#
   ```

   On Switch3:

   ```
   Switch>
   Switch>enable
   Switch#conf t
   Switch(config)#hostname Switch3
   Switch3(config)#exit
   Switch3#
   ```
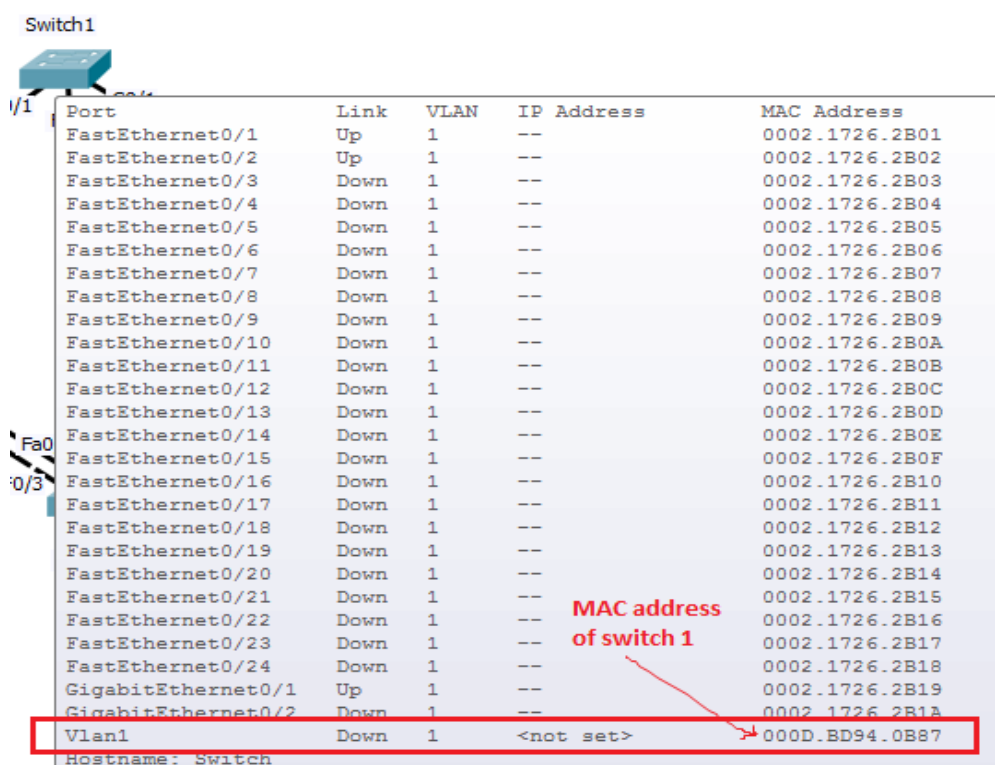
   On Switch4:

   ```
   Switch>
   ```

```
Switch>enable
Switch#conf t
Switch(config)#hostname Switch4
Switch4(config)#exit
Switch4#
```

3. **First compute the STP by hand. i.e, determine the root bridge, determine the least cost paths from each switch to the root bridge and determine the roles of the ports of each switch.**

→To compute STP by hand, you need to determine the bridge ID (priority and MAC addresses of each switch). You need to collect the priority and MAC addresses of each switch. At this time it is perfectly safe to assume that all the switches have a default priority of 32768. When working from packet tracer, you may move your mouse over the switch and record the MAC address corresponding to Vlan 1.

Switch1

```
Port                Link   VLAN   IP Address      MAC Address
FastEthernet0/1     Up     1      --              0002.1726.2B01
FastEthernet0/2     Up     1      --              0002.1726.2B02
FastEthernet0/3     Down   1      --              0002.1726.2B03
FastEthernet0/4     Down   1      --              0002.1726.2B04
FastEthernet0/5     Down   1      --              0002.1726.2B05
FastEthernet0/6     Down   1      --              0002.1726.2B06
FastEthernet0/7     Down   1      --              0002.1726.2B07
FastEthernet0/8     Down   1      --              0002.1726.2B08
FastEthernet0/9     Down   1      --              0002.1726.2B09
FastEthernet0/10    Down   1      --              0002.1726.2B0A
FastEthernet0/11    Down   1      --              0002.1726.2B0B
FastEthernet0/12    Down   1      --              0002.1726.2B0C
FastEthernet0/13    Down   1      --              0002.1726.2B0D
FastEthernet0/14    Down   1      --              0002.1726.2B0E
FastEthernet0/15    Down   1      --              0002.1726.2B0F
FastEthernet0/16    Down   1      --              0002.1726.2B10
FastEthernet0/17    Down   1      --              0002.1726.2B11
FastEthernet0/18    Down   1      --              0002.1726.2B12
FastEthernet0/19    Down   1      --              0002.1726.2B13
FastEthernet0/20    Down   1      --              0002.1726.2B14
FastEthernet0/21    Down   1      --              0002.1726.2B15
FastEthernet0/22    Down   1      --    MAC address  0002.1726.2B16
FastEthernet0/23    Down   1      --    of switch 1  0002.1726.2B17
FastEthernet0/24    Down   1      --              0002.1726.2B18
GigabitEthernet0/1  Up     1      --              0002.1726.2B19
GigabitEthernet0/2  Down   1      --              0002.1726.2B1A
Vlan1               Down   1      <not set>       000D.BD94.0B87
Hostname: Switch
```

Or you may use show spanning-tree command from the privileged mode to determine the mac address and priority of each switch.

For example, Switch1 in this case has a MAC address of 000D.BD94.0B87 and a priority of 32769. The priority is indicated as 32769 due to the fact that Cisco implements PVST (Per Vlan Spanning Tree algorithm) that adds VLAN ID to the priority value. Hence, you may assume the priority is 32768 for all switches.

```
Switch1#sh sp
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority     32769
              Address      000D.BD94.0B87          Priority
              This bridge is the root                        Mac address
              Hello Time   2 sec   Max Age 20 sec   Forward Delay 15 sec

  Bridge ID   Priority     32769   (priority 32768 sys-id-ext 1)
              Address      000D.BD94.0B87
              Hello Time   2 sec   Max Age 20 sec   Forward Delay 15 sec
              Aging Time   20

Interface          Role Sts Cost        Prio.Nbr Type
```

Similarly, you will use show spanning-tree command on all switches and record the priority and MAC address of all the switches and then you can compute STP manually by hand.

N.B: The values of the MAC addresses might be different in your case and hence, the STP might produce a different result from the outputs shown here.

After computing STP by hand, answer the following questions.

Which one of the switches is elected as the root bridge of the network? _____

Determine port roles of Switch 1. _____

Determine port roles of Switch 2. _____

Determine port roles of Switch 3. _____

Determine port roles of Switch 4. _____

4. **Use show spanning-tree command to verify STP**

On each switch, run the show spanning-tree command to verify which switch is elected as the root bridge, the least cost from any given switch to the root, and port roles of each switch.

On Switch 1:

The show spanning-tree command displays output related to the bridge ID of the root, bridge ID of the switch (in this case Switch1), and port roles of switch1. As a result, it turned out to be that Switch1 is the root. This can be verified by comparing the bridge ID of the root and Switch1. Or if switch1 is the root, then the *"This bridge is the root"* message will be displayed on Switch1.

Besides, we can verify that all ports of Switch1 are designated and their corresponding link costs are also indicated.

N.B: The values of the MAC addresses might be different in your case and hence, the STP might produce a different result from the outputs shown here.

```
Switch1>en
Switch1#sh sp
VLAN0001
  Spanning tree enabled protocol ieee          Priority and MAC address of the root bridge
  Root ID    Priority    32769
             Address     000D.BD94.0B87          Switch1 is the root bridge in this case
             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     000D.BD94.0B87
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20                     Priority and MAC address of
                                                Switch1

Interface         Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Gi0/1             Desg FWD 4    link costs  128.25   P2p
Fa0/2             Desg FWD 19               128.2    P2p
Fa0/1             Desg FWD 19               128.1    P2p

Switch1#        G0/1, F0/2, and F0/1 are all Designated ports
```

From what you have computed by hand, did you get a similar output when you issue the show spanning-tree command on switch1? _____

On Switch2:

Similarly, run show spanning-tree command on Switch2, and you will get a similar output.

```
Switch2#sh spa
VLAN0001                                        Bridge ID of the root(in my case, Switch1)
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000D.BD94.0B87          Switch will use G0/2 to reach the root
             Cost        4                       bridge and it has a cost of 4
             Port        26(GigabitEthernet0/2)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0030.F2EC.C8A9
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
                                                bridge ID of Switch2

Interface         Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Gi0/1             Desg FWD 4    both links  128.25   P2p
Gi0/2             Root FWD 4    have cost   128.26   P2p
                              of 4
              G0/1 of switch2 is Designated and
Switch2#      G0/2 is root port
```

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From what you have computed by hand, did you get a similar output when you issue the show spanning-tree command on switch2? _____

If you issue the show spanning-tree command on Switch3 and Switch4, you will get a similar output. Verify the results of your computation with show spanning-tree outputs on Switch3 and Switch4.

5. *Configure Switch3 to be the root bridge. If Switch3 is the default root bridge in your case, then configure Switch1 to be the new root bridge of the network*

By default, STP will choose a switch with lower bridge ID as the root of the network. If the priorities are not changed, then a switch with lower MAC address wins the election. What this means is that an older switch or a switch with least processing power might end up being elected as the root bridge. Hence, in practical case, you as the administrator of the network will manually configure the switch that will be serving as the root bridge.

To this end, you may decrease the priority of the switch.

In my case, I will configure Switch3 to be the root. If incase Switch3 is the root in your case, configure Switch1 as the root of the network.

On Switch3:

```
Switch3#conf t
Switch3(config)#spanning-tree vlan 1 priority 4096
Switch3(config)#
```

Once you configure a new priority value for switch3, the Spanning Tree algorithm will rerun again and elects Switch3 as the root bridge and every other switch will find a least cost path to Switch3.

N.B: the port roles will also be affected.

6. *Verify the configuration and verify the port states of each switch.*

Use show spanning-tree command on all switches and verify the root bridge, port roles and costs to the root bridge. The spanning tree updates the roles of the ports, costs leading to the root and the root bridge information accordingly. Since, we have decreased the priority of Switch3 (leaving the priority of the other switches to their default values), switch3 will the root bridge.

On switch3:

```
Switch3#sh spanning-tree
VLAN0001
   Spanning tree enabled protocol ieee
   Root ID     Priority    4097
               Address     00D0.BCA3.C5B6
```
Now switch 3 is This bridge is the root
the root bridge
```
               Hello Time   2 sec  Max Age 20 sec   Forward Delay 15 sec

   Bridge ID   Priority    4097  (priority 4096 sys-id-ext 1)
               Address     00D0.BCA3.C5B6
               Hello Time   2 sec  Max Age 20 sec   Forward Delay 15 sec
               Aging Time   20

Interface          Role Sts Cost        Prio.Nbr Type
---------------- ---- --- --------- -------- ------------------------
Gi0/1              Desg FWD 4          128.25   P2p
Fa0/1      all ports of  Desg FWD 19         128.1    P2p
Fa0/2      Switch 3 are  Desg FWD 19         128.2    P2p
Fa0/3      now designated Desg FWD 19        128.3    P2p

Switch3#
```

N.B: The values of the MAC addresses might be different in your case and hence, the STP might produce a different result from the outputs shown here.