

# Data Communication and Computer Networks

## DCCN - EEE314

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### **Lab 9**

Inter-VLAN routing and VTP configuration



**COMSATS Institute of Information Technology (CIIT)**

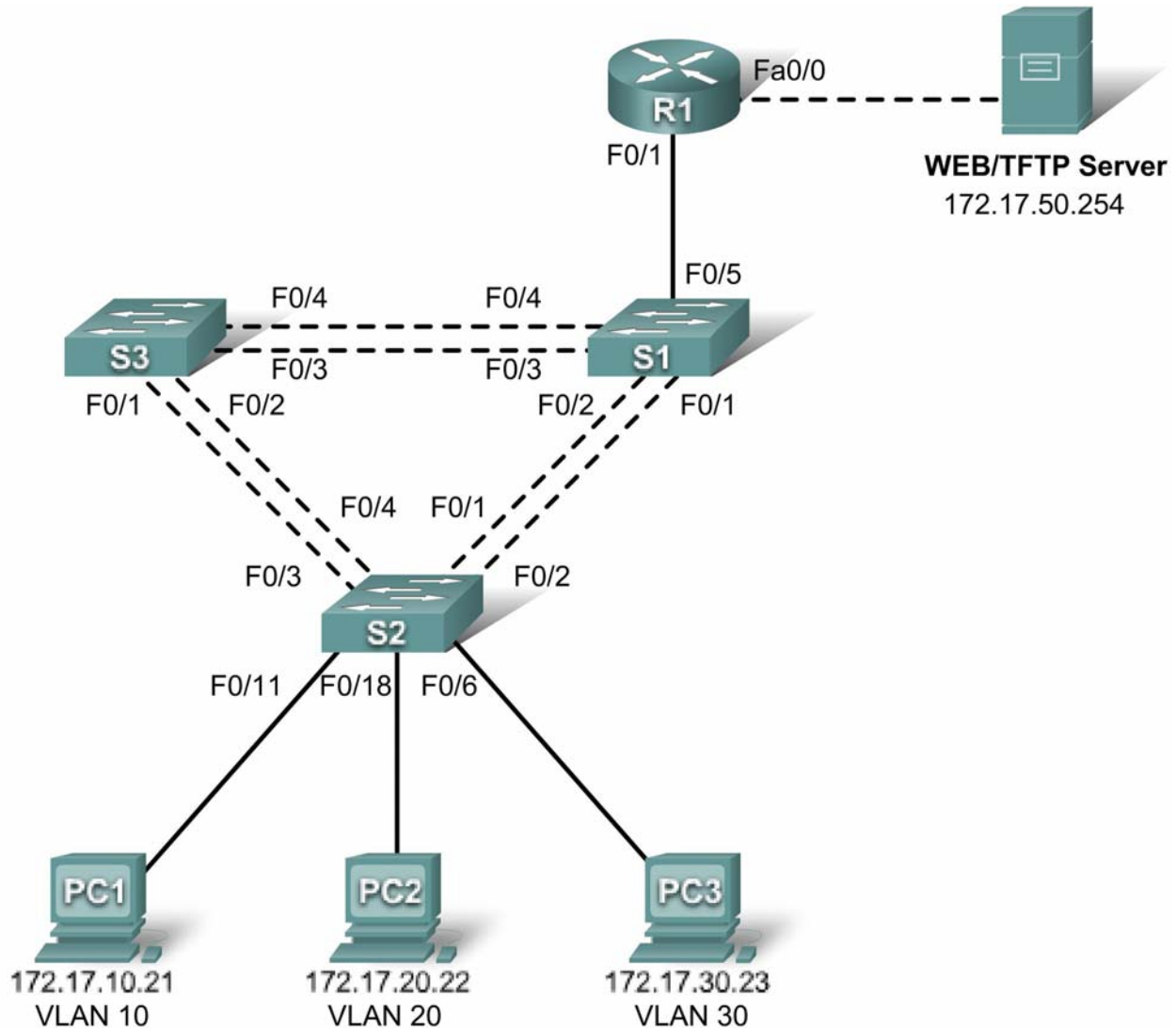
**Islamabad Campus**

## Lab 09

### Inter-VLAN routing and VTP Configuration

### Inter-VLAN routing Configuration

#### Topology Diagram



#### Addressing Table

Device (Hostname)	Interface	IP Address	Subnet Mask	Default Gateway
S1	VLAN 99	172.17.99.11	255.255.255.0	172.17.99.1
S2	VLAN 99	172.17.99.12	255.255.255.0	172.17.99.1
S3	VLAN 99	172.17.99.13	255.255.255.0	172.17.99.1

<b>R1</b>	<b>Fa 0/0</b>	172.17.50.1	255.255.255.0	N/A
<b>R1</b>	<b>Fa 0/1</b>	See Interface Configuration Table		N/A
<b>PC1</b>	<b>NIC</b>	172.17.10.21	255.255.255.0	172.17.10.1
<b>PC2</b>	<b>NIC</b>	172.17.20.22	255.255.255.0	172.17.20.1
<b>PC3</b>	<b>NIC</b>	172.17.30.23	255.255.255.0	172.17.30.1
<b>Server</b>	<b>NIC</b>	172.17.50.254	255.255.255.0	172.17.50.1

## Port Assignments – Switch 2

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

## Interface Configuration Table – Router 1

Interface	Assignment	IP Address
Fa0/1.1	VLAN1	172.17.1.1 /24
Fa0/1.10	VLAN 10	172.17.10.1 /24
Fa0/1.20	VLAN 20	172.17.20.1 /24
Fa0/1.30	VLAN 30	172.17.30.1 /24
Fa0/1.99	VLAN 99	172.17.99.1 /24

## Learning Objectives

Upon completion of this lab, you will be able to:

- Cable a network according to the topology diagram
- Clear configurations and reload a switch and a router to the default state
- Perform basic configuration tasks on a switched LAN and router
- Configure VLANs and VLAN Trunking Protocol (VTP) on all switches
- Demonstrate and explain the impact of Layer 3 boundaries imposed by creating VLANs
- Configure a router to support 802.1q trunking on a Fast Ethernet interface
- Configure a router with subinterfaces corresponding to the configured VLANs
- Demonstrate and explain inter-VLAN routing

## Task 1: Prepare the Network

### Step 1: Cable a network that is similar to the one in the topology diagram.

The output shown in this lab is based on 2960 switches and an 1841 router. You can use any current switches or routers in your lab as long as they have the required interfaces shown in the topology diagram. Other device types may produce different output. Note that Ethernet (10Mb) LAN interfaces on routers do not support trunking, and Cisco IOS software earlier than version 12.3 may not support trunking on Fast Ethernet router interfaces.

Set up console connections to all three switches and to the router.

### Step 2: Clear any existing configurations on the switches.

Clear NVRAM, delete the vlan.dat file, and reload the switches. Refer to lab 2.2.1 if necessary for the procedure. After the reload is complete, use the **show vlan** command to confirm that only default VLANs exist and that all ports are assigned to VLAN 1.

Switch#**show vlan**

VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/3, 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 Gig0/1, Gig0/2
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

### Step 3: Disable all ports using the shutdown command.

Ensure that the initial switch port states are inactive by disabling all ports. Use the **interface range** command to simplify this task. Repeat these commands on each switch in the topology.

```
Switch(config)#interface range fa0/1-24
Switch(config-if-range)#shutdown
Switch(config-if-range)#interface range gi0/1-2
Switch(config-if-range)#shutdown
```

## Task 2: Perform Basic Switch Configurations

### Step 1: Configure the S1, S2, and S3 switches.

Use the addressing table and the following guidelines:

- Configure the switch hostname.
- Disable DNS lookup.
- Configure an enable secret password of **class**.
- Configure a password of **cisco** for console connections.
- Configure a password of **cisco** for vty connections.
- Configure the default gateway on each switch

#### Output for S1 shown

```
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)#ip default-gateway 172.17.99.1
```

```

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]? [enter]
Building configuration...

```

### Step 2: Re-enable the active user ports on S2 in access mode.

```

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

```

### Task 3: Configure the Ethernet Interfaces on the Host PCs

Configure the Ethernet interfaces of PC1, PC2, PC3 and the remote TFTP/Web Server with the IP addresses from the addressing table.

### Task 4: Configure VTP on the Switches

**Step 1: Configure VTP on the three switches using the following table. Remember that VTP domain names and passwords are case-sensitive.**

Switch Name	VTP Operating Mode	VTP Domain	VTP Password
<b>S1</b>	<b>Server</b>	<b>Lab6</b>	<b>cisco</b>
<b>S2</b>	<b>Client</b>	<b>Lab6</b>	<b>cisco</b>
<b>S3</b>	<b>Client</b>	<b>Lab6</b>	<b>cisco</b>

#### S1:

```

S1(config)#vtp mode server
Device mode already VTP SERVER.
S1(config)#vtp domain Lab6
Changing VTP domain name from NULL to Lab6
S1(config)#vtp password cisco
Setting device VLAN database password to cisco
S1(config)#end

```

#### S2:

```

S2(config)#vtp mode client

```

```

Setting device to VTP CLIENT mode
S2(config)#vtp domain Lab6
Changing VTP domain name from NULL to Lab6
S2(config)#vtp password cisco
Setting device VLAN database password to cisco
S2(config)#end

```

**S3:**

```

S3(config)#vtp mode client
Setting device to VTP CLIENT mode
S3(config)#vtp domain Lab6
Changing VTP domain name from NULL to Lab6
S3(config)#vtp password cisco
Setting device VLAN database password to cisco
S3(config)#end

```

**Step 2: Configure trunking ports and designate the native VLAN for the trunks.**

Configure Fa0/1 through Fa0/5 as trunking ports, and designate VLAN 99 as the native VLAN for these trunks. Use the **interface range** command in global configuration mode to simplify this task.

```

S1(config)#interface range fa0/1-5
S1(config-if-range)#switchport mode trunk
S1(config-if-range)#switchport trunk native vlan 99
S1(config-if-range)#no shutdown
S1(config-if-range)#end

S2(config)# interface range fa0/1-5
S2(config-if-range)#switchport mode trunk
S2(config-if-range)#switchport trunk native vlan 99
S2(config-if-range)#no shutdown
S2(config-if-range)#end

S3(config)# interface range fa0/1-5
S3(config-if-range)#switchport mode trunk
S3(config-if-range)#switchport trunk native vlan 99
S3(config-if-range)#no shutdown
S3(config-if-range)#end

```

**Step 3: Configure VLANs on the VTP server.**

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)#exit
S1(config)#vlan 10

```

```

S1(config-vlan)#name faculty-staff
S1(config-vlan)#exit
S1(config)#vlan 20
S1(config-vlan)#name students
S1(config-vlan)#exit
S1(config)#vlan 30
S1(config-vlan)#name guest
S1(config-vlan)#end

```

Verify that the VLANs have been created on S1 with the **show vlan brief** command.

#### Step 4: Verify that the VLANs created on S1 have been distributed to S2 and S3.

Use the **show vlan brief** command on S2 and S3 to verify that the 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	

#### Step 5: Configure the management interface address on all three switches.

```

S1(config)#interface vlan 99
S1(config-if)#ip address 172.17.99.11 255.255.255.0
S1(config-if)#no shutdown
S1(config-if)#end

S2(config)#interface vlan 99
S2(config-if)#ip address 172.17.99.12 255.255.255.0
S2(config-if)#no shutdown
S2(config-if)#end

S3(config)#interface vlan 99
S3(config-if)#ip address 172.17.99.13 255.255.255.0
S3(config-if)#no shutdown
S3(config-if)#end

```

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 6: Assign switch ports to VLANs on S2.

Refer to the port assignments table at the beginning of the lab to assign ports to VLANs on S2.

```

S2(config)#interface range fa0/6-10
S2(config-if-range)#switchport access vlan 30
S2(config-if-range)#interface range fa0/11-17
S2(config-if-range)#switchport access vlan 10
S2(config-if-range)#interface range fa0/18-24
S2(config-if-range)#switchport access vlan 20
S2(config-if-range)#end
S2#copy running-config startup-config
Destination filename [startup-config]? [enter]
Building configuration...
[OK]

```

### Step 7: Check connectivity between VLANs.

Open command windows on the three hosts connected to S2. Ping from PC1 (172.17.10.21) to PC2 (172.17.20.22). Ping from PC2 to PC3 (172.17.30.23).

Are the pings successful? \_\_\_\_\_

If not, why do these pings fail? \_\_\_\_\_

\_\_\_\_\_

## Task 5: Configure the Router and the Remote Server LAN

### Step 1: Clear the configuration on the router and reload.

```

Router#erase nvram:
Erasing the nvram filesystem will remove all configuration files! Continue?
[confirm]
Erase of nvram: complete
Router#reload
System configuration has been modified. Save? [yes/no]: no

```

### Step 2: Create a basic configuration on the router.

- Configure the router with hostname R1.
- Disable DNS lookup.
- Configure an EXEC mode password of **cisco**.
- Configure a password of **cisco** for console connections.
- Configure a password of **cisco** for vty connections.

### Step 3: Configure the trunking interface on R1.

You have demonstrated that connectivity between VLANs requires routing at the network layer, exactly like connectivity between any two remote networks. There are a couple of options for configuring routing between VLANs.

The first is something of a brute force approach. An L3 device, either a router or a Layer 3 capable switch, is connected to a LAN switch with multiple connections—a separate connection for each VLAN that requires inter-VLAN connectivity. Each of the switch ports used by the L3 device is configured in a different VLAN on the switch. After IP addresses are assigned to the interfaces on the L3 device, the routing table has directly connected routes for all VLANs, and inter-VLAN routing is enabled. The limitations to this approach are the lack of sufficient Fast Ethernet ports on routers, under-utilization of



ports on L3 switches and routers, and excessive wiring and manual configuration. The topology used in this lab does not use this approach.

An alternative approach is to create one or more Fast Ethernet connections between the L3 device (the router) and the distribution layer switch, and to configure these connections as dot1q trunks. This allows all inter-VLAN traffic to be carried to and from the routing device on a single trunk. However, it requires that the L3 interface be configured with multiple IP addresses. This can be done by creating “virtual” interfaces, called subinterfaces, on one of the router Fast Ethernet ports and configuring them to dot1q aware.

Using the subinterface configuration approach requires these steps:

- Enter subinterface configuration mode
- Establish trunking encapsulation
- Associate a VLAN with the subinterface
- Assign an IP address from the VLAN to the subinterface

The commands are as follows:

```
R1(config)#interface fastethernet 0/1
R1(config-if)#no shutdown

R1(config-if)#interface fastethernet 0/1.1
R1(config-subif)#encapsulation dot1q 1
R1(config-subif)#ip address 172.17.1.1 255.255.255.0

R1(config-if)#interface fastethernet 0/1.10
R1(config-subif)#encapsulation dot1q 10
R1(config-subif)#ip address 172.17.10.1 255.255.255.0

R1(config-if)#interface fastethernet 0/1.20
R1(config-subif)#encapsulation dot1q 20
R1(config-subif)#ip address 172.17.20.1 255.255.255.0

R1(config-if)#interface fastethernet 0/1.30
R1(config-subif)#encapsulation dot1q 30
R1(config-subif)#ip address 172.17.30.1 255.255.255.0

R1(config-if)#interface fastethernet 0/1.99
R1(config-subif)#encapsulation dot1q 99 native
R1(config-subif)#ip address 172.17.99.1 255.255.255.0
```

Note the following points in this configuration:

- The physical interface is enabled using the **no shutdown** command, because router interfaces are down by default. The virtual interfaces are up by default.
- The subinterface can use any number that can be described with 32 bits, but it is good practice to assign the number of the VLAN as the interface number, as has been done here.
- The native VLAN is specified on the L3 device so that it is consistent with the switches. Otherwise, VLAN 1 would be the native VLAN by default, and there would be no communication between the router and the management VLAN on the switches.

Confirm creation and status of the subinterfaces with the **show ip interface brief** command:

```
R1#show ip interface brief
Interface          IP-Address      OK? Method Status          Protocol
```

FastEthernet0/0	unassigned	YES	unset	administratively down	down
FastEthernet0/1	unassigned	YES	unset	up	up
FastEthernet0/1.1	172.17.1.1	YES	manual	up	up
FastEthernet0/1.10	172.17.10.1	YES	manual	up	up
FastEthernet0/1.20	172.17.20.1	YES	manual	up	up
FastEthernet0/1.30	172.17.30.1	YES	manual	up	up
FastEthernet0/1.99	172.17.99.1	YES	manual	up	up

#### Step 4: Configure the server LAN interface on R1.

```
R1(config)# interface FastEthernet0/0
R1(config-if)#ip address 172.17.50.1 255.255.255.0
R1(config-if)#description server interface
R1(config-if)#no shutdown
R1(config-if)#end
```

There are now six networks configured. Verify that you can route packets to all six by checking the routing table on R1.

```
R1#show ip route
<output omitted>
```

Gateway of last resort is not set

```
172.17.0.0/24 is subnetted, 6 subnets
C    172.17.50.0 is directly connected, FastEthernet0/0
C    172.17.30.0 is directly connected, FastEthernet0/1.30
C    172.17.20.0 is directly connected, FastEthernet0/1.20
C    172.17.10.0 is directly connected, FastEthernet0/1.10
C    172.17.1.0 is directly connected, FastEthernet0/1.1
C    172.17.99.0 is directly connected, FastEthernet0/1.99
```

If your routing table does not show all six networks, troubleshoot your configuration and resolve the problem before proceeding.

#### Step 5: Verify Inter-VLAN routing.

From PC1, verify that you can ping the remote server (172.17.50.254) and the other two hosts (172.17.20.22 and 172.17.30.23). It may take a couple of pings before the end-to-end path is established.

Are the pings successful? \_\_\_\_\_

If not, troubleshoot your configuration. Check to make sure that the default gateways have been set on all PCs and all switches. If any of the hosts have gone into hibernation, the connected interface may go down.

#### Task 6: Reflection

In Task 5, it was recommended that you configure VLAN 99 as the native VLAN in the router Fa0/0.99 interface configuration. Why would packets from the router or hosts fail when trying to reach the switch management interfaces if the native VLAN were left in default?

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## Task 7: Clean Up

Erase the configurations and reload the switches. Disconnect and store the cabling. For PC hosts that are normally connected to other networks (such as the school LAN or to the Internet), reconnect the appropriate cabling and restore the TCP/IP settings.

## Final Configurations

### Router 1

```
hostname R1
!
enable secret class
!
no ip domain lookup
!
interface FastEthernet0/0
 ip address 172.17.50.1 255.255.255.0
 no shutdown
!
interface FastEthernet0/1
 no shutdown
!
interface FastEthernet0/1.1
 encapsulation dot1Q 1
 ip address 172.17.1.1 255.255.255.0
!
interface FastEthernet0/1.10
 encapsulation dot1Q 10
 ip address 172.17.10.1 255.255.255.0
!
interface FastEthernet0/1.20
 encapsulation dot1Q 20
 ip address 172.17.20.1 255.255.255.0
!
interface FastEthernet0/1.30
 encapsulation dot1Q 30
 ip address 172.17.30.1 255.255.255.0
!
interface FastEthernet0/1.99
 encapsulation dot1Q 99 native
 ip address 172.17.99.1 255.255.255.0
!
<output omitted - serial interfaces not configured>
!
line con 0
line aux 0
line vty 0 4
 login
 password cisco
!
```

### Switch 1

```
!
hostname S1
!
```

```
enable secret class
!
no ip domain lookup
!
interface FastEthernet0/1
  switchport trunk native vlan 99
  switchport mode trunk
!
interface FastEthernet0/2
  switchport trunk native vlan 99
  switchport mode trunk
!
interface FastEthernet0/3
  switchport trunk native vlan 99
  switchport mode trunk
!
interface FastEthernet0/4
  switchport trunk native vlan 99
  switchport mode trunk
!
interface FastEthernet0/5
  switchport trunk native vlan 99
  switchport mode trunk
!
<output omitted - all remaining ports in shutdown>
!
interface Vlan1
  no ip address
  no ip route-cache
!
interface Vlan99
  ip address 172.17.99.11 255.255.255.0
  no shutdown
!
ip default-gateway 172.17.99.1
ip http server
!
line con 0
  logging synchronous
line vty 0 4
  login
  password cisco
line vty 5 15
  login
  password cisco
```

## Switch 2

```
!
hostname S2
!
enable secret class
!
no ip domain lookup
!
interface FastEthernet0/1
  switchport trunk native vlan 99
```

```
switchport mode trunk
!
interface FastEthernet0/2
switchport trunk native vlan 99
switchport mode trunk
!
interface FastEthernet0/3
switchport trunk native vlan 99
switchport mode trunk
!
interface FastEthernet0/4
switchport trunk native vlan 99
switchport mode trunk
!
interface FastEthernet0/5
switchport trunk native vlan 99
switchport mode trunk
!
interface FastEthernet0/6
switchport access vlan 30
switchport mode access
!
interface FastEthernet0/7
switchport access vlan 30
!
interface FastEthernet0/8
switchport access vlan 30
!
interface FastEthernet0/9
switchport access vlan 30
!
interface FastEthernet0/10
switchport access vlan 30
!
interface FastEthernet0/11
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/12
switchport access vlan 10
!
interface FastEthernet0/13
switchport access vlan 10
!
interface FastEthernet0/14
switchport access vlan 10
!
interface FastEthernet0/15
switchport access vlan 10
!
interface FastEthernet0/16
switchport access vlan 10
!
interface FastEthernet0/17
switchport access vlan 10
!
```

```
interface FastEthernet0/18
  switchport access vlan 20
!
interface FastEthernet0/19
  switchport access vlan 20
!
interface FastEthernet0/20
  switchport access vlan 20
!
interface FastEthernet0/21
  switchport access vlan 20
!
interface FastEthernet0/22
  switchport access vlan 20
!
interface FastEthernet0/23
  switchport access vlan 20
!
interface FastEthernet0/24
  switchport access vlan 20
!
interface Vlan1
  no ip address
  no ip route-cache
!
interface Vlan99
  ip address 172.17.99.12 255.255.255.0
  no shutdown
!
ip default-gateway 172.17.99.1
ip http server
!
line con 0
  password cisco
  logging synchronous
  login
line vty 0 4
  password cisco
  login
line vty 5 15
  password cisco
  login
!
end
```

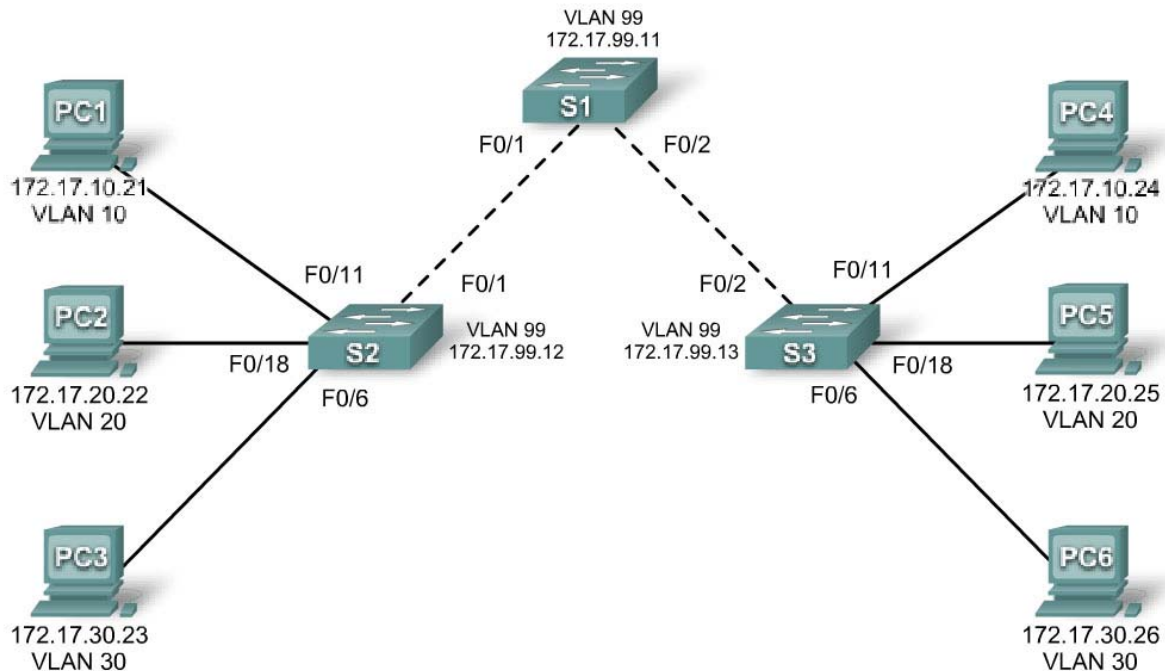
### Switch 3

```
!
hostname S3
!
enable secret class
!
no ip domain lookup
!
interface FastEthernet0/1
  switchport trunk native vlan 99
```

```
switchport mode trunk
!
interface FastEthernet0/2
switchport trunk native vlan 99
switchport mode trunk
!
interface FastEthernet0/3
switchport trunk native vlan 99
switchport mode trunk
!
interface FastEthernet0/4
switchport trunk native vlan 99
switchport mode trunk
!
interface FastEthernet0/5
switchport trunk native vlan 99
switchport mode trunk
!
<output omitted - all remaining ports in shutdown>
!
interface Vlan99
ip address 172.17.99.13 255.255.255.0
no shutdown
!
ip default-gateway 172.17.99.1
ip http server
!
control-plane
!
line con 0
password cisco
login
line vty 0 4
password cisco
login
line vty 5 15
password cisco
login
!
end
```

## VTP Configuration

### Topology Diagram



### Addressing Table

Device (Hostname)	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	172.17.10.1
PC2	NIC	172.17.20.22	255.255.255.0	172.17.20.1
PC3	NIC	172.17.30.23	255.255.255.0	172.17.30.1
PC4	NIC	172.17.10.24	255.255.255.0	172.17.10.1
PC5	NIC	172.17.20.25	255.255.255.0	172.17.20.1
PC6	NIC	172.17.30.26	255.255.255.0	172.17.30.1



## Port Assignments (Switches 2 and 3)

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

Upon completion of this lab, you will be able to:

- Cable a network according to the topology diagram
- Erase the startup configuration and reload a switch to the default state
- Perform basic configuration tasks on a switch
- Configure VLAN Trunking Protocol (VTP) on all switches
- Enable trunking on inter-switch connections
- Verify trunk configuration
- Modify VTP modes and observe the impact
- Create VLANs on the VTP server, and distribute this VLAN information to switches in the network
- Explain the differences in operation between VTP transparent mode, server mode, and client mode
- Assign switch ports to the VLANs
- Save the VLAN configuration
- Enable VTP pruning on the network
- Explain how pruning reduces unnecessary broadcast traffic on the LAN

## Task 1: Prepare the Network

### Step 1: Cable a network that is similar to the one in the topology diagram.

You can use any current switch in your lab as long as it has the required interfaces shown in the topology. The output shown in this lab is based on 2960 switches. Other switch types may produce different output. If you are using older switches, then some commands may be different or unavailable.

You will notice in the Addressing Table that the PCs have been configured with a default gateway IP address. This would be the IP address of the local router which is not included in this lab scenario. The default gateway, the router would be needed for PCs in different VLANs to be able to communicate. This is discussed in a later chapter.

Set up console connections to all three switches.

### Step 2: Clear any existing configurations on the switches.

If necessary, refer to Lab 2.5.1, Appendix 1, for the procedure to clear switch configurations and VLANs. Use the **show vlan** command to confirm that only default VLANs exist and that all ports are assigned to VLAN 1.

Switch#**show vlan**

VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/3, 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 Gig1/1, Gig1/2
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

### Step 3: Disable all ports by using the shutdown command.

Repeat these commands for each switch in the topology.

```
Switch(config)#interface range fa0/1-24
Switch(config-if-range)#shutdown
Switch(config-if-range)#interface range gi0/1-2
Switch(config-if-range)#shutdown
```

## Task 2: Perform Basic Switch Configurations

### Step 1: Complete basic configuration of switches S1, S2, and S3.

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 EXEC mode password of **class**.
- Configure a password of **cisco** for console connections.
- Configure a password of **cisco** for vty connections.

(Output for S1 shown)

```
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]

### Step 2: Re-enable the user ports on S2 and S3.

Configure the user ports in access mode. Refer to the topology diagram to determine which ports are connected to end-user devices.

```
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
```

```
S3(config)#interface fa0/6
S3(config-if)#switchport mode access
S3(config-if)#no shutdown
S3(config-if)#interface fa0/11
S3(config-if)#switchport mode access
S3(config-if)#no shutdown
S3(config-if)#interface fa0/18
S3(config-if)#switchport mode access
S3(config-if)#no shutdown
```

### Step 3: Re-enable the trunk ports on S1, S2 and S3

```
S1(config)#interface fa0/1
S1(config-if)#no shutdown
S1(config)#interface fa0/2
S1(config-if)#no shutdown
```

```
S2(config)#interface fa0/1
S2(config-if)#no shutdown
```

```
S3(config)#interface fa0/2
S3(config-if)#no shutdown
```

### Task 3: Configure the Ethernet Interfaces on the Host PCs

Configure the Ethernet interfaces of PC1, PC2, PC3, PC4, PC5, and PC6 with the IP addresses and default gateways indicated in the addressing table at the beginning of the lab.

Verify that PC1 can ping PC4, PC2 can ping PC5, and that PC3 can ping PC6.

### Task 4: Configure VTP on the Switches

VTP allows the network administrator to control the instances of VLANs on the network by creating VTP domains. Within each VTP domain, one or more switches are configured as VTP servers. VLANs are then created on the VTP server and pushed to the other switches in the domain. Common VTP configuration tasks are setting the operating mode, domain, and password. In this lab, you will be using S1 as the VTP server, with S2 and S3 configured as VTP clients or in VTP transparent mode.

### Step 1: Check the current VTP settings on the three switches.

S1#show vtp status

```
VTP Version                : 2
Configuration Revision      : 0
Maximum VLANs supported locally : 255
Number of existing VLANs    : 5
VTP Operating Mode          : Server
VTP Domain Name             :
VTP Pruning Mode            : Disabled
VTP V2 Mode                 : Disabled
VTP Traps Generation        : Disabled
MD5 digest                  : 0x57 0xCD 0x40 0x65 0x63 0x59 0x47 0xBD
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

S2#show vtp status

```
VTP Version                : 2
Configuration Revision      : 0
Maximum VLANs supported locally : 255
Number of existing VLANs    : 5
VTP Operating Mode          : Server
VTP Domain Name             :
VTP Pruning Mode            : Disabled
VTP V2 Mode                 : Disabled
VTP Traps Generation        : Disabled
MD5 digest                  : 0x57 0xCD 0x40 0x65 0x63 0x59 0x47 0xBD
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

S3#show vtp status

```
VTP Version                : 2
Configuration Revision      : 0
Maximum VLANs supported locally : 255
Number of existing VLANs    : 5
VTP Operating Mode          : Server
VTP Domain Name             :
VTP Pruning Mode            : Disabled
VTP V2 Mode                 : Disabled
VTP Traps Generation        : Disabled
MD5 digest                  : 0x57 0xCD 0x40 0x65 0x63 0x59 0x47 0xBD
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
```

Note that all three switches are in server mode. Server mode is the default VTP mode for most Catalyst switches.

### Step 2: Configure the operating mode, domain name, and VTP password on all three switches.

Set the VTP domain name to **Lab4** and the VTP password to **cisco** on all three switches. Configure S1 in server mode, S2 in client mode, and S3 in transparent mode.

```
S1(config)#vtp mode server
Device mode already VTP SERVER.
S1(config)#vtp domain Lab4
Changing VTP domain name from NULL to Lab4
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 Lab4
Changing VTP domain name from NULL to Lab4
S2(config)#vtp password cisco
Setting device VLAN database password to cisco
S2(config)#end
```

```
S3(config)#vtp mode transparent
Setting device to VTP TRANSPARENT mode.
S3(config)#vtp domain Lab4
Changing VTP domain name from NULL to Lab4
S3(config)#vtp password cisco
Setting device VLAN database password to cisco
S3(config)#end
```

Note: The VTP domain name can be learned by a client switch from a server switch, but only if the client switch domain is in the null state. It does not learn a new name if one has been previously set. For that reason, it is good practice to manually configure the domain name on all switches to ensure that the domain name is configured correctly. Switches in different VTP domains do not exchange VLAN information.

### Step 3: Configure trunking and the native VLAN for the trunking ports on all three switches.

Use the **interface range** command in global configuration mode to simplify this task.

```
S1(config)#interface range fa0/1-5
S1(config-if-range)#switchport mode trunk
S1(config-if-range)#switchport trunk native vlan 99
S1(config-if-range)#no shutdown
S1(config-if-range)#end

S2(config)# interface range fa0/1-5
S2(config-if-range)#switchport mode trunk
S2(config-if-range)#switchport trunk native vlan 99
S2(config-if-range)#no shutdown
S2(config-if-range)#end

S3(config)# interface range fa0/1-5
S3(config-if-range)#switchport mode trunk
S3(config-if-range)#switchport trunk native vlan 99
S3(config-if-range)#no shutdown
S3(config-if-range)#end
```

### Step 4: Configure port security on the S2 and S3 access layer switches.

Configure ports fa0/6, fa0/11, and fa0/18 so that they allow only a single host and learn the MAC address of the host dynamically.

```
S2(config)#interface fa0/6
S2(config-if)#switchport port-security
S2(config-if)#switchport port-security maximum 1
S2(config-if)#switchport port-security mac-address sticky
S2(config-if)#interface fa0/11
S2(config-if)#switchport port-security
```

```
S2(config-if)#switchport port-security maximum 1
S2(config-if)#switchport port-security mac-address sticky
S2(config-if)#interface fa0/18
S2(config-if)#switchport port-security
S2(config-if)#switchport port-security maximum 1
S2(config-if)#switchport port-security mac-address sticky
S2(config-if)#end
```

```
S3(config)#interface fa0/6
S3(config-if)#switchport port-security
S3(config-if)#switchport port-security maximum 1
S3(config-if)#switchport port-security mac-address sticky
S3(config-if)#interface fa0/11
S3(config-if)#switchport port-security
S3(config-if)#switchport port-security maximum 1
S3(config-if)#switchport port-security mac-address sticky
S3(config-if)#interface fa0/18
S3(config-if)#switchport port-security
S3(config-if)#switchport port-security maximum 1
S3(config-if)#switchport port-security mac-address sticky
S3(config-if)#end
```

#### Step 5: Configure VLANs on the VTP server.

There are four additional VLANs required in this lab:

- VLAN 99 (management)
- VLAN 10 (faculty/staff)
- VLAN 20 (students)
- VLAN 30 (guest)

Configure these on the VTP server.

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

Verify that the VLANs have been created on S1 with the **show vlan brief** command.

#### Step 6: Check if the VLANs created on S1 have been distributed to S2 and S3.

Use the **show vlan brief** command on S2 and S3 to determine if the VTP server has pushed its VLAN configuration to all the 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	act/unsup	
1003	token-ring-default	act/unsup	
1004	fddinet-default	act/unsup	
1005	trnet-default	act/unsup	

Are the same VLANs configured on all switches? \_\_\_\_\_

Explain why S2 and S3 have different VLAN configurations at this point. \_\_\_\_\_

### Step 7: Create a new VLAN on switch 2 and 3.

S2(config)#**vlan 88**

%VTP VLAN configuration not allowed when device is in CLIENT mode.

S3(config)#**vlan 88**

S3(config-vlan)#**name test**

S3(config-vlan)#

Why are you prevented from creating a new VLAN on S2 but not S3? \_\_\_\_\_

Delete VLAN 88 from S3.

S3(config)#**no vlan 88**

**Step 8: Manually configure VLANs.**

Configure the four VLANs identified in Step 5 on switch S3.

```
S3(config)#vlan 99
S3(config-vlan)#name management
S3(config-vlan)#exit
S3(config)#vlan 10
S3(config-vlan)#name faculty/staff
S3(config-vlan)#exit
S3(config)#vlan 20
S3(config-vlan)#name students
S3(config-vlan)#exit
S3(config)#vlan 30
S3(config-vlan)#name guest
S3(config-vlan)#exit
```

Here you see one of the advantages of VTP. Manual configuration is tedious and error prone, and any error introduced here could prevent intra-VLAN communication. In addition, these types of errors can be difficult to troubleshoot.

**Step 9: Configure the management interface address on all three switches.**

```
S1(config)#interface vlan 99
S1(config-if)#ip address 172.17.99.11 255.255.255.0
S1(config-if)#no shutdown

S2(config)#interface vlan 99
S2(config-if)#ip address 172.17.99.12 255.255.255.0
S2(config-if)#no shutdown

S3(config)#interface vlan 99
S3(config-if)#ip address 172.17.99.13 255.255.255.0
S3(config-if)#no shutdown
```

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 10: Assign switch ports to VLANs.**

Refer to the port assignment table at the beginning of the lab to assign ports to the VLANs. Use the **interface range** command to simplify this task. Port assignments are not configured through VTP. Port assignments must be configured on each switch manually or dynamically using a VMPS server. The commands are shown for S3 only, but both S2 and S1 switches should be similarly configured. Save the configuration when you are done.

```
S3(config)#interface range fa0/6-10
S3(config-if-range)#switchport access vlan 30
S3(config-if-range)#interface range fa0/11-17
S3(config-if-range)#switchport access vlan 10
S3(config-if-range)#interface range fa0/18-24
S3(config-if-range)#switchport access vlan 20
S3(config-if-range)#end
S3#copy running-config startup-config
Destination filename [startup-config]? [enter]
Building configuration...
[OK]
```



S3#

### Task 5: Configure VTP Pruning on the Switches

VTP pruning allows a VTP server to suppress IP broadcast traffic for specific VLANs to switches that do not have any ports in that VLAN. By default, all unknown unicasts and broadcasts in a VLAN are flooded over the entire VLAN. All switches in the network receive all broadcasts, even in situations in which few users are connected in that VLAN. VTP pruning is used to eliminate or prune this unnecessary traffic. Pruning saves LAN bandwidth because broadcasts do not have to be sent to switches that do not need them.

Pruning is configured on the server switch with the **vtp pruning** command in global configuration mode. The configuration is pushed to client switches.

Confirm VTP pruning configuration on each switch using the **show vtp status** command. VTP pruning mode should be enabled on each switch.

```
S1#show vtp status
VTP Version                : 2
Configuration Revision      : 17
Maximum VLANs supported locally : 255
Number of existing VLANs    : 9
VTP Operating Mode          : Server
VTP Domain Name             : Lab4
VTP Pruning Mode            : Enabled
<output omitted>
```

### Task 6: Clean Up

Erase the configurations and reload the switches. Disconnect and store the cabling. For PC hosts that are normally connected to other networks (such as the school LAN or to the Internet), reconnect the appropriate cabling and restore the TCP/IP settings.