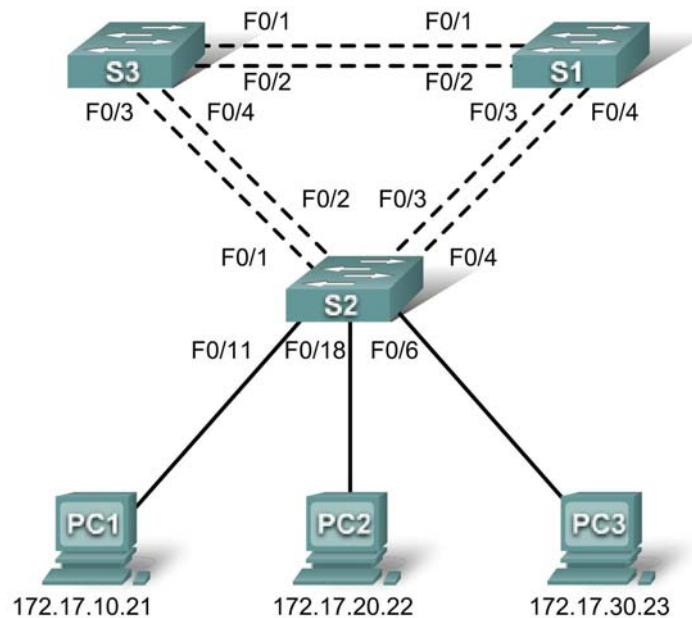


## PT Activity 5.5.2: Challenge Spanning Tree Protocol

### Topology Diagram



### Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
S1	VLAN 99	172.17.99.11	255.255.255.0	N/A
S2	VLAN 99	172.17.99.12	255.255.255.0	N/A
S3	VLAN 99	172.17.99.13	255.255.255.0	N/A
PC1	NIC	172.17.10.21	255.255.255.0	172.17.10.12
PC2	NIC	172.17.20.22	255.255.255.0	172.17.20.12
PC3	NIC	172.17.30.23	255.255.255.0	172.17.30.12

### Port Assignments – S2

Ports	Assignment	Network
Fa0/1 - 0/5	802.1q Trunks (Native VLAN 99)	172.17.99.0 /24
Fa0/6 - 0/10	VLAN 30 – Guest(Default)	172.17.30.0 /24
Fa0/11 - 0/17	VLAN 10 – Faculty/Staff	172.17.10.0 /24
Fa0/18 - 0/24	VLAN 20 - Students	172.17.20.0 /24

## Learning Objectives

- Perform basic switch configurations.
- Configure the Ethernet interfaces on the host PCs.
- Configure VLANs.
- Configure spanning tree.
- Optimizing STP.

## Introduction

In this activity, you will perform basic switch configurations, configure addressing on PCs, configure VLANs, examine the Spanning Tree Protocol and learn how to optimize it.

### Task 1: Perform Basic Switch Configurations

Configure the S1, S2, and S3 switches according to the following guidelines and save all your configurations:

Configure the switch hostname as indicated on the topology.

- Disable DNS lookup.
- Configure an encrypted privileged EXEC mode password of **class**.
- Configure a password of **cisco** for console connections.
- Configure a password of **cisco** for vty connections.

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname S1
S1(config)#enable secret class
S1(config)#no ip domain-lookup
S1(config)#line console 0
S1(config-line)#password cisco
S1(config-line)#login
S1(config-line)#line vty 0 15
S1(config-line)#password cisco
S1(config-line)#login
S1(config-line)#end
%SYS-5-CONFIG_I: Configured from console by console
S1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Your completion results should be 18 percent. If not, check for missing configuration statements.

### Task 2: Configure the Ethernet Interfaces on the Host PCs

From the **Desktop** tab, use the **IP Configuration** window to configure the Ethernet interfaces of PC1, PC2, and PC3 with the IP address, subnet mask, and gateway indicated in the addressing table.

Your completion results should be 26 percent. If not, check for missing configuration steps.

### Task 3: Configure VLANs

#### Step 1. Enable the user ports on S2 in access mode.

Refer to the topology diagram to determine which switch ports on S2 are activated for end-user device access. These three ports will be configured for access mode and enabled with the no shutdown command.

```
S2(config)#interface fa0/6
S2(config-if)#switchport mode access
S2(config-if)#no shutdown
S2(config-if)#interface fa0/11
S2(config-if)#switchport mode access
S2(config-if)#no shutdown
S2(config-if)#interface fa0/18
S2(config-if)#switchport mode access
S2(config-if)#no shutdown
```

#### Step 2. Configure VTP.

Configure VTP on the three switches using the following table. Remember that VTP domain names and passwords are case-sensitive. The default operating mode is server.

Switch Name	VTP Operating Mode	VTP Domain	VTP Password
S1	Server	Lab5	cisco
S2	Client	Lab5	cisco
S3	Client	Lab5	cisco

```
S1(config)#vtp mode server
Device mode already VTP SERVER.
S1(config)#vtp domain Lab5
Changing VTP domain name from NULL to Lab5
S1(config)#vtp password cisco
Setting device VLAN database password to cisco
S1(config)#end
```

```
S2(config)#vtp mode client
Setting device to VTP CLIENT mode
S2(config)#vtp domain Lab5
Changing VTP domain name from NULL to Lab5
S2(config)#vtp password cisco
Setting device VLAN database password to cisco
S2(config)#end
```

```
S3(config)#vtp mode client
Setting device to VTP CLIENT mode
S3(config)#vtp domain Lab5
Changing VTP domain name from NULL to Lab5
S3(config)#vtp password cisco
Setting device VLAN database password to cisco
S3(config)#end
```

### Step 3. Configure Trunk Links and Native VLAN.

Configure trunking ports and native VLAN. For each switch, configure ports Fa0/1 through Fa0/5 as trunking ports. Designate VLAN 99 as the native VLAN for these trunks. When this activity was started, these ports were disabled and must be re-enabled now using the **no shutdown** command.

Only the commands for the FastEthernet0/1 interface on each switch are shown, but the commands should be applied up to the FastEthernet0/5 interface.

```
S1(config)#interface fa0/1
S1(config-if)#switchport mode trunk
S1(config-if)#switchport trunk native vlan 99
S1(config-if)#no shutdown
S1(config)#end
```

```
S2(config)#interface fa0/1
S2(config-if)#switchport mode trunk
S2(config-if)#switchport trunk native vlan 99
S2(config-if)#no shutdown
S2(config-if)#end
```

```
S3(config)#interface fa0/1
S3(config-if)#switchport mode trunk
S3(config-if)#switchport trunk native vlan 99
S3(config-if)#no shutdown
S3(config-if)#end
```

### Step 4. Configure the VTP server with VLANs.

VTP allows you to configure VLANs on the VTP server and have those VLANs populated to the VTP clients in the domain. This ensures consistency in the VLAN configuration across the network.

Configure the following VLANs on the VTP server:

VLAN	VLAN Name
VLAN 99	management
VLAN 10	faculty-staff
VLAN 20	students
VLAN 30	guest

```
S1(config)#vlan 99
S1(config-vlan)#name management
S1(config)#vlan 10
S1(config-vlan)#name faculty-staff
S1(config)#vlan 20
S1(config-vlan)#name students
S1(config)#vlan 30
S1(config-vlan)#name guest
S1(config-vlan)#end
```

### Step 5. Verify the VLANs.

Use the **show vlan brief** command on S2 and S3 to verify that all four VLANs have been distributed to the client switches.

```
S2#show vlan brief
```

VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/4, Fa0/5 Fa0/6, Fa0/7, Fa0/8, Fa0/9 Fa0/10, Fa0/11, Fa0/12, Fa0/13 Fa0/14, Fa0/15, Fa0/16, Fa0/17 Fa0/18, Fa0/19, Fa0/20, Fa0/21 Fa0/22, Fa0/23, Fa0/24, Gi0/1 Gi0/2
10	faculty/staff	active	
20	students	active	
30	guest	active	
99	management	active	

S3#show vlan brief

VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/4, Fa0/5 Fa0/6, Fa0/7, Fa0/8, Fa0/9 Fa0/10, Fa0/11, Fa0/12, Fa0/13 Fa0/14, Fa0/15, Fa0/16, Fa0/17 Fa0/18, Fa0/19, Fa0/20, Fa0/21 Fa0/22, Fa0/23, Fa0/24, Gi0/1 Gi0/2
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

### Step 6. Configure the management interface address on all three switches.

```
S1(config)#interface vlan99
S1(config-if)#ip address 172.17.99.11 255.255.255.0
```

```
S2(config)#interface vlan99
S2(config-if)#ip address 172.17.99.12 255.255.255.0
```

```
S3(config)#interface vlan99
S3(config-if)#ip address 172.17.99.13 255.255.255.0
```

Verify that the switches are correctly configured by pinging between them. From S1, ping the management interface on S2 and S3. From S2, ping the management interface on S3.

Were the pings successful? If not, troubleshoot the switch configurations and try again.

### Step 7. Assign switch ports to the VLANs.

Port assignments are listed in the table at the beginning of the activity. However, since Packet Tracer 4.11 does not support the **interface range** command, only assign the first port from each range.

```
S2(config)#interface fa0/6
S2(config-if)#switchport access vlan 30
S2(config-if)#interface fa0/11
S2(config-if)#switchport access vlan 10
S2(config-if)#interface fa0/18
S2(config-if)#switchport access vlan 20
S2(config-if)#end
S2#copy running-config startup-config
```

```
Destination filename [startup-config]? [enter]
Building configuration...
[OK]
S2#
```

Your completion results should be 99 percent. If not, check for missing configuration statements.

## Task 4: Configure Spanning Tree

### Step 1. Examine the default configuration of 802.1D Spanning Tree Protocol (STP).

On each switch, display the spanning tree table with the **show spanning-tree** command. The output is shown for S1 only. Root selection varies depending on the default BID of each switch. In this activity S3 is currently the root.

```
S1#show spanning-tree
```

```
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority      32769
             Address      0030.F20D.D6B1
             Hello Time    2 sec   Max Age 20 sec   Forward Delay 15 sec
  Bridge ID  Priority      32769   (priority 32768 sys-id-ext 1)
             Address      0050.0F68.146E
             Aging Time    300
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	FWD	19	128.3	Shr
Fa0/2	Altn	BLK	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr
Fa0/4	Desg	FWD	19	128.3	Shr

```
VLAN0010
  Spanning tree enabled protocol ieee
  Root ID    Priority      32778
             Address      0030.F20D.D6B1
             Hello Time    2 sec   Max Age 20 sec   Forward Delay 15 sec
  Bridge ID  Priority      32778   (priority 32768 sys-id-ext 10)
             Address      0050.0F68.146E
             Aging Time    300
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	FWD	19	128.3	Shr
Fa0/2	Altn	BLK	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr
Fa0/4	Desg	FWD	19	128.3	Shr

```
VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority      32788
             Address      0030.F20D.D6B1
             Hello Time    2 sec   Max Age 20 sec   Forward Delay 15 sec
  Bridge ID  Priority      32788   (priority 32768 sys-id-ext 20)
```

Address 0050.0F68.146E  
Aging Time 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	FWD	19	128.3	Shr
Fa0/2	Altn	BLK	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr
Fa0/4	Desg	FWD	19	128.3	Shr

#### VLAN0030

Spanning tree enabled protocol ieee

Root ID Priority 32798  
Address 0030.F20D.D6B1  
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec  
Bridge ID Priority 32798 (priority 32768 sys-id-ext 30)  
Address 0050.0F68.146E  
Aging Time 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	FWD	19	128.3	Shr
Fa0/2	Altn	BLK	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr
Fa0/4	Desg	FWD	19	128.3	Shr

#### VLAN0099

Spanning tree enabled protocol ieee

Root ID Priority 32867  
Address 0030.F20D.D6B1  
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec  
Bridge ID Priority 32867 (priority 32768 sys-id-ext 99)  
Address 0050.0F68.146E  
Aging Time 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	FWD	19	128.3	Shr
Fa0/2	Altn	BLK	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr
Fa0/4	Desg	FWD	19	128.3	Shr

Note that there are five instances of STP on each switch.

Examine the VLAN 99 spanning tree for all three switches:

S1#show spanning-tree vlan 99

#### VLAN0099

Spanning tree enabled protocol ieee

Root ID Priority 32867  
Address 0030.F20D.D6B1  
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec  
Bridge ID Priority 32867 (priority 32966 sys-id-ext 99)  
Address 0050.0F68.146E  
Aging Time 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root	FWD	19	128.3	Shr
Fa0/2	Altn	BLK	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr
Fa0/4	Desg	FWD	19	128.3	Shr

S2#show spanning-tree vlan 99

VLAN0099

```
Spanning tree enabled protocol ieee
Root ID    Priority      32867
           Address      0030.F20D.D6B1
           Hello Time   2 sec    Max Age 20 sec    Forward Delay 15 sec
Bridge ID  Priority      32867 (priority 32966 sys-id-ext 99)
           Address      00E0.F7AE.7258
           Aging Time   300
```

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

S3#show spanning-tree vlan 99

VLAN0099

```
Spanning tree enabled protocol ieee
Root ID    Priority      32867
           Address      0030.F20D.D6B1
           This bridge is the root
           Hello Time   2 sec    Max Age 20 sec    Forward Delay 15 sec
Bridge ID  Priority      32867 (priority 32966 sys-id-ext 99)
           Address      0030.F20D.D6B1
           Aging Time   300
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg	FWD	19	128.3	Shr
Fa0/2	Desg	FWD	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr
Fa0/4	Desg	FWD	19	128.3	Shr

## Step 2. Examine the output.

Answer the following questions based on the output.

What is the priority for switches S1, S2, and S3 on VLAN 99?

What is the priority for S1 on VLANs 10, 20, 30, and 99?



Which ports are blocking VLAN 99 on the root switch?

---

Which ports are blocking VLAN 99 on the non-root switches?

---

How does STP select the root?

---

Since the bridge priorities are all the same, what else does the switch use to determine the root?

---

### Task 5: Optimizing STP

Because there is a separate instance of the spanning tree for every active VLAN, a separate root election is conducted for each instance. If the default switch priorities are used in root selection, the same root is elected for every spanning tree, as we have seen. This could lead to an inferior design. Some reasons to control the selection of the root switch include:

- The root switch is responsible for generating BPDUs in STP 802.1D and is the focal point for spanning tree control traffic. The root switch must be capable of handling this additional load.
- The placement of the root defines the active switched paths in the network. Random placement is likely to lead to suboptimal paths. Ideally the root is in the distribution layer.
- Consider the topology used in this activity. Of the six trunks configured, only two are carrying traffic. While this prevents loops, it is a waste of resources. Because the root can be defined on the basis of the VLAN, you can have some ports blocking for one VLAN and forwarding for another. This is demonstrated below.

In this example, it has been determined that the root selection using default values has led to under-utilization of the available switch trunks. Therefore, it is necessary to force another switch to become the root switch for VLAN 99 to impose some load-sharing on the trunks.

In the example output below, the default root switch for all VLANs is S3.

Selection of the root switch is accomplished by changing the spanning-tree priority for the VLAN. The default priority, as you have observed, is 32768 plus the VLAN ID. The lower number indicates a higher priority for root selection. Set the priority for VLAN 99 on S1 to 4096.

```
S1(config)#spanning-tree vlan 99 priority 4096
S1(config)#exit
```

Give the switches a little time to recalculate the spanning tree and then check the tree for VLAN 99 on switch S3 (the original VLAN 99 root) and switch S1 (the non-root switch selected to become the new VLAN 99 root).

```
S3#show spanning-tree vlan 99
```

```
VLAN0099
  Spanning tree enabled protocol ieee
  Root ID    Priority      4195
             Address      0050.0F68.146E
             Hello Time   2 sec    Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority      32867  (priority 32966 sys-id-ext 99)
```

Address 0030.F20D.D6B1  
Aging Time 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----	-----	-----	-----	-----	-----
Fa0/4	Desg	FWD	19	128.3	Shr
Fa0/1	Root	FWD	19	128.3	Shr
Fa0/2	Altn	BLK	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr

S1#show spanning-tree vlan 99

VLAN0099

```
Spanning tree enabled protocol ieee
Root ID    Priority      4195
           Address      0050.0F68.146E
           This bridge is the root
           Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
Bridge ID  Priority      4195 (priority 4294 sys-id-ext 99)
           Address      0050.0F68.146E
           Aging Time   300
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----	-----	-----	-----	-----	-----
Fa0/4	Desg	FWD	19	128.3	Shr
Fa0/3	Desg	FWD	19	128.3	Shr
Fa0/2	Desg	FWD	19	128.3	Shr
Fa0/1	Desg	FWD	19	128.3	Shr

Which switch is the root for VLAN 99?

Which ports are blocking VLAN 99 traffic on the new root?

Which ports are now blocking VLAN 99 traffic on the old root?

Compare the S1 VLAN 99 spanning tree above with the S1 VLAN 10 spanning tree.

S1#show spanning-tree vlan 10

VLAN0010

```
Spanning tree enabled protocol ieee
Root ID    Priority      32778
           Address      0030.F20D.D6B1
           Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
Bridge ID  Priority      32778 (priority 32788 sys-id-ext 10)
           Address      0050.0F68.146E
           Aging Time   300
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----	-----	-----	-----	-----	-----
Fa0/4	Desg	FWD	19	128.3	Shr

Fa0/3	Desg FWD 19	128.3	Shr
Fa0/2	Altn BLK 19	128.3	Shr
Fa0/1	Root FWD 19	128.3	Shr

Note that S1 can now use all four ports for VLAN 99 traffic as long as they are not blocked at the other end of the trunk. However, the original spanning tree topology, with one of four S1 ports in blocking mode, is still in place for the four other active VLANs. By configuring groups of VLANs to use different trunks as their primary forwarding path, we retain the redundancy of failover trunks, without having to leaves trunks totally unused.

Your completion results should be 100 percent. If not, use **Check Results** to find any incomplete components.