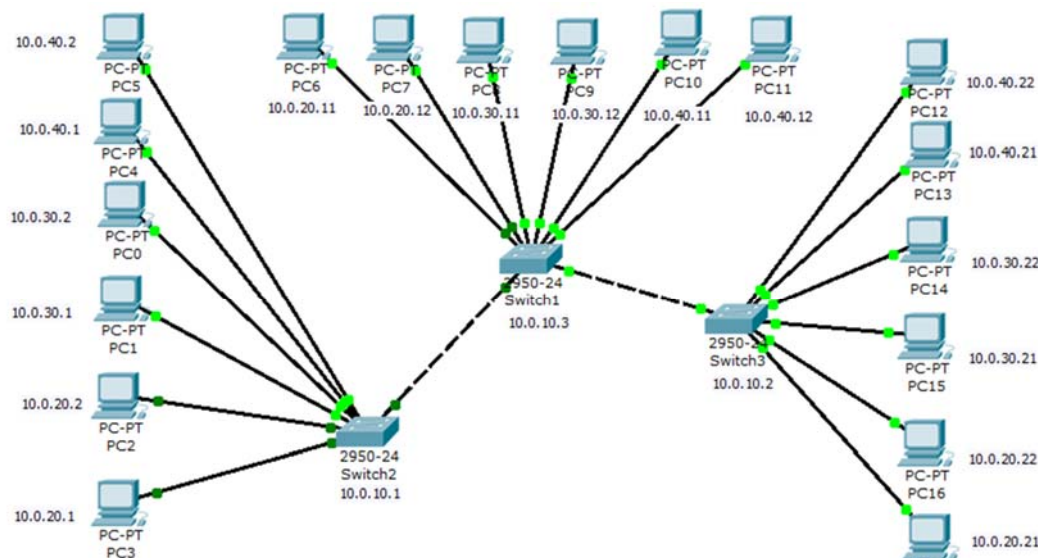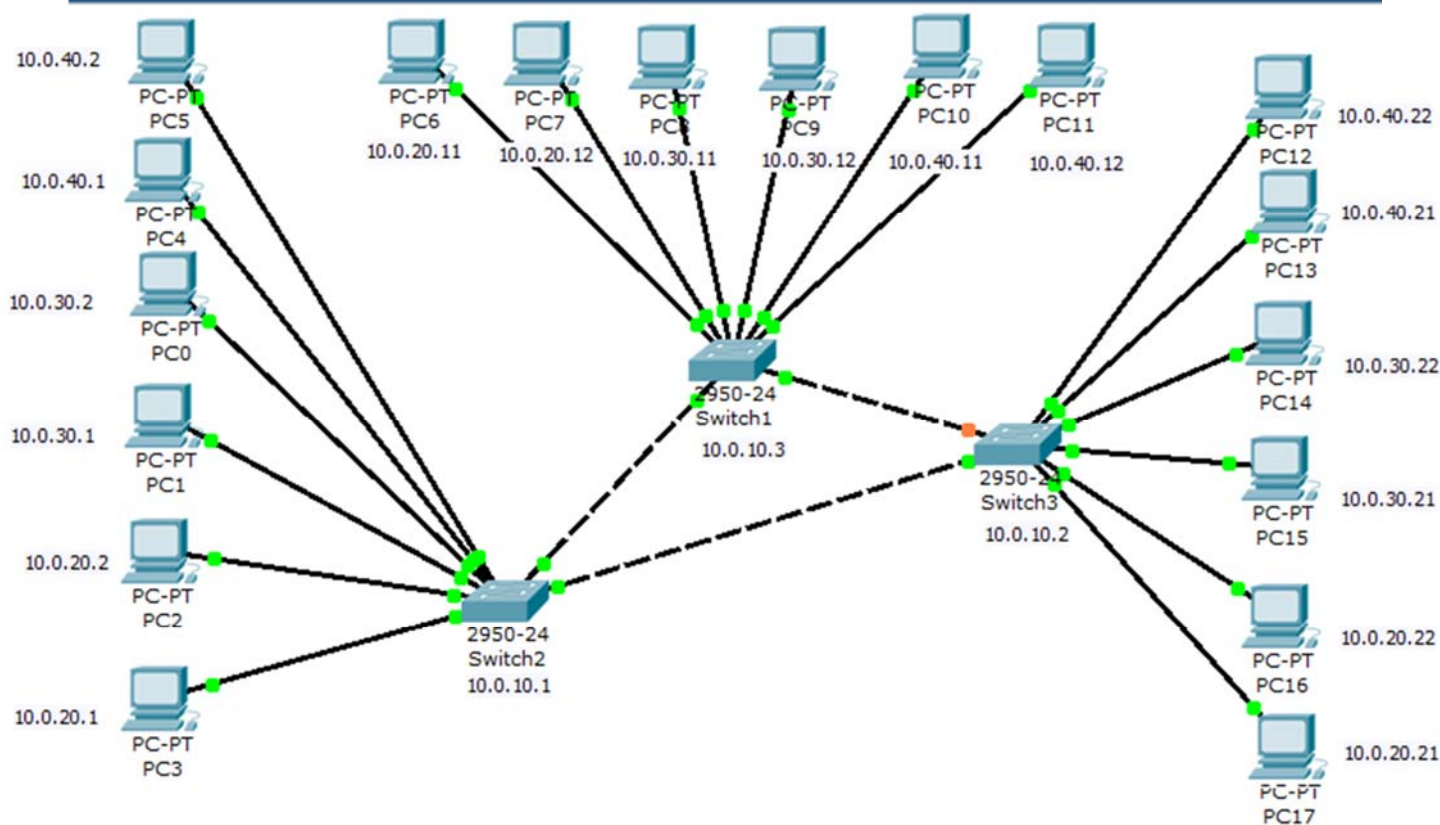# Lecture (07) STP (II)

By:

Dr. Ahmed ElShafee

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Networks I**

- Such design creates a single point of failure. We could easily tweak this simple design to make it more resilient by adding an extra path between **SW2** and **SW3**

```
SW2
+++
enable
config t
interface fa0/22
switchport mode trunk
end
copy running-config startup-config

SW03
++++
enable
config t
interface fa0/22
switchport mode trunk
end
copy running-config startup-config
```

- The redundant connection between **SW2** and **SW3** creates a loop.
- The loop in turn, will create three serious problems.
  - **Duplicate Frame Delivery**
  - **MAC Address Table Instability**
  - **Broadcast Storm**
- The last one in the list will eventually render our system unavailable.

STP

- Spanning-Tree Protocol (turned on by default), which will dynamically block redundant connections creating a loop free topology.
- Should the primary link fail, the one that is in the blocking state will start forwarding the traffic in about 30 seconds by default

Spanning-Tree Protocol Overview

STP is a layer 2 loop prevention mechanism.

- Switches running this protocol use special frames called **Bridge Protocol Data Unit** (BPDU).

- STP let switches create a loop free topology. This is accomplished using three distinct phases:

1. Select **a single switch** to be the **root bridge** machine which is the central device in the layer 2 network.

- This machine will have all its ports in the forwarding state (**designated port** role).

2. All other switches (non-root switches), will select **a single path** towards the root bridge.

- That port is called the '**root port**' and will be forwarding traffic that is destined out of the switch through the root bridge.

- This path is the least cost (best) path towards the root.

3. All other switches will select **a single path per segment** in order to block stop the loop.

- The port that is forwarding traffic is called **designated port**.

- The port that is blocking traffic to stop the loop is called **non-designated port**.

- administrator should configure the root bridge.
- Typically, the most powerful switch in the center of the network plays that role.
- You do not want some access switch to be transmitting the frames between other switches.
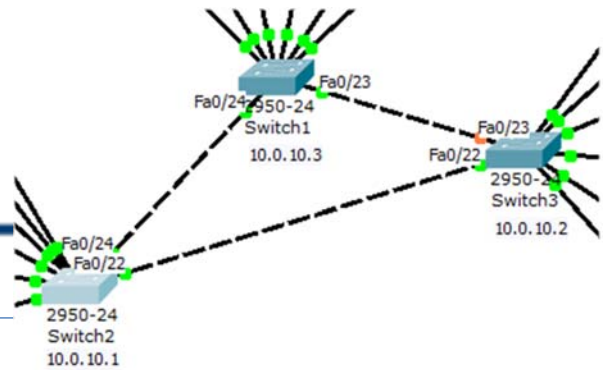- Access switches are designed to connect your computers to the network, and not to handle the majority of the traffic between the switches which root bridge must deal with.
- If you do not configure root bridge yourself, the switch with the lowest MAC address becomes the root since the priority is identical on all of them by default.

Discovering root switch

```
sw01#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
            Address      000D.BD98.4239
            Cost         19
            Port         24(FastEthernet0/24)
            Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec


  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
            Address      00D0.9721.49E8
            Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/24           Root FWD 19        128.24   P2p
Fa0/23           Desg FWD 19        128.23   P2p
```

```
SW02#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000D.BD98.4239
             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.BD98.4239
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/24           Desg FWD 19         128.24  P2p
Fa0/22           Desg FWD 19         128.22  P2p
```



```
sw03#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000D.BD98.4239
             Cost        19
             Port        22(FastEthernet0/22)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     00E0.A303.8D77
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/22           Root FWD 19         128.22  P2p
Fa0/23           Altn BLK 19         128.23  P2p
```
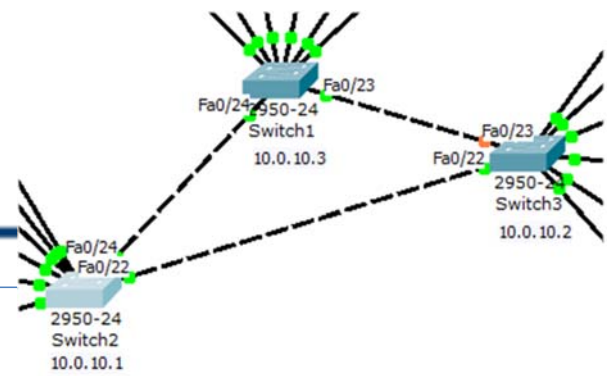
Setting root switch, Method 1

- decrement the priority on **SW1** and leave the default value on the other switches, The lowest priority value allowed is zero and if higher needs to be used, it must be an increment of 4096.

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```
FL01-R03-SW03#show vlan
VLAN Name                        Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                     active    Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                           Fa0/20, Fa0/21, Fa0/24
2    Finance                     active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                           Fa0/5
3    HR                          active    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                           Fa0/10
4    Administration              active    Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                           Fa0/15
```

```
FL01-R03-SW03(config)#spanning-tree vlan 1,2,3,4 priority 0
FL01-R03-SW03(config)#end
FL01-R03-SW03#copy running-config startup-config
```

```
sw01#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID   Priority    1
            Address     00D0.9721.49E8
            This bridge is the root
            Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    1  (priority 0 sys-id-ext 1)
            Address     00D0.9721.49E8
            Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time  20

Interface       Role Sts Cost     Prio.Nbr Type
---------------- ---- --- --------- -------- -------------------------------
Fa0/23          Desg FWD 19        128.23  P2p
Fa0/24          Desg FWD 19        128.24  P2p
```

```
SW02#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    1
           Address     00D0.9721.49E8
           Cost        19
           Port        24(FastEthernet0/24)
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
           Address     000D.BD98.4239
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
           Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/24           Root FWD 19         128.24  P2p
Fa0/22           Desg FWD 19         128.22  P2p
```
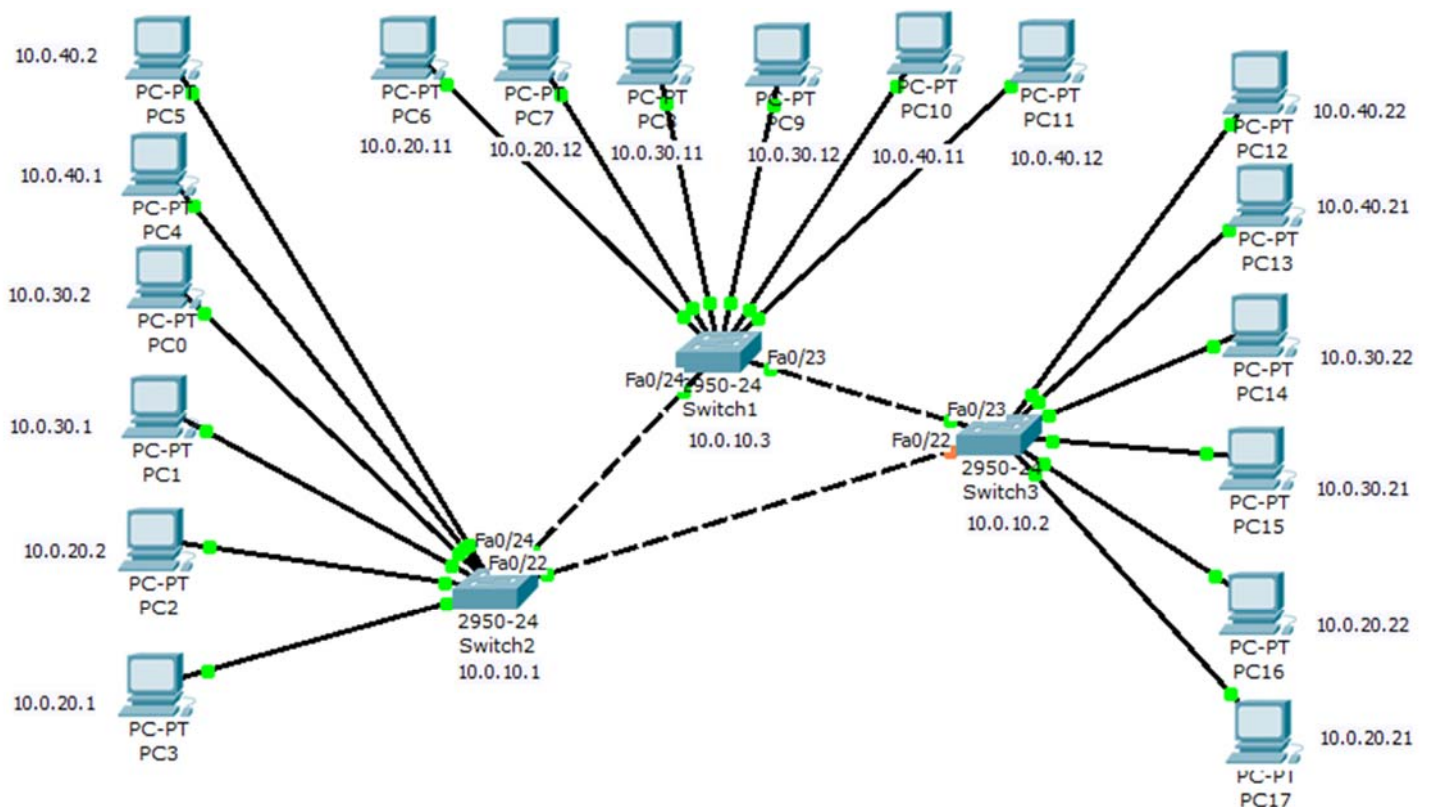
```
sw03#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    1
           Address     00D0.9721.49E8
           Cost        19
           Port        23(FastEthernet0/23)
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
           Address     00E0.A303.8D77
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
           Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/23           Root FWD 19         128.23  P2p
Fa0/22           Altn BLK 19         128.22  P2p
```

Setting root switch, Method 2

- Use spanning-tree vlan root primary macro command which decrements the priority value using Cisco best practices.

```
FL01-R03-SW03#show vlan
VLAN Name                        Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                     active    Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                           Fa0/20, Fa0/21, Fa0/24
2    Finance                     active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                           Fa0/5
3    HR                          active    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                           Fa0/10
4    Administration              active    Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                           Fa0/15
```

```
FL01-R03-SW03(config)#spanning-tree vlan 1,2,3,4 root primary
FL01-R03-SW03(config)#end
FL01-R03-SW03#copy running-config startup-config
```

```
sw01#show spanning-tree vlan 1
VLAN0001
 Spanning tree enabled protocol ieee
 Root ID    Priority    24577
            Address     00D0.9721.49E8
            This bridge is the root
            Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24577  (priority 24576 sys-id-ext 1)
            Address     00D0.9721.49E8
            Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time  20


Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/24           Desg FWD 19        128.24  P2p
Fa0/23           Desg FWD 19        128.23  P2p
```

```
SW02#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
           Address     00D0.9721.49E8
           Cost        19
           Port        24(FastEthernet0/24)
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
           Address     000D.BD98.4239
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
           Aging Time  20

Interface        Role Sts Cost     Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/22           Desg FWD 19        128.22   P2p
Fa0/24           Root FWD 19        128.24   P2p
```

```
sw03#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
           Address     00D0.9721.49E8
           Cost        19
           Port        23(FastEthernet0/23)
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
           Address     00E0.A303.8D77
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
           Aging Time  20

Interface        Role Sts Cost     Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/22           Altn BLK 19        128.22   P2p
Fa0/23           Root FWD 19        128.23   P2p
```
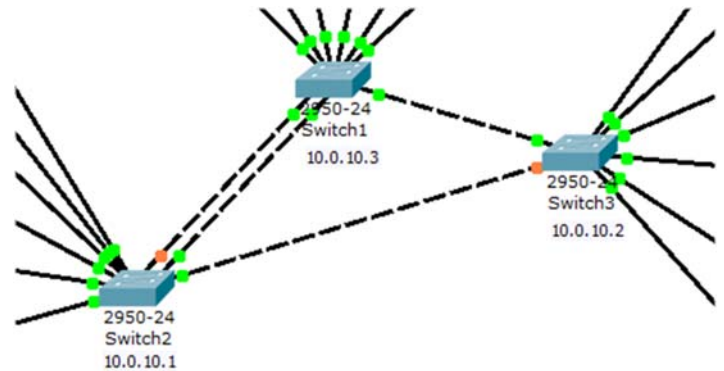
Add redundant root ports

- Firstly lets add redundant connection between SW 1,2

- Collect spanning-tree information on vlan 1 of both SW01, SW02
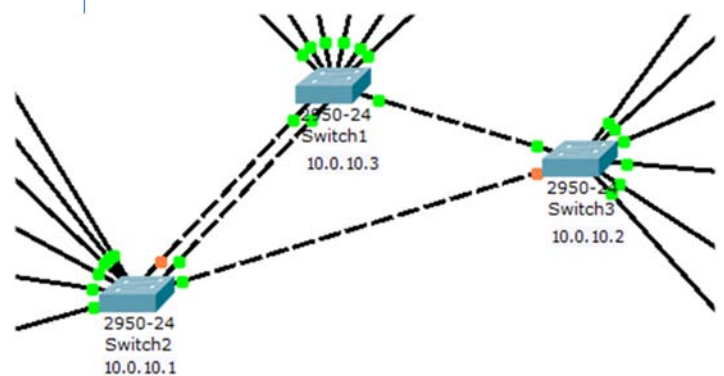

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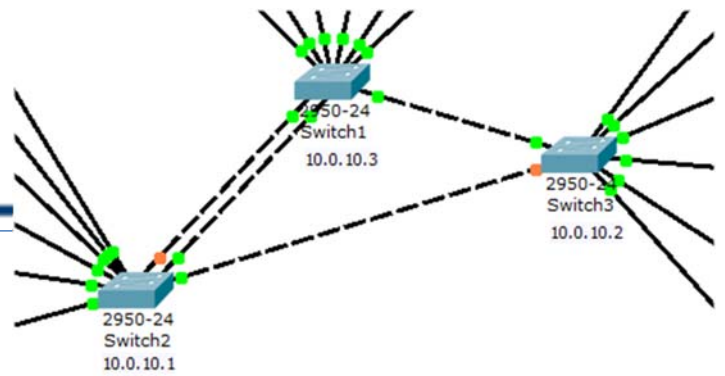

```
SW01
++++
enable
config t
interface fa0/21
switchport mode trunk
end
copy running-config startup-config

SW02
++++
enable
config t
interface fa0/21
switchport mode trunk
end
copy running-config startup-config
```


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```
sw01#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID   Priority   24577
          Address    00D0.9721.49E8
          This bridge is the root
          Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority   24577  (priority 24576 sys-id-ext 1)
          Address    00D0.9721.49E8
          Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
          Aging Time  20

Interface         Role Sts Cost       Prio.Nbr Type
---------------- ---- --- --------- -------- -------------------------------
Fa0/21            Desg FWD 19         128.21  P2p
Fa0/23            Desg FWD 19         128.23  P2p
Fa0/24            Desg FWD 19         128.24  P2p
```
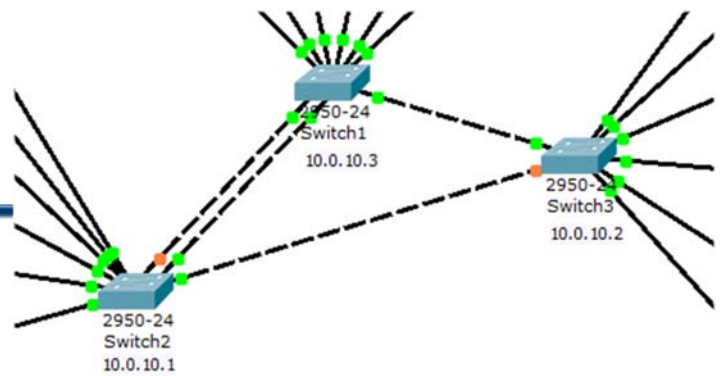


```
SW02#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID   Priority   24577
          Address    00D0.9721.49E8
          Cost       19
          Port       21(FastEthernet0/21)
          Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority   32769  (priority 32768 sys-id-ext 1)
          Address    000D.BD98.4239
          Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
          Aging Time  20

Interface         Role Sts Cost       Prio.Nbr Type
---------------- ---- --- --------- -------- -------------------------------
Fa0/22            Desg FWD 19         128.22  P2p
Fa0/24            Altn BLK 19         128.24  P2p
Fa0/21            Root FWD 19         128.21  P2p
```

Swap alternative and root ports in SW02 (24, 21)

- **@ root switch (SW1) decrease priority of alternative port (24) to 64**

```
en
config t
interface fa0/24
spanning-tree vlan 1 port-priority 64
end
copy running-config startup-config
```

```
sw01#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
        Address     00D0.9721.49E8
        This bridge is the root
        Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24577  (priority 24576 sys-id-ext 1)
        Address     00D0.9721.49E8
        Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
        Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19         128.21   P2p
Fa0/23           Desg FWD 19         128.23   P2p
Fa0/24           Desg FWD 19         64.24    P2p
```

```
SW02#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
         Address    00D0.9721.49E8
         Cost        19
         Port        24(FastEthernet0/24)
         Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
         Address    000D.BD98.4239
         Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
         Aging Time  20


Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/22           Desg FWD 19          128.22   P2p
Fa0/24           Root FWD 19          128.24   P2p
Fa0/21           Altn BLK 19        128.21   P2p
```

Load balancing between redundant ports

- @ root switch (SW01), Check spanning tree on shared ports

```
sw01#show spanning-tree interface FastEthernet 0/21
Vlan            Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
VLAN0001         Desg FWD 19          128.21   P2p
VLAN0002         Desg FWD 19          128.21   P2p
VLAN0003         Desg FWD 19          128.21   P2p
VLAN0004         Desg FWD 19          128.21   P2p
```
```
sw01#show spanning-tree interface FastEthernet 0/24
Vlan            Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
VLAN0001         Desg FWD 19          128.24   P2p
VLAN0002         Desg FWD 19          128.24   P2p
VLAN0003         Desg FWD 19          128.24   P2p
VLAN0004         Desg FWD 19          128.24   P2p
```

- @ SW02, Check spanning tree on shared ports

```
SW02>en
SW02#show spanning-tree interface FastEthernet 0/21
Vlan          Role Sts Cost     Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
VLAN0001        Root FWD 19       128.21   P2p
VLAN0002        Root FWD 19       128.21   P2p
VLAN0003        Root FWD 19       128.21   P2p
VLAN0004        Root FWD 19       128.21   P2p
```

```
SW02#show spanning-tree interface fa0/24
Vlan          Role Sts Cost     Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
VLAN0001        Altn BLK 19       128.24   P2p
VLAN0002        Altn BLK 19       128.24   P2p
VLAN0003        Altn BLK 19       128.24   P2p
VLAN0004        Altn BLK 19       128.24   P2p
```
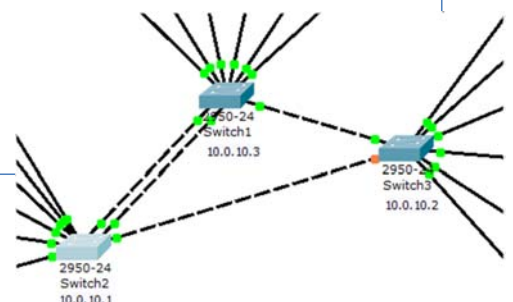
- @ root switch (SW01) decrease vlan3,4 priorities

```
interface FastEthernet 0/24
spanning-tree vlan 3 port-priority 64
spanning-tree vlan 4 port-priority 64
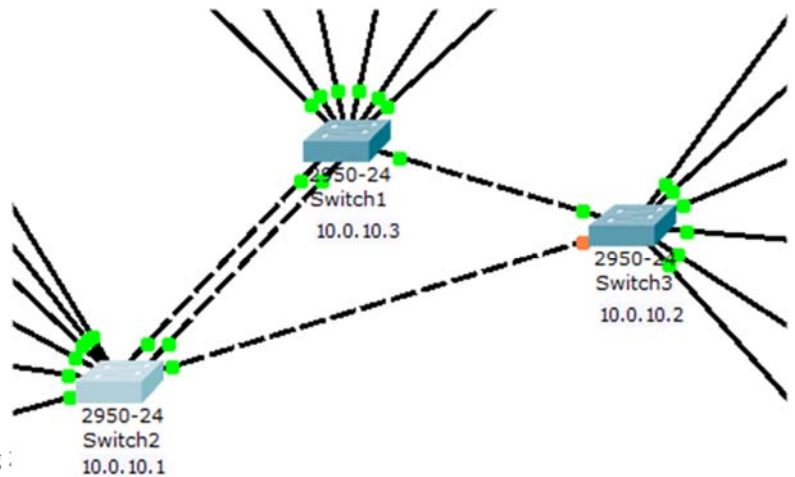```

- Check spanning tree on SW02 shared ports

```
SW02#show spanning-tree interface FastEthernet 0/21
Vlan          Role Sts Cost     Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
VLAN0001        Root FWD 19       128.21   P2p
VLAN0002        Root FWD 19       128.21   P2p
VLAN0003        Altn BLK 19       128.21   P2p
VLAN0004        Altn BLK 19       128.21   P2p
```

```
SW02#show spanning-tree interface FastEthernet 0/24
Vlan            Role Sts Cost      Prio.Nbr Type

---------------- ---- --- --------- -------- --------------------------------
VLAN0001        Altn BLK 19        128.24   P2p
VLAN0002        Altn BLK 19        128.24   P2p
VLAN0003        Root FWD 19        128.24   P2p
VLAN0004        Root FWD 19        128.24   P2p
```

```
sw01#show spanning-tree interface FastEthernet 0/21
Vlan            Role Sts Cost      Prio.Nbr Type

---------------- ---- --- --------- -------- --------------------------------
VLAN0001        Desg FWD 19        128.21   P2p
VLAN0002        Desg FWD 19        128.21   P2p
VLAN0003        Desg FWD 19        128.21   P2p
VLAN0004        Desg FWD 19        128.21   P2p
sw01#show spanning-tree interface FastEthernet 0/24
Vlan            Role Sts Cost      Prio.Nbr Type

---------------- ---- --- --------- -------- --------------------------------
VLAN0001        Desg FWD 19        128.24   P2p
VLAN0002        Desg FWD 19        128.24   P2p
VLAN0003        Desg FWD 19        64.24    P2p
VLAN0004        Desg FWD 19        64.24    P2p
```

Thanks,..

See you next week (ISA),...

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