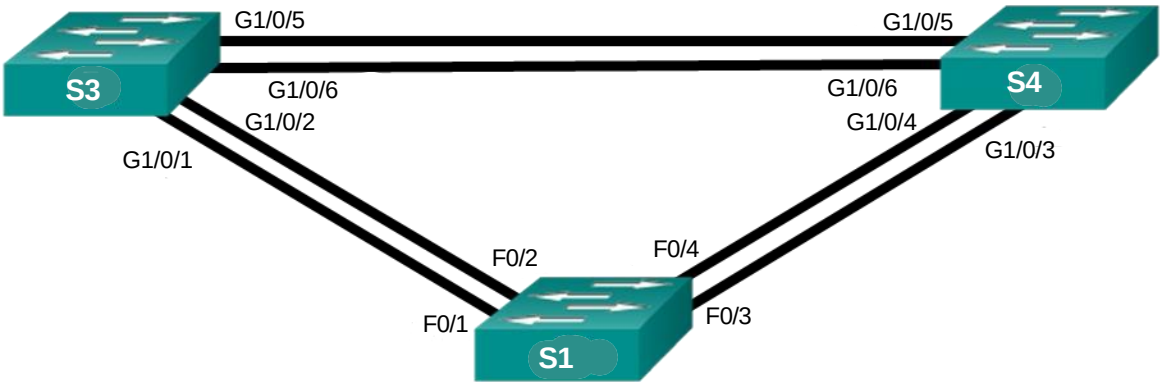
Lab – Building a Switched Network with Redundant Links

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask
S1	VLAN 1	192.168.1.1	255.255.255.0
S3	VLAN 1	192.168.1.3	255.255.255.0
S4	VLAN 1	192.168.1.4	255.255.255.0

Objectives

Part 1: Build the Network and Configure Basic Device Settings Part 2:

Determine the Root Bridge

Part 3: Observe STP Port Selection Based on Port Cost Part 4:

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.

In this lab, you will use the **show spanning-tree** command to observe the STP election process of the root bridge. You will also observe the port selection process based on cost and priority.

Note: Make sure that the switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

Required Resources

- 3 Switches
- Ethernet cables as shown in the topology

Part 1: Build the Network and Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings on the switches.

Step 1: Initialize and reload the switches as necessary.

On all switches, erase the startup-config file (write erase) the vlan.dat file (delete vlan.dat) and reload

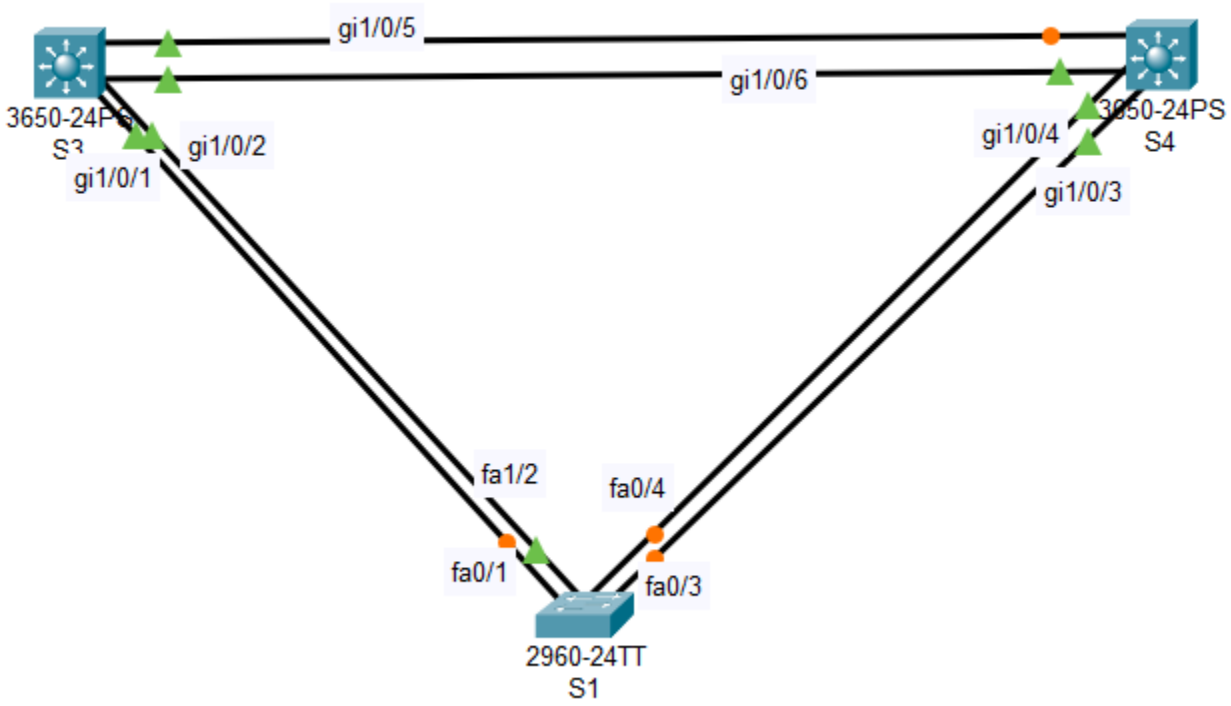
```
Switch> ena
Switch# write erase
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
Switch# delete flash:vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]
%Error deleting flash:/vlan.dat (No such file or directory)

Switch# reload
Proceed with reload? [confirm]
C2960 Boot Loader (C2960-HBOOT-M) Version 12.2(25r)FX, RELEASE SOFTWARE (fc4)
Cisco WS-C2960-24TT (RC32300) processor (revision C0) with 21039K bytes of memory.
2960-24TT starting...
Base ethernet MAC Address: 00E0.F9CE.D9E0
Xmodem file system is available.
Initializing Flash...
flashfs[0]: 1 files, 0 directories
flashfs[0]: 0 orphaned files, 0 orphaned directories
flashfs[0]: Total bytes: 64016384
flashfs[0]: Bytes used: 4670455
flashfs[0]: Bytes available: 59345929
flashfs[0]: flashfs fsck took 1 seconds.
...done Initializing Flash.

Boot Sector Filesystem (bs:) installed, fsid: 3
Parameter Block Filesystem (pb:) installed, fsid: 4


Loading "flash:/2960-lanbasek9-mz.150-2.SE4.bin"...
################################################################################ [OK]
Smart Init is enabled
smart init is sizing iomem
                 TYPE      MEMORY_REQ
               TOTAL:      0x00000000
Rounded IOMEM up to: 0Mb.
Using 6 percent iomem. [0Mb/512Mb]
```

```
Switch> ena
Switch# write erase
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
Switch#
Switch# delete flash:vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]
%Error deleting flash:/vlan.dat (No such file or directory)

Switch# reload
Proceed with reload? [confirm]
Booting...
Interface GE 0 link down***ERROR: PHY link is down
Reading full image into memory
.............................................done
Bundle Image
-------------------------------------
Kernel Address : 0x5342e350
Kernel Size : 0x418a9b / 4295323
Initramfs Address : 0x53846dec
Initramfs Size : 0xe780c3 / 15171779
Compression Format : .mzip

Bootable image at @ ram : 0x5342e350
Bootable image segment 0 address range[0x81100000, 0x82140000] is in range[0x80180000, 0x90000000].
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
File flash:/cat3k_caa-universalk9.16.03.02.SPA.bin uncompressed and installed, entry point :
0x81690280
Loading Linux kernel with entry point 0x8166a600 ...
Bootloader: Done loading app on core_mask : 0xf

### Launching Linux Kernel (flags = 0x5)

%IOSXEBOOT-7474e1d3392fed124a6b809c1b351b29-new cksum: (rp/0): 4
```

```
Switch> ena
Switch# write erase
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
Switch# delete flash:vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]
%Error deleting flash:/vlan.dat (No such file or directory)

Switch# reload
Proceed with reload? [confirm]
Booting...
Interface GE 0 link down***ERROR: PHY link is down
Reading full image into memory
..................................................done
Bundle Image
--------------------------------------
Kernel Address : 0x5342e350
Kernel Size : 0x418a9b / 4295323
Initramfs Address : 0x53846dec
Initramfs Size : 0xe780c3 / 15171779
Compression Format : .mzip

Bootable image at @ ram : 0x5342e350
Bootable image segment 0 address range[0x81100000, 0x82140000] is in range[0x80180000, 0x90000000].
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
File flash:/cat3k_caa-universalk9.16.03.02.SPA.bin uncompressed and installed, entry point :
0x81690280
Loading Linux kernel with entry point 0x8166a600 ...
Bootloader: Done loading app on core_mask : 0xf

### Launching Linux Kernel (flags = 0x5)

%IOSXEBOOT-7474e1d3392fed124a6b809c1b351b29-new_cksum: (rp/0): 4
%IOSXEBOOT - 7474e1d3392fed124a6b809c1b351b29 - saved_cksum: (rp / 0) : 4
% IOSXEBOOT - Sat - ### : (rp / 0) : Feb 4 22 : 18 : 09 Universal 2017 PLEASE DO NOT POWER CYCLE
### BOOT LOADER UPGRADING 4
```

Step 2: Cable the network as shown in the topology.

Verify the devices are interconnected as shown in the topology diagram.



Step 3: Configure basic settings for each switch.

a. Disable DNS lookup.

```
Switch# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# no ip domain-lookup
Switch(config)#
```

```
Switch> ena
Switch# config
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# no ip domain-lookup
Switch(config)#
```

```
Switch> ena
Switch# config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# no ip domain-lookup
Switch(config)#
```

b. Configure the device name as shown in the topology.

```
Switch(config)# hostname S1
S1(config)#
```

```
Switch(config)# hostname S4
S4(config)#
```

```
Switch(config)# hostname S3
S3(config)#
```

c. Configure logging synchronous for the console line.

```
S1# config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)# line console 0
S1(config-line)# logging synchronous
S1(config-line)# end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#
```

```
S4(config)# line console 0
S4(config-line)# logging synchronous
S4(config-line)# end
S4#
%SYS-5-CONFIG_I: Configured from console by console

S4#
```

```
S3(config)# line console 0
S3(config-line)# logging synchronous
S3(config-line)# end
S3#
%SYS-5-CONFIG_I: Configured from console by console

S3#
```

d. Configure a message of the day (MOTD) banner to warn users that unauthorized access is prohibited.

```
S1# config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)# banner motd +**********
Enter TEXT message.  End with the character '+'.
**********
Unauthorized access is prohibited!
**********+

S1(config)#
```

```
S4# config t
Enter configuration commands, one per line.  End with CNTL/Z.
S4(config)# banner motd +**********
Enter TEXT message.  End with the character '+'.
**********
Unauthorized access is prohibited!
**********+

S4(config)#
```

```
S3# config t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)# banner motd +*********************
Enter TEXT message.  End with the character '+'.
*********************
Unauthorized access is prohibited!
*********************+
```

e. Configure the IP address listed in the Addressing Table for VLAN 1 on all switches.

```
S1# config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)# int vlan 1
S1(config-if)# ip address 192.168.1.1 255.255.255.0
S1(config-if)# end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#
```

```
S4# config t
Enter configuration commands, one per line.  End with CNTL/Z.
S4(config)# int vlan 1
S4(config-if)# ip address 192.168.1.4 255.255.255.0
S4(config-if)# end
S4#
%SYS-5-CONFIG_I: Configured from console by console

S4#
```

```
S3(config)# int vlan 1
S3(config-if)# ip address 192.168.1.3 255.255.255.0
S3(config-if)# end
S3#
%SYS-5-CONFIG_I: Configured from console by console

S3#
```

Step 4: Test connectivity.

Verify that the each of the switches can ping all the other switches. Troubleshoot until full connectivity is achieved

```
S1# ping 192.168.1.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

```
S4# ping 192.168.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/2/8 ms
```

```
S4# ping 192.168.1.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

```
S3# ping 192.168.1.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

```
S3# ping 192.168.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

```
S1# ping 192.168.1.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

Part 2: 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, an extended system ID, and the MAC address of the switch. The priority value can range from 0 to 65,535, in increments of 4,096, with a default value of 32,768.

In the spanning tree, ports are designated as a **root** port, a **designated** port, or an **alternate** port.

- **Root Port:** A port that is activated and following it will direct traffic towards the root bridge
- **Designated Port:** A port that is activated and following it will direct traffic away from the root bridge
- **Alternate Port:** A redundant port that is currently not activated

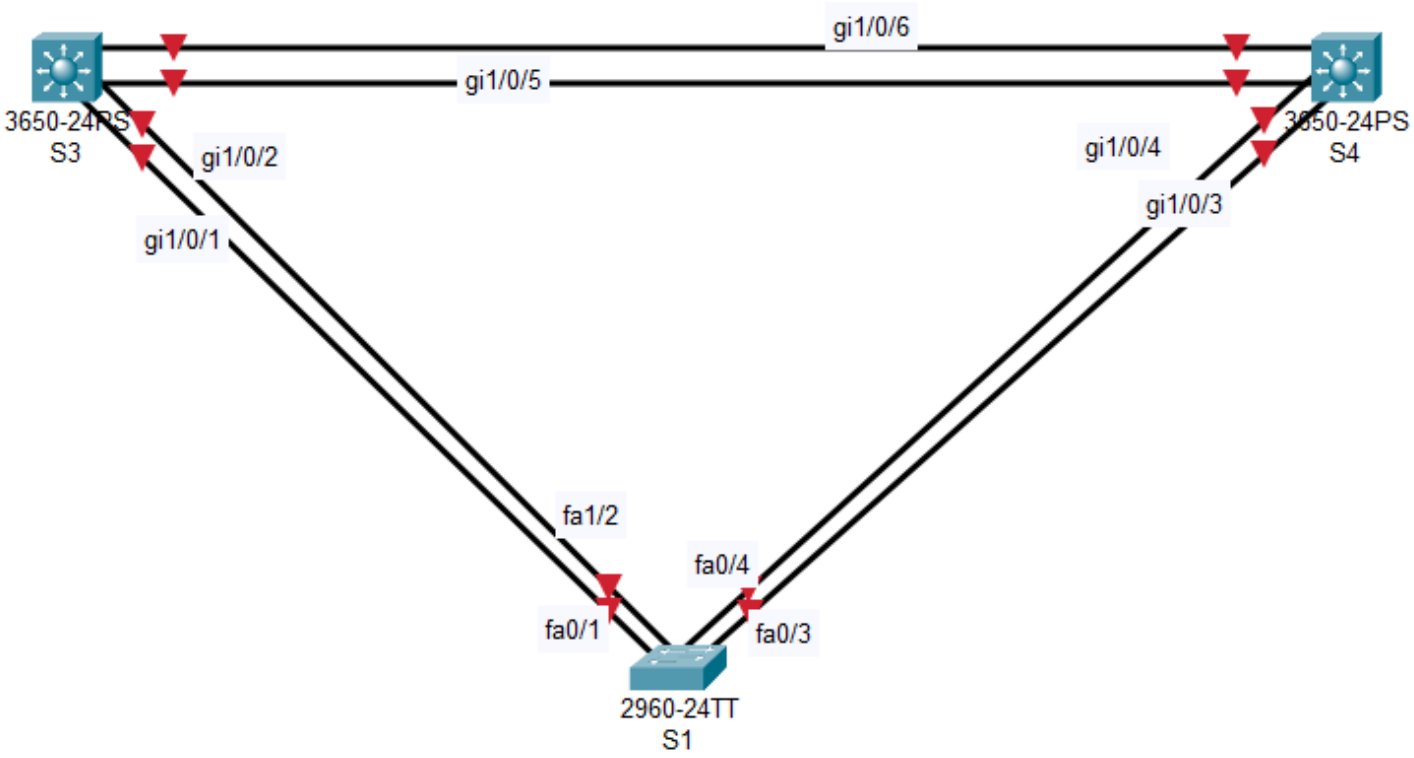
Note: If a link between two switches is disabled by STP, only one end of the link is physically blocked, the other end

will be enabled and set to a **designated** port.

Note: If a port is a **root** port, the port at the other end of the link will always be a **designated** port. This statement is not true in the reverse direction.

Step 1: Configure switches for Spanning Tree operation over trunked interfaces

a. Deactivate (shutdown) all ports on the switches

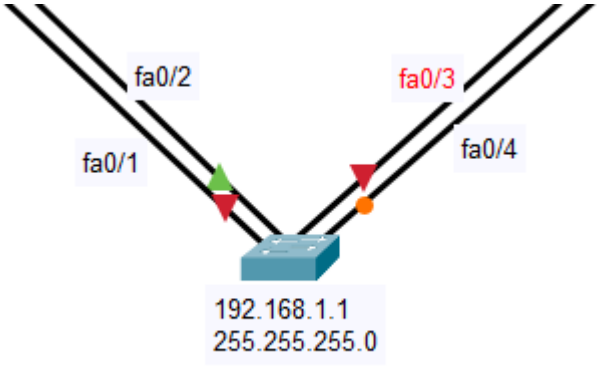


b. Configure all connected ports as trunk ports

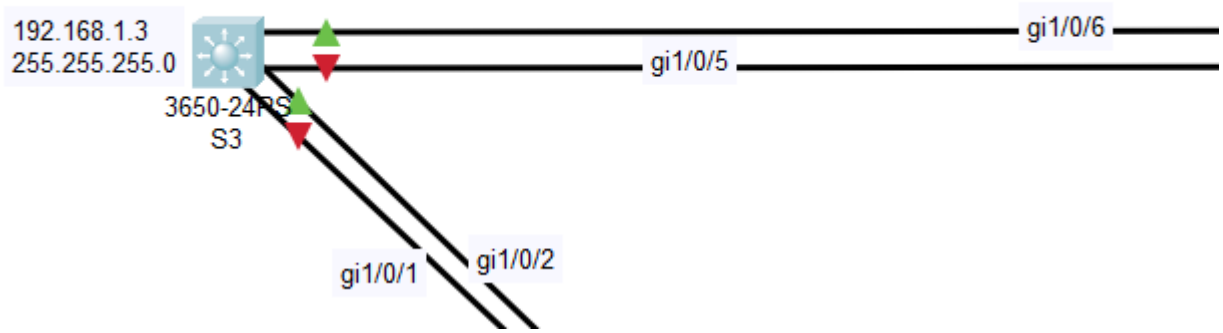
```
S3(config)# interface gil/0/5
S3(config-if)# switchport mode trunk

S3(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/5, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/5, changed state to up

S3(config-if)# exit
S3(config)# interface gil/0/6
S3(config-if)# switchport mode trunk

S3(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/6, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/6, changed state to up

S3(config-if)# exit
S3(config)# interface gil/0/1
S3(config-if)# switchport mode trunk

S3(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed state to up

S3(config-if)# exit
S3(config)# interface gil/0/2
S3(config-if)# switchport mode trunk

S3(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/2, changed state to up

S3(config-if)#
```

```
S4# config t
Enter configuration commands, one per line.  End with CNTL/Z.
S4(config)# interface gil/0/5
S4(config-if)# switchport mode trunk
S4(config-if)# exit
S4(config)# interface gil/0/6
S4(config-if)# switchport mode trunk
S4(config-if)# exit
S4(config)# interface gil/0/3
S4(config-if)# switchport mode trunk

S4(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/3, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/3, changed state to up

S4(config-if)# exit
S4(config)# interface gil/0/4
S4(config-if)# switchport mode trunk

S4(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/4, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/4, changed state to up

S4(config-if)# end
S4#
%SYS-5-CONFIG_I: Configured from console by console

S4#
```

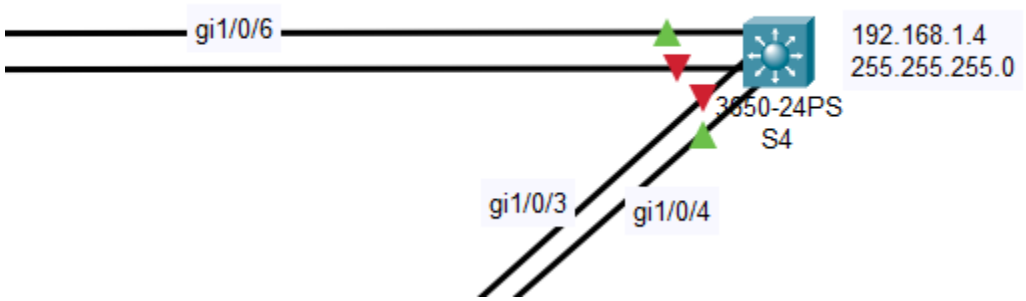
c. Activate (enable) ports **f0/2** and **f0/4** on S1



d. Activate (enable) ports **G1/0/2** and **G1/0/6** on S3



e. Activate (enable) ports **G1/0/4** and **G1/0/6** on S4



Step 2: Display spanning tree information.

Issue the **show spanning-tree** command on all three switches. 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. In the example below, all three 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 (S2 in the example).

Note: In this example, S1 will be the root bridge. As your MAC addresses will be different to this example, you will have a different root bridge.

Note: The default STP mode on 2960 Cisco Switches is Per-VLAN Spanning Tree Protocol (PVST). The default STP mode on 3650 Cisco Switches is Rapid PVST.

S1# **show spanning-tree**

```
VLAN0001
  Spanning tree enabled protocol ieee Root ID
                Priority    32769
                Address     247e.12c6.1300 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
                           247e.12c6.1300
                Hello  Time   2 sec  Max       Age 20 sec    Forward Delay 15 sec
                Aging  Time   300 sec

Interface                 Role  Sts Cost      Prio.Nbr  Type
------------------------- ------ --------- ---------- ----------------------------------------------------------
Fa0/2                     Desg  FWD 19        128.2     P2p
Fa0/4                     Desg  FWD 19        128.4     P2p
```

S3# **show spanning-tree**

VLAN0001
Spanning tree enabled protocol rstp Root ID
Priority 32769
Address 247e.12c6.1300 Cost
19
Port 2 (GigabitEthernet1/0/2)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1) Address
4c77.6d22.5c80
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec Aging Time
300 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
Gi1/0/2	Root	FWD	19	128.2	P2p Peer(STP)
Gi1/0/6	Altn	BLK	4	128.6	P2p

S4# **show spanning-tree**

VLAN0001
Spanning tree enabled protocol rstp Root ID
Priority 32769
Address 247e.12c6.1300 Cost
19
Port 4 (GigabitEthernet1/0/4)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1) Address
4c77.6d16.af00
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
Gi1/0/4	Root	FWD	19	128.4	P2p Peer(STP)
Gi1/0/6	Desg	FWD	4	128.6	P2p

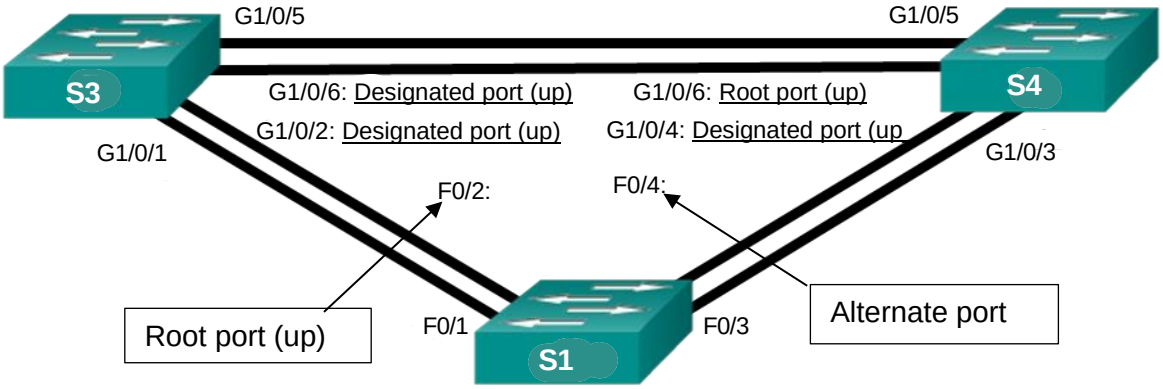
In the diagram below, record the Bridge Priority and the MAC address of the switches and the Role and Status (Sts) of the active ports on each switch in the Topology.

S3 Bridge Priority:
32769

S3 MAC:
0010.1153.AD55

S4 Bridge Priority:
32769

S4 MAC:
00E0.F9CE.3653



S1 Bridge Priority:
32769

S1 MAC:
00E0.F9CE.D9E0

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

switch is the root bridge? => The root bridge is Switch3

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

⇨ The spanning tree selected Switch3 as the root bridge because it has the smallest MAC address while all of switches had the same Bridge Priority..

Which ports are the root ports on the switches?

=> The root ports on the switches are the FastEthernet0/2 and GigabitEthernet1/0/6.

Which ports are the designated ports on the switches?

⇨ The designated ports on the switches are GigabitEthernet1/0/4, GigabitEthernet1/0/2, and GigabitEthernet1/0/6.

What port is showing as an alternate port and is currently being blocked?

⇨ The alternative port is FastEthernet0/4. Additionally, the currently blocked port are FastEthernet0/1, FastEthernet0/3, GigabitEthernet1/0/1, and GigabitEthernet1/0/5.

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

⇨ The spanning tree selected the port FastEthernet0/4 as the non-designated (blocked) port because FastEthernet0/4 – GigabitEthernet1/0/4 has the higher cost than FastEthernet0/1 – GigabitEthernét/0/1.

Part 3: Observe STP Port Selection Based on Port 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 port 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 3, you will change the port cost to control which port is blocked by spanning tree.

Step 1: Locate the switch with the blocked port.

With the current configuration, only one switch should have a port that is blocked by STP. Issue the **show spanning-tree** command on both non-root switches. In the example below, spanning tree is blocking port Gi1/0/5 on the switch with the highest BID (S3).

```
S3# show spanning-tree

VLAN0001
  Spanning tree enabled protocol rstp Root ID
                Priority    32769
                Address     247e.12c6.1300 Cost
                            19
                Port        2 (GigabitEthernet1/0/2)
                Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority      32769  (priority 32768 sys-id-ext 1) Address
                           4c77.6d22.5c80
                Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec Aging Time
                300 sec

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

Gi1/0/2                  Root FWD 19        128.2    P2p Peer(STP)
```

Gi1/0/6	Altn BLK 4	128.6	P2p	

```
S4# show spanning-tree

VLAN0001
  Spanning tree enabled protocol rstp Root ID
                Priority        32769
                Address         247e.12c6.1300 Cost
                                19
                Port            4 (GigabitEthernet1/0/4)
                Hello Time      2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority           32769  (priority 32768 sys-id-ext 1) Address
                                4c77.6d16.af00
                Hello  Time     2 sec  Max          Age 20 sec    Forward Delay 15 sec
                Aging  Time     300 sec

Interface                  Role  Sts Cost                Prio.Nbr  Type
-------------------------- ------ --------- ----------------------- ------------ --------------------------------------------------------------
Gi1/0/4                    Root  FWD 19                  128.4     P2p Peer(STP)
Gi1/0/6                    Desg  FWD 4                   128.6     P2p
```

Note: Root bridge and port selection may differ in your topology.

After locating the switch with the blocked port, you should confirm that this switch has a higher path cost to the root bridge or the highest BID.

Step 2: Change port cost.

On the non-root switch with the blocked port, as observed in Step 1, the only active port is the root port. Lower the cost of this root port by issuing the **spanning-tree cost** interface configuration mode command.

If **S1** is the root bridge in your topology, change the cost to **18**.

If **S3** or **S4** is the root bridge in your topology, change the cost to **3**.

```
S3(config)# interface g1/0/2
S3(config-if)# spanning-tree cost 3
```

Step 3: Observe spanning tree changes.

Re-issue the **show spanning-tree** command on both non-root switches. Observe that the previously blocked port is now a designated port and spanning tree is now blocking a port on the other non-root switch.

S3# **show spanning-tree**

```
VLAN0001
  Spanning tree enabled protocol rstp Root ID
                Priority        32769
                Address         247e.12c6.1300 Cost
                                3
                Port            2 (GigabitEthernet1/0/2)
                Hello Time      2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority           32769  (priority 32768 sys-id-ext 1) Address
                                4c77.6d22.5c80
                Hello Time      2 sec  Max Age 20 sec  Forward Delay 15 sec Aging Time
                300 sec

Interface                 Role Sts Cost      Prio.Nbr Type
------------------------- ------ --------- -------- --------------------------------------------
Gi1/0/2                   Root FWD 3         128.2    P2p Peer(STP)
Gi1/0/6                   Desg FWD 4         128.6    P2p
```

S4# **show spanning-tree**

```
VLAN0001
  Spanning tree enabled protocol rstp Root ID
                Priority        32769
                Address         247e.12c6.1300 Cost
                                19
                Port            4 (GigabitEthernet1/0/4)
                Hello Time      2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority           32769  (priority 32768 sys-id-ext 1) Address
                                4c77.6d16.af00
                Hello Time      2 sec  Max Age 20 sec  Forward Delay 15 sec Aging Time
                300 sec

Interface                 Role Sts Cost      Prio.Nbr Type
------------------------- ------ --------- -------- --------------------------------------------
Gi1/0/4                   Root FWD 19        128.4    P2p Peer(STP)
Gi1/0/6                   Altn BLK 4         128.6    P2p
```

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

⇨ The spanning tree previously changed the blocked port to a designated port because the cost has been changed due to the command line ‘spanning-tree cost 3’’, which means that the port has the best (lower) cost.

Step 4: Remove port cost changes.

a. Issue the **default spanning-tree cost** interface configuration mode command to remove the cost statement that you created earlier.

```
S1(config)# interface g1/0/2
S1(config-if)# default spanning-tree cost
```

b. Re-issue the **show spanning-tree** command to verify that STP has reset the port on the non-root switches back to the original port settings. It takes approximately 30 seconds for STP to complete the port transition process.

Part 4: Observe STP Port Selection Based on Port Priority

If port 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 to break ties. Lower values are always preferred. In Part 4, you will activate redundant paths to each switch to observe how STP selects a port using the port priority.

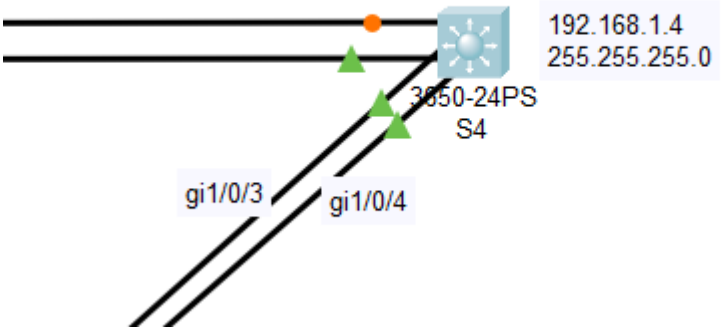
a. Activate ports F0/1 and F0/3 on S1.

```
S1(config-if)# exit
S1(config)# int fa0/3
S1(config-if)# no shutdown

S1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up

S1(config-if)#
```

b. Activate ports G1/0/5 and Gi1/0/1 on S3

```
S3# config t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)# int gil/0/1
S3(config-if)# no shutdown
S3(config-if)# exit
S3(config)# int gil/0/5
S3(config-if)# no shutdown

S3(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet1/0/5, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/5, changed state to up

S3(config-if)#
```

c. Activate ports G1/0/5 and Gi1/0/3 on S4



d. Wait 30 seconds for STP to complete the port transition process, and then issue the **show spanning-tree** command on the non-root switches. Observe that the root port has moved to the port linked to the lower numbered port on the root switch, and blocked the previous root port. Also observe that all secondary links between the switches have become redundant and have been disabled.

S3# **show spanning-tree**

VLAN0001

Spanning tree enabled protocol rstp Root ID

Priority 32769
Address 247e.12c6.1300 Cost 19
Port 1 (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 4c77.6d22.5c80
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec Aging Time 300 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
Gi1/0/1	Root	FWD	19	128.1	P2p Peer(STP)
Gi1/0/2	Altn	BLK	19	128.2	P2p Peer(STP)
Gi1/0/5	Desg	FWD	4	128.5	P2p
Gi1/0/6	Desg	FWD	4	128.6	P2p

S4# **show spanning-tree**

VLAN0001

Spanning tree enabled protocol rstp Root ID

Priority 32769
Address 247e.12c6.1300 Cost 19
Port 3 (GigabitEthernet1/0/3)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)

Address 4c77.6d16.af00

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

Interface	Role	Sts	Cost	Prio.Nbr	Type
Gi1/0/3	Root	FWD	19	128.3	P2p Peer(STP) P2p
Gi1/0/4	Altn	BLK	19	128.4	Peer(STP)
Gi1/0/5	Altn	BLK	4	128.5	P2p
Gi1/0/6	Altn	BLK	4	128.6	P2p

What port did STP select as the root port on each non-root switch?

=> The STP selected the FastEthernet0/1 in the Switch1 and GigabiEthernet1/0/5 on Switch4 as the root port.

Why did STP select these ports as the root port on these switches?

⇨ On Switch1, the STP decided FastEthernet0/1 as the root port because it had the lowest Priority Number among the interfaces.

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/4	Altn	BLK	19	128.4	P2p
Fa0/1	Root	FWD	19	128.1	P2p
Fa0/2	Altn	BLK	19	128.2	P2p
Fa0/3	Altn	BLK	19	128.3	P2p

⇨ On Switch4, the STP selected GigabitEthernet1/0/5 as the root port because it had the lowest Cost and Priority Number between the GigabitEthernet1/0/5 and GigabitEthernet1/0/6.

Interface	Role	Sts	Cost	Prio.Nbr	Type
Gi1/0/5	Root	FWD	4	128.5	P2p
Gi1/0/4	Desg	FWD	19	128.4	P2p
Gi1/0/6	Altn	BLK	4	128.6	P2p
Gi1/0/3	Desg	FWD	19	128.3	P2p

S4#

Part 5: Test redundancy

Shutdown the link between **G1/0/1** on S3 and **F0/1** on S1. Wait 30 seconds for STP to reconfigure itself.

Step 1: Verify that the alternate link between S3 and S1 has become active

Execute **show spanning-tree** to examine the port state on both switches

What is the state of the alternate port connecting S3 to S1 on S3?

⇨ There is no alternate port connecting S3 to S1

What is the state of the alternate port connecting S1 to S3 on S1?

=? There is no alternate port connecting S1 to S3 on S3

```
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gil/0/6          Desg FWD 4         128.6    P2p
Gil/0/1          Desg FWD 19        128.1    P2p
Gil/0/2          Desg FWD 19        128.2    P2p
Gil/0/5          Desg FWD 4         128.5    P2p

S3#
```

Step 2: Verify replacing the link resets the STP configuration

Re-enable the link between **G1/0/1** on S3 and **F0/1** on S1

After waiting for STP to reconfigure, re-execute **show spanning-tree** on both switches and confirm that all ports have returned to their normal state.

Reflection

1. After a root bridge has been selected, what is the first value STP uses to determine port selection?

   ⇨ After a root bridge has been selected, the first value STP uses to determine port selection is the port cost.

2. If the first value is equal on the two ports, what is the next value that STP uses to determine port selection?

   ⇨ If the first value is equal on the two ports, the next value that STP uses to determine port selection is Bridge ID.

3. If both values are equal on the two ports, what is the next value that STP uses to determine port selection?

   ⇨ If both values are equal on the two ports, , the next value that STP uses to determine port selection is the lower port number