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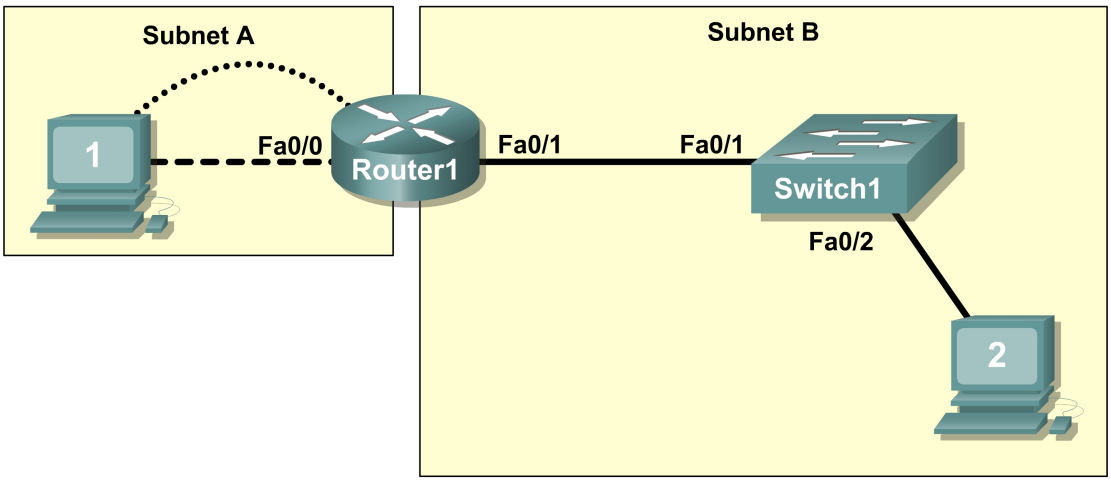
CCNA Exploration 4.0

LAN Switching and Wireless
Student Lab Manual

Lab 1.3.1: Review of Concepts from Exploration 1

Topology Diagram



Learning Objectives

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

- Create a logical topology given network requirements
- Create subnets to meet host requirements
- Configure the physical topology
- Configure the logical topology
- Verify network connectivity
- Configure and verify passwords

Scenario

In this lab, you will design and configure a small routed network and verify connectivity across multiple network devices. This requires creating and assigning two subnetwork blocks, connecting hosts and network devices, and configuring host computers and one Cisco router for basic network connectivity. Switch1 has a default configuration and does not require additional configuration. You will use common commands to test and document the network. The zero subnet is used.

Task 1: Design a Logical LAN Topology

Step 1: Design an IP addressing scheme.

Given the IP address block of **192.168.7.0 /24**, design an IP addressing scheme that satisfies the following requirements:

Subnet	Number of Hosts
Subnet A	110
Subnet B	54

The 0 subnet is used. No subnet calculators may be used. Create the smallest possible subnets that satisfy the requirements for hosts. Assign the first usable subnet to Subnet A.

Subnet A	
Specification	**Student Input**
Number of bits in the subnet	
IP mask (binary)	
New IP mask (decimal)	
Maximum number of usable subnets (including the 0 subnet)	
Number of usable hosts per subnet	
IP subnetwork address	
First IP host address	
Last IP host address	

Subnet B	
Specification	**Student Input**
Number of bits in the subnet	
IP mask (binary)	
New IP mask (decimal)	
Maximum number of usable subnets (including the 0 subnet)	
Number of usable hosts per subnet	
IP network address	
First IP host address	
Last IP host address	

Host computers will use the first usable IP address in the subnet. The network router will use the last usable IP address in the subnet.

Step 2: Write down the IP address information for each device.

Device	IP address	Mask	Gateway
Host1			
Router1-Fa0/0			
Host2			
Router1-Fa0/1			

Table 1. IP Address Assignments

Before proceeding, verify your IP addresses with the instructor.

Task 2: Configure the Physical Topology

Step 1: Cable the network.

Refer to the figure and table below for the necessary cables.

Cabling	Cable Type
LAN cable between Host1 and Router1 Fa0/0	Crossover
LAN cable between Switch1 and Router1 Fa0/1	Straight-through
LAN cable between Switch1 and Host2	Straight-through
Console cable between Host1 and Router1	Rollover

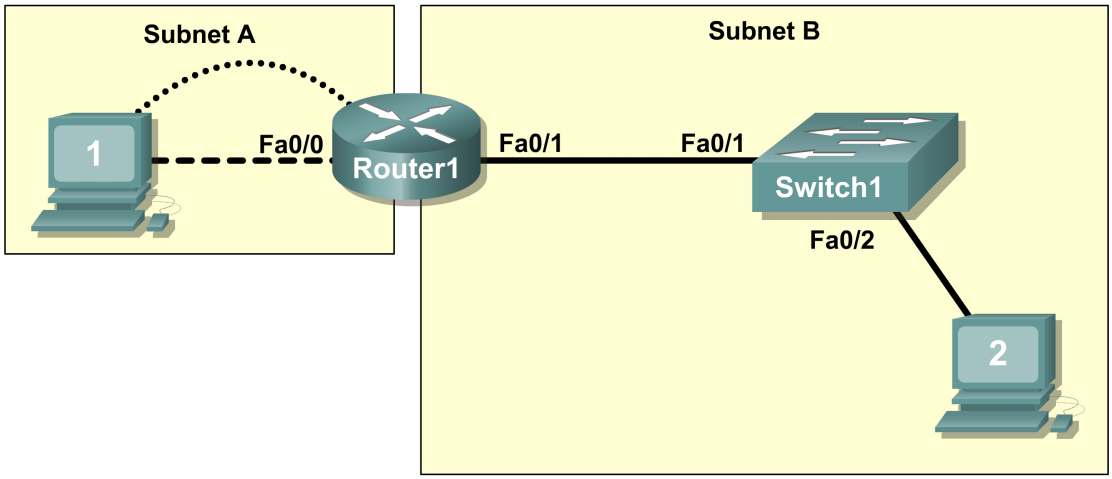


Figure 1. Cabling the network

Step 2: Physically connect lab devices.

Cable the network devices as shown in Figure 1. Turn power on to all devices if it is not already on.

Step 3: Inspect the network connections.

Verify the connections visually.

Task 3: Configure the Logical Topology

Step 1: Configure the host computers.

Configure the static IP address, subnet mask, and gateway for each host computer.

Note: The following directions are for Windows XP. To configure hosts using other operating systems, refer to the operating system manual.

To configure the host, go to **Start > Control Panel > Network Connections > Local Area Connection**. In the Local Area Connection Properties window, select **Internet Protocol (TCP/IP)** and click the **Properties** button.

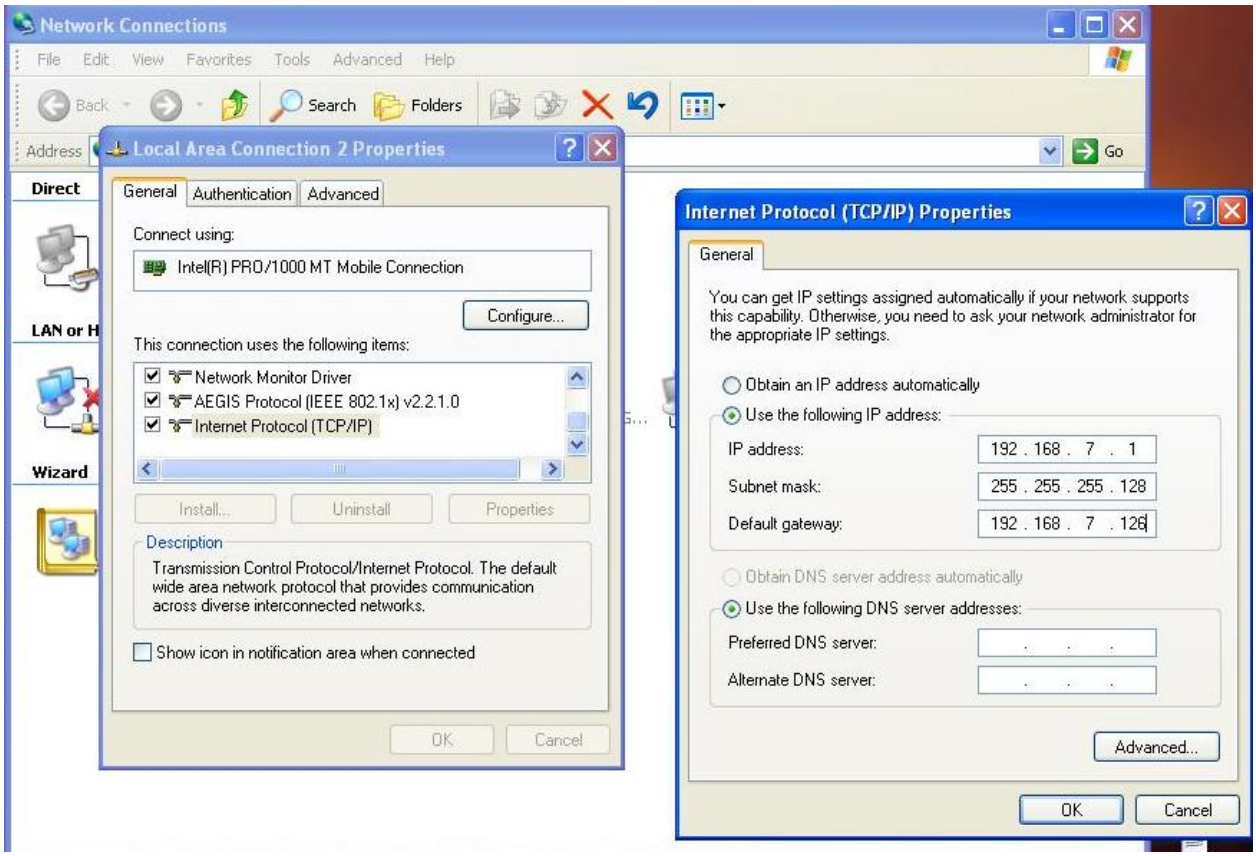


Figure 2. Setting Properties for Internet Protocol (TCP/IP)

In the TCP/IP Properties dialog box for each host, enter the IP address, network mask, and the gateway from Table 1.

After configuring each host computer, open a command window on the host by selecting **Start > Run**. When prompted to type the name of a program, enter **cmd** in the text box. From the command window, display and verify the host network settings with the **ipconfig /all** command. The settings should match those in the tables below:

Host1 Network Configuration	
IP address	192.168.7.1
Subnet mask	255.255.255.128
Default gateway	192.168.7.126

Host2 Network Configuration	
IP address	192.168.7.129
Subnet mask	255.255.255.192
Default gateway	192.168.7.190

Are the host settings in agreement with the tables? _____ If not, reconfigure as necessary.

Step 2: Configure Router1.

From Host1, connect to the console of Router 1 and establish a console session. Directions for creating a console connection using HyperTerminal are in Appendix 2.

From the router console, configure the following:

Task	Specification
Router name	Router1
Encrypted privileged exec password	class
Console access password	cisco
Telnet access password	cisco
Router1 interface Fa0/0	Set the description Set the Layer 3 address
Router1 interface Fa0/1	Set the description Set the Layer 3 address

Enter the following commands on the router:

```
Router>enable
Router#config term
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname Router1
Router1(config)#enable secret class
Router1(config)#line console 0
Router1(config-line)#password cisco
Router1(config-line)#login
Router1(config-line)#line vty 0 4
Router1(config-line)#password cisco
Router1(config-line)#login
Router1(config-line)#interface fa0/0
Router1(config-if)#ip address 192.168.7.126  255.255.255.128
Router1(config-if)#no shutdown
Router1(config-if)#description connection to host1
Router1(config-if)#interface fa0/1
Router1(config-if)#description connection to switch1
Router1(config-if)#ip address 192.168.7.190 255.255.255.192
Router1(config-if)#no shutdown
Router1(config-if)#end
Router1#
```

Task 4: Verify Network Connectivity

Step 1: Use the ping command to verify network connectivity.

You can verify network connectivity using the **ping** command.

Note: If pings to the host computers fail, temporarily disable the computer firewall and retest. To disable a Windows firewall, select **Start > Control Panel > Windows Firewall**, select **OFF**, and then **OK**.

Use the following table to verify connectivity with each network device. Take corrective action to establish connectivity if a test fails.

From	To	IP Address	Ping Results
Host1	NIC IP address	192.168.7.1	
Host1	Router1, Fa0/0	192.168.7.126	
Host1	Router1, Fa0/1	192.168.7.190	
Host1	Host2	192.168.7.129	
Host2	NIC IP address	192.168.7.129	
Host2	Router1, Fa0/1	192.168.7.190	
Host2	Router1, Fa0/0	192.168.7.126	
Host2	Host1	192.168.7.1	

In addition to the **ping** command, what other Windows command is useful in displaying network delay and breaks in the path to the destination?_____

Task 5: Verify Passwords

Step 1: Telnet to the router from Host2 and verify the Telnet password.

You should be able to telnet to either Fast Ethernet interface of the router.

In a command window on Host 2, type:

```
telnet 192.168.7.190
```

When you are prompted for the Telnet password, type **cisco** and press Enter.

Was the telnet successful? _____

Step 2: Verify that the enable secret password has been set.

From the Telnet session, enter privilege exec mode and verify it is password protected:

```
Router>enable
```

Were you prompted for the enable secret password? _____

Step 3: Verify that the console is password protected.

Terminate and then re-establish the console connection from Host1 to the router to verify that the console is password protected.

Depending on the Telnet client that you are using, the session can usually be terminated with Ctrl-]. When the session is re-established, you should be prompted for the console password before being allowed access to the command line interface.

Task 6: Reflection

How are Telnet access and console access different? When might it make sense to set different passwords on these two access ports? _____

_____

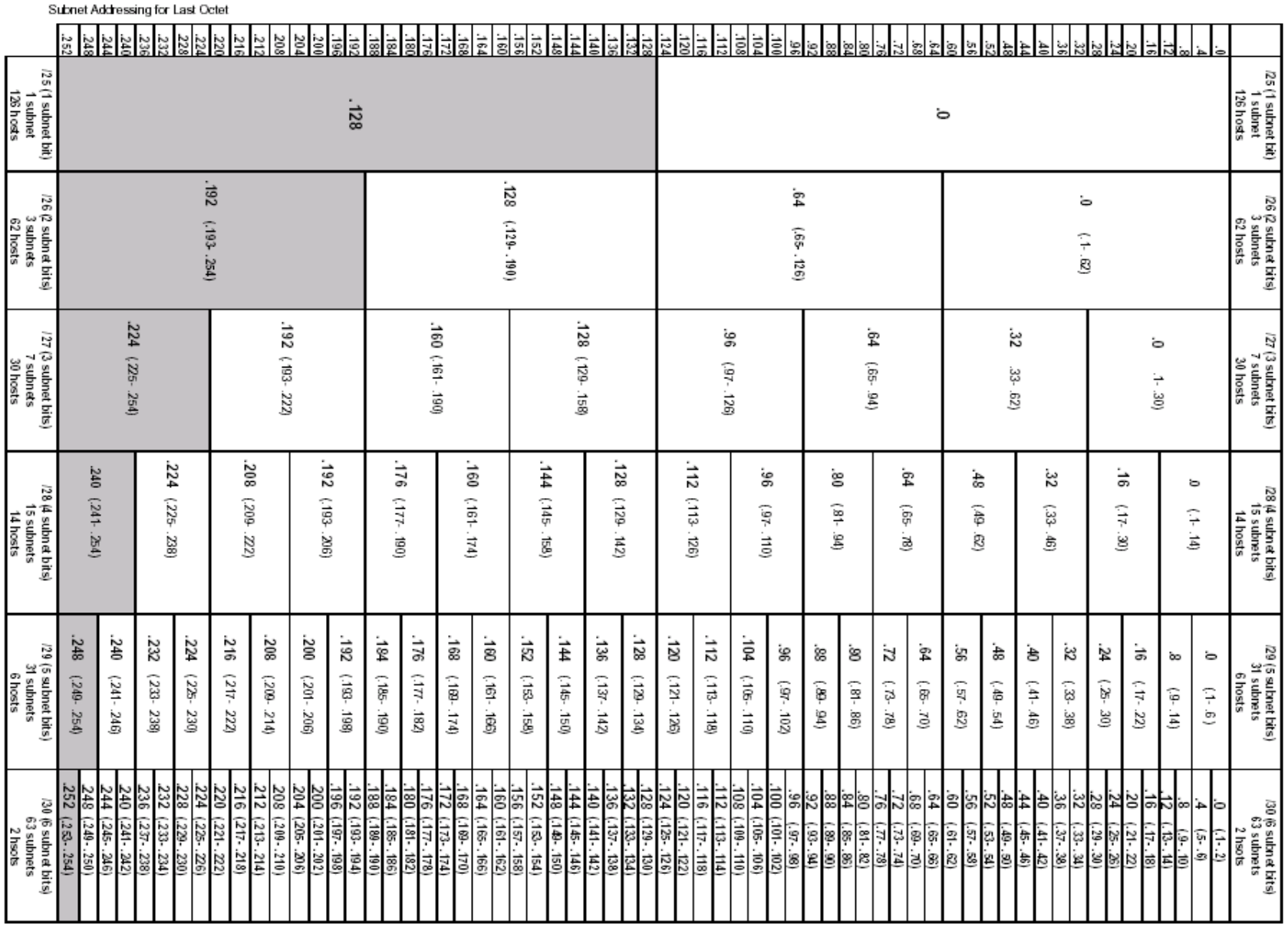
Why does the switch between Host2 and the router not require configuration with an IP address to forward packets? _____

_____

Task 7: Clean Up

Unless directed otherwise by your instructor, 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.

Appendix 1: Last Octet Subnet Chart



Appendix 2: Creating a Router Console Session using HyperTerminal

Task 1: Connect a Router and Computer with a Console Cable

Step 1: Set up a basic physical connection.

Connect the console (rollover) cable to the console port on the router. Connect the other cable end to the host computer with a DB-9 or DB-25 adapter to the COM 1 port.

Step 2: Power on devices.

If not already powered on, enable power to the computer and router.

Task 2: Configure HyperTerminal to Establish a Console Session with a Cisco IOS Router

Step 1: Start the HyperTerminal application.

Start the HyperTerminal program by clicking **Start > Programs > Accessories > Communications > HyperTerminal**.

Step 2: Configure HyperTerminal.

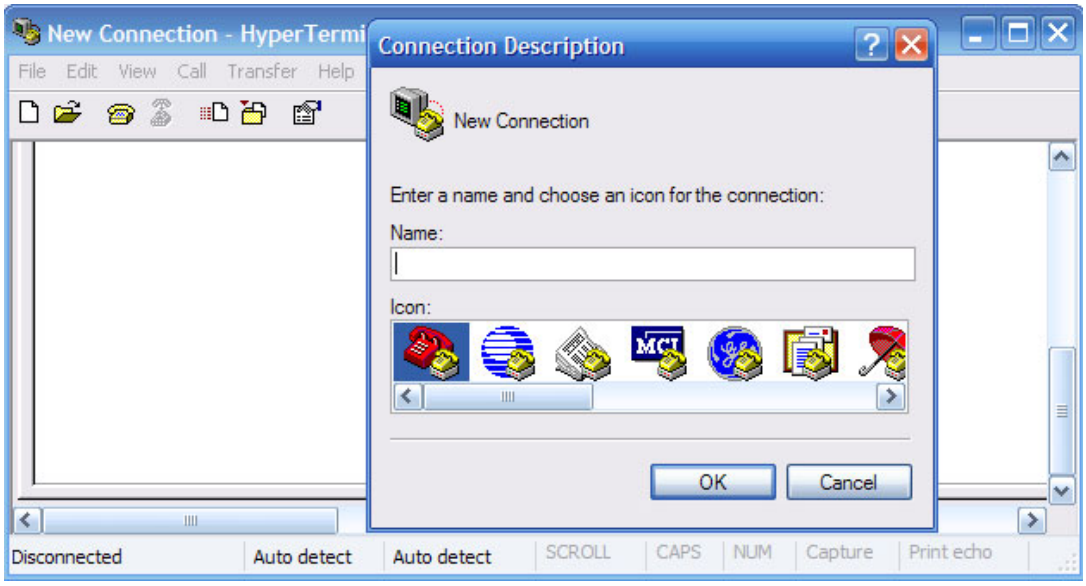


Figure 3. HyperTerminal Name Configuration Window

In the Connection Description window, enter a session name in the Name field. Select an appropriate icon, or keep the default. Click **OK**.

Figure 4. HyperTerminal Connection Type

Enter COM 1 in the Connect Using field, and then click **OK**. (Depending upon the PC you are using, it may be necessary to use a different COM port. If COM1 does not work, then systematically try the additional COM ports until you are successful.)

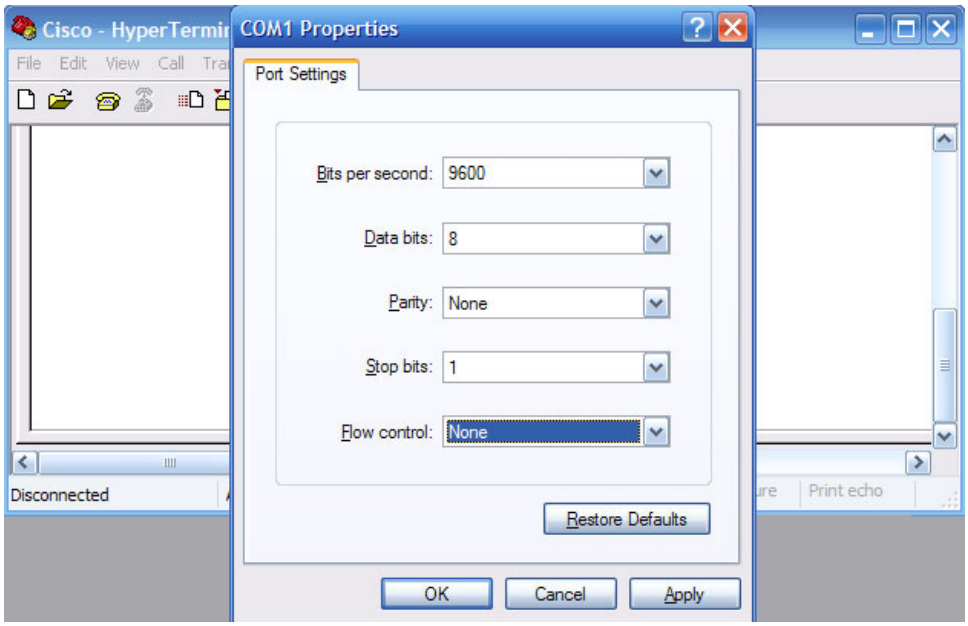


Figure 5. HyperTerminal COM1 Port Settings

As shown in Figure 3, change port settings to the following values, and then click **OK**:

Setting	**Value**
Bits per second	**9600**
Data bits	**8**
Parity	**None**
Stop bits	**1**
Flow control	**None**

When the HyperTerminal session window appears, press **Enter**. There should be a response from the router. This indicates that the connection has been successfully completed. If there is no connection, troubleshoot as necessary. For example, verify that the router has power. Check the connection to the COM 1 port on the PC and the console port on the router. If there is still no connection, ask the instructor for assistance.

Step 3: Close HyperTerminal.

When finished, close the HyperTerminal session by choosing **File > Exit**. When asked whether to save the session, click **Yes**. Enter a name for the session.

Step 4: Reconnect the HyperTerminal session.

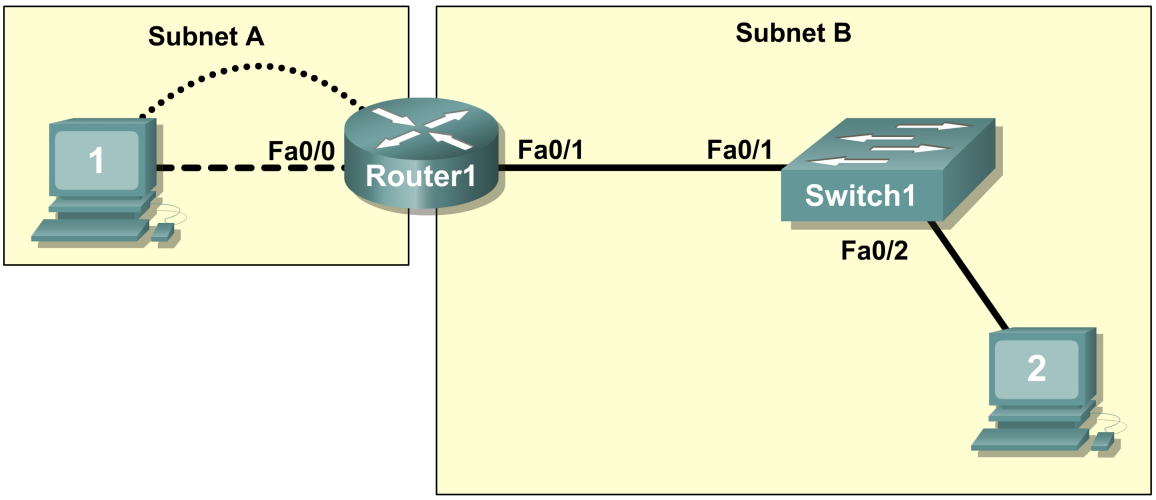
Reopen the HyperTerminal session as described in Task 2, Step 1. This time, when the Connection Description window appears (see Figure 3), click **Cancel**.

Choose **File > Open**. Select the saved session and then click **Open**. Use this step to reconnect the HyperTerminal session to a Cisco device without reconfiguring a new session.

When finished, exit HyperTerminal.

Lab 1.3.2: Review of Concepts from Exploration 1 - Challenge

Topology Diagram



Learning Objectives

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

- Create a logical topology given network requirements
- Create subnets to meet host requirements
- Configure the physical topology
- Configure the logical topology
- Verify network connectivity
- Configure and verify passwords

Scenario

In this lab, you will design and configure a small routed network and verify connectivity across multiple network devices. This requires creating and assigning two subnetwork blocks, connecting hosts and network devices, and configuring host computers and one Cisco router for basic network connectivity. Switch1 has a default configuration and does not require additional configuration. You will use common commands to test and document the network. The zero subnet is used.

Task 1: Design a Logical LAN Topology

Step 1: Design an IP addressing scheme.

Given the IP address block of **192.168.30.0 /27**, design an IP addressing scheme that satisfies the following requirements:

Subnet	Number of Hosts
Subnet A	7
Subnet B	14

The 0 subnet is used. No subnet calculators may be used. Create the smallest possible number of subnets that satisfy the requirements for hosts. Assign the first usable subnet to Subnet A.

Subnet A	
Specification	**Student Input**
Number of bits in the subnet	
IP mask (binary)	
New IP mask (decimal)	
Maximum number of usable subnets (including the 0 subnet)	
Number of usable hosts per subnet	
IP subnetwork address	
First IP host address	
Last IP host address	

Subnet B	
Specification	**Student Input**
Number of bits in the subnet	
IP mask (binary)	
New IP mask (decimal)	
Maximum number of usable subnets (including the 0 subnet)	
Number of usable hosts per subnet	
IP subnetwork address	
First IP host address	
Last IP host address	

Host computers will use the first usable IP address in the subnet. The network router will use the last usable IP address in the subnet.

Step 2: Write down the IP address information for each device.

Device	IP address	Mask	Gateway
Host1			
Router1-Fa0/0			
Host2			
Router1-Fa0/1			

Before proceeding, verify your IP addresses with the instructor.

Task 2: Configure the Physical Topology

Step 1: Determine cabling requirements.

Referring to Figure 1, identify each cable type required and document it in the table.

Correct Cabling	Cable Type
LAN cable between Host1 and Router1 Fa0/0	
LAN cable between Switch1 and Router1 Fa0/1	
LAN cable between Switch1 and Host2	
Console cable between Host1 and Router1	

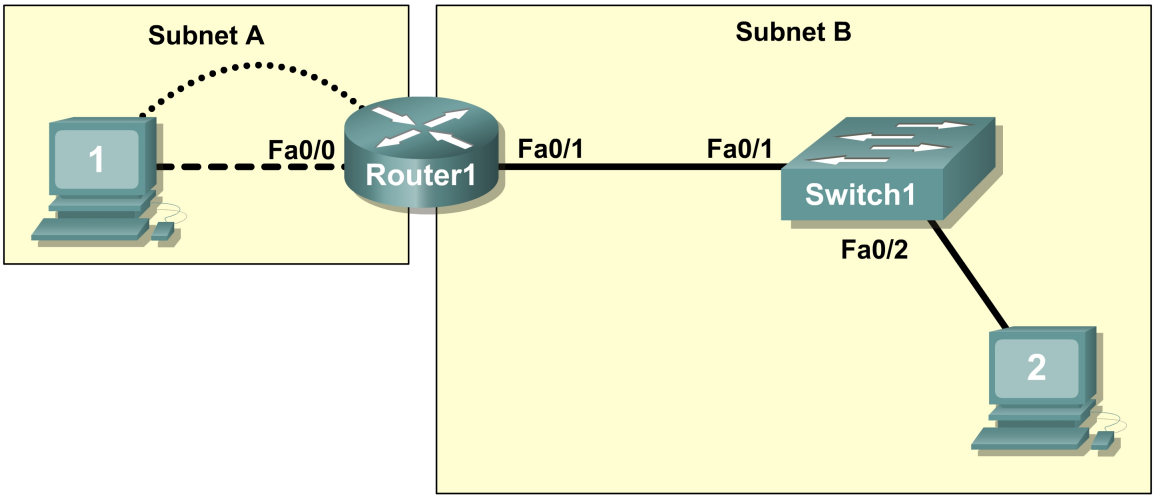


Figure 1. Cabling the network.

Step 2. Physically connect lab devices.

Cable the network devices as shown in Figure 1. Turn power on to all devices if it is not already on.

Step 3: Inspect the network connections.

After cabling the network devices, verify the connections..

Task 3: Configure the Logical Topology

Step 1: Configure the host computers.

Configure the static IP address, subnet mask, and gateway for each host computer. After configuring each host computer, display and verify the host network settings with the **ipconfig /all** command.

Host1 Network Configuration	
Physical address	
IP address	
Subnet mask	
Default gateway	

Host2 Network Configuration	
Physical address	
IP address	
Subnet mask	
Default gateway	

Step 2: Configure Router1.

From Host1, connect to the console of Router 1 and configure the following:

Task	Specification
Router name	`Router1`
Encrypted privileged exec password	`class`
Console access password	`cisco`
Telnet access password	`cisco`
Router1 interface Fa0/0	Set the description Set the Layer 3 address
Router1 interface Fa0/1	Set the description Set the Layer 3 address

Task 4: Verify Network Connectivity

Step 1: Use the ping command to verify network connectivity.

You can verify network connectivity using the **ping** command.

Note: If pings to the host computers fail, verify the existence of a firewall program running on the hosts. If a firewall is running on the host temporarily disable it and retest. To disable a Windows firewall, select **Start > Control Panel > Windows Firewall**, select **OFF**, and then **OK**.

Use the following table to verify connectivity with each network device. Take corrective action to establish connectivity if a test fails.

From	To	IP Address	Ping Results
Host1	NIC IP address		
Host1	Router1, Fa0/0		
Host1	Router1, Fa0/1		
Host1	Host2		
Host2	NIC IP address		

Host2	Router1, Fa0/1		
Host2	Router1, Fa0/0		
Host2	Host1		

In addition to the **ping** command, what other Windows command is useful in displaying network delay and breaks in the path to the destination?_____

Task 5: Verify Passwords

Step 1: Telnet to the router from Host2 and verify the Telnet password.

You should be able to telnet to either Fast Ethernet interface of the router.

Step 2: Verify that the enable secret password has been set.

From the Telnet session, enter privilege exec mode and verify that it is password protected.

Step 3: Verify that the console is password protected.

Terminate and then re-establish the console connection from Host1 to the router to verify that the console is password protected.

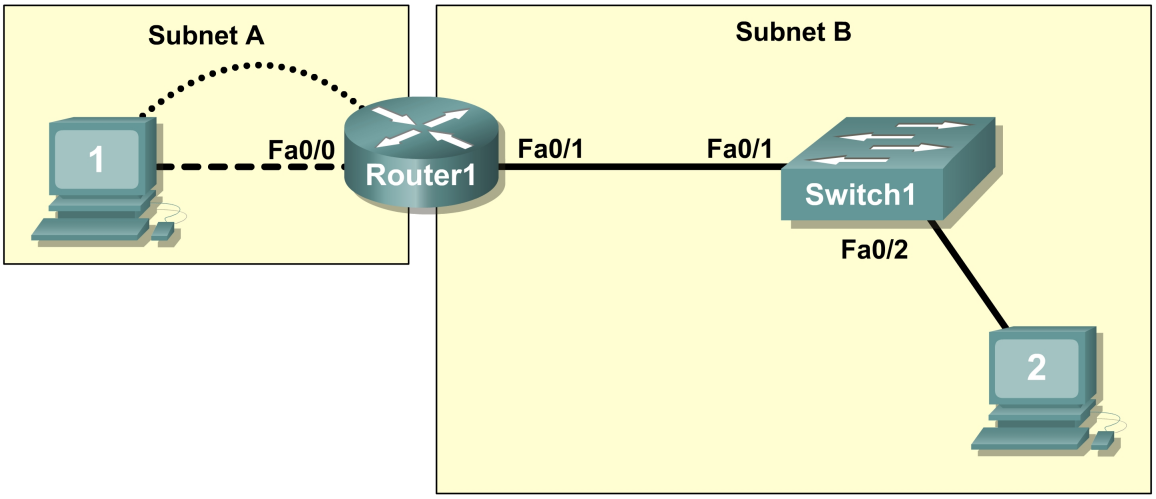
Depending on the Telnet client that you are using, the session can usually be terminated with Ctrl-].

Task 6: Clean Up

Unless directed otherwise by your instructor, 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.

Lab 1.3.3: Troubleshooting a Small Network

Topology Diagram



Learning Objectives

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

- Verify that a paper design meets stated network requirements
- Cable a network according to the topology diagram
- Erase the startup configuration and reload a router to the default state
- Load the routers with supplied scripts
- Discover where communication is not possible
- Gather information about the misconfigured portion of the network along with any other errors
- Analyze information to determine why communication is not possible
- Propose solutions to network errors
- Implement solutions to network errors

Scenario

In this lab, you are given a completed configuration for a small routed network. The configuration contains design and configuration errors that conflict with stated requirements and prevent end-to-end communication. You will examine the given design and identify and correct any design errors. You will then cable the network, configure the hosts, and load configurations onto the router. Finally, you will troubleshoot the connectivity problems to determine where the errors are occurring and correct them

using the appropriate commands. When all errors have been corrected, each host should be able to communicate with all other configured network elements and with the other host.

Task 1: Examine the Logical LAN Topology

The IP address block of 172.16.30.0 /23 is subnetted to meet the following requirements:

Subnet	Number of Hosts
Subnet A	174
Subnet B	60

Additional requirements and specifications:

- The 0 subnet is used.
- The smallest possible number of subnets that satisfy the requirements for hosts should be used, keeping the largest possible block in reserve for future use.
- Assign the first usable subnet to Subnet A.
- Host computers use the first IP address in the subnet. The network router uses the last network host address.

Based on these requirements, the following topology has been provided to you:

Subnet A	
Specification	**Value**
IP mask (decimal)	255.255.255.0
IP address	172.16.30.0
First IP host address	172.16.30.1
Last IP host address	172.16.30.254

Subnet B	
Specification	**Value**
IP mask (decimal)	255.255.255.128
IP address	172.16.31.0
First IP host address	172.16.31.1
Last IP host address	172.16.31.126

Examine each of the values in the tables above and verify that this topology meets all requirements and specifications. Are any of the given values incorrect? _____

If yes, correct the values in the table above and write the corrected values below:

_____

_____

Create a configuration table similar to the one below using your corrected values:

Device	IP address	Mask	Gateway
Host1	172.16.30.1	255.255.255.0	172.16.30.254
Router1–Fa0/0	172.16.30.254	255.255.255.0	N/A
Host2	172.16.31.1	255.255.255.128	172.16.31.126

Router1–Fa0/1	172.16.31.126	255.255.255.128	N/A

Task 2: Cable, Erase, and Reload the Router

Step 1: Cable the network.

Cable a network that is similar to the one in the topology diagram.

Step 2: Clear the configuration on the router.

Clear the configuration on the router using the **erase startup-config** command and then reload the router. Answer **no** if asked to save changes.

Task 3: Configure the Host Computers

Step 1: Configure host computers.

Configure the static IP address, subnet mask, and gateway for each host computer based on the configuration table created in Task 1. After configuring each host computer, display and verify the host network settings with the **ipconfig /all** command.

Task 4: Load the Router with the Supplied Scripts

```
enable
!
config term
!
hostname Router1
!
enable secret class
!
no ip domain-lookup
!
 interface FastEthernet0/0
 description connection to host1
 ip address 172.16.30.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 description connection to switch1
 ip address 192.16.31.1 255.255.255.192
 duplex auto
 speed auto
!
!
line con 0
 password cisco
 login
line vty 0
 login
```



```
line vty 1 4
 password cisco
 login
!
end
```

Task 5: Identify Connectivity Problems

Step 1: Use the ping command to test network connectivity.

Use the following table to test the connectivity of each network device.

From	To	IP Address	Ping Results
Host1	NIC IP address	172.16.30.1	
Host1	Router1, Fa0/0	172.16.30.254	
Host1	Router1, Fa0/1	172.16.31.126	
Host1	Host2	172.16.31.1	
Host2	NIC IP address	172.16.31.1	
Host2	Router1, Fa0/1	172.16.31.126	
Host2	Router1, Fa0/0	172.16.30.254	
Host2	Host1	172.16.30.1	

Task 6: Troubleshoot Network Connections

Step 1: Begin troubleshooting at PC1.

From host PC1, is it possible to ping PC2? _____

From host PC1, is it possible to ping the router fa0/1 interface? _____

From host PC1, is it possible to ping the default gateway? _____

From host PC1, is it possible to ping itself? _____

Where is the most logical place to begin troubleshooting the PC1 connection problems?

_____

_____

Step 2: Examine the router to find possible configuration errors.

Begin by viewing the summary of status information for each interface on the router.

Are there any problems with the status of the interfaces?

_____

_____

If there are problems with the status of the interfaces, record any commands that are necessary to correct the configuration errors.

_____

_____

Step 3: Use the necessary commands to correct the router configuration.

Step 4: View a summary of the status information.

If any changes were made to the configuration in the previous step, view the summary of the status information for the router interfaces.

Does the information in the interface status summary indicate any configuration errors on Router1?

_____

If the answer is **yes**, troubleshoot the interface status of the interfaces.

Has connectivity been restored? _____

Step 5: Verify the logical configuration.

Examine the full status of Fa 0/0 and 0/1. Is the IP addresses and subnet mask information in the interface status consistent with the configuration table? _____

If there are differences between the configuration table and the router interface configuration, record any commands that are necessary to correct the router configuration.

_____

_____

Has connectivity been restored? _____

Why is it useful for a host to ping its own address?

_____

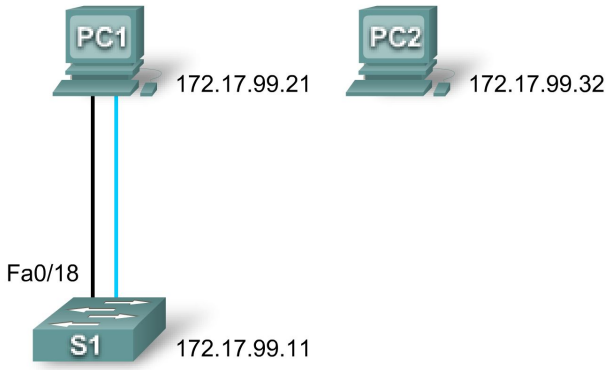
_____

Task 7: Clean Up

Unless directed otherwise by your instructor, 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.

Lab 2.5.1: Basic Switch Configuration

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
PC1	**NIC**	172.17.99.21	255.255.255.0	172.17.99.1
PC2	**NIC**	172.17.99.32	255.255.255.0	172.17.99.1
S1	**VLAN99**	172.17.99.11	255.255.255.0	172.17.99.1

Learning Objectives

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

- Cable a network according to the topology diagram
- Clear an existing configuration on a switch
- Examine and verify the default configuration
- Create a basic switch configuration, including a name and an IP address
- Configure passwords to ensure that access to the CLI is secured
- Configure switch port speed and duplex properties for an interface
- Configure basic switch port security
- Manage the MAC address table
- Assign static MAC addresses
- Add and move hosts on a switch

Scenario

In this lab, you will examine and configure a standalone LAN switch. Although a switch performs basic functions in its default out-of-the-box condition, there are a number of parameters that a network administrator should modify to ensure a secure and optimized LAN. This lab introduces you to the basics of switch configuration.

Task 1: Cable, Erase, and Reload the Switch

Step 1: Cable a network.

Cable a network that is similar to the one in the topology diagram. Create a console connection to the switch. If necessary, refer to Lab 1.3.1 on how to create a console connection.

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 from a 2960 switch. If you use other switches, the switch outputs and interface descriptions may appear different.

Note: PC2 is not initially connected to the switch. It is only used in Task 5.

Step 2: Clear the configuration on the switch.

Clear the configuration on the switch using the procedure in Appendix 1.

Task 2: Verify the Default Switch Configuration

Step 1: Enter privileged mode.

You can access all the switch commands in privileged mode. However, because many of the privileged commands configure operating parameters, privileged access should be password-protected to prevent unauthorized use. You will set passwords in Task 3.

The privileged EXEC command set includes those commands contained in user EXEC mode, as well as the **configure** command through which access to the remaining command modes are gained. Enter privileged EXEC mode by entering the **enable** command.

```
Switch>enable
Switch#
```

Notice that the prompt changed in the configuration to reflect privileged EXEC mode.

Step 2: Examine the current switch configuration.

Examine the current running configuration file.

```
Switch#show running-config
```

How many FastEthernet interfaces does the switch have? _____

How many Gigabit Ethernet interfaces does the switch have? _____

What is the range of values shown for the vty lines? _____

Examine the current contents of NVRAM:

```
Switch#show startup-config
startup-config is not present
```

Why does the switch give this response?

_____

Examine the characteristics of the virtual interface VLAN1:

```
Switch#show interface vlan1
```

Is there an IP address set on the switch? _____

What is the MAC address of this virtual switch interface? _____

Is this interface up? _____

Now view the IP properties of the interface:

```
Switch#show ip interface vlan1
```

What output do you see? _____

Step 3: Display Cisco IOS information.

Examine the following version information that the switch reports.

```
Switch#show version
```

What is the Cisco IOS version that the switch is running? _____

What is the system image filename? _____

What is the base MAC address of this switch? _____

Step 4: Examine the FastEthernet interfaces.

Examine the default properties of the FastEthernet interface used by PC1.

```
Switch#show interface fastethernet 0/18
```

Is the interface up or down? _____

What event would make an interface go up? _____

What is the MAC address of the interface? _____

What is the speed and duplex setting of the interface? _____

Step 5: Examine VLAN information.

Examine the default VLAN settings of the switch.

```
Switch#show vlan
```

What is the name of VLAN 1? _____

Which ports are in this VLAN? _____

Is VLAN 1 active? _____

What type of VLAN is the default VLAN? _____

Step 6 Examine flash memory.

Issue one of the following commands to examine the contents of the flash directory.

```
Switch#dir flash:
```

or

```
Switch#show flash
```

Which files or directories are found?

_____

Files have a file extension, such as .bin, at the end of the filename. Directories do not have a file extension. To examine the files in a directory, issue the following command using the filename displayed in the output of the previous command:

```
Switch#dir flash:c2960-lanbase-mz.122-25.SEE3
```

The output should look similar to this:

```
Directory of flash:/c2960-lanbase-mz.122-25.SEE3/
    6  drwx     4480   Mar 1 1993 00:04:42 +00:00  html
  618  -rwx  4671175   Mar 1 1993 00:06:06 +00:00  c2960-lanbase-mz.122-25.SEE3.bin
  619  -rwx      457   Mar 1 1993 00:06:06 +00:00  info
32514048 bytes total (24804864 bytes free)
```

What is the name of the Cisco IOS image file? _____

Step 7: Examine the startup configuration file.

To view the contents of the startup configuration file, issue the **show startup-config** command in privileged EXEC mode.

```
Switch#show startup-config
startup-config is not present
```

Why does this message appear? _____

Let's make one configuration change to the switch and then save it. Type the following commands:

```
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S1
S1(config)#exit
S1#
```

To save the contents of the running configuration file to non-volatile RAM (NVRAM), issue the the command **copy running-config startup-config**.

```
Switch#copy running-config startup-config
Destination filename [startup-config]?  (enter)
Building configuration...
[OK]
```

Note: This command is easier to enter by using the **copy run start** abbreviation.

Now display the contents of NVRAM using the **show startup-config** command.

```
S1#show startup-config
Using 1170 out of 65536 bytes
!
version 12.2
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname S1
!
```



```
<output omitted>
```

The current configuration has been written to NVRAM.

Task 3: Create a Basic Switch Configuration

Step 1: Assign a name to the switch.

In the last step of the previous task, you configured the hostname. Here's a review of the commands used.

```
S1#configure terminal
S1(config)#hostname S1
S1(config)#exit
```

Step 2: Set the access passwords.

Enter config-line mode for the console. Set the login password to **cisco**. Also configure the vty lines 0 to 15 with the password **cisco**.

```
S1#configure terminal
Enter the configuration commands, one for each line. When you are finished,
return to global configuration mode by entering the exit command or pressing
Ctrl-Z.

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)#exit
```

Why is the **login** command required? _____

Step 3. Set the command mode passwords.

Set the enable secret password to class. This password protects access to privileged EXEC mode.

```
S1(config)#enable secret class
```

Step 4. Configure the Layer 3 address of the switch.

Before you can manage S1 remotely from PC1, you need to assign the switch an IP address. The default configuration on the switch is to have the management of the switch controlled through VLAN 1. However, a best practice for basic switch configuration is to change the management VLAN to a VLAN other than VLAN 1. The implications and reasoning behind this action are explained in the next chapter.

For management purposes, we will use VLAN 99. The selection of VLAN 99 is arbitrary and in no way implies you should always use VLAN 99.

First, you will create the new VLAN 99 on the switch. Then you will set the IP address of the switch to 172.17.99.11 with a subnet mask of 255.255.255.0 on the internal virtual interface VLAN 99.

```
S1(config)#vlan 99
S1(config-vlan)#exit
S1(config)#interface vlan99
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to down
```



```
S1(config-if)#ip address 172.17.99.11 255.255.255.0
S1(config-if)#no shutdown
S1(config-if)#exit
S1(config)#
```

Notice that the VLAN 99 interface is in the down state even though you entered the command **no shutdown**. The interface is currently down because no switchports are assigned to VLAN 99.

Assign all user ports to VLAN 99.

```
S1(config)#interface range fa0/1 - 24
S1(config-if-range)#switchport access vlan 99
S1(config-if-range)#exit
S1(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up
```

It is beyond the scope of this lab to fully explore VLANs. This subject is discussed in greater detail in the next chapter. However, to establish connectivity between the host and the switch, the ports used by the host must be in the same VLAN as the switch. Notice in the above output that VLAN 1 interface goes down because none of the ports are assigned to VLAN 1. After a few seconds, VLAN 99 will come up because at least one port is now assigned to VLAN 99.

Step 5: Set the switch default gateway.

S1 is a Layer 2 switch, so it makes forwarding decisions based on the Layer 2 header. If multiple networks are connected to a switch, you need to specify how the switch forwards the internetwork frames, because the path must be determined at Layer 3. This is done by specifying a default gateway address that points to a router or Layer 3 switch. Although this activity does not include an external IP gateway, assume that you will eventually connect the LAN to a router for external access. Assuming that the LAN interface on the router is 172.17.99.1, set the default gateway for the switch.

```
S1(config)#ip default-gateway 172.17.99.1
S1(config)#exit
```

Step 6: Verify the management LANs settings.

Verify the interface settings on VLAN 99.

```
S1#show interface vlan 99
Vlan99 is up, line protocol is up
  Hardware is EtherSVI, address is 001b.5302.4ec1 (bia 001b.5302.4ec1)
  Internet address is 172.17.99.11/24
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:06, output 00:03:23, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     4 packets input, 1368 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     1 packets output, 64 bytes, 0 underruns
     0 output errors, 0 interface resets
```



```
     0 output buffer failures, 0 output buffers swapped out
```

What is the bandwidth on this interface? _____

What are the VLAN states? VLAN99 is _____ Line protocol is _____

What is the queuing strategy? _____

Step 7: Configure the IP address and default gateway for PC1.

Set the IP address of PC1 to 172.17.99.21, with a subnet mask of 255.255.255.0. Configure a default gateway of 172.17.99.1. (If needed, refer to Lab 1.3.1 to configure the PC NIC.)

Step 8: Verify connectivity.

To verify the host and switch are correctly configured, ping the IP address of the switch (172.17.99.11) from PC1.

Was the ping successful? _____

If not, troubleshoot the switch and host configuration. Note that this may take a couple of tries for the pings to succeed.

Step 9: Configure the port speed and duplex settings for a FastEthernet interface.

Configure the duplex and speed settings on FastEthernet 0/18. Use the **end** command to return to privileged EXEC mode when finished.

```
S1#configure terminal
S1(config)#interface fastethernet 0/18
S1(config-if)#speed 100
S1(config-if)#duplex full
S1(config-if)#end
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/18, changed
state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to down
%LINK-3-UPDOWN: Interface FastEthernet0/18, changed state to down
%LINK-3-UPDOWN: Interface FastEthernet0/18, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/18, changed
state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up
```

The line protocol for both interface FastEthernet 0/18 and interface VLAN 99 will temporarily go down.

The default on the Ethernet interface of the switch is auto-sensing, so it automatically negotiates optimal settings. You should set duplex and speed manually only if a port must operate at a certain speed and duplex mode. Manually configuring ports can lead to duplex mismatches, which can significantly degrade performance.

Verify the new duplex and speed settings on the FastEthernet interface.

```
S1#show interface fastethernet 0/18
FastEthernet0/18 is up, line protocol is up (connected)
  Hardware is FastEthernet, address is 001b.5302.4e92 (bia 001b.5302.4e92)
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, media type is 10/100BaseTX
  input flow-control is off, output flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output 00:00:01, output hang never
```



```
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     265 packets input, 52078 bytes, 0 no buffer
     Received 265 broadcasts (0 multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 32 multicast, 0 pause input
     0 input packets with dribble condition detected
     4109 packets output, 342112 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
```

Step 10: Save the configuration.

You have completed the basic configuration of the switch. Now back up the running configuration file to NVRAM to ensure that the changes made will not be lost if the system is rebooted or loses power.

```
S1#copy running-config startup-config
Destination filename [startup-config]?[Enter] Building configuration...
[OK]
S1#
```

Step 11: Examine the startup configuration file.

To see the configuration that is stored in NVRAM, issue the **show startup-config** command from privileged EXEC mode.

```
S1#show startup-config
```

Are all the changes that were entered recorded in the file? _____

Task 4: Managing the MAC Address Table

Step 1: Record the MAC addresses of the hosts.

Determine and record the Layer 2 (physical) addresses of the PC network interface cards using the following commands:

Start > Run > cmd > ipconfig /all

PC1: _____

PC2: _____

Step 2: Determine the MAC addresses that the switch has learned.

Display the MAC addresses using the **show mac-address-table** command in privileged EXEC mode.

```
S1#show mac-address-table
```

How many dynamic addresses are there? _____

How many MAC addresses are there in total? _____

Does the dynamic MAC address match the PC1 MAC address? _____

Step 3: List the show mac-address-table options.

```
S1#show mac-address-table ?
```

How many options are available for the **show mac-address-table** command? _____

Show only the MAC addresses from the table that were learned dynamically.

```
S1#show mac-address-table address dynamic
```

How many dynamic addresses are there? _____

View the MAC address entry for PC1.

```
S1#show mac-address-table address <PC1 MAC here>
```

Step 4: Clear the MAC address table.

To remove the existing MAC addresses, use the **clear mac-address-table** command from privileged EXEC mode.

```
S1#clear mac-address-table dynamic
```

Step 5: Verify the results.

Verify that the MAC address table was cleared.

```
S1#show mac-address-table
```

How many static MAC addresses are there? _____

How many dynamic addresses are there? _____

Step 6: Examine the MAC table again.

More than likely, an application running on your PC1 has already sent a frame out the NIC to S1. Look at the MAC address table again in privileged EXEC mode to see if S1 has relearned the MAC address for PC1.

```
S1#show mac-address-table
```

How many dynamic addresses are there? _____

Why did this change from the last display? _____

_____

If S1 has not yet relearned the MAC address for PC1, ping the VLAN 99 IP address of the switch from PC1 and then repeat Step 6.

Step 7: Set up a static MAC address.

To specify which ports a host can connect to, one option is to create a static mapping of the host MAC address to a port.

Set up a static MAC address on FastEthernet interface 0/18 using the address that was recorded for PC1 in Step 1 of this task. The MAC address **00e0.2917.1884** is used as an example only. You must use the MAC address of your PC1, which is different than the one given here as an example.

```
S1(config)#mac-address-table static 00e0.2917.1884 vlan 99 interface
fastethernet 0/18
```

Step 8: Verify the results.

Verify the MAC address table entries.

```
S1#show mac-address-table
```

How many total MAC addresses are there? _____

How many static addresses are there? _____

Step 10: Remove the static MAC entry.

To complete the next task, it will be necessary to remove the static MAC address table entry. Enter configuration mode and remove the command by putting a **no** in front of the command string.

Note: The MAC address 00e0.2917.1884 is used in the example only. Use the MAC address for your PC1.

```
S1(config)#no mac-address-table static 00e0.2917.1884 vlan 99 interface
fastethernet 0/18
```

Step 10: Verify the results.

Verify that the static MAC address has been cleared.

```
S1#show mac-address-table
```

How many total static MAC addresses are there? _____

Task 5 Configuring Port Security

Step 1: Configure a second host.

A second host is needed for this task. Set the IP address of PC2 to 172.17.99.32, with a subnet mask of 255.255.255.0 and a default gateway of 172.17.99.1. Do not connect this PC to the switch yet.

Step 2: Verify connectivity.

Verify that PC1 and the switch are still correctly configured by pinging the VLAN 99 IP address of the switch from the host.

Were the pings successful? _____

If the answer is no, troubleshoot the host and switch configurations.

Step 3: Copy the host MAC addresses.

Write down the MAC addresses from Task 4, Step 1.

PC1_____

PC2_____

Step 4: Determine which MAC addresses that the switch has learned.

Display the learned MAC addresses using the **show mac-address-table** command in privileged EXEC mode.

```
S1#show mac-address-table
```

How many dynamic addresses are there? _____

Does the MAC address entry match the PC1 MAC address? _____

Step 5: List the port security options.

Explore the options for setting port security on interface FastEthernet 0/18.

```
S1# configure terminal
S1(config)#interface fastethernet 0/18
S1(config-if)#switchport port-security ?
  aging        Port-security aging commands
  mac-address  Secure mac address
  maximum      Max secure addresses
  violation    Security violation mode
  <cr>

S1(config-if)#switchport port-security
```

Step 6: Configure port security on an access port.

Configure switch port FastEthernet 0/18 to accept only two devices, to learn the MAC addresses of those devices dynamically, and to block traffic from invalid hosts if a violation occurs.

```
S1(config-if)#switchport mode access
S1(config-if)#switchport port-security
S1(config-if)#switchport port-security maximum 2
S1(config-if)#switchport port-security mac-address sticky
S1(config-if)#switchport port-security violation protect
S1(config-if)#end
```

Step 7: Verify the results.

Show the port security settings.

```
S1#show port-security
```

How many secure addresses are allowed on FastEthernet 0/18?_____

What is the security action for this port? _____

Step 8: Examine the running configuration file.

```
S1#show running-config
```

Are there statements listed that directly reflect the security implementation of the running configuration?

_____

Step 9: Modify the post security settings on a port.

On interface FastEthernet 0/18, change the port security maximum MAC address count to 1 and to shut down if a violation occurs.


```
S1(config-if)#switchport port-security maximum 1
S1(config-if)#switchport port-security violation shutdown
```

Step 10: Verify the results.

Show the port security settings.

```
S1#show port-security
```

Have the port security settings changed to reflect the modifications in Step 9? _____

Ping the VLAN 99 address of the switch from PC1 to verify connectivity and to refresh the MAC address table. You should now see the MAC address for PC1 “stuck” to the running configuration.

```
S1#show run
Building configuration...

<output omitted>
!
interface FastEthernet0/18
 switchport access vlan 99
 switchport mode access
 switchport port-security
 switchport port-security mac-address sticky
 switchport port-security mac-address sticky 00e0.2917.1884
 speed 100
 duplex full
!
<output omitted>
```

Step 11: Introduce a rogue host.

Disconnect PC1 and connect PC2 to port FastEthernet 0/18. Ping the VLAN 99 address 172.17.99.11 from the new host. Wait for the amber link light to turn green. Once it turns green, it should almost immediately turn off.

Record any observations: _____

_____

Step 12: Show port configuration information.

To see the configuration information for just FastEthernet port 0/18, issue the following command in privileged EXEC mode:

```
S1#show interface fastethernet 0/18
```

What is the state of this interface?

FastEthernet0/18 is _____ Line protocol is _____

Step 13: Reactivate the port.

If a security violation occurs and the port is shut down, you can use the **no shutdown** command to reactivate it. However, as long as the rogue host is attached to FastEthernet 0/18, any traffic from the host disables the port. Reconnect PC1 to FastEthernet 0/18, and enter the following commands on the switch:

```
S1# configure terminal
```



```
S1(config)#interface fastethernet 0/18
S1(config-if)# no shutdown
S1(config-if)#exit
```

Note: Some IOS version may require a manual **shutdown** command before entering the **no shutdown** command.

Step 14: Cleanup

Unless directed otherwise, clear the configuration on the switches, turn off the power to the host computer and switches, and remove and store the cables.

Appendix 1

Erasing and Reloading the Switch

For the majority of the labs in Exploration 3, it is necessary to start with an unconfigured switch. Using a switch with an existing configuration may produce unpredictable results. These instructions show you how to prepare the switch prior to starting the lab. These instructions are for the 2960 switch; however, the procedure for the 2900 and 2950 switches is the same.

Step 1: Enter privileged EXEC mode by typing the enable command.

If prompted for a password, enter **class**. If that does not work, ask the instructor.

```
Switch>enable
```

Step 2: Remove the VLAN database information file.

```
Switch#delete flash:vlan.dat
Delete filename [vlan.dat]?[Enter]
Delete flash:vlan.dat? [confirm] [Enter]
```

If there is no VLAN file, this message is displayed:

```
%Error deleting flash:vlan.dat (No such file or directory)
```

Step 3: Remove the switch startup configuration file from NVRAM.

```
Switch#erase startup-config
```

The responding line prompt will be:

```
Erasing the nvram filesystem will remove all files! Continue? [confirm]
```

```
Press Enter to confirm.
```

The response should be:

```
Erase of nvram: complete
```

Step 4: Check that the VLAN information was deleted.

Verify that the VLAN configuration was deleted in Step 2 using the **show vlan** command.

If the VLAN information was successfully deleted in Step 2, go to Step 5 and restart the switch using the **reload** command.

If previous VLAN configuration information is still present (other than the default management VLAN 1), you must power-cycle the switch (hardware restart) instead of issuing the **reload** command. To power-cycle the switch, remove the power cord from the back of the switch or unplug it, and then plug it back in.

Step 5: Restart the software.

Note: This step is not necessary if the switch was restarted using the power-cycle method.

At the privileged EXEC mode prompt, enter the **reload** command.

```
Switch(config)#reload
```

The responding line prompt will be:

```
System configuration has been modified. Save? [yes/no]:
```


Type **n** and then press **Enter**.

The responding line prompt will be:

```
Proceed with reload? [confirm] [Enter]
```

The first line of the response will be:

```
Reload requested by console.
```

After the switch has reloaded, the line prompt will be:

```
Would you like to enter the initial configuration dialog? [yes/no]:
```

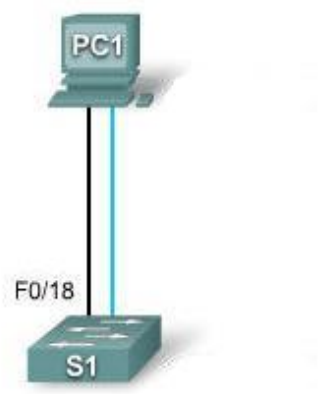
Type **n** and then press **Enter**.

The responding line prompt will be:

```
Press RETURN to get started! [Enter]
```


Lab 2.5.2: Managing Switch Operating System and Configuration Files

Topology Diagram



Addressing Table

Device	Hostname	Interface	IP Address	Subnet Mask	Default Gateway
PC1	Host-A	NIC	172.17.99.21	255.255.255.0	172.17.99.1
S1	ALSwitch	VLAN99	172.17.99.11	255.255.255.0	172.17.99.1

Learning Objectives

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

- Create and save a basic switch configuration
- Set up a TFTP server on the network
- Back up the switch Cisco IOS software to a TFTP server and then restore it
- Back up the switch configuration to a TFTP server
- Configure a switch to load a configuration from a TFTP server
- Upgrade the Cisco IOS software from a TFTP server
- Recover the password for a 2960 switch (2900 series)

Scenario

In this lab, you will examine and configure a standalone LAN switch. Although a switch performs basic functions in its default out-of-the-box condition, there are a number of parameters that a network administrator should modify to ensure a secure and optimized LAN. This lab introduces you to the basics of switch configuration.

Task 1: Cable and Initialize the Network

Step 1: Cable a network.

Cable a network that is similar to the one in the topology diagram. Create a console connection to the switch. If necessary, refer to Lab 1.3.1. The output shown in this lab is from a 2960 switch. If you use other switches, the switch outputs and interface descriptions may appear different.

Step 2: Clear the configuration on the switch.

Set up a console connection to the switch and erase the existing configuration. If necessary, refer to lab 2.5.1, Appendix 1.

Step 3: Create a basic configuration.

Use the following commands to configure a hostname, line access passwords, and the enable secret password.

```
Switch#configure terminal
Switch(config)#hostname ALSwitch
ALSwitch(config)#line con 0
ALSwitch(config-line)#password cisco
ALSwitch(config-line)#login
ALSwitch(config-line)#line vty 0 15
ALSwitch(config-line)#password cisco
ALSwitch(config-line)#login
ALSwitch(config-line)#exit
```

Create VLAN 99 and assign user ports to this VLAN using the commands shown below. Return to privileged EXEC mode when finished.

```
ALSwitch(config)#vlan 99
ALSwitch(config-vlan)#name user
ALSwitch(config-vlan)#exit
ALSwitch(config)#interface vlan 99
ALSwitch(config-if)#ip address 172.17.99.11 255.255.255.0
ALSwitch(config-if)#exit
ALSwitch(config)#interface fa0/18
ALSwitch(config-if)#switchport access vlan 99
ALSwitch(config-if)#end
ALSwitch#
```

Step 4: Configure the host attached to the switch.

Configure the host to use the IP address, mask, and default gateway identified in the addressing table at the beginning of the lab. This host acts as the TFTP server in this lab.

Step 5: Verify connectivity.

To verify that the host and switch are correctly configured, ping the switch IP address that was configured for VLAN 99 from the host.

Was the ping successful? _____

If the answer is no, troubleshoot the host and switch configurations.

Task 2: Starting and Configuring the TFTP Server

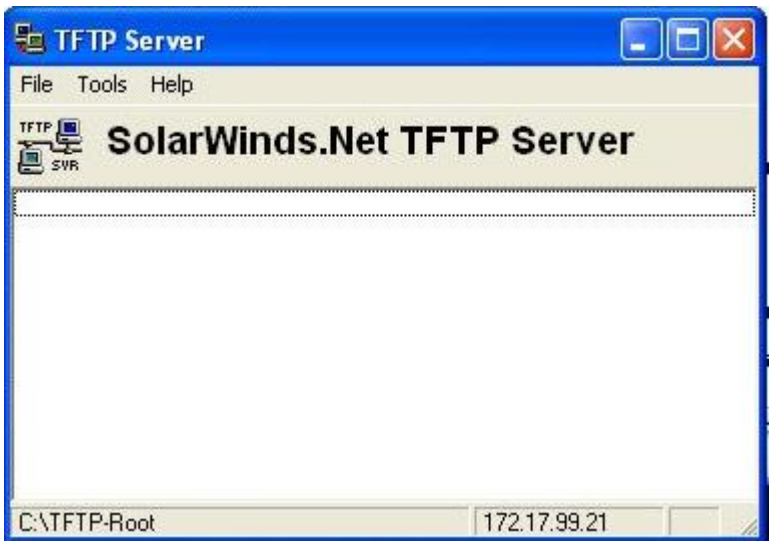
Step 1: Start up and configure the TFTP server.

The TFTP server that is shown in this lab is the SolarWinds server, available at http://www.solarwinds.com/products/freetools/free_tftp_server.aspx. If this URL is out of date, then use your favorite search engine and search for “solar winds free tftp download”.

It may not be like the one that is used in this lab. Please check with your instructor for the operating instructions for the TFTP server used in place of the Solar Winds TFTP server.

Start the server on the host **Start > All Programs > SolarWinds 2003 Standard Edition > TFTP Server.**

The server should start up and acquire the IP address of the Ethernet interface, and use the C:\TFTP-Root directory by default.



When the TFTP server is running and shows the correct address configuration on the workstation, copy the Cisco IOS file from the switch to the TFTP server.

Step 2: Verify connectivity to the TFTP server.

Verify that the TFTP server is running and that it can be pinged from the switch.

What is the IP address of the TFTP server? _____

```
ALSwitch#ping 172.17.99.21

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.99.21 , timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/202/1006
ms
ALSwitch#
```


Task 3: Save the Cisco IOS File to a TFTP Server

Step 1: Identify the Cisco IOS filename.

Determine the exact name of the image file that is to be saved. From the console session, enter **show flash**.

```
ALSwitch#show flash
Directory of flash:/
   2  -rwx         556   Mar 8 1993 22:46:45 +00:00  vlan.dat
   5  drwx         192   Mar 1 1993 00:04:53 +00:00  c2960-lanbase-
mz.122-25.FX
32514048 bytes total (26527232 bytes free)
```

Note: If the file is in a subdirectory, as is the case in the output shown above, you cannot initially see the filename. To see the Cisco IOS filename, use the **cd** command to change the switch working directory to the Cisco IOS directory:

```
ALSwitch#cd flash:/c2960-lanbase-mz.122-25.FX
ALSwitch#show flash
Directory of flash:/c2960-lanbase-mz.122-25.FX/
    6  drwx        4160   Mar 1 1993 00:03:36 +00:00  html
  368  -rwx     4414921   Mar 1 1993 00:04:53 +00:00  c2960-lanbase-
mz.122-25.FX.bin
  369  -rwx         429   Mar 1 1993 00:04:53 +00:00  info

32514048 bytes total (26527232 bytes free)
```

What is the name and size of the Cisco IOS image stored in flash? ______________________________

____

What attributes can be identified from the codes in the Cisco IOS filename?________________________

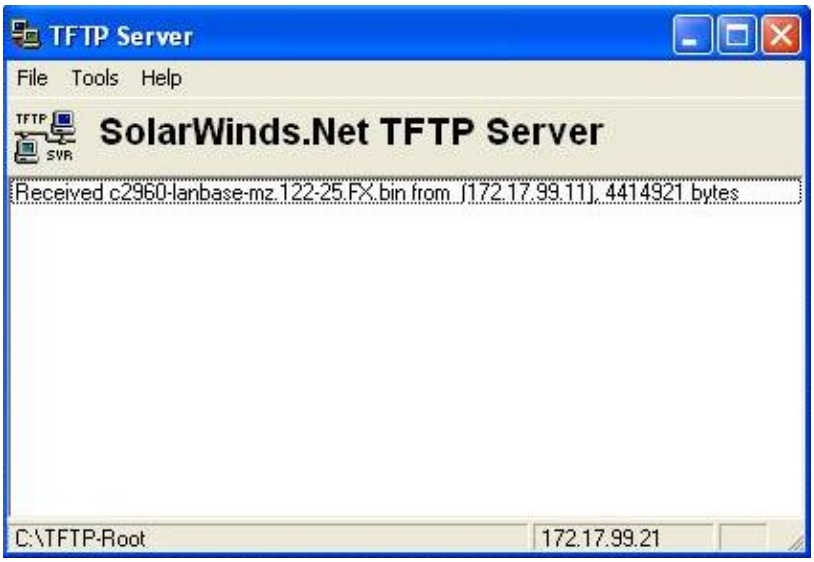
____

From privileged EXEC mode, enter the **copy flash tftp** command. At the prompts, first enter the filename of the Cisco IOS image file, then the IP address of the TFTP server. Make sure to include the complete path if the file is in a subdirectory.

```
ALSwitch#copy flash tftp
Source filename []?c2960-lanbase-mz.122-25.FX/c2960-lanbase-mz.122-
25.FX.bin
Address or name of remote host []? 172.17.99.21
Destination filename [c2960-lanbase-mz.122-25.FX.bin]? [enter]
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!<output omitted>
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
4414921 bytes copied in 10.822 secs (407958 bytes/sec)
ALSwitch#
```

Step 2: Verify the transfer to the TFTP server.

Verify the transfer to the TFTP server by checking the log file. On the SolarWinds TFTP server, the transfer can be verified from the command window, as shown in the following figure:



Verify the flash image size in the server root directory. The path for the root server is shown on the server command window—C:\TFTP-root.

Locate this directory on the server using the File Manager and look at the detail listing of the file. The file length in the **show flash** command should be the same file size as the file stored on the TFTP server. If the file sizes are not identical in size, check with your instructor.

Task 4: Restore the Cisco IOS File to the Switch from a TFTP Server

Step 1: Verify connectivity.

Verify that the TFTP server is running, and ping the TFTP server IP address from the switch.

What is the IP address of the TFTP server? _____

```
ALSwitch#ping 172.17.99.21
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.99.21 , timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/202/1006
ms
ALSwitch#
```

If the pings fail, troubleshoot the switch and server configurations.

Step 2: Identify Cisco IOS filename on the server and the entire path name of the destination for the switch.

What is the name of the file on the TFTP server root directory that will be copied to the switch?

_____

What is the destination path name for the Cisco IOS file on the switch?

_____

What is the IP address of the TFTP server? _____

Step 3: Upload the Cisco IOS software from the server to the switch.

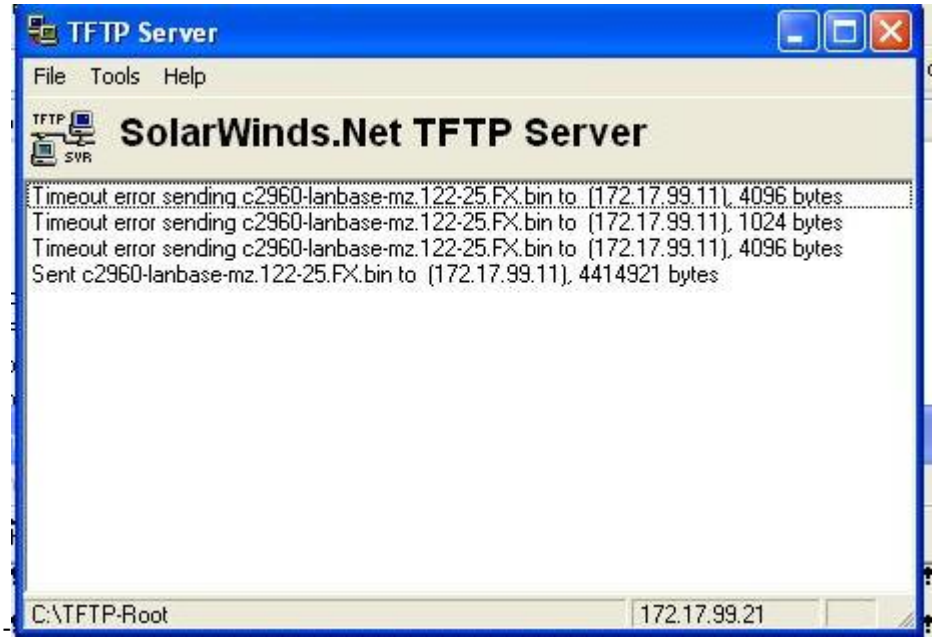
Note: It is important that this process is not interrupted.

In privileged EXEC mode, copy the file from the TFTP server to flash memory.

```
ALSwitch#copy tftp flash
Address or name of remote host []? 172.17.99.21
Source filename []? c2960-lanbase-mz.122-25.FX.bin
Destination filename [c2960-lanbase-mz.122-25.FX.bin]? c2960-lanbase-
mz.122-25.F
X/c2960-lanbase-mz.122-25.FX.bin
%Warning:There is a file already existing with this name
Do you want to over write? [confirm] [enter]
Accessing tftp://172.17.99.21 /c2960-lanbase-mz.122-25.FX.bin...
Loading c2960-lanbase-mz.122-25.FX.bin from 172.17.99.21  (via
Vlan1):!!!!!!!!!!!!!!!!!!
<output omitted>
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 4414921 bytes]

4414921 bytes copied in 43.964 secs (100421 bytes/sec)
ALSwitch#
```

The server output screen should look something like the following:



Is the file size of the uploaded file the same as that of the saved file on the TFTP root directory? _____

Step 4: Test the restored Cisco IOS image.

Verify that the switch image is correct. To do this, reload the switch and observe the startup process to confirm that there are no flash errors. If there are none, the Cisco IOS software on the switch should have started correctly. To further verify the Cisco IOS image in flash, issue the **show version** command, which will show output similar to the following:

```
System image file is "flash:c2960-lanbase-mz.122-25.FX/c2960-lanbase-mz.122-
25.FX.bin"
```

Task 5: Back Up and Restore a Configuration File from a TFTP Server

Step 1: Copy the startup configuration file to the TFTP server.

Verify that the TFTP server is running and that it can be pinged from the switch.

What is the IP address of the TFTP server? _____

In privileged EXEC mode, enter the **copy running-config startup-config** command to make sure that the running configuration file is saved to the startup configuration file.

```
ALSwitch#copy running-config startup-config
Destination filename [startup-config]?[enter] Building configuration...
[OK]
```

Back up the saved configuration file to the TFTP server with the command **copy startup-config tftp**. At the prompt, enter the IP address of the TFTP server:

```
AlSwitch#copy startup-config tftp
Address or name of remote host []? 172.17.99.21
Destination filename [alswitch-confg]? [enter]
!!
1452 bytes copied in 0.445 secs (3263 bytes/sec)#
```

Step 2: Verify the transfer to the TFTP server.

Verify the transfer to the TFTP server by checking the command window on the TFTP server. The output should look similar to the following:

```
Received alswitch-confg from (172.17.99.11), 1452 bytes
```

Verify that the alswitch-confg file is in the TFTP server directory C:\TFTP-root.

Step 3: Restore the startup configuration file from the TFTP server.

To restore the startup configuration file, the existing startup configuration file must be erased and the switch reloaded.

```
AlSwitch#erase nvram
Erasing the nvram filesystem will remove all configuration files!
Continue? [confirm]
[OK]
Erase of nvram: complete
AlSwitch#
AlSwitch#reload
Proceed with reload? [confirm] [enter]
```

When the switch has reloaded, you must reestablish connectivity between the switch and the TFTP server before the configuration can be restored. To do this, configure VLAN 99 with the correct IP

address and assign port FastEthernet 0/18 to VLAN 99. When you are finished, return to privileged EXEC mode.

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface vlan 99
Switch(config-if)#ip address 172.17.99.11 255.255.255.0
Switch(config-if)#exit
Switch(config)#interface fastethernet 0/18
Switch(config-if)#switchport access vlan 99
Switch(config-if)#end
Switch#
```

After VLAN 99 is up, verify connectivity by pinging the server from the switch.

```
Switch#ping 172.17.99.21
```

If the ping is unsuccessful, troubleshoot the switch and server configuration. Restore the configuration from the TFTP server with the **copy tftp startup-config** command.

Note: It is important that this process is not interrupted.

```
Switch#copy tftp startup-config
Address or name of remote host []? 172.17.99.21
Source filename []? alswitch-confg
Destination filename [startup-config]? [enter]
Accessing tftp://172.17.99.21 /alswitch-confg...
Loading alswitch-confg from 172.17.99.21  (via Vlan99): !
[OK - 1452 bytes]
1452 bytes copied in 9.059 secs (160 bytes/sec)
Switch#
00:21:37: %SYS-5-CONFIG_NV_I: Nonvolatile storage configured from
tftp://172.17.99.21 /alswitch-confg by console
Switch#
```

Was the operation successful? _____

Step 4: Verify the restored startup configuration file.

In privilege EXEC mode, reload the switch again. When the reload is complete, the switch should show the ALSwitch prompt. Type the command **show startup-config** to verify that the restored configuration is complete, including the line access and enable secret passwords.

Task 6: Upgrade the Cisco IOS Software of the Switch

Note: This lab requires that a combination of a Cisco IOS image and the HTML archive (tar) file be placed in the default TFTP server directory by the instructor or student. This file should be downloaded by the instructor from the Cisco Connection online software center. In this lab, the c2960-lanbase-mz.122-25.FX.tar file is referenced for instructional purposes only. This has the same filename stem as the current image. However, for the purpose of the lab, assume that this is an update. The Cisco IOS software update release includes the binary image and new HTML files to support changes to the web interface.

This lab also requires that there is a saved copy of the current configuration file as a backup.

Step 1: Determine the current boot sequence for the switch.

Use the **show boot** command to display the settings of the boot environment variables.

```
ALSwitch#show boot
BOOT path-list : flash:c2960-lanbase-mz.122-25.FX/c2960-lanbase-mz.122-
25.FX.bin
Config file         : flash:/config.text
Private Config file : flash:/private-config.text
Enable Break        : no
Manual Boot         : no
HELPER path-list    :
Auto upgrade        : yes
NVRAM/Config file
      buffer size:   65536
ALSwitch#
```

Determine if there is sufficient memory to hold multiple image files:

```
ALSwitch#sh flash
Directory of flash:/
    2  -rwx         616   Mar 1 1993 06:39:02 +00:00  vlan.dat
    4  -rwx           5   Mar 1 1993 10:14:07 +00:00  private-
config.text
    5  drwx         192   Mar 1 1993 00:04:53 +00:00  c2960-lanbase-
mz.122-25.FX
  370  -rwx        1281   Mar 1 1993 10:14:07 +00:00  config.text

32514048 bytes total (26524672 bytes free)
ALSwitch#
```

Note that on this platform, only about 6 MB is in use, and approximately 26.5 MB is free, so there is plenty of memory for multiple images. If there is insufficient space for multiple images, you must overwrite the existing image with the new one, so make sure there is a backup of the existing Cisco IOS file on the TFTP server before beginning the upgrade.

Step 2: Prepare for the new image.

If the switch has enough free memory as shown in the last step, use the **rename** command to rename the existing Cisco IOS file to the same name with the .old extension:

```
ALSwitch#rename flash:/c2960-lanbase-mz.122-25.FX/c2960-lanbase-mz.122-
25.FX.bin flash:/c2960-lanbase-mz.122-25.FX/c2960-lanbase-mz.122-25.FX.old
```

Verify that the renaming was successful:

```
ALSwitch#dir flash:/c2960-lanbase-mz.122-25.FX/
```

```
Directory of flash:/c2960-lanbase-mz.122-25.FX/

    6  drwx        4160   Mar 1 1993 00:03:36 +00:00  html
  368  -rwx     4414921   Mar 1 1993 03:26:51 +00:00  c2960-lanbase-
mz.122-25.FX.old
  369  -rwx         429   Mar 1 1993 00:04:53 +00:00  info
32514048 bytes total (26524672 bytes free)
```

Use the **delete** command to remove existing HTML files. Including an ***** in the command instead of a specific filename deletes all files in the directory.


```
ALSwitch#delete flash:/c2960-lanbase-mz.122-25.FX/html/*
```

Step 3: Extract the new Cisco IOS image and HTML files into flash memory.

Enter the following to place the new Cisco IOS image and HTML files into the flash memory target directory:

```
ALSwitch#archive tar /x tftp://172.17.99.21/c2960-lanbase-mz.122-
25.FX.tar flash:/c2960-lanbase-mz.122-25.FX
```

Step 4: Associate the new boot file.

Enter the **boot** command with the name of the new image filename at the global configuration mode prompt. When you are finished, return to privileged EXEC mode and save the configuration.

```
ALSwitch(config)#boot system flash:/c2960-lanbase-mz.122-25.FX/c2960-
lanbase-mz.122-25.FX.bin
ALSwitch(config)# end
ALSwitch#copy running-config startup-config
```

Step 5: Restart the switch.

Restart the switch using the **reload** command to see if the new Cisco IOS software loaded. Use the **show version** command to see the Cisco IOS filename.

What was the name of the Cisco IOS file the switch booted from? _____

_____ _____

Was this the proper filename? _____

If the Cisco IOS filename is now correct, remove the backup file from flash memory using this command from privileged EXEC mode:

```
ALSwitch(config)#delete flash:/c2960-lanbase-mz.122-25.FX/c2960-lanbase-
mz.122-25.FX.old
```

Task 7: Recover Passwords on the Catalyst 2960

Step 1: Reset the console password.

Have a classmate change the console and vty passwords on the switch. Save the changes to the startup-config file and reload the switch.

Now, without knowing the passwords, try to gain access to the switch.

Step 2: Recover access to the switch

Make sure that a PC is connected to the console port and a HyperTerminal window is open. Turn the switch off. Turn it back on while holding down the **MODE** button on the front of the switch at the same time that the switch is powered on. Release the **MODE** button after the SYST LED stops blinking and stays on.

The following output should be displayed:

```
The system has been interrupted prior to initializing the flash
filesystem. The following commands will initialize the flash
filesystem, and finish loading the operating system software:
flash_init
```



```
load_helper
boot
```

To initialize the file system and finish loading the operating system, enter the following commands:

```
switch:flash_init
switch:load_helper
switch:dir flash:
```

Note: Do not forget to type the colon (:) after **flash** in the command **dir flash:**.

Type **rename flash:config.text flash:config.old** to rename the configuration file. This file contains the password definition.

Step 3: Restart the system.

Type the **boot** command to boot the system. Enter **n** when prompted to continue the configuration dialog, and **y** when asked if you want to terminate auto-install.

To rename the configuration file with its original name, type the command **rename flash:config.old flash:config.text** at the privileged EXEC mode prompt.

```
Switch# rename flash:config.old flash:config.text
Destination filename [config.text]? [enter]
```

Copy the configuration file into memory:

```
Switch#copy flash:config.text system:running-config
Destination filename [running-config][enter]
```

The configuration file is now reloaded. Change the old unknown passwords as follows:

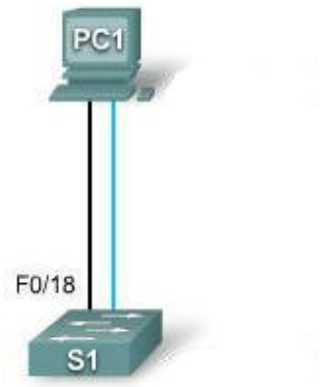
```
ALSwitch#configure terminal
ALSwitch(config)#no enable secret
ALSwitch(config)#enable secret class
ALSwitch(config)#line console 0
ALSwitch(config-line)#password cisco
ALSwitch(config-line)#exit
ALSwitch(config)#line vty 0 15
ALSwitch(config-line)#password cisco
ALSwitch(config-line)#end
ALSwitch#copy running-config startup-config
Destination filename [startup-config]?[enter] Building configuration...
[OK]
ALSwitch#
```

Terminate your console connection and then reestablish it to verify that the new passwords have been configured. If not, repeat the procedure.

Once the steps are completed, log off by typing **exit**, and turn all the devices off. Then remove and store the cables and adapter.

Lab 2.5.3: Managing Switch Operating System and Configuration Files Challenge

Topology Diagram



Addressing Table

Device	Hostname	Interface	IP Address	Subnet Mask	Default Gateway
PC1	Host-A	NIC	172.17.99.21	255.255.255.0	172.17.99.1
S1	ALSwitch	VLAN99	172.17.99.11	255.255.255.0	172.17.99.1

Learning Objectives

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

- Create and save a basic switch configuration
- Set up a TFTP server on the network
- Back up the switch Cisco IOS software to a TFTP server and then restore it
- Back up the switch configuration to a TFTP server
- Configure a switch to load a configuration from a TFTP server
- Upgrade the Cisco IOS software from a TFTP server
- Recover the password for a Cisco 2960 switch (2900 series)

Scenario

In this lab, you will explore file management and password recovery procedures on a Cisco Catalyst switch.

Task 1: Cable and Initialize the Network

Step 1: Cable a network.

Cable a network that is similar to the one in the topology diagram. Then, create a console connection to the switch. If necessary, refer to Lab 1.3.1. The output shown in this lab is from a 2960 switch. If you use other switches, the switch outputs and interface descriptions may appear different.

Step 2: Clear the configuration on the switch.

Set up a console connection to the switch. Erase the configuration on the switch.

Step 3: Create a basic configuration.

Configure the switch with the following hostname and access passwords. Then enable secret passwords on the switch.

Hostname	Console Password	Telnet Password	Command Password
ALSwitch	cisco	cisco	class

Create VLAN 99. Assign IP address 172.17.99.11 to this interface. Assign the FastEthernet 0/18 port to this VLAN.

Step 4: Configure the host attached to the switch.

Configure the host to use the IP address, mask, and default gateway identified in the Addressing table. This host acts as the TFTP server in this lab.

Step 5: Verify connectivity.

To verify that the host and switch are correctly configured, ping the switch IP address from the host.

Was the ping successful? _____

If the answer is no, troubleshoot the host and switch configurations.

Task 2: Starting and Configuring the TFTP Server

Step 1: Start up and configure the TFTP server.

The TFTP server that was used in the development of this lab is the SolarWinds server, available at http://www.solarwinds.com.

The labs in your classroom may be using a different TFTP server. If so, check with your instructor for the operating instructions for the TFTP server in use.

Start the server on the host using the Start menu: **Start > All Programs > SolarWinds 2003 Standard Edition > TFTP Server.**

The server should start up and acquire the IP address of the Ethernet interface. The server uses the C:\TFTP-Root directory by default.

Step 2: Verify connectivity to the TFTP server.

Verify that the TFTP server is running and that it can be pinged from the switch.

Task 3: Save the Cisco IOS File to the TFTP Server

Step 1: Identify the Cisco IOS filename.

Determine the exact name of the image file that is to be saved.

Note that if the file is in a subdirectory, you cannot initially see the filename. To see the Cisco IOS filename, first change the switch working directory to the Cisco IOS directory.

Examine the output from the switch and then answer these questions.

What is the name and length of the Cisco IOS image stored in flash?

_____

Which attributes can be identified from the codes in the Cisco IOS filename?

_____

Step 2: In privileged EXEC mode, copy the image file to the TFTP server.

Step 3: Verify the transfer to the TFTP server.

Verify the transfer to the TFTP server by checking the log file. With the SolarWinds TFTP server, you can verify the transfer from the command window or from the server log file at:

C:\Program Files\SolarWinds\2003 Standard Edition\TFTP-Server.log.

Verify that the flash image size is in the server root directory. The path for the root server is shown on the server command window:

C:\TFTP-root

Use the File Manager to locate this directory on the server and look at the detail listing of the file. The file length displayed by the **show flash** command should be the same size as the size of the file stored on the TFTP server. If the file sizes are not identical in size, check with your instructor.

Task 4: Restore the Cisco IOS File to the Switch from a TFTP Server

Step 1: Verify connectivity.

Verify that the TFTP server is running, and ping the TFTP server IP address from the switch.

If the pings fail, troubleshoot the switch and server configurations.

Step 2: Identify the Cisco IOS filename on the server and the entire path name of the destination for the switch.

What is the name of the file on the TFTP server root directory that will be copied to the switch?

_____

What is the destination path name for the IOS file on the switch?

_____

What is the IP address of the TFTP server? _____

Step 3: Upload the Cisco IOS software from the server to the switch.

Note: It is important that this process is not interrupted.

In privileged EXEC mode, copy the file from the TFTP server to flash memory.

Is the file size of the uploaded file the same as that of the saved file on the TFTP root directory? _____

Step 4: Test the restored Cisco IOS image.

Verify that the switch image is correct. To do this, reload the switch image and observe the startup process. Confirm that there are no flash errors. If there are no errors, the Cisco IOS software on the switch should have started correctly. To further verify the Cisco IOS image in flash, issue the command that will show the Cisco IOS version.

Task 5: Back Up and Restore a Configuration File from a TFTP Server

Step 1: Copy the startup configuration file to the TFTP server.

Verify that the TFTP server is running and that it can be pinged from the switch. Save the current configuration.

Back up the saved configuration file to the TFTP server.

Step 2: Verify the transfer to the TFTP server.

Verify the transfer to the TFTP server by checking the command window on the TFTP server. The output should look similar to the following:

```
Received alswitch-confg from (172.17.99.11), 1452 bytes
```

Verify that the alswitch-confg file is in the TFTP server directory C:\TFTP-root.

Step 3: Restore the startup configuration file from the TFTP server.

To restore the startup configuration file, first erase the existing startup configuration file, and then reload the switch.

When the switch has been reloaded, you must reestablish connectivity between the switch and the TFTP server before the configuration can be restored. To do this, reconfigure VLAN 99 with the correct IP address and assign port Fast Ethernet 0/18 to that VLAN (refer to Task 1).

After VLAN 99 is up, verify connectivity by pinging the server from the switch.

If the ping is unsuccessful, troubleshoot the switch and server configuration. Restore the configuration from the TFTP server by copying the alswitch-confg file from the server to the switch.

Note: It is important that this process is not interrupted.

Was the operation successful? _____

Step 4: Verify the restored startup configuration file.

In privilege EXEC mode, reload the router again. When the reload is complete, the switch should show the ALSwitch prompt. Examine the running configuration to verify that the restored configuration is complete, including the access and enable secret passwords.

Task 6: Upgrade the Cisco IOS Software of the Switch

Note: This lab requires that a combination of a Cisco IOS image and the HTML archive (tar) file be placed in the default TFTP server directory by the instructor or student. This file should be downloaded by the instructor from the Cisco Connection online software center. In this lab, the c2960-lanbase-mz.122-25.FX.tar file is referenced for instructional purposes only. This has the same filename stem as the current image. However, for the purpose of the lab, assume that this file is an update. The Cisco IOS software update release includes the binary image and new HTML files to support changes to the web interface.

This lab also requires that there is a saved copy of the current configuration file as a backup.

Step 1: Determine the current boot sequence for the switch and check memory availability.

Determine if there is sufficient memory to hold multiple image files. Assume that the new files require as much space as the current files in flash memory.

Is there sufficient memory capacity to store additional Cisco IOS and HTML files? _____

Step 2: Prepare for the new image

If the switch has enough free memory as described in the last step, rename the existing Cisco IOS file to the same name with the .old extension.

Verify that the renaming was successful.

As a precaution, disable access to the switch HTML pages, and then remove the existing HTML files from flash memory.

Step 3: Extract the new Cisco IOS image and HTML files into flash memory.

Enter the following to place the new Cisco IOS image and HTML files into the flash memory target directory:

```
ALSwitch#archive tar /x tftp://172.17.99.21 / c2960-lanbase-mz.122-
25.FX.tar flash:/c2960-lanbase-mz.122-25.FX
```

Re-enable the HTTP server on the switch.

Step 4: Associate the new boot file.

Enter the boot system command with the new image filename at the configuration mode prompt, and then save the configuration.

Step 5: Restart the switch.

Restart the switch using the **reload** command to see if the new Cisco IOS software loaded. Use the **show version** command to see the Cisco IOS filename.

What was the name of the Cisco IOS file the switch booted from? _____

_____

Was this the proper file name? _____

If the Cisco IOS filename is now correct, remove the backup file (with the .old extension) from flash memory.

Task 7: Recover Passwords on the Catalyst 2960

Step 1: Reset the console password.

Have a classmate change the console, vty, and enable secret passwords on the switch. Save the changes to the startup-config file and reload the switch.

Now, without knowing the passwords, try to gain access to privilege EXEC mode on the switch.

Step 2: Recover access to the switch.

Detailed password recovery procedures are available in the online Cisco support documentation. In this case, they can be found in the troubleshooting section of the Catalyst 2960 Switch Software Configuration Guide. Follow the procedures to restore access to the switch.

Once the steps are completed, log off by typing **exit**, and turn all the devices off. Then remove and store the cables and adapter.

Appendix 1: Password Recovery for the Catalyst 2960

Recovering a Lost or Forgotten Password

The default configuration for the switch allows an end user with physical access to the switch to recover from a lost password by interrupting the boot process during power-on and by entering a new password. These recovery procedures require that you have physical access to the switch.

Note On these switches, a system administrator can disable some of the functionality of this feature by allowing an end user to reset a password only by agreeing to return to the default configuration. If you are an end user trying to reset a password when password recovery has been disabled, a status message shows this during the recovery process.

These sections describes how to recover a forgotten or lost switch password:

- **Procedure with Password Recovery Enabled**
- **Procedure with Password Recovery Disabled**

You enable or disable password recovery by using the **service password-recovery** global configuration command. Follow the steps in this procedure if you have forgotten or lost the switch password.

Step 1 Connect a terminal or PC with terminal-emulation software to the switch console port.

Step 2 Set the line speed on the emulation software to 9600 baud.

Step 3 Power off the switch. Reconnect the power cord to the switch and, within 15 seconds, press the **Mode** button while the System LED is still flashing green. Continue pressing the **Mode** button until the System LED turns briefly amber and then solid green; then release the **Mode** button.

Several lines of information about the software appear with instructions, informing you if the password recovery procedure has been disabled or not.

- If you see a message that begins with this:

```
The system has been interrupted prior to initializing the flash
file system.
The following commands will initialize the flash file system
```

proceed to the "Procedure with Password Recovery Enabled" section, and follow the steps.

- If you see a message that begins with this:


```
The password-recovery mechanism has been triggered, but is
currently disabled.
```

proceed to the "Procedure with Password Recovery Disabled" section, and follow the steps.

Step 4 After recovering the password, reload the switch:

```
Switch> reload

Proceed with reload? [confirm] y
```

Procedure with Password Recovery Enabled

If the password-recovery mechanism is enabled, this message appears:

```
The system has been interrupted prior to initializing the flash
file system.
The following commands will initialize the flash file system,
and finish loading the operating system software:

flash_init
load_helper
boot
```

Step 1 Initialize the flash file system:

```
switch: flash_init
```

Step 2 If you had set the console port speed to anything other than 9600, it has been reset to that particular speed. Change the emulation software line speed to match that of the switch console port.

Step 3 Load any helper files:

```
switch: load_helper
```

Step 4 Display the contents of flash memory:

```
switch: dir flash:
```

The switch file system appears:


```
Directory of flash:
   13  drwx         192   Mar 01 1993 22:30:48  c2960-lanbase-
mz.122-25.FX
   11  -rwx        5825   Mar 01 1993 22:31:59  config.text
   18  -rwx         720   Mar 01 1993 02:21:30  vlan.dat

16128000 bytes total (10003456 bytes free)
```

Step 5 Rename the configuration file to config.text.old.

This file contains the password definition.

```
switch: rename flash:config.text flash:config.text.old
```

Step 6 Boot the system:

```
switch: boot
```

You are prompted to start the setup program. Enter **N** at the prompt:

```
Continue with the configuration dialog? [yes/no]: N
```

Step 7 At the switch prompt, enter privileged EXEC mode:

```
Switch> enable
```

Step 8 Rename the configuration file to its original name:

```
Switch# rename flash:config.text.old flash:config.text
```

Step 9 Copy the configuration file into memory:

```
Switch# copy flash:config.text system:running-config
Source filename [config.text]?
Destination filename [running-config]?
```

Press **Return** in response to the confirmation prompts.

The configuration file is now reloaded, and you can change the password.

Step 10 Enter global configuration mode:

```
Switch# configure terminal
```

Step 11 Change the password:

```
Switch (config)# enable secret password
```

The secret password can be from 1 to 25 alphanumeric characters, can start with a number, is case sensitive, and allows spaces but ignores leading spaces.

Step 12 Return to privileged EXEC mode:

```
Switch (config)# exit
Switch#
```

Step 13 Write the running configuration to the startup configuration file:

```
Switch# copy running-config startup-config
```

The new password is now in the startup configuration.

Note This procedure is likely to leave your switch virtual interface in a shutdown state. You can see which interface is in this state by entering the **show running-config** privileged EXEC command. To re-enable the interface, enter the **interface vlan** *vlan-id* global configuration command, and specify the VLAN ID of the shutdown interface. With the switch in interface configuration mode, enter the **no shutdown** command.

Step 14 Reload the switch:

```
Switch# reload
```

Procedure with Password Recovery Disabled

If the password-recovery mechanism is disabled, this message appears:

```
The password-recovery mechanism has been triggered, but
is currently disabled.  Access to the boot loader prompt
through the password-recovery mechanism is disallowed at
```



```
this point.  However, if you agree to let the system be
reset back to the default system configuration, access
to the boot loader prompt can still be allowed.

Would you like to reset the system back to the default
configuration (y/n)?
```

Caution Returning the switch to the default configuration results in the loss of all existing configurations. We recommend that you contact your system administrator to verify if there are backup switch and VLAN configuration files.

- If you enter **n** (no), the normal boot process continues as if the **Mode** button had not been pressed; you cannot access the boot loader prompt, and you cannot enter a new password. You see the message:

```
Press Enter to continue........
```

- If you enter **y** (yes), the configuration file in flash memory and the VLAN database file are deleted. When the default configuration loads, you can reset the password.

Step 1 Elect to continue with password recovery and lose the existing configuration:

```
Would you like to reset the system back to the default
configuration (y/n)? Y
```

Step 2 Load any helper files:

```
Switch: load_helper
```

Step 3 Display the contents of flash memory:

```
switch: dir flash:
```

The switch file system appears:

```
Directory of flash:
13  drwx         192   Mar 01 1993 22:30:48 c2960-lanbase-
mz.122-25.FX.0

16128000 bytes total (10003456 bytes free)
```


Step 4 Boot the system:

```
Switch: boot
```

You are prompted to start the setup program. To continue with password recovery, enter **N** at the prompt:

```
Continue with the configuration dialog? [yes/no]: N
```

Step 5 At the switch prompt, enter privileged EXEC mode:

```
Switch> enable
```

Step 6 Enter global configuration mode:

```
Switch# configure terminal
```

Step 7 Change the password:

```
Switch (config)# enable secret password
```

The secret password can be from 1 to 25 alphanumeric characters, can start with a number, is case sensitive, and allows spaces but ignores leading spaces.

Step 8 Return to privileged EXEC mode:

```
Switch (config)# exit
Switch#
```

Step 9 Write the running configuration to the startup configuration file:

```
Switch# copy running-config startup-config
```

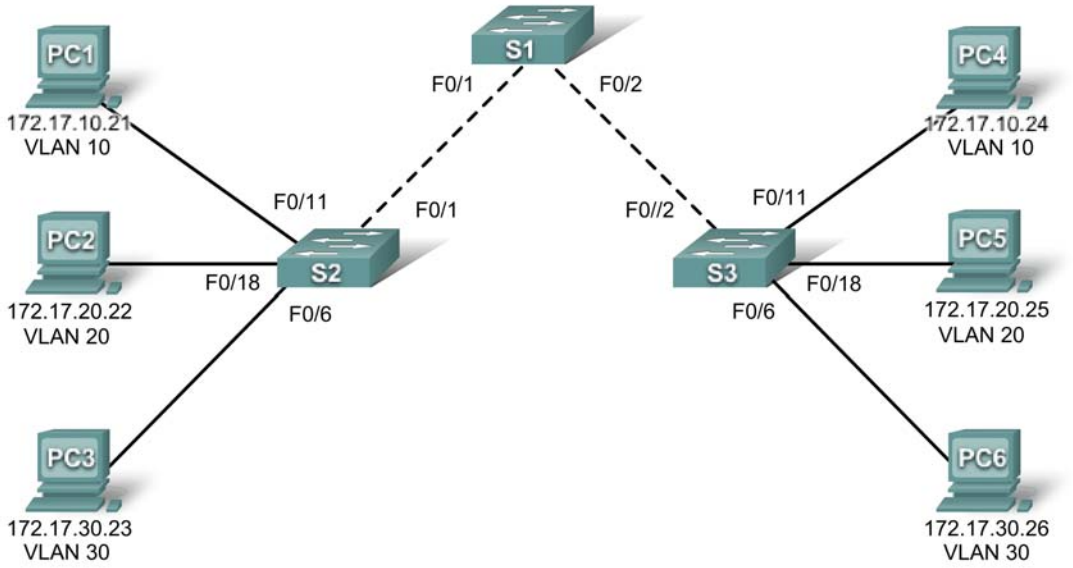
The new password is now in the startup configuration.

Note This procedure is likely to leave your switch virtual interface in a shutdown state. You can see which interface is in this state by entering the **show running-config** privileged EXEC command. To re-enable the interface, enter the **interface vlan** *vlan-id* global configuration command, and specify the VLAN ID of the shutdown interface. With the switch in interface configuration mode, enter the **no shutdown** command.

Step 10 You must now reconfigure the switch. If the system administrator has the backup switch and VLAN configuration files available, you should use those.

Lab 3.5.1: Basic VLAN 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

Initial 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
- Create VLANs
- Assign switch ports to a VLAN
- Add, move, and change ports
- Verify VLAN configuration
- Enable trunking on inter-switch connections
- Verify trunk configuration
- Save the VLAN configuration

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.

Note: If you use 2900 or 2950 switches, the outputs may appear different. Also, certain commands may be different or unavailable.

Step 2: Clear any existing configurations on the switches, and initialize all ports in the shutdown state.

If necessary, refer to Lab 2.5.1, Appendix 1, for the procedure to clear switch configurations.

It is a good practice to disable any unused ports on the switches by putting them in shutdown. Disable all ports on the switches:

```
Switch#config term
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 switches according to the following guidelines.

- Configure the switch hostname.
- 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.

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

```
S2(config)#interface range fa0/6, fa0/11, fa0/18
S2(config-if-range)#switchport mode access
```



```
S2(config-if-range)#no shutdown

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

Task 3: Configure and Activate Ethernet Interfaces

Step 1: Configure the PCs.

You can complete this lab using only two PCs by simply changing the IP addressing for the two PCs specific to a test you want to conduct. For example, if you want to test connectivity between PC1 and PC2, then configure the IP addresses for those PCs by referring to the addressing table at the beginning of the lab. Alternatively, you can configure all six PCs with the IP addresses and default gateways.

Task 4: Configure VLANs on the Switch

Step 1: Create VLANs on switch S1.

Use the **vlan** *vlan-id* command in global configuration mode to add a VLAN to switch S1. There are four VLANS configured for this lab: VLAN 10 (faculty/staff); VLAN 20 (students); VLAN 30 (guest); and VLAN 99 (management). After you create the VLAN, you will be in vlan configuration mode, where you can assign a name to the VLAN with the **name** *vlan name* command.

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

Step 2: Verify that the VLANs have been created on S1.

Use the **show vlan brief** command to verify that the VLANs have been created.

```
S1#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 3: Configure and name VLANs on switches S2 and S3.

Create and name VLANs 10, 20, 30, and 99 on S2 and S3 using the commands from Step 1. Verify the correct configuration with the **show vlan brief** command.

What ports are currently assigned to the four VLANs you have created?

_____

Step 4: Assign switch ports to VLANs on S2 and S3.

Refer to the port assignment table on page 1. Ports are assigned to VLANs in interface configuration mode, using the **switchport access vlan** *vlan-id* command. You can assign each port individually or you can use the **interface range** command to simplify this task, as shown here. The commands are shown for S3 only, but you should configure both S2 and S3 similarly. Save your configuration when 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]
```

Step 5: Determine which ports have been added.

Use the **show vlan id** *vlan-number* command on S2 to see which ports are assigned to VLAN 10.

Which ports are assigned to VLAN 10?

_____

Note: The **show vlan name** *vlan-name* displays the same output.

You can also view VLAN assignment information using the **show interfaces** *interface* **switchport** command.

Step 6: Assign the management VLAN.

A management VLAN is any VLAN that you configure to access the management capabilities of a switch. VLAN 1 serves as the management VLAN if you did not specifically define another VLAN. You assign the management VLAN an IP address and subnet mask. A switch can be managed via HTTP, Telnet, SSH, or SNMP. Because the out-of-the-box configuration of a Cisco switch has VLAN 1 as the default VLAN, VLAN 1 is a bad choice as the management VLAN. You do not want an arbitrary user who is connecting to a switch to default to the management VLAN. Recall that you configured the management VLAN as VLAN 99 earlier in this lab.

From interface configuration mode, use the **ip address** command to assign the management IP address to the 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
```

Assigning a management address allows IP communication between the switches, and also allows any host connected to a port assigned to VLAN 99 to connect to the switches. Because VLAN 99 is configured as the management VLAN, any ports assigned to this VLAN are considered management ports and should be secured to control which devices can connect to these ports.

Step 7: **Configure trunking and the native VLAN for the trunking ports on all switches.**

Trunks are connections between the switches that allow the switches to exchange information for all VLANS. By default, a trunk port belongs to all VLANs, as opposed to an access port, which can only belong to a single VLAN. If the switch supports both ISL and 802.1Q VLAN encapsulation, the trunks must specify which method is being used. Because the 2960 switch only supports 802.1Q trunking, it is not specified in this lab.

A native VLAN is assigned to an 802.1Q trunk port. In the topology, the native VLAN is VLAN 99. An 802.1Q trunk port supports traffic coming from many VLANs (tagged traffic) as well as traffic that does not come from a VLAN (untagged traffic). The 802.1Q trunk port places untagged traffic on the native VLAN. Untagged traffic is generated by a computer attached to a switch port that is configured with the native VLAN. One of the IEEE 802.1Q specifications for Native VLANs is to maintain backward compatibility with untagged traffic common to legacy LAN scenarios. For the purposes of this lab, a native VLAN serves as a common identifier on opposing ends of a trunk link. It is a best practice to use a VLAN other than VLAN 1 as the native VLAN.

Use the **interface range** command in global configuration mode to simplify configuring trunking.

```
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
```

Verify that the trunks have been configured with the **show interface trunk** command.

```
S1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       on           802.1q         trunking      99
Fa0/2       on           802.1q         trunking      99

Port      Vlans allowed on trunk
Fa0/1       1-4094
Fa0/2       1-4094

Port        Vlans allowed and active in management domain
Fa0/1       1,10,20,30,99
Fa0/2       1,10,20,30,99
```



```
Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       1,10,20,30,99
Fa0/2       1,10,20,30,99
```

Step 8: Verify that the switches can communicate.

From S1, ping the management address on both S2 and S3.

```
S1#ping 172.17.99.12
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.99.12, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/9 ms
```

```
S1#ping 172.17.99.13
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.99.13, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/1 ms
```

Step 9: Ping several hosts from PC2.

Ping from host PC2 to host PC1 (172.17.10.21). Is the ping attempt successful? _____

Ping from host PC2 to the switch VLAN 99 IP address 172.17.99.12. Is the ping attempt successful?

_____

Because these hosts are on different subnets and in different VLANs, they cannot communicate without a Layer 3 device to route between the separate subnetworks.

Ping from host PC2 to host PC5. Is the ping attempt successful? _____

Because PC2 is in the same VLAN and the same subnet as PC5, the ping is successful

Step 10: Move PC1 into the same VLAN as PC2.

The port connected to PC2 (S2 Fa0/18) is assigned to VLAN 20, and the port connected to PC1 (S2 Fa0/11) is assigned to VLAN 10. Reassign the S2 Fa0/11 port to VLAN 20. You do not need to first remove a port from a VLAN to change its VLAN membership. After you reassign a port to a new VLAN, that port is automatically removed from its previous VLAN.

```
S2#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#interface fastethernet 0/11
S2(config-if)#switchport access vlan 20
S2(config-if)#end
```

Ping from host PC2 to host PC1. Is the ping attempt successful? _____

Even though the ports used by PC1 and PC2 are in the same VLAN, they are still in different subnetworks, so they cannot communicate directly.

Step 11: Change the IP address and network on PC1.

Change the IP address on PC1 to 172.17.20.21. The subnet mask and default gateway can remain the same. Once again, ping from host PC2 to host PC1, using the newly assigned IP address.

Is the ping attempt successful? _____

Why was this attempt successful?

_____

Task 5: Document the Switch Configurations

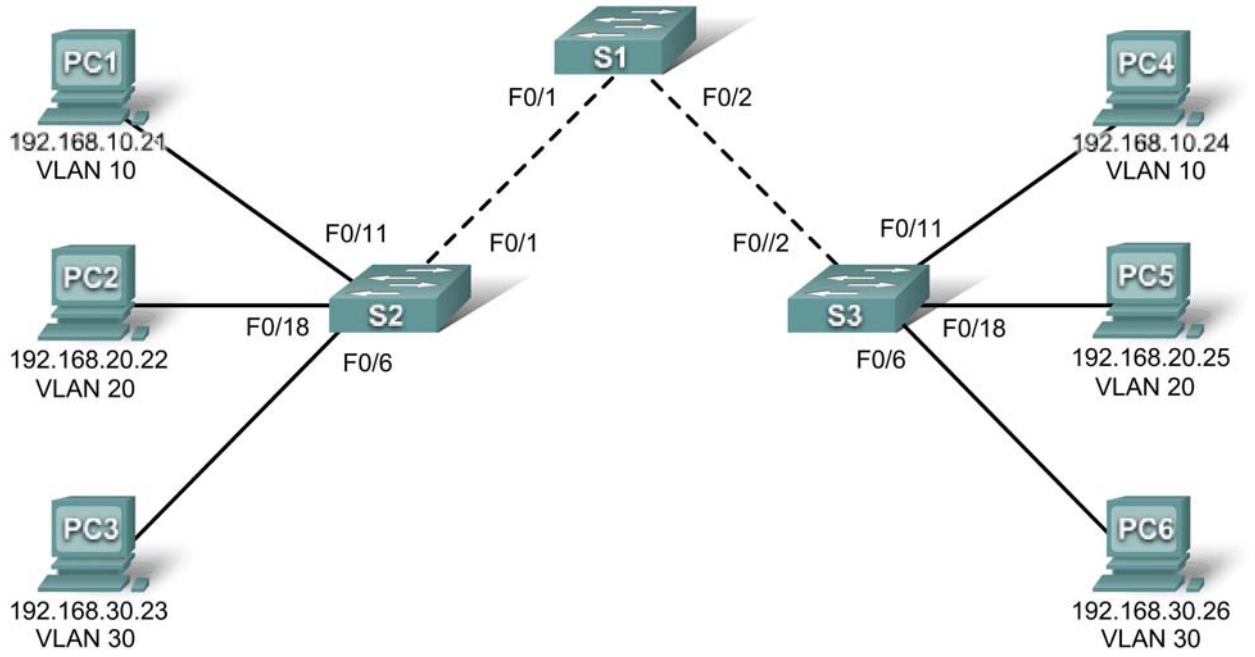
On each switch, capture the running configuration to a text file and save it for future reference.

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.

Lab 3.5.2: Challenge VLAN Configuration

Topology Diagram



Addressing Table

Device (Hostname)	Interface	IP Address	Subnet Mask	Default Gateway
S1	**VLAN 56**	192.168.56.11	255.255.255.0	N/A
S2	**VLAN 56**	192.168.56.12	255.255.255.0	N/A
S3	**VLAN 56**	192.168.56.13	255.255.255.0	N/A
PC1	**NIC**	192.168.10.21	255.255.255.0	192.168.10.1
PC2	**NIC**	192.168.20.22	255.255.255.0	192.168.20.1
PC3	**NIC**	192.168.30.23	255.255.255.0	192.168.30.1
PC4	**NIC**	192.168.10.24	255.255.255.0	192.168.10.1
PC5	**NIC**	192.168.20.25	255.255.255.0	192.168.20.1
PC6	**NIC**	192.168.30.26	255.255.255.0	192.168.30.1

Initial Port Assignments (Switches 2 and 3)

Ports	Assignment	Network
Fa0/1 – 0/5	802.1q Trunks (Native VLAN 56)	192.168.56.0 /24
Fa0/6 – 0/10	VLAN 30 – Guest (Default)	192.168.30.0 /24
Fa0/11 – 0/17	VLAN 10 – Faculty/Staff	192.168.10.0 /24
Fa0/18 – 0/24	VLAN 20 – Students	192.168.20.0 /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
- Create VLANs
- Assign switch ports to a VLAN
- Add, move, and change ports
- Verify VLAN configuration
- Enable trunking on inter-switch connections
- Verify trunk configuration
- Save the VLAN configuration

Task 1: Prepare the Network

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

Step 2: Clear any existing configurations on the switches, and initialize all ports in the shutdown state.

Task 2: Perform Basic Switch Configurations

Step 1: Configure the switches according to the following guidelines.

- Configure the switch hostname.
- 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.

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

Task 3: Configure and Activate Ethernet Interfaces

Step 1: Configure the PCs.

Configure the Ethernet interfaces of the six PCs with the IP addresses and default gateways from the addressing table at the beginning of the lab.

Task 4: Configure VLANs on the Switch

Step 1: Create VLANs on switch S1.

Step 2: Verify that the VLANs have been created on S1.

Step 3: Configure, name, and verify VLANs on switches S2 and S3.

Step 4: Assign switch ports to VLANs on S2 and S3.

Step 5: Determine which ports have been added to VLAN 10 on S2.

Step 6: Configure management VLAN 56 on each of the switches. Use the IP addresses indicated in the Addressing Table.

Step 7: Configure trunking and the native VLAN for the trunking ports on all three switches. Verify that the trunks have been configured.

Step 8: Verify that S1, S2, and S3 can communicate.

Step 9: Ping several hosts from PC2. What is the result?

Step 10: Move PC1 into the same VLAN as PC2. Can PC1 successfully ping PC2?

Step 11: Change the IP address on PC1 to 192.168.20.21. Can PC1 successfully ping PC2?

Change the IP address on PC1 to 192.168.20.21. The default gateway should be changed to 192.168.20.1. Once again, ping from host PC2 to host PC1, using the newly assigned IP address. Is the ping attempt successful?

Why was this attempt successful?

Task 5: Document the Switch Configurations

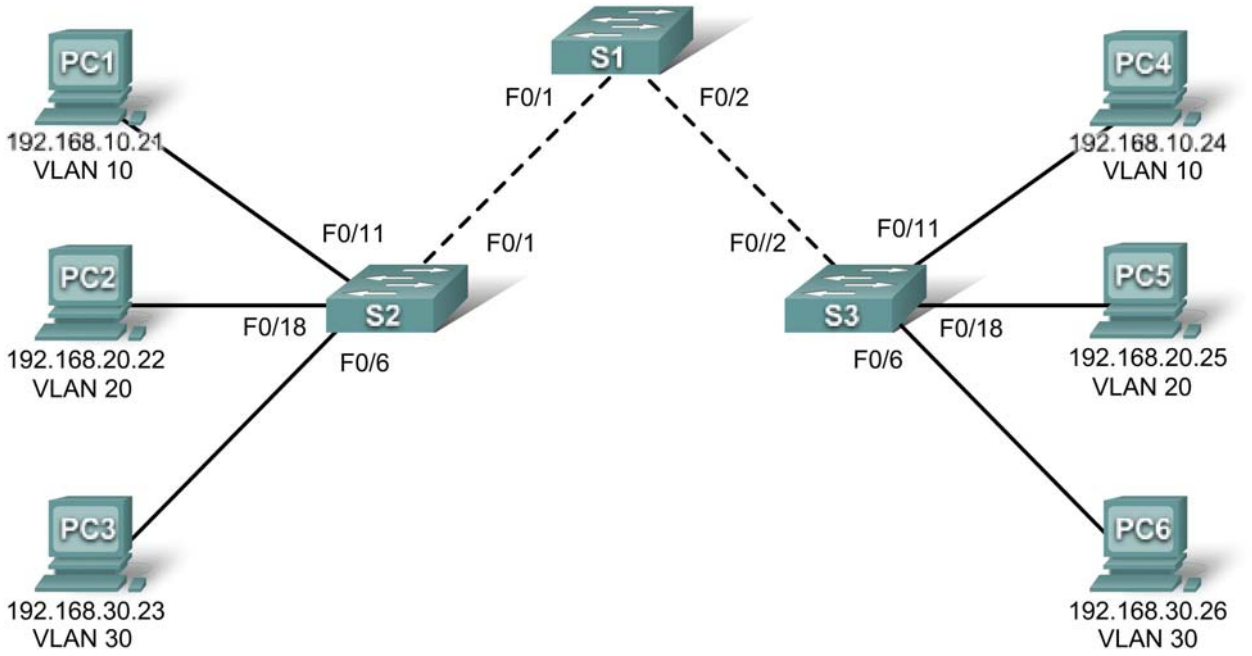
On each switch, capture the running configuration to a text file and save it for future reference.

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.

Lab 3.5.3: Troubleshooting VLAN Configurations

Topology Diagram



Addressing Table

Device (Hostname)	Interface	IP Address	Subnet Mask	Default Gateway
S1	**VLAN 56**	192.168.56.11	255.255.255.0	N/A
S2	**VLAN 56**	192.168.56.12	255.255.255.0	N/A
S3	**VLAN 56**	192.168.56.13	255.255.255.0	N/A
PC1	**NIC**	192.168.10.21	255.255.255.0	192.168.10.1
PC2	**NIC**	192.168.20.22	255.255.255.0	192.168.20.1
PC3	**NIC**	192.168.30.23	255.255.255.0	192.168.30.1
PC4	**NIC**	192.168.10.24	255.255.255.0	192.168.10.1
PC5	**NIC**	192.168.20.25	255.255.255.0	192.168.20.1
PC6	**NIC**	192.168.30.26	255.255.255.0	192.168.30.1

Initial Port Assignments (Switches 2 and 3)

Ports	Assignment	Network
Fa0/1 – 0/5	802.1q Trunks (Native VLAN 56)	192.168.56.0 /24
Fa0/6 – 0/10	VLAN 30 – Guest (Default)	192.168.30.0 /24
Fa0/11 – 0/17	VLAN 10 – Faculty/Staff	192.168.10.0 /24
Fa0/18 – 0/24	VLAN 20 – Students	192.168.20.0 /24

Learning Objective

Practice basic VLAN troubleshooting skills.

Scenario

In this lab, you will practice troubleshooting a misconfigured VLAN environment. Load or have your instructor load the configurations below into your lab gear. Your objective is to locate and correct any and all errors in the configurations and establish end-to-end connectivity. Your final configuration should match the topology diagram and addressing table. All passwords are set to **cisco**, except the enable secret password, which is set to **class**.

Task 1: Prepare the Network

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

Step 2: Clear any existing configurations on the switches, and initialize all ports in the shutdown state.

Step 3: Import the configurations below.

Switch 1

```
hostname S1
no ip domain-lookup
enable secret class
!
!
interface range FastEthernet0/1-5
 switchport mode trunk
!
interface range FastEthernet0/6-24
 shutdown
!
interface Vlan1
 no ip address
 no ip route-cache
!
interface Vlan56
 ip address 192.168.56.11 255.255.255.0
 no ip route-cache
!
line con 0
 logging synchronous
line vty 0 4
 no login
line vty 5 15
 password cisco
 login
!
end
```

Switch 2

```
hostname S2
no ip domain-lookup
enable secret class
!
vlan 10,20,30,56
```



```
!
interface range FastEthernet0/1-5
 switchport trunk native vlan 56
 switchport mode access
!
interface range FastEthernet0/6-10
 switchport access vlan 30
 switchport mode access
!
interface range FastEthernet0/11-17
 switchport access vlan 10
 switchport mode access
!
interface range FastEthernet0/18-24
 switchport access vlan 20
 switchport mode access
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 ip address 192.168.56.12 255.255.255.0
 no ip route-cache
 shutdown
!
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end
```

Switch 3

```
hostname S3
no ip domain-lookup
enable secret class
!
vlan 10,20,30
!
interface range FastEthernet0/1-5
 switchport trunk native vlan 56
 switchport mode trunk
!
interface range FastEthernet0/6-10
 switchport mode access
!
interface range FastEthernet0/11-17
 switchport mode access
!
interface range FastEthernet0/18-24
```



```
 switchport mode access
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 no ip address
 no ip route-cache
 shutdown
!
interface Vlan56
 no ip route-cache
!
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end
```

Task 2: Troubleshoot and Repair the VLAN Configuration

Task 3: Document the Switch Configurations

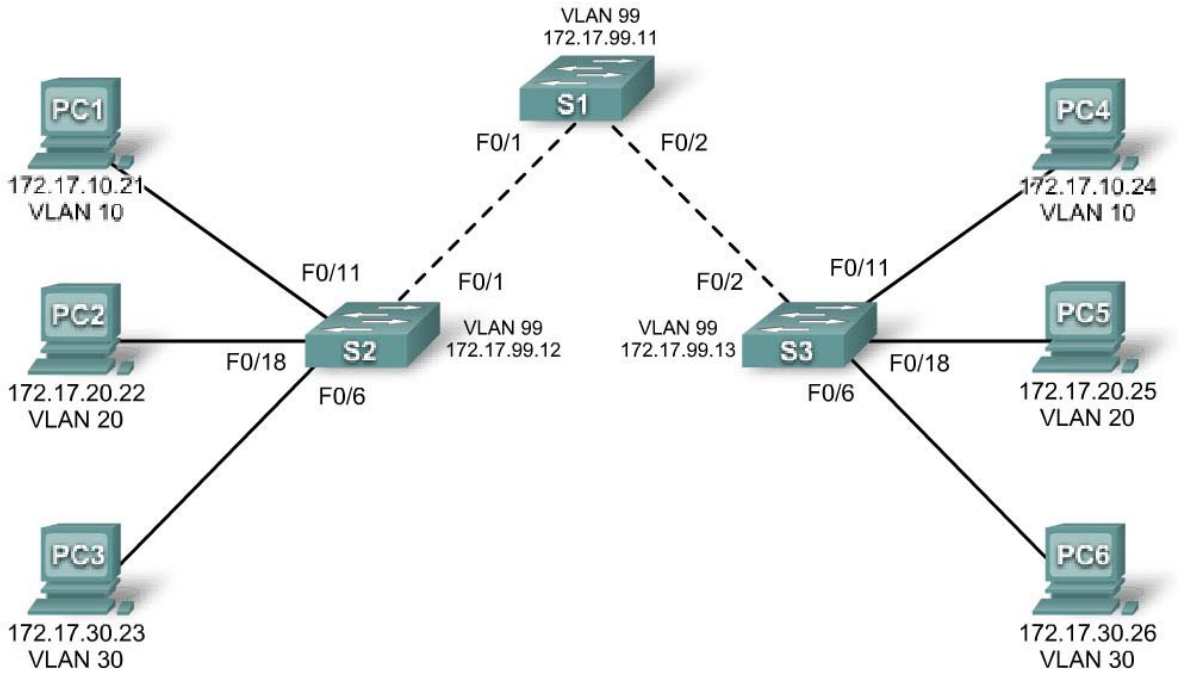
On each switch, capture the running configuration to a text file and save for future reference:

Task 4: 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.

Lab 4.4.1: Basic 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.

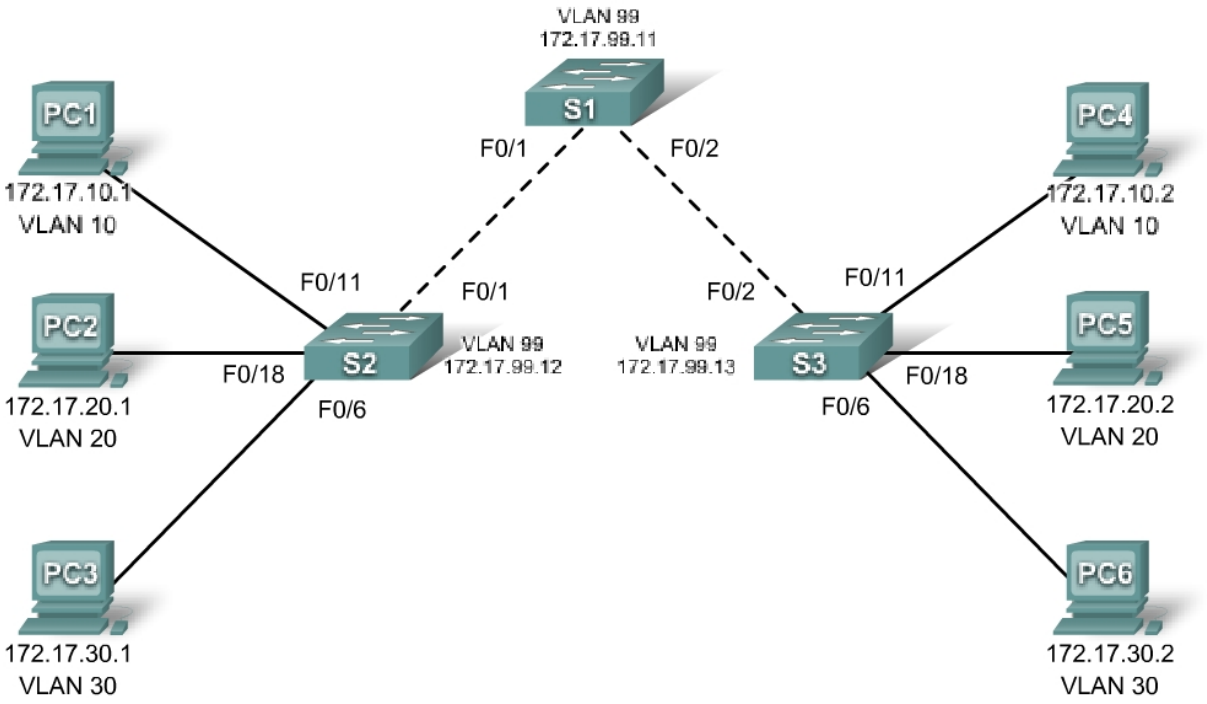
```
S1#show vtp status
VTP Version                     : 2
Configuration Revision          : 17
Maximum VLANs supported locally : 255
Number of existing VLANs        : 9
VTP Operating Mode              : Server
VTP Domain Name                 : Lab4
VTP Pruning Mode                : Enabled
<output omitted>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

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.

Lab 4.4.2 Challenge VTP Configuration

Topology



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**	172.17.10.1	255.255.255.0	
PC2	**NIC**	172.17.20.1	255.255.255.0	
PC3	**NIC**	172.17.30.1	255.255.255.0	
PC4	**NIC**	172.17.10.2	255.255.255.0	
PC5	**NIC**	172.17.20.2	255.255.255.0	
PC6	**NIC**	172.17.30.2	255.255.255.0	

Port Assignments (Switches 2 and 3)

Ports	Assignment	Network
Fa0/1 – 0/5	802.1q Trunks	
Fa0/11 – 0/17	VLAN 10 – engineering	172.17.10.0 /24
Fa0/18 – 0/24	VLAN 20 – sales	172.17.20.0 /24
Fa0/6 – 0/10	VLAN 30 – administration	172.17.30.0 /24
None	VLAN 99 – network management	172.17.99.0 /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.

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 diagram. 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.

Set up console connections to all three switches.

Step 2: Clear any existing configurations on the switches.

Erase existing configurations, VLANs, and reload the switch. Use the **show vlan** command to confirm that only default VLANs exist and that all ports are assigned to VLAN 1.

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

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.
- Save running-configuration to startup-configuration.

Step 2: Re-enable the user ports on S2 and S3 and put those ports in access mode. Refer to the topology diagram to determine which ports are connected to end-user devices.

Task 3: Configure the Ethernet Interfaces on the Host PCs

Configure the Ethernet interfaces of PC1 through PC6 with the IP addresses indicated in the addressing table at the beginning of the lab.

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 operating mode, domain, and password. In this lab, you will be configuring S1 as a VTP server, with S2 and S3 configured as VTP clients.

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

What is the current (default) VTP operating mode on the switches? _____

What is the configuration revision on S1 and S2? _____

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

Set the VTP domain name to **access** and the VTP password to **lab4** on all three switches**.** Configure S1 in server mode, and S2 and S3 in client mode.

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. Recall that VTP domain names and passwords are case-sensitive.

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

Configure ports Fa0/1 through Fa0/5 in trunking mode. Configure VLAN 99 as the native VLAN for these trunks. You can use the **interface range** command to simplify this task. Do not forget to enable the trunk interfaces.

Step 4: Configure port security on the S2 and S3 access ports.

Configure ports Fa0/6, Fa0/11, and Fa0/18 on S2 and S3 so that they allow a maximum of two hosts to connect to these ports and learn the MAC addresses of the hosts dynamically.

Step 5: Configure VLANs on the VTP server.

There are four VLANS required in this lab:

1. VLAN 99 (network management)
2. VLAN 10(engineering)
3. VLAN 20 (sales)
4. VLAN 30 (administration)

Configure these VLANs only on the VTP server.

When you are done, verify that all four VLANs have been created on S1.

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 these switches.

Are the same VLANs configured on all switches? _____

Explain why S2 and S3 have the same VLAN configurations at this point. _____

_____

_____

Step 7: Configure the management interface address on all three switches according to the addressing table at the beginning of the lab.

Assign these addresses to the network management VLAN (VLAN 99).

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 resolve.

Step 8: Assign switch ports to VLANs.

Refer to the port assignment table at the beginning of the lab to assign ports to VLANs. Use the **interface range** command to simplify this task. Note that port assignments are not configured through VTP. Port assignments must be configured on each switch manually or dynamically using a VMPS server. Save the configuration when you are done.

Step 9: Verify that the trunks are operating correctly.

From PC1, attempt to ping PC4, PC5, and PC6.

Were any of the pings successful? _____

Why did some of the pings fail? _____

_____

Which hosts could be reached from PC3? _____

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 eliminates or prunes this unnecessary traffic. Pruning saves LAN bandwidth because broadcasts do not have to be sent to switches that do not need them.

Configure pruning on the server switch, which is then pushed to client switches.

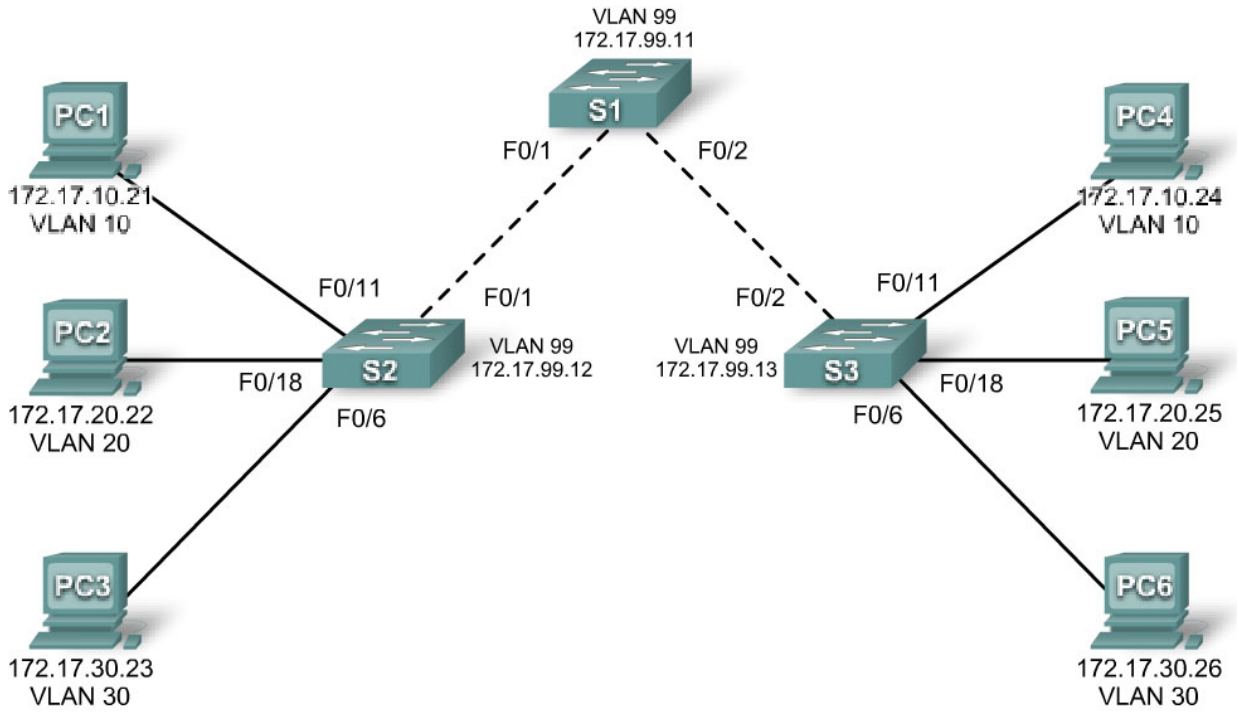
Confirm the VTP pruning configuration on each switch using the **show vtp status** command. VTP pruning mode should show “Enabled” on each switch.

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.

Lab 4.4.3 Troubleshooting VTP Configuration

Topology Diagram



Addressing Table

Device (Hostname)	Interface	IP Address	Subnet Mask
S1	**VLAN 99**	172.17.99.11	255.255.255.0
S2	**VLAN 99**	172.17.99.12	255.255.255.0
S3	**VLAN 99**	172.17.99.13	255.255.255.0
PC1	**NIC**	172.17.10.21	255.255.255.0
PC2	**NIC**	172.17.20.22	255.255.255.0
PC3	**NIC**	172.17.30.23	255.255.255.0
PC4	**NIC**	172.17.10.24	255.255.255.0
PC5	**NIC**	172.17.20.25	255.255.255.0
PC6	**NIC**	172.17.30.26	255.255.255.0

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

Objectives

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

- Cable a network according to the topology diagram
- Erase the startup configuration and vlan.dat files and reload switches to the default state
- Load the switches with supplied scripts
- Find and correct all configuration errors
- Document the corrected network

Scenario

The VLAN Trunking Protocol (VTP) helps ensure uniform VLAN configurations on your switched network, but it must be configured correctly. In this lab, you will use the supplied scripts to configure S1 as a VTP server, and S2 and S3 as VTP clients. The VTP domain name is Lab4_3, and the VTP password is cisco. However, there are a number of errors in this configuration that you must troubleshoot and correct before end-to-end connectivity within the VLAN is restored.

You will have successfully resolved all errors when the same VLANs are configured on all three switches, and you can ping between any two hosts in the same VLAN or between any two switches.

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 diagram. 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.

Set up console connections to all three switches.

Step 2: Clear any existing configurations on the switches.

Clear switch configurations and VLANs on all three switches and reload them to restore the default state. Use the **show vlan** command to confirm that only default VLANs exist and that all ports are assigned to VLAN 1.

Step 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 indicated in the addressing table at the beginning of the lab. There is no need to configure the default gateways for this lab.

Task 2: Load Switches with Supplied Scripts

S1 Configuration

```
enable
```



```
!
config term
hostname S1
enable secret class
no ip domain-lookup
!
vtp mode server
vtp domain Lab4_3
vtp password Cisco
!
vlan 99
name management
exit
!
vlan 10
name Faculty/Staff
exit
!
vlan 20
name Students
exit
!
vlan 30
name Guest
exit
!
interface FastEthernet0/1
switchport trunk native vlan 99
switchport mode trunk
!
interface FastEthernet0/2
 switchport trunk native vlan 99
 switchport mode access
!
interface FastEthernet0/3
 switchport trunk native vlan 99
 switchport mode access
!
interface FastEthernet0/4
 switchport trunk native vlan 99
 switchport mode trunk
!
interface FastEthernet0/5
 switchport trunk native vlan 99
 switchport mode trunk
!
interface range FastEthernet0/6-24
shutdown
!
interface GigabitEthernet0/1
shutdown
!
interface GigabitEthernet0/2
shutdown
!
interface Vlan99
```



```
 ip address 179.17.99.11 255.255.255.0
  no shutdown
!
line con 0
 logging synchronous
 password cisco
 login
line vty 0
 no login
line vty 1 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end
```

S2 Configuration

```
hostname S2
!
enable secret class
no ip domain-lookup
!
vtp mode client
vtp domain Lab4
!
!
interface FastEthernet0/1
 switchport trunk native vlan 99
 switchport mode access
!
interface FastEthernet0/2
 switchport trunk native vlan 99
 switchport mode access
!
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 range FastEthernet0/6 - 10
 switchport access vlan 10
!
switchport mode access
!
interface range FastEthernet0/11 - 17
```



```
 switchport access vlan 20
switchport mode access
!
interface range FastEthernet0/18 - 24
 switchport access vlan 30
 switchport mode access
!
interface Vlan99
 ip address 172.17.99.12 255.255.255.0
 no shutdown
!
ip http server
!
line con 0
  password cisco
 logging synchronous
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
```

S3 Configuration

```
hostname S3
!
enable secret class
no ip domain-lookup
!
vtp mode client
vtp domain Lab4
!
!
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 range FastEthernet0/6 - 10
 switchport access vlan 30
```



```
 switchport mode access
!
interface range FastEthernet0/11 - 17
 switchport access vlan 10
 switchport mode access
!
interface range FastEthernet0/18 - 24
 switchport access vlan 20
 switchport mode access
!
interface Vlan99
 ip address 172.17.99.12 255.255.255.0
 no shutdown
!
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
end
```

Task 3: Troubleshoot and Correct VTP and Configuration Errors

When all errors are corrected, you should be able to ping PC4 from PC1, PC5 from PC2, and PC6 from PC3. You should also be able to ping the management interfaces on both S2 and S3 from S1.

Task 4: Document the Switch Configuration

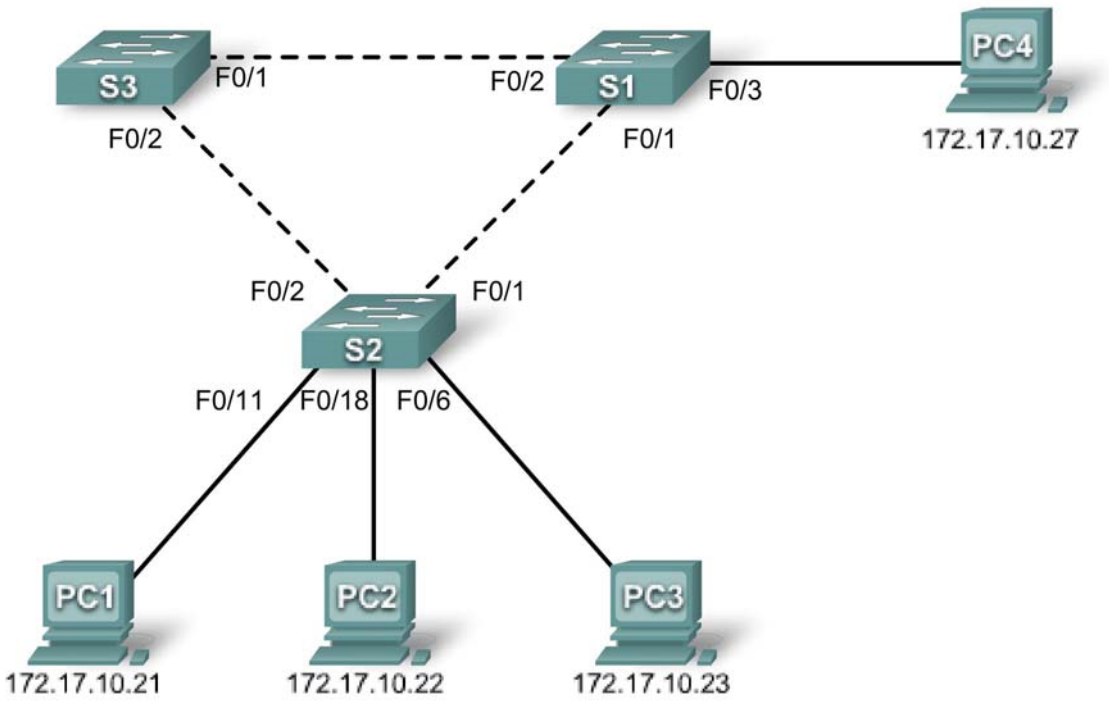
When you have completed your troubleshooting, capture the output of the **show run** command and save it to a text document for each switch.

Task 5: 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.

Lab 5.5.1: Basic Spanning Tree Protocol

Topology Diagram



Addressing Table

Device (Hostname)	Interface	IP Address	Subnet Mask	Default Gateway
S1	**VLAN 1**	172.17.10.1	255.255.255.0	N/A
S2	**VLAN 1**	172.17.10.2	255.255.255.0	N/A
S3	**VLAN 1**	172.17.10.3	255.255.255.0	N/A
PC1	**NIC**	172.17.10.21	255.255.255.0	172.17.10.254
PC2	**NIC**	172.17.10.22	255.255.255.0	172.17.10.254
PC3	**NIC**	172.17.10.23	255.255.255.0	172.17.10.254
PC4	**NIC**	172.17.10.27	255.255.255.0	172.17.10.254

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 the default configuration, setting a switch to the default state
- Perform basic configuration tasks on a switch
- Observe and explain the default behavior of Spanning Tree Protocol (STP, 802.1D)
- Observe the response to a change in the spanning tree topology

Task 1: Perform Basic Switch Configurations

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 diagram. The output shown in this lab is based on Cisco 2960 switches. Other switch models may produce different output.

Set up console connections to all three switches.

Step 2: Clear any existing configurations on the switches.

Clear NVRAM, delete the vlan.dat file, and reload the switches. Refer to Lab 2.5.1 for the procedure. After the reload is complete, use the **show vlan** privileged EXEC command to confirm that only default VLANs exist and that all ports are assigned to VLAN 1.

```
S1#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: Configure basic switch parameters.

Configure the S1, S2, and S3 switches according to the following guidelines:

- Configure the switch hostname.
- 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]
```

Task 2: Prepare the Network

Step 1: Disable all ports by using the shutdown command.

Ensure that the initial switch port states are inactive with the **shutdown** command. Use the **interface-range** command to simplify this task.

```
S1(config)#interface range fa0/1-24
S1(config-if-range)#shutdown
S1(config-if-range)#interface range gi0/1-2
S1(config-if-range)#shutdown
```

```
S2(config)#interface range fa0/1-24
S2(config-if-range)#shutdown
S2(config-if-range)#interface range gi0/1-2
S2(config-if-range)#shutdown
```

```
S3(config)#interface range fa0/1-24
S3(config-if-range)#shutdown
S3(config-if-range)#interface range gi0/1-2
S3(config-if-range)#shutdown
```

Step 2: Re-enable the user ports on S1 and 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.

```
S1(config)#interface fa0/3
S1(config-if)#switchport mode access
S1(config-if)#no shutdown

S2(config)#interface range fa0/6, fa0/11, fa0/18
```



```
S2(config-if-range)#switchport mode access
S2(config-if-range)#no shutdown
```

Step 3: Enable trunk ports on S1, S2, and S3.

Only a single VLAN is being used in this lab, however trunking has been enabled on all links between switches to allow for additional VLANs to be added in the future.

```
S1(config-if-range)#interface range fa0/1, fa0/2
S1(config-if-range)#switchport mode trunk
S1(config-if-range)#no shutdown

S2(config-if-range)#interface range fa0/1, fa0/2
S2(config-if-range)#switchport mode trunk
S2(config-if-range)#no shutdown

S3(config-if-range)#interface range fa0/1, fa0/2
S3(config-if-range)#switchport mode trunk
S3(config-if-range)#no shutdown
```

Step 4: Configure the management interface address on all three switches.

```
S1(config)#interface vlan1
S1(config-if)#ip address 172.17.10.1 255.255.255.0
S1(config-if)#no shutdown

S2(config)#interface vlan1
S2(config-if)#ip address 172.17.10.2 255.255.255.0
S2(config-if)#no shutdown

S3(config)#interface vlan1
S3(config-if)#ip address 172.17.10.3 255.255.255.0
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.

Task 3: Configure Host PCs

Configure the Ethernet interfaces of PC1, PC2, PC3, and PC4 with the IP address, subnet mask, and gateway indicated in the addressing table at the beginning of the lab.

Task 4: Configure Spanning Tree

Step 1: Examine the default configuration of 802.1D STP.

On each switch, display the spanning tree table with the **show spanning-tree** command. Root selection varies depending on the BID of each switch in your lab resulting in varying outputs.

```
S1#show spanning-tree


VLAN0001
```



```
  Spanning tree enabled protocol ieee
  Root ID     Priority    32769
              Address     0019.068d.6980

              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     0019.068d.6980
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    P2p
Fa0/2            Desg FWD 19        128.4    P2p
Fa0/3            Desg FWD 19        128.5    P2p

S2#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    32769
              Address     0019.068d.6980
              Cost        19
              Port        1 (FastEthernet0/1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     001b.0c68.2080
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Root FWD 19        128.1    P2p
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/6            Desg FWD 19        128.6    P2p
Fa0/11           Desg FWD 19        128.11   P2p
Fa0/18           Desg FWD 19        128.18   P2p


S3#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    32769
              Address     0019.068d.6980
              Cost        19
              Port        1 (FastEthernet0/1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     001b.5303.1700
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 300
```



```
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Root FWD 19        128.1    P2p
Fa0/2            Altn BLK 19        128.2    P2p
```

Step 2: Examine the output.

The bridge identifier (bridge ID), stored in the spanning tree BPDU consists of the bridge priority, the system ID extension, and the MAC address. The combination or addition of the bridge priority and the system ID extension are known as the ***bridge ID priority***. The system ID extension is always the number of the VLAN. For example, the system ID extension for VLAN 100 is 100. Using the default bridge priority value of 32768, the ***bridge ID priority*** for VLAN 100 would be 32868 (32768 + 100).

The **`show spanning-tree`** command displays the value of ***bridge ID priority***. Note: The "priority" value within the parentheses represents the bridge priority value, which is followed by the value of the system ID extension.

Answer the following questions based on the output.

1. What is the bridge ID priority for switches S1, S2, and S3 on VLAN 1?
   a. S1 _____
   b. S2 _____
   c. S3 _____
2. Which switch is the root for the VLAN 1 spanning tree? _____
3. Which spanning tree ports are in the blocking state on the root switch? _____
4. Do either of the non-root switches have a blocking port? _____Which switch and port is in the blocking state? _____
5. How does STP elect the root switch? _____
6. Since the bridge priorities are all the same, what else does the switch use to determine the root? _____

Task 5: Observe the response to the topology change in 802.1D STP

Now let's observe what happens when we intentionally simulate a broken link

Step 1: Place the switches in spanning tree debug mode using the command `debug spanning-tree events`.

```
S1#debug spanning-tree events
Spanning Tree event debugging is on

S2#debug spanning-tree events
Spanning Tree event debugging is on

S3#debug spanning-tree events
Spanning Tree event debugging is on
```

Step 2: Intentionally shutdown a port on the root switch. This example uses S1, since it is the

root. Your root switch may vary.

```
S1(config)#interface fa0/1
S1(config-if)#shutdown
```

Step 3: Record the debug output from the non-root switches. In this example we record the output from S2 and S3, since they are the non-root switches.

```
S2#
1w2d: STP: VLAN0001 we are the spanning tree root
S2#
1w2d: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down
1w2d: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to down
S2#
1w2d: STP: VLAN0001 heard root 32769-0019.068d.6980 on Fa0/2
1w2d:      supersedes 32769-001b.0c68.2080
1w2d: STP: VLAN0001 new root is 32769, 0019.068d.6980 on port Fa0/2, cost 38
1w2d: STP: VLAN0001 sent Topology Change Notice on Fa0/2

S3#
1w2d: STP: VLAN0001 heard root 32769-001b.0c68.2080 on Fa0/2
1w2d: STP: VLAN0001 Fa0/2 -> listening
S3#
1w2d: STP: VLAN0001 Topology Change rcvd on Fa0/2
1w2d: STP: VLAN0001 sent Topology Change Notice on Fa0/1
S3#
1w2d: STP: VLAN0001 Fa0/2 -> learning
S3#
1w2d: STP: VLAN0001 sent Topology Change Notice on Fa0/1
1w2d: STP: VLAN0001 Fa0/2 -> forwarding
```

Based on the output from this example, when the link from S2 that is connected to the root switch goes down, what is its initial conclusion about the spanning tree root?_____

Once S2 receives new information on Fa0/2, what new conclusion does it draw?_____

Port Fa0/2 on S3 was previously in a blocking state before the link between S2 and S1 went down. What states does it go through as a result of the topology change? _____

Step 4: Examine what has changed in the spanning tree topology using the `show spanning-tree` command.

```
S2#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0019.068d.6980
             Cost        38
             Port        2 (FastEthernet0/2)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     001b.0c68.2080
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
```



```
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Root FWD 19        128.2    P2p
Fa0/6            Desg FWD 19        128.6    P2p
Fa0/11           Desg FWD 19        128.11   P2p
Fa0/18           Desg FWD 19        128.18   P2p


S3#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0019.068d.6980
             Cost        19
             Port        1 (FastEthernet0/1)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     001b.5303.1700
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Root FWD 19        128.1    P2p
Fa0/2            Desg FWD 19        128.2    P2p
```

Answer the following questions based on the output.

1. What has changed about the way that S2 forwards traffic? _____
2. What has changed about the way that S3 forwards traffic?_____

Task 6: Using the show run command, record the configuration of each switch.

```
S1#show run
!<output omitted>
!
hostname S1
!
!
interface FastEthernet0/1
 switchport mode trunk
!
interface FastEthernet0/2
 switchport mode trunk
!
interface FastEthernet0/3
 switchport mode access
!
! <output omitted>
```



```
!
interface Vlan1
 ip address 172.17.10.1 255.255.255.0
!
end
```

```
S2#show run
!<output omitted>
!
hostname S2
!
!
interface FastEthernet0/1
 switchport mode trunk
!
interface FastEthernet0/2
 switchport mode trunk
!
! <output omitted>
!
interface FastEthernet0/6
 switchport mode access
!
interface FastEthernet0/11
 switchport mode access
!
interface FastEthernet0/18
 switchport mode access
!
!
interface Vlan1
 ip address 172.17.10.2 255.255.255.0
!
end
```

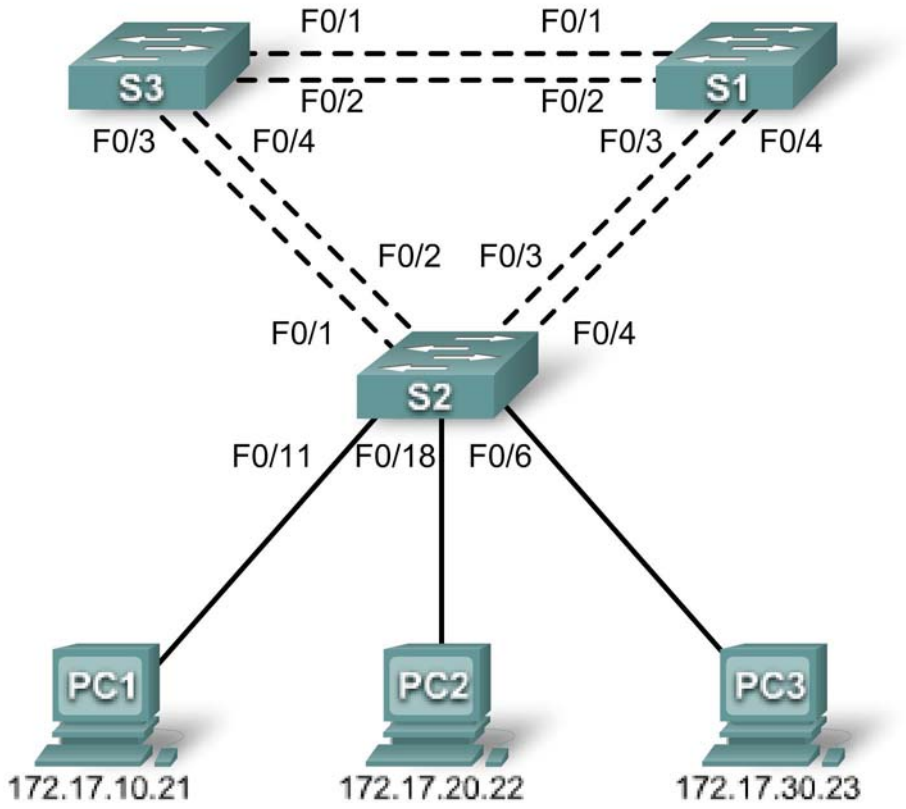
```
S3#show run
!<output omitted>
!
hostname S3
!
!
interface FastEthernet0/1
 switchport mode trunk
!
interface FastEthernet0/2
 switchport mode trunk
!
!
! <output omitted>
!
interface Vlan1
 ip address 172.17.10.3 255.255.255.0
!
end
```


Task 7: Clean Up

Erase the configurations and reload the default configurations for 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.

Lab 5.5.2: Challenge Spanning Tree Protocol

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	172.17.10.12
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 – Switch 2

Ports	Assignment	Network
Fa0/1 – 0/4	802.1q Trunks (Native VLAN 99)	172.17.99.0 /24
Fa0/5 – 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 the default configuration, setting a switch to the default state
- Perform basic configuration tasks on a switch
- Configure VLAN Trunking Protocol (VTP) on all switches
- Observe and explain the default behavior of Spanning Tree Protocol (STP, 802.1D)
- Modify the placement of the spanning tree root
- Observe the response to a change in the spanning tree topology
- Explain the limitations of 802.1D STP in supporting continuity of service
- Configure Rapid STP (802.1W)
- Observe and explain the improvements offered by Rapid STP

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 diagram. The output shown in this lab is based on Cisco 2960 switches. Other switch models may produce different output.

Set up console connections to all three switches.

Step 2: Clear any existing configurations on the switches.

Clear NVRAM, delete the vlan.dat file, and reload the switches. Refer to Lab 2.5.1 for the procedure. After the reload is complete, use the **show vlan** privileged EXEC 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.

Ensure that the initial switch port states are inactive with the **shutdown** command. Use the **interface-range** command to simplify this task. Repeat these commands on each switch.

```
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

Configure the S1, S2, and S3 switches according to the following guidelines:

- Configure the switch hostname.
- 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]
```

Task 3: Configure Host PCs

Configure the Ethernet interfaces of PC1, PC2, and PC3 with the IP address, subnet mask, and gateway indicated in the addressing table at the beginning of the lab.

Task 4: Configure VLANs

Step 1: 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 2: Configure Trunk Links and Native VLAN

Configure trunking ports and native VLAN. For each switch, configure ports Fa0/1 through Fa0/4 as trunking ports. Designate VLAN 99 as the native VLAN for these trunks. Use the **interface range** command in global configuration mode to simplify this task. Remember that these ports were disabled in a previous step and must be re-enabled using the **no shutdown** command.

```
S1(config)#interface range fa0/1-4
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 fa0/1-4
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 fa0/1-4
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 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)#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
```

Step 4: 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
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 vlan99
S1(config-if)#ip address 172.17.99.11 255.255.255.0
S1(config-if)#no shutdown

S2(config)#interface vlan99
S2(config-if)#ip address 172.17.99.12 255.255.255.0
S2(config-if)#no shutdown

S3(config)#interface vlan99
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 6: Assign switch ports to the VLANs.

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

```
S2(config)#interface range fa0/5-10
S2(config-if-range)#switchport mode access
S2(config-if-range)#switchport access vlan 30
S2(config-if-range)#interface range fa0/11-17
S2(config-if-range)#switchport mode access
S2(config-if-range)#switchport access vlan 10
S2(config-if-range)#interface range fa0/18-24
S2(config-if-range)#switchport mode access
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]
S2#
```

Step 7: Re-enable the user ports on S2.

Refer to the topology diagram to determine which switch ports on S2 are activated for end-user device

access. These three ports will be enabled with the **no shutdown** command.

```
S2(config)#interface range fa0/6, fa0/11, fa0/18
S2(config-if-range)#no shutdown
```

Task 5: Configure Spanning Tree

Step 1: Examine the default configuration of 802.1D 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 BID of each switch in your lab.

```
S1#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0019.068d.6980
             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     0019.068d.6980
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    P2p
Fa0/2            Desg FWD 19        128.4    P2p
Fa0/3            Desg FWD 19        128.5    P2p
Fa0/4            Desg FWD 19        128.6    P2p

VLAN0010
  Spanning tree enabled protocol ieee
  Root ID    Priority    32778
             Address     0019.068d.6980
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32778  (priority 32768 sys-id-ext 10)
             Address     0019.068d.6980
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    P2p
Fa0/2            Desg FWD 19        128.4    P2p
Fa0/3            Desg FWD 19        128.5    P2p
Fa0/4            Desg FWD 19        128.6    P2p

VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    32788
             Address     0019.068d.6980
```



```
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32788  (priority 32768 sys-id-ext 20)
             Address     0019.068d.6980
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    P2p
Fa0/2            Desg FWD 19        128.4    P2p
Fa0/3            Desg FWD 19        128.5    P2p
Fa0/4            Desg FWD 19        128.6    P2p

VLAN0030
  Spanning tree enabled protocol ieee
  Root ID    Priority    32798
             Address     0019.068d.6980
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32798  (priority 32768 sys-id-ext 30)
             Address     0019.068d.6980
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    P2p
Fa0/2            Desg FWD 19        128.4    P2p
Fa0/3            Desg FWD 19        128.5    P2p
Fa0/4            Desg FWD 19        128.6    P2p

VLAN0099
  Spanning tree enabled protocol ieee
  Root ID    Priority    32867
             Address     0019.068d.6980
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32867  (priority 32768 sys-id-ext 99)
             Address     0019.068d.6980
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    P2p
Fa0/2            Desg FWD 19        128.4    P2p
Fa0/3            Desg FWD 19        128.5    P2p
Fa0/4            Desg FWD 19        128.6    P2p
```

Note that there are five instances of the spanning tree on each switch. The default STP configuration on Cisco switches is Per-VLAN Spanning Tree (PVST+), which creates a separate spanning tree for each

VLAN (VLAN 1 and any user-configured VLANs).

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     0019.068d.6980
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32867  (priority 32768 sys-id-ext 99)
              Address     0019.068d.6980
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    P2p
Fa0/2            Desg FWD 19        128.4    P2p
Fa0/3            Desg FWD 19        128.5    P2p
Fa0/4            Desg FWD 19        128.6    P2p

S2#show spanning-tree vlan 99

VLAN0099
  Spanning tree enabled protocol ieee
  Root ID     Priority    32867
              Address     0019.068d.6980   This is the MAC address of the root switch (S1 in
this case)
              Cost        19
              Port        3 (FastEthernet0/3)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32867  (priority 32768 sys-id-ext 99)
              Address     001b.0c68.2080
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 15

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

S3#show spanning-tree vlan 99

VLAN0099
  Spanning tree enabled protocol ieee
  Root ID     Priority    32867
              Address     0019.068d.6980   This is the MAC address of the root switch (S1 in
this case)
              Cost        19
              Port        1 (FastEthernet0/1)
```



```
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority     32867  (priority 32768 sys-id-ext 99)
             Address      001b.5303.1700
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

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

Step 2: Examine the output.

Answer the following questions based on the output.

1. What is the bridge ID priority for switches S1, S2, and S3 on VLAN 99?
   a. S1 _____
   b. S2 _____
   c. S3 _____
2. What is the bridge ID priority for S1 on VLANs 10, 20, 30, and 99?
   a. VLAN 10 _____
   b. VLAN 20_____
   c. VLAN 30_____
   d. VLAN 99_____
3. Which switch is the root for the VLAN 99 spanning tree? _____
4. On VLAN 99, which spanning tree ports are in the blocking state on the root switch?
   _____
5. On VLAN 99, which spanning tree ports are in the blocking state on the non-root switches?
   _____
6. How does STP elect the root switch? _____
7. Since the bridge priorities are all the same, what else does the switch use to determine the root?
   _____

Task 6: 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 processing 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 lab. 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.

Selection of the root switch is accomplished by changing the spanning-tree priority for the VLAN. Because the default root switch may vary in your lab environment, we will configure S1 and S3 to be the root switches for specific VLANs. 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 S3 to 4096.

```
S3(config)#spanning-tree vlan 99 ?
  forward-time  Set the forward delay for the spanning tree
  hello-time    Set the hello interval for the spanning tree
  max-age       Set the max age interval for the spanning tree
  priority      Set the bridge priority for the spanning tree
  root          Configure switch as root
  <cr>

S3(config)#spanning-tree vlan 99 priority ?
  <0-61440>  bridge priority in increments of 4096

S3(config)#spanning-tree vlan 99 priority 4096
S3(config)#exit
```

Set the priority for VLANs 1, 10, 20, and 30 on S1 to 4096. Once again, the lower number indicates a higher priority for root selection.

```
S1(config)#spanning-tree vlan 1 priority 4096
S1(config)#spanning-tree vlan 10 priority 4096
S1(config)#spanning-tree vlan 20 priority 4096
S1(config)#spanning-tree vlan 30 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 S1 and switch S3.

```
S1#show spanning-tree vlan 99

VLAN0099
  Spanning tree enabled protocol ieee
  Root ID     Priority    4195
              Address     001b.5303.1700   This is now the MAC address of S3, (the new root
switch)
              Cost        19
              Port        3 (FastEthernet0/1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32867  (priority 32768 sys-id-ext 99)
              Address     0019.068d.6980
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 300
```



```
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Root FWD 19        128.3    P2p
Fa0/2            Altn BLK 19        128.4    P2p
Fa0/3            Desg FWD 19        128.5    P2p
Fa0/4            Desg FWD 19        128.6    P2p
```

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

```
VLAN0099
  Spanning tree enabled protocol ieee
  Root ID     Priority    4195
              Address     001b.5303.1700
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    4195   (priority 4096 sys-id-ext 99)
              Address     001b.5303.1700
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/3            Desg FWD 19        128.3    P2p
Fa0/4            Desg FWD 19        128.4    P2p
```

Which switch is the root for VLAN 99? _____

On VLAN 99, which spanning tree ports are in the blocking state on the new root switch? _____

On VLAN 99, which spanning tree ports are in the blocking state on the old root switch? _____

Compare the S3 VLAN 99 spanning tree above with the S3 VLAN 10 spanning tree.

S3#**show spanning-tree vlan 10**

```
VLAN0010
  Spanning tree enabled protocol ieee
  Root ID     Priority    4106
              Address     0019.068d.6980
              Cost        19
              Port        1 (FastEthernet0/1)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32778  (priority 32768 sys-id-ext 10)
              Address     001b.5303.1700
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time 300

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


Note that S3 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 three of four S3 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.

Task 7: Observe the response to the topology change in 802.1D STP

To observe continuity across the LAN during a topology change, first reconfigure PC3, which is connected to port S2 Fa0/6, with IP address 172.17.99.23 255.255.255.0. Then reassign S2 port Fa0/6 to VLAN 99. This allows you to continuously ping across the LAN from the host.

```
S2(config)# interface fa0/6
S2(config-if)#switchport access vlan 99
```

Verify that the switches can ping the host.

```
S2#ping 172.17.99.23
Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 172.17.99.23, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/202/1007 ms

S1#ping 172.17.99.23

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.99.23, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/202/1007 ms
```

Put S1 in spanning-tree event debug mode to monitor changes during the topology change.

```
S1#debug spanning-tree events
Spanning Tree event debugging is on
```

Open a command window on PC3 and begin a continuous ping to the S1 management interface with the command **ping –t 172.17.99.11**. Now disconnect the trunks on S1 Fa0/1 and Fa0/3. Monitor the pings. They will begin to time out as connectivity across the LAN is interrupted. As soon as connectivity has been re-established, terminate the pings by pressing Ctrl-C.

Below is a shortened version of the debug output you will see on S1 (several TCNs are omitted for brevity).

```
S1#debug spanning-tree events
Spanning Tree event debugging is on
S1#
6d08h: STP: VLAN0099 new root port Fa0/2, cost 19
6d08h: STP: VLAN0099 Fa0/2 -> listening
6d08h: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down
6d08h: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to down
6d08h: STP: VLAN0099 sent Topology Change Notice on Fa0/2
6d08h: STP: VLAN0030 Topology Change rcvd on Fa0/2
6d08h: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3,
changed state to down
6d08h: %LINK-3-UPDOWN: Interface FastEthernet0/3, changed state to down
6d08h: STP: VLAN0001 Topology Change rcvd on Fa0/4
6d08h: STP: VLAN0099 Fa0/2 -> learning
6d08h: STP: VLAN0099 sent Topology Change Notice on Fa0/2
6d08h: STP: VLAN0099 Fa0/2 -> forwarding
```



```
6d08h: STP: VLAN0001 Topology Change rcvd on Fa0/4
```

Recall that when the ports are in listening and learning mode, they are not forwarding frames, and the LAN is essentially down. The spanning tree recalculation can take up to 50 seconds to complete – a significant interruption in network services. The output of the continuous pings shows the actual interruption time. In this case, it was about 30 seconds. While 802.1D STP effectively prevents switching loops, this long restoration time is considered a serious drawback in the high availability LANs of today.

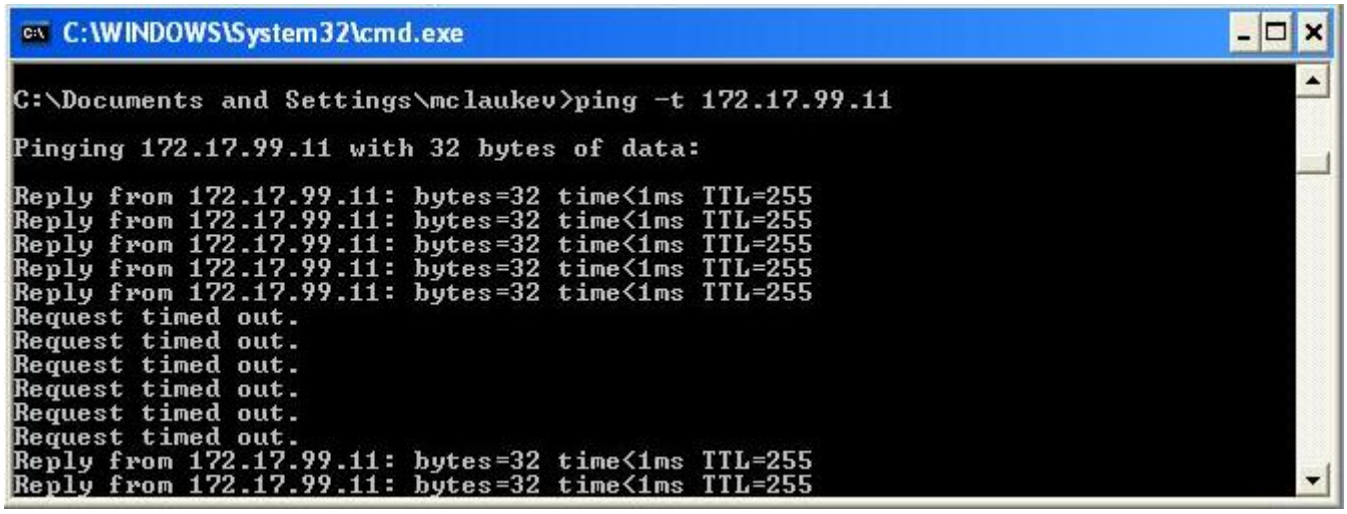


Figure 1. These pings show a 30-second lapse in connectivity while the spanning tree is recalculated.

Task 8: Configure PVST Rapid Spanning Tree Protocol

Cisco has developed several features to address the slow convergence times associated with standard STP. PortFast, UplinkFast, and BackboneFast are features that, when properly configured, can dramatically reduce the time required to restore connectivity. Incorporating these features requires manual configuration, and care must be taken to do it correctly. The longer term solution is Rapid STP (RSTP), 802.1w, which incorporates these features among others. RSTP-PVST is configured as follows:

```
S1(config)#spanning-tree mode rapid-pvst
```

Configure all three switches in this manner.

Use the command **show spanning-tree summary** to verify that RSTP is enabled.

Task 9: Observe the convergence time of RSTP

Begin by restoring the trunks you disconnected in Task 7, if you have not already done so (ports Fa0/1 and Fa0/3 on S1). Then follow these steps in Task 7:

- Set up host PC3 to continuously ping across the network.
- Enable spanning-tree event debugging on switch S1.
- Disconnect the cables connected to ports Fa0/1 and Fa0/3.
- Observe the time required to re-establish a stable spanning tree.

Below is the partial debug output:

```
S1#debug spanning-tree events
Spanning Tree event debugging is on
S1#
6d10h: RSTP(99): updt rolesroot port Fa0/3 is going down
```



```
6d10h: RSTP(99): Fa0/2 is now root port
```
Connectivity has been restored; less than 1 second interruption
```
6d10h: RSTP(99): syncing port Fa0/1
6d10h: RSTP(99): syncing port Fa0/4
6d10h: RSTP(99): transmitting a proposal on Fa0/1
6d10h: RSTP(99): transmitting a proposal on Fa0/4
6d10h: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3,
changed state to down
6d10h: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down
```

The restoration time with RSTP enabled was less than a second, and not a single ping was dropped.

Task 10: Clean Up

Erase the configurations and reload the default configurations for 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

Switch S1

```
hostname S1
!
enable secret class
!
no ip domain-lookup
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 1 priority 4096
spanning-tree vlan 10 priority 4096
spanning-tree vlan 20 priority 4096
spanning-tree vlan 30 priority 4096
!
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
 shutdown
!
```



```
interface FastEthernet0/6
 shutdown
!
interface FastEthernet0/7
 shutdown
!
(remaining port configuration ommitted - all non-used ports are shutdown)
!
!
interface Vlan1
 no ip address
 no ip route-cache
!
interface Vlan99
 ip address 172.17.99.11 255.255.255.0
 no ip route-cache
!
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end
```

Switch S2

```
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 access vlan 30
```



```
 switchport mode access
 shutdown
!
interface FastEthernet0/6
 switchport access vlan 30
 switchport mode access
!
interface FastEthernet0/7
 switchport access vlan 30
 switchport mode access
 shutdown
!
interface FastEthernet0/8
 switchport access vlan 30
 switchport mode access
 shutdown
!
interface FastEthernet0/9
 switchport access vlan 30
 switchport mode access
 shutdown
!
interface FastEthernet0/10
 switchport access vlan 30
 switchport mode access
 shutdown
!
interface FastEthernet0/11
 switchport access vlan 10
 switchport mode access
!
interface FastEthernet0/12
 switchport access vlan 10
 switchport mode access
 shutdown
!
interface FastEthernet0/13
 switchport access vlan 10
 switchport mode access
 shutdown
!
interface FastEthernet0/14
 switchport access vlan 10
 switchport mode access
 shutdown
!
interface FastEthernet0/15
 switchport access vlan 10
 switchport mode access
 shutdown
!
interface FastEthernet0/16
 switchport access vlan 10
 switchport mode access
 shutdown
!
```



```
interface FastEthernet0/17
 switchport access vlan 10
 switchport mode access
 shutdown
!
interface FastEthernet0/18
 switchport access vlan 20
 switchport mode access
!
interface FastEthernet0/19
 switchport access vlan 20
 switchport mode access
 shutdown
!
interface FastEthernet0/20
switchport access vlan 20
 switchport mode access
 shutdown
!
interface FastEthernet0/21
 switchport access vlan 20
 switchport mode access
 shutdown
!
interface FastEthernet0/22
 switchport access vlan 20
 switchport mode access
 shutdown
!
interface FastEthernet0/23
 switchport access vlan 20
 switchport mode access
 shutdown
!
interface FastEthernet0/24
 switchport access vlan 20
 switchport mode access
 shutdown
!
interface GigabitEthernet0/1
 shutdown
!
interface GigabitEthernet0/2
 shutdown
!
interface Vlan1
 no ip address
 no ip route-cache
!
interface Vlan99
 ip address 172.17.99.12 255.255.255.0
 no ip route-cache
!
line con 0
line vty 0 4
 password cisco
```



```
 login
line vty 5 15
 password cisco
 login
!
end
```

Switch S3

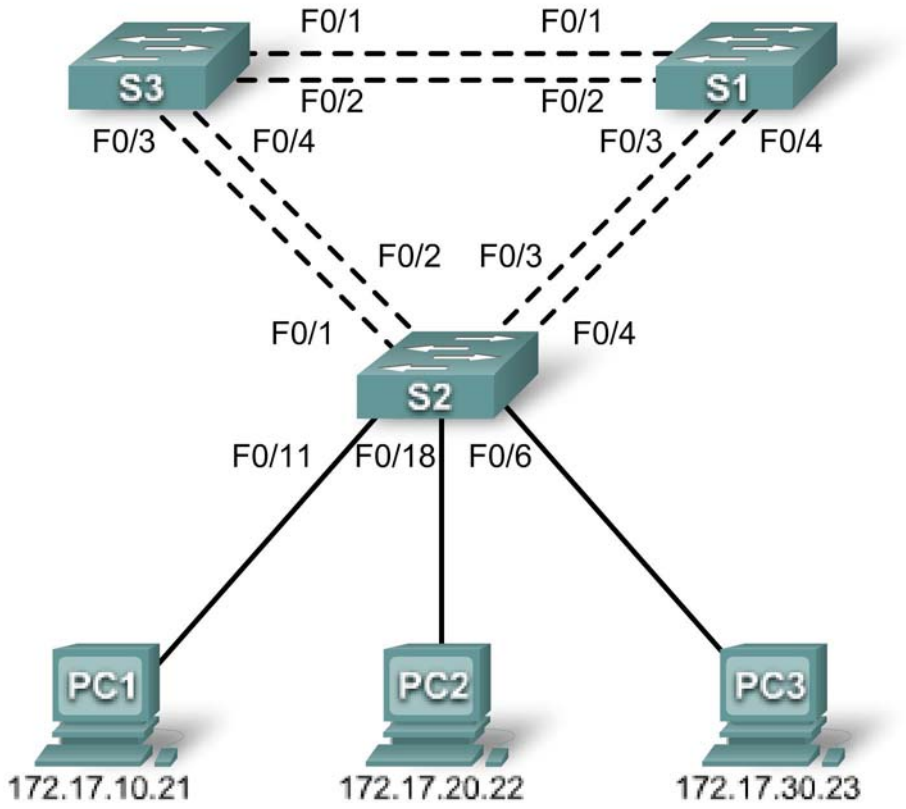
```
hostname S3
!
enable secret class
!
no ip domain-lookup
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 99 priority 4096
!
interface FastEthernet0/1
 switchport trunk native vlan 99
 switchport mode trunk
!
interface FastEthernet0/2
 switchport trunk native vlan 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
 shutdown
!
interface FastEthernet0/6
 shutdown
!
interface FastEthernet0/7
 shutdown
!
(remaining port configuration ommitted - all non-used ports are shutdown)
!
interface Vlan1
 no ip address
 no ip route-cache
 shutdown
!
interface Vlan99
 ip address 172.17.99.13 255.255.255.0
 no ip route-cache
!
```



```
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end
```


Lab 5.5.3: Troubleshooting Spanning Tree Protocol

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

Port Assignments – Switch 2

Ports	Assignment	Network
Fa0/1 – 0/4	802.1q Trunks (Native VLAN 99)	172.17.99.0 /24
Fa0/5 – 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:

- Analyze a congestion problem in a redundant, switched LAN network.
- Recognize the capabilities for per-VLAN load balancing with PVST.
- Modify the default STP configuration to optimize available bandwidth.
- Verify that modifications have had the intended effect.

Scenario

You are responsible for the operation of the redundant switched LAN shown in the topology diagram. You and your users have been observing increased latency during peak usage times, and your analysis points to congested trunks. You recognize that of the six trunks configured, only two are forwarding packets in the default STP configuration currently running. The solution to this problem requires more effective use of the available trunks. The PVST+ feature of Cisco switches provides the required flexibility to distribute the inter-switch traffic using all six trunks.

This lab is complete when all wired trunks are carrying traffic, and all three switches are participating in per-VLAN load balancing for the three user VLANs.

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 diagram. The output shown in this lab is based on Cisco 2960 switches. Other switch models may produce different output.

Set up console connections to all three switches.

Step 2: Clear any existing configurations on the switches.

Clear NVRAM, delete the vlan.dat file, and reload the switches.

Step 3: Load the switches with the following script:

S1 Configuration

```
hostname S1
enable secret class
```



```
no ip domain-lookup
!
vtp mode server
vtp domain Lab5
vtp password cisco
!
vlan 99
name Management
exit
!
vlan 10
name Faculty/Staff
exit
!
vlan 20
name Students
exit
!
vlan 30
name Guest
exit
!
interface FastEthernet0/1
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/2
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/3
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/4
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface range FastEthernet0/5-24
shutdown
!
interface GigabitEthernet0/1
shutdown
!
interface GigabitEthernet0/2
shutdown
!
interface Vlan99
 ip address 172.17.99.11 255.255.255.0
 no shutdown
!
line con 0
```



```
 logging synchronous
 password cisco
 login
line vty 0
 no login
line vty 1 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end
```

S2 Configuration

```
hostname S2
!
enable secret class
no ip domain-lookup
!
vtp mode client
vtp domain Lab5
vtp password cisco
!
interface FastEthernet0/1
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/2
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/3
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/4
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface range FastEthernet0/5 - 10
 switchport access vlan 30
 switchport mode access
!
interface range FastEthernet0/11 - 17
 switchport access vlan 10
 switchport mode access
!
interface range FastEthernet0/18 - 24
 switchport access vlan 20
```



```
 switchport mode access
!
interface fa0/6
no shutdown
interface fa0/11
no shutdown
interface fa0/18
no shutdown
!
interface Vlan99
 ip address 172.17.99.12 255.255.255.0
 no shutdown
!
line con 0
 password cisco
 logging synchronous
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
```

S3 Configuration

```
hostname S3
!
enable secret class
no ip domain-lookup
!
vtp mode client
vtp domain Lab5
vtp password cisco
!
interface FastEthernet0/1
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/2
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/3
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/4
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface range FastEthernet0/5 - 10
```



```
 switchport access vlan 30
 switchport mode access
!
interface range FastEthernet0/11 - 17
 switchport access vlan 10
 switchport mode access
!
interface range FastEthernet0/18 - 24
 switchport access vlan 20
 switchport mode access
!
interface Vlan99
 ip address 172.17.99.13 255.255.255.0
 no shutdown
!
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
end
```

Task 2: Configure Host PCs

Configure the Ethernet interfaces of PC1, PC2, and PC3 with the IP address, subnet mask, and gateway indicated in the addressing table.

Task 3: Identify the Initial State of All Trunks

On each of the switches, display the spanning tree table with the **show spanning-tree** command. Note which ports are forwarding on each switch, and identify which trunks are not being used in the default configuration. You can use your network topology drawing to document the initial state of all trunk ports.

Task 4: Modify Spanning Tree to Achieve Load Balancing

Modify the spanning tree configuration so that all six trunks are in use. Assume that the three user LANs (10, 20, and 30) carry an equal amount of traffic. Aim for a solution that will have a different set of ports forwarding for each of the three user VLANs. At a minimum, each of the three user VLANs should have a different switch as the root of the spanning tree.

Task 5: Document the Switch Configuration

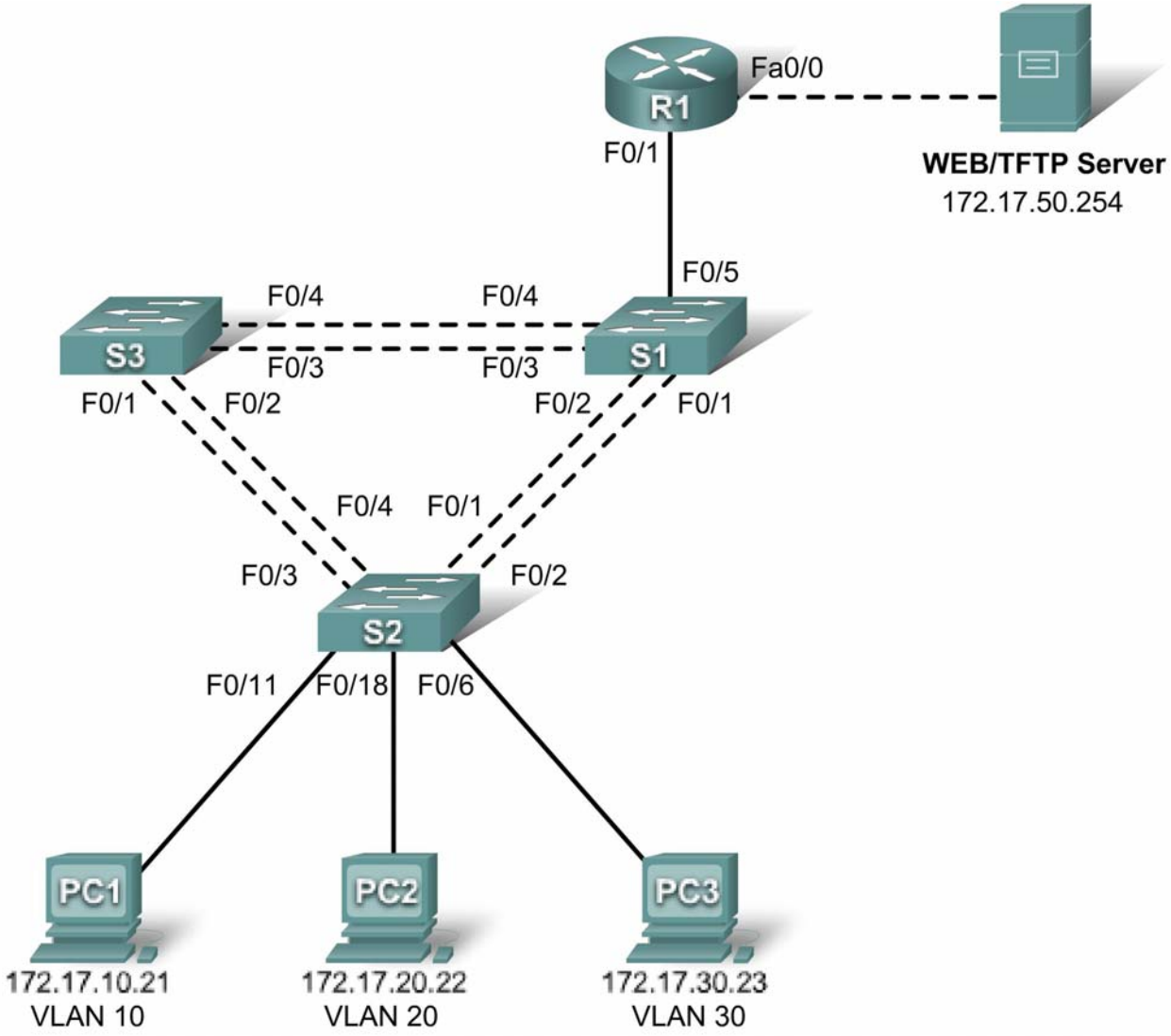
When you have completed your solution, capture the output of the **show run** command and save it to a text file for each switch.

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.

Lab 6.4.1: Basic Inter-VLAN Routing

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

R1	**Fa 0/0**	172.17.50.1	255.255.255.0	N/A
R1	**Fa 0/1**	See Interface Configuration Table		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
Server	**NIC**	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
S1	**Server**	**Lab6**	**cisco**
S2	**Client**	**Lab6**	**cisco**
S3	**Client**	**Lab6**	**cisco**

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?

_____

_____

_____

_____

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

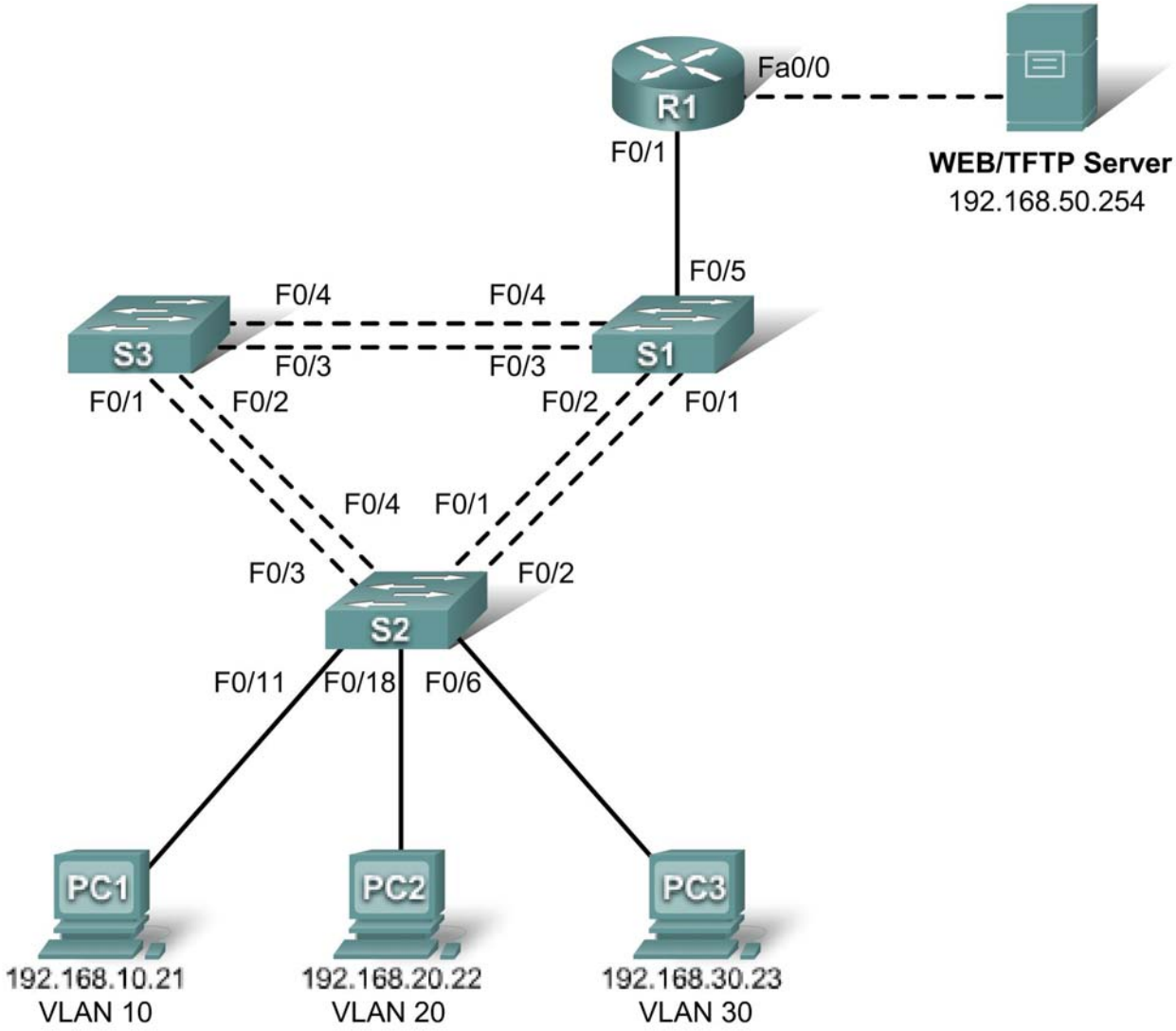
```
!
hostname S3
!
enable secret class
!
no ip domain lookup
!
interface FastEthernet0/1
 switchport trunk native vlan 99
```



```
 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
```


Lab 6.4.2: Challenge Inter-VLAN Routing

Topology Diagram



Addressing Table

Device (Hostname)	Interface	IP Address	Subnet Mask	Default Gateway
S1	**VLAN 99**	192.168.99.11	255.255.255.0	192.168.99.1
S2	**VLAN 99**	192.168.99.12	255.255.255.0	192.168.99.1
S3	**VLAN 99**	192.168.99.13	255.255.255.0	192.168.99.1
R1	**Fa 0/0**	192.168.50.1	255.255.255.0	N/A

R1	**Fa 0/1**	See Subinterface Configuration Table		N/A
PC1	**NIC**	192.168.10.21	255.255.255.0	192.168.10.1
PC2	**NIC**	192.168.20.22	255.255.255.0	192.168.20.1
PC3	**NIC**	192.168.30.23	255.255.255.0	192.168.30.1
Server	**NIC**	192.168.50.254	255.255.255.0	192.168.50.1

Port Assignments – Switch 2

Ports	Assignment	Network
Fa0/1 – 0/5	802.1q Trunks (Native VLAN 99)	192.168.99.0 /24
Fa0/6 – 0/10	VLAN 30 – Sales	192.168.30.0 /24
Fa0/11 – 0/17	VLAN 10 – R&D	192.168.10.0 /24
Fa0/18 – 0/24	VLAN 20 – Engineering	192.168.20.0 /24

Subinterface Configuration Table – Router 1

Router Interface	Assignment	IP Address
Fa0/1.1	VLAN1	192.168.1.1
Fa0/1.10	VLAN 10	192.168.10.1
Fa0/1.20	VLAN 20	192.168.20.1
Fa0/1.30	VLAN 30	192.168.30.1
Fa0/1.99	VLAN 99	192.168.99.1

Learning Objectives

Upon completion of this lab, you will be able to 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 a router
- Configure VLANs and VLAN Trunking Protocol (VTP) on all switches
- Configure a router to support 802.1q trunking on a Fast Ethernet interface
- Configure a router with subinterfaces corresponding to the configured VLANs
- Demonstrate 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.

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. Remember to repeat the process on each switch in the topology.

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 EXEC mode 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.

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

Enable ports Fa0/6, Fa0/11, and Fa0/18 on S2 using the **no shutdown** command, and configure them as access ports.

Task 3: Configure the Ethernet Interfaces on the Server and Host PCs

Configure the Ethernet interfaces of PC1, PC2, PC3 and the remote TFTP/Web Server with the IP addresses from the addressing table. Connect these devices using the correct cables and interfaces.

Task 4: Configure VTP on the Switches

Step 1: Configure VTP on the three switches.

Use the following table to configure the switches. Remember that VTP domain names and passwords are case-sensitive.

Switch Name	VTP Operating Mode	VTP Domain	VTP Password
S1	**Server**	**Lab6**	**cisco**
S2	**Client**	**Lab6**	**cisco**
S3	**Client**	**Lab6**	**cisco**

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.

Step 3: Configure VLANs on the VTP server.

Configure the following VLANS on the VTP server.

VLAN	VLAN Name
VLAN 99	**Management**
VLAN 10	**R&D**
VLAN 20	**Engineering**
VLAN 30	**Sales**

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.

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

Refer to the addressing table at the beginning of the lab to assign the management IP address on all three switches.

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 resolve.

Step 6: Assign switch ports to VLANs on S2.

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

Step 7: Check connectivity between VLANs.

Open command windows on the three hosts connected to S2. Ping from PC1 (192.168.10.21) to PC2 (192.168.20.22). Ping from PC2 to PC3 (192.168.30.23).

Are the pings successful? _____

If not, why do these pings fail?_____

_____

Task 5: Configure the Router

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

Step 2: Create a basic configuration on the router.

- Configure the router with hostname R1.
- 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.

Step 3: Configure the trunking interface on R1.

Configure the Fa0/1 interface on R1 with five subinterfaces, one for each VLAN identified in the Subinterface Configuration Table at the beginning of the lab. Configure these subinterfaces with dot1q encapsulation, and use the first address in each VLAN subnet on the router subinterface. Specify VLAN 99 as the native VLAN on its subinterface. Do not assign an IP address to the physical interface, but be sure to enable it. Document your subinterfaces and their respective IP addresses in the subinterface table.

Step 4: Configure the server LAN interface on R1.

Refer to the addressing table and configure Fa0/0 with the correct IP address and mask.

Step 5: Verify the routing configuration.

At this point, there should be six networks configured on R1. Verify that you can route packets to all six by checking the routing table on R1.

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

Step 6: Verify inter-VLAN routing

From PC1, verify that you can ping the remote server (192.168.50.254) and the other two hosts (192.168.20.22 and 192.168.30.23). 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 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.

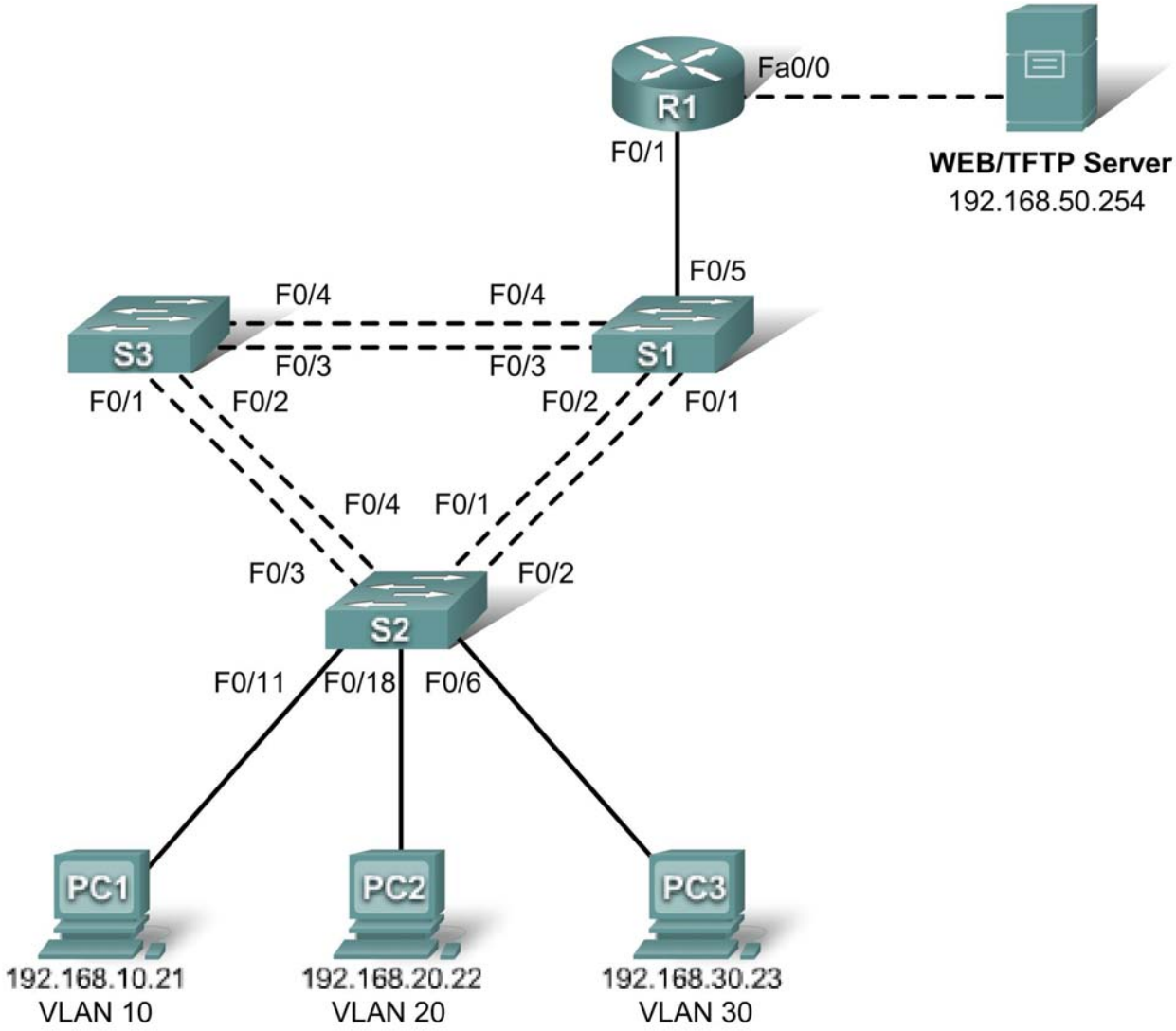
At this point, you should be able to ping any node on any of the six networks configured on your LAN, including the switch management interfaces.

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.

Lab 6.4.3: Troubleshooting Inter-VLAN Routing

Topology Diagram



Addressing Table

Device (Hostname)	Interface	IP Address	Subnet Mask	Default Gateway
S1	**VLAN 99**	192.168.99.11	255.255.255.0	192.168.99.1
S2	**VLAN 99**	192.168.99.12	255.255.255.0	192.168.99.1
S3	**VLAN 99**	192.168.99.13	255.255.255.0	192.168.99.1
R1	**Fa 0/0**	192.168.50.1	255.255.255.0	N/A

R1	**Fa 0/1**	See Subinterface Configuration Table		N/A
PC1	**NIC**	192.168.10.21	255.255.255.0	192.168.10.1
PC2	**NIC**	192.168.20.22	255.255.255.0	192.168.20.1
PC3	**NIC**	192.168.30.23	255.255.255.0	192.168.30.1
Server	**NIC**	192.168.50.254	255.255.255.0	192.168.50.1

Port Assignments – Switch 2

Ports	Assignment	Network
Fa0/1 – 0/5	802.1q Trunks (Native VLAN 99)	192.168.99.0 /24
Fa0/6 – 0/10	VLAN 30 – Sales	192.168.30.0 /24
Fa0/11 – 0/17	VLAN 10 – R&D	192.168.10.0 /24
Fa0/18 – 0/24	VLAN 20 – Engineering	192.168.20.0 /24

Subinterface Configuration Table – Router 1

Router Interface	Assignment	IP Address
Fa0/1.1	VLAN1	192.168.1.1
Fa0/1.10	VLAN 10	192.168.10.1
Fa0/1.20	VLAN 20	192.168.20.1
Fa0/1.30	VLAN 30	192.168.30.1
Fa0/1.99	VLAN 99	192.168.99.1

Learning Objectives

To complete this lab:

- Cable a network according to the topology diagram
- Erase any existing configurations and reload switches and the router to the default state
- Load the switches and the router with supplied scripts
- Find and correct all configuration errors
- Document the corrected network

Scenario

The network has been designed and configured to support five VLANs and a separate server network. Inter-VLAN routing is being provided by an external router in a router-on-a-stick configuration, and the server network is routed across a separate Fast Ethernet interface. However, it is not working as designed, and complaints from your users have not given much insight into the source of the problems. You must first define what is not working as expected, and then analyze the existing configurations to determine and correct the source of the problems.

This lab is complete when you can demonstrate IP connectivity between each of the user VLANs and the external server network, and between the switch management VLAN and the server network.

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 switch configurations on all three switches, and reload to restore the default state. Use the **show vlan** command to confirm that only default VLANs exist and that all ports are assigned to VLAN 1.

Step 3: Configure the Ethernet interfaces on the host PCs and the server.

Configure the Ethernet interfaces of PC1, PC2, PC3 and the server with the IP addresses and default gateways listed in the addressing table.

Task 2: Load the Router and Switches with Supplied Scripts

Router 1 Configuration

```
hostname R1
!
no ip domain lookup
!
interface FastEthernet0/0
 ip address 192.168.50.1 255.255.255.192
!
interface FastEthernet0/1
 no ip address
!
interface FastEthernet0/1.1
 encapsulation dot1Q 1
 ip address 192.168.1.1 255.255.255.0
!
interface FastEthernet0/1.10
 encapsulation dot1Q 11
ip address 192.168.10.1 255.255.255.0
!
interface FastEthernet0/1.20
 encapsulation dot1Q 20
 ip address 192.168.20.1 255.255.255.0
!
interface FastEthernet0/1.30
ip address 192.168.30.1 255.255.255.0
!
interface FastEthernet0/1.99
 encapsulation dot1Q 99 native
 ip address 192.168.99.1 255.255.255.0
!
line con 0
 logging synchronous
 password cisco
 login
!
line vty 0 4
password cisco
 login
!
```



```
end
```

Switch 1 Configuration

```
hostname S1
!
vtp mode server
vtp domain lab6_3
vtp password cisco
!
vlan 99
name Management
exit
!
vlan 10
name R&D
exit
!
vlan 30
name Sales
exit
!
interface FastEthernet0/1
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/2
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/3
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/4
 switchport trunk native vlan 99
 switchport mode trunk
 shutdown
!
interface FastEthernet0/5
 switchport trunk native vlan 99
 switchport mode trunk

!
interface range FastEthernet0/6 - 24
 shutdown
!
interface Vlan99
 ip address 192.168.99.11 255.255.255.0
 no shutdown
!
exit
!
ip default-gateway 192.168.99.1
```



```
!
line con 0
 logging synchronous
 password cisco
 login
!
line vty 0 4
password cisco
 login
!
line vty 5 15
 password cisco
 login
!
end
```

Switch 2 Configuration

```
!
hostname S2
no ip domain-lookup
enable secret class
!
vtp mode client
vtp domain lab6_3
vtp password cisco
!
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 range FastEthernet0/6 - 11
 switchport access vlan 30
 switchport mode access
!
interface range FastEthernet0/12 - 17
 switchport access vlan 10
!
interface range FastEthernet0/18 -24
 switchport mode access
 switchport access vlan 20
```



```
!
interface Vlan99
 ip address 192.168.99.12 255.255.255.0
 no shutdown
exit
!
ip default-gateway 192.168.99.1
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 Configuration

```
!
hostname S3
!
enable secret class
!
vtp mode client
vtp domain lab6_3
vtp password cisco
!
interface FastEthernet0/1
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/2
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/3
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/4
 switchport trunk native vlan 99
 switchport mode trunk
 no shutdown
!
interface FastEthernet0/5
 switchport trunk native vlan 99
 switchport mode trunk
```



```
!
interface range FastEthernet0/6 - 24
 shutdown
 exit
!
ip default-gateway 192.168.99.1
!
line con 0
 logging synchronous
 password cisco
 login
!
line vty 0 4
password cisco
 login
!
line vty 5 15
 password cisco
 login
!
end
```

Task 3: Troubleshoot and Correct the Inter-VLAN Issues and Configuration Errors

Begin by identifying what is working and what is not. What is the state of the interfaces? What hosts can ping other hosts? Which hosts can ping the server? What routes should be in the R1 routing table? What could prevent a configured network from being installed in the routing table?

When all errors are corrected, you should be able to ping the remote server from any PC or any switch. In addition, you should be able to ping between the three PCs and ping the management interfaces on switches from any PC.

Task 4: Document the Network Configuration

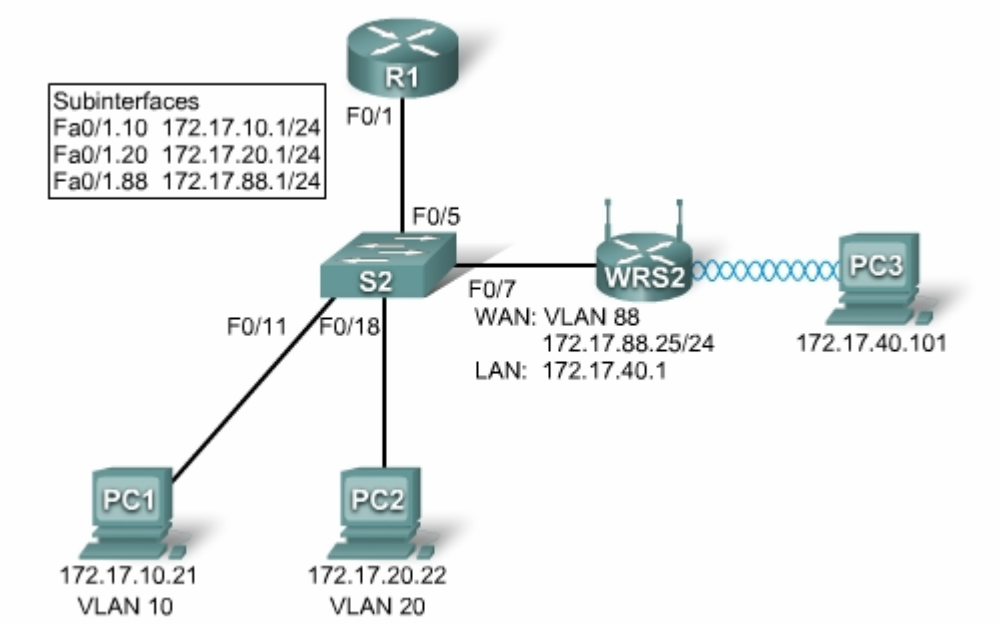
When you have successfully completed your troubleshooting, capture the output of the router and all three switches with the **show run** command and save it to a text file.

Task 5: Clean Up

Erase the configurations and reload the switches and router. 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.

Lab 7.5.1: Basic Wireless Configuration

Topology Diagram



Learning Objectives

- Configure options in the Linksys Setup tab.
- Configure options in the Linksys Wireless tab.
- Configure options in the Linksys Administration tab.
- Configure options in the Linksys Security tab.
- Add wireless connectivity to a PC.
- Test connectivity.

Introduction

In this activity, you will configure a Linksys wireless router, allowing for remote access from PCs as well as wireless connectivity with WEP security.

Task 1: Load the starting configurations.

Step 1. Load R1's configurations.

```
hostname R1
!
interface FastEthernet0/0
 ip address 172.17.50.1 255.255.255.0
 no shutdown
!
interface FastEthernet0/1
 no ip address
 no shutdown
!
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 FastEthernet0/1.88
 encapsulation dot1Q 88
 ip address 172.17.88.1 255.255.255.0
!
```

Step 2. Load S2's configurations.

```
hostname S2
!
interface FastEthernet0/5
switchport mode trunk
 no shutdown
!
interface FastEthernet0/7
 switchport access vlan 88
 switchport mode access
 no shutdown
!
interface FastEthernet0/11
 switchport access vlan 10
 switchport mode access
 no shutdown
!
interface FastEthernet0/18
 switchport access vlan 20
 switchport mode access
 no shutdown
!
```


Task 2: Connect and log into the Wireless Router.

To clear any previous configurations, do a hard reset. Find the reset button on the back of the router. Using a pen or other thin instrument, hold down the reset button for 5 seconds. The router should now be restored to its factory default settings.

The WEB GUI will be used to configure the settings on the wireless router. The GUI can be accessed by navigating to the router's LAN/Wireless IP address with a web browser. The factory default address is 192.168.1.1.

Step 1. Establish physically connectivity.

Connect a straight through cable from the PC to one of the wireless router's LAN ports, labeled Ethernet 1 - 4. By default, the wireless router will provide an IP address to the PC using default DHCP configurations.

Step 2. Open a web browser.

Step 3. Navigate to the wireless router's Web Utility.

- Set the URL of the browser to http://192.168.1.1.

The default login credentials are a blank username and a password of: **admin**. Note that this is very insecure since it is the factory default and provided publicly. We will set our own unique password in a later task.

Step 4. Log in

- Leave the username blank and set the password to: **admin**.

Task 3: Configure Options in the Linksys Setup Tab.

Step 1. Set the Internet connection type to static IP.

- By default the start up page is the **Setup** screen. In the menus at the top notice you are in the Setup section and under the **Basic Setup** tab.
- In the Setup screen for the Linksys router, locate the **Internet Connection Type** option in the **Internet Setup** section of this page. Click the drop-down menu and select **Static IP** from the list.

Step 2. Configure the VLAN 88 IP address, subnet mask, and default gateway for WRS2.

- Set the **Internet IP address** to 172.17.88.25.
- Set the **Subnet Mask** to 255.255.255.0.
- Set the **Default Gateway** to 172.17.88.1.

Note: Typically in a home or small business network, this Internet IP address is assigned by the ISP through DHCP or PPPoE. (The specifics of PPPoE are outside the scope of this course.)

Step 3. Configure the router IP parameters.

- Still on the Basic Setup page, scroll down to **Network Setup**. For the **Router IP** fields do the following:
  - Set the IP address to **172.17.40.1** and the subnet mask to **255.255.255.0**.
  - Under the **DHCP Server Setting**, ensure that the DHCP server is **Enabled**.

Step 4. Save settings.

Click the **Save Settings** button at the bottom of the **Setup** screen.

Note that the IP address range for the DHCP pool adjusts to a range of addresses to match the Router IP parameters. These addresses are used for wireless clients and clients that connect to the router's internal switch. Clients receive an IP address and mask, and are given the router IP to use as a gateway.

Step 5. Reconnect to WRS2.

Since we have changed the router's IP address and DHCP pool, we will have to reconnect to it using the new address previously configured.

- Reconnect to the router. You will need to reacquire an IP address from the router via DHCP or manually set your own.
- Reconnect to the router's configuration GUI using an IP address of **172.17.40.1**. Remember to use the default password of **admin**.

Task 4: Configure Options in the Linksys Wireless Tab.

Step 1. Set the network name (SSID).

- Click the **Wireless** tab.
- Under **Network Name (SSID)**, rename the network from **linksys** to **WRS_LAN_*number***, where *number* is a unique ID assigned by your instructor corresponding to your group number. This will help to avoid conflicts with other students working on this lab at the same time.
- Click **Save Settings**.

Step 2. Set the security mode.

- Click **Wireless Security**. It is located next to **Basic Wireless Settings** in the main **Wireless** tab.
- Change **Security Mode** from **Disabled** to **WEP**.
- Using the default Encryption of 40/64-Bit, set **Key1** to **1234567890**,
- Click **Save Settings**.

Task 5: Configure Options in the Linksys Administration Tab

Step 1. Set the router password.

- Click the **Administration** tab.
- Under **Management** in the **Router Access** section, change the router password to **cisco123**. Re-enter the same password to confirm.

Step 2. Enable remote management.

- In the **Remote Access** section, set **Remote Management** to **Enabled**.
- Click **Save Settings**.
- You may be prompted to log in again. Use the new password of **cisco123** and still keep the username blank

Task 6: Configure Options in the Linksys Security Tab

By default ping requests to WRS2's LAN/Wireless interface (172.17.40.1) from sources on its WAN interface (for example PC1 & PC2) will be blocked for security reasons implemented by the wireless router. For the purpose of verifying connectivity in this lab we would like to allow these pings.

Step 1. Allow anonymous internet requests.

- Click the **Security** tab.
- Under **Internet Filter**, uncheck **Filter Anonymous Internet Requests**.
- Click **Save Settings**.

Task 7: Add Wireless Connectivity to a PC

Step 1. Disconnect the Ethernet connection from PC3 to WRS2.

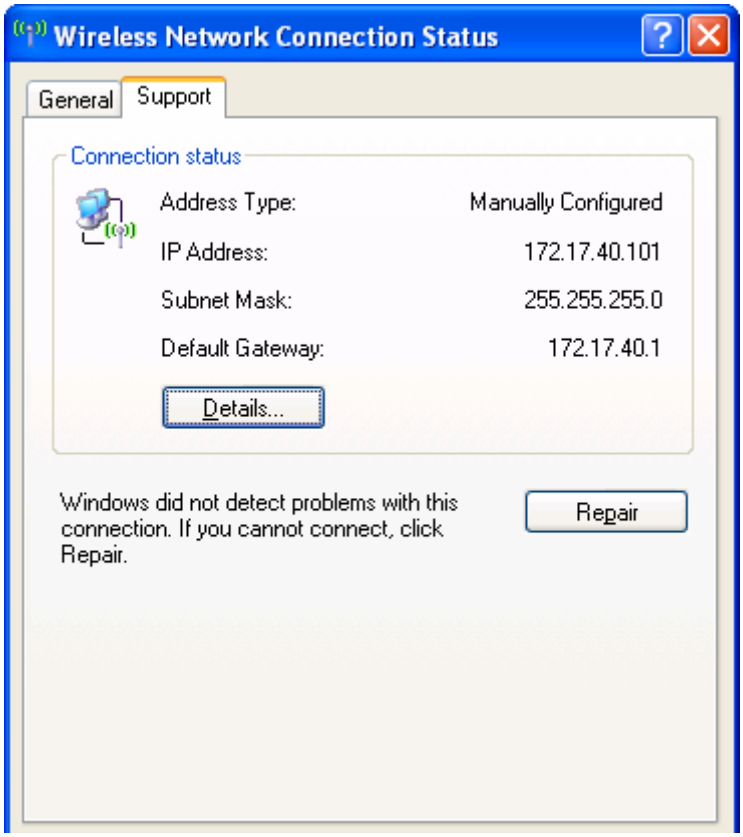
Step 2: Use Windows XP to connect to the wireless router.

The following steps in this task demonstrate how to use Windows XP's built in Wireless Network Connection Utility. Depending on the model of NIC you use, this might be disabled, and you will need to use the utility provided by the NIC manufacturer. Consult your instructor for instructions if this is the case.

- Locate the Wireless Network Connection icon in your taskbar, or go to **Start > Control Panel > Network Connections**.
- Select the **Wireless Network Connection**.
- Navigate to the **File** menu and select **Status**.
- Click **View Wireless Networks**.
- Locate the 'WRS_LAN_*number*' SSID in the list of available networks and connect to it.
- When prompted for the WEP key enter it as in Task 3, **1234567890** and click **Connect**.

Step 3: Verify the Connection.

- In the **Status** window, select the **Support** tab. Verify that PC3 has received an IP address from WRS2's DHCP address pool or has been manually configured.



Task 8: Test Connectivity

Step 1. Ping WRS2's LAN/Wireless interface.

- On PC3, click **Start->Run**
- Type **cmd** and select open. This will open the command prompt
- In the command prompt type (without quotes) "**ping 172.17.40.1**".

Step 2. Ping R1's Fa0/1.88 Interface.

- In the command prompt type (without quotes) "**ping 172.17.88.1**"

Step 3. Ping PC1 and PC2 from PC3.

- In the command prompt type (without quotes) "**ping 172.17.10.21**" to ping PC1.
- Repeat on PC2's address, 172.17.20.22.

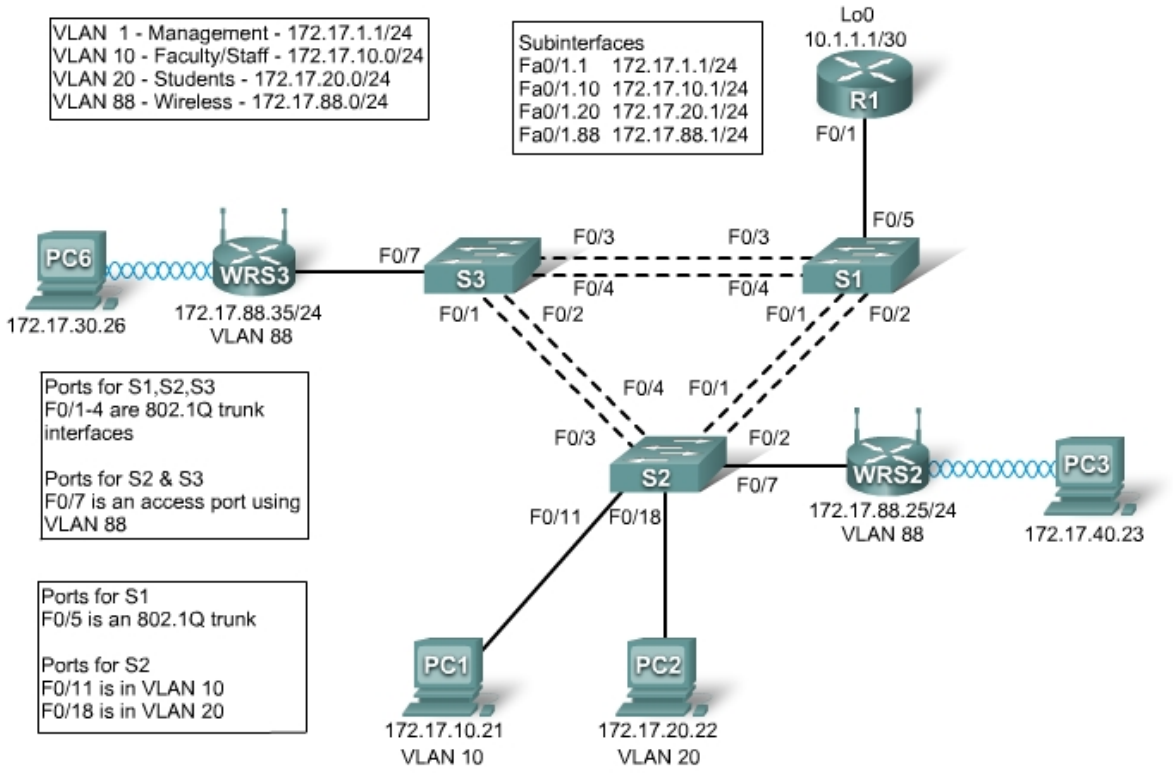
Note: Due to the security on the WRS, PC 3 can ping both PC 1 and 2, but PC 1 and 2 are not able to ping PC 3.

Task 9: Erase Configuration

Erase the configuration on the WRS by navigating to the **Administration** page, selecting the **Factory Defaults** tab, and clicking the **Restore All Settings** button.

Lab 7.5.2: Challenge Wireless Configuration

Topology Diagram



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	**Fa0/1.1**	172.17.1.1	255.255.255.0	N/A
	Fa0/1.10	172.17.10.1	255.255.255.0	N/A
	Fa0/1.20	172.17.20.1	255.255.255.0	N/A
	Fa0/1.88	172.17.88.1	255.255.255.0	N/A
	Lo0	10.1.1.1	255.255.255.252	N/A
WRS2	**WAN**	172.17.88.25	255.255.255.0	172.17.88.1
	LAN/Wireless	172.17.40.1	255.255.255.0	N/A
WRS3	**WAN**	172.17.88.35	255.255.255.0	172.17.88.1
	LAN/Wireless	172.17.30.1	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

Learning Objectives

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

- Configure switch port VLAN information and port security.
- Hard reset a Linksys WRT300N router.
- Connect and verify connectivity to a wireless router.
- Navigate to a Linksys WRT300N's web utility page.
- Configure the IP settings of a Linksys WRT300N.
- Configure DHCP on a Linksys WRT300N.
- Configure static routes on both standard Cisco routers and on a WRT300N.
- Change the network mode and corresponding network channel on a WRT300N.
- Enable WEP encryption and disable SSID broadcast.
- Enable a wireless MAC filter.
- Configure access restrictions on a WRT300N.
- Configure router management password on a WRT300N.
- Enable logging on a WRT300N.
- Upgrade WRT300N firmware.
- Learn diagnosis, backup, restore, and confirmation mechanisms on a WRT300N.

Scenario

In this lab, you will configure a Linksys WRT300N, port security on a Cisco switch, and static routes on multiple devices. Make note of the procedures involved in connecting clients to a wireless network. Some configuration changes will cause clients to disconnect. These clients then have to reconnect after making changes to the configuration.

Task 1: Perform Basic Router Configurations

Step 1: Physically connect the devices based on the topology diagram.

Step 2: Configure R1 according to the following guidelines:

- Configure router hostname.
- Disable DNS lookup.
- Configure privileged EXEC password of **Cisco**.
- Configure FastEthernet 0/1 and its subinterfaces.
- Configure Loopback0.
- Configure synchronous logging, exec-timeout, and a password of **cisco** on the console port.

Task 2: Configure Switch Interfaces

Configure switch hostnames on S1, S2, and S3. Set the switches to transparent, clear the VLAN information, and create VLANs 10, 20, and 88.

Step 1: Configure switch port interfaces on S1, S2, and S3.

Configure the interfaces on the S1, S2, and S3 switches with the connections from topology diagram.

Configure connections between two switches configure trunks.

Configure connections to a wireless router as access mode for VLAN 88.

Configure S2's connection to PC1 in VLAN 10 and PC2's connection in VLAN 20.

Configure S1's connection to R1 as a trunk.

Allow all VLANS across trunking interfaces.

Step 2: Verify VLANs and trunking.

Use the **show ip interface trunk** command on S1 and the **show vlan** command on S2 to verify that the switches are trunking correctly and the proper VLANs exist.

```
S1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       on           802.1q         trunking      1
Fa0/2       on           802.1q         trunking      1
Fa0/3       on           802.1q         trunking      1
Fa0/4       on           802.1q         trunking      1
Fa0/5       on           802.1q         trunking      1

Port      Vlans allowed on trunk
Fa0/1       1-4094
Fa0/2       1-4094
Fa0/3       1-4094
Fa0/4       1-4094
Fa0/5       1-4094

Port        Vlans allowed and active in management domain
Fa0/1       1,10,20,88
Fa0/2       1,10,20,88
Fa0/3       1,10,20,88
Fa0/4       1,10,20,88
Fa0/5       1,10,20,88

Port        Vlans in spanning tree forwarding state and not pruned

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       1,10,20,88
Fa0/2       none          <-- blocked due to STP – varies based on root
Fa0/3       1,10,20,88
Fa0/4       1,10,20,88
Fa0/5       1,10,20,88>
```


S2#show vlan

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/5, Fa0/6, Fa0/8, Fa0/9
                                                 Fa0/10, Fa0/12, Fa0/13,Fa0/14
                                                 Fa0/15, Fa0/16, Fa0/17,Fa0/19
                                                 Fa0/20, Fa0/21, Fa0/22,Fa0/23
                                                 Fa0/24, Gi0/1, Gi0/2
10   VLAN0010                          active    Fa0/11
20   VLAN0020                          active    Fa0/18
88   VLAN0088                          active    Fa0/7
1002 fddi-default                      act/unsup
1003 token-ring-default                act/unsup
1004 fddinet-default                   act/unsup
1005 trnet-default                     act/unsup
```

When you have finished, be sure to save the running configuration to the NVRAM of the router and switches.

Step 3: Configure the Ethernet interfaces of PC1 and PC2.

Configure the Ethernet interfaces of PC1 and PC2 with the IP addresses and default gateways according to the addressing table at the beginning of the lab.

Step 4: Test the PC configuration.

Ping the default gateway from the PC: 172.17.10.1 for PC1, and 172.17.20.1 from PC2.

Go to Start->Run->cmd and type ping 172.17.x.x

```
C:\Documents and Settings\Administrator>ping 172.17.10.1

Pinging 172.17.10.1 with 32 bytes of data:

Reply from 172.17.10.1: bytes=32 time<1ms TTL=255
Reply from 172.17.10.1: bytes=32 time<1ms TTL=255
Reply from 172.17.10.1: bytes=32 time<1ms TTL=255
Reply from 172.17.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.17.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Task 3: Connect to the Linksys WRT300N Router WRS3

Check with your instructor that the wireless router has its factory default settings. If it does not, you must hard reset the router. To do so, find the reset button on the back of the router. Using a pen or other thin instrument, hold down the reset button for 5 seconds. The router should now be restored to its factory default settings.

Step 1: Connect to the wireless router.

When the wireless router is returned to its default configuration, it will broadcast the default SSID of “linksys”. Step 1: Use Windows XP to connect to the wireless router.

Note: Before attempting to connect to the WRS3 router, make sure that the WRS2 router’s power cord is unplugged. Having both wireless routers powered on will cause the PC to find two wireless networks with an SSID of “linksys”, making it difficult to distinguish which router you are trying to connect to.

Locate the Wireless Network Connection icon in your taskbar, or go to **Start > Control Panel > Network Connections**. Right-click the icon and select View Available Wireless Networks.

You are prompted with the following display. Note that the factory default SSID of the router is simply "Linksys."

Select **Linksys** and click **Connect**.

After a period of time you will be connected.

Step 2: Verify connectivity settings.

Verify the connectivity settings by going to **Start > Run** and typing **cmd**. At the command prompt, type the command **ipconfig** to view your network device information. Notice which IP address is the default gateway. This is the default IP address of a Linksys WRT300N.

```
IP Address. . . . . . . . . . . . : 192.168.1.100
Subnet Mask . . . . . . . . . . . : 255.255.255.0
Default Gateway . . . . . . . . . : 192.168.1.1
```


Task 4: Configure the WRS3 Using the Web Utility

Step 1: Go to the default URL.

Using a web browser, navigate to **http://192.168.1.1** which is the default URL for the WRT300N.

Step 2: Enter authentication information.

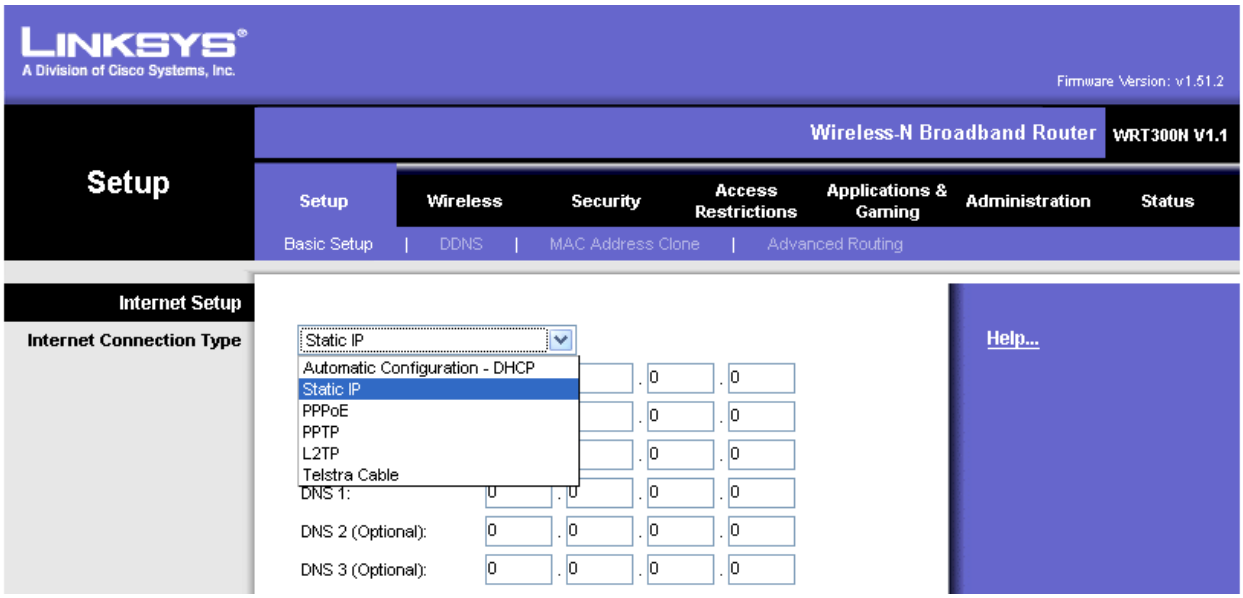
You are prompted for a username and password. Enter the WRT300N factory default password of **admin** and leave the username field blank.

You should now be viewing the default page of the Linksys WRT300N web utility.

Task 5: Configure IP Settings for the Linksys WRT300N

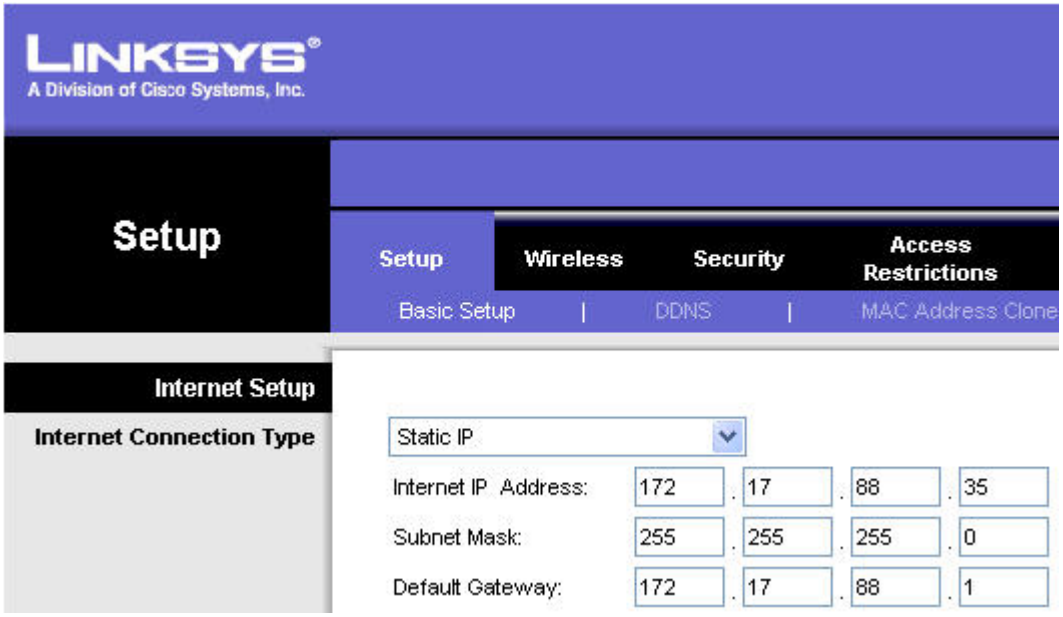
The best way to understand the difference between the **Internet Setup** and the **Network Setup** options is to think of the WRT300N as being similar to a Cisco IOS-based router with two separate interfaces. One of the interfaces, the one configured under **Internet Setup**, acts as the connection to the switches and the rest of the network. This connection would eventually lead out to the Internet, although in our topology there is no connection to the Internet. The other interface, configured under **Network Setup**, acts as the interface connecting to clients, both wireless and wired.

Step 1: Set the Internet connection type to static IP.

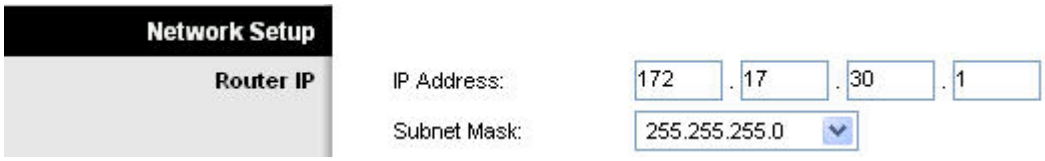


Step 2: Set the IP address settings for Internet Setup.

- Set the Internet IP Address to **172.17.88.35**.
- Set the Subnet Mask to **255.255.255.0**.
- Set the Default Gateway to **172.17.88.1** (the FastEthernet 0/1 VLAN 88 IP address of R1).



Step 3: Configure the Network Setup IP address to 172.17.30.1.



Step 4: Save the settings.

Click **Save Settings**. You are prompted to click **Continue**. Since you are connected wirelessly, you will not be redirected to the new URL of the web utility (**http://172.17.30.1**).

In order for the new IP address changes to take place, the PC has to release its old IP address and dynamically acquire a new one from the 172.17.30.0/24 network.

Step 5: Release the old Network Setup IP Address

In command prompt, use the command **ipconfig /release** to release the current DHCP address. To get a new IP address in the new network, issue the command **ipconfig /renew**. A new IP address should be pulled from the 172.17.30.0/24 network.

Step 6: View the PC IP configuration settings.

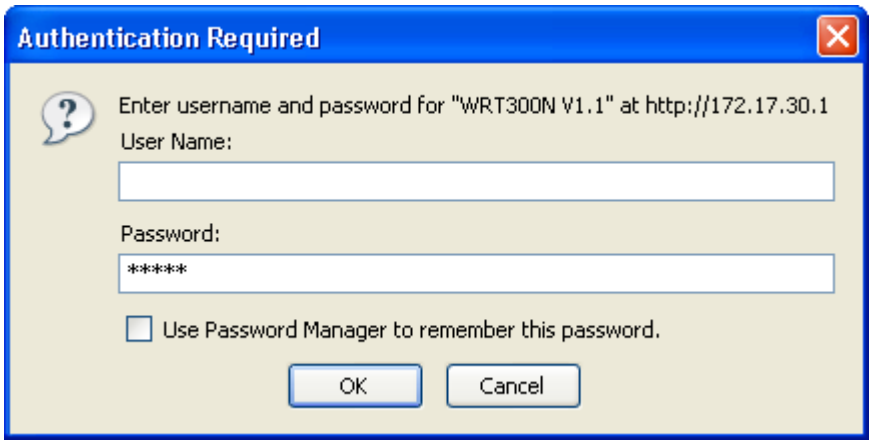
Go to command prompt and use the command **ipconfig**. If the address has not been updated to the 172.17.30.0/24 network, it will be necessary to release and renew the IP address on the client.

```
Ethernet adapter Local Area Connection:

        Connection-specific DNS Suffix  . : cisco.com
        IP Address. . . . . . . . . . . . : 172.17.30.100
        Subnet Mask . . . . . . . . . . . : 255.255.255.0
        Default Gateway . . . . . . . . . : 172.17.30.1
```

Step 7: Go to the new URL and enter authentication information.

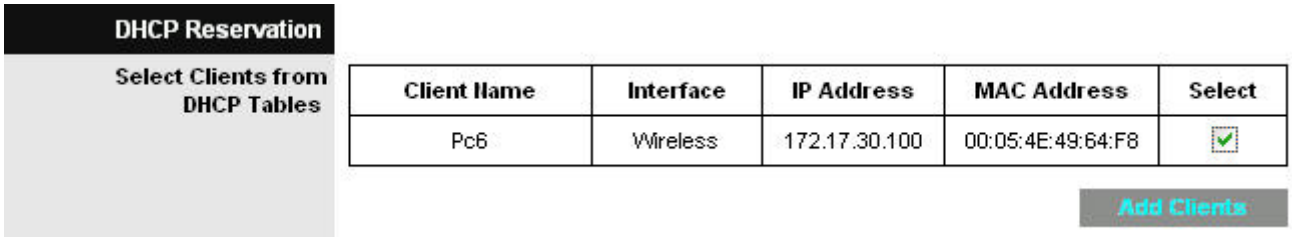
In your favorite web browser, navigate to **http://172.17.30.1** which is the new URL for the WRT300N. Enter the default username and password when you are prompted to do so.



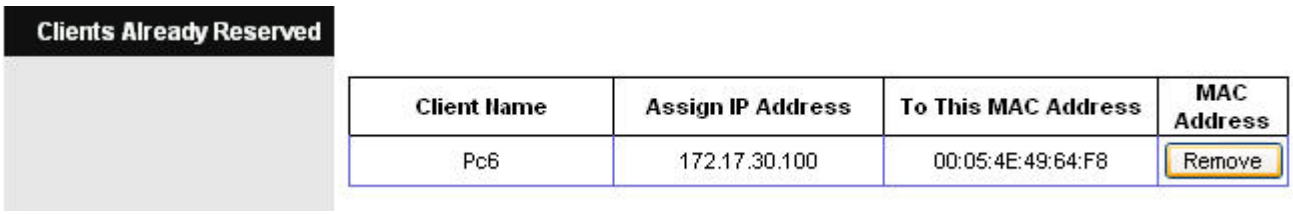
Task 6: Configure DHCP Settings and Router Time Zone Settings

Step 1: Give PC6 a static DHCP binding.

From the **Basic Setup** page in the **Network Setup** section, click **DHCP Reservations.** Find PC6 in the list of current DHCP clients. (Note that your PC may have a different name.) Click the check box in the correct row for the PC and then click **Add Clients**.

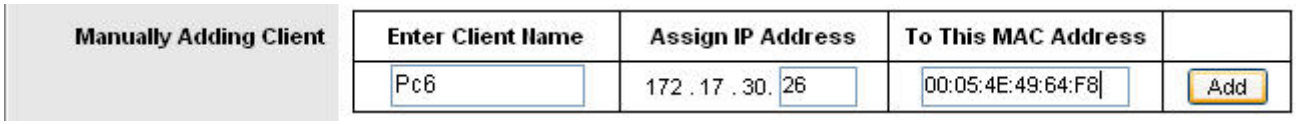


This gives PC6, the computer with a MAC address of 00:05:4E:49:64:F8, the same IP address, 172.17.30.100, whenever it requests an address through DHCP. This is only an example of a quick way to permanently bind a client to its current DHCP-given IP address. Now, you will assign PC6 the IP address in the topology diagram, not the one it received initially. Click **Remove** to assign a new address.



Step 2: Assign PC6 the 172.17.30.26 address.

By entering the PC6 address under Manually Adding Client, whenever PC6 connects to the wireless router, it receives the IP address 172.17.30.26 via DHCP. Save your changes.

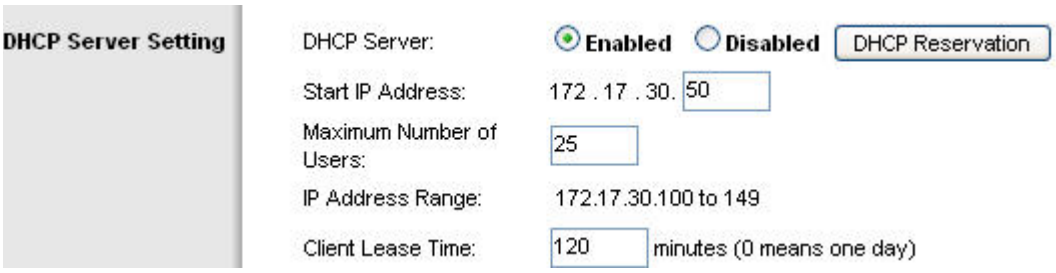


Step 3: Verify the static IP address change.

Since we already have an IP address from DHCP we are not going to get the new address, 172.17.30.26, until we reconnect. We will wait and notice that later in Task 7, Step 6 and verify that this change has taken place.

Step 4: Configure the DHCP server.

Set the start address to 50, the maximum number of users to 25, and the lease time to 2 hours (or 120 minutes).

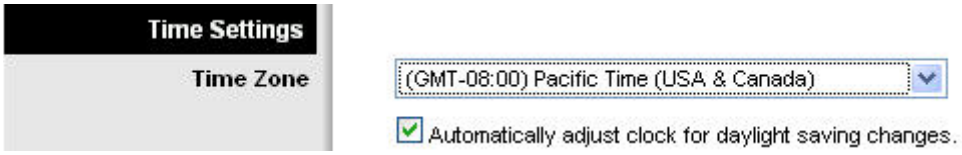


These settings give any PC that connects to this router wirelessly requesting an IP address through DHCP, an address between 172.17.30.50–74. Only 25 clients at a time are able to get an IP address and can only have the IP address for two hours, after which time they must request a new one.

Note: IP Address Range does not update until you click **Save Settings**.

Step 5: Configure the router for the appropriate time zone.

At the bottom of the Basic Setup page, change the time zone of the router to reflect your location.



Step 6: Save your settings!

Click Save Settings**.** You are prompted to click **Continue.**

Task 7: Basic Wireless Settings

Step 1: Navigate to the Wireless page and set the network mode in the Basic Wireless Settings tab.

The Linksys WRT300N allows you to choose in which network mode to operate. Currently, the most used network mode for clients is Wireless-G and for routers is BG-Mixed. When a router is operating in BG-Mixed, it can accept both B and G clients. However, if a B client connects, the router must scale down to the slower level of B. For this lab, we are assuming all clients are running B only, so choose Wireless-B Only.

Step 2: Configure other settings.

Change the **Network Name (SSID**) to WRS3_[number], where the number is a unique ID number given to you by your instructor. Change the **Standard Channel** to the channel assigned to you by your instructor, and disable SSID Broadcast.

Why is it good to change the wireless channel to be different from the default channel?

_____

_____

Why is it recommended to disable SSID broadcast?

_____

_____

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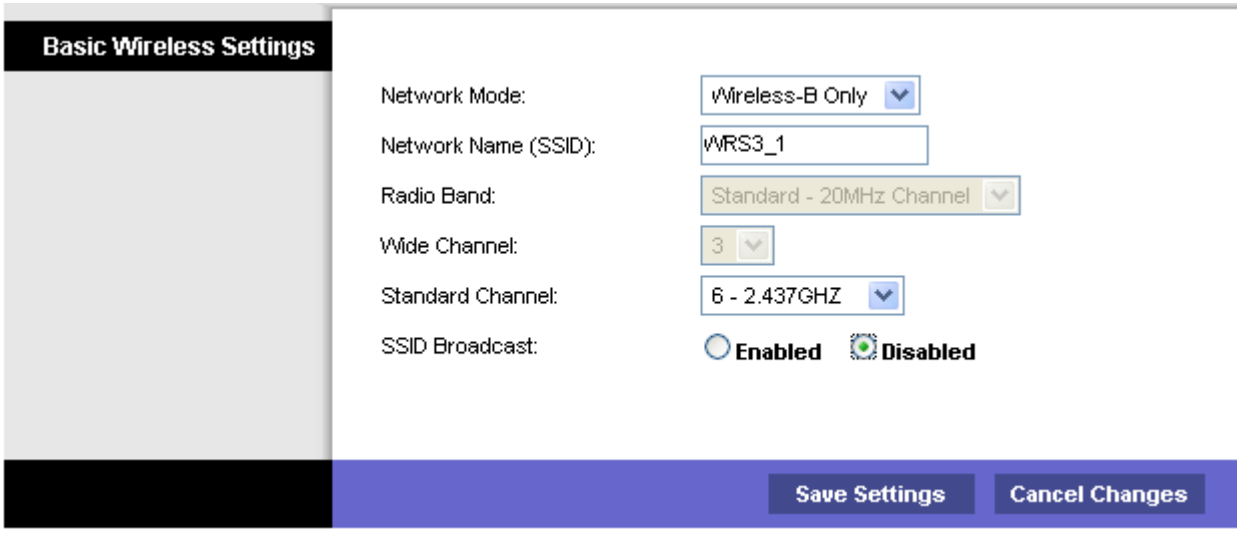


Step 3: Save Settings.

Select the **Save Settings** link to save all changes. Click **Continue** to continue to the next task.

Step 4: Verify that the SSID of the router is no longer being broadcast.

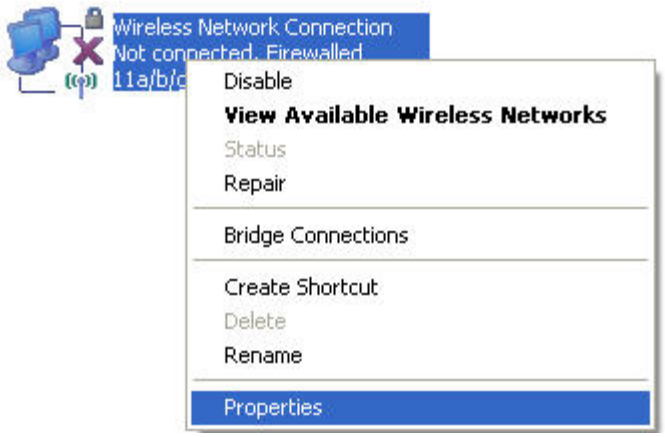
Scan for wireless networks. Locate the Wireless Network Connection icon in your taskbar, or go to **Start > Control Panel > Network Connections**. Right-click the icon and select View Available Wireless Networks.

Does the SSID of the wireless router appear?

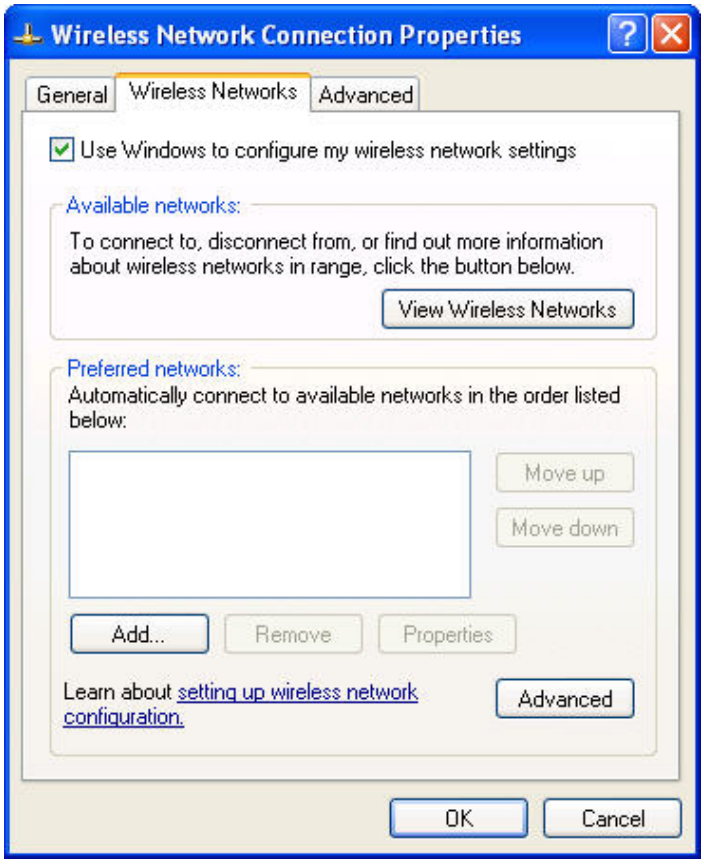
_____

Step 5: Reconnect to the wireless network.

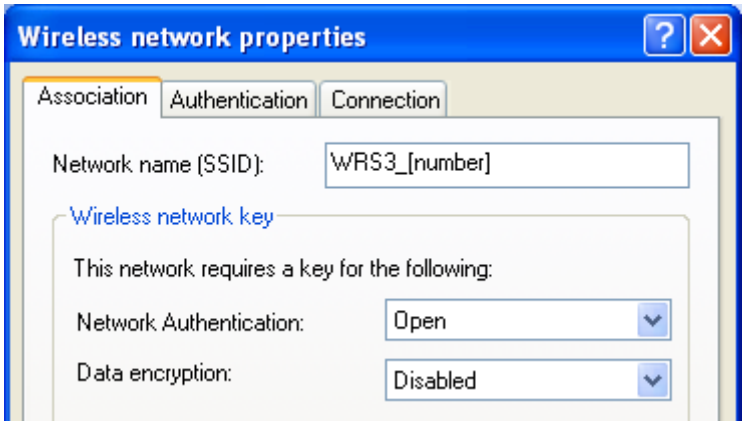
Navigate to **Start > Control Panel > Network Connections**, right-click the Wireless Network Connection icon, and select Properties.



In the Wireless Networks tab, select **Add**.



In the **Association** tab, enter WRS3_[number] as the SSID, and set the Data Encryption to **Disabled**. Select **OK**, and then select **OK** again. Windows should now try to reconnect to the wireless router.



Step 6: Verify the settings.

Now that you have reconnected to the network, you have the new DHCP settings that you configured in Task 6, Step 2. Verify this at the command prompt of PC6 with the **ipconfig** command.

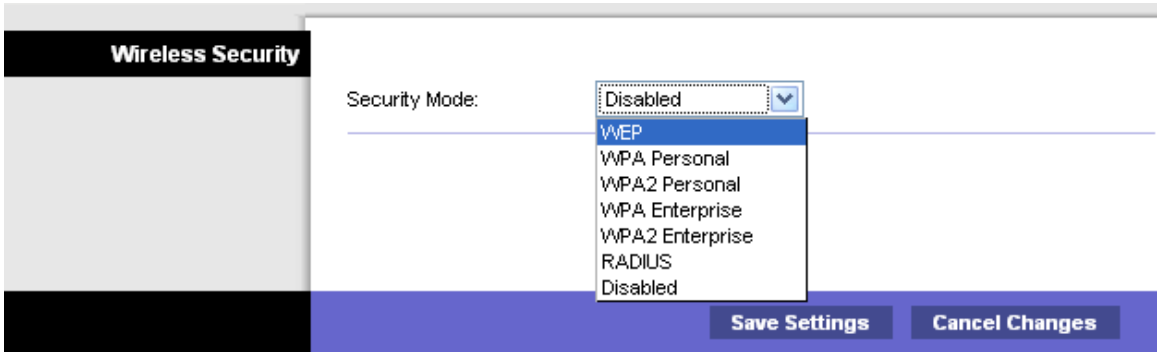

```
IP Address. . . . . . . . . . . . : 172.17.30.26
Subnet Mask . . . . . . . . . . . : 255.255.255.0
Default Gateway . . . . . . . . . : 172.17.30.1
```

Task 8: Enable Wireless Security

Step 1: Reconnect to the router setup page (http://172.17.30.1).

Step 2: Navigate to the Wireless page and then select the Wireless Security tab.

Step 3: Under Security Mode, select WEP.

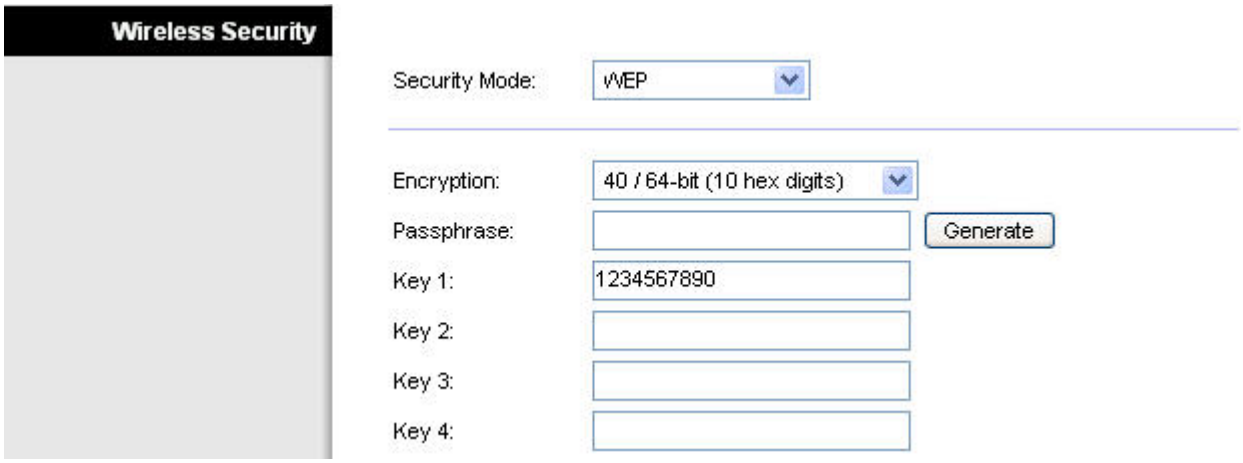


Step 4: Enter a WEP key.

A network is only as secure as its weakest point, and a wireless router is a very convenient place to start if someone wants to damage your network. By not broadcasting the SSID and requiring a WEP key to connect to the router, you are adding a few levels of security.

Unfortunately, there are tools that can discover networks that are not even broadcasting their SSID, and there are even tools that can crack WEP key encryption.

Add the WEP key **1234567890** as Key 1.



Step 5: Save your settings.

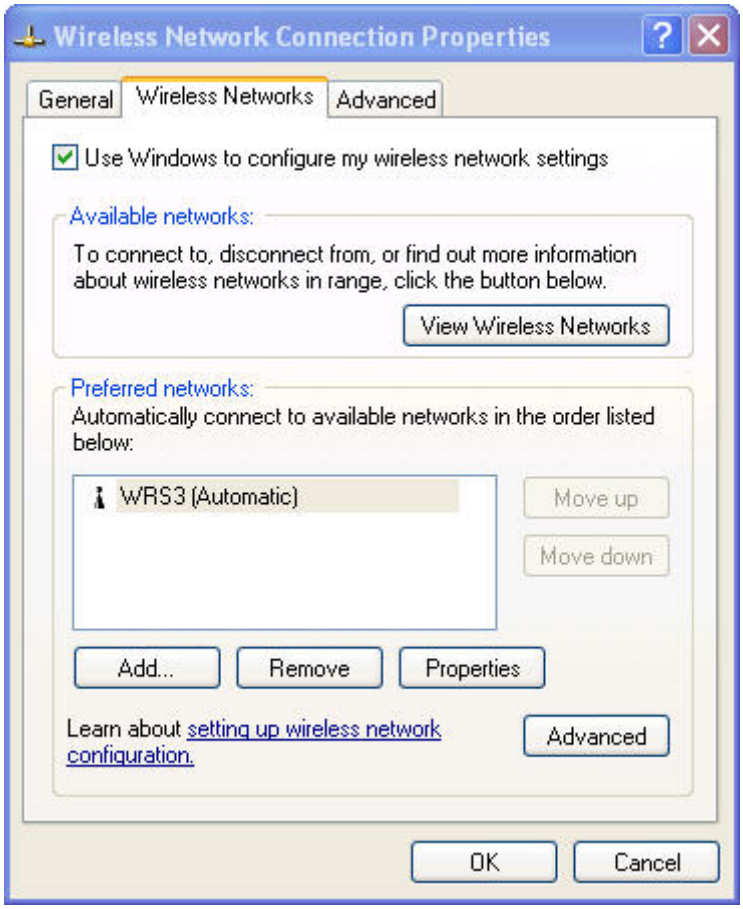
Now that WRS3 has been configured with WEP security, and PC6 is not configured with WEP, you will be disconnected from the network.

Step 6: Configure Windows to use WEP authentication.

Navigate to the Network Connections page again and right-click the **Wireless Network Connection** icon. In the Wireless Networks tab, locate the WRS3 network, and click **Properties**.

- Set Data Encryption to **WEP**.
- Uncheck This Key Is Provided For Me.
- Enter the network key of **1234567890**, as configured before on the router.
- Click **OK** and **OK**.

Windows should now reconnect to the network.



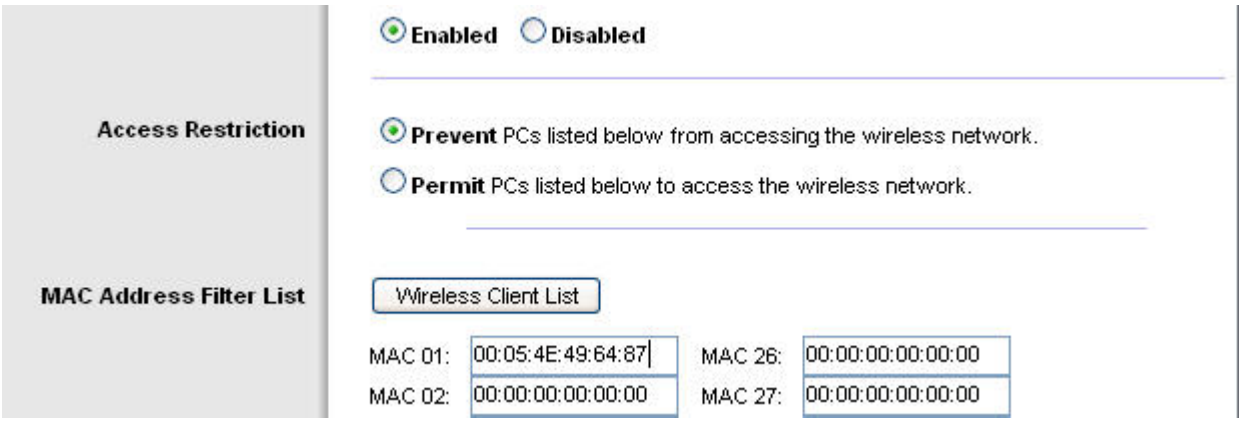
Task 9: Configure a Wireless MAC Filter

Step 1: Add a MAC filter.

- Navigate back to the web utility page of the router (http://172.17.30.1).
- Navigate to the Wireless page and then to the Wireless MAC Filter tab.
- Check Enabled.
- Select **Prevent PCs listed below from accessing the wireless network**.
- Enter the MAC address 00:05:4E:49:64:87.

- Click **Save Settings**.

This prevents any client with the MAC address 00:05:4E:49:64:87 from accessing the wireless network.



Step 2: Click Wireless Client List.

The **Wireless Client List** shows anyone currently connected to the router via a wireless connection. Also take note of the option **Save to MAC filter list**. Checking this option automatically adds the MAC address of that client to the list of MAC addresses to prevent or permit access to the wireless network.

What is an extremely robust way of only allowing clients of your choosing to connect to the wireless network?

_____

_____

_____

Why is this not feasible in large networks?

_____

_____

_____

What is a convenient way of adding MAC addresses if everyone to whom you wanted to allow access was already connected to the wireless network?

_____

_____

_____

Task 10: Setting Access Restrictions

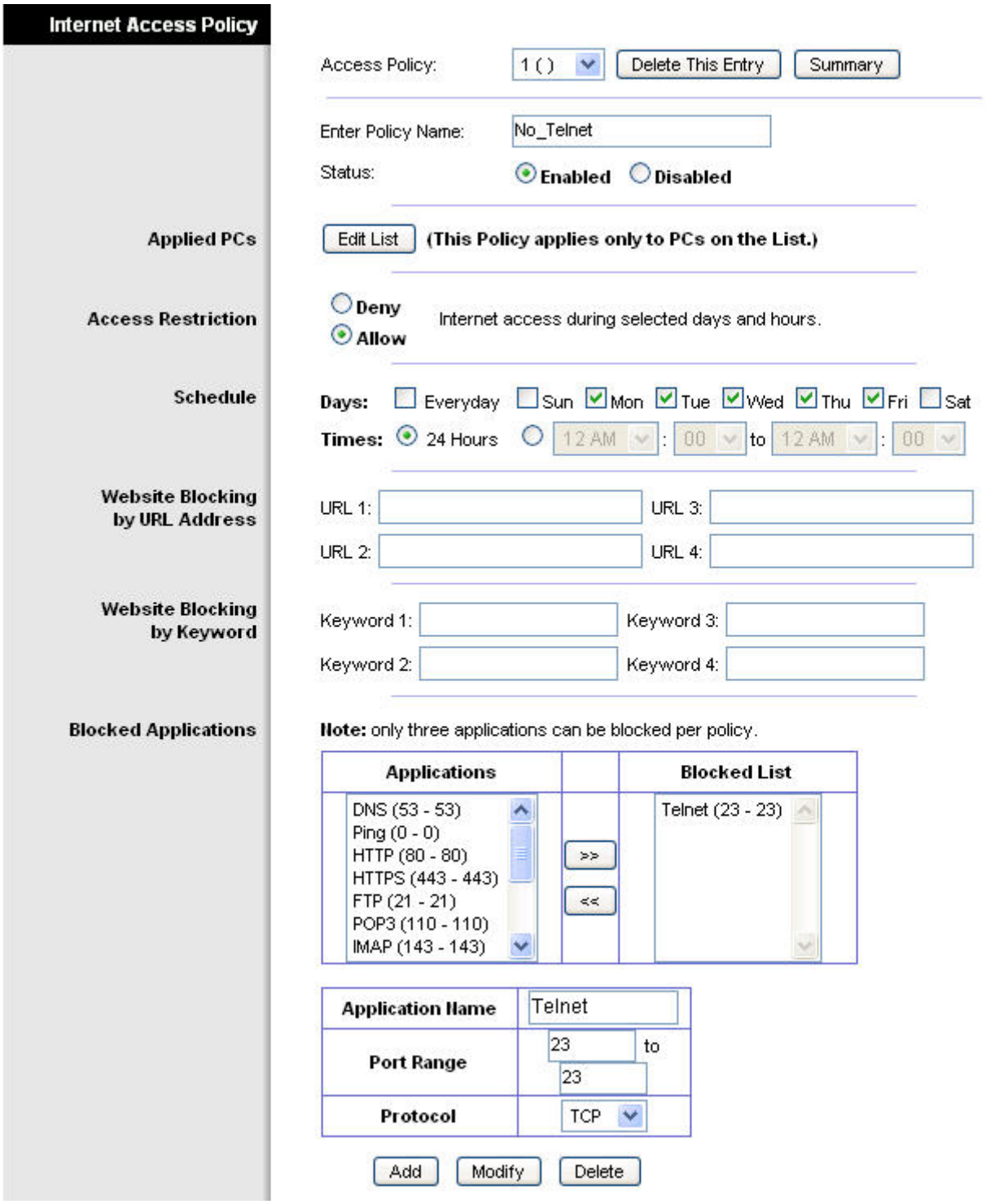
Configure an access restriction that prevents Telnet access Monday through Friday to users getting a DHCP address from the preset pool (172.17.30.50 – 74).

Step 1: Navigate to the Access Restrictions tab.

In the Access Restrictions tab, set the following:

- Policy Name – No_Telnet
- Status – **Enabled**
- Access Restriction – **Allow**

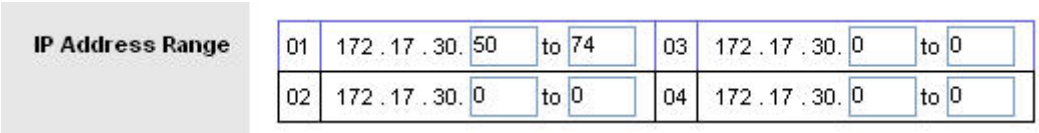
- Schedule – Uncheck Everyday and recheck **Monday** through **Friday**
- Blocked Applications – Add **Telnet** to Blocked List



Step 2: Set the IP address range.

Apply this configuration to anyone that is using a default DHCP address in the range of 172.17.30.50 – 74.

Click the **Edit List** button at the top of the window and enter the IP address range. Save the settings.



Click the **Save Settings** button to save the access restriction settings. Click **Close** to close the window and continue with the next task.

Task 11: Managing and Securing the Web Utility of the Router

Step 1: Configure web access.

Navigate to the **Administration** section. Change the router password to **cisco**.

For **Web Utility Access**, select both HTTP and HTTPS. Selecting HTTPS access allows a network administrator to manage the router via https://172.17.30.1 with SSL, a more secure form of HTTP. If you choose to do this in the lab, you may have to accept certificates.

For **Web Utility Access via Wireless,** select **Enabled**. If you disabled this option, the Web Utility would not be available to clients connected wirelessly. Disabling access is another form of security, because it requires the user to be directly connected to the router before changing settings. However, in this lab scenario, you are configuring the router via wireless access, so disabling access would not be a good idea!

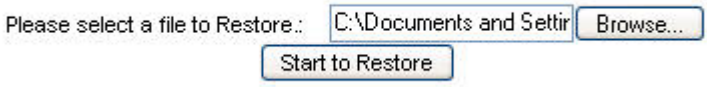
Click the **Save Settings** option at the bottom of the page. You may be prompted for the configured password. Enter **cisco** for the password and reconnect.

Now back up your configuration by clicking the **Backup Configurations** button. When prompted, save the file to your desktop.

Step 2: Restore your configuration.

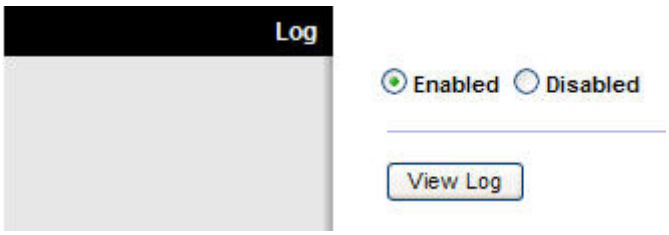
If your settings are accidentally or intentionally changed or erased, you can restore them from a working configuration using the **Restore Configurations** option located in the **Backup and Restore** section.

Click the **Restore Configuration** button now. In the Restore Configurations window, browse to the previously saved configuration file. Click the **Start to Restore** button. Your previous settings should be successfully restored.



Step 3: Enable logging.

Navigate to the **Log** tab of the **Administration** section and enable logging. You are now able to view the log of the router.

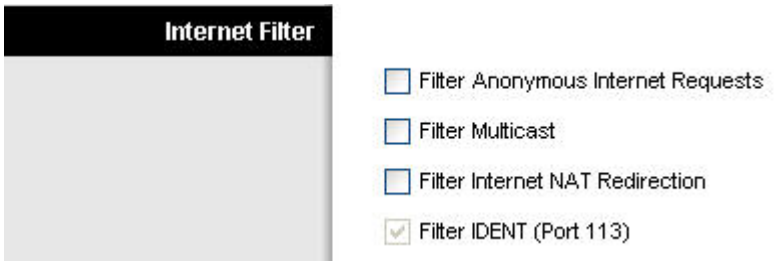


Step 4: Save your settings.

Task 12: Creating and Verifying Full Connectivity

Step 1: Filter anonymous Internet requests.

In the **Security** page, uncheck **Filter Anonymous Internet Requests**. Disabling this option allows you to ping the WRS3 internal LAN/wireless IP address, 172.17.30.1, from places connected to its WAN port. Don't forget to **Save** your settings.



Step 2: Disable NAT.

In the **Setup** page, click the **Advanced Routing** tab. Disable NAT. Don't forget to **Save** your settings.

Step 3: Connect to WRS2.

Now that WRS3 has been configured, it no longer broadcasts the default SSID of linksys. Power up the WRS2 wireless router and perform similar configurations. Review previous steps to connect PC3 to WRS2 via a wireless connection.

Set the IP address settings for Internet Setup.

- Set the Internet IP address to **172.17.88.25**.
- Set the Subnet Mask to **255.255.255.0**.

Set the Default Gateway to the FastEthernet 0/1 VLAN 88 IP address of R1, **172.17.88.1**.

Configure the Network Setup IP address to **172.17.40.1**.

Statically bind the MAC address of PC3 to the DHCP address **172.17.40.23**.

Change the wireless SSID to **WRS2**_[number].

Step 4: Configure R1 with static routes to the 172.17.30.0 and 172.17.40.0 networks.

```
R1(config)#ip route 172.17.30.0 255.255.255.0 172.17.88.35
R1(config)#ip route 172.17.40.0 255.255.255.0 172.17.88.25
```

Step 5: Repeat steps 1 and 2 above for WRS2.

Disable the Filter anonymous Internet requests.

Disable NAT.

Step 6: Verify connectivity.

Verify that R1 has routes to PC3 and PC6 and that it can successfully ping them.

```
R1#sh ip route
<output deleted>

Gateway of last resort is not set

     172.17.0.0/24 is subnetted, 5 subnets
S       172.17.40.0 [1/0] via 172.17.88.25
S       172.17.30.0 [1/0] via 172.17.88.35
C       172.17.20.0 is directly connected, FastEthernet0/1.20
C       172.17.10.0 is directly connected, FastEthernet0/1.10
C       172.17.88.0 is directly connected, FastEthernet0/1.88
     10.0.0.0/30 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Loopback0


R1#ping 172.17.30.26

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.30.26, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms


R1#ping 172.17.40.23

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.40.23, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

Verify that PC3 and PC6 can ping the loopback of R1.

Verify that PC3 and PC6 can ping each other.

Verify that PC3 and PC6 can ping PC1 and PC2.


```
        IP Address. . . . . . . . . . . . : 172.17.30.26
        Subnet Mask . . . . . . . . . . . : 255.255.255.0
        Default Gateway . . . . . . . . . : 172.17.30.1

C:\Documents and Settings\Administrator>ping 10.1.1.1

Pinging 10.1.1.1 with 32 bytes of data:

Reply from 10.1.1.1: bytes=32 time=1ms TTL=254
Reply from 10.1.1.1: bytes=32 time=1ms TTL=254
Reply from 10.1.1.1: bytes=32 time=1ms TTL=254
Reply from 10.1.1.1: bytes=32 time=1ms TTL=254

Ping statistics for 10.1.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\Documents and Settings\Administrator>ping 172.17.40.23

Pinging 172.17.40.23 with 32 bytes of data:

Reply from 172.17.40.23: bytes=32 time=1ms TTL=126
Reply from 172.17.40.23: bytes=32 time=1ms TTL=126
Reply from 172.17.40.23: bytes=32 time=1ms TTL=126
Reply from 172.17.40.23: bytes=32 time=1ms TTL=126

Ping statistics for 172.17.40.23:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\Documents and Settings\Administrator>ping 172.17.10.21

Pinging 172.17.10.21 with 32 bytes of data:

Reply from 172.17.10.21: bytes=32 time=1ms TTL=126
Reply from 172.17.10.21: bytes=32 time<1ms TTL=126
Reply from 172.17.10.21: bytes=32 time<1ms TTL=126
Reply from 172.17.10.21: bytes=32 time<1ms TTL=126

Ping statistics for 172.17.10.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Task 13: Configuring Routing Efficiency

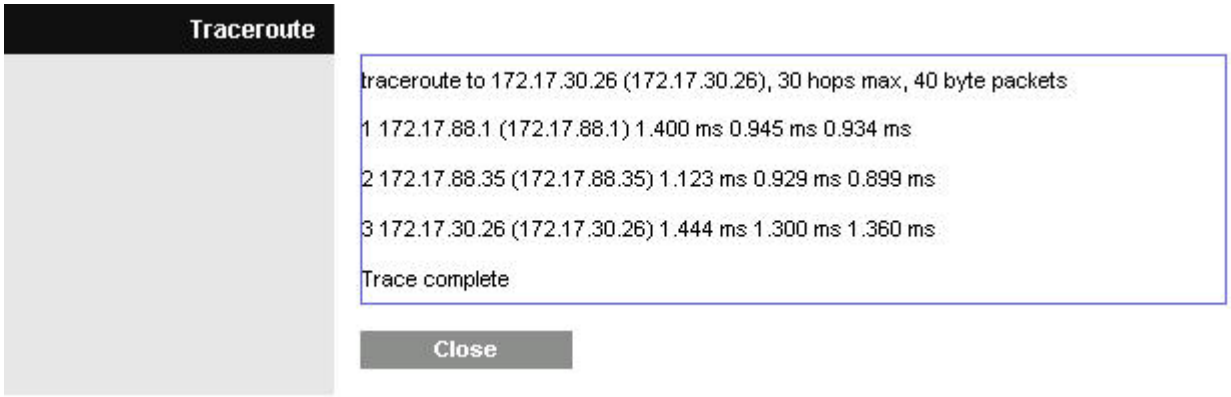
Step 1: Use Traceroute to view the network connection.

Because R1 is the default gateway, the Linksys router goes to R1 to get to a network it does not know how to get to, including the clients of the other Linksys routers.

A packet from PC3 to PC6 first reaches its default gateway of 172.17.40.1, then it is sent out the WRS2 WAN interface of 172.17.88.25 toward the WRS2 default gateway (172.17.88.1). From there, R1 send the packet to the WRS3 WAN interface, 172.17.88.35, where WRS3 handles it.

On WRS2, you can verify this in the **Diagnostics** tab in the Administration section. In the Traceroute Test field, enter the IP address of PC6, 172.17.30.26

Now click Start to Traceroute, a pop-up will appear.

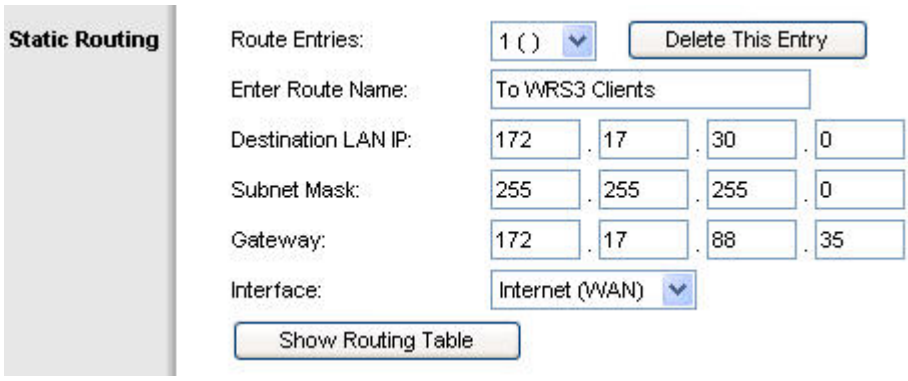


If WRS2 knew that it could get to the 172.17.30.0 network from 172.17.88.35 it would just directly send it to that IP address. So let's tell it!

Step 2: Configure a new route.

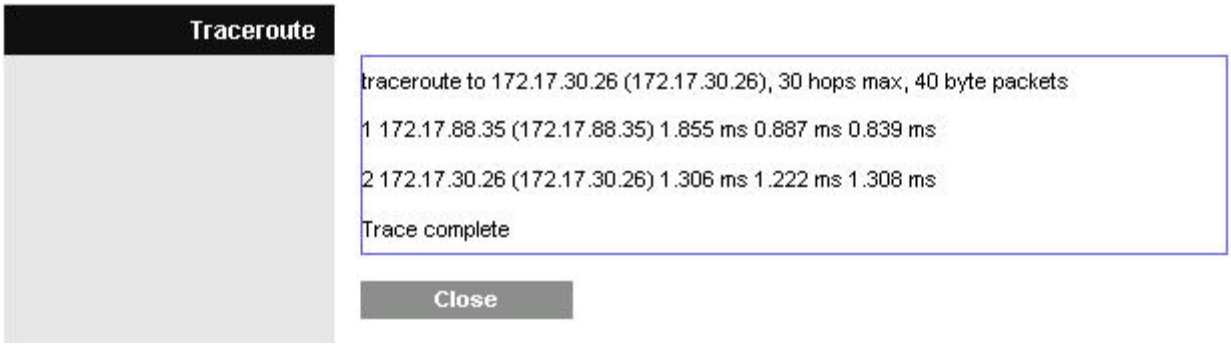
On WRS2, on the **Setup** page, click the **Advanced Routing** tab. For Static Routing, enter the following settings:

- In the **Route Name** field, enter **To WRS3 Clients**.
- For **Destination LAN IP**, enter the network behind WRS3: **172.17.30.0**.
- Enter a subnet mask of **255.255.255.0**.
- Enter a gateway of **172.17.88.35**.
- Set the interface to **Internet (WAN)**.
- Save your settings.



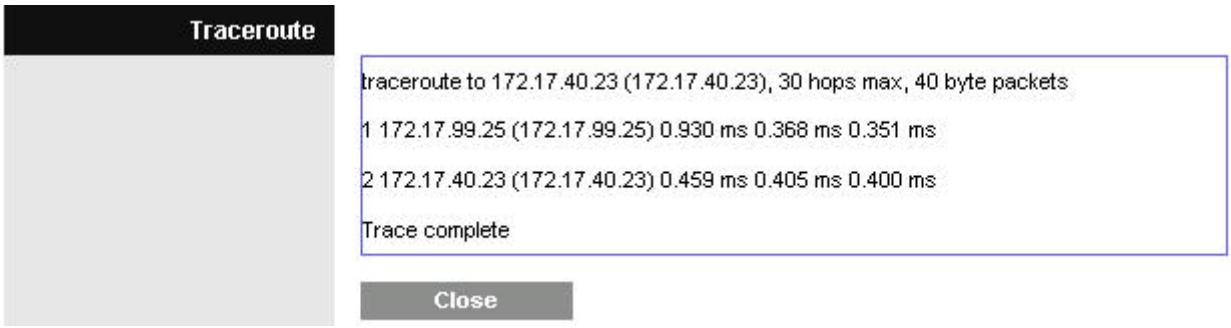
Step 3: Verify the new route.

In the **Diagnostics** tab in the Administration section, re-enter the IP address of PC3 in the Traceroute Test field. Click **Start to Traceroute** to see the route.



Notice WRS2 goes straight to WRS3 and saves us the extra hop to R1!

Do the same thing on WRS3 for the 172.17.40.0/24 network, pointing towards WRS2's WAN interface, 172.17.88.25.



Task 14: Configuring Port Security

Step 1: Configure PC1 port security.

Log on to switch S2. Configure the PC1 switch port, FastEthernet 0/11 with port security, and enable dynamic sticky MAC addresses.

Step 2: Configure PC2 port security.

Repeat for FastEthernet 0/18.

Step 3: Generate traffic across the ports by pinging PC2 from PC1.

Step 4: Verify port security.

```
S2#show port-security address
          Secure Mac Address Table
------------------------------------------------------------------------
Vlan    Mac Address       Type                    Ports   Remaining Age
                                                            (mins)
----    -----------       ----                    -----   -------------
  10    0006.5b1e.33fa    SecureSticky            Fa0/11       -
  20    0001.4ac2.22ca    SecureSticky            Fa0/18       -
------------------------------------------------------------------------
Total Addresses in System (excluding one mac per port)     : 0
Max Addresses limit in System (excluding one mac per port) : 6272
```



```
S2#show port-security interface FastEthernet 0/11
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 1
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 1
Last Source Address:Vlan   : 0006.5b1e.33fa:10
Security Violation Count   : 0
```

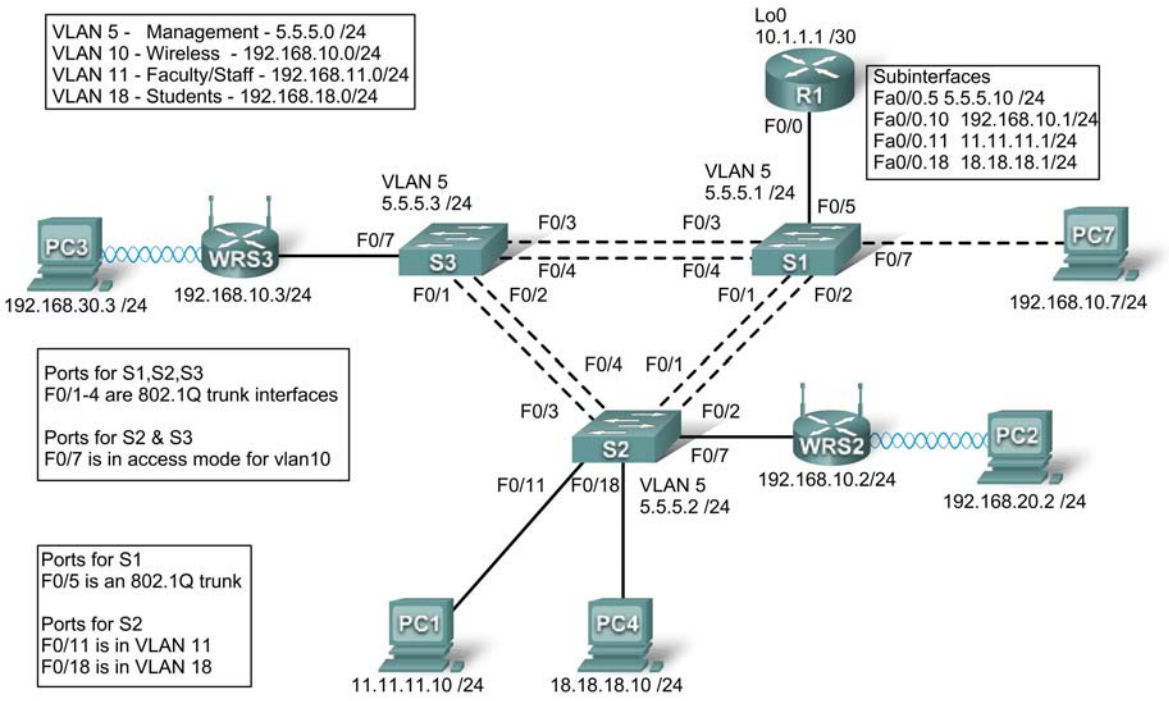
Task 15: Restore WRT300N routers to factory defaults

Step 1: Clear settings of both WRT300N routers.

In order to clear both of the WRT300N routers to their factory defaults, navigate to the Administration page, click on **Factory Defaults,** and click the **Restore All Settings** button.

Lab 7.5.3: Troubleshooting Wireless Configuration

Topology Diagram



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	**Fa0/0.5**	5.5.5.10	255.255.255.0	N/A
	Fa0/0.10	192.168.10.1	255.255.255.0	N/A
	Fa0/0.11	11.11.11.1	255.255.255.0	N/A
	Fa0/0.18	18.18.18.1	255.255.255.0	N/A
	Lo0	10.1.1.1	255.255.255.252	N/A
WRS2	**WAN**	192.168.10.2	255.255.255.0	192.168.10.1
	LAN/Wireless	192.168.20.1	255.255.255.0	N/A
WRS3	**WAN**	192.168.10.3	255.255.255.0	192.168.10.1
	LAN/Wireless	192.168.30.1	255.255.255.0	N/A
PC1	**NIC**	11.11.11.10	255.255.255.0	11.11.11.1
PC4	**NIC**	18.18.18.10	255.255.255.0	18.18.18.1
S1	**VLAN 5**	5.5.5.1	255.255.255.0	N/A

S2	**VLAN 5**	5.5.5.2	255.255.255.0	N/A
S3	**VLAN 5**	5.5.5.3	255.255.255.0	N/A

Scenario

In this lab, a basic network and wireless network have been configured improperly. You must find and correct the misconfigurations based on the minimum network specifications provided by your company.

Here are the configurations to load into your router and switches.

R1 Configuration

```
hostname R1
!
interface Loopback0
 ip address 10.1.1.1 255.255.255.0
!
interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
 no shutdown
!
interface FastEthernet0/0.5
 encapsulation dot1Q 5
 ip address 5.5.5.10 255.255.255.0
!
interface FastEthernet0/0.10
 encapsulation dot1Q 10
 ip address 192.168.11.1 255.255.255.0
!
!
interface FastEthernet0/0.18
 encapsulation dot1Q 18
 ip address 18.18.18.1 255.255.255.0
!
ip route 192.168.20.0 255.255.255.0 192.168.10.2
ip route 192.168.30.0 255.255.255.0 192.168.10.3
!
line con 0
 exec-timeout 0 0
 logging synchronous
!
end
```

Switch 1 Configuration

```
hostname S1
!
vtp mode transparent
!
vlan 5,10-11
!
```



```
interface FastEthernet0/1
 switchport trunk allowed vlan 5,10,11
 switchport mode trunk
 switchport trunk native vlan 5
!
interface FastEthernet0/2
 switchport trunk allowed vlan 5,10,11
 switchport mode trunk
 switchport trunk native vlan 5
!
interface FastEthernet0/3
 switchport trunk allowed vlan 5,10,11
 switchport mode trunk
 switchport trunk native vlan 5
!
interface FastEthernet0/4
 switchport trunk allowed vlan 5,10,11
 switchport mode trunk
 switchport trunk native vlan 5
!
interface FastEthernet0/5
 switchport mode trunk
 switchport trunk native vlan 5
!
interface Vlan5
 ip address 5.5.5.1 255.255.255.0
 no shutdown
!
line con 0
 exec-timeout 0 0
 logging synchronous
!
End
```

Switch 2 Configuration

```
hostname S2
!
vtp mode transparent
ip subnet-zero
!
vlan 5,10-11,18
!
interface FastEthernet0/1
 switchport trunk allowed vlan 5,10,11,18
 switchport mode access
!
interface FastEthernet0/2
 switchport trunk allowed vlan 5,10,11,18
 switchport mode access
!
interface FastEthernet0/3
 switchport trunk allowed vlan 5,10,11,18
 switchport mode access
!
```



```
interface FastEthernet0/4
 switchport trunk allowed vlan 5,10,11,18
 switchport mode access
!
interface FastEthernet0/7
 switchport access vlan 10
!
interface FastEthernet0/11
 switchport access vlan 11
 switchport mode access
 switchport port-security mac-address sticky
 switchport port-security mac-address sticky 0336.5b1e.33fa
!
interface FastEthernet0/18
 switchport access vlan 18
 switchport mode access
 switchport port-security
 switchport port-security mac-address sticky
 switchport port-security mac-address sticky 022c.ab13.22fb
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan5
 ip address 5.5.5.2 255.255.255.0
 no shutdown
!
line con 0
 exec-timeout 0 0
 logging synchronous
!
End
```

Switch 3 Configuration

```
hostname S3
!
vtp mode transparent
!
vlan 5,10-11,18
!
interface FastEthernet0/1
 switchport trunk allowed vlan 5,10,11,18
 switchport mode trunk
 switchport trunk native vlan 5
!
interface FastEthernet0/2
 switchport trunk allowed vlan 5,10,11,18
 switchport mode trunk
 switchport trunk native vlan 5
!
interface FastEthernet0/3
 switchport trunk allowed vlan 5,10,11,18
 switchport mode trunk
```



```
 switchport trunk native vlan 5
!
interface FastEthernet0/4
 switchport trunk allowed vlan 5,10,11,18
 switchport mode trunk
 switchport trunk native vlan 5
!
interface FastEthernet0/7
!
interface Vlan1
 no ip address
 no ip route-cache
!
interface Vlan5
 ip address 6.6.6.3 255.255.255.0
no shutdown
!
line con 0
 exec-timeout 0 0
 logging synchronous
!
end
```

Wireless Router Network Requirements

While troubleshooting WRS2 and WRS3, ensure that at least the following capabilities exist:

1. Connections via the IP addresses shown in the topology diagram.
2. More than 30 clients can get an IP address through DHCP at a single time.
3. A client can have a DHCP address for at least 2 hours.
4. Clients using both B and G wireless network modes can connect, but N clients cannot.
5. Wireless clients must be authenticated using WEP with a key of 5655545251.
6. Traffic between PC2 and PC3 must take the most efficient route possible.
7. Ping requests coming from outside WAN ports of the Linksys routers to their inside LAN/wireless IP addresses (192.168.30.1) must be successful.
8. DHCP must not give out IP addresses in a range that includes the addresses for PC2 and PC3.
9. The two wireless networks must not interfere with each other.

Wireless Network Solution

Record your solution below.

