This document describes the documented class exercises . The objective of the document is to present complete and easy to follow detailed procedures to describe the exercises done in class.

Course Procedure Manual

420-633-AB NETWORK INFRASTRUCTURE (CCNA II : Switching, Routing, and Wireless Essentials)

Teacher: Michael Hughes
Student: Monica Perez Mata
Student id : 2498056

TABLE OF CONTENT

1 Introduction

This document outlines the procedures learned during the courses

- 420-633-AB NETWORK INFRASTRUCTURE (CISCO CCNA II)

The aim of the document is to present complete and easy to follow detailed procedures to describe the necessary steps for all the procedures carried out as class exercises.
These exercises provide practical, hands-on experience in configuring and managing network settings, ensuring that users can effectively implement and troubleshoot these configurations in real-world scenarios.

The exercises include:

- Virtual Local Area Network (VLAN)
- Ethernet Channel (EtherChannel)
- Dynamic Host Configuration Protocol (DHCP)
- Hot Standby Router Protocol (HSRP)
- Basic Switch Settings
- Dynamic Host Configuration Protocol for IPv4 (DHCPv4)
- Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
- Routing Information Protocol (RIP)
- Enhanced Interior Gateway Routing Protocol (EIGRP)
- Open Shortest Path First (OSPF)
- Spanning Tree Protocol (STP)
- Layer 3 switch

2 General activities

This section describes the pre-requisites and the setup to work with procedures related to operating systems.

The required pre-requisites:

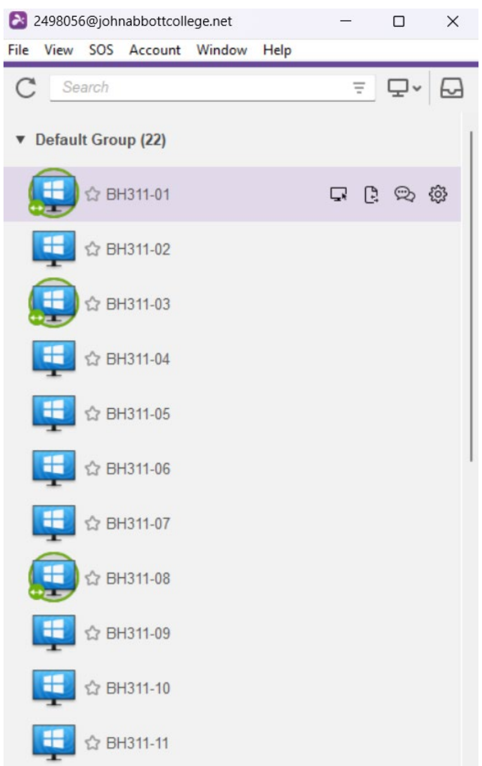
1) The use of Splashtop to securely access John Abbott College Computer Lab is up and running.
2) A computer is available to work in John Abbott College Computer Lab
3) Vmware Workstation Pro Virtual environment software is installed to create virtual machines on the assigned computer and is up and running.

The procedures for installing Splashtop on your home computer are not included in this manual.

2.1 Splashtop and Computer

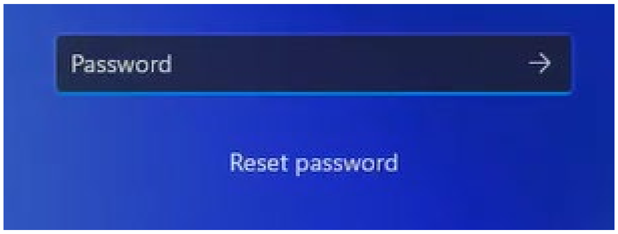
Splashtop Business is a remote desktop software that allows users to securely access their computers from anywhere. As a pre-requisite for all activities in this document, Splashtop Business is installed, and a PC is assigned, and both are working

A) Splashtop Business Application is installed in your home computer, user is logged in and a computer list appears on Splashtop Business, as shown in the image below:

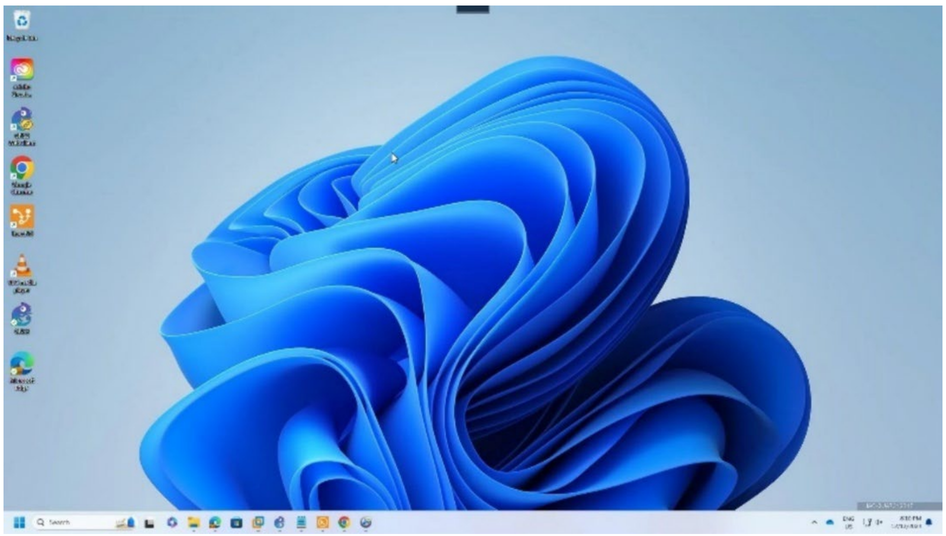


The computer assigned is correctly working when double click computer starts.

B) User login to computer with appropriate user and password



C) Windows desktop (like the image below) appears when user logs in.



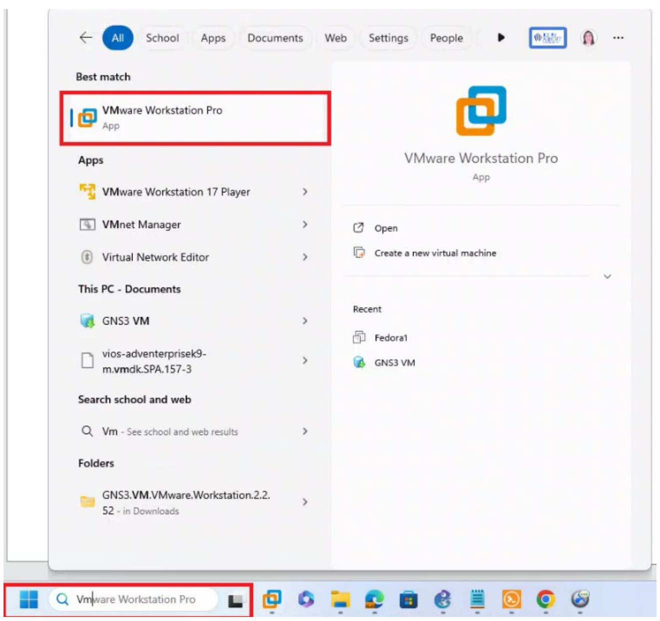
2.2 Verify VMWare Workstation Pro is installed

VMware Workstation Pro enables users to set up virtual machines (VMs) on a single physical machine.

As a pre-requisite for all activities in this document

1) Make sure VMware Workstation Pro is installed. Check in the search tab at the left down corner of the desktop and look for VMware Workstation Pro.

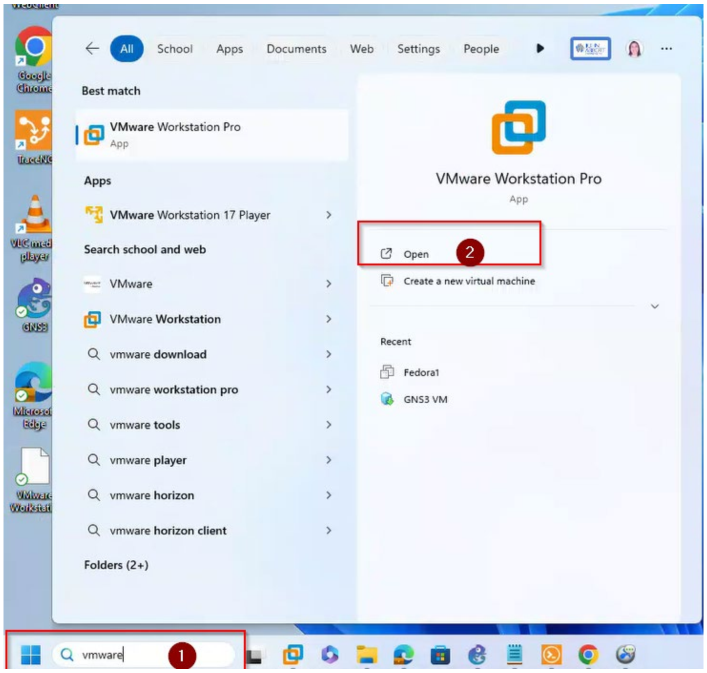
   The application appears in the menu.



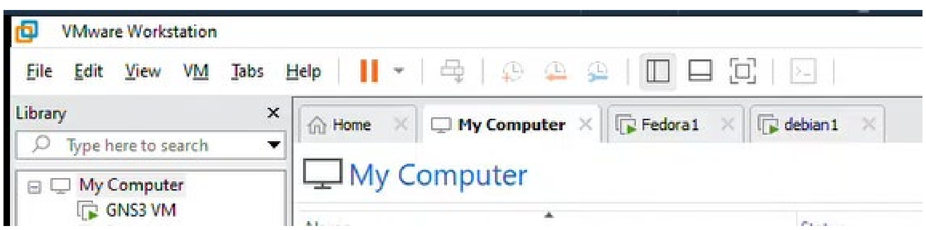
2.3 Updating VMware Workstation Pro

A) Open the VMware Workstation App

1 Look for application in windows search
2 Once VMware Workstation Pro appears, open application

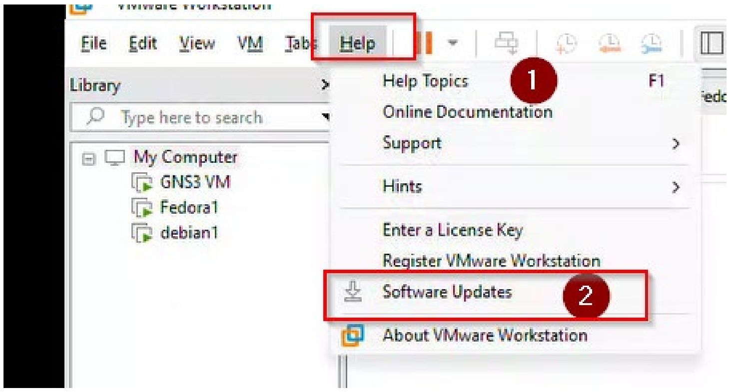


B) VMware workstation opens:

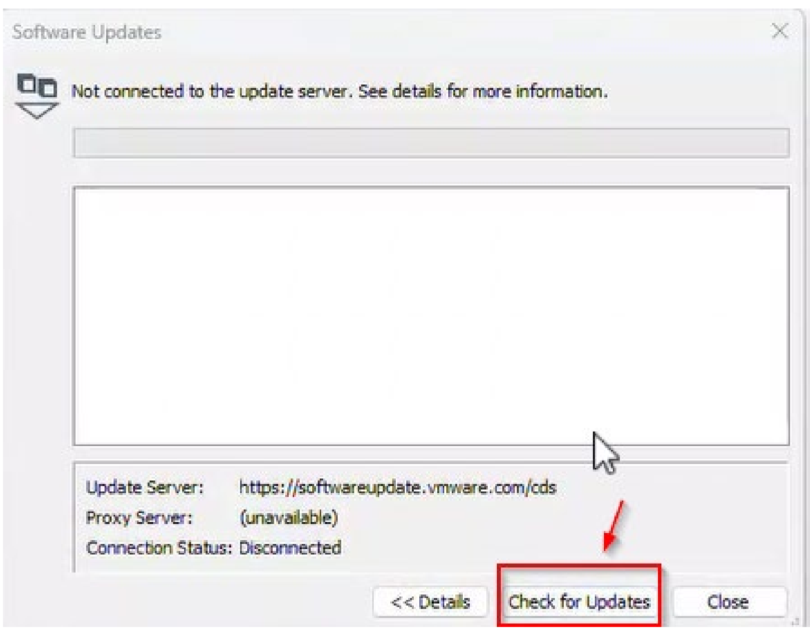


C) Select from top menu and submenu

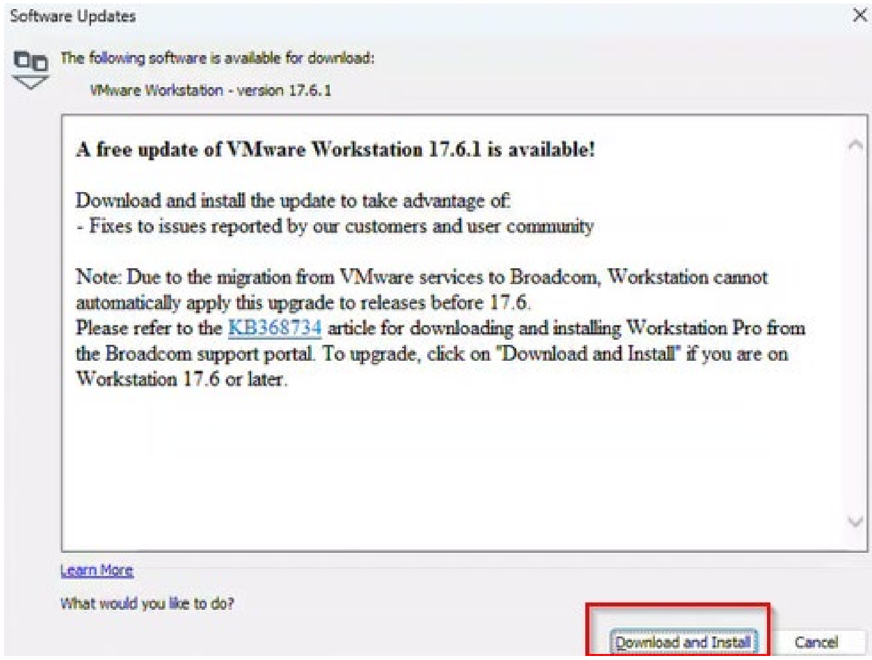
1. Help
2. Select Software Updates



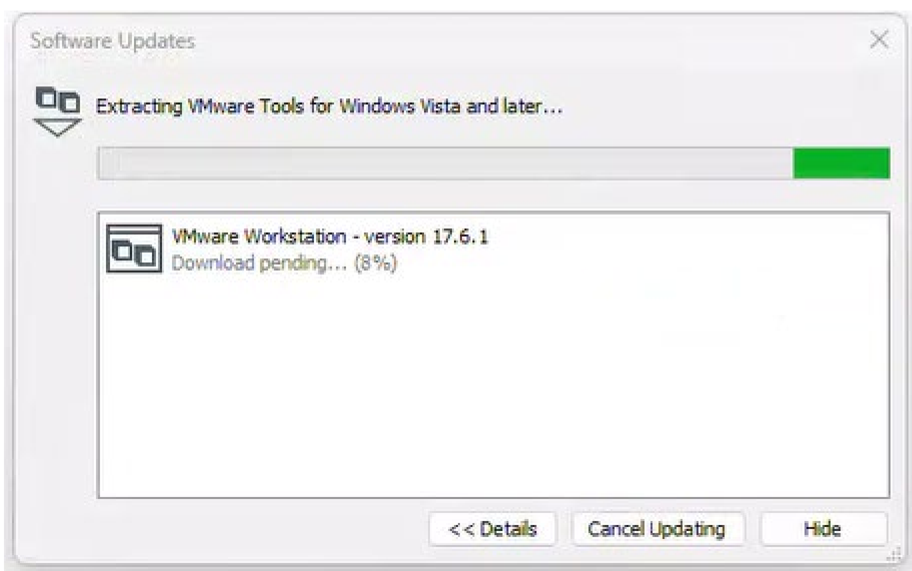
D) A new window will open, select Check for updates



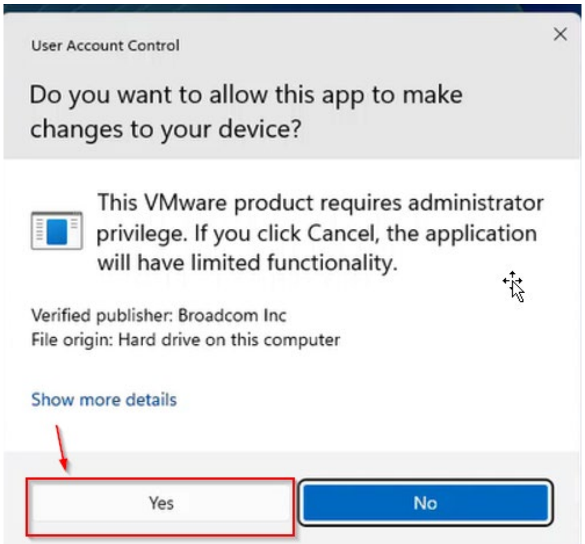
E) After a couple of second a second a new window appears indicating upgrades are available, click “Download and Install”



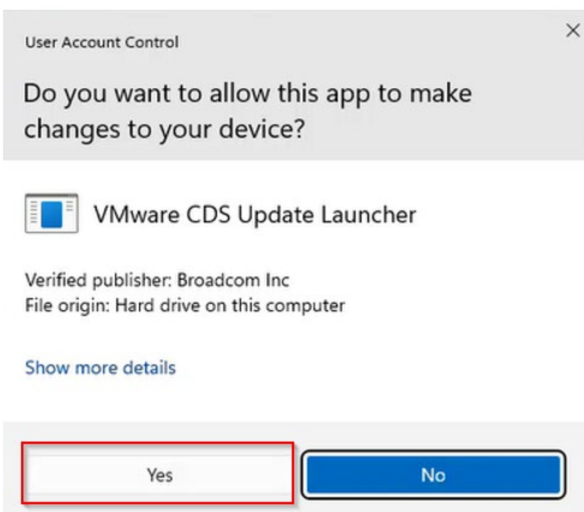
F) Wait while new VMWare version is extracting



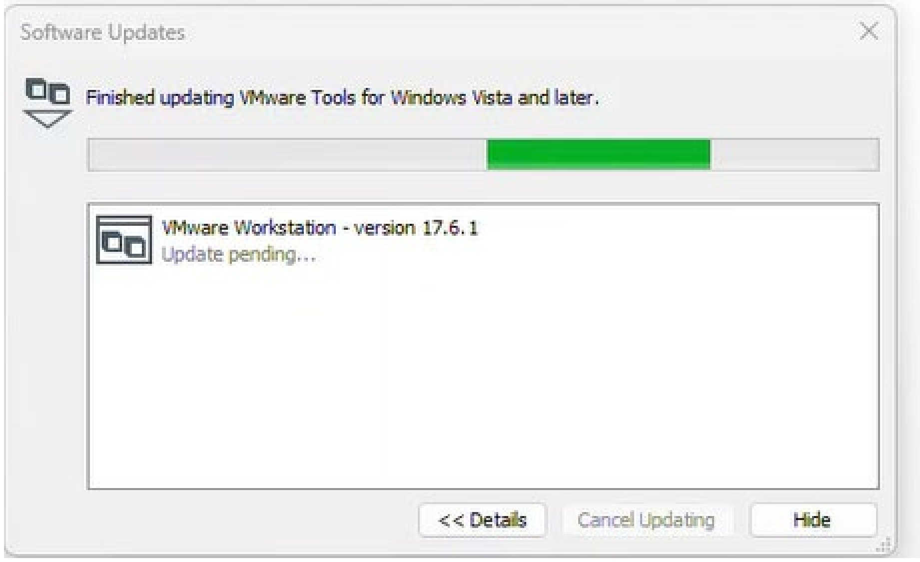
G) When prompted that “Do you want to allow this app to make changes to your device? This VMware product requires administrator privilege. Click “Yes”



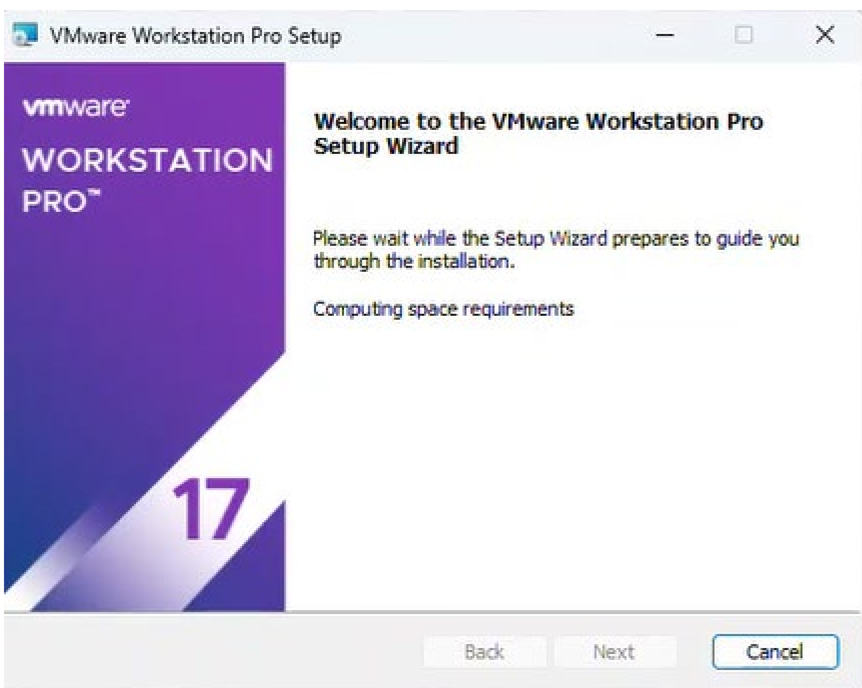
H) When prompted “Do you want to allow this app to make changes to your device? VMware CDS Update Launcher”, click “Yes”.



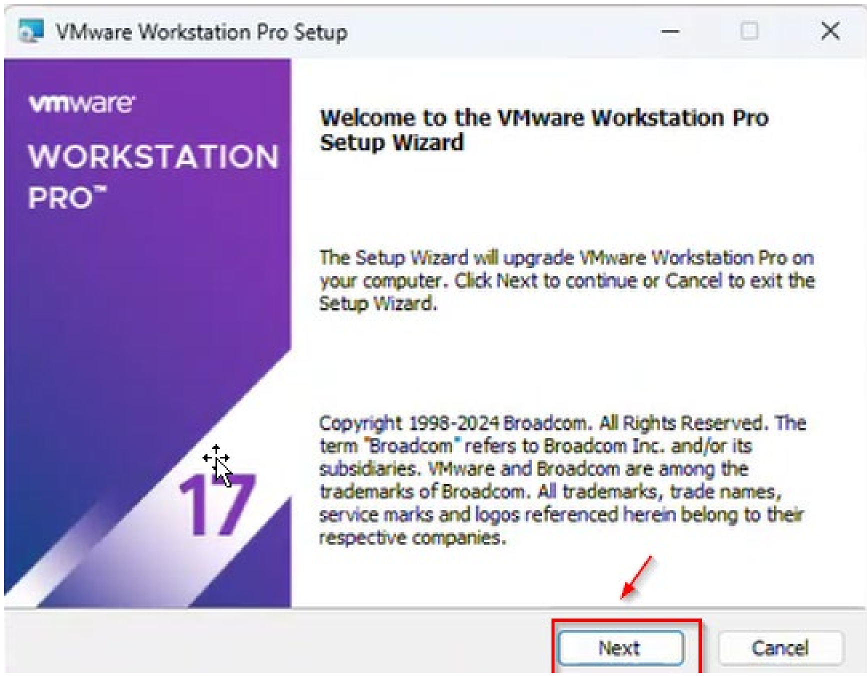
I) Finished uploading VMware tools window appears, wait until finished.



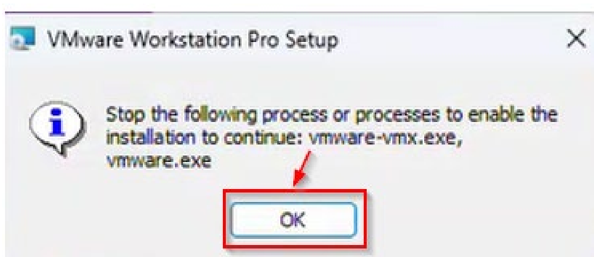
J) New window with message "Welcome to VMware Workstation Pro Setup Wizard, wait until "Next" is enabled.



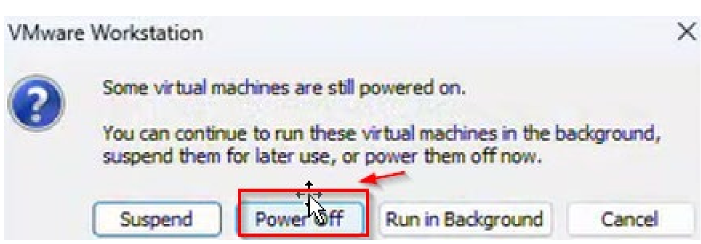
K) When the in the window "Welcome to the VMware Workstation Pro Setup Wizard" "Next" is enabled, click on it.



L) If the following window appears is because the VMWare Workstation is running virtual machines. Press "OK" and go ahead to close the VMWare Workstation

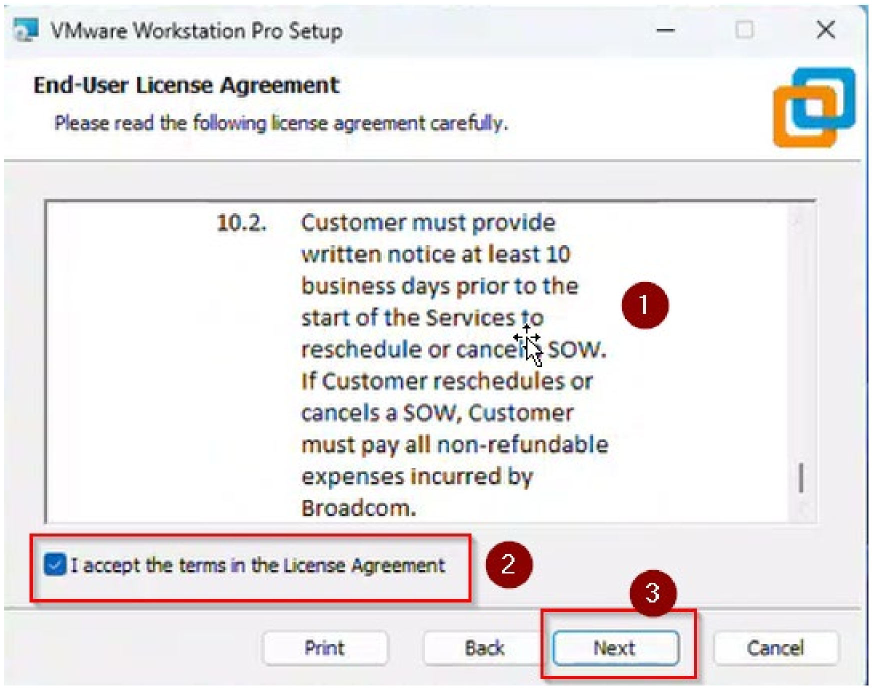


M) To Stop VMWare Workstation all virtual machines should be powered off. Press "Power Off"

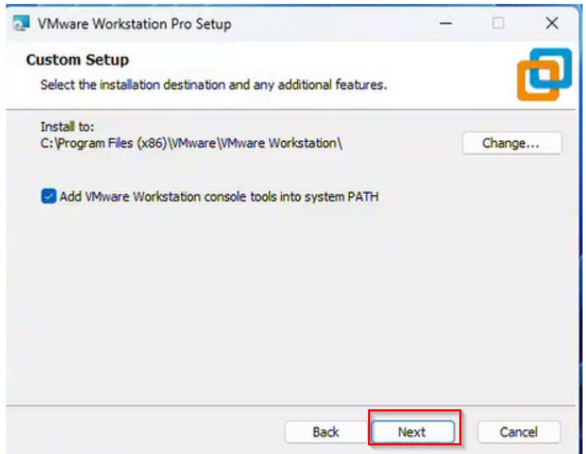


N) End-User License Agreement,

1. Read the End-User License Agreement
2. Accept the End-User License Agreement by Selecting "I accept the terms in the License Agreement".
3. Click "Next"

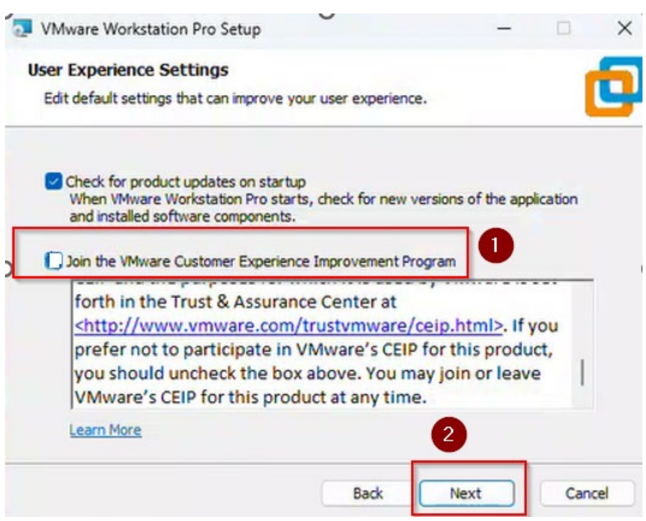


O) In the “Custom Setup” window, keep the installation destination, select “Add VMWare Workstation console tools into system PATH” and then click “Next”

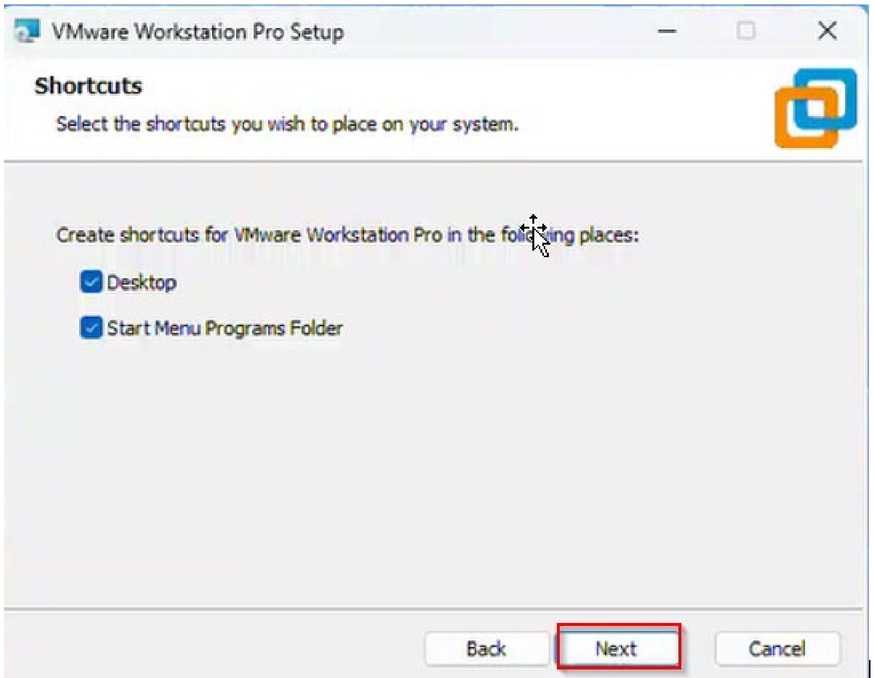


P) When the “User Experience Settings” window pops up,

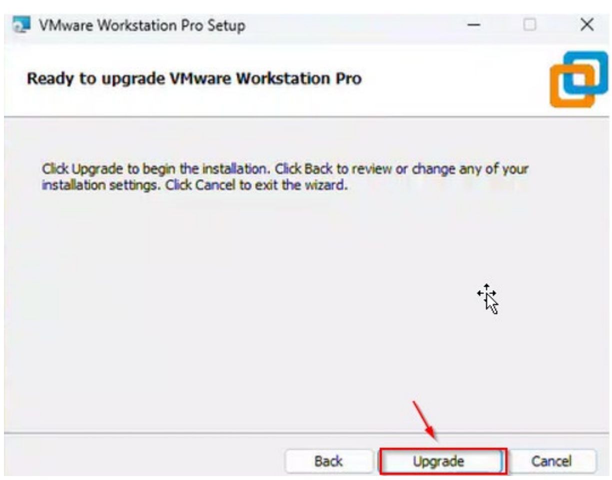
1. Uncheck the checkbox “Join the VMware Customer Experience Improvement Program”
2. Click “Next”



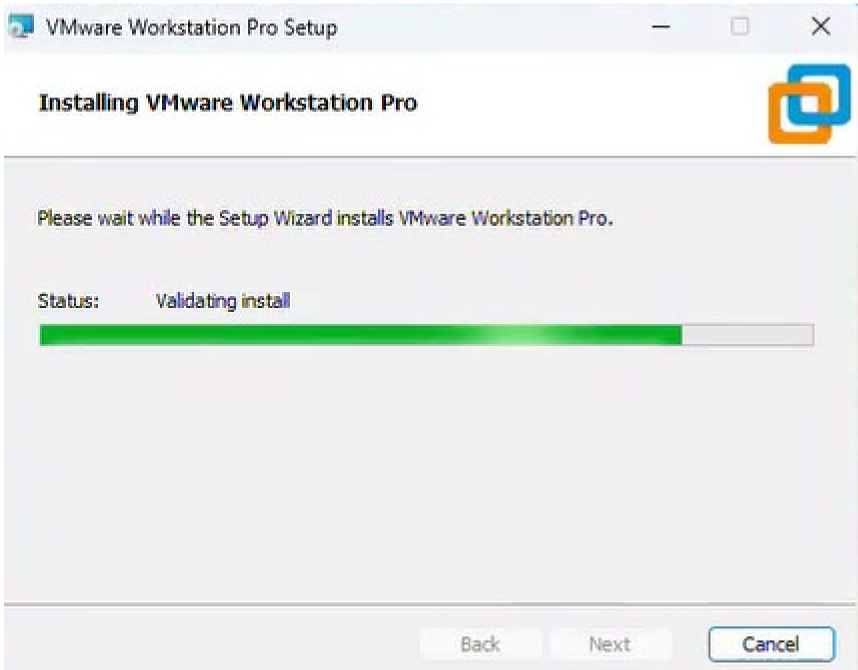
Q) When the "Shortcuts" window pops up, both boxes should be checked, then click "Next".



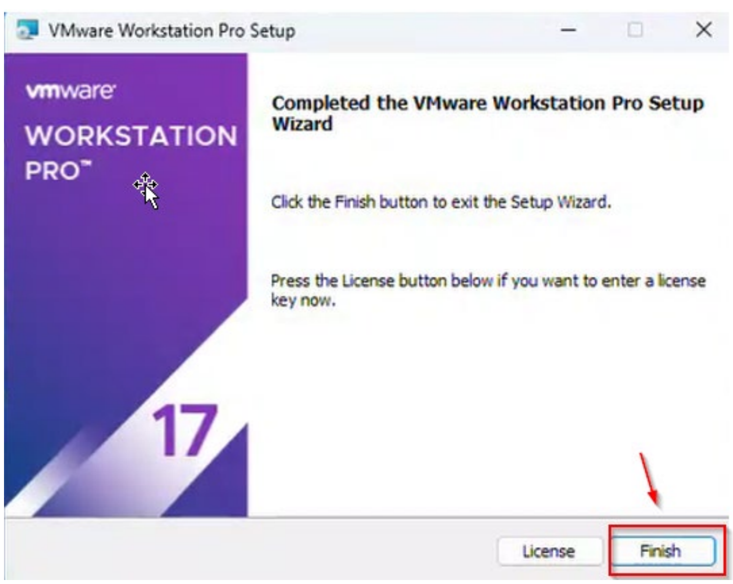
R) When the window "Ready to upgrade VMware Workstation Pro" appears click "Upgrade"



S) The window "Installing VMware Workstation Pro" showing the installation process is initiated, the green bar indicates the process status. Please wait this can take time.



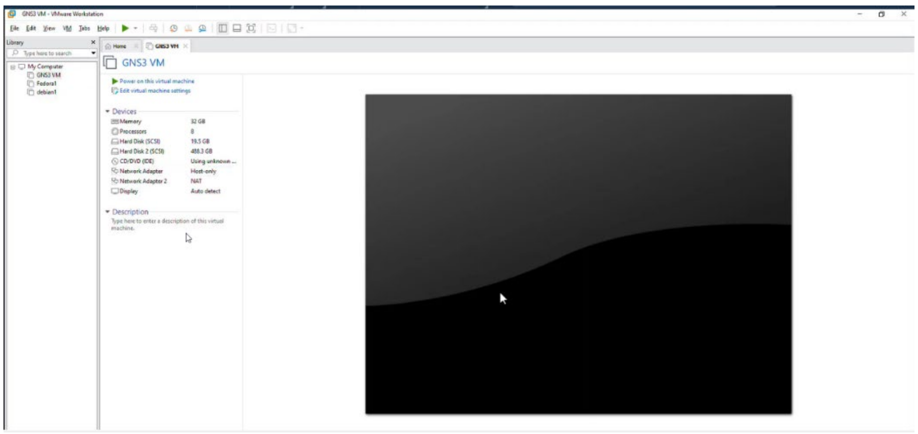
T) When the "Completed the VMware Workstation Pro Setup Wizard" window pops up, click "Finish".



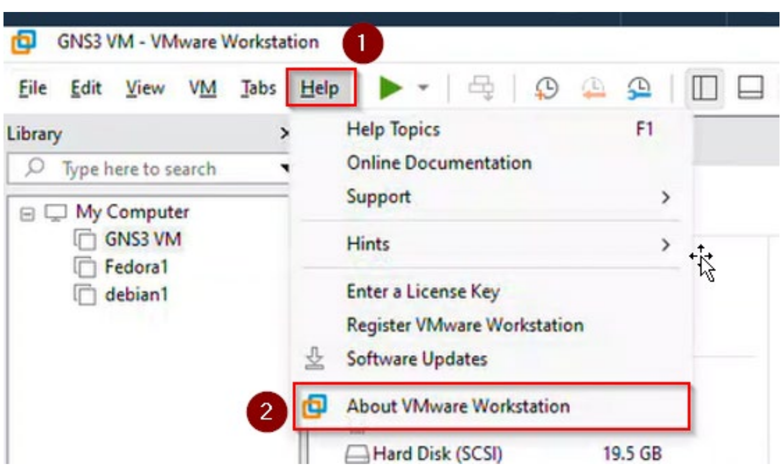
2.3.1 Post VMware Workstation Pro upgrade activities

A) When prompted "You must restart your system for the configuration changes made to VMware Workstation to take effect. Click "Yes" for restart or "No" if you plan to manually restart later.

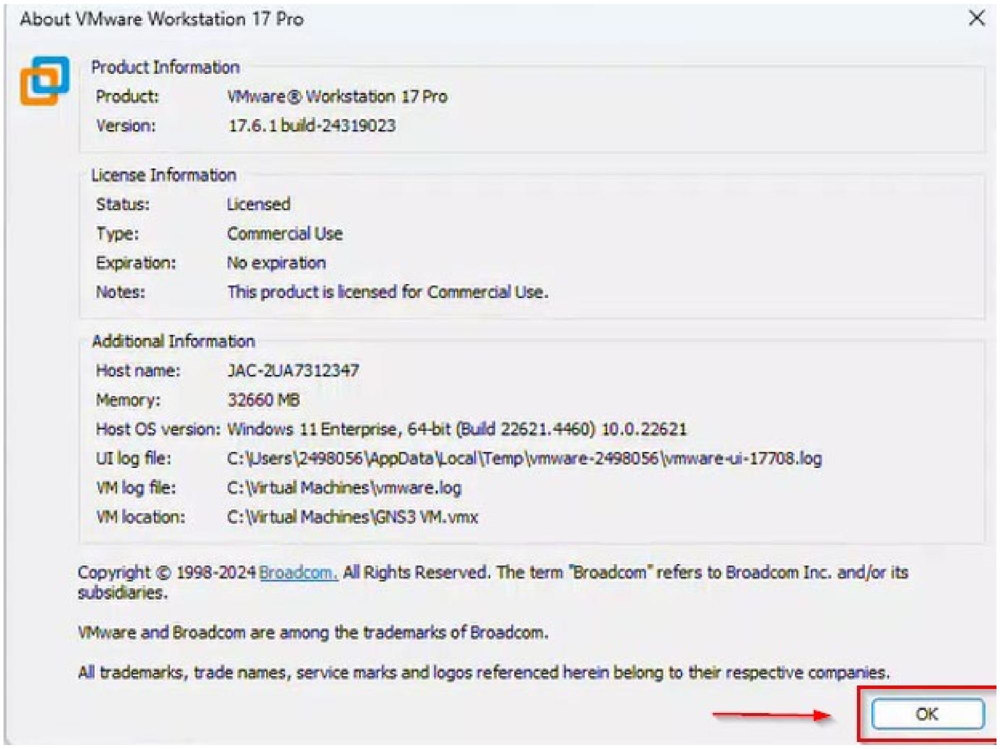
B) The virtual machines appear on the screen; virtual machines are not running.



C) Verify the version of the VMWare workstation Select "Help" from the menu. A submenu will appear, select "About VMware Workstation."



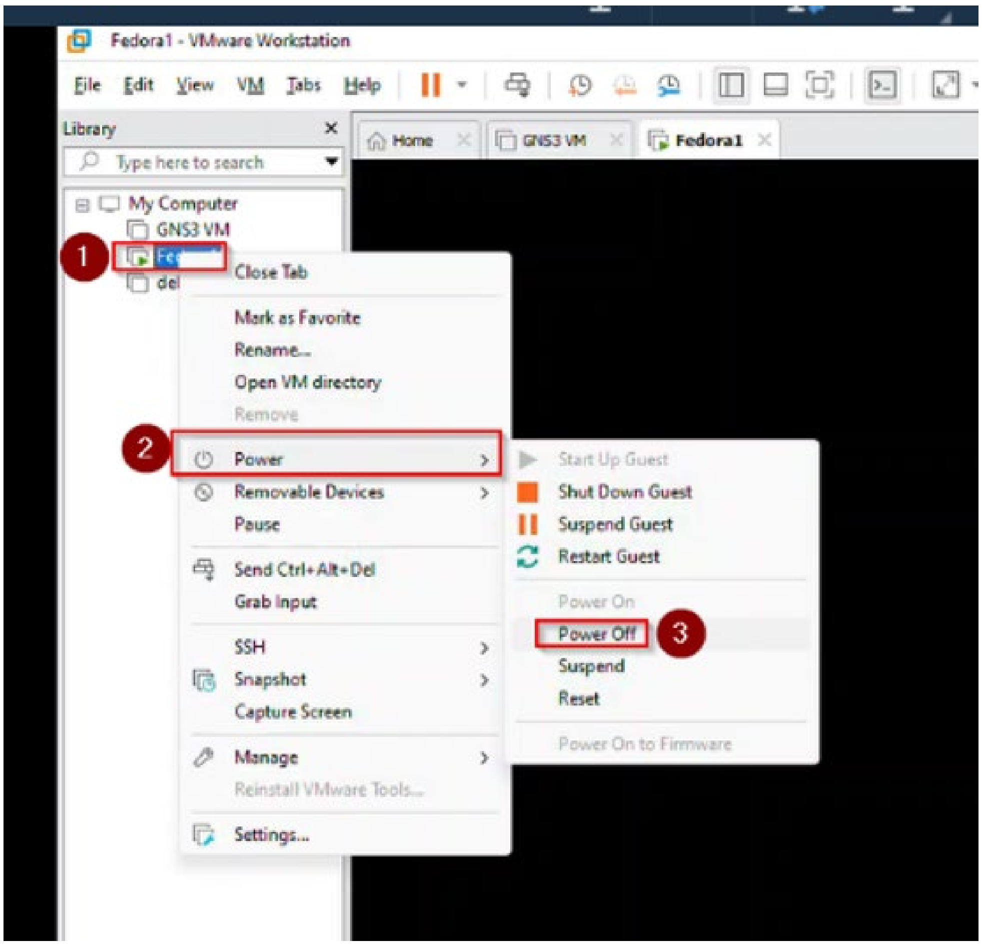
D) The information about the installed software will pop up. Verify the latest version is installed. Click OK and you are ready to start the VMWare Workstation Pro.



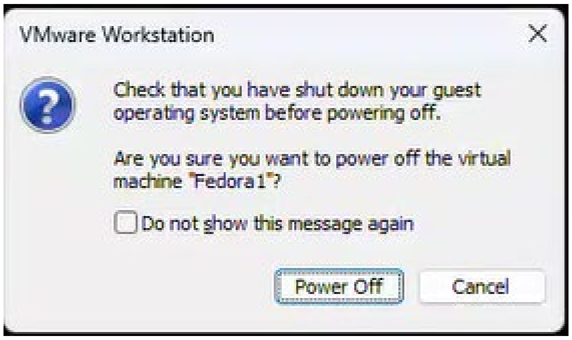
2.4 Delete VM

A) Power off virtual machine if needed.

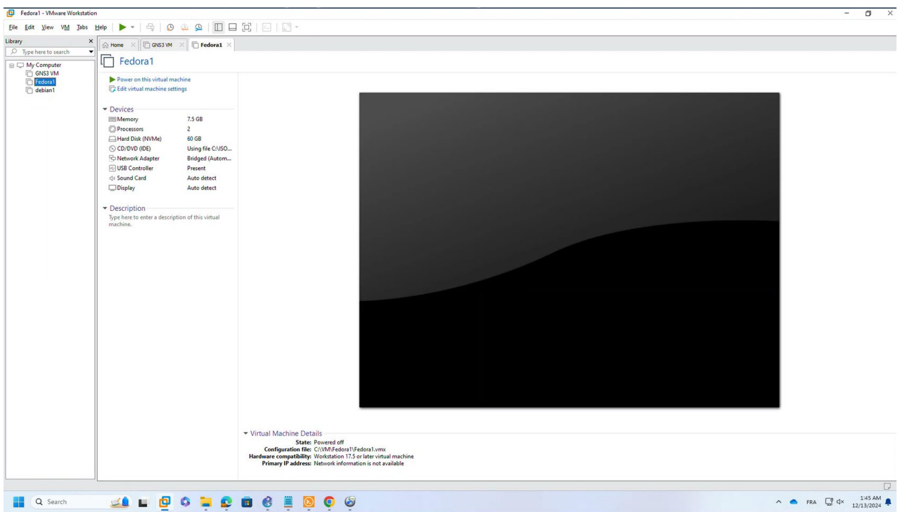
1. Select virtual machine to delete and right click to make submenu appear.
2. In the submenu select “Power>”
3. Submenu will appear select if machine is running “Power off”



4. A confirmation window will appear asking: Are you sure to want to power off the virtual machine <name>”? Press “Power off” to continue with the process.

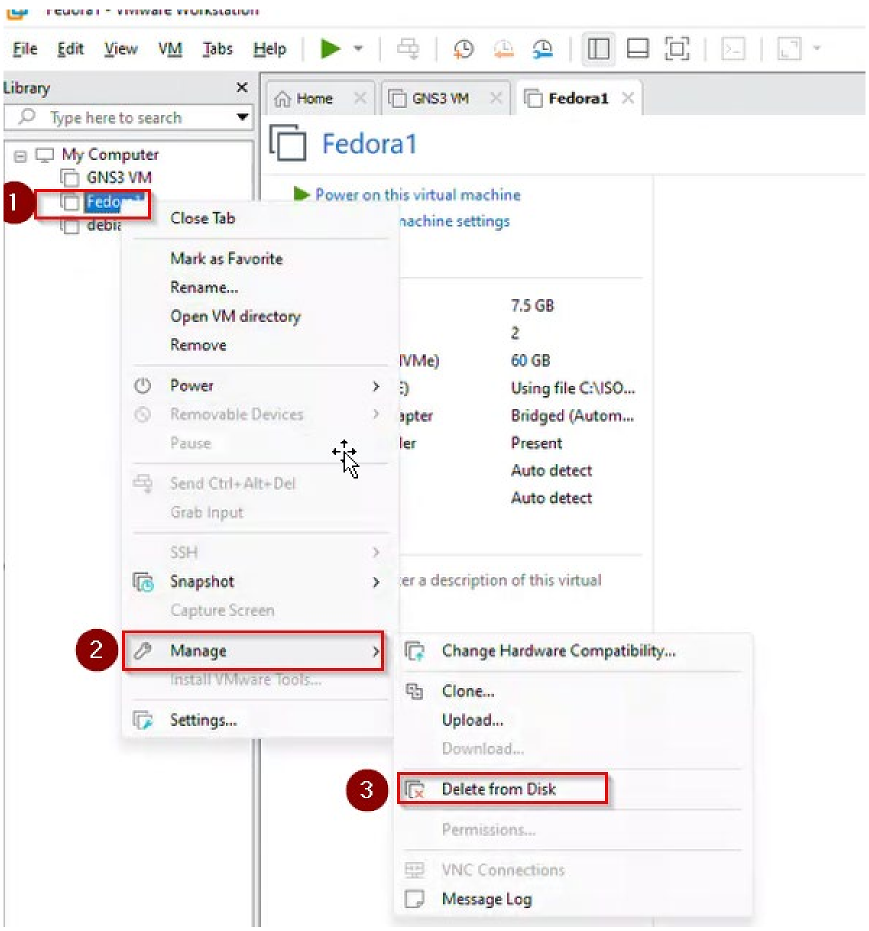


B) Verify virtual machine to be removed is turned off

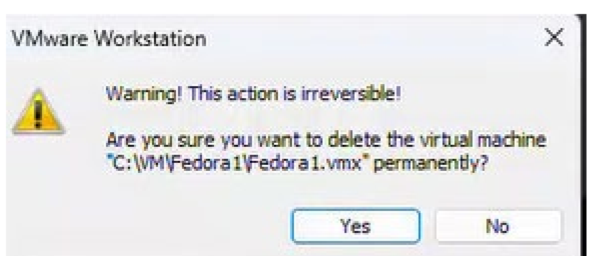


C) Delete form disk
   1. Select virtual machine to delete and right click to make submenu appear.
   2. In the submenu select “Manage”

3. Submenu will appear select if machine is running “Delete from Disk”

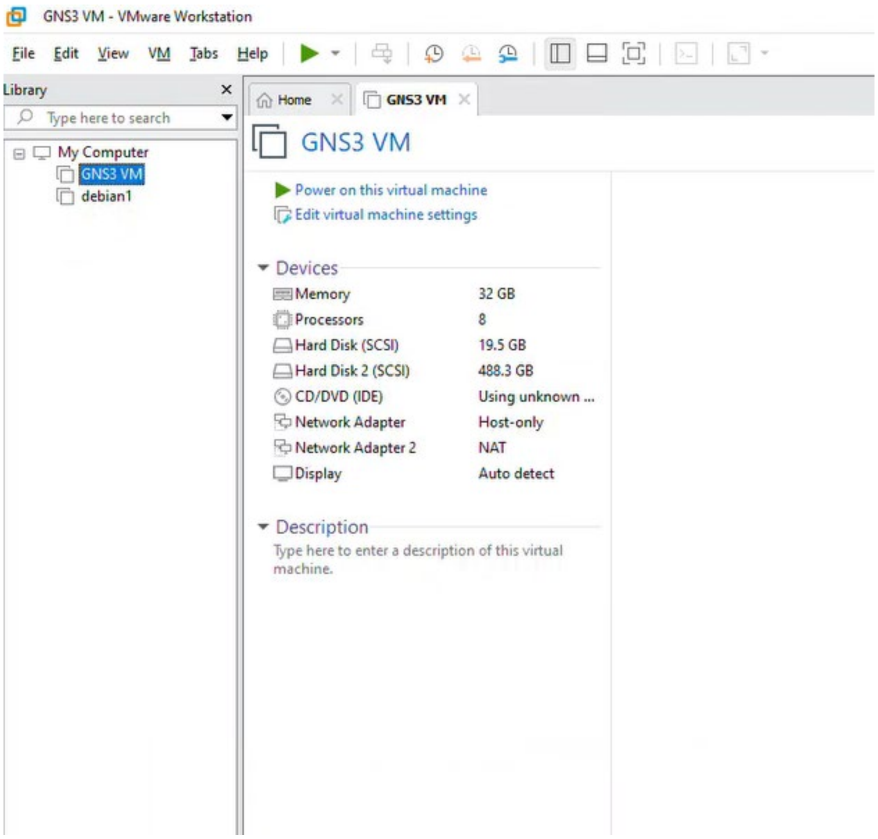


D) Confirm you want to delete VM Press “Yes”



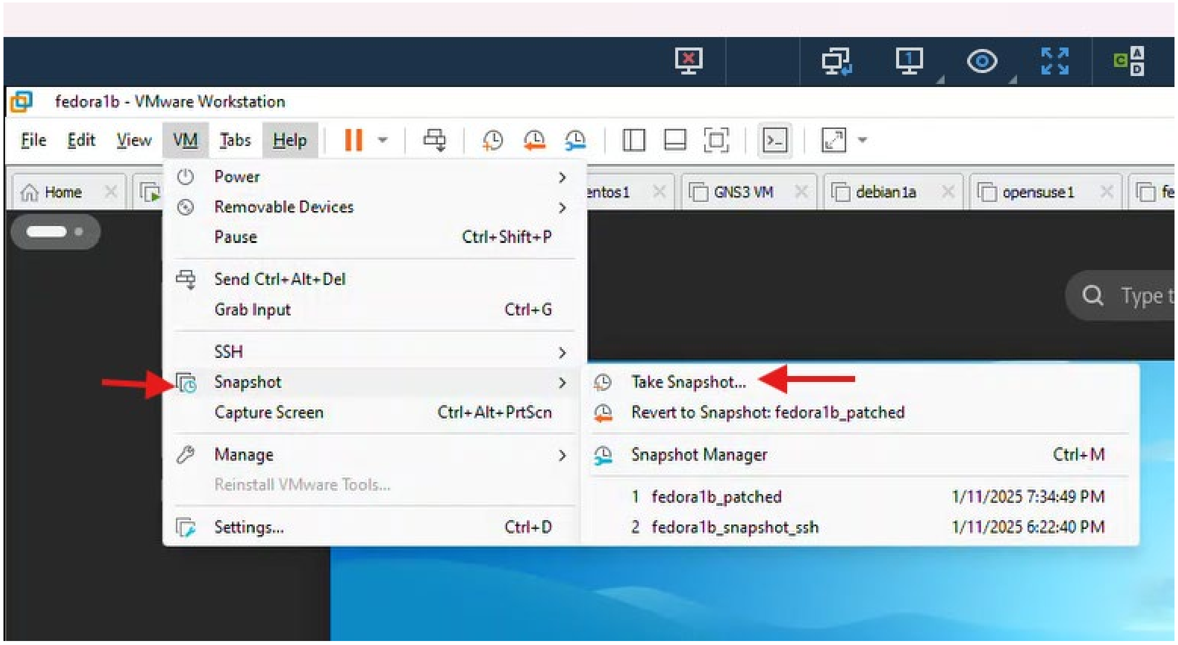
E) Immediately Deleted VM is removed from VMware Workstation Pro

Verify machine is removed from VMware Workstation Pro, VM does not appear on VMware Workstation Pro window.

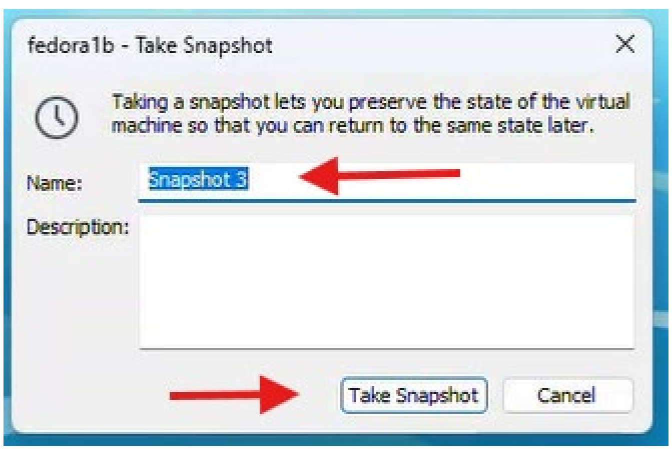


2.5 Create a snapshot for VM

A) From the VM you want tot take a snapshot select from Main menu “Snapshot” From Submenu Select “Take Snapshot”.

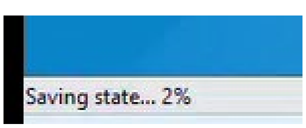


A window opens , give a name and a description to the snapshot. Press “Take Snapshot”



The process will start , It can take some time. Wait until; the snapshot finished to use the VM

The process per centage is seen at the bottom left of the VM



3 CCNA 2 Switching, Routing, and Wireless Essentials

3.1 Concepts

3.1.1.1 IP Addressing

An IP address is divided into four sections, or what we call octets. Each section is 8 bits, and there are 4 sections, resulting in a total of 32 bits. This is a typical IP address format.

3.1.1.2 Binary Representation

- A bit is a binary digit with two possible values: 0 (off) and 1 (on).
- Each bit position has a different value (e.g., 2^0, 2^1, 2^2, etc.).
- When a bit is turned on (value of 1), it adds its corresponding value to the overall position value.

8 bits			8 bits					8 bits								8 bits								8 bits							
8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
128	**64**	**32**	**16**	**8**	**4**	**2**	**1**	128	64	32	16	8	4	2	1	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**	128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

3.1.1.3 Network classes

The classification of IP addresses into Classes A, B, C, D, and E was designed to efficiently allocate and manage IP address space based on different networking needs.

These classifications help to efficiently manage IP address allocation and ensure that different types of networks can operate without overlapping addresses. Each class serves a specific purpose based on the size and type of network, which helps in organizing and optimizing network infrastructure.

The table below describes each network class.

Class	First octet	Binary Representation	Range Start	Range End	IP Address Range	Default Subnet Mask	CIDR Notation bits for network	Format N - Network H - Host	Usage	Number of Networks	Number of Usable Hosts per Network
Class A	0XXXXXXX	The first bit of the first octet is always 0. The remaining 7 bits can be either 0 or 1	1	127	1.0.0.0 - 126.255.255.255	255.0.0.0	/8	N.**H.H.H**	Designed for very large networks with a huge number of hosts - Large organizations and service providers	128	16,777,214
Class B	10XXXXXX	The first two bits of the first octet are 10. The remaining 6 bits can be either 0 or 1.	128	191	128.0.0.0 - 191.255.255.255	255.255.0.0	/16	N.N.**H.H**	Medium-sized networks - Universities, large businesses, and smaller ISPs	16,384	65,534
Class C	110XXXXX	The first three bits of the first octet are 110. The remaining 5 bits can be either 0 or 1.	192	223	192.0.0.0 - 223.255.255.255	255.255.255.0	/24	N.N.N.**H**	Small networks - Small businesses and organizations.	2,097,152	254
Class D	1110XXXX	he first four bits of the first octet are 1110. The remaining 4 bits can be either 0 or 1.	224	239	224.0.0.0 - 239.255.255.255	N/A	N/A	N/A	Multicast - involves sending data to multiple destinations simultaneously. Multimedia streaming, teleconferencing.	N/A	N/A
Class E	1111XXXX	The first four bits of the first octet are 1111. The remaining 4 bits can be either 0 or 1.	240	254	240.0.0.0 - 255.255.255.255	N/A	N/A	N/A	Experimental - Not used for general networking; reserved for future applications and experiments.	N/A	N/A

3.1.1.4 Broadcast address

A broadcast address is a network address used to send data packets to all devices on a specific network or subnet. When a device sends a packet to the broadcast address, all devices on that network will receive and process the packet1. This is useful for tasks like network discovery or sending updates to multiple devices simultaneously.

3.1.1.5 Loop back address

A loopback address is a special IP address that a computer uses to communicate with itself. This address is mainly used for testing and diagnostic purposes, ensuring that the TCP/IP stack on the machine is functioning correctly.

IPv4 Loopback Address: The most commonly used loopback address in IPv4 is 127.0.0.1. Any IP address in the range 127.0.0.0 to 127.255.255.255 is considered a loopback address.

Used for:

- Allow a machine to test its own network interfaces and services.

- Developers often use loopback addresses to test applications locally without needing a network connection.
- Helps isolate network traffic meant for internal communication within the same machine.

When you ping the loopback address (ping 127.0.0.1 for IPv4 or ping ::1 for IPv6), it verifies that the network stack is installed and functioning properly.

3.2 Subnetting

3.2.1 4 steps to subnet - example requested number of networks

A) Identify the Class and Default Subnet Mask

Class	Start	Default Subnet Mask
A	1-126	255.0.0.0
B	128-191	255.255.0.0
C	192-223	255.255.255.0

B) Determine Subnetting Needs

1. Calculate the required number of subnets or hosts.
2. Use powers of 2 (2, 4, 8, 16, 32, 64, 128) to find the closest match.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

Each power of 2 represents the number of subnets or hosts possible by borrowing one more bit.

C) Determine the New Subnet Mask

1. **Borrow bits** from the host portion of the default mask.
2. For each borrowed bit, add the corresponding value (128, 64, 32, 16, 8, 4, 2, 1) to the last octet of the subnet mask.

D) Determine the Subnet Increment

1. Subtract the new subnet mask's last octet value from 256.
2. This value is the increment used to define the range of each subnet.

E) Calculate Subnet Details

1. Start with 0 and add the increment to find the starting address of each subnet.
2. Network Address: The first address in each subnet.
3. First Usable IP: The address after the network address.
4. Last Usable IP: The address before the broadcast address.
5. Broadcast Address: The last address in the subnet.

F) Verify Usable Ips

Subtract 2 from the total number of IPs in each subnet. One IP for the network address and one for the broadcast address.

3.2.1.1 Example: Class A Network

IP: 10.0.0.0

Subnets needed: 10

1. **Identify the class of the IP**

   10.0.0.0 , IP is class A

   Use powers of 2 (2, 4, 8, 16, 32, 64, 128) to find the closest match to 10 subnets

   Three bits will only give me 8 , next value is 16 (2^4).

   Need 4 bits

   Number of Subnets = 2^number of borrowed bits = 2^4 = 16

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

2. **Borrow * 4 bits of class A network mask 255.0.0.0**

   Class B Octets for Network Mask

N	N	H	H
255	0	0	0
255	240 (128+64+32+16)	0	0

New subnet mask 255.240.0.0

Second octet

8	7	6	5	4	3	2	1
128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
N	**N**	**N**	**N**	**H**	**H**	**H**	**H**

(*) Borrowing Bits: Taking bits from the host portion of the IP address to create more subnets. From left to right.

Total IPs per Subnet=2^number of host bits = 2^20 = 1,048,576

3. **Increment = 256 - 240 = 16**

4. **Subnets**

   Start with 0 (in the octet that changed = third octet) and add the increment .

   We have 16 subnets; I just need 10

Subnetworks	Usable IP Range		Broadcast Address
10.0.0.0	10.0.0.1	10.15.255.254	10.15.255.255
10.16.0.0	10.16.0.1	10.31.255.254	10.31.255.255
10.32.0.0	10.32.0.1	10.47.255.254	10.47.255.255
10.48.0.0	10.48.0.1	10.63. 255.254	10.63.255.255
10.64.0.0	10.64.0.1	10.79.255.254	10.79.255.255
10.80.0.0	10.80.0.1	10.95.255.254	10.95.255.255
10.96.0.0	10.96.0.1	10.111.255.254	10.111.255.255
10.112.0.0	10.112.0.1	10.127.255.254	10.127.255.255
10.128.0.0	10.128.0.1	10.143.255.254	10.143.255.255
10.144.0.0	10.144.0.1	10.159.255.254	10.159.255.255
10.160.0.0	10.160.0.1	10.175.255.254	10.175.255.255
10.176.0.0	10.176.0.1	10.191.255.254	10.191.255.255
10.192.0.0	10.192.0.1	10.207.255.254	10.207.255.255
10.208.0.0	10.209.0.1	10.223.255.254	10.223.255.255
10.224.0.0	10.224.0.1	10.239.255.254	10.239.255.255
10.240.0.0	10.240.0.1	10.255.255.254	10.255.255.255

3.2.1.2 Example: Class B Network

IP: 172.16.0.0

Subnets needed: 10

1. **Identify the class of the IP**

   172.16.0.0 , IP is class B

   Use powers of 2 (2, 4, 8, 16, 32, 64, 128) to find the closest match to 10 subnets

   Three bits will only give me 8 , next value is 16 (2^4).

   Need 4 bits – so number of subnets will be 16

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

2. **Borrow * 4 bits of class B network mask 255.255.0.0**

   Class B Octets for Network Mask

N	N	H	H
255	255	0	0
255	255	240 (128+64+32+16)	0

New subnet mask 255.255.240.0

Third octet

8	7	6	5	4	3	2	1
128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
$\mathbf{2^7}$	$\mathbf{2^6}$	$\mathbf{2^5}$	$\mathbf{2^4}$	$\mathbf{2^3}$	$\mathbf{2^2}$	$\mathbf{2^1}$	$\mathbf{2^0}$
N	**N**	**N**	**N**	**H**	**H**	**H**	**H**

(*) Borrowing Bits: Taking bits from the host portion of the IP address to create more subnets. From left to right.

Total usable IPs per Subnet=2^number of host bits – 2 = 2^12 = 4,096 -2 = 4094 (one for network address, one for broadcast address).

3. **Increment = 256 - 240 = 16**
4. **Subnets**

   Start with 0 (in the octet that changed = third octect) and add the increment .

   We have 16 subnets; I just need 10

Subnetworks	Usable IP Range		Broadcast Address
172.16.0.0	172.16.0.1	172.16.15.254	172.16.15.255
172.16.16.0	172.16.16.1	172.16.31.254	172.16.31.255
172.16.32.0	172.16.32.1	172.16.47.254	172.16.47.255
172.16.48.0	172.16.48.1	172.16.63.254	172.16.63.255
172.16.64.0	172.16.64.1	172.16.79.254	172.16.79.255
172.16.80.0	172.16.80.1	172.16.95.255	172.16.95.255
172.16.96.0	172.16.96.1	172.16.111.254	172.16.111.255
172.16.112.0	172.16.112.1	172.16.127.254	172.16.127.255
172.16.128.0	172.16.128.1	172.16.143.254	172.16.143.255
172.16.144.0	172.16.144.1	172.16.159.254	172.16.159.255
172.16.160.0	172.16.160.1	172.16.175.254	172.16.175.255
172.16.176.0	172.16.176.1	172.16.191.254	172.16.191.255
172.16.192.0	172.16.192.1	172.16.207.254	172.16.207.255
172.16.208.0	172.16.208.1	172.16.223.254	172.16.223.255
172.16.224.0	172.16.224.1	172.16.239.254	172.16.239.255
172.16.240.0	172.16.240.1	172.16.255.254	172.16.255.255

3.2.1.3 Example: Class C Network

IP: 192.168.1.0

Subnets needed: 5

1. Identify the class of the IP 192.168.1.0, IP is class C

   Use powers of 2 (2, 4, 8, 16, 32, 64, 128) to find the closest match to 5 subnets

   Two bits will only give me 4 , next value is 8 (2^3).

Need 3 bits - – so number of subnets will be 8

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

2. Borrow * 3 bits of class C network mask 255.255.255.0

   Class C Octets for Network Mask

N	N	N	H
255	255	255	0
255	255	255	224 (128+64+32)

Last octet

8	7	6	5	4	3	2	1
128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
N	**N**	**N**	**H**	**H**	**H**	**H**	**H**

(*) Borrowing Bits: Taking bits from the host portion of the IP address to create more subnets. From left to right.

3. Increment = 256 - 224 = 32

4. Subnets

   Start with 0 and add the increment

   We

   have 8 subnets; I just need 5

Subnetworks	Usable IP Range		Broadcast Address
192.168.1.0	1	30	192.168.1.31
192.168.1.32	33	62	192.168.1.63
192.168.1.64	65	94	192.168.1.95
192.168.1.96	97	126	192.168.1.127
192.168.1.128	129	158	192.168.1.159
192.168.1.160	161	190	192.168.1.191

192.168.1.192	193	222	192.168.1.223
192.168.1.224	225	254	192.168.1.255

3.2.2 4 steps to subnet - example requested number of hosts

We previously determined that to divide a network into at least 5 subnets, we needed to create 8 subnets because subnetting must be done in powers of 2 (1, 2, 4, 8, 16, etc.). Now, let's slightly modify the problem.

Instead of requiring 5 networks, we now need **14 host addresses per network**.

Understanding Host Requirements

For every subnet, we must allocate:

- One IP address for the network identifier
- One IP address for the broadcast address

Thus, if we need **14 usable host addresses**, we require **16 total IP addresses** (14 usable + 2 reserved).

Step 1: Identify the Class and Default Subnet Mask

- Assume we are using a **Class C address** (**192.168.10.0**).
- The default subnet mask for Class C is **255.255.255.0**.
- Class C addresses provide **8 host bits** to work with.

N	N	N	H
255	255	255	0

Step 2: Determine the Number of Hosts Needed

- We need **14 usable host addresses per subnet**.
- The closest power of 2 that accommodates this is **16** (**2^4 = 16**).
- Therefore, we must **retain 4 host bits** and borrow the remaining bits for subnetting.

Step 3: Allocate Network and Host Bits

- Class C addresses have **8 bits** available for hosts.
- Since we need **4 bits for hosts**, we use the remaining **4 bits for subnetting**.
- The borrowed bits allow us to create **2^4 = 16 subnets**.

Step 4: Calculate the New Subnet Mask

- The new subnet mask is obtained by adding the borrowed bits:
  - **128 + 64 + 32 + 16 = 240**
  - **New subnet mask: 255.255.255.240**

	OCTET 1								OCTET 2								OCTET 3								OCTET 4							
	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	H	H	H	H
New mask	255								255								255								240 (128+64+32+16)				0			
Standard Mask	255								255								255								0							

Number of Usable IPs per Subnet = 2^number of host bits – 2 = (2^4) – 2 =16 -2 = 14

So, each subnet will have 14 usable IP addresses.

Step 5: Determine the Subnet Increments

- The subnet increment is calculated as:
  - **256 - 240 = 16**
- The subnet ranges will be:
  - **0, 16, 32, 48, 64, 80, 96, 112, 128, 144, 160, 176, 192, 208, 224, 240**

Step 6: Calculate Addresses

Network Address	First Usable IP	Last Usable IP	Broadcast Address
192.168.10.**0**	192.168.10.1	192.168.10.14	192.168.10.15
192.168.10.**16**	192.168.10.17	192.168.10.30	192.168.10.31
192.168.10.**32**	192.168.10.33	192.168.10.46	192.168.10.47
192.168.10.**48**	192.168.10.49	192.168.10.62	192.168.10.63

192.168.10.**64**	192.168.10.65	192.168.10.78	192.168.10.79
192.168.10.**80**	192.168.10.81	192.168.10.94	192.168.10.95
192.168.10.**96**	192.168.10.97	192.168.10.110	192.168.10.111
192.168.10.**112**	192.168.10.113	192.168.10.126	192.168.10.127
192.168.10.**128**	192.168.10.129	192.168.10.142	192.168.10.143
192.168.10.**144**	192.168.10.145	192.168.10.158	192.168.10.159
192.168.10.**160**	192.168.10.161	192.168.10.174	192.168.10.175
192.168.10.**176**	192.168.10.177	192.168.10.190	192.168.10.191
192.168.10.**192**	192.168.10.193	192.168.10.206	192.168.10.207
192.168.10.**208**	192.168.10.209	192.168.10.222	192.168.10.223
192.168.10.**224**	192.168.10.225	192.168.10.238	192.168.10.239
192.168.10.**240**	192.168.10.241	192.168.10.254	192.168.10.255

3.3 CISCO IOS Commands & Procedures Overview

3.3.1 IPv4 & IPv6 Loopback /interfaces

Enabling and assigning a loopback address

```
Router(config)# interface loopback number

Router(config-if)# ip address ip-address subnet-mask

Router(config-if)# ipv6 address ipv6-address/prefix-length
```

Example:

```
Router(config)# interface loopback 0
Router(config-if)# ip address 10.0.0.1 255.255.255.0

Router(config-if)# ipv6 address 2001:db8:acad:1::1/64
```

3.3.2 VLAN Configuration

3.3.2.1 VLAN Creation

```
S1# configure terminal
S1(config)# vlan 20
S1(config-vlan)# name student
S1(config-vlan)# end
```

3.3.2.2 VLAN Port Assignment

```
S1# configure terminal
S1(config)# interface fa0/6
S1(config-if)# switchport mode access
S1(config-if)# switchport access vlan 20 S1(config-if)# end
```

3.3.2.3 Data and Voice VLANs

```
S3(config)# vlan 20
S3(config-vlan)# name student
S3(config-vlan)# vlan 150
S3(config-vlan)# name VOICE
S3(config-vlan)# exit
S3(config)# interface fa0/18
S3(config-if)# switchport mode access
S3(config-if)# switchport access vlan 20
S3(config-if)# mls qos trust cos
S3(config-if)# switchport voice vlan 150
S3(config-if)# end
```

3.3.3 Trunk Configuration

3.3.3.1 Trunk configuration

```
S1(config)# interface fastEthernet 0/1
S1(config-if)# switchport mode trunk
S1(config-if)# switchport trunk native vlan 99
S1(config-if)# switchport trunk allowed vlan 10,20,30,99
S1(config-if)# end
```

3.3.3.2 Verify Trunk Configuration

```
S1# show interfaces fa0/1 switchport
S1# show interface trunk
```

3.3.3.3 Reset The Trunk to the Default State

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

3.3.4 DTP Configuration

```
Switch(config-if)# switchport mode dynamic auto
```

or

```
Switch(config-if)# switchport mode dynamic desirable
```

3.3.4.1 *Enable trunking from a Cisco switch to a device that does not support DTP*

```
S1(config-if)# switchport mode trunk
S1(config-if)# switchport nonegotiate
```

3.3.5 Router-on-a-Stick /nter-VLAN Routing

Step 1. Create and name the VLANs.

```
S1(config)# vlan 10
S1(config-vlan)# name LAN10
S1(config-vlan)# exit
S1(config)# vlan 20
S1(config-vlan)# name LAN20
S1(config-vlan)# exit
S1(config)# vlan 99
S1(config-vlan)# name Management
S1(config-vlan)# exit
```

Step 2. Create the management interface.

```
S1(config)# interface vlan 99
S1(config-if)# ip add 192.168.99.2 255.255.255.0
S1(config-if)# no shut
S1(config-if)# exit
S1(config)# ip default-gateway 192.168.99.1
```

Step 3. Configure access ports.

```
S1(config)# interface fa0/6
S1(config-if)# switchport mode access
S1(config-if)# switchport access vlan 10
S1(config-if)# no shut
S1(config-if)# exit
```

Step 4. Configure trunking ports.

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

Step 5. On the Router, create subinterfaces for each VLAN, configure dot1q encapsulation and IP addresses for each subinterface and enable the physical interface interface.

```
R1(config)# interface G0/0/1.10
R1(config-subif)# description Default Gateway for VLAN  10
R1(config-subif)# encapsulation dot1Q  10
R1(config-subif)# ip add 192.168.10.1  255.255.255.0
R1(config-subif)# exit
R1(config)#
R1(config)# interface G0/0/1.20
R1(config-subif)# description Default  Gateway for VLAN 20
R1(config-subif)# encapsulation dot1Q  20
R1(config-subif)# ip add 192.168.20.1  255.255.255.0
R1(config-subif)# exit
R1(config)#
R1(config)# interface G0/0/1.99
R1(config-subif)# description Default  Gateway for VLAN 99
R1(config-subif)# encapsulation dot1Q  99 native
R1(config-subif)# ip add 192.168.99.1  255.255.255.0
R1(config-subif)# exit
R1(config)#
R1(config)# interface G0/0/1
R1(config-if)# description Trunk link  to S1
R1(config-if)# no shut
R1(config-if)# end
```

Step 6. Verify connectivity between PCs using ping command.

Step 7. Verify and troubleshoot Inter-VLAN routing.

- `show ip route`
- `show ip interface brief`
- `show interfaces`
- `show interfaces trunk`

3.3.6 Layer 3 Switch /Inter-VLAN Routing

Step 1. Create the VLANs - First, create the two VLANs as shown in the output.

```
S1(config)# vlan 10
S1(config-vlan)# name LAN10
S1(config-vlan)# vlan 20
S1(config-vlan)# name LAN20
S1(config-vlan)# exit
```

Step 2. Create the SVI VLAN interfaces - Configure the SVI for VLANs 10 and 20. The IP addresses that are configured will serve as the default gateways to the hosts in the respective VLANs.

```
S1(config)# interface vlan 10
S1(config-if)# description Default Gateway SVI for 192.168.10.0/24
S1(config-if)# ip add 192.168.10.1 255.255.255.0
S1(config-if)# no shut
S1(config-if)# exit S1(config)# int vlan 20
S1(config-if)# description Default Gateway SVI for 192.168.20.0/24
S1(config-if)# ip add 192.168.20.1 255.255.255.0
S1(config-if)# no shut
S1(config-if)# exit
```

Step 3. Configure access ports - Next, configure the access ports connecting to the hosts and assign them to their respective VLANs.

```
S1(config)# interface GigabitEthernet1/0/6
S1(config-if)# description Access port to PC1
S1(config-if)# switchport mode access S1(config-if)# switchport access vlan 10
S1(config-if)# exit
S1(config)# interface GigabitEthernet1/0/18
S1(config-if)# description Access port to PC2
S1(config-if)# switchport mode access S1(config-if)# switchport access vlan 20
S1(config-if)# exit
```

Step 4. Enable IP routing - Finally, enable IPv4 routing with the ip routing global configuration command to allow traffic to be exchanged between VLANs 10 and 20. This command must be configured to enable inter-VAN routing on a Layer 3 switch for IPv4.

```
S1(config)# ip routing
```

Step 5. Configure the routed port - Configure G0/0/1 to be a routed port, assign it an IPv4 address, and enable it.

```
S1(config)# interface GigabitEthernet0/0/1
S1(config-if)# description routed Port Link to R1
S1(config-if)# no switchport
S1(config-if)# ip address 10.10.10.2 255.255.255.0
S1(config-if)# no shut
S1(config-if)# exit
```

Step 6. Configure routing - Configure the OSPF routing protocol to advertise the VLAN 10 and VLAN 20 networks, along with the network that is connected to R1.

```
S1(config)# router ospf 10
S1(config-router)# network 192.168.10.0 0.0.0.255 area 0
S1(config-router)# network 192.168.20.0 0.0.0.255 area 0
S1(config-router)# network 10.10.10.0 0.0.0.3 area 0
S1(config-router)# end
```

Step 7. Verify routing - Verify the routing table on D1. Notice that D1 now has a route to the 10.20.20.0/24 network.

```
S1# show ip route | begin Gateway
```

Step 8. Verify connectivity - At this time, PC1 and PC2 are able to ping the server connected to R1.

3.3.7 Configure a MultiLayer Switch Connected Between the Internet and a Switch

Step 1. On MLS, configure G0/2 as a routed port and assign an IP address. This is the interface that would be connected to the internet or another router.

```
MLS(config)# interface g0/2
MLS(config-if)# no switchport
MLS(config-if)# ip address 209.165.200.225 255.255.255.252
MLS(config-if)# ipv6 address 2001:db8:acad:a::1/64
```

Step 2. Add VLANs to MLS.

Step 3. Configure and activate the SVI interfaces for VLANs.

```
MLS(config)# interface vlan 10
MLS(config-if)# ip address 192.168.10.254 255.255.255.0
MLS(config-if)# ipv6 address 2001:db8:acad:10::1/64
MLS(config)# interface vlan 20
MLS(config-if)# ip address 192.168.20.254 255.255.255.0
MLS(config-if)# ipv6 address 2001:db8:acad:20::1/64
MLS(config)# interface vlan 30
MLS(config-if)# ip address 192.168.30.254 255.255.255.0
MLS(config-if)# ipv6 address 2001:db8:acad:30::1/64
MLS(config)# interface vlan 99
MLS(config-if)# ip address 192.168.99.254 255.255.255.0
```

Step 4. Configure Trunking on MLS. Trunk configuration differs slightly on a Layer 3 switch. On the Layer 3 switch, the trunking interface needs to be encapsulated with the dot1q protocol, however it is not necessary to specify VLAN numbers as it is when working with a router and subinterfaces. This interface would be connected to another switch.

```
MLS(config)# int g0/1
MLS(config-if)# switchport mode trunk
MLS(config-if)# switchport trunk native vlan 99
MLS(config-if)# switchport trunk encapsulation dot1q
```

Step 5. Enable routing on MLS.

```
MLS(config)# ip routing
MLS(config)# ipv6 unicast-routing
```

Step 6. Configure Trunking on the switch connected at the other end.

```
S1# config t
S1(config)# int g0/1
```

```
S1(config-if)# switchport mode trunk
S1(config-if)# switchport trunk native vlan 99
```

3.3.8 EtherChannel

Step 1. On each switch, configure the ports that will be used in the Port Channels as static trunk ports.

SWA

```
SWA# conf t
SWA(config)# int g0/1
SWA(config-if)# switchport mode trunk
SWA(config-if)# int g0/2
SWA(config-if)# switchport mode trunk
SWA(config-if)# int F0/21
SWA(config-if)# switchport mode trunk
SWA(config-if)# int f0/22
SWA(config-if)# switchport mode trunk
```

SWB

```
SWB# conf t
SWB(config)# int g0/1
SWB(config-if)# switchport mode trunk
SWB(config-if)# int g0/2
SWB(config-if)# switchport mode trunk
SWB(config-if)# int F0/23
SWB(config-if)# switchport mode trunk
SWB(config-if)# int f0/24
SWB(config-if)# switchport mode trunk
```

SWC

```
SWC# conf t
SWC(config)# int F0/21
SWC(config-if)# switchport mode trunk
SWC(config-if)# int f0/22
SWC(config-if)# switchport mode trunk
SWC(config-if)# int F0/23
SWC(config-if)# switchport mode trunk
SWC(config-if)# int f0/24
SWC(config-if)# switchport mode trunk
```

Step 2. Specify the interfaces that compose the EtherChannel group using the interface range *interjace* global configuration mode command. Create the port channel interface with the channel-group *number* mode {active I passive I desirable I auto} command in interface range configuration mode. LACP modes are active and passive, PAgP modes are desirable and auto.

SWA

```
SWA# config t
SWA(config)# int range g0/1-2
SWA(config-if-range)# shutdown
```

```
SWA(config-if-range)# channel-group 1 mode desirable
SWA(config-if-range)# no shutdown
SWA(config-if-range)# int range f0/21-22
SWA(config-if-range)# shutdown
SWA(config-if-range)# channel-group 2 mode active
SWA(config-if-range)# no shutdown
SWA(config-if-range)# exit
```

SWB

```
SWB# config t
SWB(config)# int range g0/1 - 2
SWB(config-if-range)# shutdown
SWB(config-if-range)# channel-group 1 mode desirable
SWB(config-if-range)# no shutdown
SWB(config-if-range)# int range f0/23 - 24
SWB(config-if-range)# shutdown
SWB(config-if-range)# channel-group 3 mode passive
SWB(config-if-range)# no shutdown
SWB(config-if-range)# exit
```

Step 3. Set the port-channel to trunk and configure allowed VLANs on all switches.

```
SWA(config)# interface port-channel 1
SWA(config-if)# switchport mode trunk

SWA(config-if)# switchport trunk allowed vlan 1,2,20
```

Step 4. Verify EtherChannel

- `show interfaces port-channel 1`
- `show etherchannel summary`
- `show etherchannel port-channel`
- `show interfaces f0/1 etherchannel`

3.3.8.1 Troubleshoot EtherChannel

Step 1. View the EtherChannel Summary Information

```
S1# show etherchannel summary
```

Step 2. View Port Channel Configuration

```
S1# show run | begin interface port-channel
```

Step 3: Correct the Misconfiguration

```
S1(config)# no interface port-channel 1
S1(config)# interface range fa0/1 - 2
S1(config-if-range)# shutdown
S1(config-if-range)# channel-group 1 mode {desirable | active}
S1(config-if-range)# no shutdown
S1(config-if-range)# exit
S1(config)# interface port-channel 1
S1(config-if)# switchport mode trunk
S1(config-if)# end
```

Step 4. Verify EtherChannel is Operational

```
S1# show etherchannel summary
```

3.3.9 DHCPv4

3.3.9.1 Configure a Cisco IOS DHCPv4 Server

Step 1. Exclude IPv4 addresses.
Step 2. Define a DHCPv4 pool name.
Step 3. Configure the DHCPv4 pool.

```
R1(config)# ip dhcp excluded-address 192.168.10.1 192.168.10.9
R1(config)# ip dhcp excluded-address 192.168.10.254
R1(config)# ip dhcp pool LAN-POOL-1
R1(dhcp-config)# network 192.168.10.0 255.255.255.0
R1(dhcp-config)# default-router 192.168.10.1
R1(dhcp-config)# dns-server 192.168.11.5
R1(dhcp-config)# domain-name example.com
R1(dhcp-config)# end
```

Optional DHCPv4 pool commands

Task	I0S Command
Define the address pool.	**network** *network-number* [*mask* I / *prejix-length*]
Define the default router or gateway. **Note:** If the DHCP server is configured on another router, use the default gateway address that the hosts are assigned to.	**default-router** address [*address2..address8*]
Define a DNS server.	**dns-server** *address* [*address2.address8*]
Define the domain name.	**domain-name** *domain*
Define the duration of the DHCP lease.	**lease** {*days* [*hours* [*minutes*]] I **infinite**}
Define the NetBIOS WINS server.	**netbios-name-server** *address* [*address2.address8*]

3.3.9.2 DHCPv4 Relay

```
R1(config)# interface g0/0/0
R1(config-if)# ip helper-address DHCP-server-IPv4address
```

```
R1(config-if)# end
```

3.3.9.3 Configure a Cisco Router as a DHCPv4 Client

```
SOHO(config)# interface G0/0/1
SOHO(config-if)# ip address dhcp
SOHO(config-if)# no shutdown
```

3.3.9.4 DHCPv4 Verification Commands

- `show running-config | section dhcp`
- `show ip dhcp binding`
- `show ip dhcp server statistics`

3.3.10 SLAAC

Enable IPv6 Routing

```
R1(config)# ipv6 unicast-routing
```

Verify SLAAC is enabled

```
R1# show ipv6 interface G0/0/1 | section Joined
```

3.3.11 Stateless DHCPv6

3.3.11.1 Configure a Stateless DHCPv6 Server

Step 1. Enable IPv6 routing.

Step 2. Define a DHCPv6 pool name.

Step 3. Configure the DHCPv6 pool.

Step 4. Bind the DHCPv6 pool to an interface.

```
R1(config)# ipv6 unicast-routing
R1(config)# ipv6 dhcp pool IPV6-STATELESS
R1(config-dhcpv6)# dns-server 2001:db8:acad:1::254
R1(config-dhcpv6)# domain-name example.com
R1(config-dhcpv6)# exit
R1(config)# interface GigabitEthernet0/0/1
R1(config-if)# description Link to LAN
R1(config-if)# ipv6 address fe80::1 link-local
R1(config-if)# ipv6 address 2001:db8:acad:1::1/64
R1(config-if)# ipv6 nd other-config-flag
R1(config-if)# ipv6 dhcp server IPV6-STATELESS
R1(config-if)# no shut
R1(config-if)# end
```

Step x. Verify that the hosts have received IPv6 addressing information.

```
C:\PC1> ipconfig /all
```

3.3.11.2 Configure a Stateless DHCPv6 Client

Step 1. Enable IPv6 routing.

Step 2. Configure the client router to create an LLA.
Step 3. Configure the client router to use SLAAC.

```
R3(config)# ipv6 unicast-routing
R3(config)# interface g0/0/1 R3(config-if)# ipv6 enable
R3(config-if)# ipv6 address autoconfig
R3(config-if)# end
```

Step 4. Verify that the client router is assigned a GUA.

```
R3# show ipv6 int brief
```

Step 5. Verify that the client router received other necessary DHCPv6 information.

```
R3# Show ipv6 dhcp int g0/0/1
```

3.3.12 Stateful DHCPv6

3.3.12.1 Configure a Stateful DHCPv6 Server

Step 1. Enable IPv6 routing.

Step 2. Define a DHCPv6 pool name.

Step 3. Configure the DHCPv6 pool.

Step 4. Bind the DHCPv6 pool to an interface.

```
R1(config)# ipv6 unicast-routing
R1(config)# ipv6 dhcp pool IPV6-STATEFUL
R1(config-dhcpv6)# dns-server 2001:db8:acad:1::254
R1(config-dhcpv6)# domain-name example.com R1(config-dhcpv6)# exit
R1(config)# interface GigabitEthernet0/0/1 R1(config-if)# description Link to LAN
R1(config-if)# ipv6 address fe80::1 link-local
R1(config-if)# ipv6 address 2001:db8:acad:1::1/64
R1(config-if)# ipv6 nd managed-config-flag R1(config-if)# ipv6 dhcp server IPV6-
STATEFUL
R1(config-if)# no shut
R1(config-if)# end
```

Step 5. Verify that the hosts have received IPv6 addressing information.

```
C:\PC1> ipconfig /all
```

3.3.12.2 Configure a Stateful DHCPv6 Client

Step 1. Enable IPv6 routing.

Step 2. Configure the client router to create an LLA.

Step 3. Configure the client router to use DHCPv6.

```
R3(config)# ipv6 unicast-routing
R3(config)# interface g0/0/1 R3(config-if)# ipv6 enable R3(config-if)# ipv6
address dhcp
R3(config-if)# end
```

Step 4. Verify that the client router is assigned a GUA.

```
R3# show ipv6 int brief
```

Step 5. Verify that the client router received other necessary DHCPv6 information.

3.3.13 DHCPv6 Relay Agent

3.3.13.1 Configure a DHCPv6 Relay Agent

```
R1(config)# interface gigabitethernet 0/0/1
R1(config-if)# ipv6 dhcp relay destination 2001:db8:acad:1::2 G0/0/0
R1(config-if)# exit
```

3.3.13.2 Verify the DHCPv6 Relay Agent

```
R1# show ipv6 dhcp interface
R3# show ipv6 dhcp binding

C:\PC1> ipconfig /all
```

3.3.14 HSRP

Step 1. Configure Hot Standby Routing on a R1 interface connected to a LAN.

```
R1# conf t
R1(config)# int f0/0
R1(config-if)# standby version 2
R1(config-if)# standby 1 ip virtual-gateway-ip-address
R1(config-if)# standby 1 priority 150
R1(config-if)# standby 1 preempt
R1(config-if)# end
```

Note: use preempt to force a new HSRP election process to take place when a higher priority router comes online. With preemption enabled, a router that comes online with a higher HSRP priority will assume the role of the active router.

Step 2. Verify the standby with the show standby command.

```
R1# show standby
```

Step 3. Configure Hot Standby Routing on a R3 interface connected to the other LAN.

```
R3# conf t
R3(config)# int f0/0
R3(config-if)# standby version 2
R3(config-if)# standby 1 ip virtual-gateway-ip-address
R3(config-if)# standby 1 priority 100
R3(config-if)# standby 1 preempt R3(config-if)# end
```

Step 4. Verify the standby with the show standby command. Take note of which router is active and which router is on standby.

```
R3# show standby
```

Step 5. Reconfigure IP address on PC1 & PC2 with the HSRP Virtual Gateway as the default gateway. Verify address change with the show command.

PC1

```
ip ip-address subnet-mask virtual-gateway-ip-address
```

save

show

PC2

```
ip ip-address subnet-mask virtual-gateway-ip-address
```

save

show

3.3.15 SSH

```
R1(config)# ip domain-name example.com
R1(config)# crypto key generate rsa general-keys modulus 1024
R1(config)# username Admin secret Str0ng3rPa55w0rd
R1(config)# ip ssh version 2 *optional*
R1(config)# line vty 0 4
R1(config-line)# transport input ssh
R1(config-line)# login local
```

3.3.16 Port Security

Step 1. Secure unused ports.
Step 2. Manually configure the interface as an access port, then enable port security.

Step 3. Set the maximum number of MAC addresses allowed on a port.
Step 4. Manually configures a static MAC address(es) for each secure MAC address on the port.
Step 5. Enable the switch to dynamically learn the MAC address and "stick" them to the running configuration.
Step 6 ***(optional).*** Enable or disable static aging for the secure port, or to set the aging time or type.
Step 7 ***(optional).*** Set the port security violation mode

```
S1(config)# interface range fa0/8 - 24 S1(config-if-range)# shutdown S1(config)#
interface f0/1
S1(config-if)# switchport mode access
S1(config-if)# switchport port-security
S1(config-if)# switchport port-security maximum value
S1(config-if)# switchport port-security mac-address sticky
S1(config-if)# switchport port-security aging {static | time minutes} S1(config-
if)# switchport port-security aging type {absolute | inactivity}
S1(config-if)# switchport port-security violation {protext | restrict
| shutdown}
```

```
conf t

interface range fa0/8 - 24
 shutdown
 exit

interface f0/1
 switchport mode access
 switchport port-security
 switchport port-security maximum 1
 switchport port-security mac-address sticky
 switchport port-security aging time [minutes]
 switchport port-security aging type {absolute | inactivity}
 switchport port-security violation {protect | restrict | shutdown}
 exit
```

Violation Modes

Shutdown (default) - The port transitions to the error-disabled state immediately, turns off the port

LED, and sends a syslog message. It increments the violation counter. When a secure port is in the error-disabled state, an administrator must re-enable it by entering the **shutdown** and **no shutdown** commands

Restrict - The port drops packets with unknown source addresses until you remove a sufficient number of secure MAC addresses to drop below the maximum value or increase the maximum value. This mode causes the Security Violation counter to increment and generates a syslog message.

Protect - This is the least secure of the security violation modes. The port drops packets with unknown MAC source addresses until you remove a sufficient number of secure MAC addresses to drop below the maximum value or increase the maximum value. No syslog message is sent.

Step 8. Verify port security

```
S1# show port-security
S1# show port-security interface fastethernet 0/1
S1# show run interface fa0/1
S1# show port-security address
```

3.3.17 Mitigate VLAN Hopping Attacks

Step 1. Disable DTP (auto trunking) negotiations on non-trunking ports by using the **switchport mode access** interface configuration command.

Step 2. Disable unused ports and put them in an unused VLAN.
Step 3. Manually enable the trunk link on a trunking port by using the **switchport mode trunk** command.
Step 4. Disable DTP (auto trunking) negotiations on trunking ports by using the **switchport nonegotiate** command.
Step 5. Set the native VLAN to a VLAN other than VLAN 1 by using the **switchport trunk native vlan** *vlan*˛ *number* command.

For example, assume the following:

- FastEthernet ports 0/1 through fa0/16 are active access ports
- FastEthernet ports 0/17 through 0/20 are not currently in use
- FastEthernet ports 0/21 through 0/24 are trunk ports.

VLAN hopping can be mitigated by implementing the following configuration.

```
S1(config)# interface range fa0/1 - 16
S1(config-if-range)# switchport mode access
S1(config-if-range)# exit
S1(config)#
S1(config)# interface range fa0/17 - 20
S1(config-if-range)# switchport mode access
S1(config-if-range)# switchport access vlan 1000
S1(config-if-range)# shutdown
S1(config-if-range)# exit
S1(config)#
S1(config)# interface range fa0/21 - 24 S1(config-if-range)# switchport mode
trunk S1(config-if-range)# switchport nonegotiate
S1(config-if-range)# switchport trunk native vlan 999
S1(config-if-range)# end
S1#
```

3.3.18 DHCP Snooping

Step 1. Enable DHCP snooping by using the **ip dhcp snooping** global configuration command.
Step 2. On trusted ports, use the **ip dhcp snooping trust** interface configuration command.
Step 3. Limit the number of DHCP discovery messages that can be received per second on untrusted ports by using the **ip dhcp snooping limit rate** interface configuration command.
Step 4. Enable DHCP snooping by VLAN, or by a range of VLANs, by using the **ip dhcp snooping** *vlan* global configuration command.

```
S1(config)# ip dhcp snooping
S1(config)# interface f0/1
S1(config-if)# ip dhcp snooping trust
S1(config-if)# exit
S1(config)# interface range f0/5 - 24
S1(config-if-range)# ip dhcp snooping limit rate 6
S1(config-if-range)# exit
S1(config)# ip dhcp snooping vlan 5,10,50-52
S1(config)# end
S1#
```

Step 5. Verify DHCP snooping configuration.

```
S1# show ip dhcp snooping
```

3.3.19 Dynamic ARP /nspection

Step 1. Enable DHCP snooping globally.

Step 2. Enable DHCP snooping on selected VLANs.

Step 3. Enable DAI on selected VLANs.

Step 4. Configure trusted interfaces for DHCP snooping and ARP inspection.

Step 5. Configure DAI to check for both destination or source MAC and IP addresses

```
S1(config)# ip dhcp snooping
S1(config)# ip dhcp snooping vlan 10
S1(config)# ip arp inspection vlan 10
S1(config)# interface fa0/24
S1(config-if)# ip dhcp snooping trust
S1(config-if)# ip arp inspection trust
S1(config-if)# exit
S1(config)# ip arp inspection validate {[src-mac] [dst-mac] [ip]}
```

Step 6. Verify DAI configuration

```
S1# show run | include validate
```

3.3.20 PortFast & BPDU Guard

PortFast can be enabled on an interface by using the **spanning-tree portfast** interface configuration command. Alternatively, Portfast can be configured globally on all access ports by using the **spanning- tree portfast default** global configuration command. BPDU Guard can be enabled on a port by using the **spanning-tree bpduguard enable** interface configuration command. Alternatively, Use the **spanning- tree portfast bpduguard default** global configuration command to globally enable BPDU guard on all PortFast-enabled ports.

Note: Always enable BPDU Guard on all PortFast-enabled ports.

```
S1(config)# interface fa0/1
S1(config-if)# switchport mode access S1(config-if)# spanning-tree portfast
S1(config-if)# spanning-tree bpduguard enable
or

S1(config)# spanning-tree portfast default
S1(config)# spanning-tree portfast bpduguard default
```

To verify whether PortFast is enabled globally you can use either the **show running-config | begin span** command or the **show spanning-tree summary** command. To verify if PortFast is enabled an interface, use the **show running-config interface** *type/number* command, as shown in the following example. The **show spanning-tree interface** *type/number* **detail** command can also be used for verification. To display information about the state of spanning tree, use the **show spanning-tree summary** command.

```
S1# show running-config | begin span
S1# show spanning-tree summary
S1# show running-config interface type/number
S1# show spanning-tree interface type/number detail
```

3.3.21 Basic Network & Wireless Setup

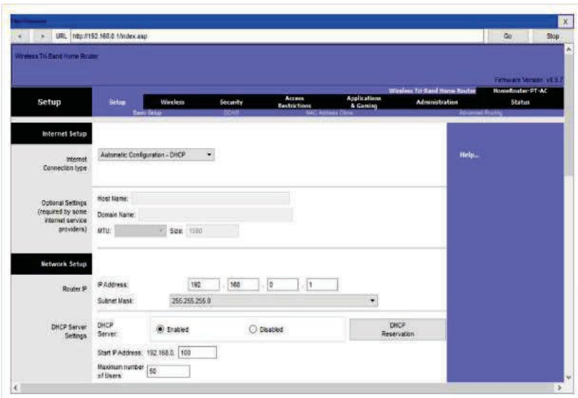
3.3.21.1 Basic Network Setup

Basic network setup includes the following steps:

1. Log in to the router from a web browser.
2. Change the default administrative password.
3. Log in with the new administrative password.
4. Change the default DHCP IPv4 addresses.
5. Renew the IP address.
6. Log in to the router with the new IP address.

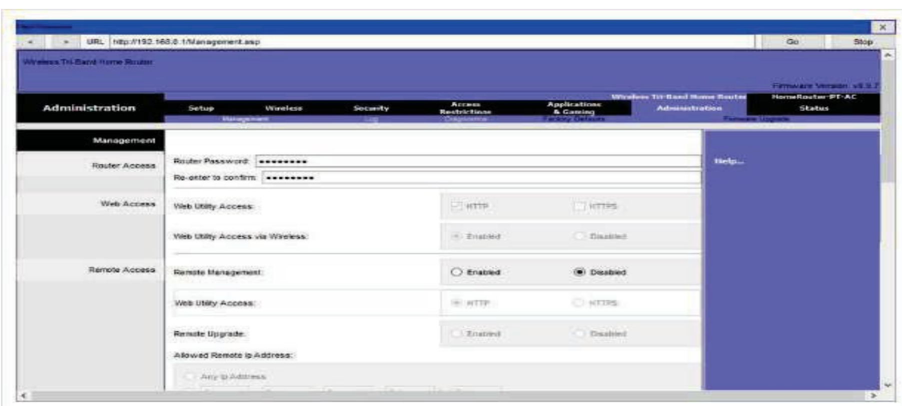
Log in to the router from a web browser.

After logging in, a GUI opens. The GUI will have tabs or menus to help you navigate to various router configuration tasks. It is often necessary to save the settings changed in one window before proceeding to another window. At this point, it is a best practice to make changes to the default settings.



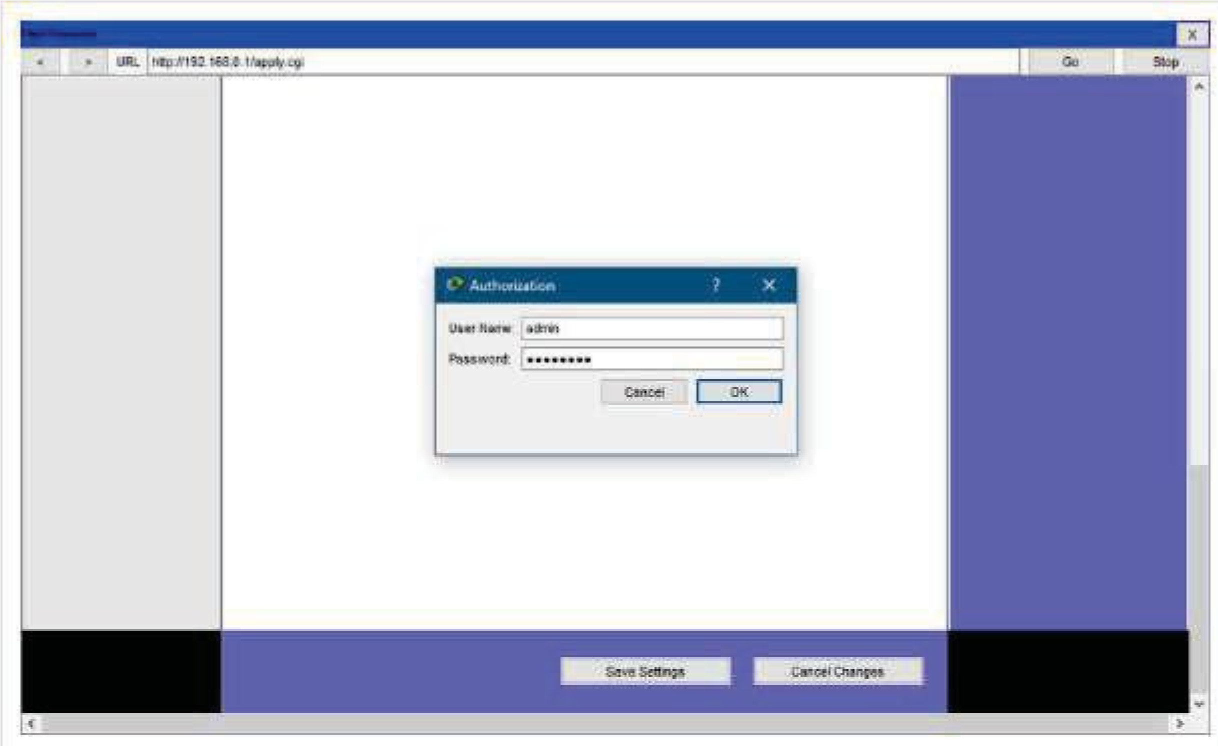
Change the default administrative password.

To change the default login password, find the administration portion of the router's GUI. In this example, the Administration tab was selected. This is where the router password can be changed. On some devices, such as the one in the example, you can only change the password. The username remains admin or whatever the default username is for the router you are configuring.



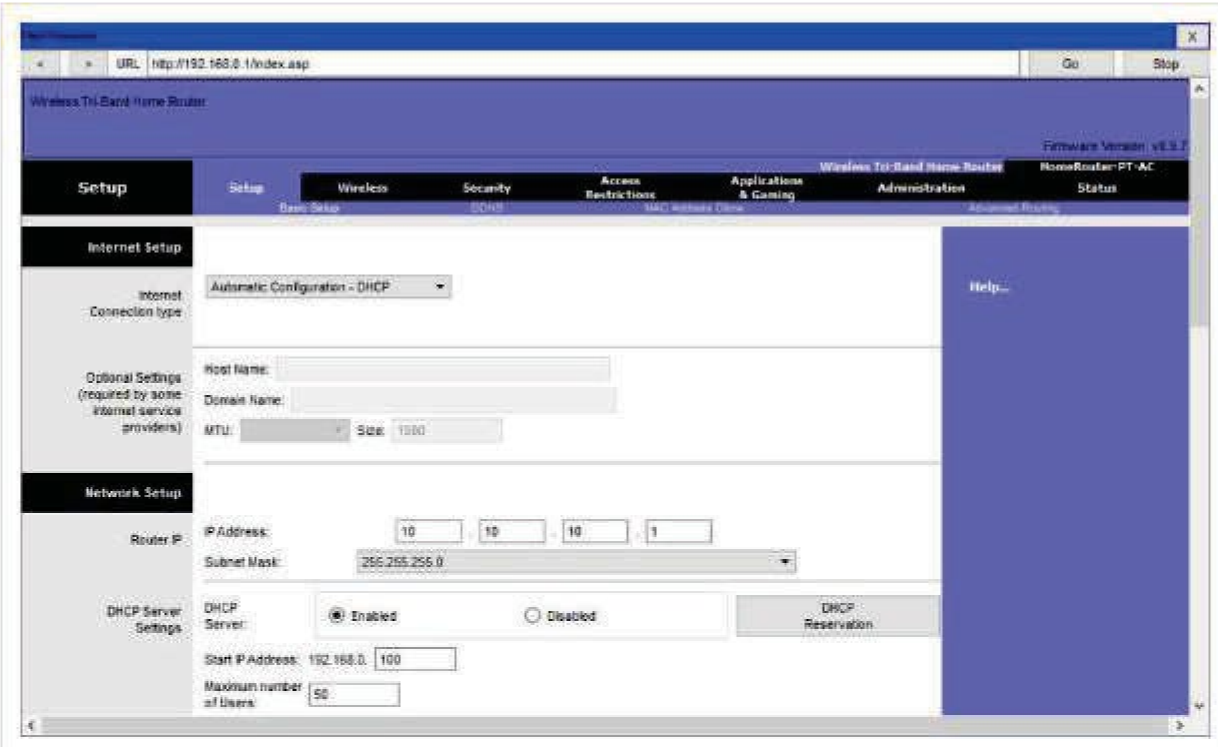
Log in with the new administrative password.

After you save the new password, the wireless router will request authorization again. Enter the username and new password, as shown in the example.


URL
http://192.168.0.1/apply.cgi
Go
Stop
Authorization
User Name:
admin
Password:
Cancel
OK
Save Settings
Cancel Changes

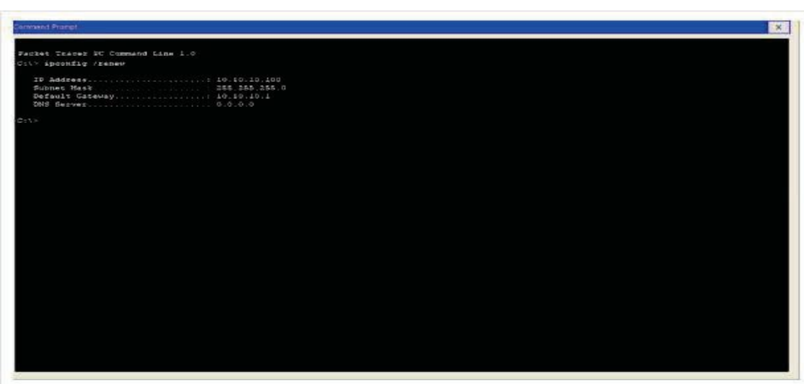
Change the default DHCP IPv4 addresses.

Change the default router IPv4 address. It is a best practice to use private IPv4 addressing inside your network. The IPv4 address 10.10.10.1 is used in the example but it could be any private IPv4 address you choose.



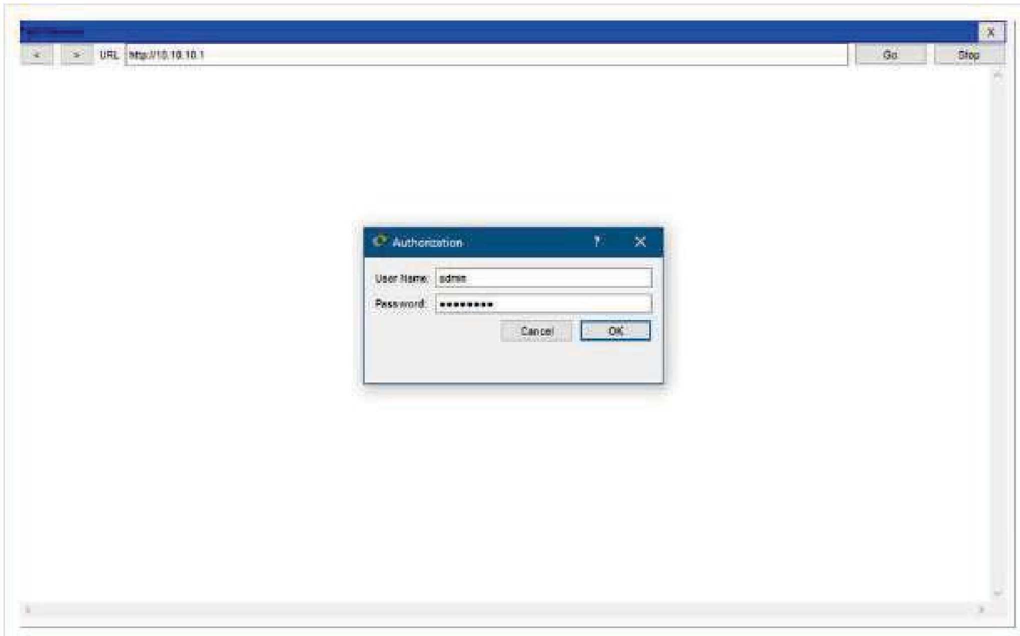
Renew the IP address.

When you click save, you will temporarily lose access to the wireless router. Open a command window and renew your IP address with the ipconfig /renew command, as shown in the example.



Log in to the router with the new IP address.

Enter the router's new IP address to regain access to the router configuration GUI, as shown in the example. You are now ready to continue configuring the router for wireless access.



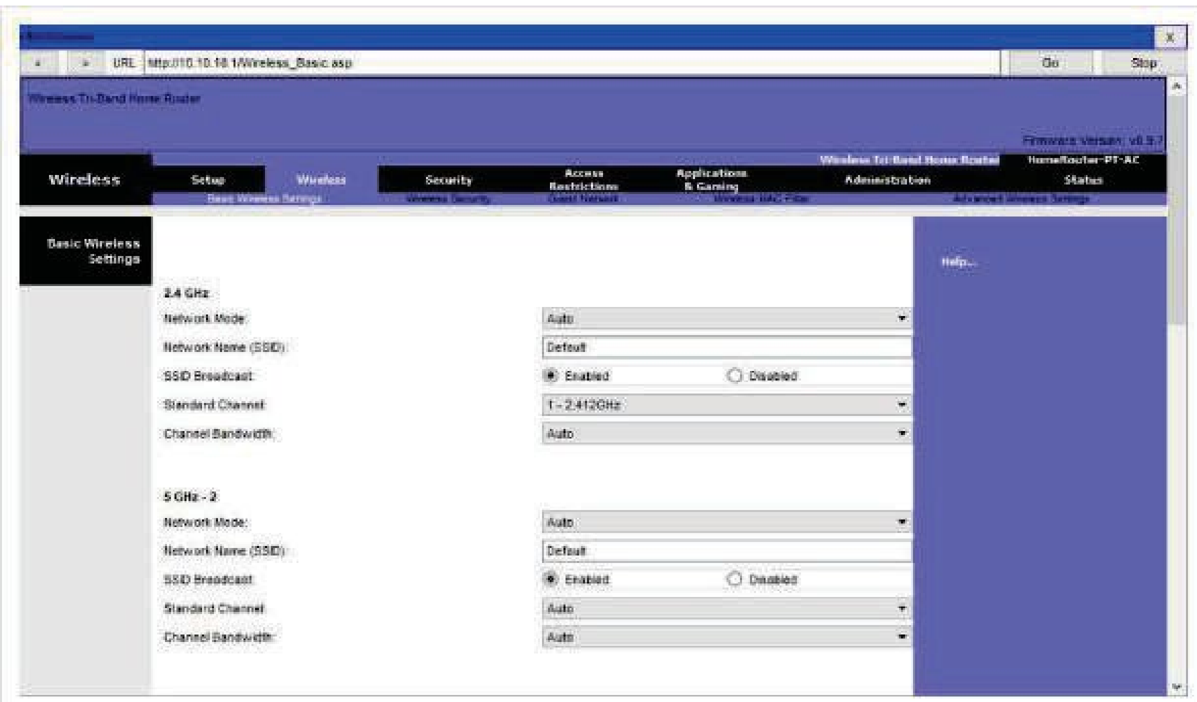
3.3.21.2 Basic Wireless Setup

Basic wireless setup includes the following steps:

1. View the WLAN defaults.
2. Change the network mode.
3. Configure the SSID.
4. Configure the channel.
5. Configure the security mode.
6. Configure the passphrase.

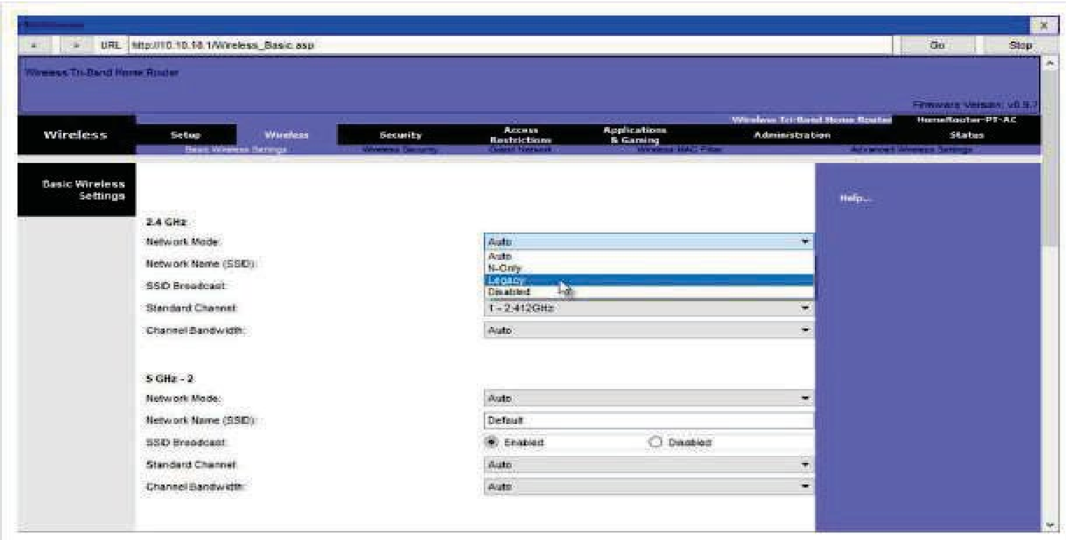
View the WLAN defaults.

Out of the box, a wireless router provides wireless access to devices using a default wireless network name and password. The network name is called the Service Set Identified (SSID). Locate the basic wireless settings for your router to change these defaults, as shown in the example.



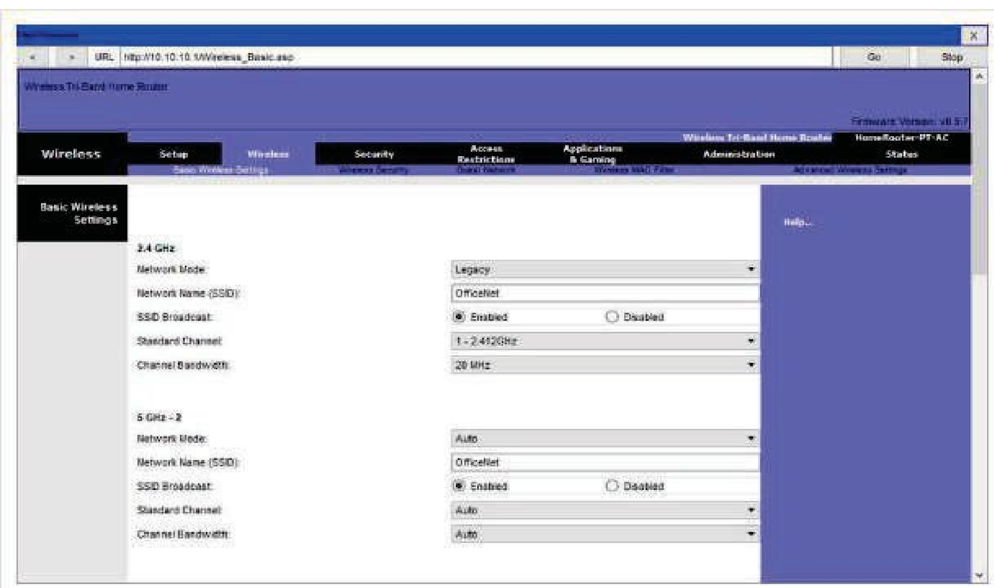
Change the network mode.

Some wireless routers allow you to select which 802.11 standard to implement. The example shows that "Legacy" has been selected. This means wireless devices connecting to the wireless router can have a variety of wireless NICs installed. Today's wireless routers configured for legacy or mixed mode most likely support 802.11a, 802.11n, and 802.11ac NICs.



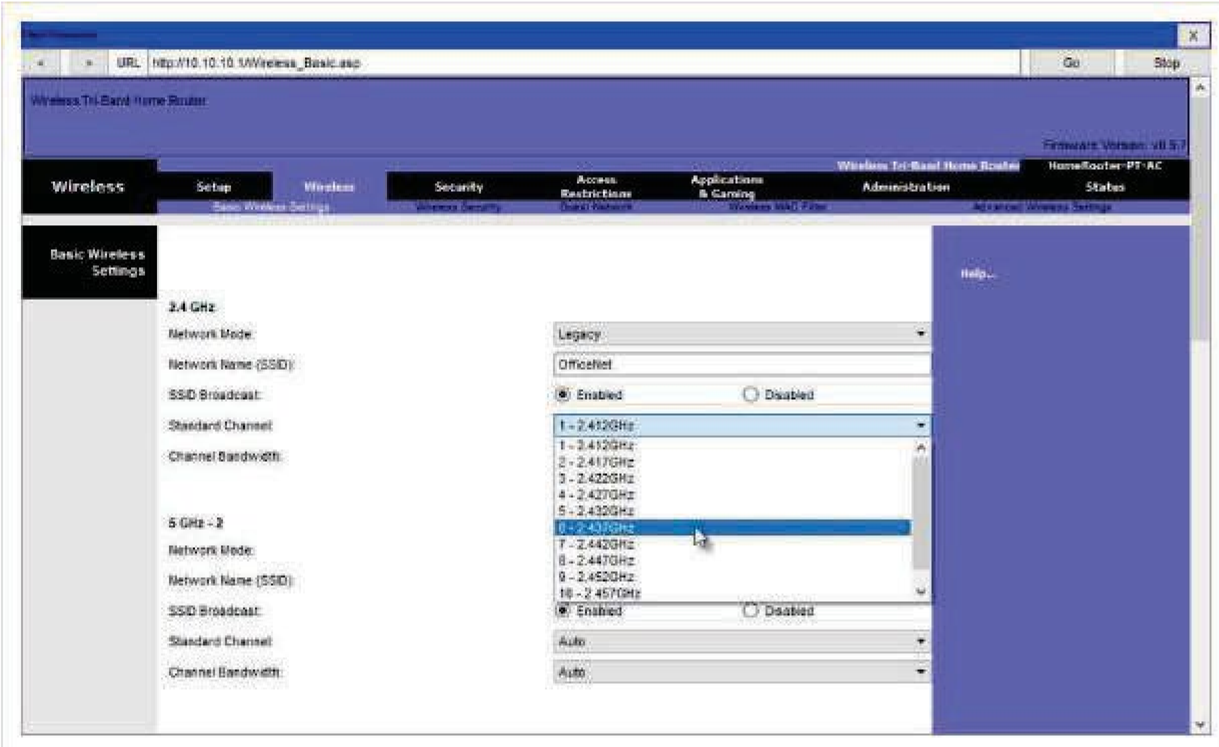
Configure the SSID.

Assign an SSID to the WLANs. OfficeNet is used in the example for all three WLANs (the third WLAN is not shown). The wireless router announces its presence by sending broadcasts advertising its SSID. This allows wireless hosts to automatically discover the name of the wireless network. If the SSID broadcast is disabled, you must manually enter the SSID on each wireless device that connects to the WLAN.



Configure the channel.

Devices configured with the same channel within the 2.4GHz band may overlap and cause distortion, slowing down the wireless performance and potentially break network connections. The solution to avoid interference is to configure non-overlapping channels on the wireless routers and access points that are near to each other. Specifically, channels 1, 6, and 11 are non-overlapping. In the example, the wireless router is configured to use channel 6.

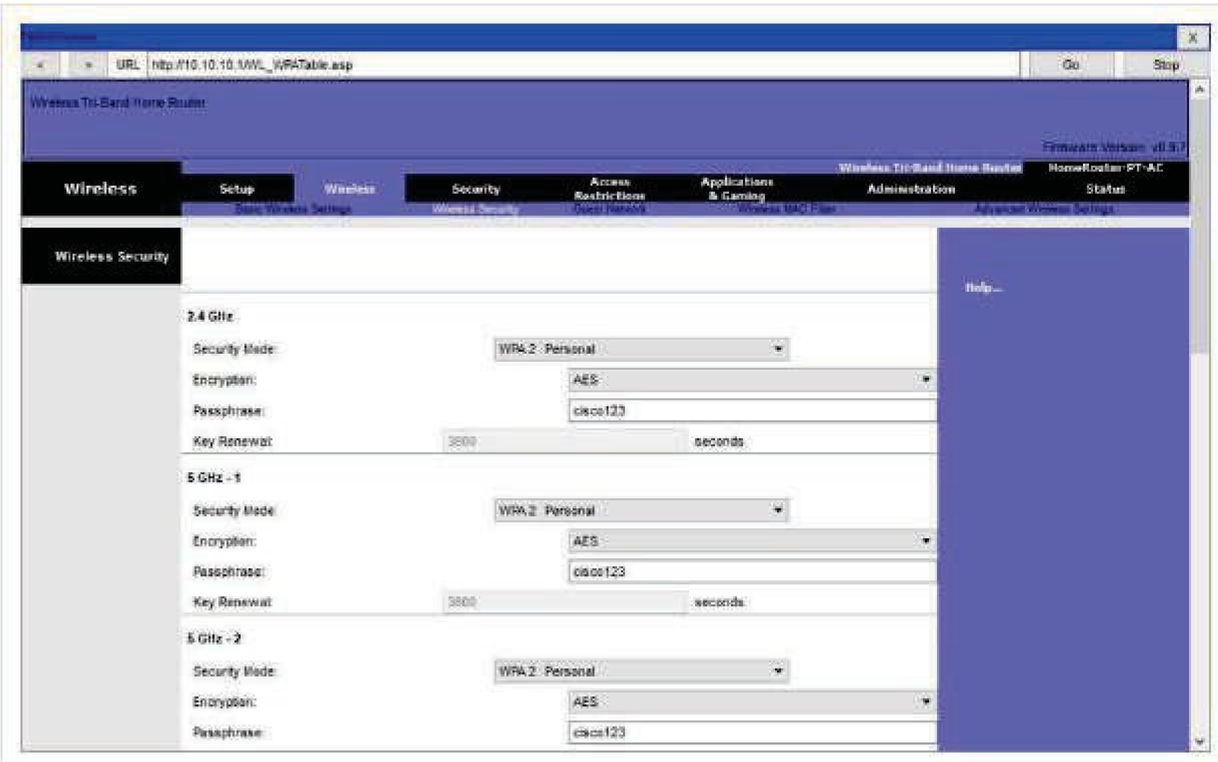


Configure the security mode.

Out of the box, a wireless router may have no WLAN security configured. In the example, the personal version of Wi-Fi Protected Access version 2 (WPA2 Personal) is selected for all three WLANs. WPA2 with Advanced Encryption Standard (AES) encryption is currently the strongest security mode.

Configure the passphrase.

WPA2 personal uses a passphrase to authenticate wireless clients. WPA2 personal is easier to use in a small office or home environment because it does not require an authentication server. Larger organizations implement WPA enterprise and require wireless clients to authenticate with a username and password.



3.3.22 Configure a Basic WLAN on the WLC

Basic WLAN configuration on the WLC includes the following steps:

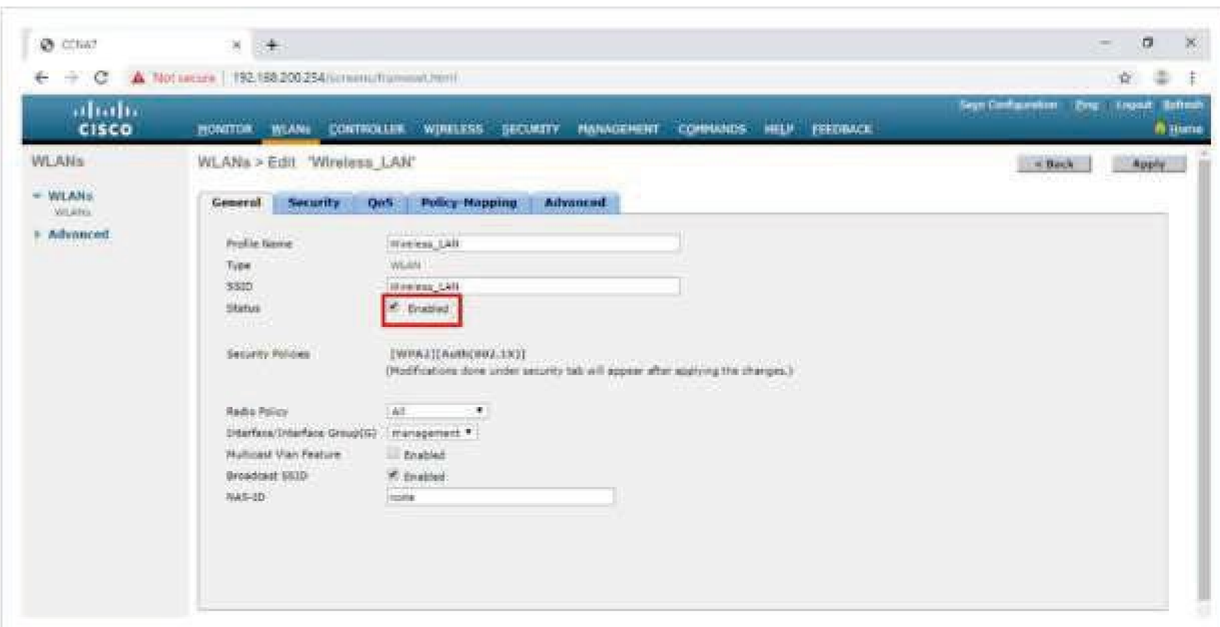
1. Create the WLAN
2. Apply and Enable the WLAN
3. Select the Interface
4. Secure the WLAN
5. Verify the WLAN is Operational
6. Monitor the WLAN
7. View Wireless Client Information

Create the WLAN

In the figure, the administrator is creating a new WLAN that will use **Wireless_LAN** as the name and service set identifier (SSID). The ID is an arbitrary value that is used to identify the WLAN in display output on the WLC.

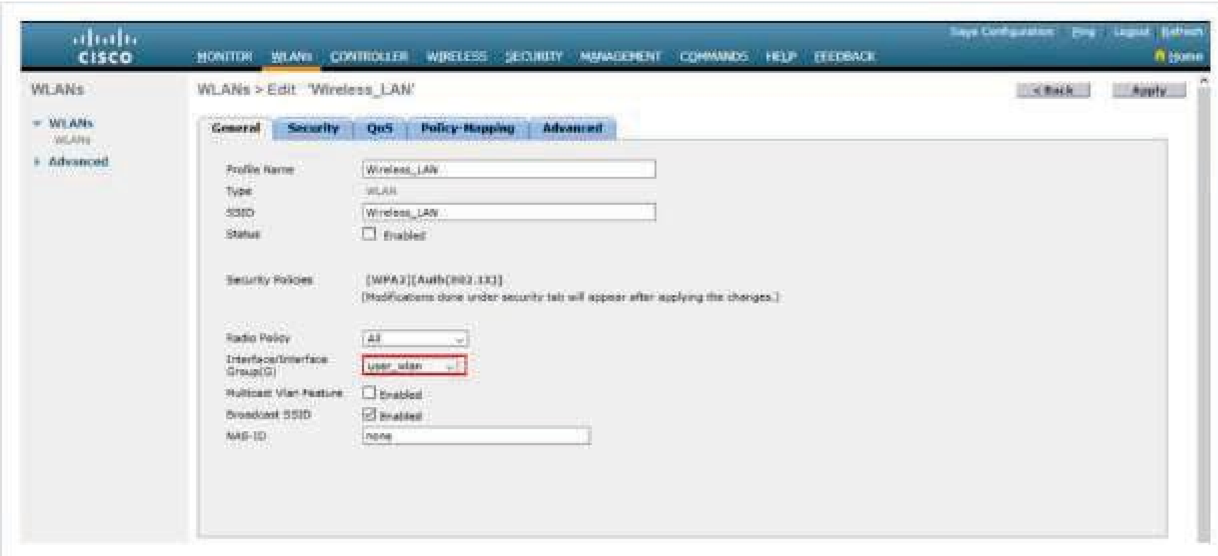
Apply and Enable the WLAN

After clicking **Apply**, the network administrator must enable the WLAN before it can be accessed by users, as shown in the figure. The Enable checkbox allows the network administrator to configure a variety of features for the WLAN, as well as additional WLANs, before enabling them for wireless client access. From here, the network administrator can configure a variety of settings for the WLAN including security, QoS, policies, and other advanced settings.



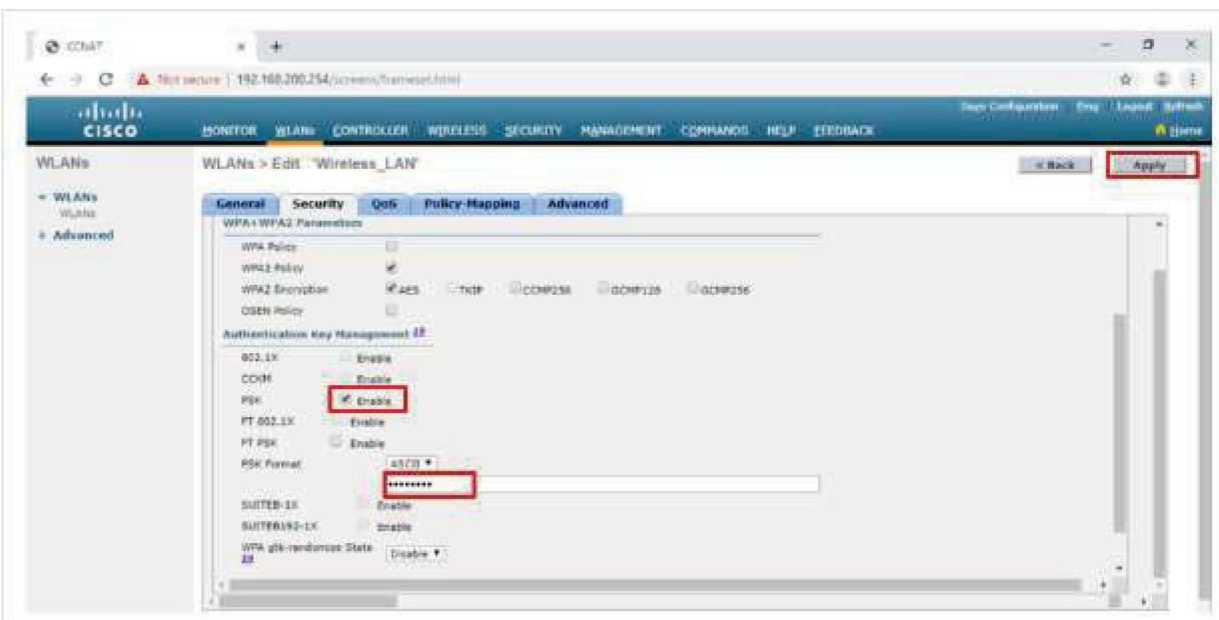
Select the Interface

When you create a WLAN, you must select the interface that will carry the WLAN traffic. The next figure shows the selection of an interface that has already been created on the WLC. We will learn how to create interfaces later in this module.



Secure the WLAN

Click the Security tab to access all the available options for securing the LAN. The network administrator wants to secure Layer 2 with WPA2-PSK. WPA2 and 802.1X are set by default. In the Layer 2 Security drop down box, verify that **WPA+WPA2** is selected (not shown). Click PSK and enter the pre-shared key, as shown in the figure. Then click **Apply**. This will enable the WLAN with WPA2-PSK authentication. Wireless clients that know the pre-shared key can now associate and authenticate with the AP.

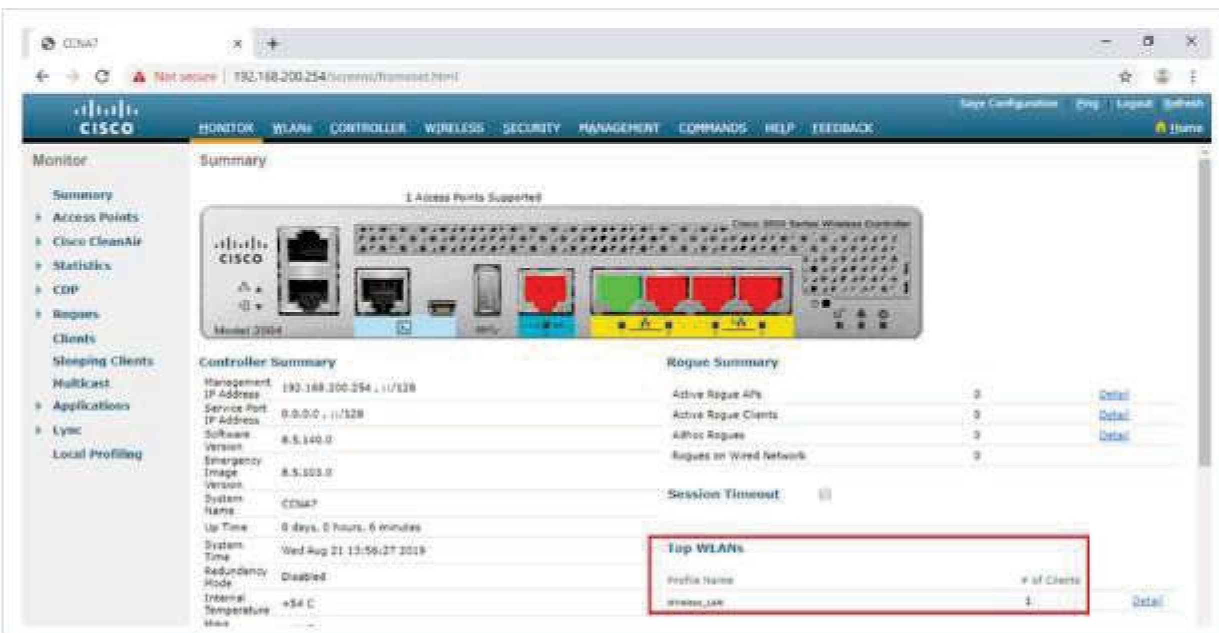


Verify the WLAN is Operational

Click **WLANs** in the menu on the left to view the newly configured WLAN. In the figure, you can verify that WLAN ID 1 is configured with **Wireless_LAN** as the name and SSID, it is enabled, and is using WPA2 PSK security.

Monitor the WLAN

Click the **Monitor** tab at the top to access the advanced **Summary** page again. Here you can see that the **Wireless_LAN** now has one client using its services, as shown in the figure.



3.3.22.1 View Wireless Client Details

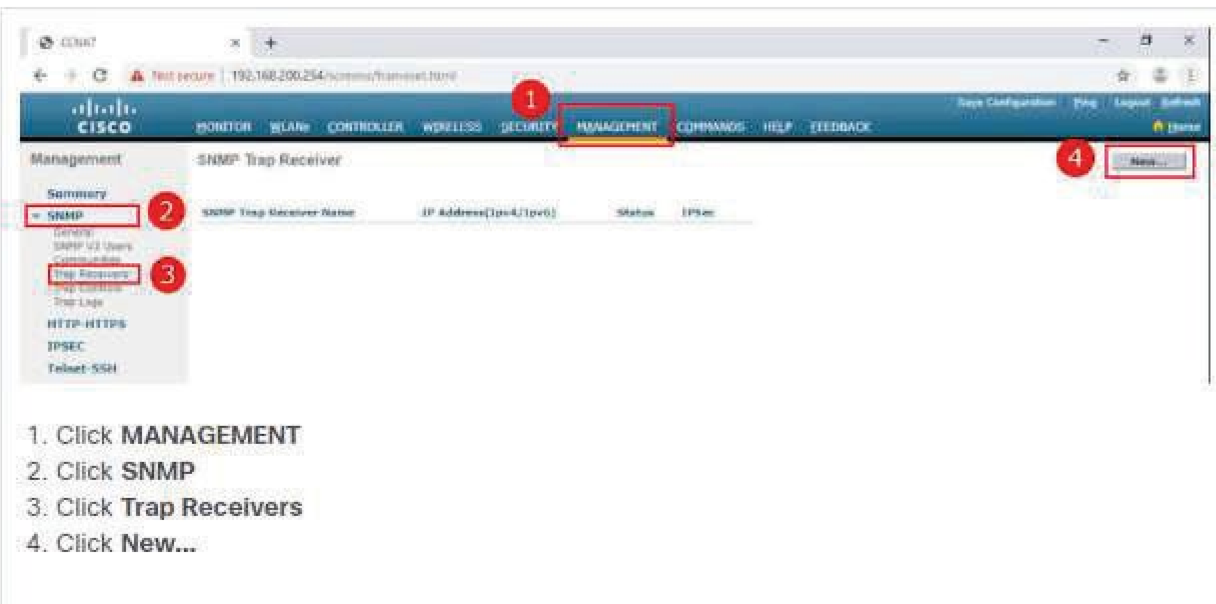
Click **Clients** in the left menu to view more information about the clients connected to the WLAN, as shown in the figure. One client is attached to **Wireless_LAN** through AP1 and was given the IP address 192.168.5.2. DHCP services in this topology are provided by the router.

3.3.23 Configure a WPA2 Enterprise WLAN on the WLC

Configure SNMP Server Information

Click the **MANAGEMENT** tab to access a variety of management features. SNMP is listed at the top of the menu on the left. Click **SNMP** to expand the sub-menus, and then click **Trap Receivers**. Click **New...**

to configure a new SNMP trap receiver, as shown in the figure.



Enter the SNMP Community name and the IP address (IPv4 or IPv6) for the SNMP server. Click **Apply**. The WLC will now forward SNMP log messages to the SNMP server.

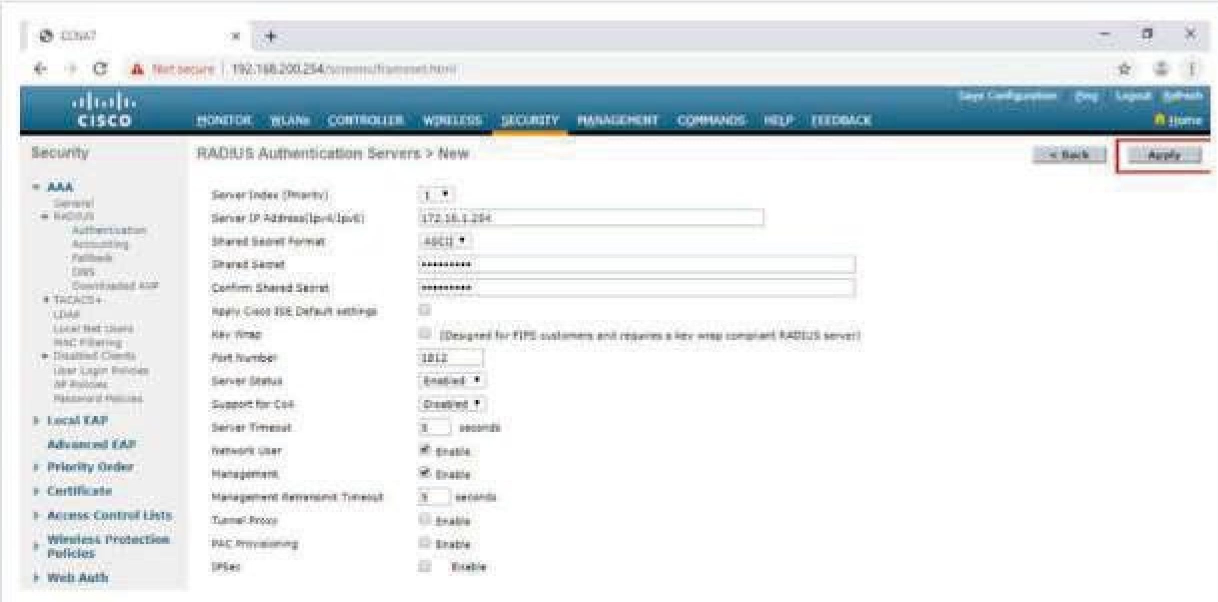
3.3.24 Configure RADIUS Server Information

In our example configuration, the network administrator wants to configure a WLAN using WPA2 Enterprise, as opposed to WPA2 Personal or WPA2 PSK. Authentication will be handled by the RADIUS server running on PC-A.

To configure the WLC with the RADIUS server information, click the **SECURITY** tab > **RADIUS** > **Authentication**. No RADIUS servers are currently configured. Click **New...** to add PC-A as the RADIUS server.

1. Click **SECURITY**
2. Click **RADIUS**
3. Click **Authentication**
4. Click **New...**

Enter the IPv4 address for PC-A and the shared secret. This is the password used between the WLC and the RADIUS server. It is not for users. Click **Apply**, as shown in the figure.



After clicking **Apply**, the list of configured **RADIUS Authentication Servers** refreshes with the new server listed, as shown in the figure.

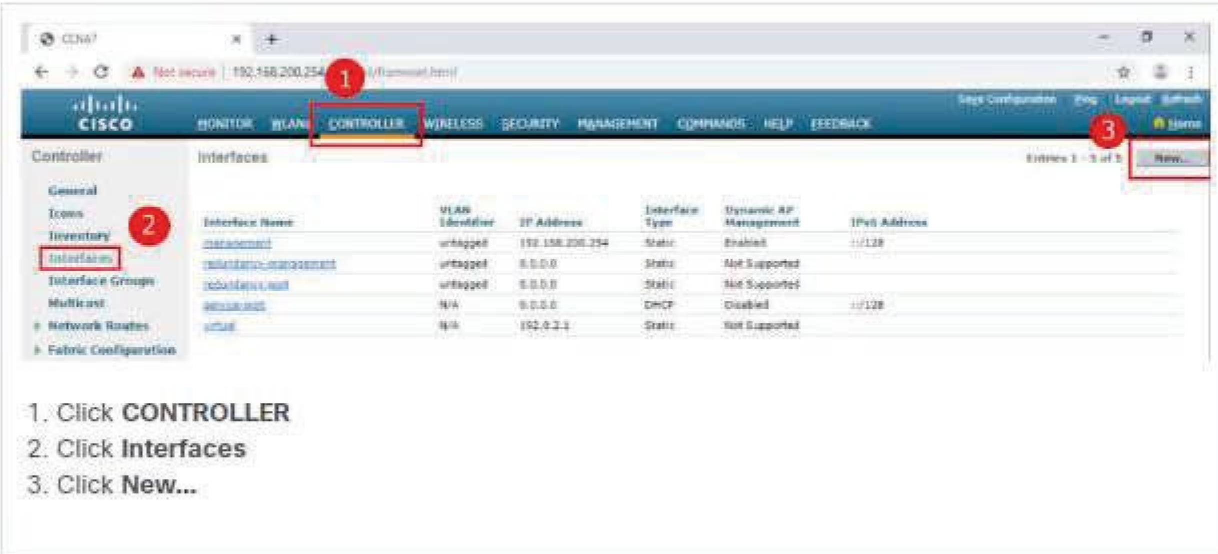
3.3.25 Configure a New Interface

VLAN interface configuration on the WLC includes the following steps:

1. Create a new interface.
2. Configure the VLAN name and ID.
3. Configure the port and interface address.
4. Configure the DHCP server address.
5. Apply and Confirm.
6. Verify Interfaces.

Create a new interface.

To add a new interface, click **C0NTR0LLER > Interfaces > New...**, as shown in the figure.

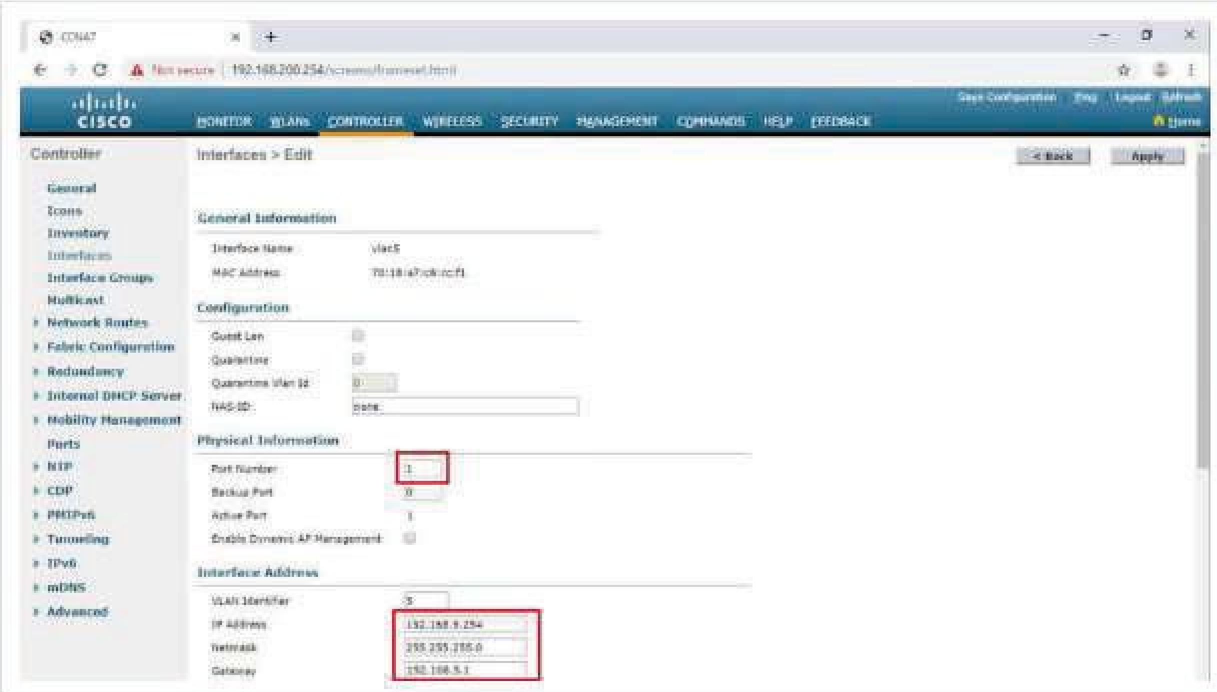


Configure the VLAN name and ID.

In the figure, the network administrator configures the interface name as **vlan5** and the VLAN ID as **5**. Clicking **Apply** will create the new interface.

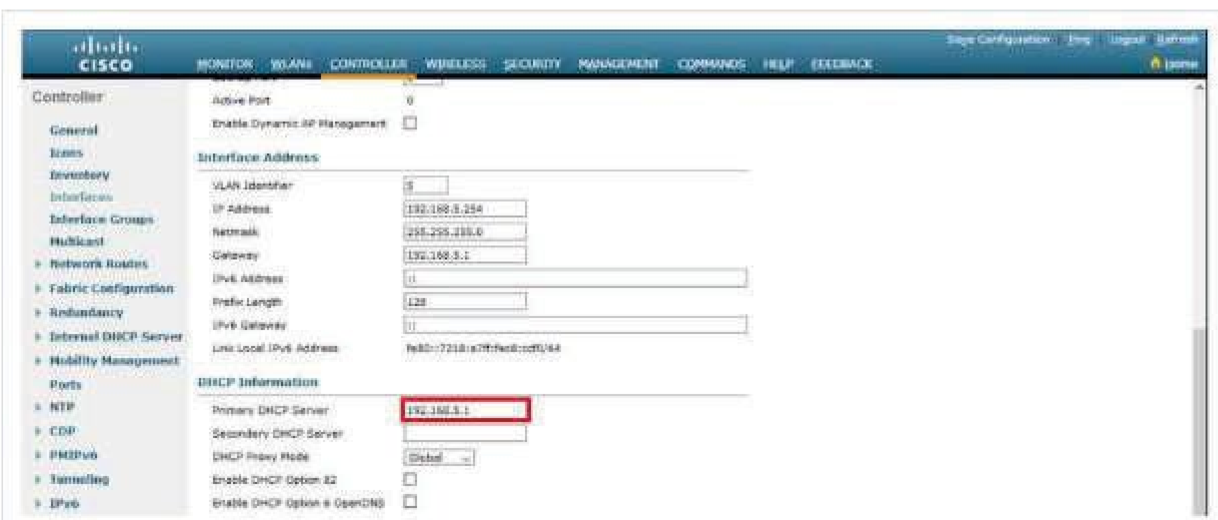
Configure the port and interface address.

On the **Edit** page for the interface, configure the physical port number. G1 in the topology is Port Number 1 on the WLC. Then configure the VLAN 5 interface addressing. In the figure, VLAN 5 is assigned IPv4 address 192.168.5.254/24. R1 is the default gateway at IPv4 address 192.168.5.1.



Configure the DHCP server address.

In larger enterprises, WLCs will be configured to forward DHCP messages to a dedicated DHCP server. Scroll down the page to configure the primary DHCP server as IPv4 address 192.168.5.1, as shown in the figure. This is the default gateway router address. The router is configured with a DHCP pool for the WLAN network. As hosts join the WLAN that is associated with the VLAN 5 interface, they will receive addressing information from this pool.



Apply and Confirm.

Scroll to the top and click **Apply**, as shown in the figure. Click **0K** for the warning message.

Verify Interfaces.

Click **Interfaces.** The new **vlan5** interface is now shown in the list of interfaces with its IPv4 address, as shown in the figure.

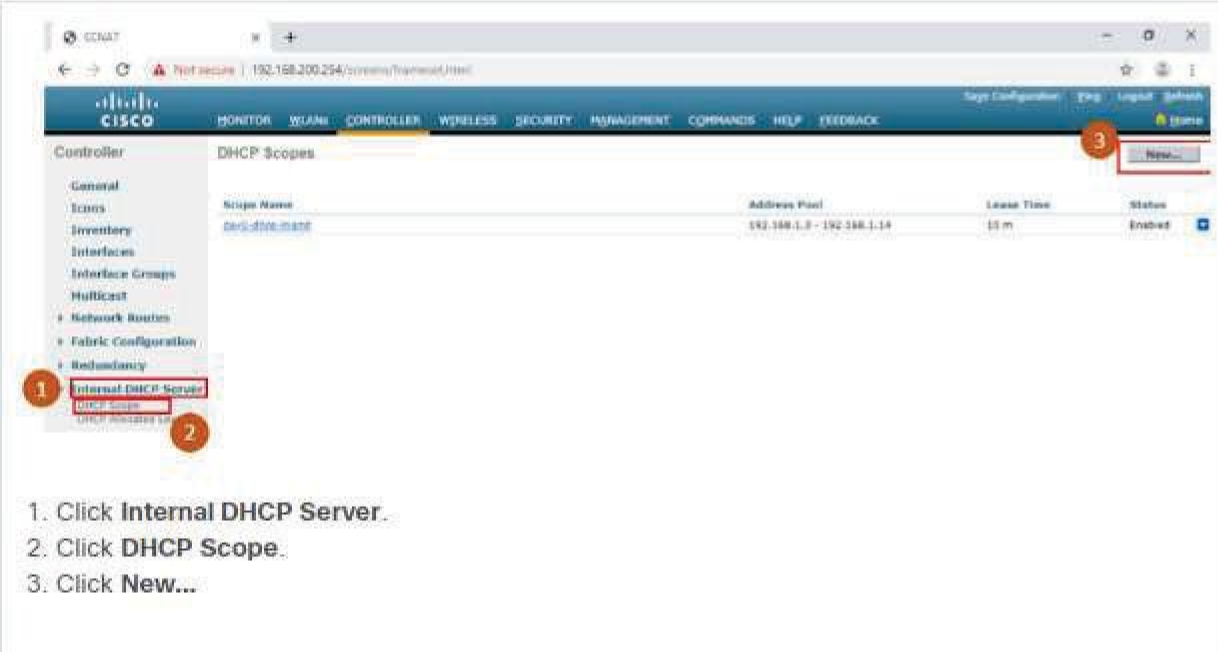
3.3.26 Configure a DHCP Scope

DHCP scope configuration includes the following steps:

1. Create a new DHCP scope.
2. Name the DHCP scope.
3. Verify the new DHCP scope.
4. Configure and enable the new DHCP scope.
5. Verify the enable DHCP scope

Create a new DHCP scope.

A DHCP scope is remarkably similar to a DHCP pool on a router. It can include a variety of information including a pool of addresses to assign to DHCP clients, DNS server information, lease times, and more. To configure a new DHCP scope, click **Internal DHCP Server > DHCP Scope > New...**, as shown in the figure.



Name the DHCP scope.

On the next screen, name the scope. Because this scope will apply to the wireless management network, the network administrator uses **Wireless_Management** as the Scope Name and clicks **Apply**.

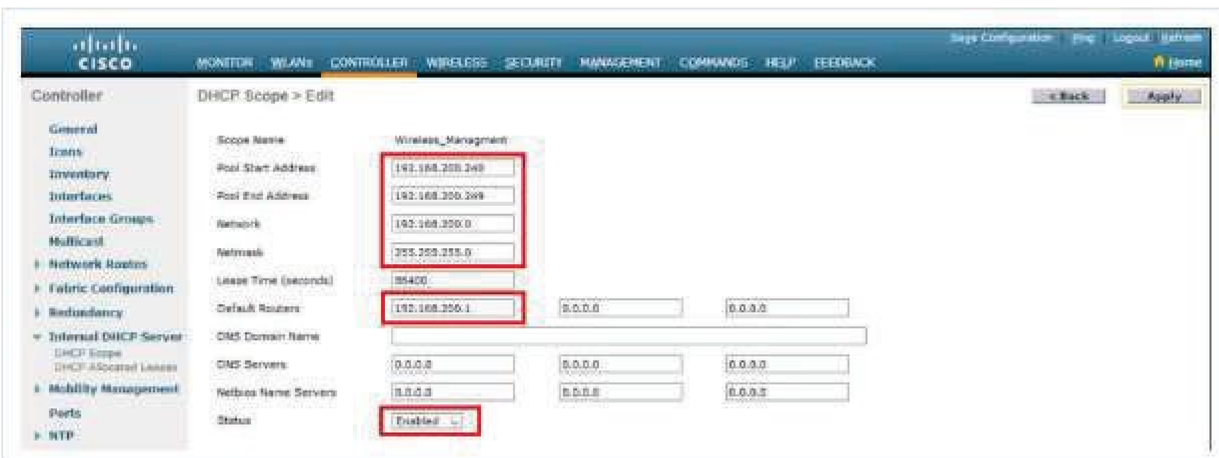
Verify the new DHCP scope.

You are returned to the **DHCP Scopes** page and can verify the scope is ready to be configured. Click the new Scope Name to configure the DHCP scope.

Configure and enable the new DHCP scope.

On the Edit screen for the **Wireless_Management** scope, configure a pool of addresses for the

192.168.200.0/24 network starting at .240 and ending at .249. The network address and subnet mask are configured. The default router IPv4 address is configured, which is the subinterface for R1 at 192.168.200.1. For this example, the rest of the scope is left unchanged. The network administrator selects **Enabled** from the Status drop down and clicks **Apply**.



Verify the enable DHCP scope

The network administrator is returned to the **DHCP Scopes** page and can verify the scope is ready to be allocated to a new WLAN.

3.3.27 Configure a WPA2 Enterprise WLAN

By default, all newly created WLANs on the WLC will use WPA2 with Advanced Encryption System (AES). 802.1X is the default key management protocol used to communicate with the RADIUS server. Because the network administrator already configured the WLC with the IPv4 address of the RADIUS server running on PC-A, the only configuration left to do is to create a new WLAN to use interface **vlan5**.

Configuring a new WLAN on the WLC includes the following steps:

1. Create a new WLAN.
2. Configure the WLAN name and SSID.
3. Enable the WLAN for VLAN 5.
4. Verify AES and 802.1X defaults.
5. Configure WLAN security to use the RADIUS server.
6. Verify the new WLAN is available.

Create a new WLAN.

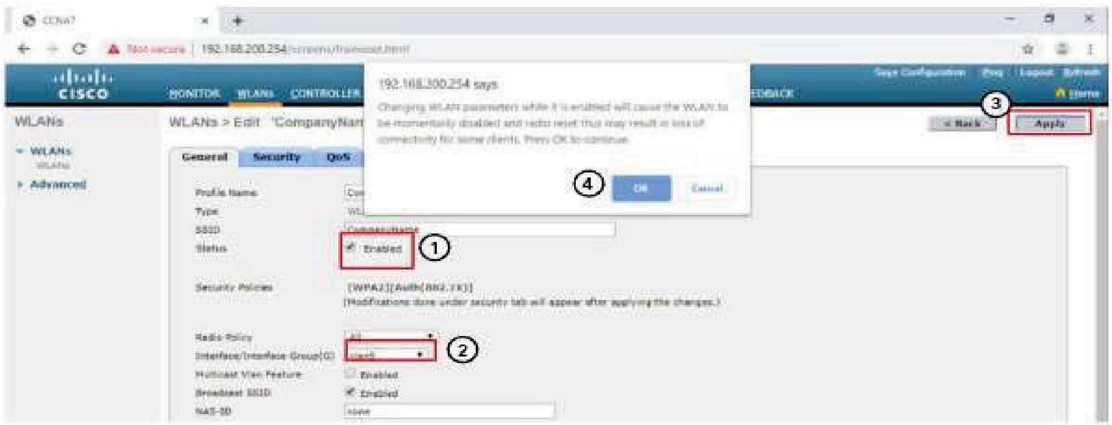
Click the **WLANs** tab and then **Go** to create a new WLAN, as shown in the figure.

Configure the WLAN name and SSID.

Fill in the profile name and SSID. In order to be consistent with the VLAN that was previously configured, choose an ID of **5**. However, any available value can be used. Click **Apply** to create the new WLAN, as shown in the figure.

Enable the WLAN for VLAN 5.

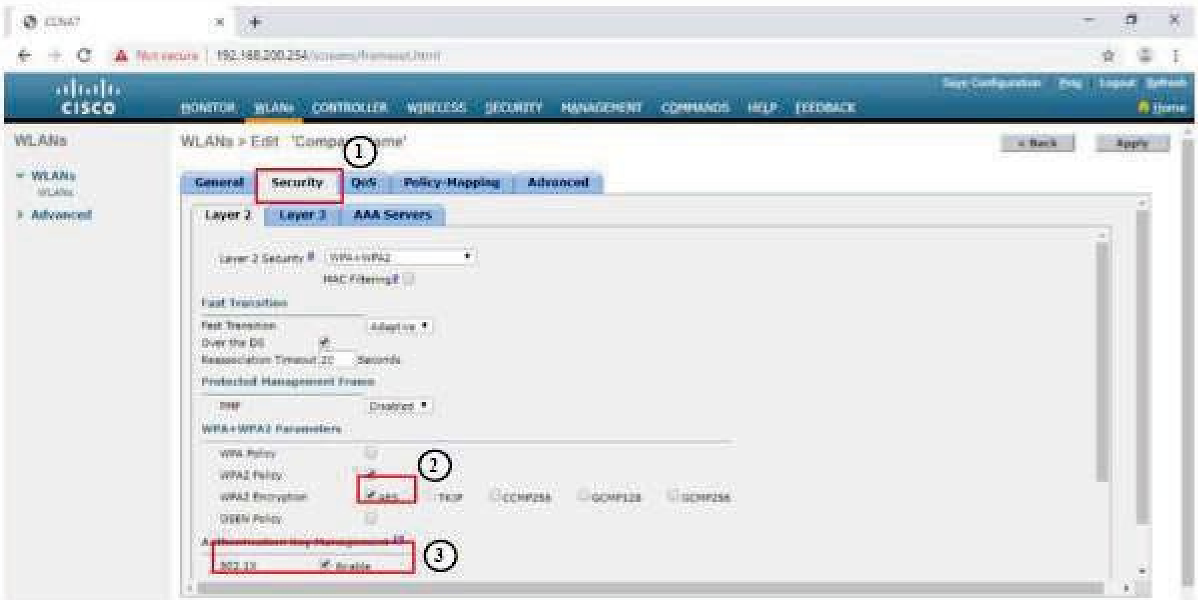
The WLAN is created but it still needs to be enabled and associated with the correct VLAN interface. Change the status to **Enabled** and choose **vlan5** from the Interface/Interface Group(G) dropdown list. Click **Apply** and click **0K** to accept the popup message, as shown in the figure.



1. Click **Enabled**
2. Choose **vlan5**.
3. Click **Apply**.
4. Click **Ok**.

Verify AES and 802.1X defaults.

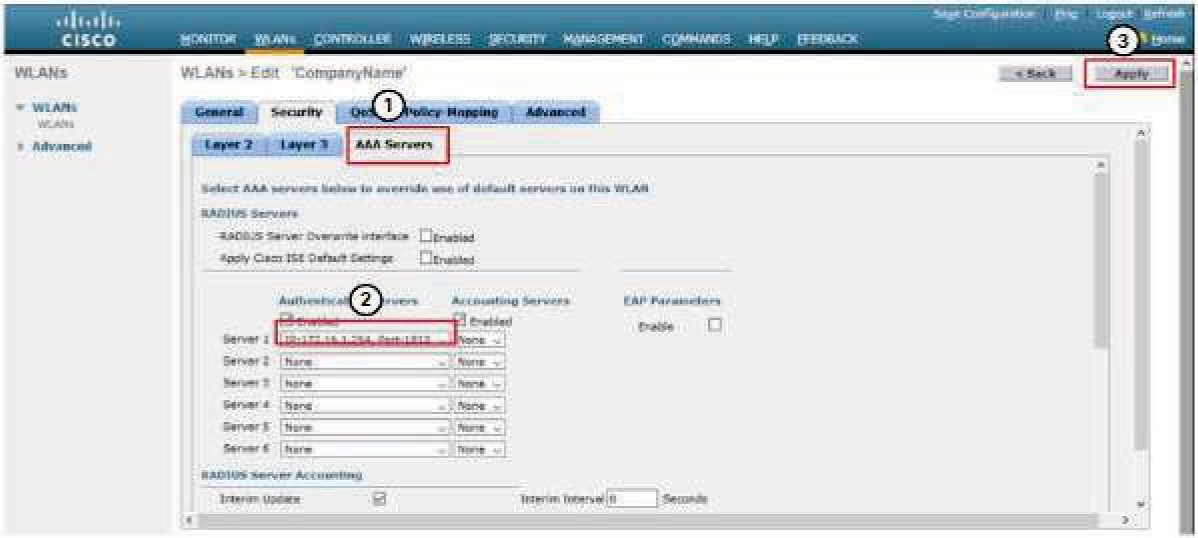
Click the **Security** tab to view the default security configuration for the new WLAN. The WLAN will use WPA2 security with AES encryption. Authentication traffic is handled by 802.1X between the WLC and the RADIUS server.



1. Click **Security** tab.
2. Verify **AES** is the encryption.
3. Verify **802.1X** is the authentication key management protocol.

Configure the RADIUS server.

We now need to select the RADIUS server that will be used to authenticate users for this WLAN. Click the **AAA Servers** tab. In the dropdown box select the RADIUS server that was configured on the WLC previously. Apply your changes.



1. Click the **AAA servers** tab.
2. Select the RADIUS server with the IP address **172.16.1.254** from the drop-down list next to Server 1.
3. **Apply** your changes.

Verify that the new WLAN is available.

To verify the new WLAN is listed and enabled, click **Back** or the **WLANs** submenu on the left. Both the **Wireless_LAN** WLAN and the **CompanyName** WLAN are listed. In the figure, notice that both are enabled. **Wireless_LAN** is using WPA2 with PSK authentication. **CompanyName** is using WPA2 security with 802.1X authentication.

3.3.28 Static Routes

3.3.28.1 Configure IP Static Routes

IPv4 Next-Hop Static Route

```
Router(config)# ip route network-address subnet-mask next-hop-ip- address
```

IPv6 Next-Hop Static Route

```
Router(config)# ipv6 unicast-routing
Router(config)# ipv6 route ipv6-prefix/prefix-length next-hop-ipv6- address
```

IPv4 Directly Connected Static Route

```
Router(config)# ip route network-address subnet-mask exit-intf
```

IPv6 Directly Connected Static Route

```
Router(config)# ipv6 unicast-routing
Router(config)# ipv6 route ipv6-prefix/prefix-length exit-intf
```

IPv4 Fully Specified Static Route

```
Router(config)# ip route network-address subnet-mask exit-intf next- hop-ip-
address
```

IPv6 Fully Specified Static Route

```
Router(config)# ipv6 unicast-routing
Router(config)# ipv6 route ipv6-prefix/prefix-length exit-intf next- hop-ipv6-
address
```

3.3.28.2 Configure IP Default Static Routes

IPv4 Dejault Static Route

```
Router(config)# ip route 0.0.0.0 0.0.0.0 {next-hop-ip-address | exit- intf}
```

IPv6 Default Static Route

```
Router(config)# ipv6 route ::/0 {next-hop-ipv6-address | exit-intf}
```

Configure Floating Static Routes

```
Router(config)# ip route network-address subnet-mask { ip-address |
exit-intf [ip-address]} distance
```

```
Router(config)# ipv6 route ipv6-prefix/prefix-length {ipv6-address |
exit-intf [ipv6-address]} distance
```

```
Router(config)# ip route 0.0.0.0 0.0.0.0 {next-hop-ip-address | exit- intf}
distance
```

```
Router(config)# ipv6 route ::/0 {next-hop-ipv6-address | exit-intf} distance
```

3.3.28.3 Configure Static Host Routes

```
Branch(config)# ip route destination-ip-address 255.255.255.255 next- hop-ip-
address
```

```
Branch(config)# ipv6 route destination-ipv6-address/128 next-hop-ipv6- address
```

Configure IPv6 Static Host Route with Link-Local Next-Hop

```
Branch(config)# ipv6 route destination-ipv6-address/128 exit-intf next-hop-link-
local-ipv6-address
```

Note: Exit interface type and number must be specified when using a link-local address as the next hop

Verify a Static Route

3.3.28.3.1.1 Display Only IPv4 Static Routes

```
Router(config)# show ip route static | begin Gateway
```

3.3.28.3.1.2 Display a Specific IPv4 Network

```
Router(config)# show ip route ip-address
```

3.3.28.3.1.3 Display the IPv4 Static Route Configuration

```
Router(config)# show running-config | section ip route
```

3.3.28.3.1.4 Display Only IPv6 Static Routes

```
Router(config)# show ipv6 route static
```

3.3.28.3.1.5 Display a Specific IPv6 Network

```
Router(config)# show ip route ipv6-address
```

3.3.28.3.1.6 Display the IPv6 Static Route Configuration

```
Router(config)# show running-config | section ipv6 route
```

3.3.29 Troubleshooting Static and Default Routes

Common IOS troubleshooting commands include the following:

- **ping**
- **traceroute**
- **show ip route**
- **show ip interface brief**
- **show cdp neighbors detail**

Solve a Connectivity Problem

Step 1. Verify connectivity

- Ping the Remote LAN
- Ping the Next-Hop Router
- Ping the Remote Router

Step 2. Verify routing table

R1# show ip route | begin gateway

```
R1# show ipv6 route
```

Step 3. Correct the Static Route Configuration

```
R1(config)# ip route network-address subnet-mask { ip-address | exit- intf [ip-address]}

R1(config)# ipv6 route ipv6-prefix/prefix-length {ipv6-address | exit- intf [ipv6-
address]}
```

Step 4. Verify new static route is installed

```
R1# show ip route | begin gateway
R1# show ipv6 route
```

Step 5. Verify connectivity

Ping the Remote LAN again

3.4 Netacad Module 1- Basic Device Configuration

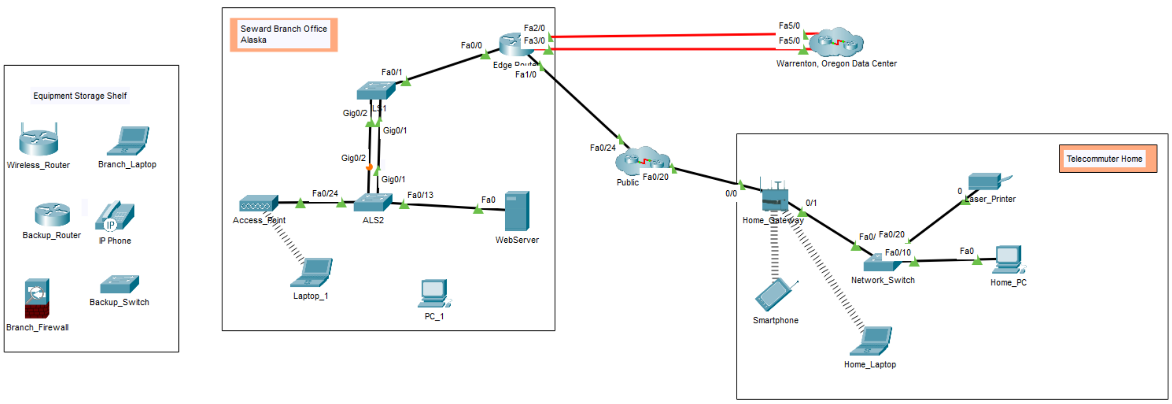
3.4.1 Section 1.0 Introduction

3.4.1.1 Exercise 1.0.5 Packet Tracer - Logical and Physical Mode Exploration

3.4.1.1.1 Topology

Physical

Logical



3.4.1.1.2 Objectives

Part 1: Investigate the Bottom Toolbar

Part 2: Investigate Devices in a Wiring Closet

Part 3: Connect End Devices to Networking Devices

Part 4: Install a Backup Router

Part 5: Configure a Hostname

Part 6: Explore the Rest of the Network

3.4.1.1.3 Background / Scenario

The network model in this Packet Tracer Physical Mode (PTPM) activity incorporates many of the technologies that you can master in Cisco Networking Academy courses. It represents a simplified version of how a small to medium-sized business network might look.

Most of the devices in the Seward branch office and Warrenton data center are already deployed and configured. You have just been hired to review the devices and networks deployed. It is not important that you understand everything you see and do in this activity. Feel free to explore the network on your own. If you wish to proceed more systematically, follow the steps below. Answer the questions to the best of your ability.

Note: This activity opens in and focuses on **Physical** mode. Many of the Packet Tracer activities you encounter in Cisco Networking Academy courses will use **Logical** mode. You can switch between these modes at any time to compare the differences by clicking the **Logical** (Shift+L) and **Physical** (Shift+P) buttons. However, in other activities in this course you may be locked out of one mode or the other.

3.4.1.1.4 Instructions

3.4.1.1.4.1 Part 1: Investigate the Bottom Toolbar

The icon toolbar at the bottom left-hand corner has various categories of networking components. You should see categories that correspond to **Network Devices**, **End Devices**, and **Components**. The fourth category (with the lightning bolt icon) is **Connections** and represents the networking media supported by Packet Tracer. The last two categories are **Miscellaneous** and **Multiuser Connection.**

What are the subcategories for Network Devices?

ANSWER – Routers Switches Hubs, wireless devices , Security WAN Emulation

3.4.1.1.4.2 Part 2: Investigate Devices in a Wiring Closet

a. If you went exploring, return to **Physical** mode and **Intercity** now. In the top blue bar, click **Physical**, and then use the **Navigation Panel** or **Back level** buttons to navigate to **Intercity**.

b. Click **Seward**, and then click the **Branch Office**.

c. Click the **Branch Office Wiring Closet**. Notice that the wiring closet has a **Rack**, a **Cable Pegboard**, a **Table**, and a **Shelf**.

   The **Rack** contains devices that can be racked mounted. If you zoom in on the rack (zoom tool or Ctrl+scroll wheel), you can see that the devices are screwed in (mounted) in the rack. Below the power distribution device, you will find a router. Routers connect different networks.

d. Below the router are two switches. These switches provide wired connections to connect to other devices. Notice that the devices have a name assigned by the network administrator. **What devices use a wired connection to connect to switch ALS2?**

   ANSWER - ALS1, Access_Point, and WebServer

e. Below the switches in the **Rack** is a wireless access point named **Access_Point**. Wireless access points use a wireless connection to connect to other devices. Switch to **Logical** Mode. Which device is connected to **Access_Point**?

ANSWER Laptop_1

f. Switch to **Physical** mode. You should be back in the **Branch Office Wiring Closet**. Where is the device connected to **Access_Point** physically located?

ANSWER On the Table

3.4.1.1.4.3 Part 3: Connect End Devices to Networking Devices

Devices can be connected in a variety of ways. For network connectivity, devices are typically connected using either a copper straight-through cable or wirelessly. For management connectivity, devices are typically connected using either a console cable or USB cable.

Note: Packet Tracer will grade the rest of this activity. At any time, you can click **Check Results** at the bottom of the **Tasks** window. Then click **Assessment Items** to see which items you have not yet completed.

a. Investigate the **Cable Pegboard**. It includes two **Console** cables, ten **Copper Straight-Through** cables, four **Fiber** cables, two **Coaxial** cables, and two **USB** cables. Notice that the cable representations in **Physical** mode are more representative of their real-world counterparts. Switch to **Logical** mode. Notice that the cable representations are different in this mode.

b. Switch to **Physical** mode. Click a **Copper Straight-Through** cable from the **Cable Pegboard**.

c. Float your mouse over the ports on **PC_1** until you see the **FastEthernet0** popup. The other **RS232** port is for connecting **Console** cables.

d. With the **Copper Straight-Through** cable still selected, click the **FastEthernet0** port to connect the cable. The port should now be highlighted in green.

e. Connect the other end of the cable to the **ALS2** switch by clicking an empty Fast Ethernet port. The cable should now be dangling between **PC_1** and the **ALS2** port.

f. PCs and laptops can also be connected to networking devices using a console cable or a USB cable. This connection provides management access. Click a **Console** cable from the **Cable Pegboard**.

g. Click the **RS232** port on **PC_1**. The port should now be highlighted in green.

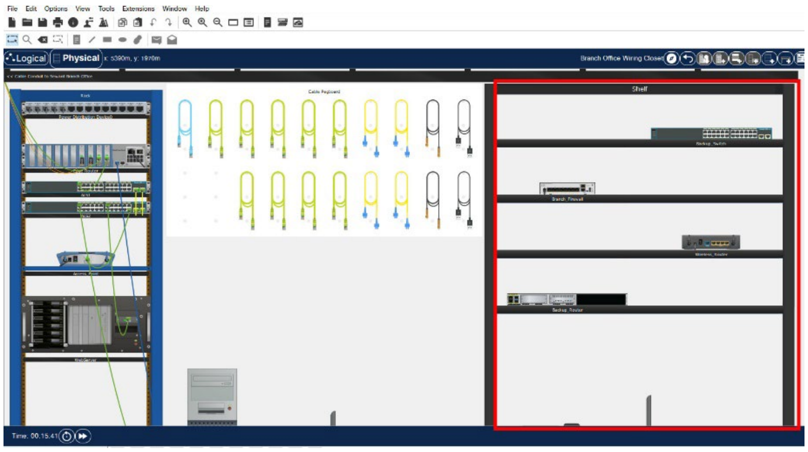
h. Float your mouse over the **Edge_Router** and find the **Console** port. You can **right-click** > **Inspect Front** to zoom in and make finding the port easier.

i. Click the **Console** port on **Edge_Router** to connect the **Console** cable. The cable should now be dangling between **PC_1** and the **Console** port on the **Edge_Router**.

3.4.1.1.4.4 Part 4: Install a Backup Router

Newer models of networking devices can be accessed through a USB port for management configuration. This is necessary because newer laptops and PCs typically do not include an RS232 port for console cable connections.

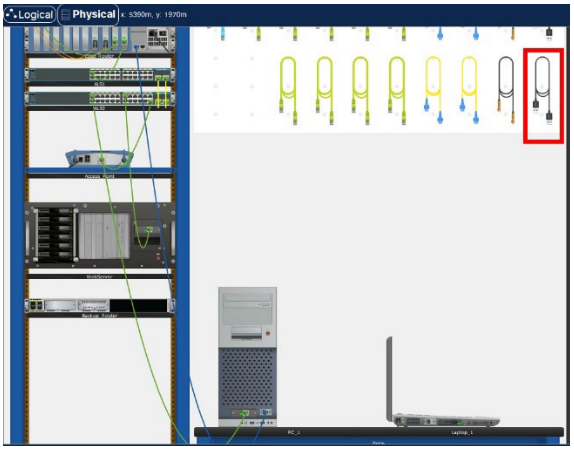
a. Investigate the **Shelf**. This includes an inventory of devices in the Seward Branch Office that are not currently installed.



b. Click and drag the **Backup_Router** to an empty spot in the **Rack**.

c. Some devices are not automatically powered on when installed in the **Rack**. Click **Backup_Router** > **Inspect Rear**. Find the power button and turn the router on.

d. On the **Cable Pegboard**, choose a **USB** cable. Return to the rear view of **Backup_Router** and find the **USB Console** port on the far left. Click the port to connect the USB cable. The port should now be highlighted in green.

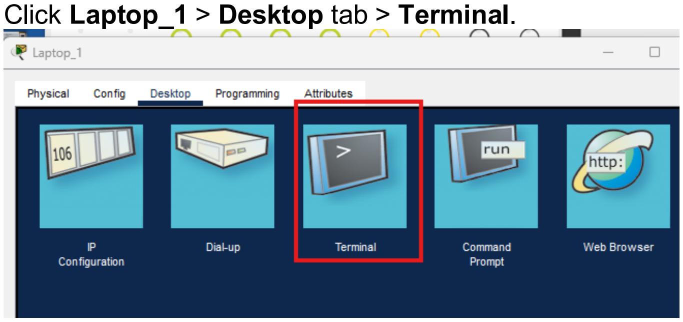


e. Connect the other end of the USB cable to either of the USB ports on **Laptop_1**. The cable will not dangle like the cables did for the connections to **PC_1**.

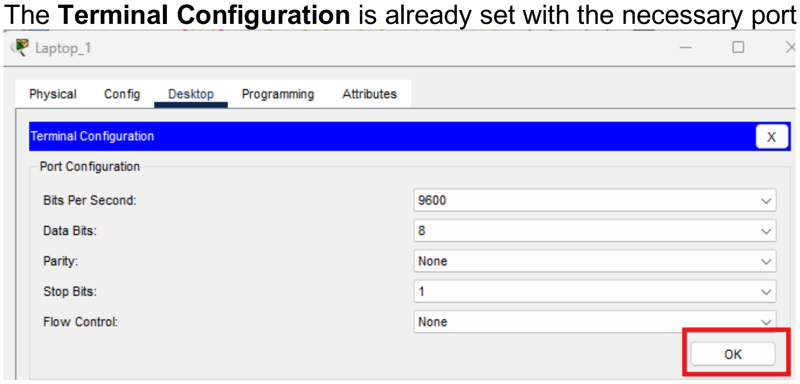
3.4.1.1.4.5 Part 5: Configure a Hostname

Network administrators typically assign a name to networking devices. To do this, you will use your console connection to the **Backup_Router**.

a. Click **Laptop_1** > **Desktop** tab > **Terminal**.



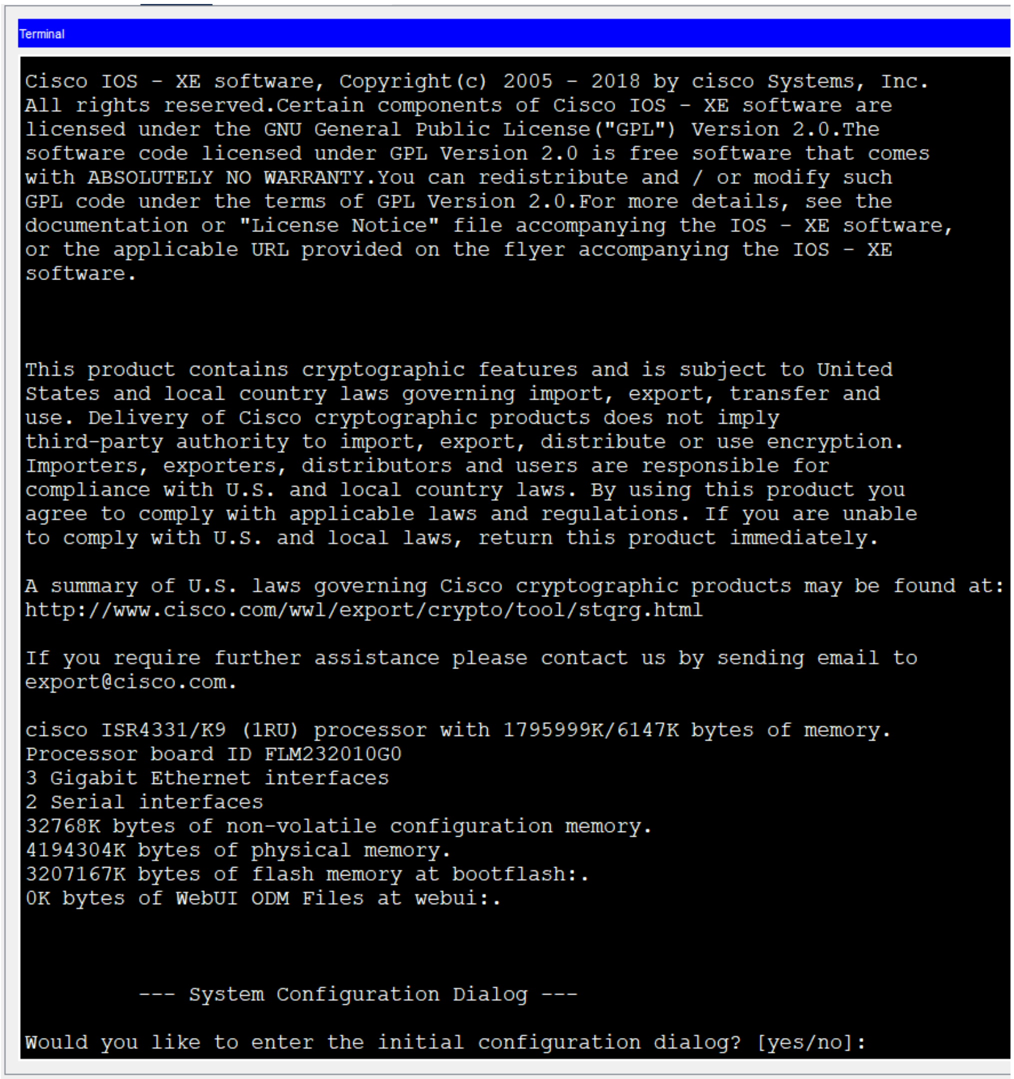
b. The **Terminal Configuration** is already set with the necessary port configuration. Click **OK**.



c. You are now at the command line for **Backup_Router** and should see the following.

```
<output omitted>
cisco ISR4331/K9 (1RU) processor with 1795999K/6147K bytes of memory.
Processor board ID FLM232010G0
3 Gigabit Ethernet interfaces
2 Serial interfaces
32768K bytes of non-volatile configuration memory.
```

```
4194304K bytes of physical memory.
3207167K bytes of flash memory at bootflash:.
0K bytes of WebUI ODM Files at webui:.



--- System Configuration Dialog ---

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




```
Cisco IOS - XE software, Copyright(c) 2005 - 2018 by cisco Systems, Inc.
All rights reserved.Certain components of Cisco IOS - XE software are
licensed under the GNU General Public License("GPL") Version 2.0.The
software code licensed under GPL Version 2.0 is free software that comes
with ABSOLUTELY NO WARRANTY.You can redistribute and / or modify such
GPL code under the terms of GPL Version 2.0.For more details, see the
documentation or "License Notice" file accompanying the IOS - XE software,
or the applicable URL provided on the flyer accompanying the IOS - XE
software.



This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

cisco ISR4331/K9 (1RU) processor with 1795999K/6147K bytes of memory.
Processor board ID FLM232010G0
3 Gigabit Ethernet interfaces
2 Serial interfaces
32768K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
3207167K bytes of flash memory at bootflash:.
0K bytes of WebUI ODM Files at webui:.



         --- System Configuration Dialog ---

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

d. Answer **no** to the question and then press ENTER to get the **Router>** command prompt.

```
Press RETURN to get started!

<ENTER>

Router>
```

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


Press RETURN to get started!



Router>
```

e. Enter the following commands to name the router **Edge_Router_Backup**.

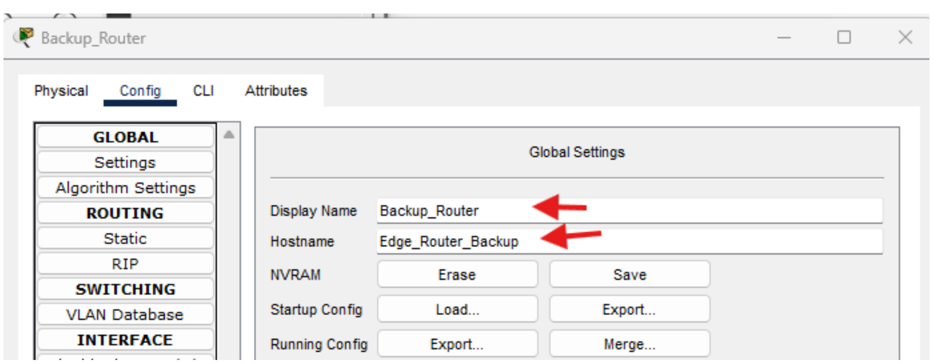
```
Router> enable
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# hostname Edge_Router_Backup
Edge_Router_Backup(config)# end
Edge_Router_Backup#
```

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostbane
Router(config)#hostname
Router(config)#hostname Edge_Router_Backup
Edge_Router_Backup(config)#end
Edge_Router_Backup#
%SYS-5-CONFIG_I: Configured from console by console

Edge_Router_Backup#
```

Notice that the hostname changed from **Router** to **Edge_Router_Backup**.

f. Close the **Laptop_1** window and return to the **Branch Office Wiring Closet**.

g. Notice that the display name for Backup_Router did not change. Click **Backup_Router** > **Config tab**. In Global Settings, notice that Packet Tracer maintains two names for the device: a **Display Name** and a **Hostname**.



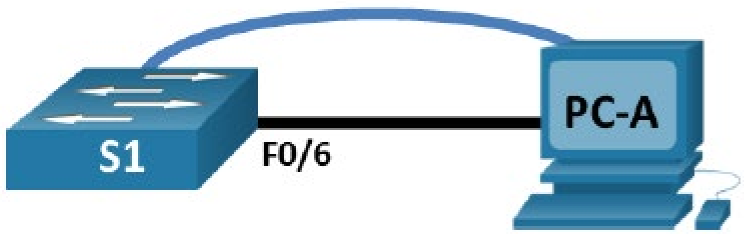
3.4.1.1.4.6 Part 6: Explore the Rest of the Network

Take some time to explore the rest of the network. Become familiar with the network representations in both **Logical** and **Physical** modes. In **Physical** mode, navigate to other areas such as the **Wellington Data Center** and **Teleworker Home**. The technologies used in these locations are discussed in greater detail in Cisco Networking Academy courses. For now, see what you can discover on your own. Don't worry about breaking anything. You can always close Packet Tracer and open a fresh copy to start exploring again.

3.4.2 Section 1.1 - Configure a Switch with Initial Settings

3.4.2.1 Exercise 1.1.7 Lab - Basic Switch Configuration

3.4.2.1.1 Topology



3.4.2.1.2 *Addressing table*

Device	Interface	IP Address / Prefix
S1	VLAN 99	192.168.1.2 /24
		2001:db8:acad:1::2 /64
		fe80::2
PC-A	NIC	192.168.1.10 /24
		2001:db8:acad:1::10 /64

3.4.2.1.3 Objectives

Part 1: Cable the Network and Verify the Default Switch Configuration

Part 2: Configure Basic Network Device Settings

Part 3: Verify and Test Network Connectivity

3.4.2.1.4 Background / Scenario

Cisco switches can be configured with a special IP address known as the switch virtual interface (SVI).

The SVI, or management address, can be used for remote access to the switch to display or configure settings.

If the VLAN 1 SVI is assigned an IP address, by default, all ports on VLAN 1 have access to the SVI IP address.

In this activity:

1) You will build a simple topology using Ethernet LAN cabling to access a Cisco switch using the console and remote access methods.
2) You will examine default switch configurations before configuring basic switch settings. These basic switch settings include:
   - device name
   - interface description
   - local passwords
   - message of the day (MOTD) banner
   - IP addressing
   - and static MAC address
3) You will also use a management IP address for remote switch management.

   The topology consists of one switch and two hosts using only Ethernet and console ports.
4) You will verify network connectivity and manage a MAC address table using two end devices.

3.4.2.1.5 Instructions

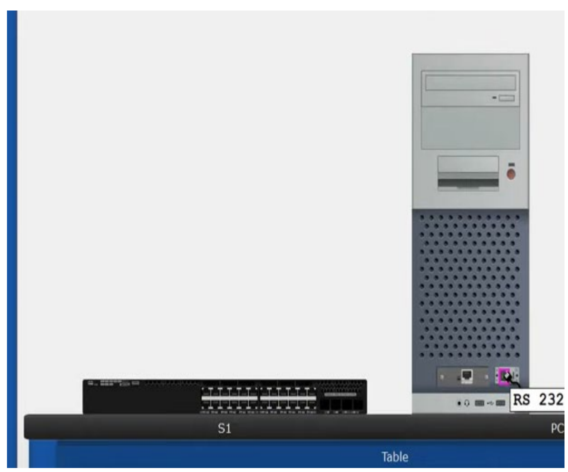
3.4.2.1.5.1 Part 1: Cable the Network and Verify the Default Switch Configuration

In Part 1, you will set up the network topology and verify default switch settings.

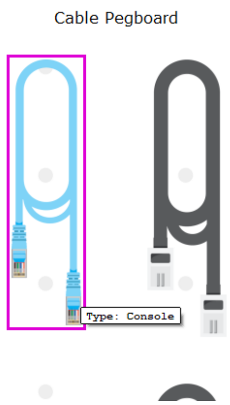
3.4.2.1.5.1.1 Step 1: Cable the network as shown in the topology.

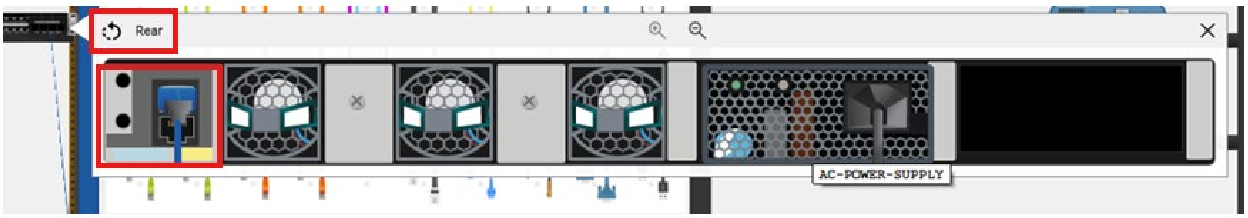
a. From the shelf, click and drag switch **S1** and place it on the left side of the table.

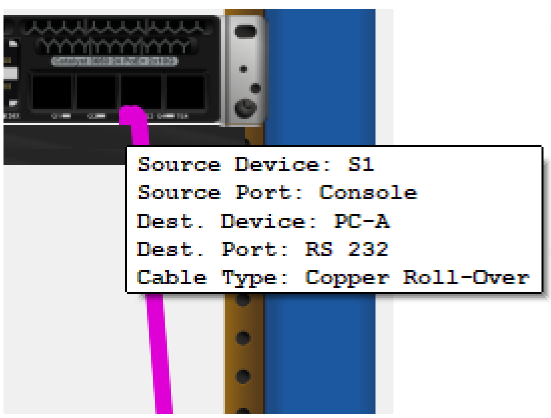
b. From the shelf, click and drag the device **PC-A** and place it on the right side of the table. Power on PC-A.

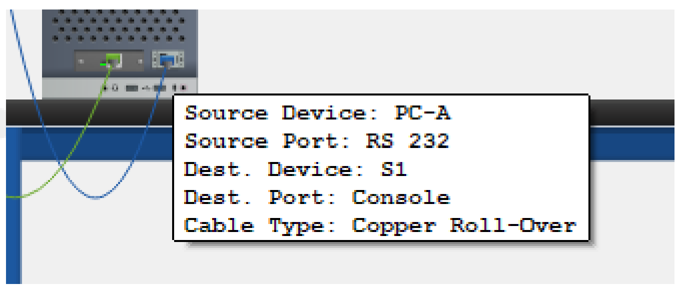


c. Connect a console cable from device **PC-A** to switch **S1**, as shown in the topology. Do not connect the device PC-A Ethernet cable at this time.



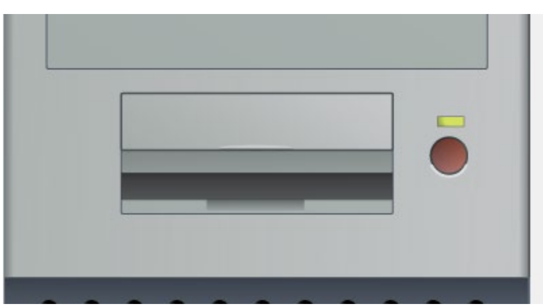




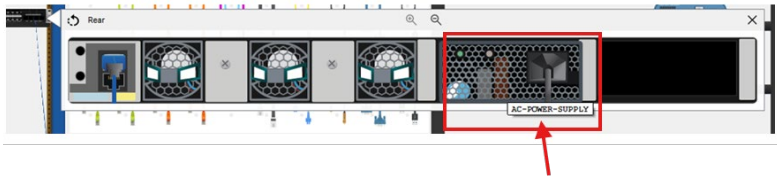


d. From the **Desktop** tab of PC-A, use **Terminal** to connect to the switch.

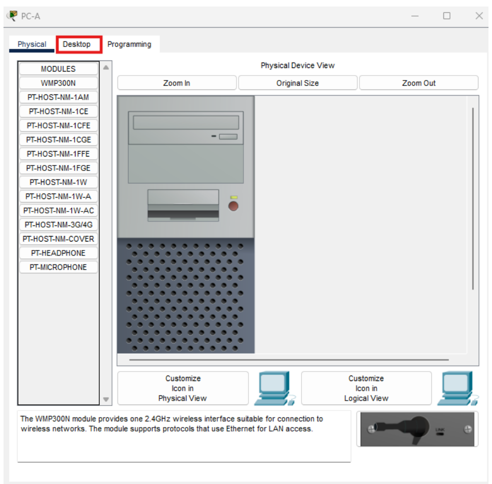
1. Turn on the PC



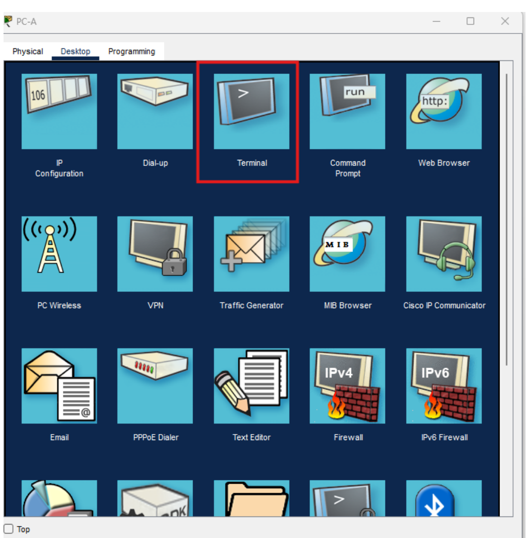
2. Turn on the switch



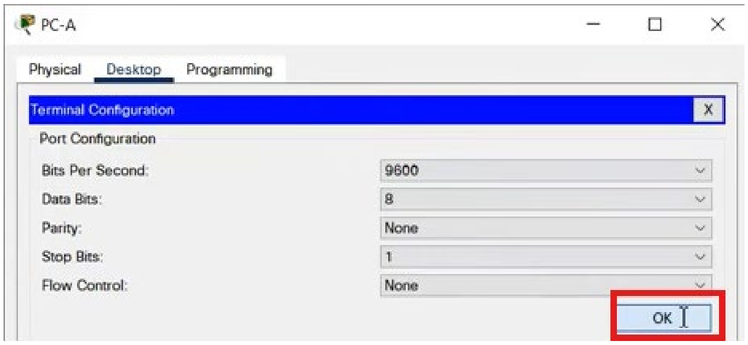
3. Open PC/ Desktop



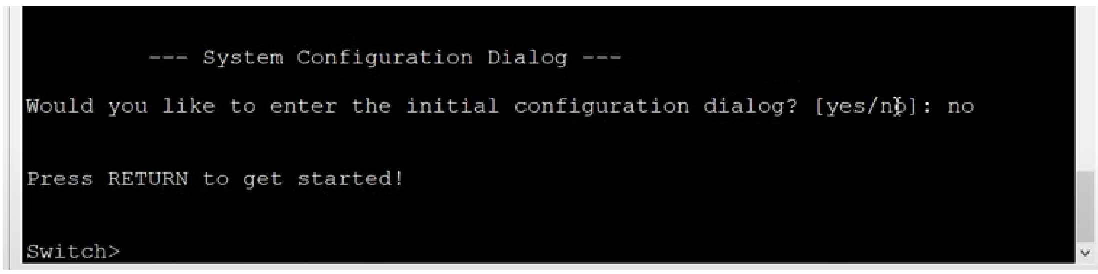
4. Open terminal



5. Press Ok



6. Terminal opens, Answer no to the question.



Question: **Why must you use a console connection to initially configure the switch? Why is it not possible to connect to the switch via Telnet or SSH?**

ANSWER – Telnet or SSH h as not been configured on the switch, No IP addressing parameters are configured yet.

3.4.2.1.5.1.2 Step 2: Verify the default switch configuration.

In this step, you will examine the default switch settings, such as current switch configuration, IOS information, interface properties, VLAN information, and flash memory.

You can access all of the switch IOS commands in privileged EXEC mode. Access to privileged EXEC mode should be restricted by password protection to prevent unauthorized use because it provides direct access to global configuration mode and commands used to configure operating parameters. You will set passwords later in this activity.

The privileged EXEC mode command set includes those commands contained in user EXEC mode, as well as the **configure** command through which the access to the remaining command modes is gained. Use the **enable** command to enter privileged EXEC mode.

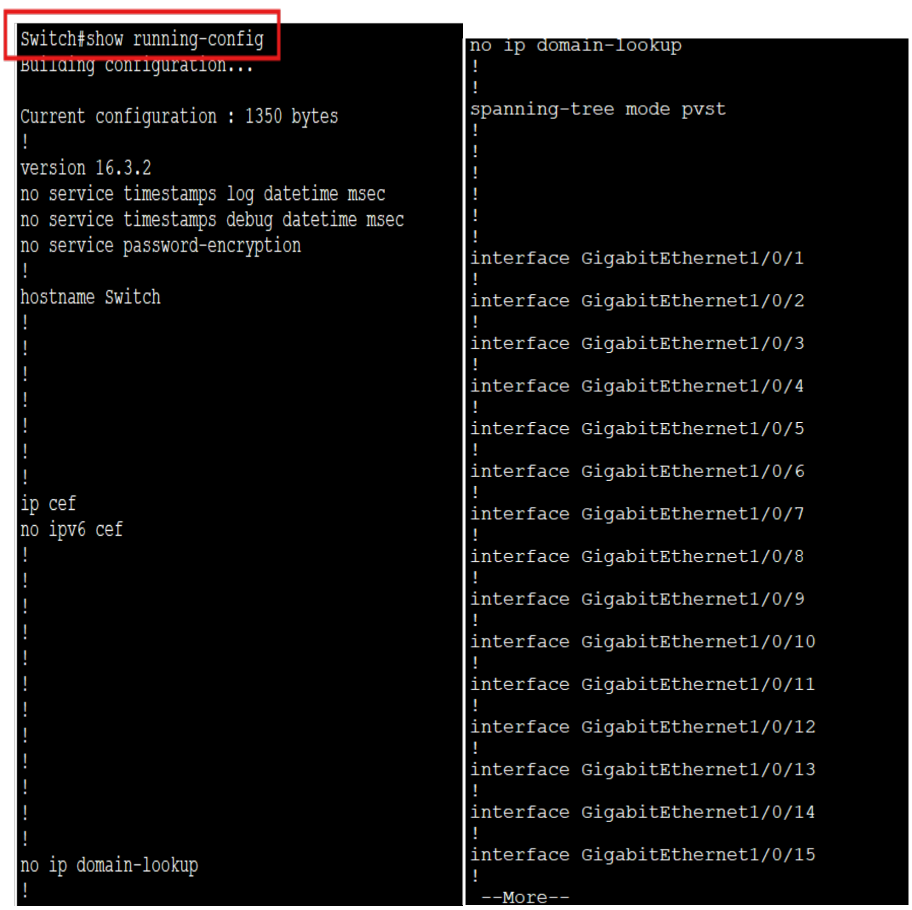
a. Assuming the switch had no configuration file stored in nonvolatile random-access memory (NVRAM), a console connection using Terminal will place you at the user EXEC mode prompt on the switch with a prompt of Switch>. Use the **enable** command to enter privileged EXEC mode. Open configuration window Notice that the prompt changed in the configuration to reflect privileged EXEC mode.

The enable command on a Cisco switch is used to enter privileged EXEC mode from user EXEC mode. Switch prompt changed to ***Switch#***

Switch> enable
Switch#

b. Verify that there is a clean default configuration file on the switch by issuing the ***show running-config*** privileged EXEC mode command. Examine the current running configuration file.

Switch> show running-config



```
interface GigabitEthernet1/0/15
!
interface GigabitEthernet1/0/16
!
interface GigabitEthernet1/0/17
!
interface GigabitEthernet1/0/18
!
interface GigabitEthernet1/0/19
!
interface GigabitEthernet1/0/20
!
interface GigabitEthernet1/0/21
!
interface GigabitEthernet1/0/22
!
interface GigabitEthernet1/0/23
!
interface GigabitEthernet1/0/24
!
interface GigabitEthernet1/1/1
!
interface GigabitEthernet1/1/2
!
interface GigabitEthernet1/1/3
!
interface GigabitEthernet1/1/4
!
interface Vlan1
 no ip address
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
 --More--
```

```
ip flow-export version 9
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
!
end
```

Questions:

How many GigabitEthernet interfaces does the switch have?

ANSWER – 24

From - interface GigabitEthernet1/0/1 to interface GigabitEthernet1/0/24

```
interface GigabitEthernet1/0/1
!
interface GigabitEthernet1/0/2
!
interface GigabitEthernet1/0/3
!
interface GigabitEthernet1/0/4
!
interface GigabitEthernet1/0/5
```

```
interface GigabitEthernet1/0/19
!
interface GigabitEthernet1/0/20
!
interface GigabitEthernet1/0/21
!
interface GigabitEthernet1/0/22
!
interface GigabitEthernet1/0/23
!
interface GigabitEthernet1/0/24
```

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

ANSWER – 0-4

```
line vty 0 4
 login
```

c. Examine the startup configuration file in NVRAM.

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

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

Question: Why does this message appear?

ANSWER - Because the running config has not been saved to NVRAM yet.

d. Examine the characteristics of the SVI for VLAN 1.

Switch# show interface vlan1

```
Switch#show interface vlan1
Vlan1 is administratively down, line protocol is down
  Hardware is CPU Interface, address is 0060.2fde.172d (bia 0060.2fde.172d)
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000000 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 21:40:21, output never, 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
     1682 packets input, 530955 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
     563859 packets output, 0 bytes, 0 underruns
     0 output errors, 23 interface resets
     0 output buffer failures, 0 output buffers swapped out

Switch#
```

Questions:

Is there an IP address assigned to VLAN 1?
ANSWER – No IP address is assigned
What is the MAC address of this SVI? Answers will vary.

ANSWER - bia 0060.2fde.172d

Is this interface up?

ANSWER Interface is down

VLAN 1 will not reach the up/up state until a port is assigned to it and this port is also up.

e. Examine the IP properties of the SVI VLAN 1.

Switch# **show ip interface vlan1**

Question: What output do you see?

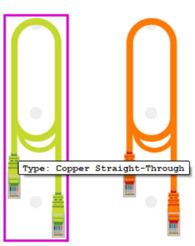
Switch#show ip interface vlan1

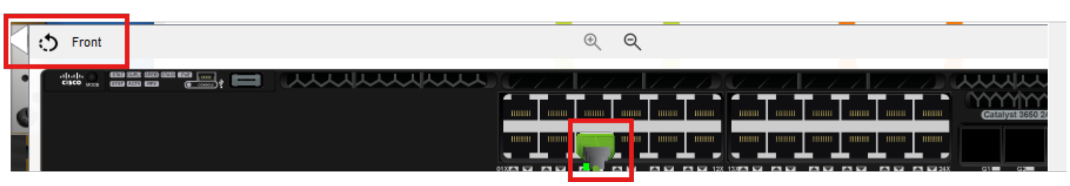
Vlan1 is administratively down, line protocol is down

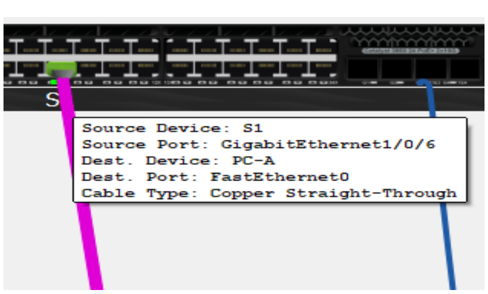
Internet protocol processing disabled

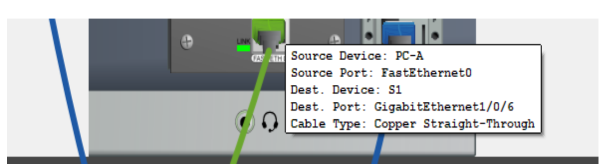
```
Switch#
Switch#
Switch#show ip interface vlan1
Vlan1 is administratively down, line protocol is down
  Internet protocol processing disabled

Switch#
```

f. Connect an Ethernet cable from PC-A to GigabitEthernet1/0/6 on the switch. Allow time for the switch and PC to negotiate duplex and speed parameters. Examine the IP properties of the SVI VLAN 1.









Question: What output do you see?

The Interface GigabitEthernet1/0/6, changed state to up
Line protocol on Interface GigabitEthernet1/0/6, changed state to up

```
%LINK-5-CHANGED: Interface GigabitEthernet1/0/6, changed state to up

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

Examine the IP properties of the SVI VLAN 1.

Switch**> show ip interface vlan1**

The vlan1 is administratively down, the line protocol is down, and the internet protocol processing is disabled.

```
Switch>
Switch>show ip interface vlan1
Vlan1 is administratively down, line protocol is down
  Internet protocol processing disabled

Switch>
```

g. Enter global configuration and enable the SVI VLAN 1 interface.

1. Enter global configuration

Switch>enable
Switch # config t

```
Switch>enable
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface
```

2. Enable the SV1 VLAN1 interface

Switch(config)# interface VLAN 1
Switch(config)# no shutdown

```
Switch(config)#interface
Switch(config)#interface V
Switch(config)#interface VLAN 1
Switch(config-if)#no shutdown

Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up
```

h. Examine the IP properties of the SVI VLAN 1.

Question: What output do you see?

Answer

Switch# show ip interface VLAN 1
Vlan1 is up, line protocol is up
  Internet protocol processing disabled

```
Switch#show ip interface vlan 1
Vlan1 is up, line protocol is up
  Internet protocol processing disabled
```

i. Examine the Cisco IOS version information of the switch.

Switch# show version

```
Switch#show version
Cisco IOS Software [Denali], Catalyst L3 Switch Software (CAT3K_CAA-UNIVERSALK9-M), Version 16.3.2, RELEASE SOFTWARE (fc4)
Technical Support : http://www.cisco.com/techsupport
Copyright(c) 1986 - 2016 by Cisco Systems, Inc.
Compiled Tue 08 - Nov - 16 17:31 by pt_team


Cisco IOS-XE software, Copyright(c) 2005 - 2016 by cisco Systems, Inc.
All rights reserved.Certain components of Cisco IOS - XE software are
licensed under the GNU General Public License("GPL") Version 2.0.The
software code licensed under GPL Version 2.0 is free software that comes
with ABSOLUTELY NO WARRANTY.You can redistribute and / or modify such
GPL code under the terms of GPL Version 2.0.For more details, see the
documentation or "License Notice" file accompanying the IOS - XE software,
or the applicable URL provided on the flyer accompanying the IOS - XE
software.


ROM: IOS-XE ROMMON
BOOTLDR: CAT3K_CAA Boot Loader (CAT3K_CAA-HBOOT-M) Version 4.26, RELEASE SOFTWARE (P)

test uptime is 7 hours, 33 minutes
Uptime for this control processor is 7 hours, 36 minutes
System returned to ROM by Power Failure
System image file is "flash:/cat3k_caa-universalk9.16.03.02.SPA.bin"
Last reload reason : Power Failure
```

```
This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.



Technology Package License Information :

---------------------------------------------------------------- -
Technology - package                  Technology - package
Current             Type              Next reboot
------------------------------------------------------------------
ipservicesk9        Permanent         ipservicesk9

cisco WS-C3650-24PS (MIPS) processor (revision N0) with 865815K/6147K bytes of memory.
Processor board ID FDO2031E1Q6
1 Virtual Ethernet interface
28 Gigabit Ethernet/IEEE 802.3 interface(s)
2048K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
250456K bytes of Crash Files at crashinfo : .
1609272K bytes of Flash at flash : .
0K bytes of  at webui : .
```

```
Base ethernet MAC Address        : 00:60:2F:DE:17:2D
Motherboard assembly number      : 73-15899-06
Motherboard serial number        : FDO20311WHP
Model revision number            : N0
Motherboard revision number      : A0
Model number                     : WS-C3650-24PS
System serial number             : FDO2031Q0TD


Switch   Ports  Model              SW Version            SW Image              Mode
------   -----  -----              ----------            ----------            ----
*    1   28     WS-C3650-24PS      16.3.2                CAT3K_CAA-UNIVERSALK9 BUNDLE

Configuration register is 0x102


Switch#
```

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

Answer Version 16.3.2, RELEASE SOFTWARE (fc4)

```
Switch#show version
Cisco IOS Software [Denali], Catalyst L3 Switch Software (CAT3K_CAA-UNIVERSALK9-M), Version 16.3.2, RELEASE SOFTWARE (fc4)
Technical Support : http://www.cisco.com/techsupport
Copyright(c) 1986 - 2016 by Cisco Systems, Inc.
Compiled Tue 08 - Nov - 16 17:31 by pt_team
```

What is the system image filename?

Answer System image file is "flash:/cat3k_caa-universalk9.16.03.02.SPA.bin"

```
test uptime is 7 hours, 33 minutes
Uptime for this control processor is 7 hours, 36 minutes
System returned to ROM by Power Failure
System image file is "flash:/cat3k_caa-universalk9.16.03.02.SPA.bin"
Last reload reason : Power Failure
```

What is the base Ethernet MAC address of this switch?

Answer Base ethernet MAC Address : 00:60:2F:DE:17:2D

```
Base ethernet MAC Address          : 00:60:2F:DE:17:2D
Motherboard assembly number        : 73-15899-06
Motherboard serial number          : FDO20311WHP
Model revision number              : N0
Motherboard revision number        : A0
Model number                       : WS-C3650-24PS
System serial number               : FDO2031Q0TD
```

j. Examine the default properties of the GigabitEthernet1/0/6 interface used by PC-A.

Switch# **show interface gig1/0/6**

```
Switch#show interface gig1/0/6
GigabitEthernet1/0/6 is up, line protocol is up (connected)
  Hardware is Lance, address is 000c.8589.1806 (bia 000c.8589.1806)
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s
  input flow-control is off, output flow-control is off
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:08, output 00:00:05, 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
     956 packets input, 193351 bytes, 0 no buffer
     Received 956 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 watchdog, 0 multicast, 0 pause input
     0 input packets with dribble condition detected
     2357 packets output, 263570 bytes, 0 underruns
     0 output errors, 0 collisions, 10 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
```

Question:

Is the interface up or down?

Answer GigabitEthernet1/0/6 is up, line protocol is up (connected)

What event would make an interface go down?

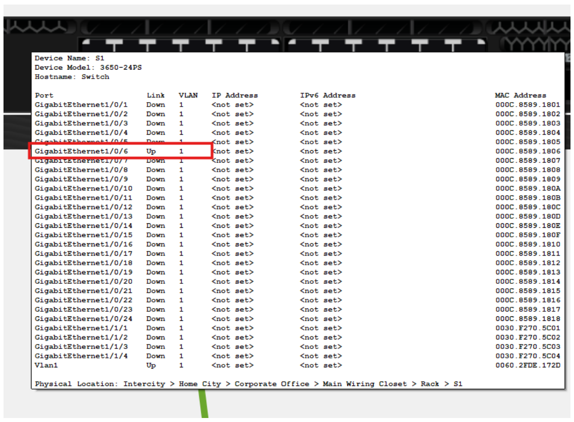
Answer If the ethernet cable were to be disconnected from the port.

What is the MAC address of the interface?

Answer bia 000c.8589.1806

What is the speed and duplex setting of the interface?

Answer Full-duplex, 100Mb/s



```
Device Name: S1
Device Model: 3650-24PS
Hostname: Switch

Port                   Link   VLAN  IP Address     IPv6 Address                MAC Address
GigabitEthernet1/0/1   Down   1     <not set>      <not set>                   000C.8589.1801
GigabitEthernet1/0/2   Down   1     <not set>      <not set>                   000C.8589.1802
GigabitEthernet1/0/3   Down   1     <not set>      <not set>                   000C.8589.1803
GigabitEthernet1/0/4   Down   1     <not set>      <not set>                   000C.8589.1804
GigabitEthernet1/0/5   Down   1     <not set>      <not set>                   000C.8589.1805
GigabitEthernet1/0/6   Up     1     <not set>      <not set>                   000C.8589.1806
GigabitEthernet1/0/7   Down   1     <not set>      <not set>                   000C.8589.1807
GigabitEthernet1/0/8   Down   1     <not set>      <not set>                   000C.8589.1808
GigabitEthernet1/0/9   Down   1     <not set>      <not set>                   000C.8589.1809
GigabitEthernet1/0/10  Down   1     <not set>      <not set>                   000C.8589.180A
GigabitEthernet1/0/11  Down   1     <not set>      <not set>                   000C.8589.180B
GigabitEthernet1/0/12  Down   1     <not set>      <not set>                   000C.8589.180C
GigabitEthernet1/0/13  Down   1     <not set>      <not set>                   000C.8589.180D
GigabitEthernet1/0/14  Down   1     <not set>      <not set>                   000C.8589.180E
GigabitEthernet1/0/15  Down   1     <not set>      <not set>                   000C.8589.180F
GigabitEthernet1/0/16  Down   1     <not set>      <not set>                   000C.8589.1810
GigabitEthernet1/0/17  Down   1     <not set>      <not set>                   000C.8589.1811
GigabitEthernet1/0/18  Down   1     <not set>      <not set>                   000C.8589.1812
GigabitEthernet1/0/19  Down   1     <not set>      <not set>                   000C.8589.1813
GigabitEthernet1/0/20  Down   1     <not set>      <not set>                   000C.8589.1814
GigabitEthernet1/0/21  Down   1     <not set>      <not set>                   000C.8589.1815
GigabitEthernet1/0/22  Down   1     <not set>      <not set>                   000C.8589.1816
GigabitEthernet1/0/23  Down   1     <not set>      <not set>                   000C.8589.1817
GigabitEthernet1/0/24  Down   1     <not set>      <not set>                   000C.8589.1818
GigabitEthernet1/1/1   Down   1     <not set>      <not set>                   0030.F270.5C01
GigabitEthernet1/1/2   Down   1     <not set>      <not set>                   0030.F270.5C02
GigabitEthernet1/1/3   Down   1     <not set>      <not set>                   0030.F270.5C03
GigabitEthernet1/1/4   Down   1     <not set>      <not set>                   0030.F270.5C04
Vlan1                  Up     1     <not set>      <not set>                   0060.2FDE.172D

Physical Location: Intercity > Home City > Corporate Office > Main Wiring Closet > Rack > S1
```

k. Examine the default VLAN settings of the switch.

Switch# show vlan

```
Switch#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gig1/0/1, Gig1/0/2, Gig1/0/3, Gig1/0/4
                                                Gig1/0/5, Gig1/0/6, Gig1/0/7, Gig1/0/8
                                                Gig1/0/9, Gig1/0/10, Gig1/0/11, Gig1/0/12
                                                Gig1/0/13, Gig1/0/14, Gig1/0/15, Gig1/0/16
                                                Gig1/0/17, Gig1/0/18, Gig1/0/19, Gig1/0/20
                                                Gig1/0/21, Gig1/0/22, Gig1/0/23, Gig1/0/24
                                                Gig1/1/1, Gig1/1/2, Gig1/1/3, Gig1/1/4


99   VLAN0099                         active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
Switch#
```

What is the name of VLAN 1?

Answer default

```
Switch#show vlan

VLAN Name
---- ---------------
1    default
```

Which ports are in VLAN 1?

Answer Gig1/0/1- Gig1/0/24 and Gig1/1/1 to Gig1/1/4

```
Ports
-------------------------------
Gig1/0/1, Gig1/0/2, Gig1/0/3, Gig1/0/4
Gig1/0/5, Gig1/0/6, Gig1/0/7, Gig1/0/8
Gig1/0/9, Gig1/0/10, Gig1/0/11, Gig1/0/12
Gig1/0/13, Gig1/0/14, Gig1/0/15, Gig1/0/16
Gig1/0/17, Gig1/0/18, Gig1/0/19, Gig1/0/20
Gig1/0/21, Gig1/0/22, Gig1/0/23, Gig1/0/24
Gig1/1/1, Gig1/1/2, Gig1/1/3, Gig1/1/4
```

Is VLAN 1 active?

Answer Yes, status is Active

```
Status
---------
active
```

What type of VLAN is the default VLAN?

Answer enet = Ethernet

```
VLAN Type  S
---- ----- -
1    enet  1
```

l. Examine flash memory.

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

Switch# show flash:
Switch# dir flash:

```
Switch#show flash:

System flash directory:
File  Length    Name/status
  3   505532849 cat3k caa-universalk9.16.03.02.SPA.bin
  4   616       vlan.dat
[505533465 bytes used, 1034042343 available, 1539575808 total]
1.50426e+06K bytes of processor board System flash (Read/Write)


Switch#dir flash:
Directory of flash:/

    3  -rw-    505532849          <no date>  cat3k caa-universalk9.16.03.02.SPA.bin
    4  -rw-          616          <no date>  vlan.dat

1539575808 bytes total (1034042343 bytes free)
Switch#
```

Files have a file extension, such as .bin, at the end of the filename. Directories do not have a file extension.

Question:

What is the filename of the Cisco IOS image?

Answer cat3k_caa-universalk9.16.03.02.SPA.bin

3.4.2.1.5.2 Part 2: Configure Basic Network Device Settings

In Part 2, you will configure basic settings for the switch and PC.

3.4.2.1.5.2.1 Step 1: Configure basic switch settings.

a. Copy the following basic configuration and paste it into S1 while in global configuration mode.

```
no ip domain-lookup
hostname S1
service password-encryption
enable secret class
banner motd #
Unauthorized access is strictly prohibited. #
```

```
Switch#
Switch#
Switch#
Switch#enable
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#no ip domain-lookup
Switch(config)#hostname S1
S1(config)#service password-encryption
S1(config)#enable secret class
S1(config)#banner motd #
Enter TEXT message.  End with the character '#'.
Unauthorized access is strictly prohibited. #

S1(config)#
```

b. Set the SVI IP address of the switch. This allows remote management of the switch.

Before you can manage S1 remotely from PC-A, you must 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.

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

1) First, create the new VLAN 99 on the switch.
2) Next, set the IP address of the switch to 192.168.1.2 with a subnet mask of 255.255.255.0 on the internal virtual interface VLAN 99.
3) An IPv6 address can also be configured on the SVI interface. Use the IPv6 addresses listed in the **Addressing Table**.

```
S1(config)#vlan 99
S1(config-vlan)#exit
S1(config)#interface vlan99
S1(config-if)#
%LINK-5-CHANGED: Interface Vlan99, changed state to up
S1(config-if)#ip address 192.168.1.2 255.255.255.0
S1(config-if)#ipv6 address 2001:db8:acad:1::2/64
S1(config-if)#ipv6 address fe80::2 link-local
S1(config-if)#no shutdown
S1(config-if)#exit
S1(config)#
```

```
S1(config)#
S1(config)#vlan 99
S1(config-vlan)#exit
S1(config)#interface vlan99
S1(config-if)#
%LINK-5-CHANGED: Interface Vlan99, changed state to up

S1(config-if)#ip address 192.168.1.2 255.255.255.0
S1(config-if)#ipv6 address 2001:db8:acad:1::2/64
S1(config-if)#ipv6 address fe80::2 link-local
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 **no shutdown** command. The interface is currently down because no switch ports are assigned to VLAN 99.

```
S1#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gig1/0/1, Gig1/0/2, Gig1/0/3, Gig1/0/4
                                                Gig1/0/5, Gig1/0/6, Gig1/0/7, Gig1/0/8
                                                Gig1/0/9, Gig1/0/10, Gig1/0/11, Gig1/0/12
                                                Gig1/0/13, Gig1/0/14, Gig1/0/15, Gig1/0/16
                                                Gig1/0/17, Gig1/0/18, Gig1/0/19, Gig1/0/20
                                                Gig1/0/21, Gig1/0/22, Gig1/0/23, Gig1/0/24
                                                Gig1/1/1, Gig1/1/2, Gig1/1/3, Gig1/1/4
99   VLAN0099                         active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
```

```
S1#show ip int vlan 99
Vlan99 is up, line protocol is down
  Internet address is 192.168.1.2/24
  Broadcast address is 255.255.255.255
  Address determined by setup command
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Outgoing access list is not set
  Inbound  access list is not set
  Proxy ARP is enabled
  Local Proxy ARP is disabled
  Security level is default
  Split horizon is enabled
  ICMP redirects are always sent
  ICMP unreachables are always sent
  ICMP mask replies are never sent
  IP fast switching is disabled
  IP fast switching on the same interface is disabled
  IP Null turbo vector
  IP multicast fast switching is disabled
  IP multicast distributed fast switching is disabled
  IP route-cache flags are None
  Router Discovery is disabled
  IP output packet accounting is disabled
  IP access violation accounting is disabled
  TCP/IP header compression is disabled
  RTP/IP header compression is disabled
  Probe proxy name replies are disabled
  Policy routing is disabled
  Network address translation is disable
  WCCP Redirect outbound is disabled
  WCCP Redirect inbound is disabled
  WCCP Redirect exclude is disabled
  BGP Policy Mapping is disabled

S1#
```

c. Assign all user ports to VLAN 99.

To establish connectivity between the host and the switch, the ports used by the host must be in the same VLAN as the switch. After a few seconds, VLAN 99 comes up because at least one active port (Fa0/6 with PC-A attached) is now assigned to VLAN 99.

```
S1(config)# interface range gig1/0/1-24
S1(config-if-range)# switchport access vlan 99
S1(config-if-range)# exit
```

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface range gig1/0/1-24
S1(config-if-range)#switchport access vlan 99
S1(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up

S1(config-if-range)#exit
S1(config)#
```

d. Issue the **show vlan brief** command to verify that all ports are in VLAN 99.

S1#show vlan brief

```
S1(config)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gig1/1/1, Gig1/1/2, Gig1/1/3, Gig1/1/4
99   VLAN0099                         active    Gig1/0/1, Gig1/0/2, Gig1/0/3, Gig1/0/4
                                                Gig1/0/5, Gig1/0/6, Gig1/0/7, Gig1/0/8
                                                Gig1/0/9, Gig1/0/10, Gig1/0/11, Gig1/0/12
                                                Gig1/0/13, Gig1/0/14, Gig1/0/15, Gig1/0/16
                                                Gig1/0/17, Gig1/0/18, Gig1/0/19, Gig1/0/20
                                                Gig1/0/21, Gig1/0/22, Gig1/0/23, Gig1/0/24
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

e. Configure the default gateway for S1. If no default gateway is set, the switch cannot be managed from a remote network that is more than one router away. 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 192.168.1.1, set the default gateway for the switch.

S1(config)# **ip default-gateway 192.168.1.1**

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#
S1(config)#
S1(config)#ip default-gateway 192.168.1.1
S1(config)#
```

f. Console port access should also be restricted with a password. Use **cisco** as the console login password in this activity. The default configuration is to allow all console connections with no password needed. To prevent console messages from interrupting commands, use the **logging synchronous** option.

```
S1(config)# line con 0
S1(config-line)# logging synchronous
S1(config-line)#password cisco
S1(config-line)#login
```

```
S1(config-line)#line console 0
S1(config-line)#loggin syn
S1(config-line)#loggin synchronous
S1(config-line)#password cisco
S1(config-line)#login
```

g. Configure the virtual terminal (vty) lines for the switch to allow Telnet access. If you do not configure a vty password, you will not be able to use Telnet to access the switch.

```
S1(config-line)#login
S1(config-line)#line vty 0 15
S1(config-line)#password cisco
S1(config-line)#transport input telnet
S1(config-line)#login
S1(config-line)#end
```

```
S1(config)#line vty 0 15
S1(config-line)#password cisco
S1(config-line)#transport input telnet
S1(config-line)#login
S1(config-line)#end
S1#
```

Question:

Why is the login command required?

ANSWER - Without the login command, the switch will not prompt you for a password.

3.4.2.1.5.2.2 Step 2: Configure an IP address on PC-A.

Assign the IP address and subnet mask to the PC, as shown in the **Addressing Table**. An abbreviated version of the procedure is described here. A default gateway is not required for this topology to function; however, you should enter **192.168.1.1** and **fe80::1** to simulate a router attached to S1.

a. Navigate to the **Desktop** tab.

b. Click **IP Configuration**.

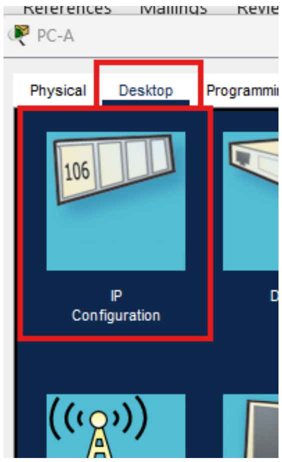
c. Verify that the **Static** IP Configuration radial button is selected.

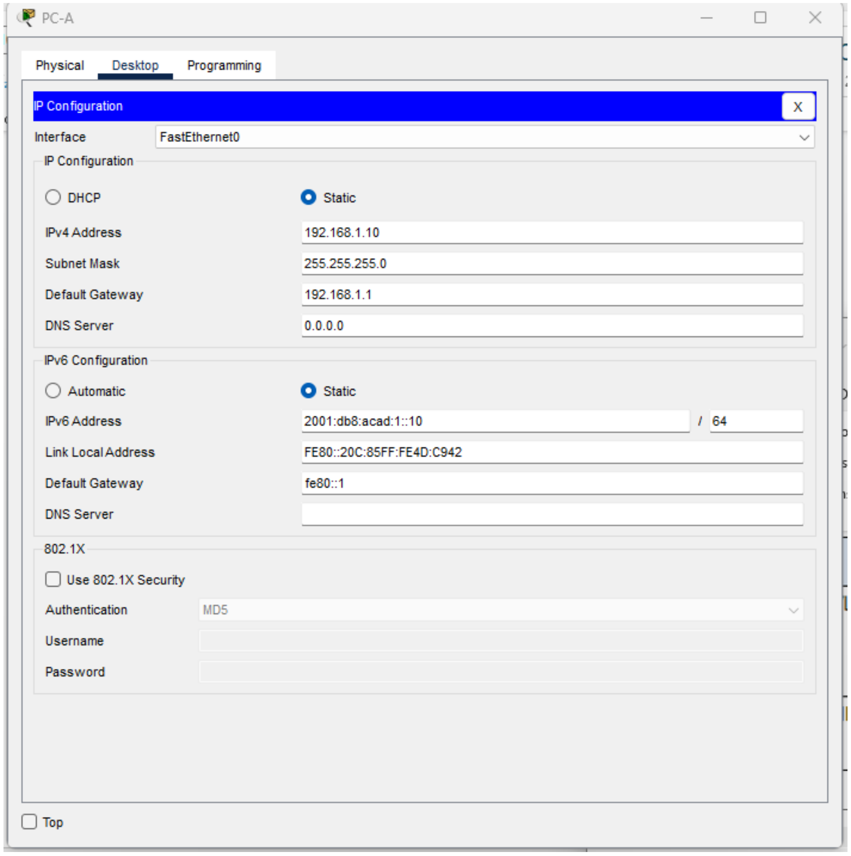
d. Enter the IPv4 address, subnet mask, and default gateway.

e. Verify that the **Static** IPv6 Configuration radial button is selected.

f. Enter the IPv6 address, prefix, and default gateway

g. Click the **X** to close the **IP Configuration** window.

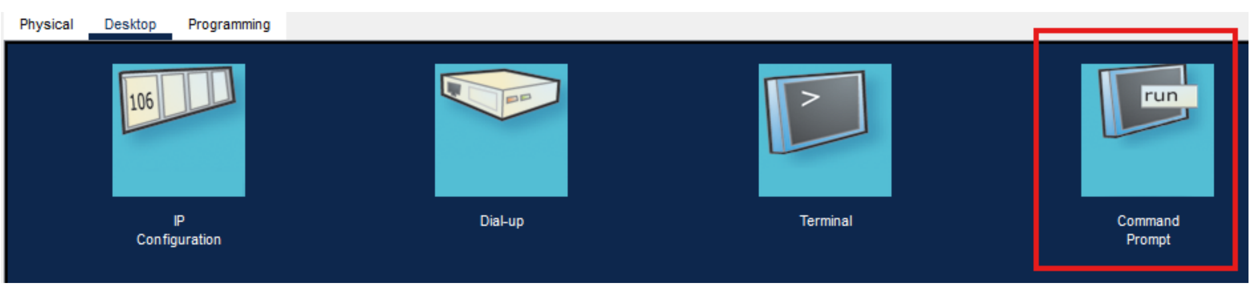




3.4.2.1.5.3 Part 3: Verify and Test Network Connectivity

In Part 3, you will verify and document the switch configuration, test end-to-end connectivity between PC-A and S1, and test the remote management capability of the switch.

Open command prompt form PC



Test end-to-end connectivity between PC-A and S1

C:\>telnet 192.168.1.2

```
ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time<1ms TTL=255
Reply from 192.168.1.2: bytes=32 time<1ms TTL=255
Reply from 192.168.1.2: bytes=32 time<1ms TTL=255
Reply from 192.168.1.2: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

C:\>ping 2001:db8:acad:1::2

```
C:\>
C:\>ping 2001:db8:acad:1::2

Pinging 2001:db8:acad:1::2 with 32 bytes of data:

Reply from 2001:DB8:ACAD:1::2: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:1::2: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:1::2: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:1::2: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:1::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Test the remote management capability of the switch

C:\>telnet 192.168.1.2

Password cisco

```
C:\>
C:\>telnet 192.168.1.2
Trying 192.168.1.2 ...Open
Unauthorized access is strictly prohibited.


User Access Verification

Password:
S1>
S1>
S1>
```

3.4.2.1.5.3.1 Step 1: Display the switch configuration.

Use the console connection on PC-A to display and verify the switch configuration. The **show run** command displays the entire running configuration, one page at a time. Use the spacebar to advance paging.

a. A sample configuration is shown here. The settings you configured are highlighted in yellow. The other configuration settings are IOS defaults.

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

Current configuration : 2424 bytes
!
version 16.3.2
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname S1
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCi1!
no ip cef
no ipv6 cef
!
!
no ip domain-lookup
!
<output omitted>
!
interface GigabitEthernet1/0/6
switchport access vlan 99
!
<output omitted>
!
interface GigabitEthernet1/0/24
switchport access vlan 99
!
<output omitted>
!
interface Vlan1
no ip address
shutdown
!
interface Vlan99
mac-address 00e0.f795.d201
ip address 192.168.1.2 255.255.255.0
```

```
ipv6 address FE80::2 link-local
ipv6 address 2001:DB8:ACAD:1::2/64
!
ip default-gateway 192.168.1.1
ip classless
!
banner motd ^C
Unauthorized access is strictly prohibited. ^C
!
line con 0
password 7 0822455D0A16
logging synchronous
login
line vty 0 4
password 7 0822455D0A16
login
line vty 5 15
password 7 0822455D0A16
login
!
End
```

ANSWER

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

Current configuration : 2449 bytes
!
version 16.3.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname S1
!
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCi1
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
!
!
no ip domain-lookup
!
!
spanning-tree mode pvst
!
!
!
!
!
```

```
!
interface GigabitEthernet1/0/1
switchport access vlan 99
!
interface GigabitEthernet1/0/2
switchport access vlan 99
!
interface GigabitEthernet1/0/3
switchport access vlan 99
!
interface GigabitEthernet1/0/4
switchport access vlan 99
!
interface GigabitEthernet1/0/5
switchport access vlan 99
!
interface GigabitEthernet1/0/6
switchport access vlan 99
!
interface GigabitEthernet1/0/7
switchport access vlan 99
!
interface GigabitEthernet1/0/8
switchport access vlan 99
!
interface GigabitEthernet1/0/9
switchport access vlan 99
!
interface GigabitEthernet1/0/10
switchport access vlan 99
!
interface GigabitEthernet1/0/11
switchport access vlan 99
!
interface GigabitEthernet1/0/12
switchport access vlan 99
!
interface GigabitEthernet1/0/13
switchport access vlan 99
!
interface GigabitEthernet1/0/14
switchport access vlan 99
!
interface GigabitEthernet1/0/15
switchport access vlan 99
!
interface GigabitEthernet1/0/16
switchport access vlan 99
!
interface GigabitEthernet1/0/17
switchport access vlan 99
!
interface GigabitEthernet1/0/18
switchport access vlan 99
!
interface GigabitEthernet1/0/19
switchport access vlan 99
!
interface GigabitEthernet1/0/20
switchport access vlan 99
!
interface GigabitEthernet1/0/21
switchport access vlan 99
!
interface GigabitEthernet1/0/22
switchport access vlan 99
```

```
!
interface GigabitEthernet1/0/23
switchport access vlan 99
!
interface GigabitEthernet1/0/24
switchport access vlan 99
!
interface GigabitEthernet1/1/1
!
interface GigabitEthernet1/1/2
!
interface GigabitEthernet1/1/3
!
interface GigabitEthernet1/1/4
!
interface Vlan1
no ip address
!
interface Vlan99
mac-address 0060.2fde.1701
ip address 192.168.1.2 255.255.255.0
ipv6 address FE80::2 link-local
ipv6 address 2001:DB8:ACAD:1::2/64
!
ip default-gateway 192.168.1.1
ip classless
!
ip flow-export version 9
!
!
!
banner motd ^C
Unauthorized access is strictly prohibited. ^C
!
!
!
!
line con 0
password 7 0822455D0A16
logging synchronous
login
!
line aux 0
!
line vty 0 4
password 7 0837585E
login
transport input telnet
line vty 5 15
password 7 0837585E
login
transport input telnet
!
!
!
!
end


S1#
```

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

Current configuration : 2449 bytes
!
version 16.3.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname S1
!
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCi1
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
!
!
no ip domain-lookup
!
!
```

```
no ip domain-lookup
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface GigabitEthernet1/0/1
 switchport access vlan 99
!
interface GigabitEthernet1/0/2
 switchport access vlan 99
!
interface GigabitEthernet1/0/3
 switchport access vlan 99
!
interface GigabitEthernet1/0/4
 switchport access vlan 99
!
interface GigabitEthernet1/0/5
 switchport access vlan 99
!
interface GigabitEthernet1/0/6
 switchport access vlan 99
!
interface GigabitEthernet1/0/7
 switchport access vlan 99
!
interface GigabitEthernet1/0/8
 switchport access vlan 99
!
interface GigabitEthernet1/0/9
 switchport access vlan 99
!
interface GigabitEthernet1/0/10
 switchport access vlan 99
!
```

```
!
interface GigabitEthernet1/0/10
 switchport access vlan 99
!
interface GigabitEthernet1/0/11
 switchport access vlan 99
!
interface GigabitEthernet1/0/12
 switchport access vlan 99
!
interface GigabitEthernet1/0/13
 switchport access vlan 99
!
interface GigabitEthernet1/0/14
 switchport access vlan 99
!
interface GigabitEthernet1/0/15
 switchport access vlan 99
!
interface GigabitEthernet1/0/16
 switchport access vlan 99
!
interface GigabitEthernet1/0/17
 switchport access vlan 99
!
interface GigabitEthernet1/0/18
 switchport access vlan 99
!
interface GigabitEthernet1/0/19
 switchport access vlan 99
!
interface GigabitEthernet1/0/20
 switchport access vlan 99
!
interface GigabitEthernet1/0/21
 switchport access vlan 99
!
interface GigabitEthernet1/0/22
```

```
!
interface GigabitEthernet1/0/22
 switchport access vlan 99
!
interface GigabitEthernet1/0/23
 switchport access vlan 99
!
interface GigabitEthernet1/0/24
 switchport access vlan 99
!
interface GigabitEthernet1/1/1
!
interface GigabitEthernet1/1/2
!
interface GigabitEthernet1/1/3
!
interface GigabitEthernet1/1/4
!
interface Vlan1
 no ip address
!
interface Vlan99
 mac-address 0060.2fde.1701
 ip address 192.168.1.2 255.255.255.0
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:ACAD:1::2/64
!
ip default-gateway 192.168.1.1
ip classless
!
ip flow-export version 9
!
!
!
banner motd ^C
Unauthorized access is strictly prohibited. ^C
!
!
```

```
!
line con 0
 password 7 0822455D0A16
 logging synchronous
 login
!
line aux 0
!
line vty 0 4
 password 7 0837585E
 login
 transport input telnet
line vty 5 15
 password 7 0837585E
 login
 transport input telnet
!
!
!
!
end
```

b. Verify the management VLAN 99 settings.

S1# **show interface vlan 99**

Questions

What is the bandwidth on this interface?

ANSWER100 000 kbit (100 Mbs)

What is the VLAN 99 state?

ANSWER Vlan 99 is up

What is the line protocol state?

ANSWER Line protocol is up

```
S1#
S1#show interface vlan 99
Vlan99 is up, line protocol is up
  Hardware is CPU Interface, address is 0060.2fde.1701 (bia 0060.2fde.1701)
  Internet address is 192.168.1.2/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000000 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 21:40:21, output never, 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
     1682 packets input, 530955 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
     563859 packets output, 0 bytes, 0 underruns
     0 output errors, 23 interface resets
     0 output buffer failures, 0 output buffers swapped out

S1#
```

3.4.2.1.5.3.2 Step 2: Test end-to-end connectivity with ping.

Verify that PC-A can ping the IPv4 and IPv6 address for S1.

C:\> **ping 192.168.1.2**

C:\> **ping 2001:db8:acad:1::2**

Test end-to-end connectivity between PC-A and S1

C:\>telnet 192.168.1.2

```
ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time<1ms TTL=255
Reply from 192.168.1.2: bytes=32 time<1ms TTL=255
Reply from 192.168.1.2: bytes=32 time<1ms TTL=255
Reply from 192.168.1.2: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

C:\>ping 2001:db8:acad:1::2

```
C:\>
C:\>ping 2001:db8:acad:1::2

Pinging 2001:db8:acad:1::2 with 32 bytes of data:

Reply from 2001:DB8:ACAD:1::2: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:1::2: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:1::2: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:1::2: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:1::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Test the remote management capability of the switch

C:\>telnet 192.168.1.2

Password cisco

```
C:\>
C:\>telnet 192.168.1.2
Trying 192.168.1.2 ...Open
Unauthorized access is strictly prohibited.


User Access Verification

Password:
S1>
S1>
S1>
```

Because PC-A needs to resolve the MAC address of S1 through ARP, the first packet may time out. If ping results continue to be unsuccessful, troubleshoot the basic device configurations. Check both the physical cabling and logical addressing.

3.4.2.1.5.3.3 Step 3: Test and verify remote management of S1.

You will now use Telnet to remotely access the switch. In this activity, PC-A and S1 reside side by side. In a production network, the switch could be in a wiring closet on the top floor while your management PC is located on the ground floor. In this step, you will use Telnet to remotely access switch S1 using the SVI management address. Telnet is not a secure protocol; however, you will use it to test remote access. With Telnet, all information, including passwords and commands, are sent in plaintext. In subsequent activities, you will use SSH to remotely access network devices.

a. Open the **Desktop** tab on PC-A.

b. Scroll down in the listing of apps and click the **Telnet/SSH Client.**

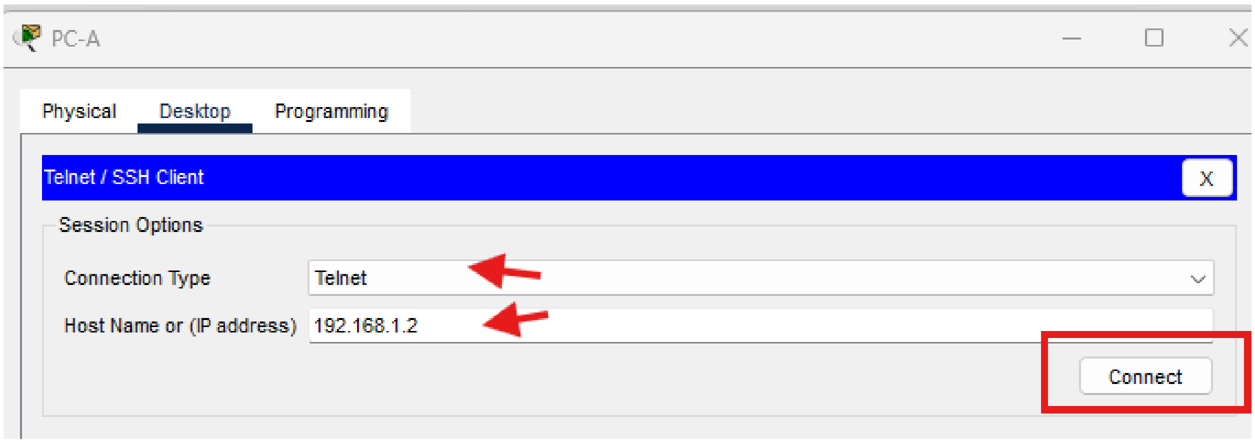
c. Set the **Connection Type** to be **Telnet.**

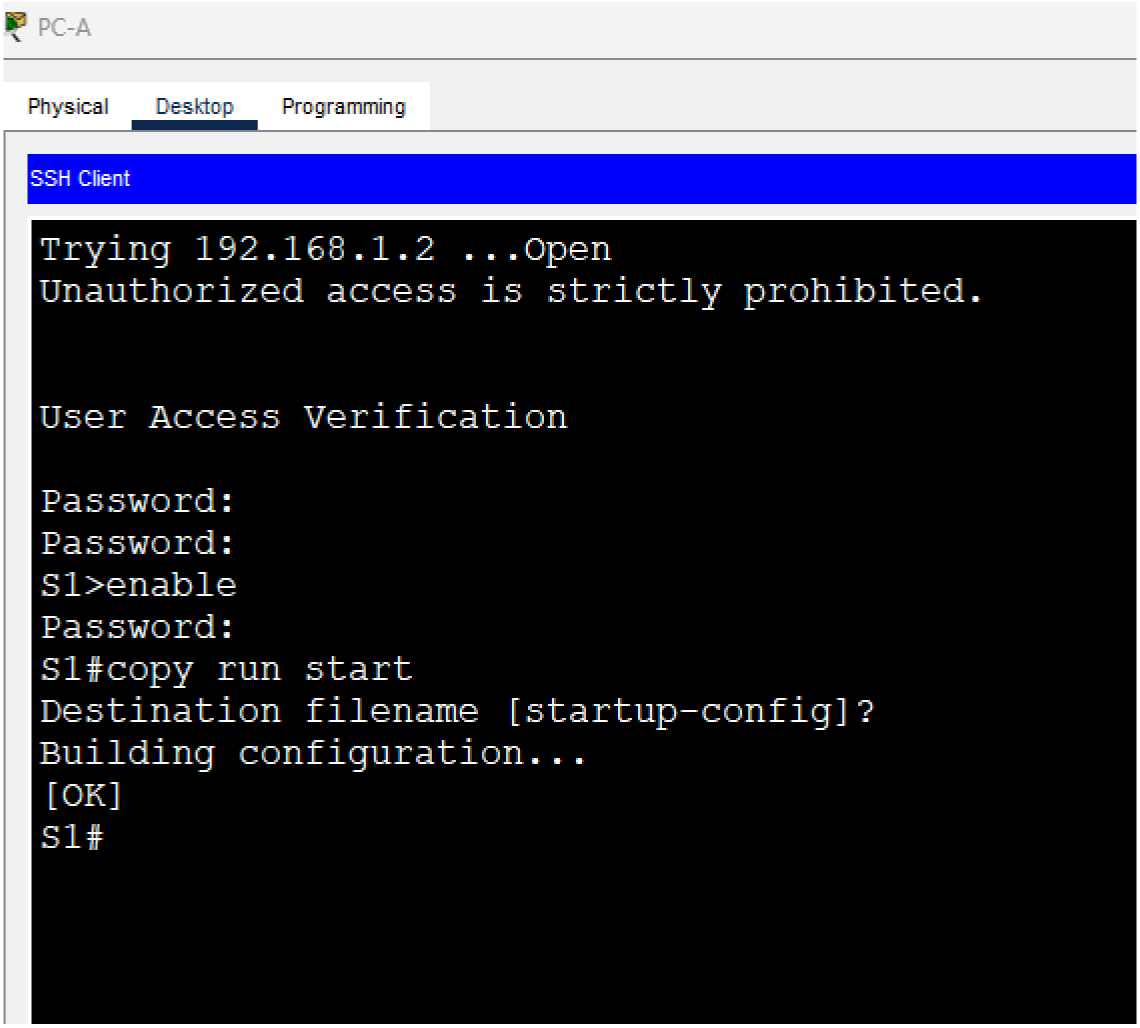
d. Enter the SVI management address to connect to S1 and click **Connect**.

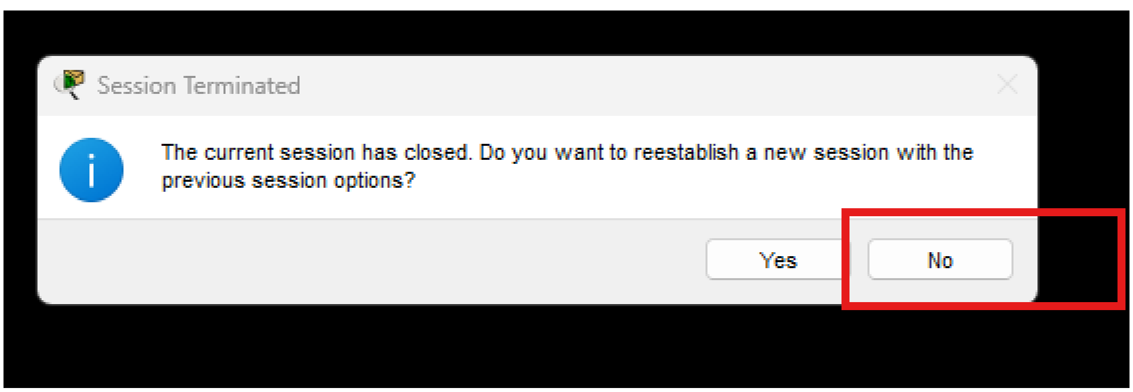
e. After entering the password **cisco**, you will be at the user EXEC mode prompt. Access privileged EXEC mode using the **enable** command and providing the secret password **class**.

f. Save the configuration.

g. Type **exit** to end the Telnet session. Click **No** to the pop-up.







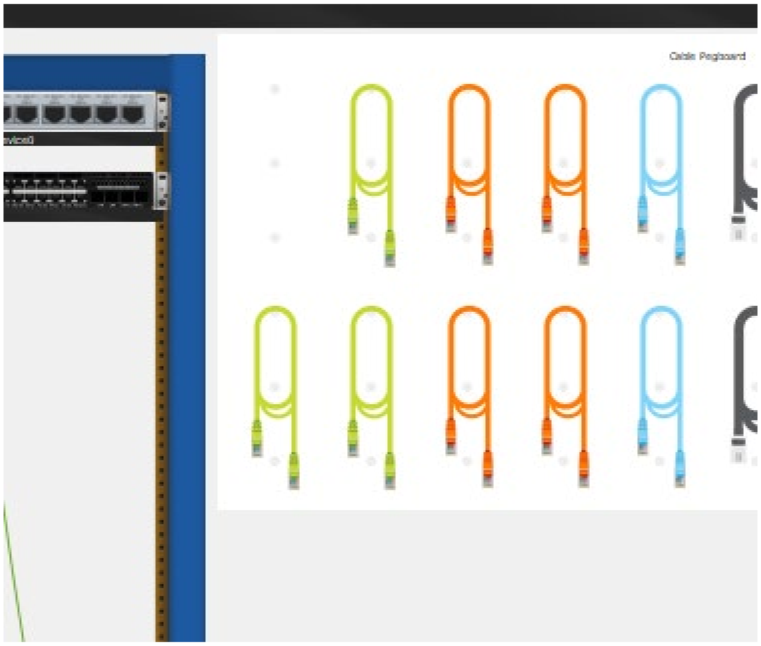
3.4.2.1.5.3.4 Step 4: Deploy switch S1 on the production network.

You will now install switch S1 on the production network and disconnect the console cable. Telnet will be used to remotely access the switch and complete any additional configuration and verification. In subsequent activities, you will use SSH to remotely access network devices.

a. Move switch **S1** to the **Rack**.

b. Right-click switch **S1** and select **Inspect Rear**.

c. Click and drag the **console cable** to the **peg board**.



3.4.2.1.6 Reflection Questions

1. **Why should you configure the vty password for the switch?**
   ANSWER To provide secure access to the device and allow only authorized users with the password to remotely access the switch.
2. **Why change the default VLAN 1 to a different VLAN number?**
   ANSWER A best practice for basic switch configuration is to change the management VLAN to a VLAN other than VLAN 1, as VLAN 1 is the default configuration, and we wouldn't want anyone who is not authorized to know which VLAN we are using.
3. **How can you prevent passwords from being sent in plaintext?**
   ANSWER Use the service password-encryption global configuration command.

3.4.3 Section 1.3 - Secure Remote Access

3.4.3.1 Exercise 1.3.6 Packet Tracer - Configure SSH

3.4.3.1.1 Topology

3.4.3.1.2 Addressing Table

Device	Interface	IP Address	Subnet Mask
S1	VLAN 1	10.10.10.2	255.255.255.0
PC1	NIC	10.10.10.10	255.255.255.0

3.4.3.1.3 Objectives

Part 1: Secure Passwords

Part 2: Encrypt Communications

Part 3: Verify SSH Implementation

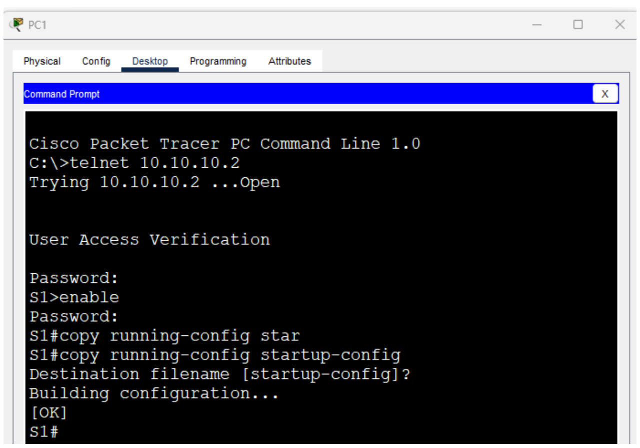
3.4.3.1.4 Background

SSH should replace Telnet for management connections. Telnet uses insecure plain text communications. SSH provides security for remote connections by providing strong encryption of all transmitted data between devices. In this activity, you will secure a remote switch with password encryption and SSH.

3.4.3.1.5 Instructions

3.4.3.1.5.1 Part 1: Secure Passwords

a. Using the command prompt on **PC1**, Telnet to **S1**. The user EXEC and privileged EXEC password is **cisco**.
b. Save the current configuration so that any mistakes you might make can be reversed by toggling the power for **S1**.



c. Show the current configuration and note that the passwords are in plain text. Enter the command that encrypts plain text passwords:

```
S1#show running-config
Building configuration...

Current configuration : 1150 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S1
!
!
enable password cisco
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
```

```
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 ip address 10.10.10.2 255.255.255.0
!
!
!
!
```

```
interface Vlan1
 ip address 10.10.10.2 255.255.255.0
!
!
!
!
!
!
line con 0
!
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
!
!
!
end
```

S1(config)# **service password-encryption**

```
S1#config t
S1#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#service pass
S1(config)#service password-encryption
S1(config)#
```

d. Verify that the passwords are encrypted.

```
S1#show running-config
Building configuration...

Current configuration : 1174 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname S1
!
!
enable password 7 0822455D0A16
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
 --More--
```

```
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 ip address 10.10.10.2 255.255.255.0
!
!
!
!
 --More--
```

```
!
!
!
!
line con 0
!
line vty 0 4
 password 7 0822455D0A16
 login
line vty 5 15
 password 7 0822455D0A16
 login
!
!
!
!
end


S1#
S1#
```

3.4.3.1.5.2 Part 2: Encrypt Communications

3.4.3.1.5.2.1 Step 1: Set the IP domain name and generate secure keys.

It is generally not safe to use Telnet, because data is transferred in plain text. Therefore, use SSH whenever it is available.

a. Configure the domain name to be **netacad.pka**.

b. Secure keys are needed to encrypt the data. Generate the RSA keys using a 1024 key length.

```
S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#ip domain name netacad.pka
S1(config)#crypto key
S1(config)#crypto key generate
S1(config)#crypto key generate  rsa
The name for the keys will be: S1.netacad.pka
Choose the size of the key modulus in the range of 360 to 4096 for your
  General Purpose Keys. Choosing a key modulus greater than 512 may take
  a few minutes.

How many bits in the modulus [512]: 1024
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

S1(config)#
*Mar 1 2:27:26.455: %SSH-5-ENABLED: SSH 1.99 has been enabled
S1(config)#
S1(config)#
```

3.4.3.1.5.2.2 Step 2: Create an SSH user and reconfigure the VTY lines for SSH-only access.

a. Create an **administrator** user with **cisco** as the secret password.

b. Configure the VTY lines to check the local username database for login credentials and to only allow SSH for remote access. Remove the existing vty line password.

```
S1(config)#
S1(config)#
S1(config)#username administrator secret cisco
S1(config)#
S1(config)#line vty 0 15
S1(config-line)#no password
S1(config-line)#transport input ssh
S1(config-line)#login local
S1(config-line)#exit
S1(config)#exit
S1#exit

[Connection to 10.10.10.2 closed by foreign host]
```

3.4.3.1.5.3 Step 3: Verify SSH Implementation

a. Exit the Telnet session and attempt to log back in using Telnet. The attempt should fail.

b. Attempt to log in using SSH. Type **ssh** and press **Enter** without any parameters to reveal the command usage instructions. **Hint**: The **-l** option is the letter “L”, not the number 1.

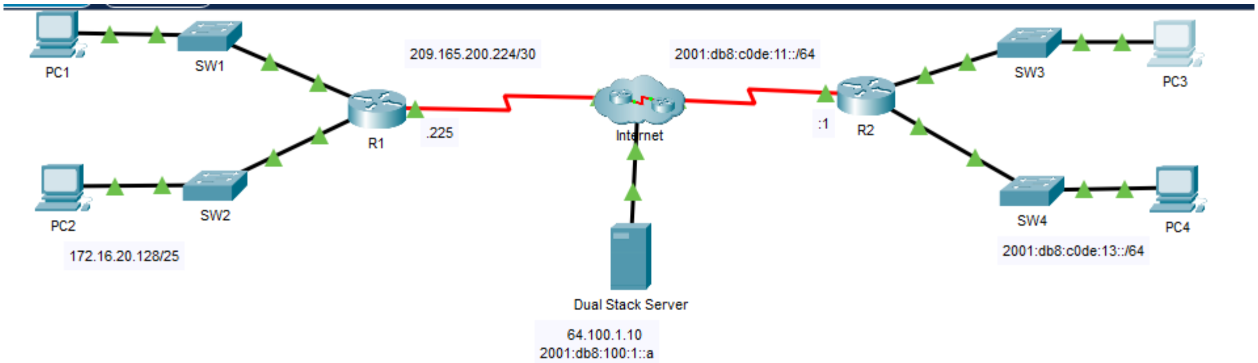
c. Upon successful login, enter privileged EXEC mode and save the configuration. If you were unable to successfully access **S1**, toggle the power and begin again at Part 1.

```
[Connection to 10.10.10.2 closed by foreign host]
C:\>telnet 10.10.10.2
Trying 10.10.10.2 ...Open

[Connection to 10.10.10.2 closed by foreign host]
C:\>ssh
Cisco Packet Tracer PC SSH

Usage: SSH -l username target

C:\>ssh -l administrator 10.10.10.2

Password:



S1>enable
Password:
S1#copy runni
S1#copy running-config str
S1#copy running-config sta
S1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
S1#
S1#
```

3.4.4 Section 1.4 – Basic Routing configuration

3.4.4.1 Exercise 1.4.7 Packet Tracer- Configure Router Interfaces

3.4.4.1.1 Topology



3.4.4.1.2 Addressing Table

Device	Interface	IP Address/Prefix	Default Gateway
R1	G0/0	172.16.20.1 /25	N/A
	G0/1	172.16.20.129 /25	N/A
	S0/0/0	209.165.200.225 /30	N/A
PC1	NIC	172.16.20.10 /25	172.16.20.1
PC2	NIC	172.16.20.138 /25	172.16.20.129
R2	G0/0	2001:db8:c0de:12::1/64	N/A
	G0/1	2001:db8:c0de:13::1/64	N/A
	S0/0/1	2001:db8:c0de:11::1/64	N/A
		fe80::2	N/A
PC3	NIC	2001:db8:c0de:12::a/64	fe80::2
PC4	NIC	2001:db8:c0de:13::a/64	fe80::2

3.4.4.1.3 Objectives

Part 1: Configure IPv4 Addressing and Verify Connectivity

Part 2: Configure IPv6 Addressing and Verify Connectivity

3.4.4.1.4 Background

Routers R1 and R2 each have two LANs. Your task is to configure the appropriate addressing on each device and verify connectivity between the LANs.

Note: The user EXEC password is **cisco**. The privileged EXEC password is **class**.

3.4.4.1.5 Instructions

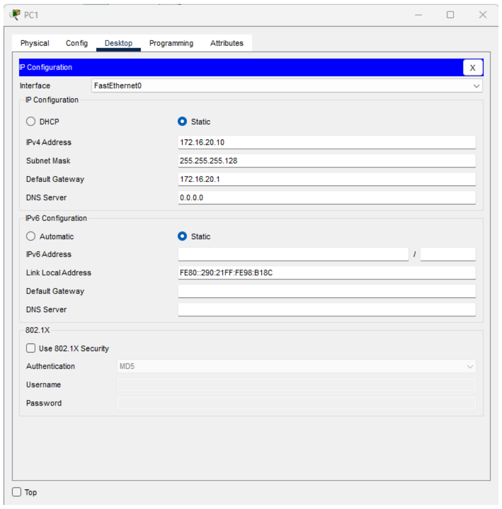
3.4.4.1.5.1 Part 1: Configure IPv4 Addressing and Verify Connectivity

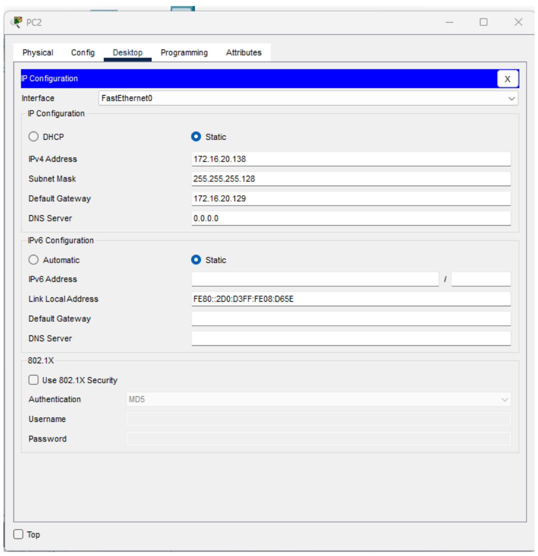
3.4.4.1.5.1.1 Step 1: Assign IPv4 addresses to R1 and LAN devices.

Referring to the **Addressing Table**, configure IP addressing for **R1** LAN interfaces, **PC1** and **PC2**. The serial interface has already configured.

```
User Access Verification


Password:

R1>enable
Password:
R1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#interface g0/0
R1(config-if)#ip address 172.16.20.1 255.255.255.128
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state
to up

R1(config-if)#interface g0/1
R1(config-if)#ip address 172.16.20.129 255.255.255.128
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state
to up

R1(config-if)#
```

```
User Access Verification

Password:
Password:

R1>enable
Password:
R1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface g0/0
R1(config-if)#ip address 172.16.20.1 255.255.255.128
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

R1(config-if)#interface g0/1
R1(config-if)#ip address 172.16.20.129 255.255.255.128
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

R1(config-if)#
```





3.4.4.1.5.1.2 Step 2: Verify connectivity.

PC1 and **PC2** should be able to ping each other and the **Dual Stack Server**.

PC1 to PC2

C:\>ping 172.16.20.138

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172,16,20.138
Ping request could not find host 172,16,20.138. Please
check the name and try again.
C:\>ping 172.16.20.138

Pinging 172.16.20.138 with 32 bytes of data:

Request timed out.
Reply from 172.16.20.138: bytes=32 time<1ms TTL=127
Reply from 172.16.20.138: bytes=32 time<1ms TTL=127
Reply from 172.16.20.138: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.20.138:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

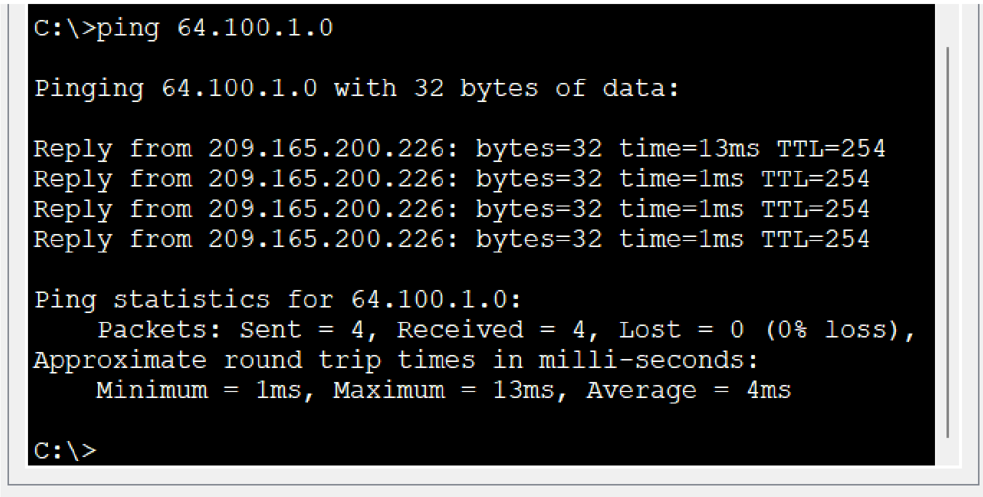
PC1 to default gateway

C:\>ping 172.16.20.1

```
C:\>ping 172.16.20.1

Pinging 172.16.20.1 with 32 bytes of data:

Reply from 172.16.20.1: bytes=32 time<1ms TTL=255
Reply from 172.16.20.1: bytes=32 time<1ms TTL=255
Reply from 172.16.20.1: bytes=32 time<1ms TTL=255
Reply from 172.16.20.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.20.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC1 to Dual stack server

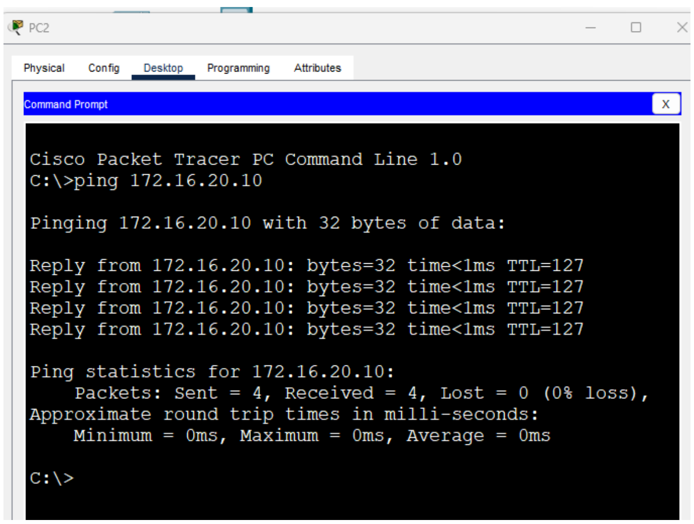
C:\>ping 64.100.0



```
C:\>ping 64.100.1.0

Pinging 64.100.1.0 with 32 bytes of data:

Reply from 209.165.200.226: bytes=32 time=13ms TTL=254
Reply from 209.165.200.226: bytes=32 time=1ms TTL=254
Reply from 209.165.200.226: bytes=32 time=1ms TTL=254
Reply from 209.165.200.226: bytes=32 time=1ms TTL=254

Ping statistics for 64.100.1.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 13ms, Average = 4ms

C:\>
```

PC2 to PC1

C:\>ping 172.16.20.10




```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.16.20.10

Pinging 172.16.20.10 with 32 bytes of data:

Reply from 172.16.20.10: bytes=32 time<1ms TTL=127
Reply from 172.16.20.10: bytes=32 time<1ms TTL=127
Reply from 172.16.20.10: bytes=32 time<1ms TTL=127
Reply from 172.16.20.10: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.20.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC2 to default gateway

C:\>ping 172.16.20.1

```
C:\>ping 172.16.20.1

Pinging 172.16.20.1 with 32 bytes of data:

Reply from 172.16.20.1: bytes=32 time<1ms TTL=255
Reply from 172.16.20.1: bytes=32 time<1ms TTL=255
Reply from 172.16.20.1: bytes=32 time<1ms TTL=255
Reply from 172.16.20.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.20.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC2 to Dual stack server

C:\>ping 64.100.0

```
C:\>ping 64.100.1.0

Pinging 64.100.1.0 with 32 bytes of data:

Reply from 209.165.200.226: bytes=32 time=14ms TTL=254
Reply from 209.165.200.226: bytes=32 time=10ms TTL=254
Reply from 209.165.200.226: bytes=32 time=9ms TTL=254
Reply from 209.165.200.226: bytes=32 time=11ms TTL=254

Ping statistics for 64.100.1.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 9ms, Maximum = 14ms, Average = 11ms

C:\>
```

3.4.4.1.5.2 Part 2: Configure IPv6 Addressing and Verify Connectivity

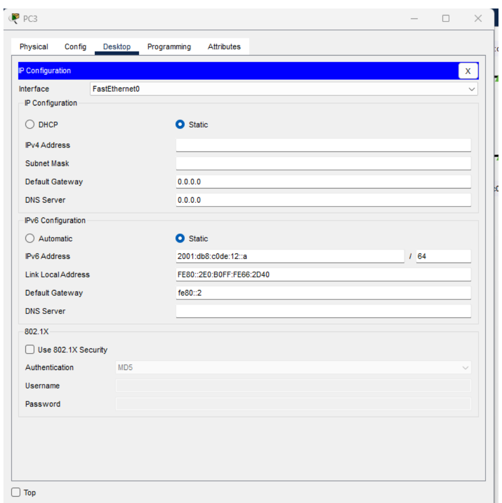
3.4.4.1.5.2.1 Step 1: Assign IPv6 addresses to R2 and LAN devices.

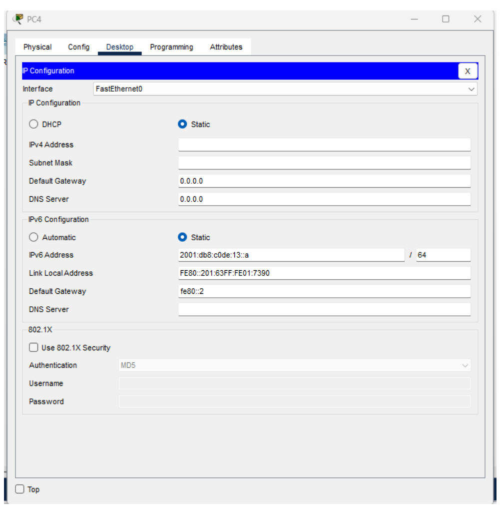
Referring to the **Addressing Table**, configure IP addressing for **R2 LAN interfaces**, **PC3** and **PC4**. The serial interface is already configured.

```
R2>enable
Password:
R2#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#interface g0/0
R2(config-if)#ipv6 address 2001:db8:c0de:12::1/64
R2(config-if)#no shutdown

R2(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

R2(config-if)#exit
```

```
R2(config)#interface g0/1
R2(config-if)#ipv6 address 2001:db8:c0de:13::1/64
R2(config-if)#no shutdown
R2(config-if)#exit


R2(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

R2(config-if)#exit
R2(config)#
```

```
R2>enable
Password:
R2#interface g0/0
             ^
% Invalid input detected at '^' marker.

R2#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#interface g0/0
R2(config-if)#ipv6 address 2001:db8:c0de:12::1/64
R2(config-if)#no shutdown

R2(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

R2(config-if)#exit
R2(config)#interface g0/1
R2(config-if)#ipv6 address 2001:db8:c0de:13::1/64
R2(config-if)#exit
R2(config)#interface g0/1
R2(config-if)#no shutdown

R2(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

R2(config-if)#exit
R2(config)#
```





3.4.4.1.5.2.2 Step 2: Verify connectivity.

PC3 and **PC4** should be able to ping each other and the **Dual Stack Server**.

PC3 to PC4

```
C:\>ping 2001:db8:c0de:13::a
```

PC3 to Dual Stack Server

```
C:\>ping 2001:db8:100:1::a
```

```
C:\>ping 2001:db8:c0de:13::a

Pinging 2001:db8:c0de:13::a with 32 bytes of data:

Reply from 2001:DB8:C0DE:13::A: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:C0DE:13::A: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:C0DE:13::A: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:C0DE:13::A: bytes=32 time<1ms TTL=127

Ping statistics for 2001:DB8:C0DE:13::A:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:db8:100:1::a

Pinging 2001:db8:100:1::a with 32 bytes of data:

Reply from 2001:DB8:100:1::A: bytes=32 time=10ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=1ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=9ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=7ms TTL=126

Ping statistics for 2001:DB8:100:1::A:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 6ms

C:\>
```

PC4 to PC3

```
C:\>ping 2001:db8:c0de:12::a
```

PC4 to Dual Stack Server

```
C:\>ping 2001:db8:100:1::a
```

PC4

Physical | Config | Desktop | Programming | Attributes

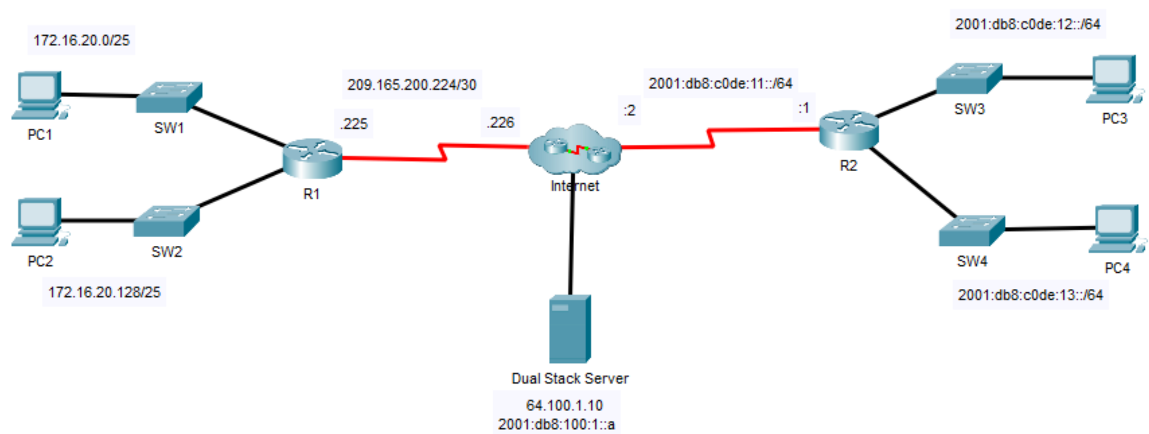
Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 2001:db8:c0de:12::a

Pinging 2001:db8:c0de:12::a with 32 bytes of data:

Reply from 2001:DB8:C0DE:12::A: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:C0DE:12::A: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:C0DE:12::A: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:C0DE:12::A: bytes=32 time<1ms TTL=127

Ping statistics for 2001:DB8:C0DE:12::A:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:db8:100:1::a

Pinging 2001:db8:100:1::a with 32 bytes of data:

Reply from 2001:DB8:100:1::A: bytes=32 time=26ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=10ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=7ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=6ms TTL=126

Ping statistics for 2001:DB8:100:1::A:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 6ms, Maximum = 26ms, Average = 12ms

C:\>
```

3.4.5 Section 1.5 Verify Directly Connected Networks

3.4.5.1 Exercise 1.5.10 Packet Tracer - Verify Directly Connected Networks

3.4.5.1.1 Topology



3.4.5.1.2 Addressing Table

Device	Interface	IP Address / Prefix	Default Gateway
R1	G0/0/0	172.16.20.1/25	N/A
	G0/0/1	172.16.20.129/25	N/A
	S0/1/0	209.165.200.225/30	N/A
PC1	NIC	172.16.20.10/25	172.16.20.1
PC2	NIC	172.16.20.138/25	172.16.20.129
R2	G0/0/0	2001:db8:c0de:12::1/64	N/A
	G0/0/1	2001:db8:c0de:13::1/64	N/A
	S0/1/1	2001:db8:c0de:11::1/64	N/A
		fe80::2	N/A
PC3	NIC	2001:db8:c0de:12::a/64	fe80::2
PC4	NIC	2001:db8:c0de:13::a/64	fe80::2

3.4.5.1.3 Objectives

- Verify IPv4 Directly Connected Networks
- Verify IPv6 Directly Connected Networks
- Troubleshoot connectivity issues.

3.4.5.1.4 Background

Routers R1 and R2 each have two LANs. Your task is to verify the addressing on each device and verify connectivity between the LANs.

Note: The user EXEC password is **cisco**. The privileged EXEC password is **class**.

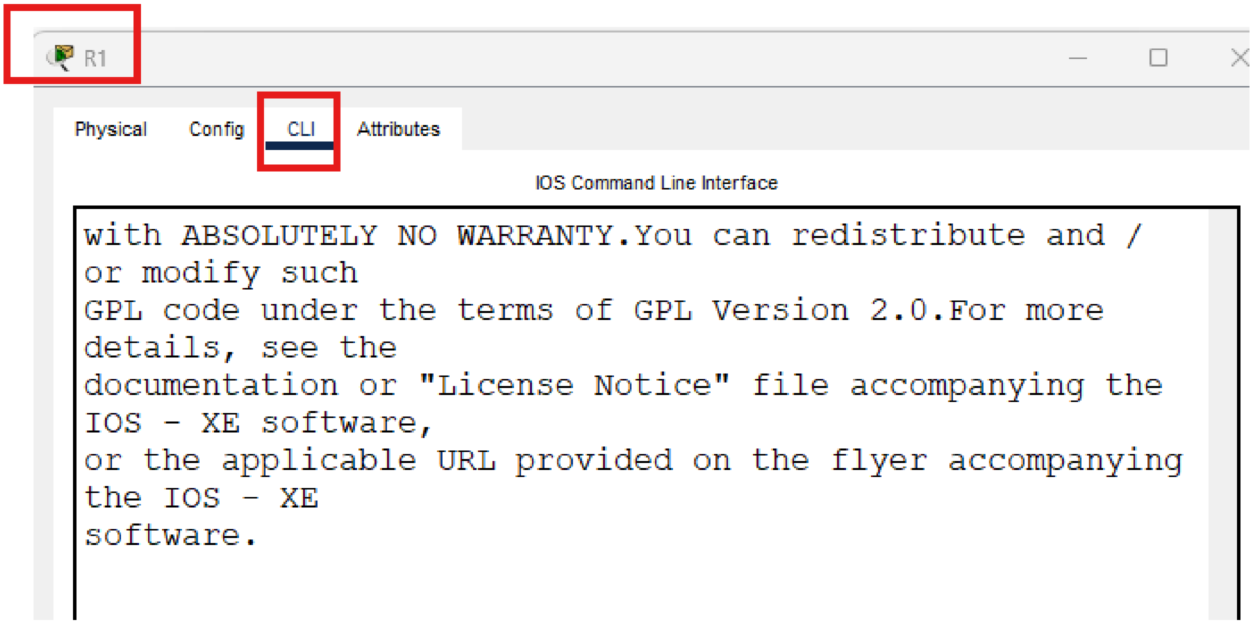
3.4.5.1.5 Instructions

3.4.5.1.5.1 Part 1: Verify IPv4 Directly Connected Networks

3.4.5.1.5.1.1 Step 1: Verify IPv4 addresses and port status on R1.

a. Check the status of the configured interfaces by filtering the output.

Open configuration window



R1# **show ip interface brief | exclude unassigned**

```
User Access Verification

Password:

R1>enable
Password:
R1#show ip interface brief | exclude unassigned
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   172.16.20.1     YES manual administratively down down
GigabitEthernet0/0/1   172.16.20.129   YES manual up                    up
Serial0/1/0            209.165.200.229 YES manual up                    up
R1#
```

b. Based on the output, correct any port status problems that you see.

```
User Access Verification

Password:

R1>enable
Password:
R1#show ip interface brief | exclude unassigned
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   172.16.20.1     YES manual administratively down down
GigabitEthernet0/0/1   172.16.20.129   YES manual up                    up
Serial0/1/0            209.165.200.229 YES manual up                    up
R1#
```

c. Refer to the **Addressing Table** and verify the IP addresses configured on R1. Make any corrections to addressing if necessary.

```
R1#config t
R1#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface g0/0/0
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0, changed state to up

R1(config-if)#interface s0/1/0
R1(config-if)#ip add
R1(config-if)#ip address 209.165.200.225 255.255.255.252
R1(config-if)#exit
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#
```

```
R1#show ip interface brief | exclude unassigned
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   172.16.20.1     YES manual up                    up
GigabitEthernet0/0/1   172.16.20.129   YES manual up                    up
Serial0/1/0            209.165.200.225 YES manual up                    up
R1#
```

d. Display the routing table by filtering to start the output at the word **Gateway**.

Note: Terms that are used to filter output can be shortened to match text as long as the match is unique. For example, Gateway, Gate, and Ga will have the same effect. G will not. Filtering is case-sensitive

R1# **show ip route | begin Gate**

```
R1#show ip route | begin Gate
Gateway of last resort is 209.165.200.226 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks
C       172.16.20.0/25 is directly connected, GigabitEthernet0/0/0
L       172.16.20.1/32 is directly connected, GigabitEthernet0/0/0
C       172.16.20.128/25 is directly connected, GigabitEthernet0/0/1
L       172.16.20.129/32 is directly connected, GigabitEthernet0/0/1
     209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C       209.165.200.224/30 is directly connected, Serial0/1/0
L       209.165.200.225/32 is directly connected, Serial0/1/0
S*   0.0.0.0/0 [1/0] via 209.165.200.226

R1#
```

Notes for printout

C (Connected): This indicates that the route is directly connected to one of the router's interfaces. It means the network is reachable directly through an interface without needing to go through another hop.

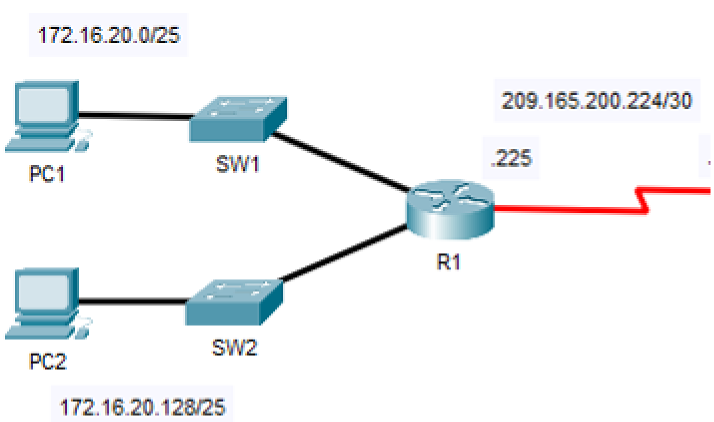
For example, C 172.16.20.0/25 is directly connected, GigabitEthernet0/0/0 means the network 172.16.20.0/25 is directly connected to the GigabitEthernet0/0/0 interface.

L (Local): This refers to the local address assigned to the router's interface. It is a host route with a /32 prefix length, indicating the exact IP address of the interface.

For example, L 172.16.20.1/32 is directly connected, GigabitEthernet0/0/0 means the IP address 172.16.20.1 is assigned to the GigabitEthernet0/0/0 interface.

These entries help the router quickly identify and route traffic for directly connected networks and interfaces.

We can see from topology



Question:

What is the Gateway of last resort address?

ANSWER - Gateway of last resort is 209.165.200.226

e. Display interface information and filter for **Description** or **connected**.

Note: When using **include** or **exclude** multiple searches can be performed by separating the search strings with a pipe symbol (**|**)

R1# **show interface | include Desc|conn**

```
R1#show interface | include Desc|conn
GigabitEthernet0/0/0 is up, line protocol is up (connected)
  Description: Connection to SW1
GigabitEthernet0/0/1 is up, line protocol is up (connected)
  Description: Connection to SW2
Serial0/1/0 is up, line protocol is up (connected)
  Description: Circuit ID BCB123450001
R1#
```

Question:

What is the Circuit ID displayed from your output?

ANSWER - Circuit ID BCB123450001

f. Display specific interface information for G0/0/0 by filtering for **duplex**.

R1#show interface g0/0/0 | include duplex

```
R1#
R1#show interface g0/0/0 | include duplex
  Full-duplex, 100Mb/s, media type is RJ45
R1#
```

Question:

What is the duplex setting, speed, and media type?

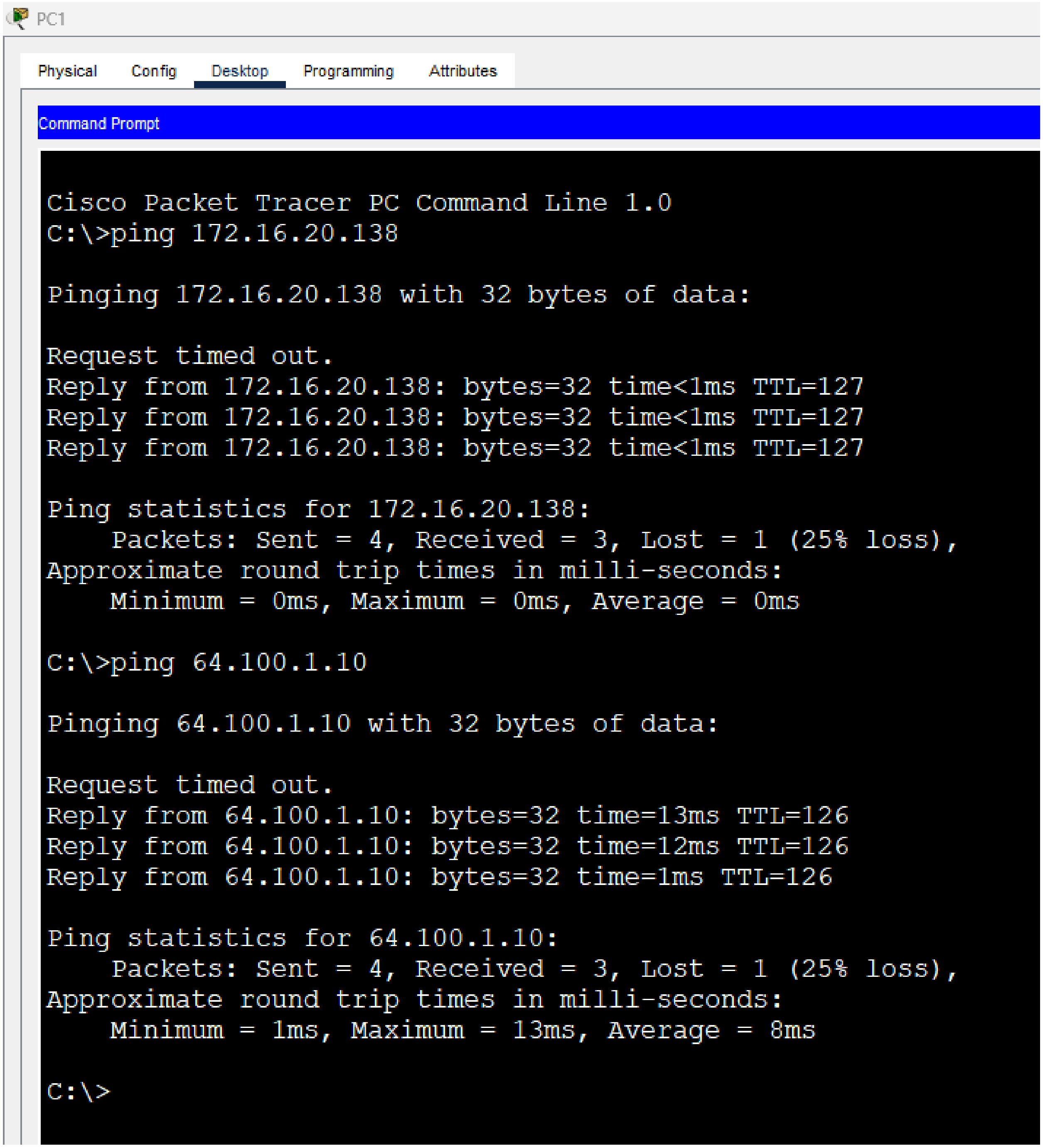
ANSWER

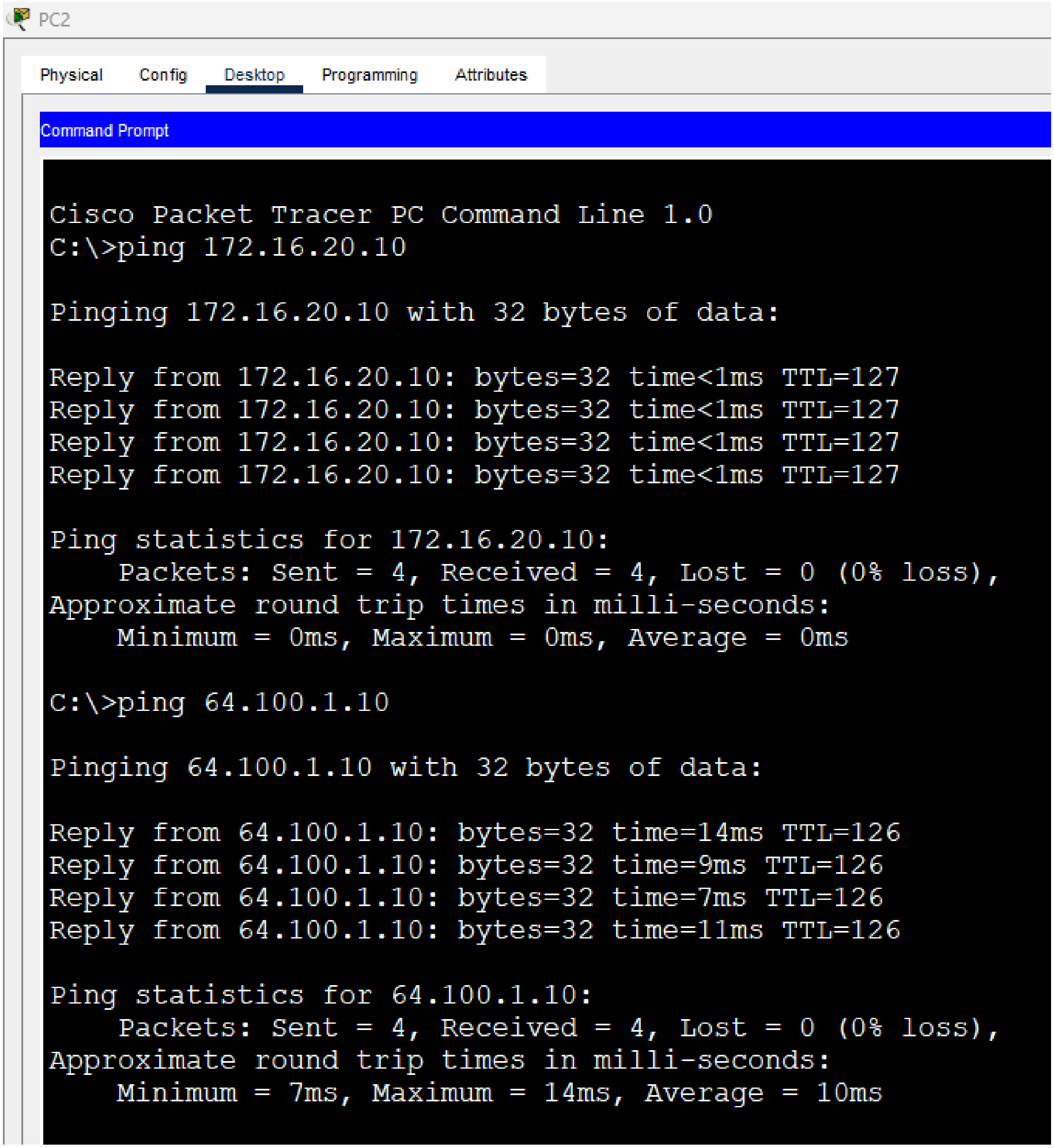
duplex setting	Full-duplex
speed	100Mb/s
media type	RJ45

Close configuration window

3.4.5.1.5.1.2 Step 2: Verify connectivity.

PC1 and **PC2** should be able to ping each other and the **Dual Stack Server**. If not, verify the status of the interfaces and the IP address assignments.


PC1
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.16.20.138
Pinging 172.16.20.138 with 32 bytes of data:
Request timed out.
Reply from 172.16.20.138: bytes=32 time<1ms TTL=127
Reply from 172.16.20.138: bytes=32 time<1ms TTL=127
Reply from 172.16.20.138: bytes=32 time<1ms TTL=127
Ping statistics for 172.16.20.138:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 64.100.1.10
Pinging 64.100.1.10 with 32 bytes of data:
Request timed out.
Reply from 64.100.1.10: bytes=32 time=13ms TTL=126
Reply from 64.100.1.10: bytes=32 time=12ms TTL=126
Reply from 64.100.1.10: bytes=32 time=1ms TTL=126
Ping statistics for 64.100.1.10:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 1ms, Maximum = 13ms, Average = 8ms
C:\>



3.4.5.1.5.2 Part 2: Verify IPv6 Directly Connected Networks

3.4.5.1.5.2.1 Step 1: Verify IPv6 addresses and port status on R2.

a. Check the status of the configured interfaces.

Open configuration window

R2# **show ipv6 int brief**

```
User Access Verification

Password:

R2>enable
Password:
R2#show ipv6 int brief
GigabitEthernet0/0/0        [up/up]
    FE80::2
    2001:DB8:C0DE:12::1
GigabitEthernet0/0/1        [up/up]
    FE80::2
    2001:DB8:C0DE:14::1
Serial0/1/0                 [administratively down/down]
    unassigned
Serial0/1/1                 [up/up]
    FE80::2D0:BCFF:FE32:7C24
    2001:DB8:C0DE:11::1
Vlan1                       [administratively down/down]
    unassigned
R2#
```

Question:

What is the status of the configured interfaces?

ANSWER – Up and Administratively down

b. Refer to the **Addressing Table** and make any corrections to addressing as necessary.

Note: When changing an IPv6 address it is necessary to remove the incorrect address since an interface is capable of supporting multiple IPv6 networks.

R2(config)# **int g0/0/1**
R2(config-if)# **no ipv6 address 2001:db8:c0de:14::1/64**

```
R2(config)#int g0/0/1
R2(config-if)#no ipv6 address 2001:db8:c0de:14::1/64
R2(config-if)#
R2(config-if)#
R2(config-if)#ipv6 address 2001:db8:c0de:13::1/64
R2(config-if)#exit
```

Question:

Configure the correct address on the interface.

```
R2#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#int g0/0/1
R2(config-if)#no ipv6 address 2001:db8:c0de:14::1/64
R2(config-if)#
R2(config-if)#
R2(config-if)#ipv6 address 2001:db8:c0de:13::1/64
R2(config-if)#exit
```

c. Display the IPv6 routing table.

Note: Filtering commands do not presently work with the IPv6 commands.

```
R2#show ipv6 route
IPv6 Routing Table - 8 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route, M - MIPv6
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       D - EIGRP, EX - EIGRP external
S   ::/0 [1/0]
     via Serial0/1/1, directly connected
C   2001:DB8:C0DE:11::/64 [0/0]
     via Serial0/1/1, directly connected
L   2001:DB8:C0DE:11::1/128 [0/0]
     via Serial0/1/1, receive
C   2001:DB8:C0DE:12::/64 [0/0]
     via GigabitEthernet0/0/0, directly connected
L   2001:DB8:C0DE:12::1/128 [0/0]
     via GigabitEthernet0/0/0, receive
C   2001:DB8:C0DE:13::/64 [0/0]
     via GigabitEthernet0/0/1, directly connected
L   2001:DB8:C0DE:13::1/128 [0/0]
     via GigabitEthernet0/0/1, receive
L   FF00::/8 [0/0]
     via Null0, receive
R2#
R2#
```

d. Display all IPv6 addressing configured on interfaces by filtering the output of the **running-config**.

Filter the output on **R2** for **ipv6** or **interface**.

R2# **sh run | include ipv6|interface**

```
R2#sh run | include ipv6|interface
ipv6 unicast-routing
no ipv6 cef
interface GigabitEthernet0/0/0
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:C0DE:12::1/64
 ipv6 enable
interface GigabitEthernet0/0/1
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:C0DE:13::1/64
 ipv6 enable
interface Serial0/1/0
interface Serial0/1/1
 ipv6 address 2001:DB8:C0DE:11::1/64
 ipv6 enable
interface Vlan1
ipv6 route ::/0 Serial0/1/1
R2#
```

Question:

How many addresses are configured on each Gigabit interface?

ANSWER - There are 2 IPv6 addresses. The IPv6 /64 address and the IPv6 link-local address

```
interface GigabitEthernet0/0/0
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:C0DE:12::1/64
 ipv6 enable
interface GigabitEthernet0/0/1
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:C0DE:13::1/64
 ipv6 enable
```

Close configuration window

3.4.5.1.5.2.2 Step 2: Verify connectivity.

PC3 and **PC4** should be able to ping each other and the **Dual Stack Server**. If not, verify the interface status and IPv6 address assignments.

PC3

```
C:\>
C:\>ping 2001:db8:c0de:13::1

Pinging 2001:db8:c0de:13::1 with 32 bytes of data:

Reply from 2001:DB8:C0DE:13::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:C0DE:13::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:C0DE:13::1: bytes=32 time=1ms TTL=255
Reply from 2001:DB8:C0DE:13::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:C0DE:13::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 2001:DB8:100:1::a

Pinging 2001:DB8:100:1::a with 32 bytes of data:

Reply from 2001:DB8:100:1::A: bytes=32 time=12ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=1ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=2ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=10ms TTL=126

Ping statistics for 2001:DB8:100:1::A:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 12ms, Average = 6ms

C:\>
```

PC4

```
C:\>
C:\>ping 2001:DB8:C0DE:12::1

Pinging 2001:DB8:C0DE:12::1 with 32 bytes of data:

Reply from 2001:DB8:C0DE:12::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:C0DE:12::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:C0DE:12::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:C0DE:12::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:C0DE:12::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:DB8:100:1::a

Pinging 2001:DB8:100:1::a with 32 bytes of data:

Reply from 2001:DB8:100:1::A: bytes=32 time=15ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=6ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=11ms TTL=126
Reply from 2001:DB8:100:1::A: bytes=32 time=8ms TTL=126

Ping statistics for 2001:DB8:100:1::A:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 6ms, Maximum = 15ms, Average = 10ms

C:\>
```

3.4.6 Section 1.6 Module Practice and Quiz

3.4.6.1 Exercise 1.6.1 Packet Tracer - Implement a Small Network

3.4.6.1.1 Addressing Table

Device	Interface	Address	Subnet Mask	Default Gateway
RTA	G0/0	10.10.10.1	255.255.255.0	N/A
	G0/1	10.10.20.1	255.255.255.0	N/A
SW1	VLAN1	10.10.10.2	255.255.255.0	
SW2	VLAN1	10.10.20.2	255.255.255.0	
PC-1	NIC		255.255.255.0	
PC-2	NIC		255.255.255.0	

3.4.6.1.2 Objectives

Part 1: Create the Network Topology

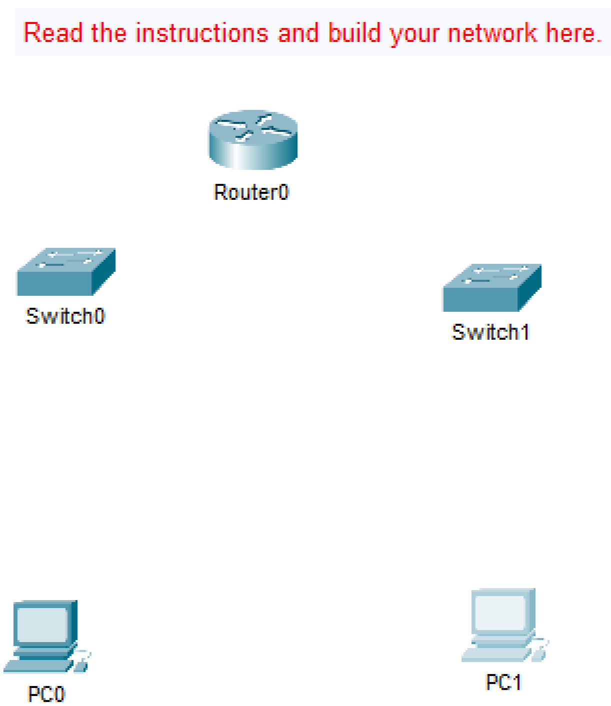
Part 2: Configure Devices and Verify Connectivity

3.4.6.1.3 Instructions

3.4.6.1.3.1 Part 1: Create the Network Topology

3.4.6.1.3.1.1 Step 1: Obtain the required devices.

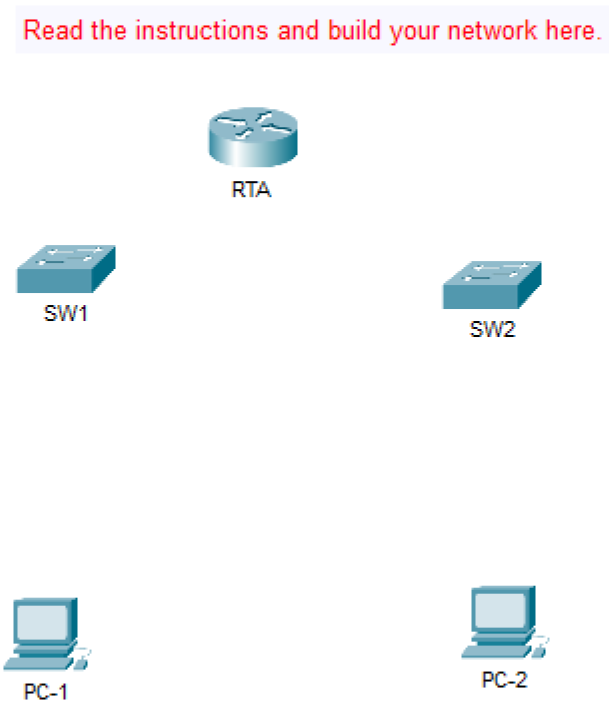
a. Click the **Network Devices** icon in the bottom tool bar.
b. Click the router icon in the submenu.
c. Locate the **1941** router icon. Click and drag the icon for the 1941 router into the topology area.
d. Click the switch entry in the submenu.
e. Locate the **2960** switch icon. Click and drag the icon for the 2960 switch into the topology area.
f. Repeat the step above so that there are **two** 2960 switches in the topology area.
g. Click the **End Devices** icon.
h. Locate the PC icon. Drag **two** PCs to the topology area.
i. Arrange the devices into a layout that you can work with by clicking and dragging.



3.4.6.1.3.1.2 Step 2: Name the devices.

The devices have default names that you will need to change. You will name the devices as shown in the Addressing Table. You are changing the display names of the devices. This is the text label that appears below each device. Your display names must match the information in the Addressing Table **exactly**. If a display name does not match, you will not be scored for your device configuration.

a. Click the device display name that is below the device icon. A text field should appear with a flashing insertion point. If the configuration window for the device appears, close it and try again, clicking a little further away from the device icon.
b. Replace the current display name with the appropriate display name from the Addressing Table.
c. Repeat until all devices are named.



3.4.6.1.3.1.3 Step 3: Connect the devices.

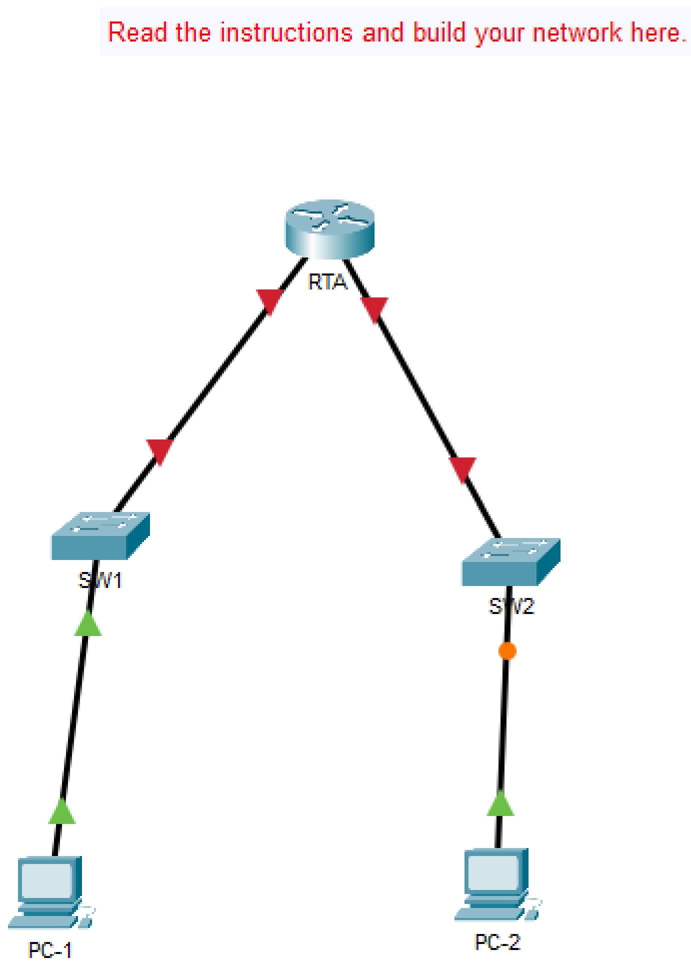
a. Click the orange lightning bolt connections icon in the bottom toolbar.

b. Locate the Copper Straight-Through cable icon. It looks like a solid black diagonal line.

c. To connect the device, click the Copper Straight-Through cable icon and then click the first device that you want to connect. Select the correct port and then click the second device. Select the correct port and the devices will be connected.

d. Connect the devices as specified in the table below.

From Device	Port	To Device	Port
RTA	G0/0	SW1	G0/1
	G0/1	SW2	G0/1
SW1	F0/1	PC-1	Fastethernet0
SW2	F0/1	PC-2	Fastethernet0



3.4.6.1.3.2 Part 2: Configure Devices

Record the PC addressing and gateway addresses in the addressing table. You can use any available address in the network for PC-1 and PC-2.

3.4.6.1.3.2.1 Step 1: Configure the router.

Open configuration window

a. Configure basic settings.

1) Hostname as shown in the Addressing Table.
2) Configure **Ciscoenpa55** as the encrypted password.
3) Configure **Ciscolinepa55** as the password on the lines.
4) All lines should accept connections.
5) Configure an appropriate message of the day banner.

b. Configure interface settings.

1) Addressing.
2) Descriptions on the interfaces.
3) Save your configuration.

```
Router>enab
Router>enable
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname RTA
RTA(config)#enable secret Ciscoenpa55
RTA(config)#line console 0
RTA(config-line)#
RTA(config-line)#pass
RTA(config-line)#password Ciscolinepa55
RTA(config-line)#login
RTA(config-line)#exit
RTA(config)#line vty 0 15
RTA(config-line)#pass
RTA(config-line)#password Ciscolinepa55
RTA(config-line)#login
RTA(config-line)#exit
RTA(config)#banner motd #WARNING#
RTA(config)#service password-encryption
RTA(config)#
RTA(config)#
```

```
RTA(config)#
RTA(config)#
RTA(config)#interface g0/0
RTA(config-if)#ip address 10.10.10.1 255.255.255.0
RTA(config-if)#description Link to SW1
RTA(config-if)#no shutdown

RTA(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

RTA(config-if)#exit
RTA(config)#
RTA(config)#
RTA(config)#interface g0/1
RTA(config-if)#ip address 10.10.20.1 255.255.255.0
RTA(config-if)#description Link to SW2
RTA(config-if)#no shutdown

RTA(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

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

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

3.4.6.1.3.2.2 Step 2: Configure switch SW1 and SW2.

a. Configure the default management interface so that it will accept connections over the network from local and remote hosts. Use the values in the addressing table.

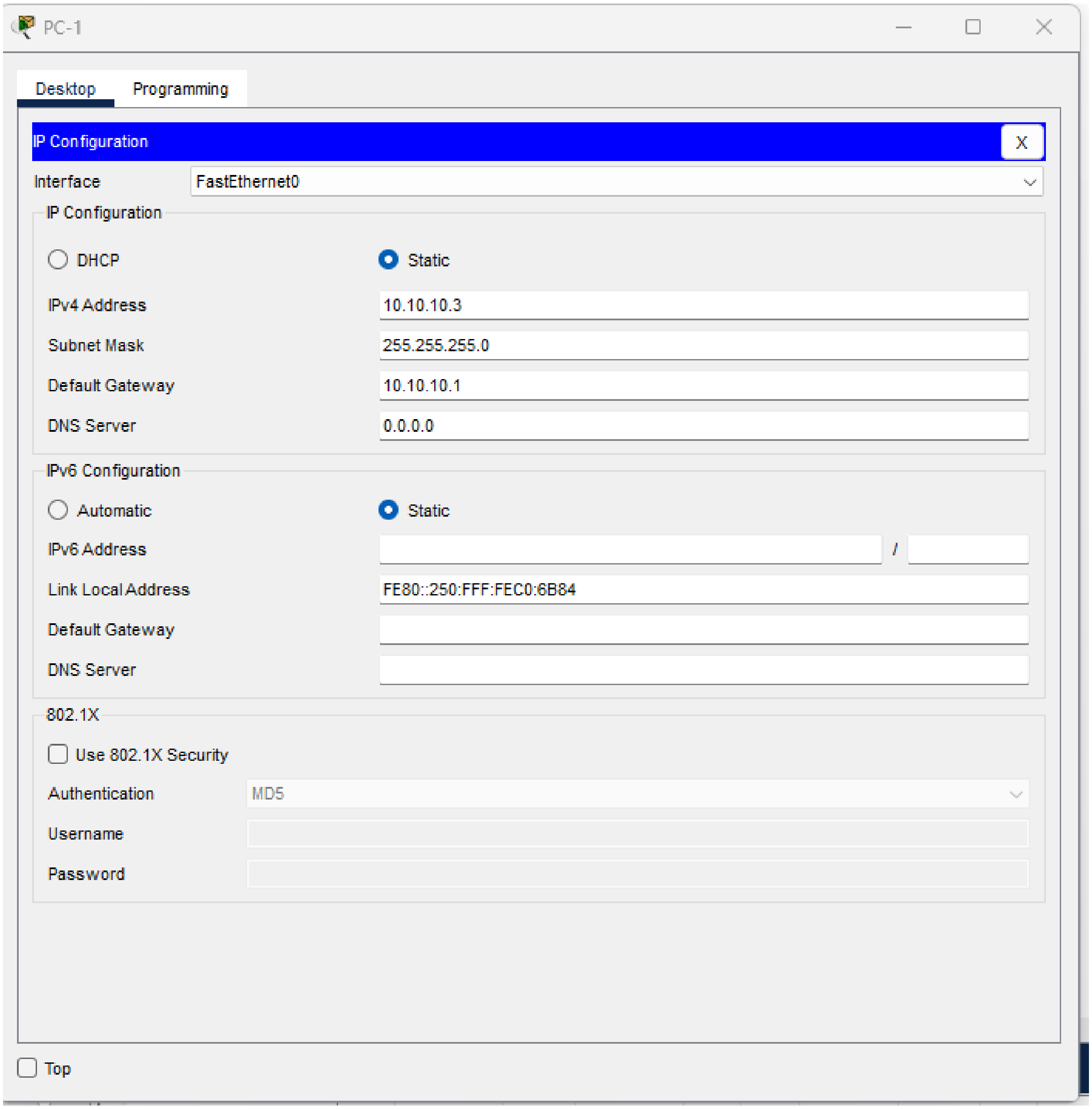
b. Configure an encrypted password using the value in step 1a above.
c. Configure all lines to accept connections using the password from step 1a above.
d. Configure the switches so that they can send data to hosts on remote networks.
e. Save your configuration.

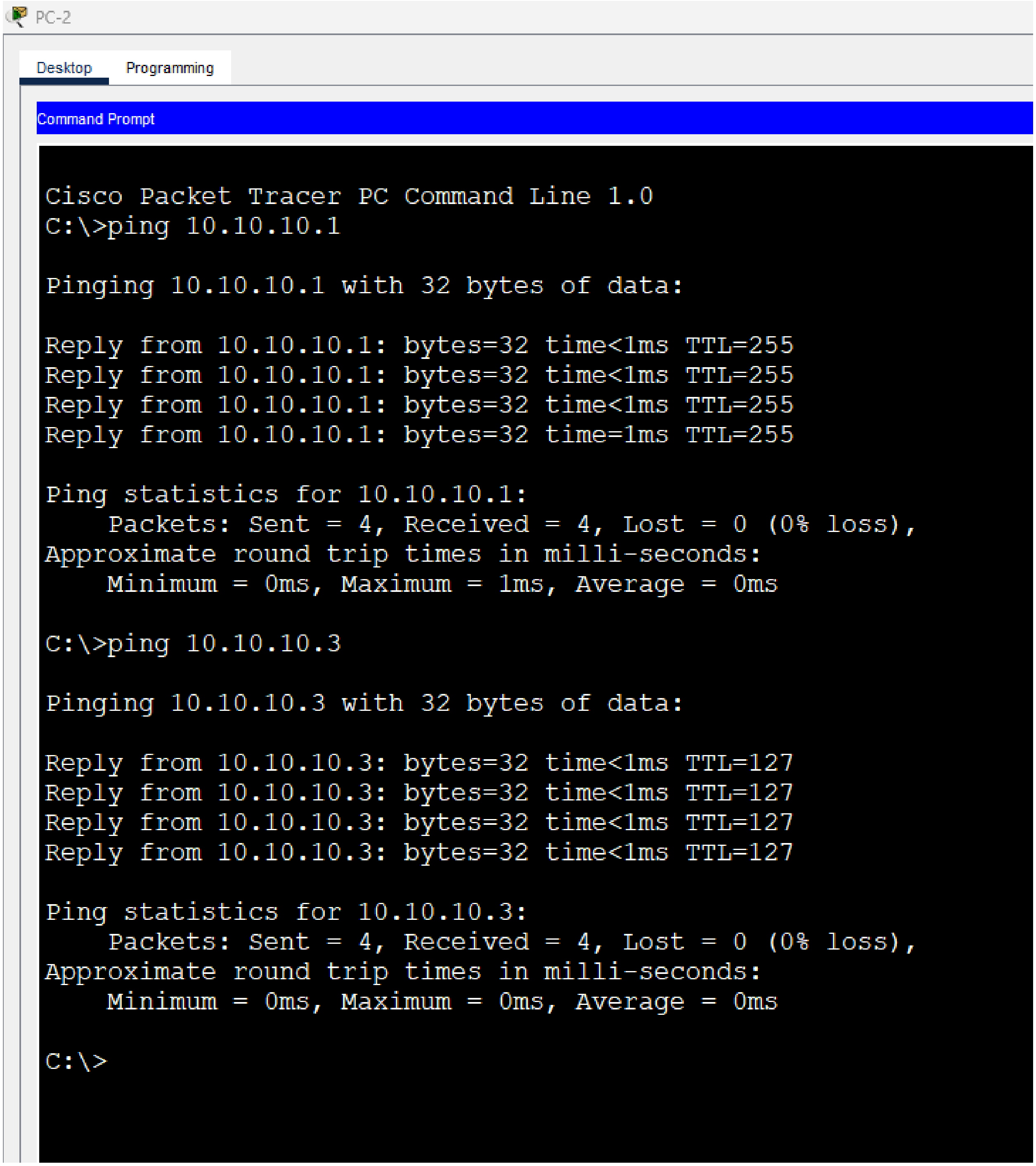
```
Switch>
Switch>enable
Switch#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname SW1
SW1(config)#enable secret Ciscoenpa55
SW1(config)#line console 0
SW1(config-line)#password Ciscolinepa55
SW1(config-line)#login
SW1(config-line)#exit
SW1(config)#line vty 0 4
SW1(config-line)#password Ciscolinepa55
SW1(config-line)#login
SW1(config-line)#exit
SW1(config)#service password-encryption
SW1(config)#interface vlan 1
SW1(config-if)#ip address 10.10.10.2 255.255.255.0
SW1(config-if)#no shutdown

SW1(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up

SW1(config-if)#exit
SW1(config)#
SW1(config)#ip default-gateway 10.10.10.1
SW1(config)#end
SW1#
%SYS-5-CONFIG_I: Configured from console by console

SW1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
SW1#
SW1#
```

Close configuration window

3.4.6.1.3.2.3 Step 3: Configure the hosts.

Configure addressing on the hosts. If your configurations are complete, you should be able to ping all devices in the topology.


PC-1
Desktop
Programming
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
10.10.10.3
Subnet Mask
255.255.255.0
Default Gateway
10.10.10.1
DNS Server
0.0.0.0
IPv6 Configuration
Automatic
Static
IPv6 Address
/
Link Local Address
FE80::250:FFF:FEC0:6B84
Default Gateway
DNS Server
802.1X
Use 802.1X Security
Authentication
MD5
Username
Password
Top




```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.10.10.1

Pinging 10.10.10.1 with 32 bytes of data:

Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time=1ms TTL=255

Ping statistics for 10.10.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.10.10.3

Pinging 10.10.10.3 with 32 bytes of data:

Reply from 10.10.10.3: bytes=32 time<1ms TTL=127
Reply from 10.10.10.3: bytes=32 time<1ms TTL=127
Reply from 10.10.10.3: bytes=32 time<1ms TTL=127
Reply from 10.10.10.3: bytes=32 time<1ms TTL=127

Ping statistics for 10.10.10.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

3.4.6.2 Exercise 1.6.2 Lab - Configure Basic Router Settings

3.4.6.2.1 Topology

3.4.6.2.2 Addressing

Device	Interface	IP Address / Prefix	Default Gateway
R1	G0/0/0	192.168.0.1 /24	N/A
		2001:db8:acad::1 /64	
		fe80::1	
	G0/0/1	192.168.1.1 /24	
		2001:db8:acad:1::1 /64	
		fe80::1	
	Loopback0	10.0.0.1 /24	
		2001:db8:acad:2::1 /64	
		fe80::1	
PC-A	NIC	192.168.1.10 /24	192.168.1.1
		2001:db8:acad:1::10 /64	fe80::1
Server	NIC	192.168.0.10 /24	192.168.0.1
		2001:db8:acad::10 /64	fe80::1

3.4.6.2.3 Objectives

Part 1: Set Up the Topology and Initialize Devices

Part 2: Configure Devices and Verify Connectivity

Part 3: Display Router Information

3.4.6.2.4 Background / Scenario

This is a comprehensive Packet Tracer Physical Mode (PTPM) activity to review previously covered IOS router commands. In Parts 1 and 2, you will cable the equipment and complete basic configurations and interface settings on the router.

In Part 3, you will use SSH to connect to the router remotely and use the IOS commands to retrieve information from the device to answer questions about the router.

For review purposes, this activity provides the commands necessary for specific router configurations.

3.4.6.2.5 Instructions

3.4.6.2.5.1 Part 1: Set Up the Topology and Initialize Devices

3.4.6.2.5.1.1 Step 1: Cable the network as shown in the topology.

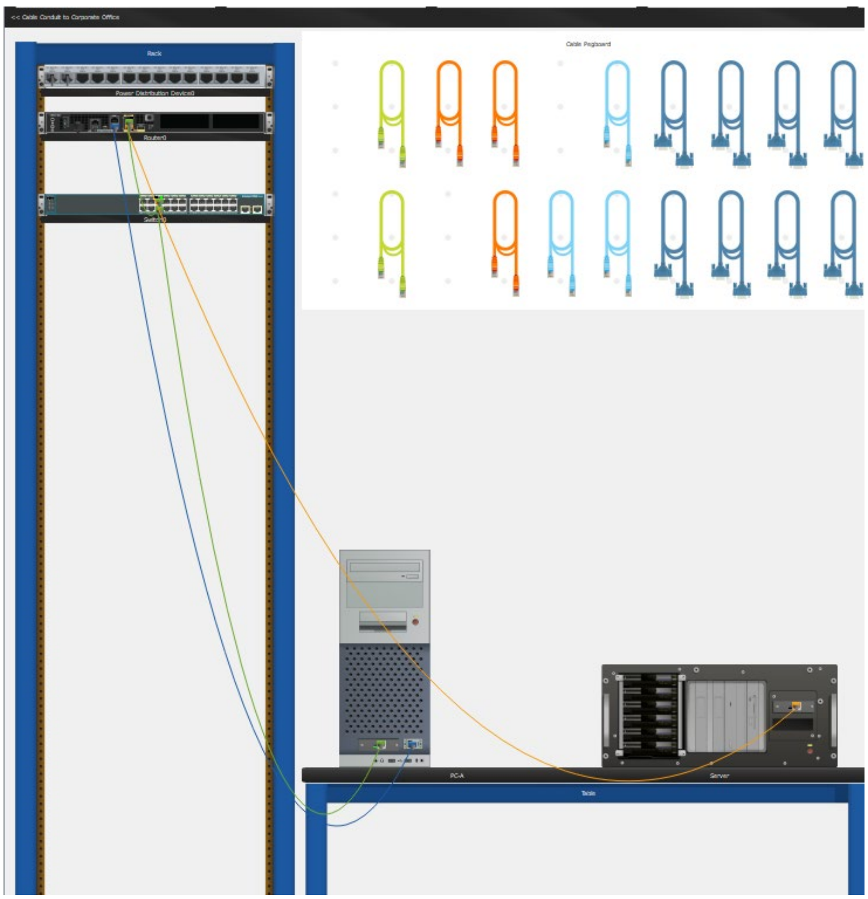
a. Click and drag the **Cisco 4321 ISR**, the **Cisco 2960 Switch**, and the **Server** from the **Shelf** to the **Rack**.

b. Click and drag the **PC** from the **Shelf** to the **Table**.

c. Cable the devices as specified in the topology diagram. Use **Copper Straight-through** cables for network connections.

d. From the **PC**, connect a **Console Cable** to the **Cisco 4321 ISR**.

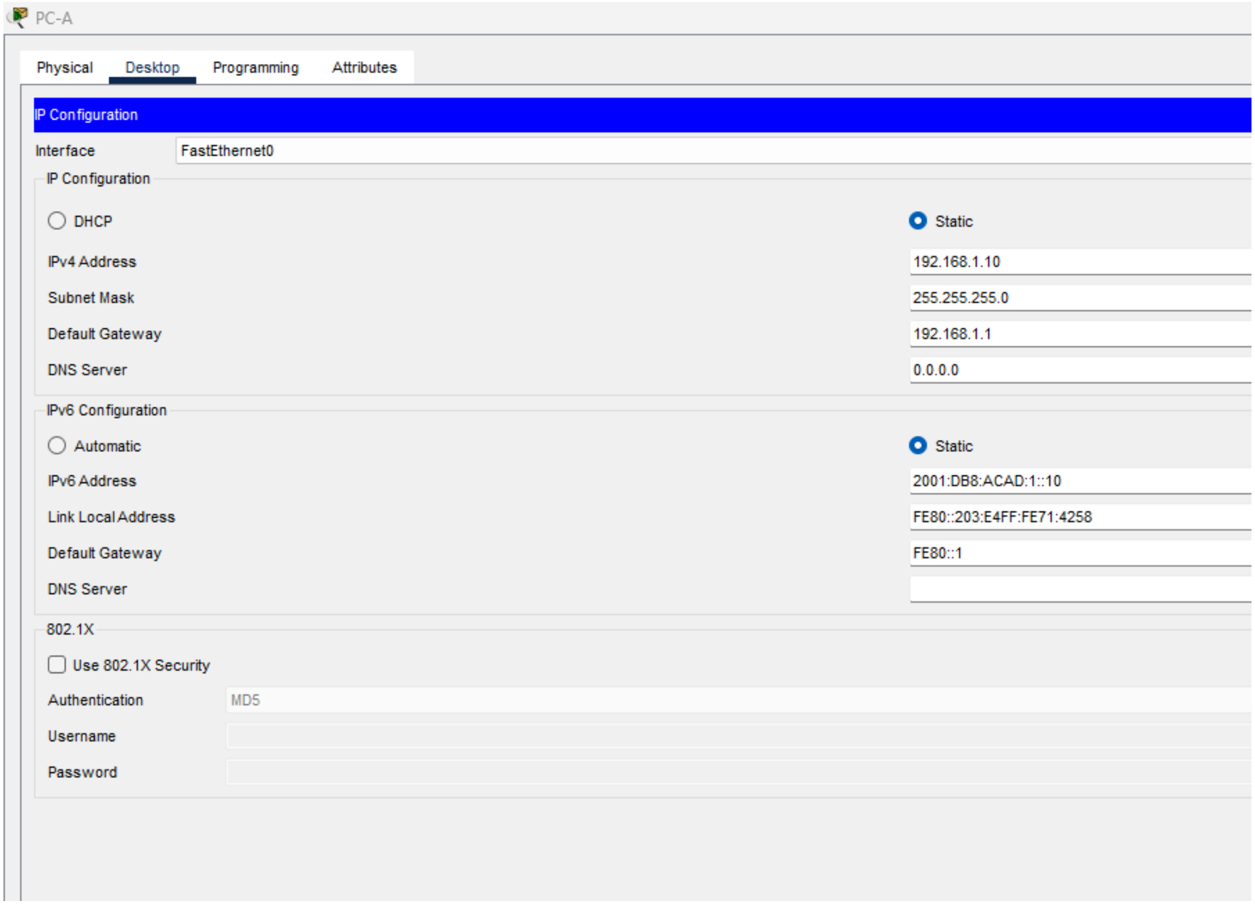
e. Power on the **Cisco 4321 ISR**, **PC-A**, and **Server**. The power button for **Server** is on the bottom right. The 2960 switch should power on automatically.



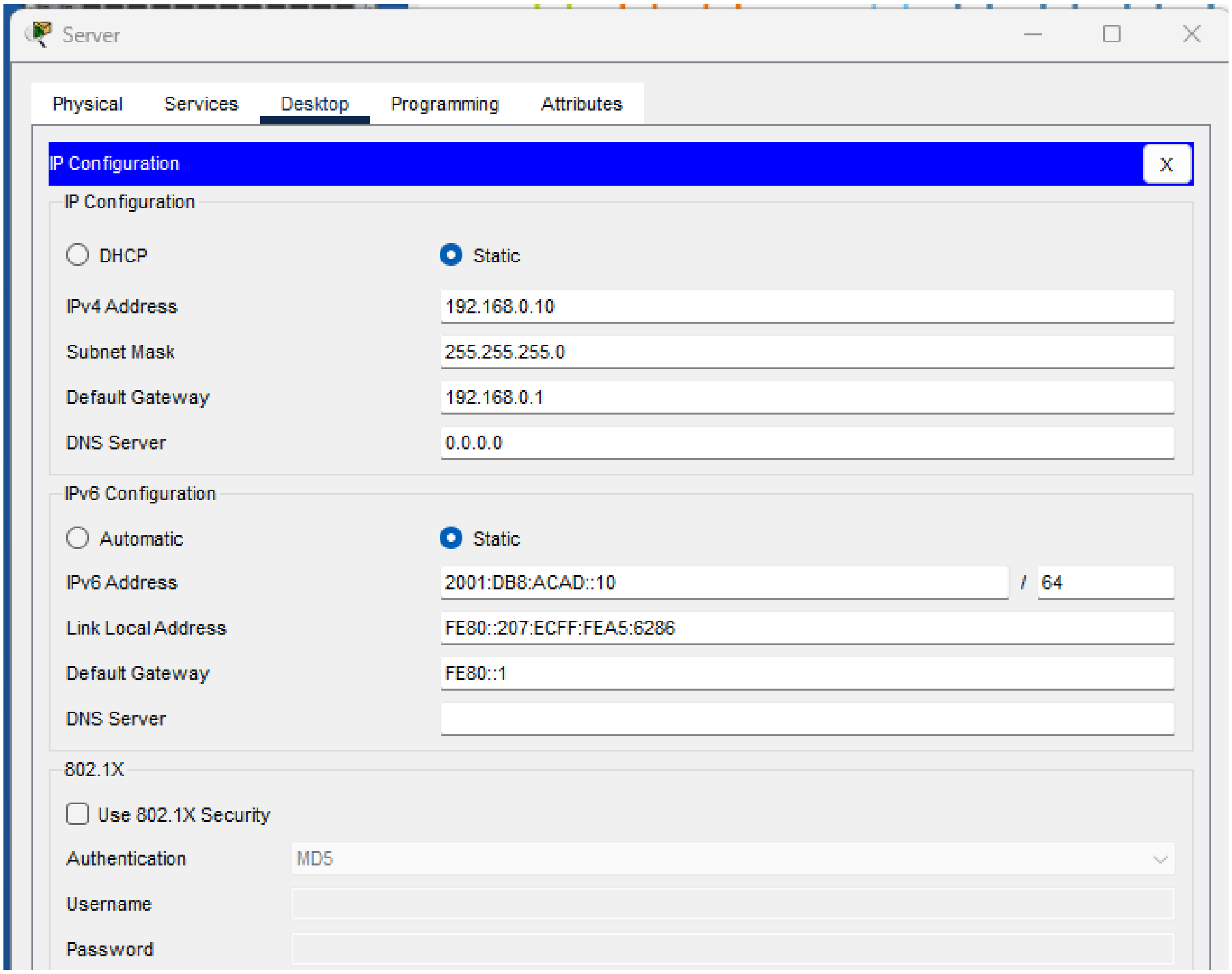
3.4.6.2.5.2 Part 2: Configure Devices and Verify Connectivity

3.4.6.2.5.2.1 Step 1: Configure the PC interfaces.

a. Configure the IP address, subnet mask, and default gateway settings on **PC-A**.



b. Configure the IP address, subnet mask, and default gateway settings on **Server**.



3.4.6.2.5.2.2 Step 2: Configure the router.

Open configuration window

a. Console into the router and enable privileged EXEC mode.
b. Enter configuration mode.
c. Assign a device name to the router.
d. Set the router's domain name as ccna-lab.com.
e. Encrypt the plaintext passwords.
f. Configure the system to require a minimum 12-character password.
g. Configure the username **SSHadmin** with an encrypted password of **55Hadm!n2020**.
h. Generate a set of crypto keys with a 1024 bit modulus.
i. Assign **$cisco!PRIV*** as the privileged EXEC password.
j. Assign **$cisco!!CON*** as the console password. Configure sessions to disconnect after four minutes of inactivity, and enable login.
k. Assign **$cisco!!VTY*** as the vty password. Configure the vty lines to accept SSH connections only. Configure sessions to disconnect after four minutes of inactivity, and enable login using the local database.
l. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.
m. Enable IPv6 routing.

```
Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#ip domain-name ccna-lab.com
R1(config)#service password-encryption
R1(config)#security passwords min-length 12
R1(config)#username SSHadmin secret 55Hadm!n2020
R1(config)#crypto key generate rsa general-keys modulus 1024
The name for the keys will be: R1.ccna-lab.com

% The key modulus size is 1024 bits
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]
*Mar 1 0:6:23.762: %SSH-5-ENABLED: SSH 1.99 has been enabled
R1(config)#enable secret $cisco!PRIV*
R1(config)#line console 0
R1(config-line)#password $cisco!!CON*
R1(config-line)#exec-timeout 4 0
R1(config-line)#login
R1(config-line)#line vty 0 4
R1(config-line)#password $cisco!!VTY*
R1(config-line)#exec-timeout 4 0
R1(config-line)#transport input ssh
R1(config-line)#login local
R1(config-line)#banner motd $ Authorized Users Only! $
R1(config)#ipv6 unicast-routing
R1(config)#
```

n. Configure all three interfaces on the router with the IPv4 and IPv6 addressing information from the addressing table above. Configure all three interfaces with descriptions. Activate all three interfaces.

```
R1(config)#interface g0/0/0
R1(config-if)#ip address 192.168.0.1 255.255.255.0
R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#ipv6 address 2001:db8:acad::1/64
R1(config-if)#description Connection to Server
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0, changed
state to up

R1(config-if)#exit
R1(config)#
```

```
R1(config)#
R1(config)#interface g0/0/1
R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#ipv6 address 2001:db8:acad:1::1/64
R1(config-if)#description Connection to S1
R1(config-if)#no shutdown

R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/1, changed
state to up

R1(config-if)#exit
R1(config)#
R1(config)#
```

```
R1(config)#
R1(config)#interface loopback0

R1(config-if)#
%LINK-5-CHANGED: Interface Loopback0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

R1(config-if)#ip address 10.0.0.1 255.255.255.0
R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#ipv6 address 2001:db8:acad:2::1/64
R1(config-if)#description loopback adapter
R1(config-if)#no shutdown
R1(config-if)#
R1(config-if)#exit
```

The router should not allow vty logins for two minutes if three failed login attempts occur within 60 seconds.

```
R1(config)#
R1(config)#login block-for 120 attempts 3 within 60
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#
```

o. Set the clock on the router.

```
R1#clock set 22:41:00 4 Feb 2025
R1#
```

p. Save the running configuration to the startup configuration file.

```
R1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
R1#
```

Question:

What would be the result of reloading the router prior to completing the copy running-config startup-config command?

ANSWER - The contents of the running configuration in RAM would be erased during reload. As a result, the router would boot up without a startup configuration and the user would be asked if they would like to enter initial configuration dialog.

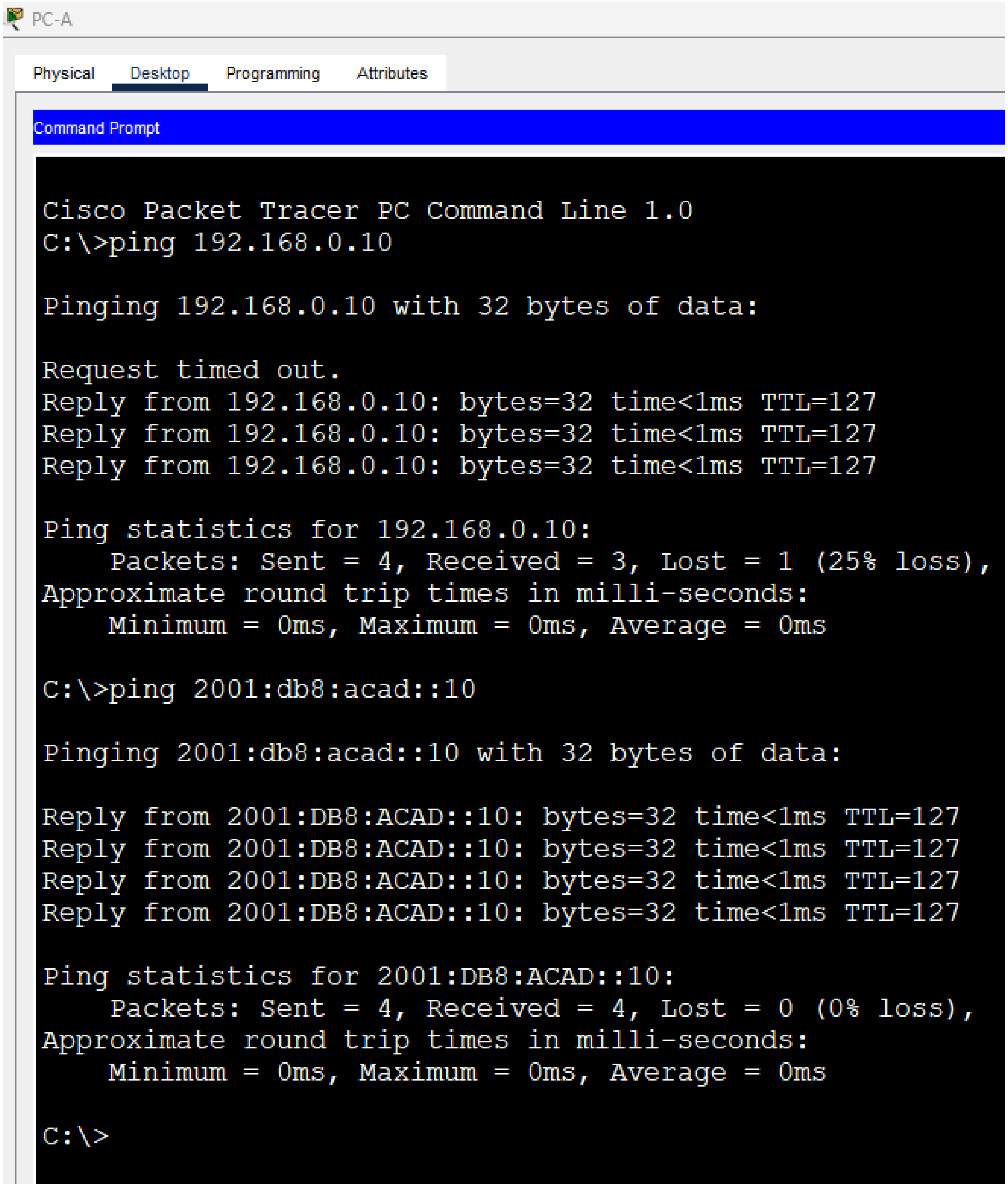
Close configuration window

3.4.6.2.5.2.3 Step 3: Verify network connectivity.

a. Using the command line at **PC-A**, ping the IPv4 and IPv6 addresses for **Server**.

Question:

Were the pings successful? Yes

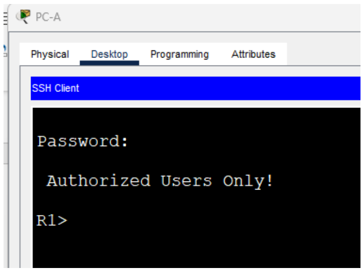


b. From **PC-A**, remotely access **R1** using the Telnet / SSH client.

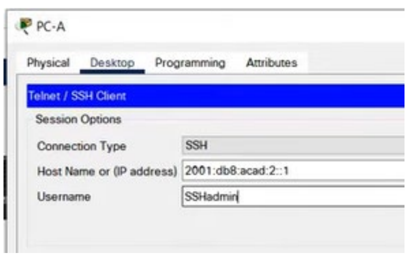
Using the Telnet / SSH client on PC-A, open an SSH session to the R1 Loopback interface IPv4 address. Ensure that the Connection Type is set to **SSH** and use **SSHadmin** as the username. When prompted, enter the password **55Hadm!n2020**.

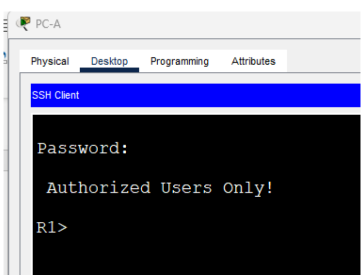
Question:

Was remote access successful? Yes



b. Using the Telnet / SSH client on **PC-A**, open an SSH session to the R1 Loopback interface IPv6 address. Ensure that the Connection Type is set to **SSH** and use **SSHadmin** as the username. When prompted, enter the password **55Hadm!n2020**.





Questions:

Was remote access successful? Yes

Why is the Telnet protocol considered to be a security risk?

Answer - A Telnet session can be seen in plaintext. It is not encrypted. Passwords can easily be seen using a packet sniffer

3.4.6.2.5.3 Part 3: Display Router Information

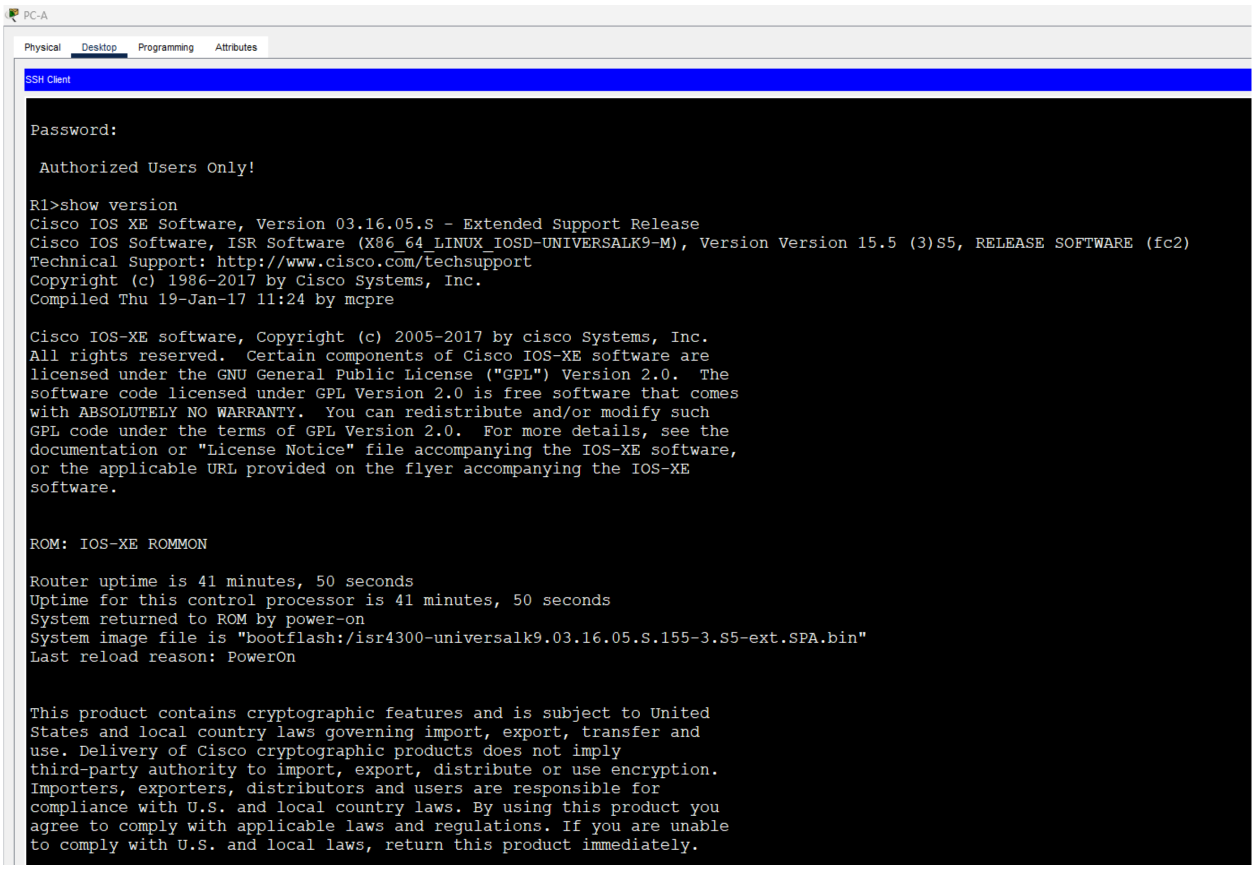
In Part 3, you will use **show** commands from an SSH session to retrieve information from the router.

3.4.6.2.5.3.1 Step 1: Establish an SSH session to R1.

Using Telnet / SSH client on PC-A, open an SSH session to the R1 Loopback interface IPv6 address and log in as **SSHadmin** with the password **55Hadm!n2020**.

3.4.6.2.5.3.2 Step 2: Retrieve important hardware and software information.

a. Use the **show version** command to answer questions about the router.




```
Password:

 Authorized Users Only!

R1>show version
Cisco IOS XE Software, Version 03.16.05.S - Extended Support Release
Cisco IOS Software, ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version Version 15.5 (3)S5, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2017 by Cisco Systems, Inc.
Compiled Thu 19-Jan-17 11:24 by mcpre

Cisco IOS-XE software, Copyright (c) 2005-2017 by cisco Systems, Inc.
All rights reserved.  Certain components of Cisco IOS-XE software are
licensed under the GNU General Public License ("GPL") Version 2.0.  The
software code licensed under GPL Version 2.0 is free software that comes
with ABSOLUTELY NO WARRANTY.  You can redistribute and/or modify such
GPL code under the terms of GPL Version 2.0.  For more details, see the
documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.


ROM: IOS-XE ROMMON

Router uptime is 41 minutes, 50 seconds
Uptime for this control processor is 41 minutes, 50 seconds
System returned to ROM by power-on
System image file is "bootflash:/isr4300-universalk9.03.16.05.S.155-3.S5-ext.SPA.bin"
Last reload reason: PowerOn


This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.
```

```
A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.



Suite License Information for Module:'esg'

--------------------------------------------------------------------------------
Suite                 Suite Current         Type           Suite Next reboot

--------------------------------------------------------------------------------
FoundationSuiteK9     None                  None           None

securityk9
appxk9

AdvUCSuiteK9          None                  None           None

uck9
cme - srst
cube


Technology Package License Information:

------------------------------------------------------------------------
Technology    Technology-package                   Technology-package
              Current              Type            Next reboot
------------------------------------------------------------------------
appxk9           None             None             None
uck9             None             None             None
securityk9       securityk9       Permanent        securityk9
ipbase           ipbasek9         Permanent        ipbasek9
security         securityk9       Permanent        securityk9
ipbase           ipbasek9         Permanent        ipbasek9
```

```
cisco ISR4321/K9 (1RU) processor with 1687137K/6147K bytes of memory.
Processor board ID FLM2041W2HD
2 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
3223551K bytes of flash memory at bootflash:.


Configuration register is 0x2102


R1>
R1>
```

Questions:

What is the name of the IOS image that the router is running?

Answer - bootflash:/isr4300-universalk9.03.16.05.S.155-3.S5-ext.SPA.bin"

How much non-volatile random-access memory (NVRAM) does the router have?

Answer- 32768K bytes of non-volatile configuration memory.

How much Flash memory does the router have?

Answer- 3223551K bytes of flash memory at bootflash:.

b. The **show** commands often provide multiple screens of outputs. Filtering the output lets you display certain sections of the output. To enable the filtering command, enter a pipe (**|**) character after a **show** command, followed by a filtering parameter and a filtering expression. You can match the output to the filtering statement by using the **include** keyword to display all lines from the output that contain the filtering expression. Filter the **show version** command, using **show version | include register** to answer the following question.

Question:

What would be the boot process for the router on the next reload if the configuration register was 0x2142?

```
R1>show version | include register
Configuration register is 0x2102
R1>
```

In most cases the configuration register will have a value of 0x2102 signifying that the router will undergo a normal boot, load the IOS from the Flash memory, and load the startup configuration from the NVRAM if present.

If the config register is 0x2142, the router will bypass the startup config and begin at the user-mode command prompt. If the initial boot fails, the router goes into ROMMON mode.

3.4.6.2.5.3.3 Step 3: Display the startup configuration.

a. Use the **show startup-config** command on the router to answer the following question.

```
R1#show start
Using 1495 bytes
!
version 15.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
security passwords min-length 12
!
hostname R1
!
login block-for 120 attempts 3 within 60
!
!
enable secret 5 $1$mERr$2q6B19eTeuK92k7m8Bhgz/
!
!
!
!
!
!
ip cef
ipv6 unicast-routing
!
no ipv6 cef
!
!
!
username SSHadmin secret 5 $1$mERr$fuFUxOtVJZMfnQOcoB7vt/
!
!
!
!
!
!
!
!
ip domain-name ccna-lab.com
!
!
```

```
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface Loopback0
 description loopback adapter
 ip address 10.0.0.1 255.255.255.0
 ipv6 address FE80::1 link-local
 ipv6 address 2001:DB8:ACAD:2::1/64
!
interface GigabitEthernet0/0/0
 description Connection to Server
 ip address 192.168.0.1 255.255.255.0
 duplex auto
 speed auto
 ipv6 address FE80::1 link-local
 ipv6 address 2001:DB8:ACAD::1/64
!
interface GigabitEthernet0/0/1
 description Connection to S1
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
 ipv6 address FE80::1 link-local
 ipv6 address 2001:DB8:ACAD:1::1/64
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
!
ip flow-export version 9
!
!
ip access-list extended sl_def_acl
```

```
!
ip access-list extended sl_def_acl
 deny tcp any any eq telnet
 deny tcp any any eq www
 deny tcp any any eq 22
 permit tcp any any eq 22
!
banner motd ^C Authorized Users Only! ^C
!
!
!
!
line con 0
 exec-timeout 4 0
 password 7 08654F471A1A0A565328232A60
 login
!
line aux 0
!
line vty 0 4
 exec-timeout 4 0
 password 7 08654F471A1A0A56533D383D60
 login local
 transport input ssh
!
!
!
end
```

Question:

How are passwords presented in the output?

Answer - Passwords are encrypted because of the service password-encryption command

b. Use the **show running-config | section vty** command.

Question:

What is the result of using this command?

Answer - A user receives the startup configuration output, beginning with the line that includes the first instance of the filtering expression.

```
R1#show running-config | section vty
line vty 0 4
 exec-timeout 4 0
 password 7 08654F471A1A0A56533D383D60
 login local
 transport input ssh
R1#
```

3.4.6.2.5.3.4 Step 4: Display the routing table on the router.

Use the **show ip route** command on the router to answer the following questions.

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.0.0.0/24 is directly connected, Loopback0
L       10.0.0.1/32 is directly connected, Loopback0
     192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.0.0/24 is directly connected, GigabitEthernet0/0/0
L       192.168.0.1/32 is directly connected, GigabitEthernet0/0/0
     192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, GigabitEthernet0/0/1
L       192.168.1.1/32 is directly connected, GigabitEthernet0/0/1
```

Questions:

What code is used in the routing table to indicate a directly connected network?

Answer - The C designates a directly connected subnet. An L designates a local interface. Both answers are correct.

How many route entries are coded with a C code in the routing table?

Answer - 3

3.4.6.2.5.3.5 Step 5: Display a summary list of the interfaces on the router.

a. Use the **show ip interface brief** command on the router to answer the following question.

```
R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   192.168.0.1     YES manual up                    up
GigabitEthernet0/0/1   192.168.1.1     YES manual up                    up
Loopback0              10.0.0.1        YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R1#
```

Question:

What command changed the status of the Gigabit Ethernet ports from administratively down to up? The command used to change the status of the Gigabit Ethernet ports from administratively down to up is no shutdown

b. Use the **show ipv6 int brief** command to verify IPv6 settings on R1.

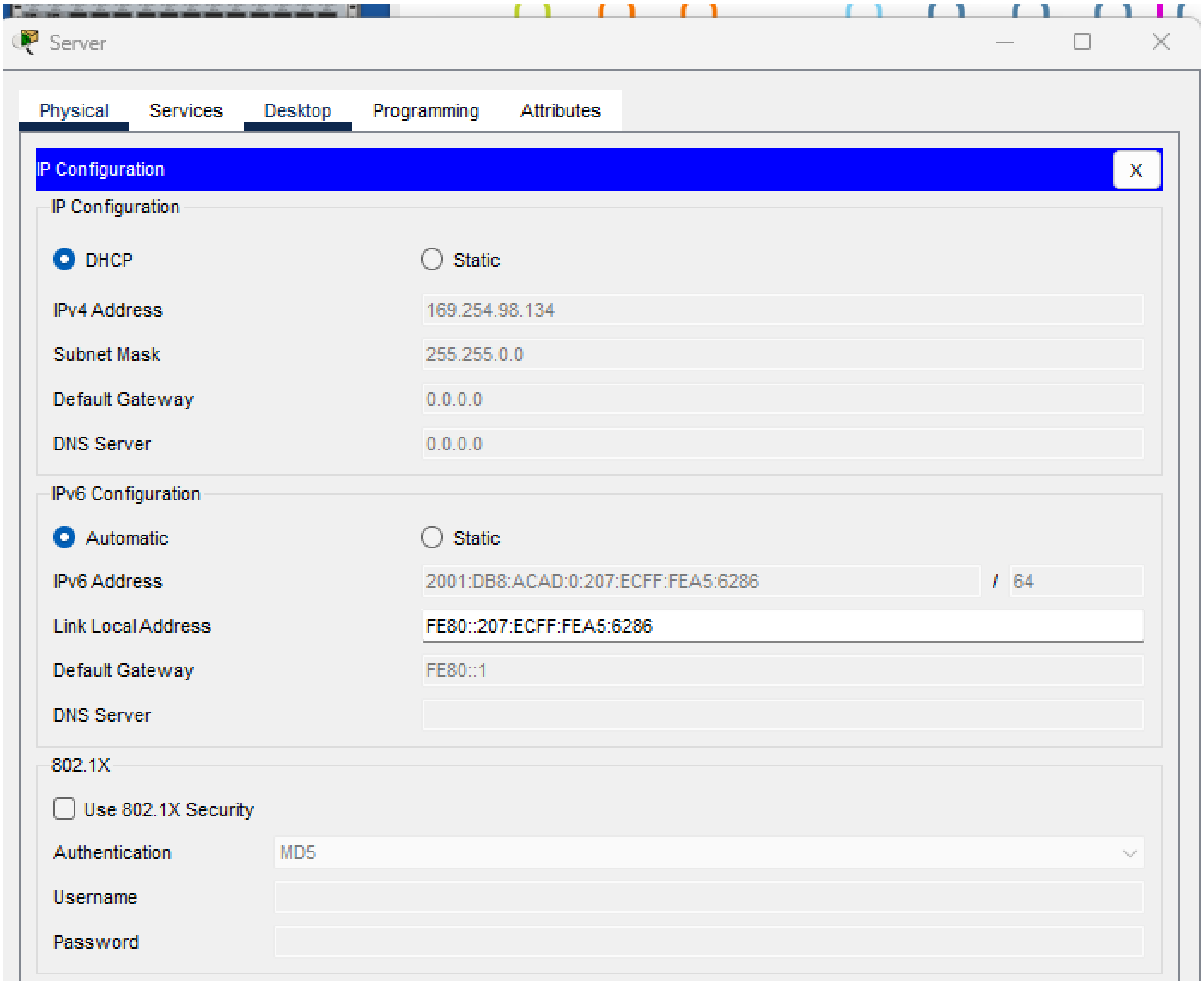
```
R1#
R1#show ipv6 interface brief
GigabitEthernet0/0/0       [up/up]
    FE80::1
    2001:DB8:ACAD::1
GigabitEthernet0/0/1       [up/up]
    FE80::1
    2001:DB8:ACAD:1::1
Loopback0                  [up/up]
    FE80::1
    2001:DB8:ACAD:2::1
Vlan1                      [administratively down/down]
    unassigned
R1#
R1#
```

Question:

What is the meaning of the [up/up] part of the output?

Answer - The [up/up] status reflects the Layer 1 and Layer 2 status of the interface and does not rely on Layer 3 for status.

c. On **Server**, change its configuration so that it no longer has a static IPv6 address. Then, issue the **ipconfig** command on **Server** to examine the IPv6 configuration.




```
Cisco Packet Tracer SERVER Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: FE80::207:ECFF:FEA5:6286
   IPv6 Address....................: 2001:DB8:ACAD::10
   IPv4 Address....................: 192.168.0.10
   Subnet Mask.....................: 255.255.255.0
   Default Gateway.................: FE80::1
                                     192.168.0.1

C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: FE80::207:ECFF:FEA5:6286
   IPv6 Address....................: 2001:DB8:ACAD:0:207:ECFF:FEA5:6286
   Autoconfiguration IPv4 Address..: 169.254.98.134
   Subnet Mask.....................: 255.255.0.0
   Default Gateway.................: FE80::1
                                     0.0.0.0

C:\>
```

Questions:

What is the IPv6 address assigned to Server?

ANSWER - IPv6 Address....................: 2001:DB8:ACAD:0:207:ECFF:FEA5:6286

What is the default gateway assigned to **Server**?

ANSWER - Default Gateway.................: FE80::1

From PC-B, issue a ping to the R1 default gateway link local address. Was it successful?

```
C:\>ping 2001:db8:acad::1

Pinging 2001:db8:acad::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD::1: bytes=32 time=3ms TTL=255
Reply from 2001:DB8:ACAD::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms
```

From Server, issue a ping to the R1 IPv6 unicast address 2001:db8:acad::1. Was it successful?

```
C:\>ping 2001:db8:acad::1

Pinging 2001:db8:acad::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

3.4.6.2.6 Reflection Questions

1. In researching a network connectivity issue, a technician suspects that an interface was not enabled. What **show** command could the technician use to troubleshoot this issue?

Answer - **show ip interface brief**

2. In researching a network connectivity issue, a technician suspects that an interface was assigned an incorrect subnet mask. What **show** command could the technician use to troubleshoot this issue?

End of document

Answer - show startup-config

show running-config interface <interface-id>

show ip interface command to verify the subnet mask and other details for all interface

Router Interface Summary Table

Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
4221	Gigabit Ethernet 0/0/0 (G0/0/0)	Gigabit Ethernet 0/0/1 (G0/0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
4300	Gigabit Ethernet 0/0/0 (G0/0/0)	Gigabit Ethernet 0/0/1 (G0/0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

3.5 Netacad Module 2 - Switching Concepts

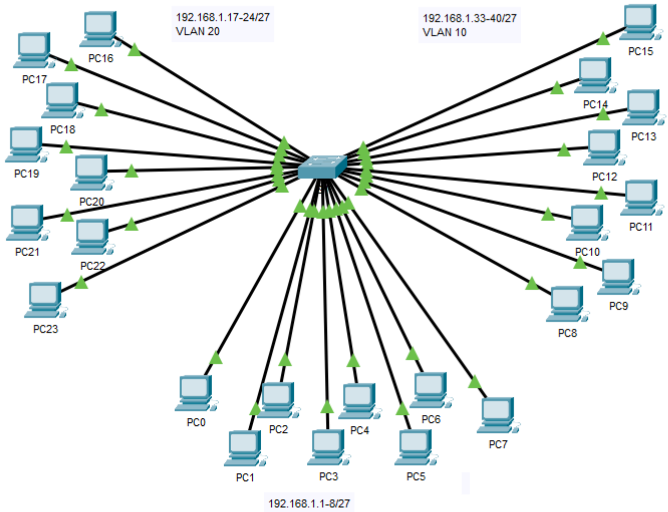
No exercises for this module

3.6 Netacad Module 3 - VLANs

3.6.1 Section 3.1. Overview of VLANs

3.6.1.1 Exercise 3.1.4 Packet Tracer – Who Hears the Broadcast?

3.6.1.1.1 Topology



3.6.1.1.2 Objectives

Part 1: Observe Broadcast Traffic in a VLAN Implementation

Part 2: Complete Review Questions

3.6.1.1.3 Scenario

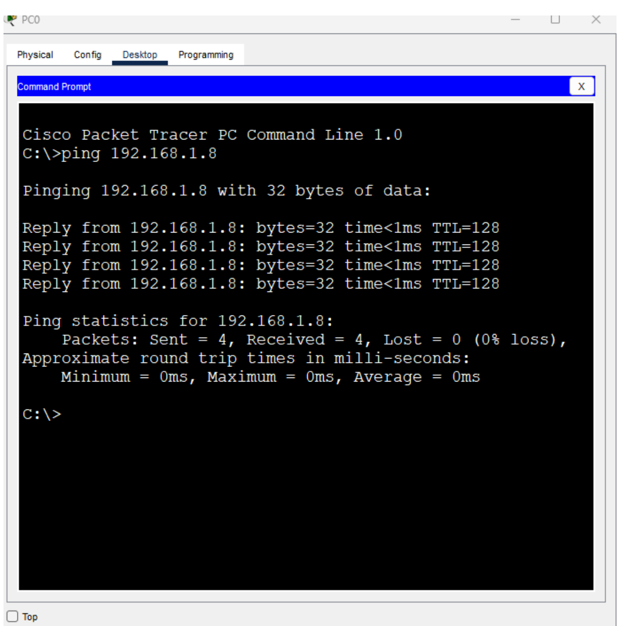
In this activity, a 24-port Catalyst 2960 switch is fully populated. All ports are in use. You will observe broadcast traffic in a VLAN implementation and answer some reflection questions.

3.6.1.1.4 Instructions

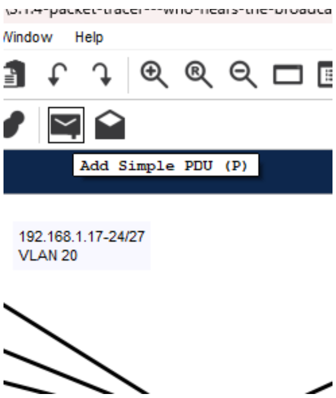
3.6.1.1.4.1 Step 1: Use ping to generate traffic.

a. Click **PC0** and click the **Desktop** tab> **Command Prompt**.

b. Enter the **ping 192.168.1.8** command. The ping should succeed.



Instead of Ping we can use Add simple PDU



Select two pc’s from each subnet and send message . See results

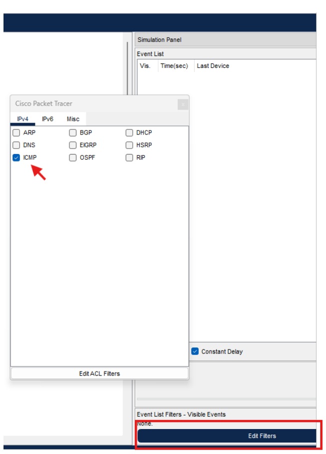
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC16	PC23	ICMP		0.000	N	0	(edit)	
	Successful	PC15	PC10	ICMP		0.000	N	1	(edit)	
	Successful	PC1	PC5	ICMP		0.000	N	2	(edit)	

Unlike a LAN, a VLAN is a broadcast domain created by switches. Using Packet Tracer **Simulation** mode, ping the end devices within their own VLAN. Based on your observation, answer the questions in Step 2.

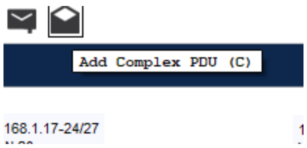
3.6.1.1.4.2 Step 2: Generate and examine broadcast traffic in a VLAN implementation.

a. Switch to **Simulation** mode.

b. Click **Edit Filters** in the Simulation Panel. Uncheck the **Show All/None** checkbox. Check the **ICMP** checkbox.

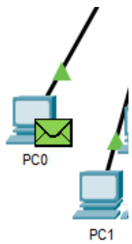


c. Click the **Add Complex PDU** tool, this is the open envelope icon on the right toolbar.



d. Float the mouse cursor over the topology and the pointer changes to an envelope with a plus (+) sign.

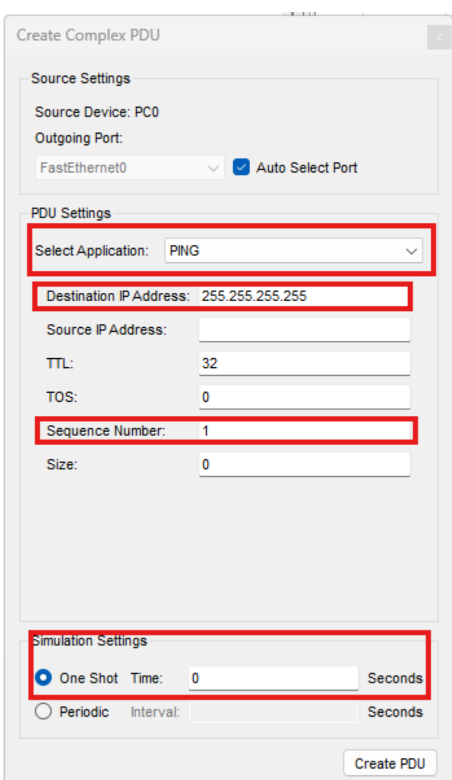
e. Click **PC0** to serve as the source for this test message and the **Create Complex PDU** dialog window opens.



Enter the following values:

- Destination IP Address: 255.255.255.255 (broadcast address)
- Sequence Number: 1
- One Shot Time: 0

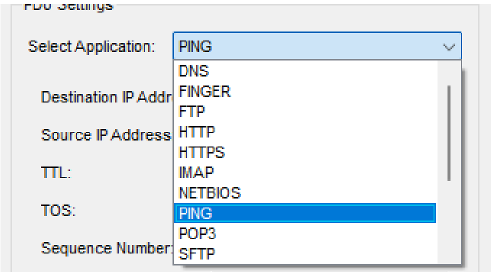
Within the PDU settings, the default for **Select Application:** is PING.



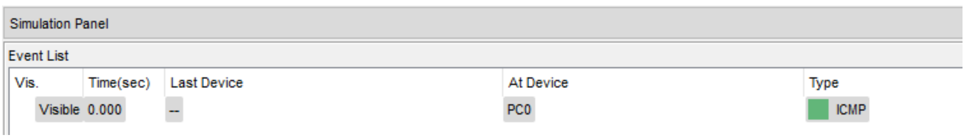
Question:

What are at least 3 other applications available for use?

ANSWER - DNS, FINGER, FTP, HTTP, HTTPS, IMAP, NETBIOS, PING, POP3, SFTP, SMTP, SNMP, SSH, TELNET, TFTP and OTHER



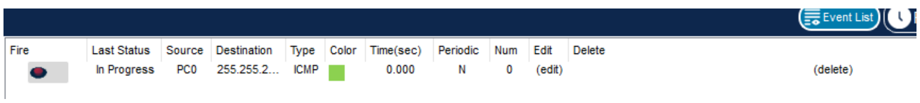
f. Click **Create PDU**. This test broadcast packet now appears in the **Simulation Panel Event List.** It also appears in the PDU List window. It is the first PDU for Scenario 0.



Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
Visible	0.000	--	PC0	ICMP



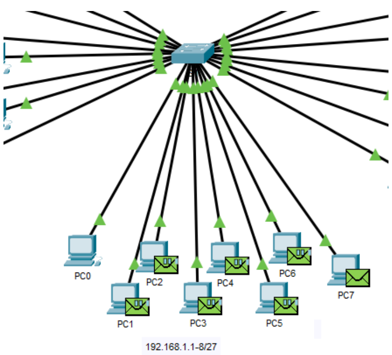
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	In Progress	PC0	255.255.2...	ICMP		0.000	N	0	(edit)	(delete)

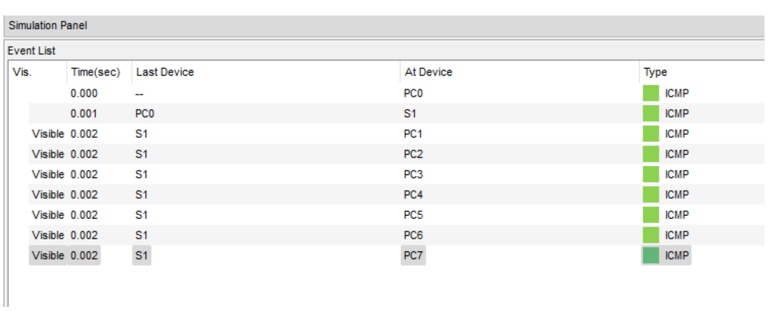
g. Click **Capture/Forward** twice.

Question:

What happened to the packet?

Is broadcasted to all subnet. Furst from Pco0 to S1 then from S1 to all PC's (except PC0)



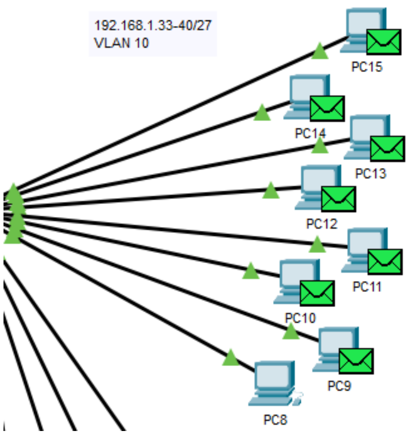


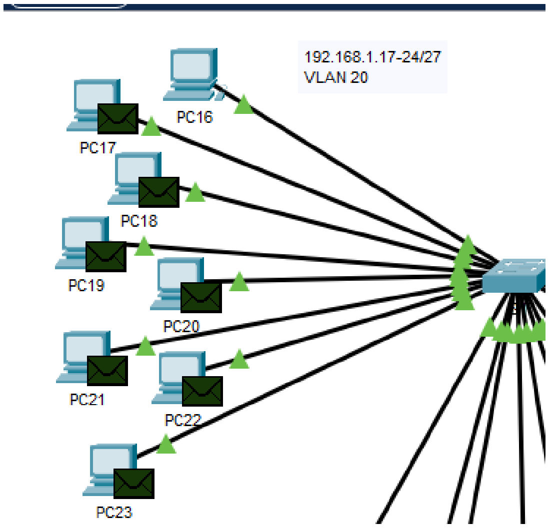
Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	PC0	ICMP
	0.001	PC0	S1	ICMP
Visible	0.002	S1	PC1	ICMP
Visible	0.002	S1	PC2	ICMP
Visible	0.002	S1	PC3	ICMP
Visible	0.002	S1	PC4	ICMP
Visible	0.002	S1	PC5	ICMP
Visible	0.002	S1	PC6	ICMP
Visible	0.002	S1	PC7	ICMP

h. Repeat this process for **PC8** and **PC16**.





Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	255.255.2...	ICMP		0.000	N	0	(edit)	(delete)
	Successful	PC8	255.255.2...	ICMP		0.000	N	1	(edit)	(delete)
	Successful	PC16	255.255.2...	ICMP		0.000	N	2	(edit)	(delete)

3.6.1.1.5 Reflection Questions

1. If a PC in VLAN 10 sends a broadcast message, which devices receive it?

ANSWER – All PC's on VLAN10

2. If a PC in VLAN 20 sends a broadcast message, which devices receive it?

ANSWER – All PC's on VLAN20

3. If a PC in VLAN 30 sends a broadcast message, which devices receive it?

ANSWER – All PC's on VLAN30

4. What happens to a frame sent from a PC in VLAN 10 to a PC in VLAN 30?

ANSWER - Is dropped because not ini same VLAN

5. Which ports on the switch light up if a PC connected to port 11 sends a unicast message to a PC connected to port 13?

ANSWER – Ports 11 and 13 will light up.

6. Which ports on the switch light if a PC connected to port 2 sends a unicast message to a PC connected to port 23?

ANSWER – the packet will be dropped

7. In terms of ports, what are the collision domains on the switch?

ANSWER - Each port is its own collision domain.

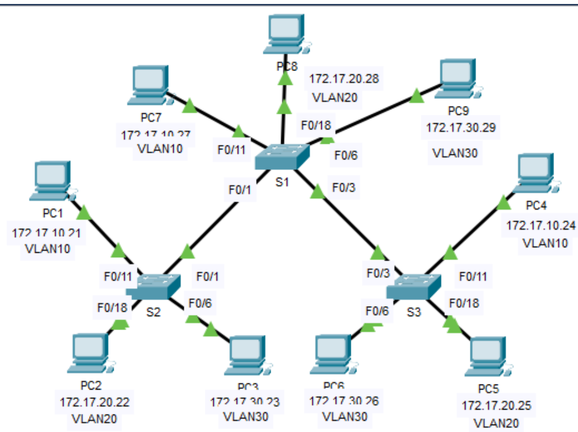
8. In terms of ports, what are the broadcast domains on the switch?

ANSWER - Each VLAN is its own broadcast domain.

3.6.2 Section 3.2. VLANs in a Multi-Switched Environment

3.6.2.1 Exercise 3.2.8 Packet Tracer - Investigate a VLAN Implementation

3.6.2.1.1 Topology



3.6.2.1.2 Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
S1	VLAN 99	172.17.99.31	255.255.255.0	N/A
S2	VLAN 99	172.17.99.32	255.255.255.0	N/A
S3	VLAN 99	172.17.99.33	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
PC7	NIC	172.17.10.27	255.255.255.0	172.17.10.1
PC8	NIC	172.17.20.28	255.255.255.0	172.17.20.1
PC9	NIC	172.17.30.29	255.255.255.0	172.17.30.1

3.6.2.1.3 Objectives

Part 1: Observe Broadcast Traffic in a VLAN Implementation

Part 2: Observe Broadcast Traffic without VLANs

3.6.2.1.4 Background

In this activity, you will observe how broadcast traffic is forwarded by the switches when VLANs are configured and when VLANs are not configured.

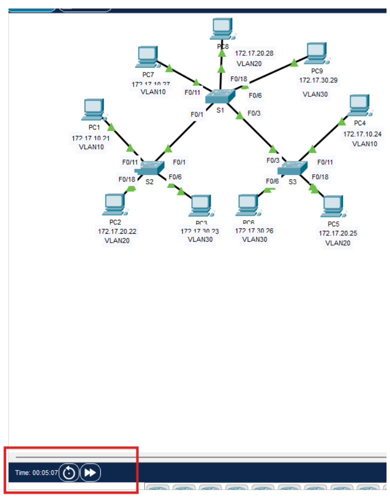
3.6.2.1.5 Instructions

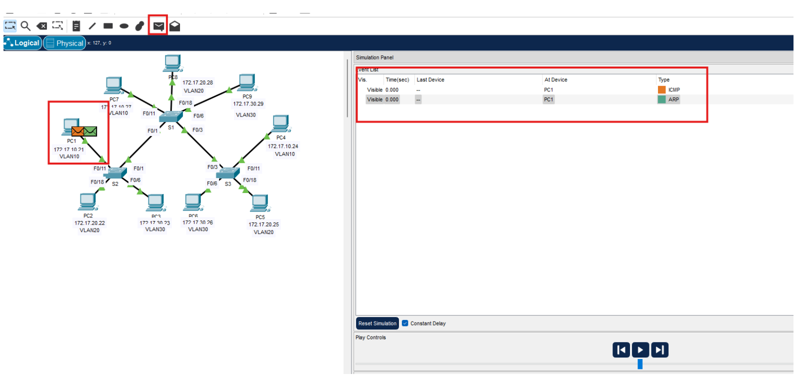
3.6.2.1.5.1 Part 1: Observe Broadcast Traffic in a VLAN Implementation

3.6.2.1.5.1.1 Step 1: Ping from PC1 to PC6.

a. Wait for all the link lights to turn to green. To accelerate this process, click **Fast Forward Time** located in the bottom tool bar.

All ports are green

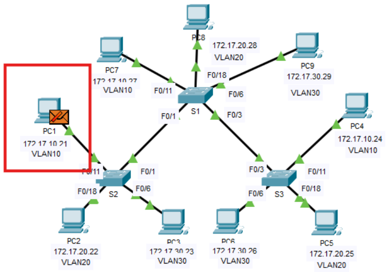


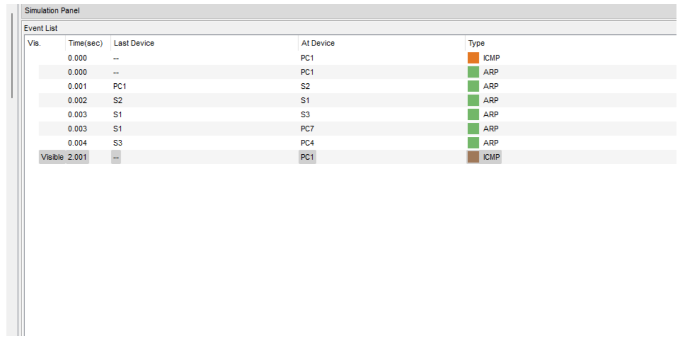


b. Click the **Simulation** tab and use the **Add Simple PDU** tool. Click **PC1**, and then click **PC6**.

c. Click the **Capture/Forward** button to step through the process. Observe the ARP requests as they traverse the network. When the Buffer Full window appears, click the **View Previous Events** button.

An error is seen in PC1, we can see from events that it tried to send packet towards PC's in same Lan. And no one answered.





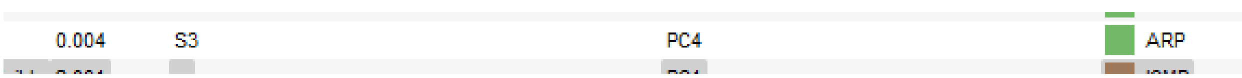
Questions:

Were the pings successful? Explain.

ANSWER - No, the pings were not successful because PC1 is on a different VLAN than PC6, which won't allow these devices to communicate with each other because they are separated logically.

Look at the Simulation Panel, where did S3 send the packet after receiving it?

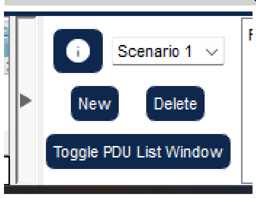
ANSWER – To PC4

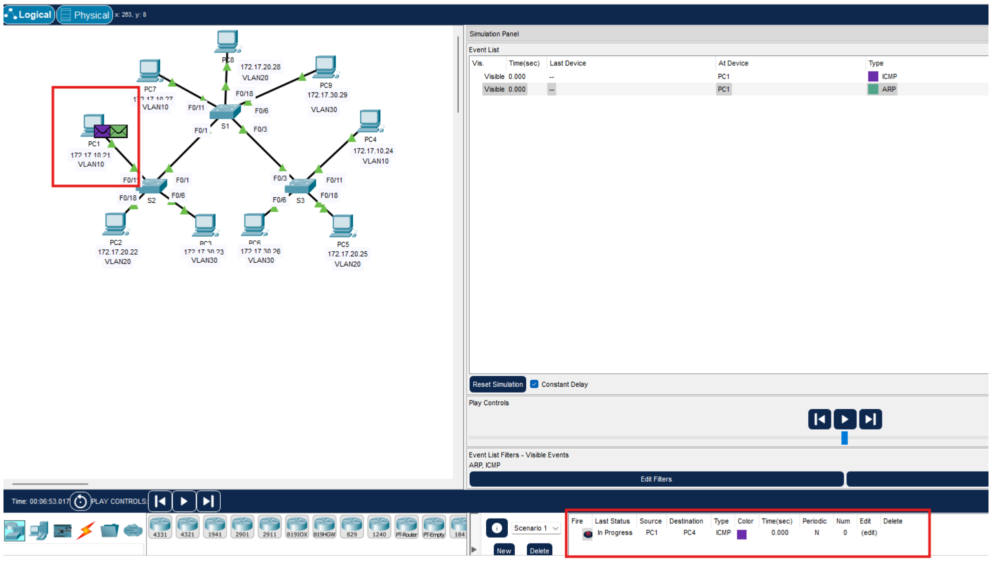


In normal operation, when a switch receives a broadcast frame on one of its ports, it forwards the frame out all other ports. Notice that **S2** only sends the ARP request out F0/1 to **S1**. Also notice that **S3** only sends the ARP request out F0/11 to **PC4**. **PC1** and **PC4** both belong to VLAN 10. **PC6** belongs to VLAN 30. Because broadcast traffic is contained within the VLAN, **PC6** never receives the ARP request from **PC1**. Because **PC4** is not the destination, it discards the ARP request. The ping from **PC1** fails because **PC1** never receives an ARP reply.

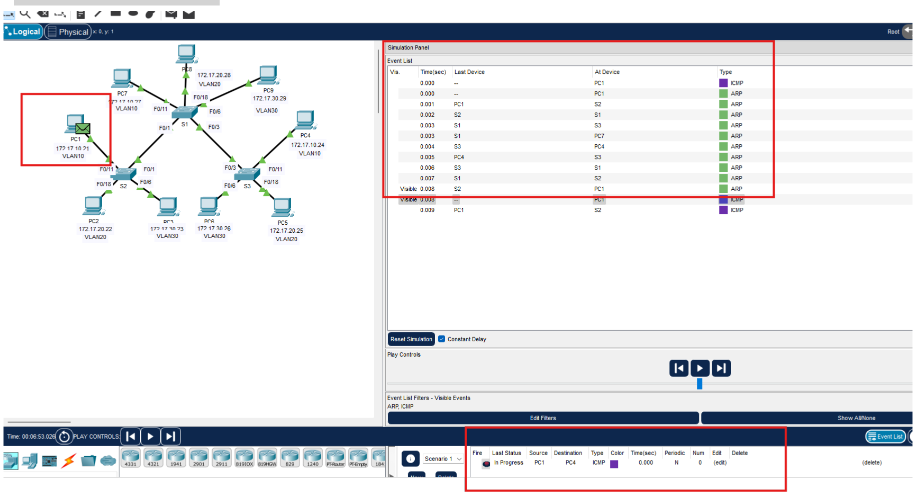
3.6.2.1.5.1.2 Step 2: Ping from PC1 to PC4.

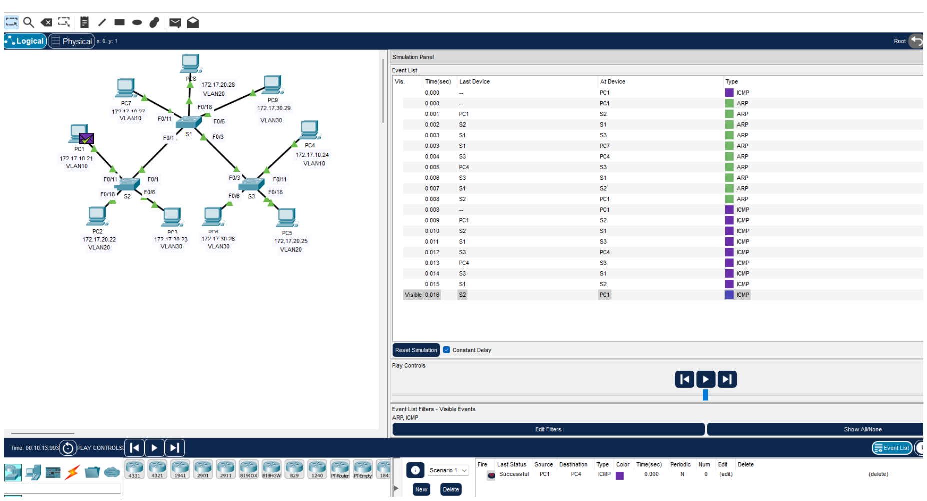
a. Click the **New** button under the Scenario 0 dropdown tab. Now click on the **Add Simple PDU** icon on the right side of Packet Tracer and ping from **PC1** to **PC4**.





b. Click the **Capture/Forward** button to step through the process. Observe the ARP requests as they traverse the network. When the Buffer Full window appears, click the **View Previous Events** button.





Question:

Were the pings successful? Explain.

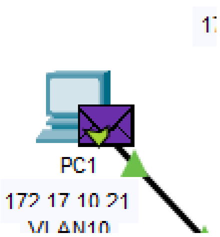
ANSWER Yes, because PC1 and PC4 both belong to VLAN 10, so the path of the ARP request is the same as before. Because PC4 is the destination, it replies to the ARP request. PC1 is then able to send the ping with the destination MAC address for PC4.

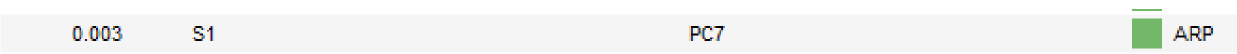
c. Examine the Simulation Panel.

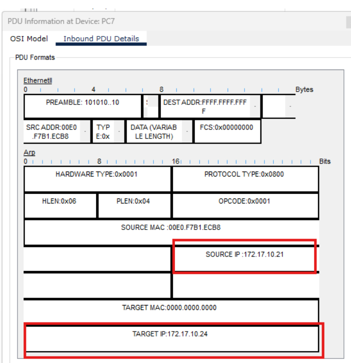
Question:

When the packet reached **S1**, why does it also forward the packet to **PC7**?

ANSWER Because PC7 also belong to VLAN 10 and the ARP requests was for VLAN10, switches will forward to any devices that are connected to VLAN10 in their port.



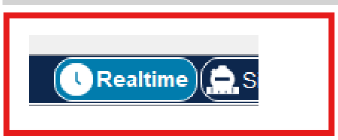




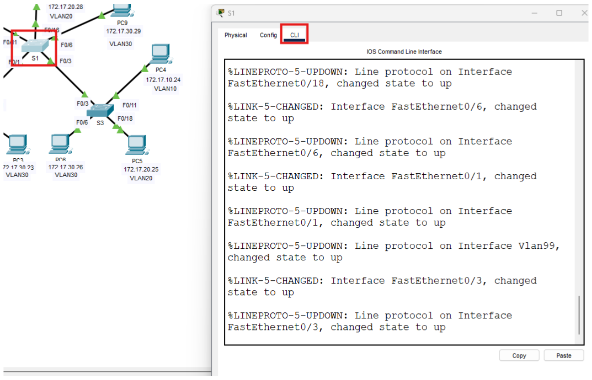
3.6.2.1.5.2 Part 2: Observe Broadcast Traffic without VLANs

3.6.2.1.5.2.1 Step 1: Clear the configurations on all three switches and delete the VLAN database.

a. Return to **Realtime** mode.



Open configuration window



b. Delete the startup configuration on all 3 switches.

```
S1>enable
S1#erase start
S1#erase startup-config
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
S1#show flash
Directory of flash:/

    1  -rw-     4414921          <no date>  c2960-lanbase-mz.122-25.FX.bin
    2  -rw-         796          <no date>  vlan.dat

32514048 bytes total (28098331 bytes free)
S1#
S1#
S1#delete vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]

S1#
```


```
S1>enable
S1#erase start
S1#erase startup-config
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
S1#show flash
Directory of flash:/

1 -rw- 4414921 <no date> c2960-lanbase-mz.122-25.FX.bin
2 -rw- 796 <no date> vlan.dat

32514048 bytes total (28098331 bytes free)
S1#
S1#
S1#delete vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]

S1#
```

```
S2>enable
S2#erase start
S2#erase startup-config
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
S2#show flash
Directory of flash:/

    1  -rw-     4414921          <no date>  c2960-lanbase-mz.122-25.FX.bin
    2  -rw-         796          <no date>  vlan.dat

32514048 bytes total (28098331 bytes free)
S2#delete vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]

S2#
```


```
S2>enable
S2#erase start
S2#erase startup-config
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
S2#show flash
Directory of flash:/

1 -rw- 4414921 <no date> c2960-lanbase-mz.122-25.FX.bin
2 -rw- 796 <no date> vlan.dat

32514048 bytes total (28098331 bytes free)
S2#delete vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]
S2#
```


```
S3>enable
S3#erase startup-config
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
S3#show flash
Directory of flash:/

    1  -rw-     4414921          <no date>  c2960-lanbase-mz.122-25.FX.bin
    2  -rw-         796          <no date>  vlan.dat

32514048 bytes total (28098331 bytes free)
S3#delete vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]

S3#
```


```
S3>enable
S3#erase startup-config
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
S3#show flash
Directory of flash:/

1 -rw- 4414921 <no date> c2960-lanbase-mz.122-25.FX.bin
2 -rw- 796 <no date> vlan.dat

32514048 bytes total (28098331 bytes free)
```

```
S3#delete vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]
S3#
```

Questions:

What command is used to delete the startup configuration of the switches?

```
S1>
S1>
S1>enable
S1#erase start
S1#erase startup-config
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV BLOCK INIT: Initialized the geometry of nvram
```

ANSWER - S1#erase startup-config

Where is the VLAN file stored in the switches

```
S1#show flash
Directory of flash:/

    1  -rw-     4414921          <no date>  c2960-lanbase-mz.122-25.FX.bin
    2  -rw-         796          <no date>  vlan.dat

32514048 bytes total (28098331 bytes free)
S1#
```

ANSWER vlan.dat

c. Delete the VLAN file on all 3 switches.

Question:

What command deletes the VLAN file stored in the switches?

```
S1#
S1#delete vlan.dat
Delete filename [vlan.dat]?
Delete flash:/vlan.dat? [confirm]

S1#
```

ANSWER delete vlan.dat

3.6.2.1.5.2.2 Step 2: Reload the switches.

Use the **reload** command in privileged EXEC mode to reset all the switches. Wait for the entire link to turn green. To accelerate this process, click **Fast Forward Time** located in the bottom yellow tool bar.

S1#reload

S2#reload

S#reload

```
S1#
S1#
S1#reload
Proceed with reload? [confirm]
C2960 Boot Loader (C2960-HBOOT-M) Version 12.2(25r)FX, RELEASE SOFTWARE (fc4)
Cisco WS-C2960-24TT (RC32300) processor (revision C0) with 21039K bytes of memory.
2960-24TT starting...
Base ethernet MAC Address: 0030.A3C0.74BA
Xmodem file system is available.
Initializing Flash...
flashfs[0]: 1 files, 0 directories
flashfs[0]: 0 orphaned files, 0 orphaned directories
flashfs[0]: Total bytes: 32514048
flashfs[0]: Bytes used: 4414921
flashfs[0]: Bytes available: 28099127
flashfs[0]: flashfs fsck took 1 seconds.
...done Initializing Flash.

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


Loading "flash:/c2960-lanbase-mz.122-25.FX.bin"...
########################################################################## [OK]
              Restricted Rights Legend
Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
           cisco Systems, Inc.
           170 West Tasman Drive
           San Jose, California 95134-1706
Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 15.0(2)SE4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2013 by Cisco Systems, Inc.
Compiled Wed 26-Jun-13 02:49 by mnguyen
Initializing flashfs...
```

```
Compiled Wed 26-Jun-13 02:49 by mnguyen
Initializing flashfs...
fsck: Disable shadow buffering due to heap fragmentation.
flashfs[2]: 2 files, 1 directories
flashfs[2]: 0 orphaned files, 0 orphaned directories
flashfs[2]: Total bytes: 32514048
flashfs[2]: Bytes used: 11952128
flashfs[2]: Bytes available: 20561920
flashfs[2]: flashfs fsck took 2 seconds.
flashfs[2]: Initialization complete....done Initializing flashfs.
Checking for Bootloader upgrade..
Boot Loader upgrade not required (Stage 2)
POST: CPU MIC register Tests : Begin
POST: CPU MIC register Tests : End, Status Passed
POST: PortASIC Memory Tests : Begin
POST: PortASIC Memory Tests : End, Status Passed
POST: CPU MIC interface Loopback Tests : Begin
POST: CPU MIC interface Loopback Tests : End, Status Passed
POST: PortASIC RingLoopback Tests : Begin
POST: PortASIC RingLoopback Tests : End, Status Passed
POST: PortASIC CAM Subsystem Tests : Begin
POST: PortASIC CAM Subsystem Tests : End, Status Passed
POST: PortASIC Port Loopback Tests : Begin
POST: PortASIC Port Loopback Tests : End, Status Passed
Waiting for Port download...Complete

This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.
A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html
If you require further assistance please contact us by sending email to
export@cisco.com.
cisco WS-C2960-24TT-L (PowerPC405) processor (revision B0) with 65536K bytes of memory.
Processor board ID FOC1010X104
```

```
Processor board ID FOC1010X104
Last reset from power-on
1 Virtual Ethernet interface
24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
The password-recovery mechanism is enabled.
64K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address       : 00:30:A3:C0:74:BA
Motherboard assembly number     : 73-10390-03
Power supply part number        : 341-0097-02
Motherboard serial number       : FOC10093R12
Power supply serial number      : AZS1007032H
Model revision number           : B0
Motherboard revision number     : B0
Model number                    : WS-C2960-24TT-L
System serial number            : FOC1010X104
Top Assembly Part Number        : 800-27221-02
Top Assembly Revision Number    : A0
Version ID                      : V02
CLEI Code Number                : COM3L00BRA
Hardware Board Revision Number  : 0x01

Switch Ports Model              SW Version            SW Image
------ ----- -----              ----------            ----------
*    1 26    WS-C2960-24TT-L    15.0(2)SE4            C2960-LANBASEK9-M

Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 15.0(2)SE4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2013 by Cisco Systems, Inc.
Compiled Wed 26-Jun-13 02:49 by mnguyen



Press RETURN to get started!


%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
```

```
Press RETURN to get started!


%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up

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

%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up

%LINK-5-CHANGED: Interface FastEthernet0/11, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/11, changed state to up

%LINK-5-CHANGED: 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 FastEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

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

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

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with S2 FastEthernet0/1 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (1), with S3 FastEthernet0/3 (99).
%SPANTREE-2-RECV_PVID_ERR: Received BPDU with inconsistent peer vlan id 99 on FastEthernet0/1 VLAN1.

%SPANTREE-2-BLOCK_PVID_LOCAL: Blocking FastEthernet0/1 on VLAN0001. Inconsistent local vlan.
```

```
%SPANTREE-2-BLOCK_PVID_LOCAL: Blocking FastEthernet0/1 on VLAN0001. Inconsistent local vlan.

%SPANTREE-2-RECV_PVID_ERR: Received BPDU with inconsistent peer vlan id 99 on FastEthernet0/3 VLAN1.

%SPANTREE-2-BLOCK_PVID_LOCAL: Blocking FastEthernet0/3 on VLAN0001. Inconsistent local vlan.


Switch>
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with S2 FastEthernet0/1 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (1), with S3 FastEthernet0/3 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with S2 FastEthernet0/1 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (1), with S3 FastEthernet0/3 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with S2 FastEthernet0/1 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (1), with S3 FastEthernet0/3 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with S2 FastEthernet0/1 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (1), with S3 FastEthernet0/3 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/1 (1), with S2 FastEthernet0/1 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/3 (1), with S3 FastEthernet0/3 (99).
```

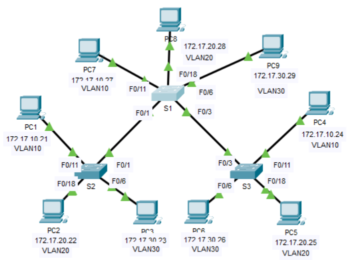
```
S2>enable
S2#reload
Proceed with reload? [confirm]
C2960 Boot Loader (C2960-HBOOT-M) Version 12.2(25r)FX, RELEASE SOFTWARE (fc4)
Cisco WS-C2960-24TT (RC32300) processor (revision C0) with 21039K bytes of memory.
2960-24TT starting...
Base ethernet MAC Address: 0001.6421.0A17
Xmodem file system is available.
Initializing Flash...
flashfs[0]: 1 files, 0 directories
flashfs[0]: 0 orphaned files, 0 orphaned directories
flashfs[0]: Total bytes: 32514048
flashfs[0]: Bytes used: 4414921
flashfs[0]: Bytes available: 28099127
flashfs[0]: flashfs fsck took 1 seconds.
...done Initializing Flash.

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


Loading "flash:/c2960-lanbase-mz.122-25.FX.bin"...
########################################################################## [OK]
              Restricted Rights Legend
Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
           cisco Systems, Inc.
           170 West Tasman Drive
           San Jose, California 95134-1706
Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 15.0(2)SE4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2013 by Cisco Systems, Inc.
Compiled Wed 26-Jun-13 02:49 by mnguyen
```

```
S3>
S3>enable
S3#reload
Proceed with reload? [confirm]
C2960 Boot Loader (C2960-HBOOT-M) Version 12.2(25r)FX, RELEASE SOFTWARE (fc4)
Cisco WS-C2960-24TT (RC32300) processor (revision C0) with 21039K bytes of memory.
2960-24TT starting...
Base ethernet MAC Address: 0090.0C9B.686A
Xmodem file system is available.
Initializing Flash...
flashfs[0]: 1 files, 0 directories
flashfs[0]: 0 orphaned files, 0 orphaned directories
flashfs[0]: Total bytes: 32514048
flashfs[0]: Bytes used: 4414921
flashfs[0]: Bytes available: 28099127
flashfs[0]: flashfs fsck took 1 seconds.
...done Initializing Flash.

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


Loading "flash:/c2960-lanbase-mz.122-25.FX.bin"...
########################################################################## [OK]
              Restricted Rights Legend
Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
           cisco Systems, Inc.
           170 West Tasman Drive
           San Jose, California 95134-1706
Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 15.0(2)SE4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2013 by Cisco Systems, Inc.
Compiled Wed 26-Jun-13 02:49 by mnguyen
Initializing flashfs...
fsck: Disable shadow buffering due to heap fragmentation.
```

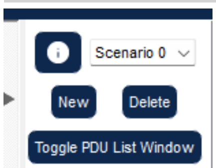
Close configuration window

3.6.2.1.5.2.3 Step 3: Click Capture/Forward to send ARP requests and pings.

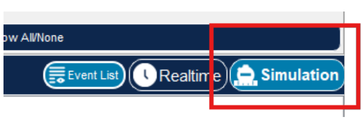
a. After the switches reload and the link lights return to green, the network is ready to forward your ARP and ping traffic.

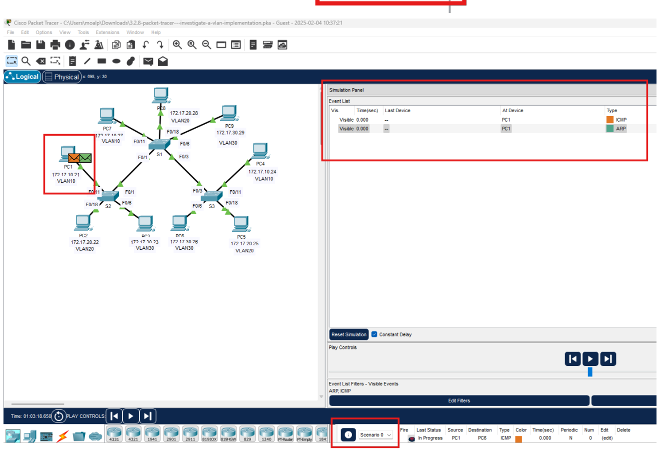


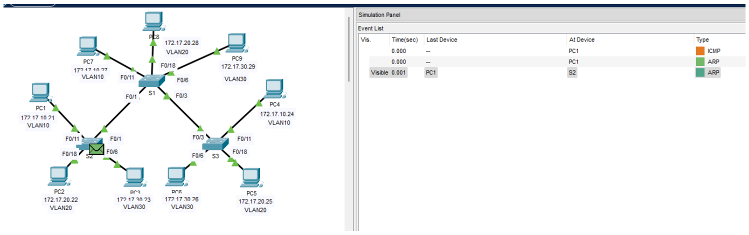
b. Select **Scenario 0** from the drop-down tab to return to Scenario 0.

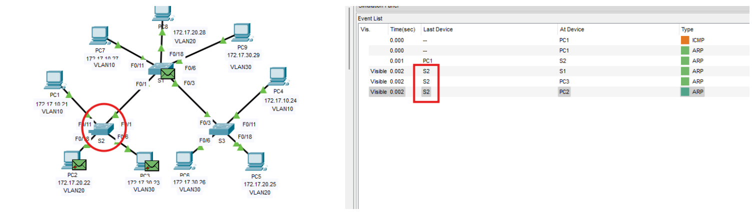


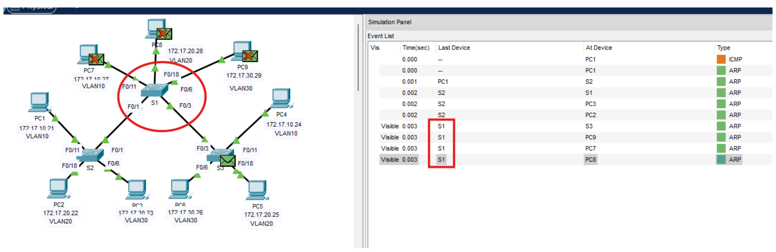
c. From **Simulation** mode, click the **Capture/Forward** button to step through the process. Notice that the switches now forward the ARP requests out all ports, except the port on which the ARP request was received. This default action of switches is why VLANs can improve network performance. Broadcast traffic is contained within each VLAN. When the **Buffer Full** window appears, click the **View Previous Events** button.

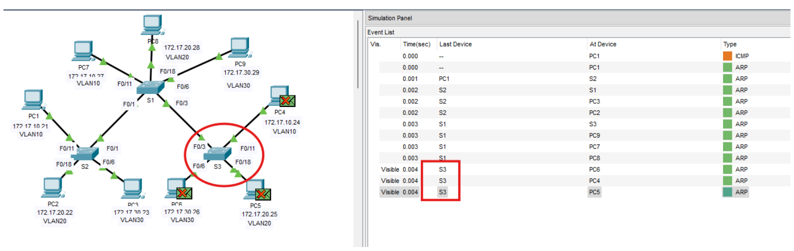


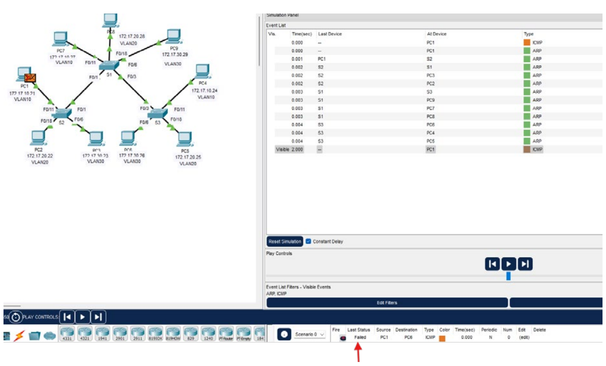












3.6.2.1.6 Reflection Questions

1. **If a PC in VLAN 10 sends a broadcast message, which devices receive it?**
   ANSWER Only devices on VLAN 10
2. **If a PC in VLAN 20 sends a broadcast message, which devices receive it?**
   ANSWER Only devices on VLAN 20
3. **If a PC in VLAN 30 sends a broadcast message, which devices receive it?**
   ANSWER Only devices on VLAN 30
4. **What happens to a frame sent from a PC in VLAN 10 to a PC in VLAN 30?**

ANSWER Is dropped

5. **In terms of ports, what are the collision domains on the switch?**
   ANSWER Each port is a separate collision domain.
6. **In terms of ports, what are the broadcast domains on the switch?**
   ANSWER Each vlan is a broadcast domain . They are divided by the number of VLANs in the switch.

3.6.3 Section 3.3. VLAN Configuration

3.6.3.1 Exercise 3.3.12 - Packet Tracer - VLAN Configuration

3.6.3.1.1 Addressing Table

Device	Interface	IP Address	Subnet Mask	VLAN
PC1	NIC	172.17.10.21	255.255.255.0	10
PC2	NIC	172.17.20.22	255.255.255.0	20
PC3	NIC	172.17.30.23	255.255.255.0	30
PC4	NIC	172.17.10.24	255.255.255.0	10
PC5	NIC	172.17.20.25	255.255.255.0	20
PC6	NIC	172.17.30.26	255.255.255.0	30

3.6.3.1.2 Objectives

Part 1: Verify the Default VLAN Configuration

Part 2: Configure VLANs

Part 3: Assign VLANs to Ports

3.6.3.1.3 Background

VLANs are helpful in the administration of logical groups, allowing members of a group to be easily moved, changed, or added. This activity focuses on creating and naming VLANs, and assigning access ports to specific VLANs.

3.6.3.1.4 Instructions

3.6.3.1.4.1 Part 1: View the Default VLAN Configuration

3.6.3.1.4.1.1 Step 1: Display the current VLANs.

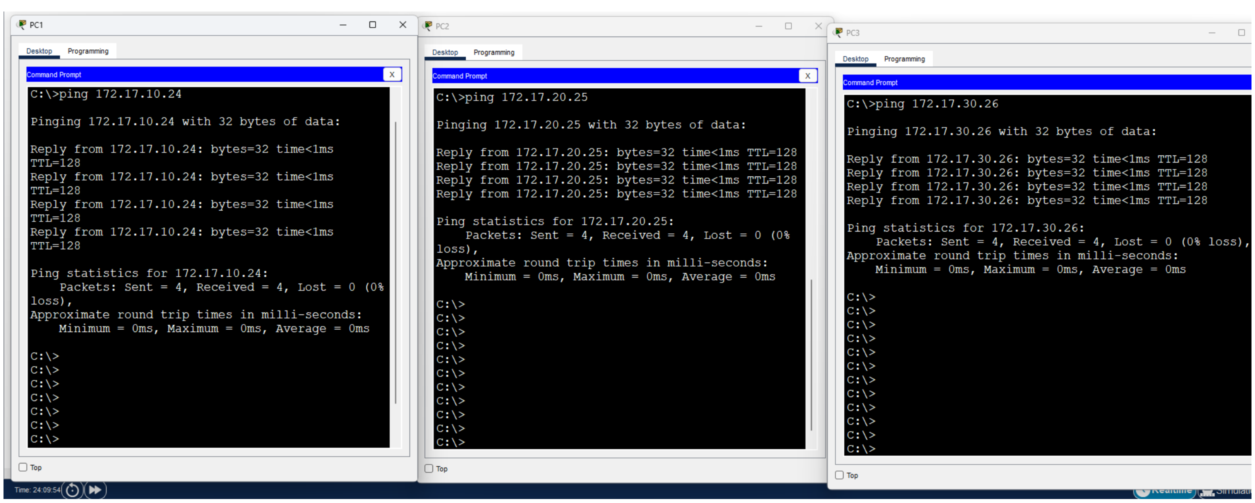
On S1, issue the command that displays all VLANs configured. By default, all interfaces are assigned to VLAN 1.

```
S1>enable
S1#show vlan brief

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
S1#
S1#
```

3.6.3.1.4.1.2 Step 2: Verify connectivity between PCs on the same network.

Notice that each PC can ping the other PC that shares the same subnet.

- PC1 can ping PC4
- PC2 can ping PC5
- PC3 can ping PC6



Pings to hosts on other networks fail.

Question:

What benefits can VLANs provide to the network?

Answer - the primary benefits of using VLANs are as follows: security, cost reduction, higher performance, broadcast storm mitigation, improved IT staff efficiency, and simpler project and application management.

3.6.3.1.4.2 Part 2: Configure VLANs

3.6.3.1.4.2.1 Step 1: Create and name VLANs on S1.

a. Create the following VLANs. Names are case-sensitive and must match the requirement exactly:

· VLAN 10: Faculty/Staff

Open configuration window

S1#(config)# **vlan 10**

S1#(config-vlan)# **name Faculty/Staff**

b. Create the remaining VLANS.

· VLAN 20: Students

· VLAN 30: Guest(Default)

· VLAN 99: Management&Native

· VLAN 150: VOICE

```
S1#config t
S1#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
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(Default)
S1(config-vlan)#vlan 99
S1(config-vlan)#name Management&Native
S1(config-vlan)#vlan 150
S1(config-vlan)#name VOICE
S1(config-vlan)#
```

3.6.3.1.4.2.2 Step 2: Verify the VLAN configuration.

Question:

Which command will only display the VLAN name, status, and associated ports on a switch?

S1#show vlan brief

```
S1#show vlan brief

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
10   Faculty/Staff                    active
20   Students                         active
30   Guest(Default)                   active
99   Management&Native                active
150  VOICE                            active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
S1#
```

3.6.3.1.4.2.3 Step 3: Create the VLANs on S2 and S3.

Use the same commands from Step 1 to create and name the same VLANs on S2 and S3.

S2

CLI

IOS Command Line Interface

```
GigabitEthernet0/1, changed state to up


S2>
S2>enable
S2#config t
S2#config terminal
Enter configuration commands, one per line.  End with
CNTL/Z.
S2(config)#vlan 10
S2(config-vlan)#name Faculty/Staff
S2(config-vlan)#vlan 20
S2(config-vlan)#name Students
S2(config-vlan)#vlan 30
S2(config-vlan)#name Guest(Default)
S2(config-vlan)#vlan 99
S2(config-vlan)#name Management&Native
S2(config-vlan)#vlan 150
S2(config-vlan)#name VOICE
S2(config-vlan)#end
S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#
```

S3

CLI

IOS Command Line Interface

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/11, changed state to up


S3>
S3>
S3>enable
S3#config t
S3#config terminal
Enter configuration commands, one per line.  End with
CNTL/Z.
S3(config)#vlan 10
S3(config-vlan)#name Faculty/Staff
S3(config-vlan)#vlan 20
S3(config-vlan)#name Students
S3(config-vlan)#vlan 30
S3(config-vlan)#name Guest(Default)
S3(config-vlan)#vlan 99
S3(config-vlan)#name Management&Native
S3(config-vlan)#vlan 150
S3(config-vlan)#name VOICE
S3(config-vlan)#
S3(config-vlan)#
```

3.6.3.1.4.2.4 Step 4: Verify the VLAN configuration.

```
S2#show vlan brief

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
10   Faculty/Staff                    active
20   Students                         active
30   Guest(Default)                   active
99   Management&Native                active
150  VOICE                            active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S2#
```

```
S3#show vlan brief

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
10   Faculty/Staff                    active
20   Students                         active
30   Guest(Default)                   active
99   Management&Native                active
150  VOICE                            active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S3#
```

Close configuration window

3.6.3.1.4.3 Part 3: Assign VLANs to Ports

3.6.3.1.4.3.1 Step 1: Assign VLANs to the active ports on S2.

a. Configure the interfaces as access ports and assign the VLANs as follows:

· VLAN 10: FastEthernet 0/11

Open configuration window

S2(config)# **interface f0/11**

S2(config-if)# **switchport mode access**

S2(config-if)# **switchport access vlan 10**

b. Assign the remaining ports to the appropriate VLAN.

· VLAN 20: FastEthernet 0/18

· VLAN 30: FastEthernet 0/6

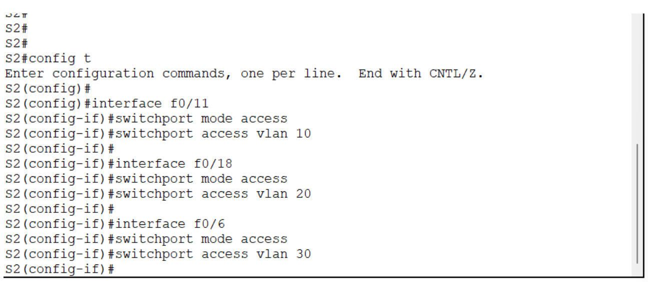
3.6.3.1.4.3.2 Step 2: Assign VLANs to the active ports on S3.

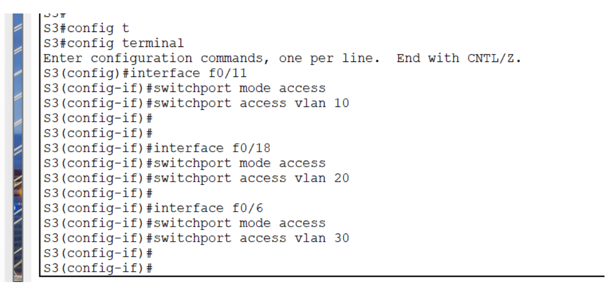
S3 uses the same VLAN access port assignments as S2. Configure the interfaces as access ports and assign the VLANs as follows:

· VLAN 10: FastEthernet 0/11

· VLAN 20: FastEthernet 0/18

· VLAN 30: FastEthernet 0/6


```
S2#
S2#
S2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#
S2(config)#interface f0/11
S2(config-if)#switchport mode access
S2(config-if)#switchport access vlan 10
S2(config-if)#
S2(config-if)#interface f0/18
S2(config-if)#switchport mode access
S2(config-if)#switchport access vlan 20
S2(config-if)#
S2(config-if)#interface f0/6
S2(config-if)#switchport mode access
S2(config-if)#switchport access vlan 30
S2(config-if)#
```


```
S3#config t
S3#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#interface f0/11
S3(config-if)#switchport mode access
S3(config-if)#switchport access vlan 10
S3(config-if)#
S3(config-if)#
S3(config-if)#interface f0/18
S3(config-if)#switchport mode access
S3(config-if)#switchport access vlan 20
S3(config-if)#
S3(config-if)#interface f0/6
S3(config-if)#switchport mode access
S3(config-if)#switchport access vlan 30
S3(config-if)#
S3(config-if)#
```

3.6.3.1.4.3.3 Step 3: Assign the VOICE VLAN to FastEthernet 0/11 on S3.

As shown in the topology, the S3 FastEthernet 0/11 interface connects to a Cisco IP Phone and PC4. The IP phone contains an integrated three-port 10/100 switch. One port on the phone is labeled Switch and connects to F0/4. Another port on the phone is labeled PC and connects to PC4. The IP phone also has an internal port that connects to the IP phone functions.

The S3 F0/11 interface must be configured to support user traffic to PC4 using VLAN 10 and voice traffic to the IP phone using VLAN 150. The interface must also enable QoS and trust the Class of Service (CoS) values assigned by the IP phone. IP voice traffic requires a minimum amount of throughput to support acceptable voice communication quality. This command helps the switchport to provide this minimum amount of throughput.

S3(config)# interface f0/11
S3(config-if)# mls qos trust cos
S3(config-if)# switchport voice vlan 150

```
S3(config)#interface f0/11
S3(config-if)#mls qos trust cos
S3(config-if)#switchport voice vlan 150
S3(config-if)#
```

3.6.3.1.4.3.4 Step 4: Verify loss of connectivity.

Previously, PCs that shared the same network could ping each other successfully.

Study the output of from the following command on **S2** and answer the following questions based on your knowledge of communication between VLANS. Pay close attention to the Gig0/1 port assignment.

S2# **show vlan brief**

```
S2#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, 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, Gig0/1, Gig0/2
10   Faculty/Staff                    active    Fa0/11
20   Students                         active    Fa0/18
30   Guest(Default)                   active    Fa0/6
99   Management&Native                active
150  VOICE                            active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S2#
S2#
```

VLAN Name Status Ports

---- -------------------------------- --------- -------------------------------

1 default active Fa0/1, Fa0/2, Fa0/3, Fa0/4

Fa0/5, Fa0/7, 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, Gig0/1, Gig0/2

10 Faculty/Staff active Fa0/11

20 Students active Fa0/18

30 Guest(Default) active Fa0/6

99 Management&Native active

150 VOICE active

Try pinging between PC1 and PC4.

```
C:\>ping 172.17.10.24

Pinging 172.17.10.24 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.17.10.24:
    Packets: Sent = 4, Received = 0, Lost = 4 (100%
loss),

C:\>
```

Questions:

Although the access ports are assigned to the appropriate VLANs, were the pings successful? Explain.

Answer - No, the pings failed because the ports between the switches are in VLAN 1 and PC1 and PC4 are in VLAN 10.

What could be done to resolve this issue?

Answer Configure the ports between the switches as trunk ports.

3.6.3.1.5 Answer Scripts

3.6.3.1.5.1 Switch S1

```
vlan 10
 name Faculty/Staff
vlan 20
 name Students
vlan 30
 name Guest(Default)
vlan 99
 name Management&Native
vlan 150
 name VOICE
```

3.6.3.1.5.2 Switch S2

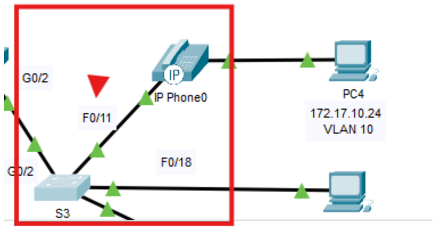
```
vlan 10
 name Faculty/Staff
vlan 20
 name Students
vlan 30
 name Guest(Default)
vlan 99
 name Management&Native
vlan 150
 name VOICE
interface fa0/11
 switchport mode access
 switchport access vlan 10
interface fa0/18
 switchport mode access
 switchport access vlan 20
interface fa0/6
 switchport mode access
 switchport access vlan 30
```

3.6.3.1.5.3 Switch S3

```
vlan 10
 name Faculty/Staff
vlan 20
 name Students
vlan 30
 name Guest(Default)
vlan 99
 name Management&Native
vlan 150
 name VOICE
interface fa0/11
 switchport mode access
 switchport access vlan 10
 mls qos trust cos
 switchport voice vlan 150
```

```
interface fa0/18
 switchport mode access
 switchport access vlan 20
interface fa0/6
 switchport mode access
 switchport access vlan 30
```

show vlan brief	Displays a concise summary of all VLANs configured on the switch, showing VLAN ID, name, status, and ports assigned to each VLAN.



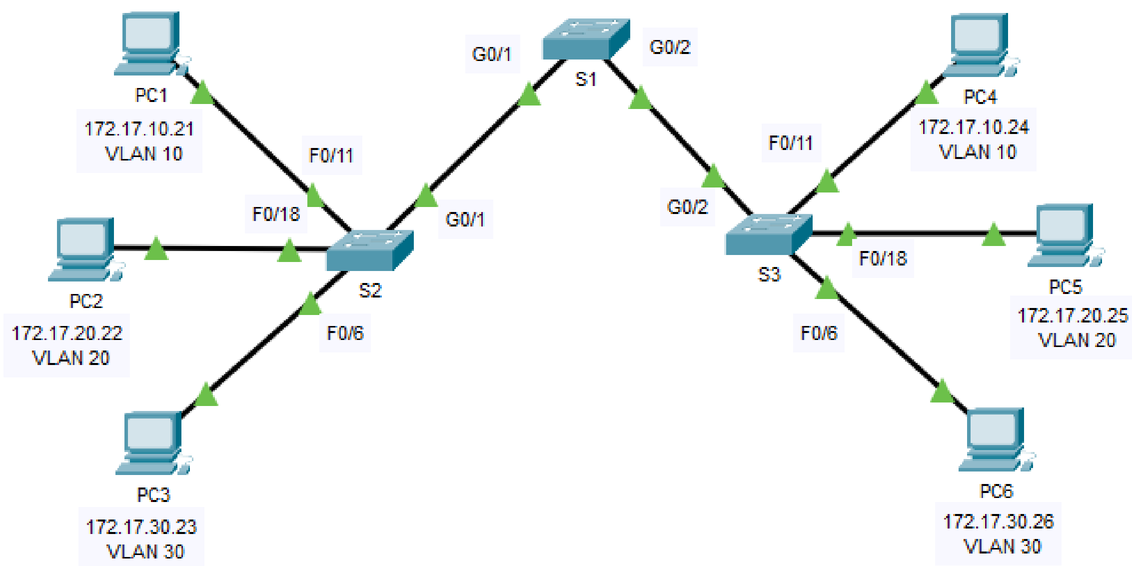
interface f0/11	Enters the configuration mode for FastEthernet interface 0/11.
mls qos trust cos	Enables QoS on the interface and trusts the Class of Service (CoS) values in incoming frames, allowing the switch to prioritize traffic based on these values.
switchport voice vlan 150	Configures the interface to assign voice traffic to VLAN 150, ensuring proper traffic management and QoS for voice devices.

copy running-config startup-config - To save the configuration on a Cisco router or switch

3.6.4 Section 3.4. VLAN Trunks

3.6.4.1 Exercise 3.4.5 - Packet Tracer - Configure Trunks

3.6.4.1.1 Topology



3.6.4.1.2 Addressing Table

Device	Interface	IP Address	Subnet Mask	Switch Port	VLAN
PC1	NIC	172.17.10.21	255.255.255.0	S2 F0/11	10
PC2	NIC	172.17.20.22	255.255.255.0	S2 F0/18	20
PC3	NIC	172.17.30.23	255.255.255.0	S2 F0/6	30
PC4	NIC	172.17.10.24	255.255.255.0	S3 F0/11	10
PC5	NIC	172.17.20.25	255.255.255.0	S3 F0/18	20
PC6	NIC	172.17.30.26	255.255.255.0	S3 F0/6	30

3.6.4.1.3 Objectives

Part 1: Verify VLANs

Part 2: Configure Trunks

3.6.4.1.4 Background

Trunks are required to pass VLAN information between switches. A port on a switch is either an access port or a trunk port. Access ports carry traffic from a specific VLAN assigned to the port. A trunk port by default is a member of all VLANs. Therefore, it carries traffic for all VLANs. This activity focuses on creating trunk ports and assigning them to a native VLAN other than the default.

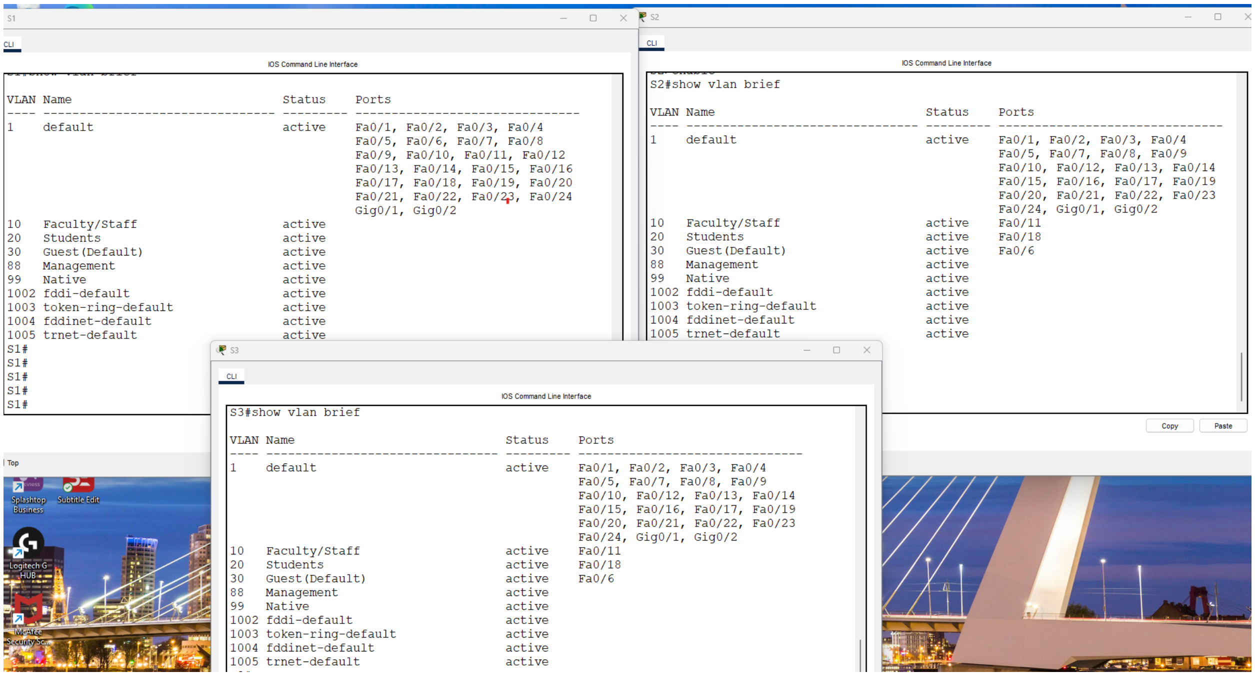
3.6.4.1.5 Instructions

3.6.4.1.5.1 Part 1: Verify VLANs

3.6.4.1.5.1.1 Step 1: Display the current VLANs.

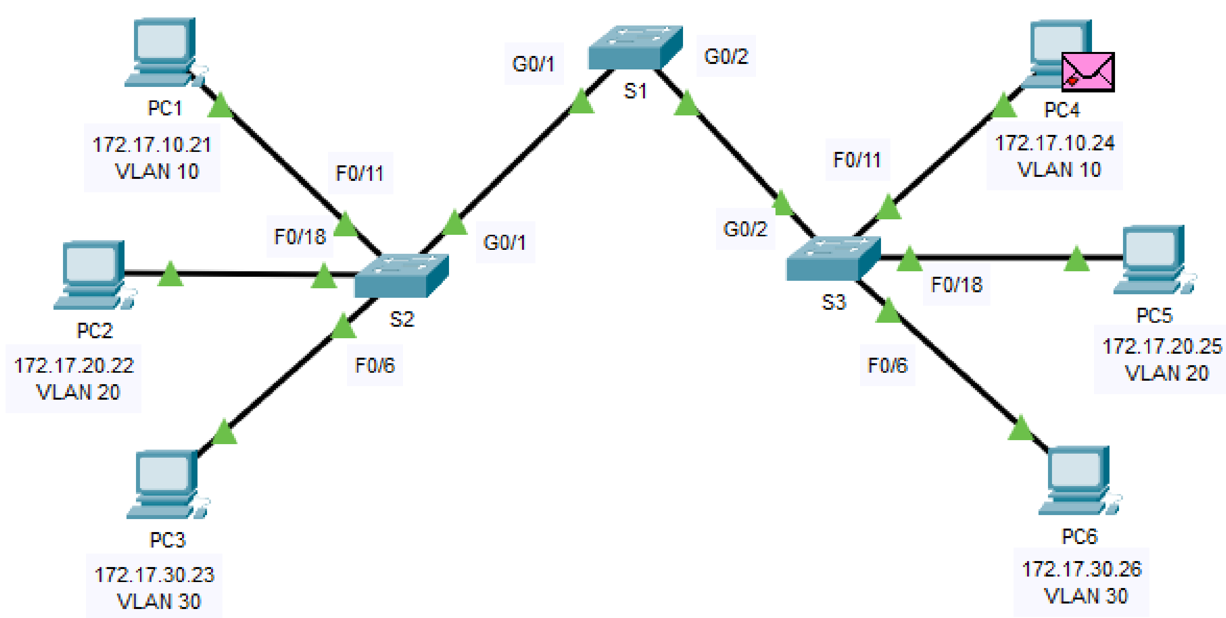
a. On **S1**, issue the command that will display all VLANs configured. There should be ten VLANs in total. Notice that all 26 access ports on the switch are assigned to VLAN 1.

b. On **S2** and **S3**, display and verify that all the VLANs are configured and assigned to the correct switch ports according to the **Addressing Table**.



3.6.4.1.5.1.2 Step 2: Verify loss of connectivity between PCs on the same network.

Ping between hosts on the same VLAN on the different switches. Although **PC1** and **PC4** are on the same network, they cannot ping one another. This is because the ports connecting the switches are assigned to VLAN 1 by default. In order to provide connectivity between the PCs on the same network and VLAN, trunks must be configured.



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Failed	PC1	PC4	ICMP		0.000	N	0	(edit)	

3.6.4.1.5.2 Part 2: Configure Trunks

3.6.4.1.5.2.1 Step 1: Configure trunking on S1 and use VLAN 99 as the native VLAN.

a. Configure G0/1 and G0/2 interfaces on S1 for trunking.

   S1(config)# **interface range g0/1 - 2**

   S1(config-if)# **switchport mode trunk**

b. Configure VLAN 99 as the native VLAN for G0/1 and G0/2 interfaces on **S1**.

   S1(config-if)# **switchport trunk native vlan 99**

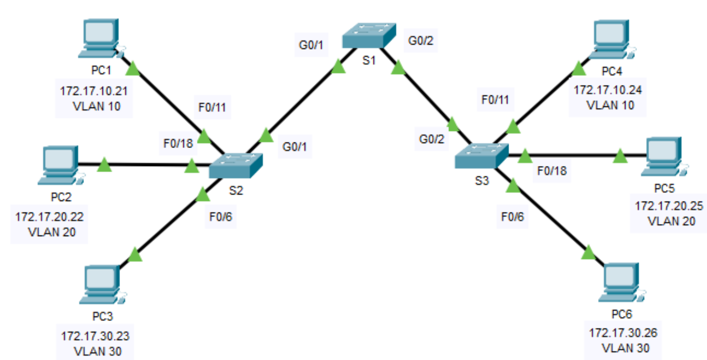
   The trunk port takes about a short time to become active due to Spanning Tree Protocol. Click **Fast Forward Time** to speed the process. After the ports become active, you will periodically receive the following syslog messages:

   %CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/2 (99), with S3 GigabitEthernet0/2 (1).

   %CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (99), with S2 GigabitEthernet0/1 (1).

   You configured VLAN 99 as the native VLAN on S1. However, S2 and S3 are using VLAN 1 as the default native VLAN as indicated by the syslog message.

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#
S1(config)#interface range g0/1 - 2
S1(config-if-range)#switchport mode trunk

S1(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

S1(config-if-range)#switchport trunk native vlan 99
S1(config-if-range)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/2 (99), with S3 GigabitEthernet0/2 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (99), with S2 GigabitEthernet0/1 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/2 (99), with S3 GigabitEthernet0/2 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (99), with S2 GigabitEthernet0/1 (1).
```



Question:

Although you have a native VLAN mismatch, pings between PCs on the same VLAN are now successful. Explain.

Answer - Pings are successful because trunking has been enabled on S1. Dynamic Trunking Protocol (DTP) has automatically negotiated the other side of the trunk links. In this case, S2 and S3 have now automatically configured the ports attached to S1 as trunking ports.

3.6.4.1.5.2.2 Step 2: Verify trunking is enabled on S2 and S3.

On **S2** and **S3**, issue the **show interface trunk** command to confirm that DTP has successfully negotiated trunking with S1 on S2 and S3. The output also displays information about the trunk interfaces on S2 and S3. You will learn more about DTP later in the course.

```
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
GigabitEthernet0/1 (1), with S1 GigabitEthernet0/1 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
GigabitEthernet0/1 (1), with S1 GigabitEthernet0/1 (99).

S2#
S2#
S2#show interface tru
S2#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      auto         n-802.1q       trunking      1

Port        Vlans allowed on trunk
Gig0/1      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,10,20,30,88,99

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      10,20,30,88

S2#
```

```
GigabitEthernet0/2 (1), with S1 GigabitEthernet0/2 (99).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
GigabitEthernet0/2 (1), with S1 GigabitEthernet0/2 (99).

S3#show interface turnk
                     ^
% Invalid input detected at '^' marker.

S3#show interface trun
S3#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/2      auto         n-802.1q       trunking      1

Port        Vlans allowed on trunk
Gig0/2      1-1005

Port        Vlans allowed and active in management domain
Gig0/2      1,10,20,30,88,99

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/2      10,20,30,88

S3#
```

Question:

Which active VLANs are allowed to cross the trunk?

Answer - 1,10,20,30,88,99

3.6.4.1.5.2.3 Step 3: Correct the native VLAN mismatch on S2 and S3.

a. Configure VLAN 99 as the native VLAN for the appropriate interfaces on S2 and S3.

```
S2#config te
S2#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#interface g0/1
S2(config-if)#switchport mode trunk
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
GigabitEthernet0/1 (1), with S1 GigabitEthernet0/1 (99).

S2(config-if)#switchport trunk native vlan 99
S2(config-if)#%SPANTREE-2-UNBLOCK_CONSIST_PORT: Unblocking GigabitEthernet0/1
on VLAN0099. Port consistency restored.

%SPANTREE-2-UNBLOCK_CONSIST_PORT: Unblocking GigabitEthernet0/1 on VLAN0001.
Port consistency restored.


S2(config-if)#
```

```
S3#con
S3#confi
S3#configure ter
S3#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#interface g0/2
S3(config-if)#switchport mode trunk
S3(config-if)#switchport trunk native vlan 99
S3(config-if)#
S3(config-if)#%SPANTREE-2-UNBLOCK_CONSIST_PORT: Unblocking
GigabitEthernet0/2 on VLAN0099. Port consistency restored.

%SPANTREE-2-UNBLOCK_CONSIST_PORT: Unblocking GigabitEthernet0/2 on
VLAN0001. Port consistency restored.


S3(config-if)#
```

b. Issue **show interface trunk** command to verify the correct native VLAN configuration.

```
S2(config-if)#
S2(config-if)#end
S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      on           802.1q         trunking      99

Port        Vlans allowed on trunk
Gig0/1      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,10,20,30,88,99

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,10,20,30,88,99

S2#
```

```
S3(config-if)#
S3(config-if)#end
S3#
%SYS-5-CONFIG_I: Configured from console by console

S3#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/2      on           802.1q         trunking      99

Port        Vlans allowed on trunk
Gig0/2      1-1005

Port        Vlans allowed and active in management domain
Gig0/2      1,10,20,30,88,99

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/2      1,10,20,30,88,99

S3#
```

3.6.4.1.5.2.4 Step 4: Verify configurations on S2 and S3.

a. Issue the **show interface** *interface* **switchport** command to verify that the native VLAN is now 99.

```
S2#
S2#
S2#show interface g0/1 switchport
Name: Gig0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 99 (Native)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

IOS Command Line Interface

```
S3#show interface g0/2 switchport
Name: Gig0/2
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 99 (Native)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

b. Use the **show vlan** command to display information regarding configured VLANs.

```
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
10   Faculty/Staff                    active
20   Students                         active
30   Guest(Default)                   active
88   Management                       active
99   Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
88   enet  100088     1500  -      -      -        -    -        0      0
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
```

```
S2#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, 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, Gig0/2
10   Faculty/Staff                    active    Fa0/11
20   Students                         active    Fa0/18
30   Guest(Default)                   active    Fa0/6
88   Management                       active
99   Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
88   enet  100088     1500  -      -      -        -    -        0      0
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
```

IOS Command

```
S3#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, 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, Gig0/1
10   Faculty/Staff                    active    Fa0/11
20   Students                         active    Fa0/18
30   Guest(Default)                   active    Fa0/6
88   Management                       active
99   Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
88   enet  100088     1500  -      -      -        -    -        0      0
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
```

Question:

Why is port G0/1 on S2 no longer assigned to VLAN 1?

Answer - Port G0/1 is a trunk port and trunks ports are not displayed.

3.6.4.1.6 Scripts

Switch S1

```
interface range g0/1 – 2
switchport mode trunk
switchport trunk native vlan 99
```

Switch S2

interface range g0/1 – 2
switchport mode trunk
switchport trunk native vlan 99

Switch S3

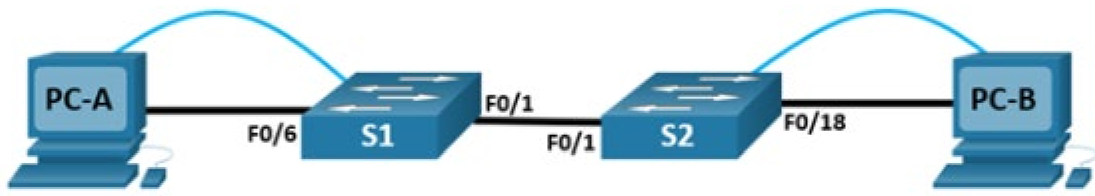
interface range g0/1 – 2

```
switchport mode trunk
switchport trunk native vlan 99
```

show vlan

3.6.4.2 Exercise 3.4.6 Lab - Configure VLANs and Trunking

3.6.4.2.1 Topology



3.6.4.2.2 Addressing

Device	Interface	IP Address	Subnet Mask	Default Gateway
S1	VLAN 1	192.168.1.11	255.255.255.0	N/A
S2	VLAN 1	192.168.1.12	255.255.255.0	N/A
PC-A	NIC	192.168.10.3	255.255.255.0	192.168.10.1
PC-B	NIC	192.168.10.4	255.255.255.0	192.168.10.1

3.6.4.2.3 Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Create VLANs and Assign Switch Ports

Part 3: Maintain VLAN Port Assignments and the VLAN Database

Part 4: Configure an 802.1Q Trunk Between the Switches

3.6.4.2.4 Background / Scenario

Modern switches use virtual local-area networks (VLANs) to improve network performance by separating large Layer 2 broadcast domains into smaller ones. VLANs can also be used as a security measure by controlling which hosts can communicate. In general, VLANs make it easier to design a network to support the goals of an organization.

VLAN trunks are used to span VLANs across multiple devices. Trunks allow the traffic from multiple VLANS to travel over a single link, while keeping the VLAN identification and segmentation intact.

In this Packet Tracer Physical Mode (PTPM) activity, you will create VLANs on both switches in the topology, assign VLANs to switch access ports, and verify that VLANs are working as expected. You will then create a VLAN trunk between the two switches to allow hosts in the same VLAN to communicate through the trunk, regardless of which switch to which the host is attached.

3.6.4.2.5 Instructions

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

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

3.6.4.2.5.1.1 Step 1: Build the network as shown in the topology.

Attach the devices as shown in the topology diagram, and cable as necessary.

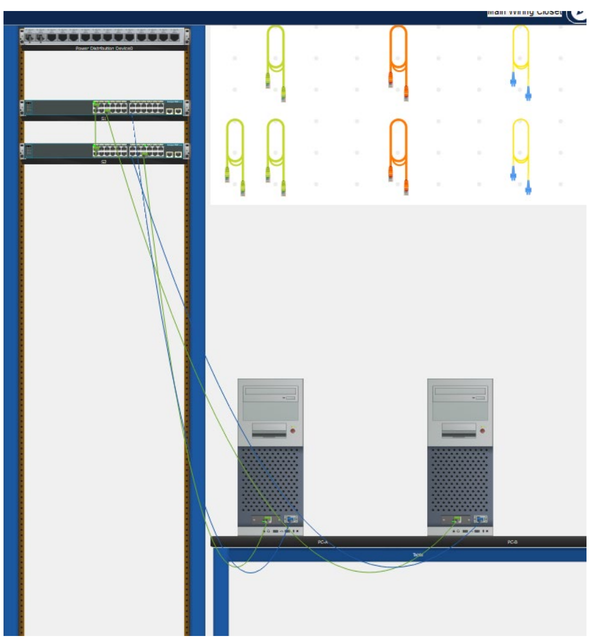
a. Click and drag both switch **S1** and **S2** to the **Rack**.

Note: This activity will open with 37% completion because the switch ports are all shutdown. When you install the switches in the rack, the ports will automatically be activated. After about a minute, the score will drop to 1%. Later in the activity, you will shut down unused ports.

b. Click and drag both **PC-A** and **PC-B** to the **Table** and use the power button to turn them on.

c. Provide network connectivity by connecting **Copper Straight-through** cables, as shown in the topology.

d. Connect **Console Cable** from device **PC-A** to **S1** and from device **PC-B** to **S2**.



3.6.4.2.5.1.2 Step 2: Configure basic settings for each switch.

a. From the **Desktop Tab** on each PC, use the **Terminal** to console into each switch and enable privileged EXEC mode.

Open configuration window

b. Enter configuration mode.

c. Assign a device name to each switch.

d. Assign **class** as the privileged EXEC encrypted password.

e. Assign **cisco** as the console password and enable login.

f. Assign **cisco** as the vty password and enable login.

g. Encrypt the plaintext passwords.

h. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

i. Configure the IP address listed in the Addressing Table for VLAN 1 on the switch.

Note: The VLAN 1 address is not grade because you will remove it later in the activity. However, you will need VLAN 1 to test connectivity later in this Part.

j. Shut down all interfaces that will not be used.

k. Set the clock on each switch.

Note: The clock setting cannot be graded in Packet Tracer.

```
Switch>enable
Switch#
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S1
S1(config)#enable secret class
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)#service password-encryption
S1(config)#banner motd $ Authorized Users Only! $
S1(config)#interface vlan 1
S1(config-if)#ip address 192.168.1.11 255.255.255.0
S1(config-if)#no shutdown

S1(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up

S1(config-if)#exit
S1(config)#interface range f0/2-5, f0/7-24, g0/1-2
S1(config-if-range)#shutdown

%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/4, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/5, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/7, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/8, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/9, changed state to administratively down
```

…

```
%LINK-5-CHANGED: Interface FastEthernet0/24, changed state to administratively down

%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to administratively down

%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down
S1(config-if-range)#exit
S1(config)#exit
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#clock set 02:20:00 5 February 2025
S1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
S1#
```

S2

```
Switch>enable
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S2
S2(config)#enable secret class
S2(config)#line console 0
S2(config-line)#password cisco
S2(config-line)#loin
                   ^
% Invalid input detected at '^' marker.

S2(config-line)#login
S2(config-line)#line vty 0 15
S2(config-line)#password cisco
S2(config-line)#login
S2(config-line)#service password-encryption
S2(config)#banner motd $ Authorized Users Only! $
S2(config)#interface vlan 1
S2(config-if)#ip address 192.168.1.12 255.255.255.0
S2(config-if)#no shutdown

S2(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up

S2(config-if)#exit
S2(config)#interface range f0/2-17, f0/19-24, g0/1-2
S2(config-if-range)#shutdown

%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/4, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/5, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to administratively down
```

```
%LINK-5-CHANGED: Interface FastEthernet0/23, changed state to administratively down

%LINK-5-CHANGED: Interface FastEthernet0/24, changed state to administratively down

%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to administratively down

%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down
S2(config-if-range)#exit
S2(config)#clock set 02:20:00 5 February 2025
                 ^
% Invalid input detected at '^' marker.

S2(config)#exit
S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#clock set 02:20:00 5 February 2025
S2#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

l. Save the running configuration to the startup configuration file.

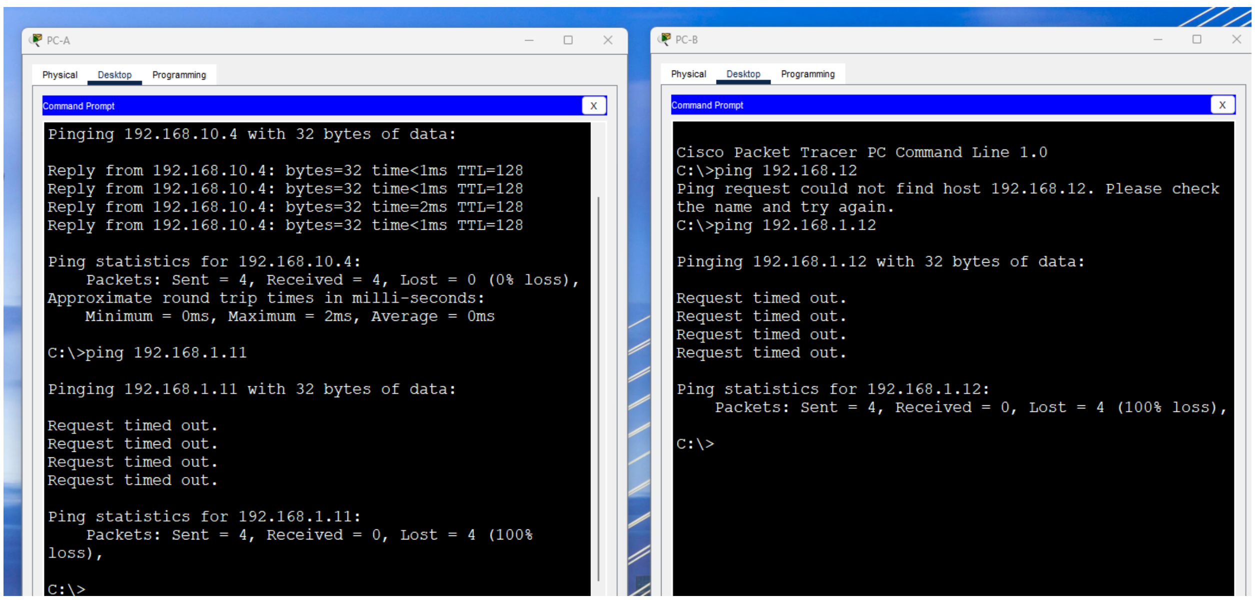
Close configuration window

3.6.4.2.5.1.3 Step 3: Configure PC hosts.

From the **Desktop** tab on each **PC**, click IP Configuration and enter the addressing information as displayed in the Addressing Table.

3.6.4.2.5.1.4 Step 4: Test connectivity.

Test network connectivity by attempting to ping between each of the cabled devices.



Questions:

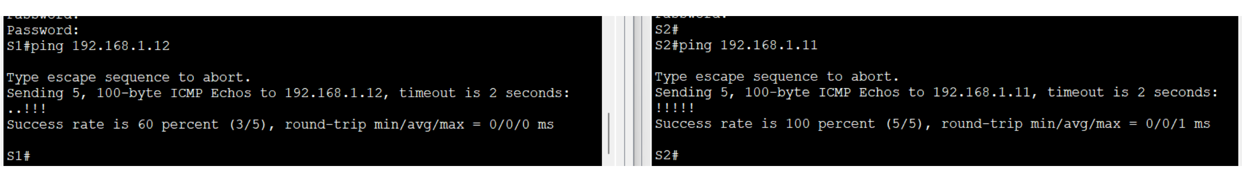
Can PC-A ping PC-B? YEs

Can PC-A ping S1? No

Can PC-B ping S2? No

Open configuration window

Can S1 ping S2? Yes



If you answered no to any of the above questions, why were the pings unsuccessful?

Answer - Pings were unsuccessful when trying to ping a device on a different subnet. For those pings to be successful, a default gateway must exist to route traffic from one subnet to another.

Close configuration window

3.6.4.2.5.2 Part 2: Create VLANs and Assign Switch Ports

In Part 2, you will create Management, Operations, Parking_Lot, and Native VLANs on both switches. You will then assign the VLANs to the appropriate interface. The **show vlan** command is used to verify your configuration settings.

3.6.4.2.5.2.1 Step 1: Create VLANs on the switches.

From the **Desktop Tab** on each **PC**, use Terminal to continue configuring both network switches.

Open configuration window

a. Create the VLANs on **S1**.

S1(config)# **vlan 10**

S1(config-vlan)# **name Operations**

S1(config-vlan)# **vlan 20**

S1(config-vlan)# **name Parking_Lot**

S1(config-vlan)# **vlan 99**

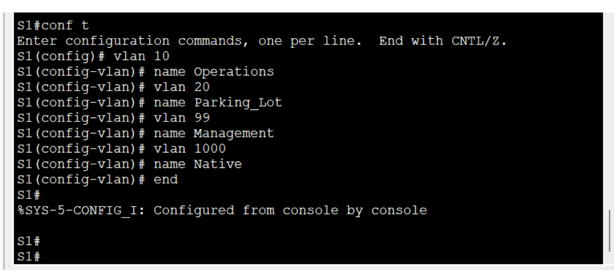
S1(config-vlan)# **name Management**

S1(config-vlan)# **vlan 1000**

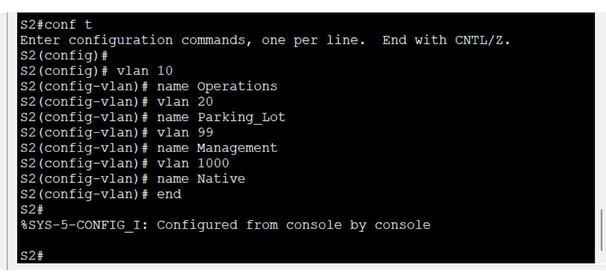
S1(config-vlan)# **name Native**

S1(config-vlan)# **end**

b. Create the same VLANs on S2.

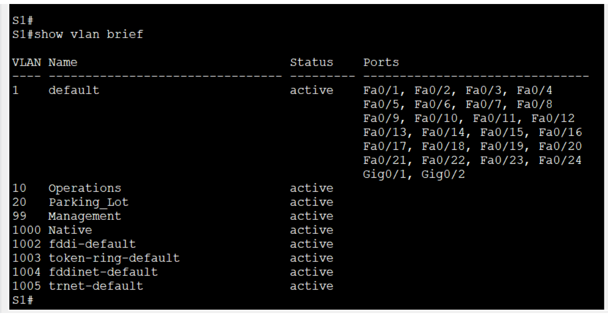


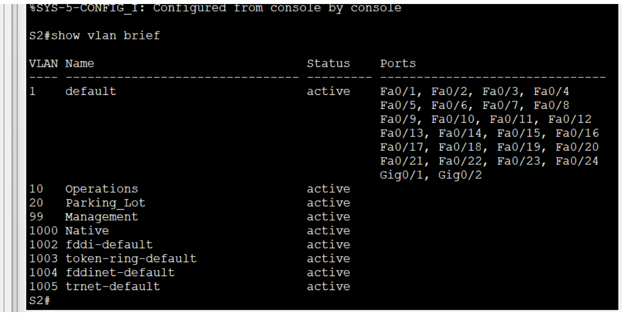
```
S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)# vlan 10
S1(config-vlan)# name Operations
S1(config-vlan)# vlan 20
S1(config-vlan)# name Parking_Lot
S1(config-vlan)# vlan 99
S1(config-vlan)# name Management
S1(config-vlan)# vlan 1000
S1(config-vlan)# name Native
S1(config-vlan)# end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#
S1#
```



```
S2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#
S2(config)# vlan 10
S2(config-vlan)# name Operations
S2(config-vlan)# vlan 20
S2(config-vlan)# name Parking_Lot
S2(config-vlan)# vlan 99
S2(config-vlan)# name Management
S2(config-vlan)# vlan 1000
S2(config-vlan)# name Native
S2(config-vlan)# end
S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#
```

c. Issue the **show vlan brief** command to view the list of VLANs on **S1**.





S1# **show vlan brief**

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

Gi0/1, Gi0/2

10 Operations active

20 Parking_Lot active

99 Management active

1000 Native active

1002 fddi-default active

1003 token-ring-default active

1004 fddinet-default active

1005 trnet-default active

Questions:

What is the default VLAN? Answer VLAN 1

What ports are assigned to the default VLAN? Answer All switch ports are assigned to VLAN 1 by default.

3.6.4.2.5.2.2 Step 2: Assign VLANs to the correct switch interfaces.

a. Assign VLANs to the interfaces on **S1**.

1) Assign PC-A to the Operation VLAN.

S1(config)# **interface f0/6**

S1(config-if)# **switchport mode access**

S1(config-if)# **switchport access vlan 10**

2) From VLAN 1, remove the management IP address and configure it on VLAN 99.

S1(config)# **interface vlan 1**

S1(config-if)# **no ip address**

S1(config-if)# **interface vlan 99**

S1(config-if)# **ip address 192.168.1.11 255.255.255.0**

S1(config-if)# **end**

```
S1#config
Configuring from terminal, memory, or network [terminal]? t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface f0/6
S1(config-if)#switchport mode access
S1(config-if)#switchport access vlan 10
S1(config-if)#
S1(config-if)#interface vlan 1
S1(config-if)#no ip address
S1(config-if)#interface vlan 99
S1(config-if)#ip address 192.168.1.11 255.255.255.0
S1(config-if)#end
%LINK-5-CHANGED: Interface Vlan99, changed state to up

S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#
```

b. Issue the **show vlan brief** command and verify that the VLANs are assigned to the correct interfaces.

```
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, 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
10   Operations                       active    Fa0/6
20   Parking_Lot                      active
99   Management                       active
1000 Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
```

c. Issue the **show ip interface brief** command.

```
S1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/1        unassigned      YES manual up                    up
FastEthernet0/2        unassigned      YES manual administratively down down
FastEthernet0/3        unassigned      YES manual administratively down down
FastEthernet0/4        unassigned      YES manual administratively down down
FastEthernet0/5        unassigned      YES manual administratively down down
FastEthernet0/6        unassigned      YES manual up                    up
FastEthernet0/7        unassigned      YES manual administratively down down
FastEthernet0/8        unassigned      YES manual administratively down down
FastEthernet0/9        unassigned      YES manual administratively down down
FastEthernet0/10       unassigned      YES manual administratively down down
FastEthernet0/11       unassigned      YES manual administratively down down
FastEthernet0/12       unassigned      YES manual administratively down down
FastEthernet0/13       unassigned      YES manual administratively down down
FastEthernet0/14       unassigned      YES manual administratively down down
FastEthernet0/15       unassigned      YES manual administratively down down
FastEthernet0/16       unassigned      YES manual administratively down down
FastEthernet0/17       unassigned      YES manual administratively down down
FastEthernet0/18       unassigned      YES manual administratively down down
FastEthernet0/19       unassigned      YES manual administratively down down
FastEthernet0/20       unassigned      YES manual administratively down down
FastEthernet0/21       unassigned      YES manual administratively down down
FastEthernet0/22       unassigned      YES manual administratively down down
FastEthernet0/23       unassigned      YES manual administratively down down
FastEthernet0/24       unassigned      YES manual administratively down down
GigabitEthernet0/1     unassigned      YES manual administratively down down
GigabitEthernet0/2     unassigned      YES manual administratively down down
Vlan1                  unassigned      YES manual up                    up
Vlan99                 192.168.1.11    YES manual up                    down
S1#
```

Question:

What is the status of VLAN 99? Explain.

Answer - The status of VLAN 99 is up/down, up because the VLAN exists in the database but down because the VLAN has not been assigned to an active port yet.

d. Assign **PC-B** to the Operations VLAN on **S2**.

e. From VLAN 1, remove the management IP address and configure it on VLAN 99 according to the Addressing Table .

```
S2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#
S2(config)#interface f0/18
S2(config-if)#switchport mode access
S2(config-if)#switchport access vlan 10
S2(config-if)#
S2(config-if)#interface vlan 1
S2(config-if)#no ip address
S2(config-if)#interface vlan 99
S2(config-if)#ip address 192.168.1.12 255.255.255.0
%LINK-5-CHANGED: Interface Vlan99, changed state to up

S2(config-if)#
S2(config-if)#end
S2#
```

f. Use the **show vlan brief** command to verify that the VLANs are assigned to the correct interfaces.

```
S2#show vlan brief

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, Fa0/19, Fa0/20, Fa0/21
                                                Fa0/22, Fa0/23, Fa0/24, Gig0/1
                                                Gig0/2
10   Operations                       active    Fa0/18
20   Parking_Lot                      active
99   Management                       active
1000 Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S2#
S2#
```

Questions:

Is S1 able to ping S2? Explain.

Answer - No. The IP addresses for the switches now reside in VLAN 99. VLAN 99 traffic will not be sent over interface F0/1.

```
S1#ping 192.168.1.12

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.12, timeout
is 2 seconds:
.....
Success rate is 0 percent (0/5)

S1#
```

Close configuration window

Is PC-A able to ping PC-B? Explain.

Answer – No. Interface F0/1 is not assigned to VLAN 10, so VLAN 10 traffic will not be sent over it.

```
C:\>ping 192.168.10.4

Pinging 192.168.10.4 with 32 bytes of data:

Request timed out.
```

3.6.4.2.5.3 Part 3: Maintain VLAN Port Assignments and the VLAN Database

In Part 3, you will change port VLAN assignments and remove VLANs from the VLAN database.

3.6.4.2.5.3.1 Step 1: Assign a VLAN to multiple interfaces.

From the **Desktop Tab** on each **PC**, use **Terminal** to continue configuring both network switches.

Open configuration window

a. On S1, assign interfaces F0/11 – 24 to VLAN99.

S1(config)# **interface range f0/11-24**

S1(config-if-range)# **switchport mode access**

S1(config-if-range)# **switchport access vlan 99**

S1(config-if-range)# **end**

b. Issue the **show vlan brief** command to verify VLAN assignments.

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface range f0/11-24
S1(config-if-range)#switchport mode access
S1(config-if-range)#switchport access vlan 99
S1(config-if-range)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, Gig0/1, Gig0/2
10   Operations                       active    Fa0/6
20   Parking_Lot                      active
99   Management                       active    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
1000 Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

c. Reassign F0/11 and F0/21 to VLAN 10.

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface range f0/11, f0/21
S1(config-if-range)#switchport access vlan 10
S1(config-if-range)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console
```

d. Verify that VLAN assignments are correct.

```
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, Gig0/1, Gig0/2
10   Operations                       active    Fa0/6, Fa0/11, Fa0/21
20   Parking_Lot                      active
99   Management                       active    Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                                Fa0/20, Fa0/22, Fa0/23, Fa0/24
1000 Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
S1#
```

3.6.4.2.5.3.2 Step 2: Remove a VLAN assignment from an interface.

a. Use the **no switchport access vlan** command to remove the VLAN 99 assignment to F0/24.

S1(config)# **interface f0/24**

S1(config-if)# **no switchport access vlan**

S1(config-if)# **end**

b. Verify that the VLAN change was made.

Question:

Which VLAN is F0/24 now associated with?

Answer - VLAN 1, the default VLAN**.**

Step 3: Remove a VLAN ID from the VLAN database.

a. Add VLAN 30 to interface F0/24 without issuing the global VLAN command.

S1(config)# **interface f0/24**

S1(config-if)# **switchport access vlan 30**

% Access VLAN does not exist. Creating vlan 30

Note: Current switch technology no longer requires that the **vlan** command be issued to add a VLAN to the database. By assigning an unknown VLAN to a port, the VLAN will be created and added to the VLAN database.

b. Verify that the new VLAN is displayed in the VLAN table.

Question:

What is the default name of VLAN 30?

c. Use the **no vlan 30** command to remove VLAN 30 from the VLAN database.

S1(config)# **no vlan 30**

S1(config)# **end**

d. Issue the **show vlan brief** command. F0/24 was assigned to VLAN 30.

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface f0/24
S1(config-if)#no switchport access vlan
S1(config-if)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface f0/24
S1(config-if)#switchport access vlan 30
% Access VLAN does not exist. Creating vlan 30
S1(config-if)#no vlan 30
S1(config)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, Gig0/1, Gig0/2
10   Operations                       active    Fa0/6, Fa0/11, Fa0/21
20   Parking_Lot                      active
99   Management                       active    Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                                Fa0/20, Fa0/22, Fa0/23
1000 Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

Question:

After deleting VLAN 30 from the VLAN database, why is F0/24 no longer displayed in the output of the **show vlan brief** command? What VLAN is port F0/24 now assigned to? What happens to the traffic destined to the host that is attached to F0/24?

Answer - When you delete a VLAN, any ports assigned to that VLAN become inactive. Port F0/24 is still associated to VLAN 30 but is no longer shown in the output. VLAN 30 is now inactive because it does not exist in the VLAN database. Any port associated with VLAN 30 will not transfer any traffic.

e. On interface F0/24, issue the **no switchport access vlan** command.

f. Issue the **show vlan brief** command to determine the VLAN assignment for F0/24.

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface f0/24
S1(config-if)#no switchport access vlan
S1(config-if)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console
shwo vlan brief
        ^
% Invalid input detected at '^' marker.

S1#show vlan brie
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, Fa0/24, Gig0/1, Gig0/2
10   Operations                       active    Fa0/6, Fa0/11, Fa0/21
20   Parking_Lot                      active
99   Management                       active    Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                                Fa0/20, Fa0/22, Fa0/23

1000 Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

Questions:

To which VLAN is F0/24 assigned?

Answer – Vlan 1 default Vlan

Note: Before removing a VLAN from the database, it is recommended that you reassign all the ports assigned to that VLAN.

Why should you reassign a port to another VLAN before removing the VLAN from the VLAN database?

Answer - The interfaces assigned to a VLAN that is the removed from the VLAN database become inactive and are unavailable for use until they are reassigned to another VLAN. This can be a tricky thing to troubleshoot as trunked interfaces do not show up in the port list as we

Close configuration window

3.6.4.2.5.4 Part 4: Configure an 802.1Q Trunk Between the Switches

In Part 4, you will configure interface F0/1 to use the Dynamic Trunking Protocol (DTP) to allow it to negotiate the trunk mode. After this has been accomplished and verified, you will disable DTP on interface F0/1 and manually configure it as a trunk.

3.6.4.2.5.4.1 Step 1: Use DTP to initiate trunking on F0/1.

The default DTP mode of a 2960 switch port is dynamic auto. This allows the interface to convert the link to a trunk if the neighboring interface is set to trunk or dynamic desirable mode.

Open configuration window

a. On **S1**, set F0/1 to negotiate trunk mode.

S1(config)# **interface f0/1**

S1(config-if)# **switchport mode dynamic desirable**

Sep 19 02:51:47.257: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

Sep 19 02:51:47.291: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up

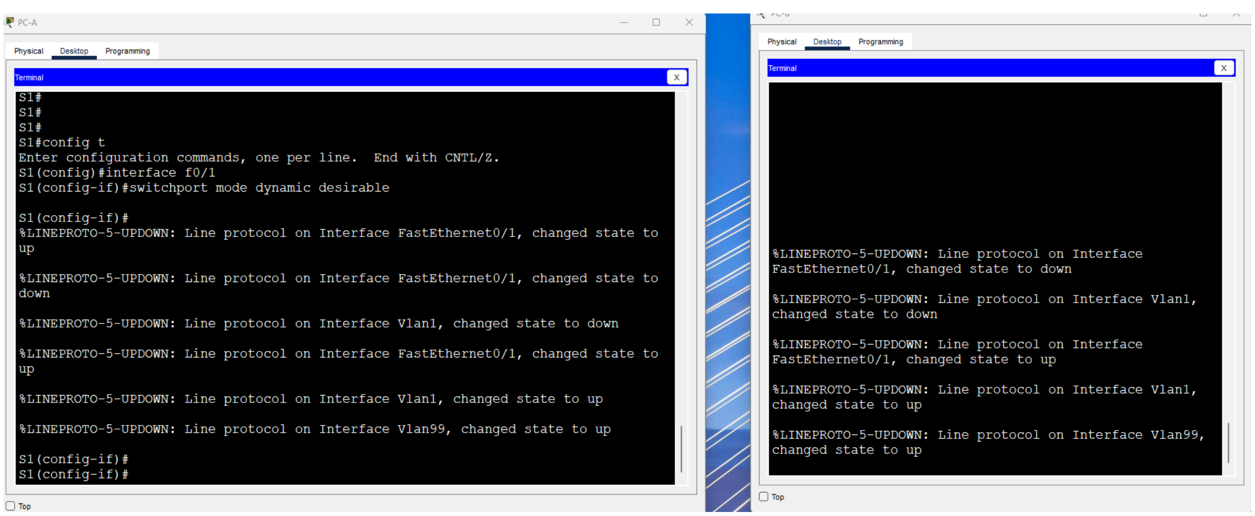
You should also receive link status messages on S2.

S2#

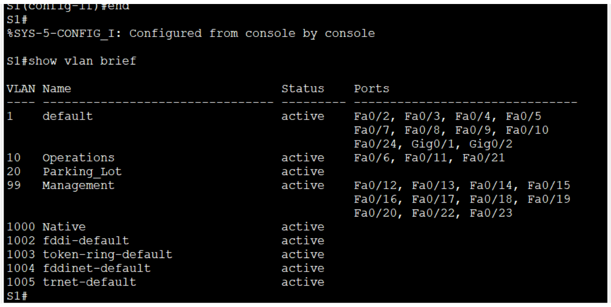
Sep 19 02:42:19.424: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up

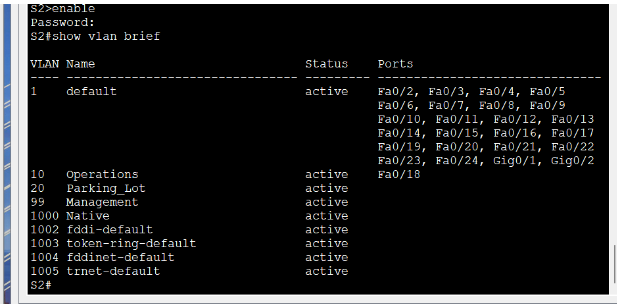
Sep 19 02:42:21.454: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up

Sep 19 02:42:22.419: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up



b. On **S1** and **S2**, issue the **show vlan brief** command. Interface F0/1 is no longer assigned to VLAN 1. Trunked interfaces are not listed in the VLAN table.

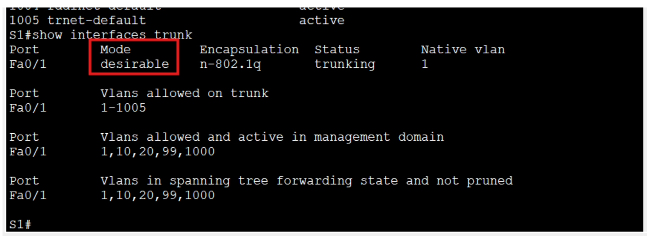


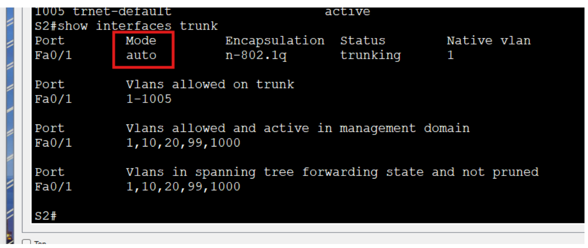


c. Issue the **show interfaces trunk** command to view trunked interfaces. Notice that the mode on **S1** is set to desirable, and the mode on **S2** is set to auto.

S1# **show interfaces trunk**

S2# **show interfaces trunk**





Note: By default, all VLANs are allowed on a trunk. The **switchport trunk** command allows you to control what VLANs have access to the trunk. For this activity, keep the default settings. This allows all VLANs to traverse F0/1.

Close configuration window

d. Verify that VLAN traffic is traveling over trunk interface F0/1.

Questions:

Can S1 ping S2? yes

Can PC-A ping PC-B? yes

Can PC-A ping S1? No

Can PC-B ping S2? No

If you answered no to any of the above questions, explain below.

Answer The switches are in VLAN 99 and the PCs are in VLAN 10; therefore, the pings between VLANs were unsuccessful.

3.6.4.2.5.4.2 Step 2: Manually configure trunk interface F0/1.

The **switchport mode trunk** command is used to manually configure a port as a trunk. This command should be issued on both ends of the link.

a. On interface F0/1, change the switchport mode to force trunking. Make sure to do this on both switches.

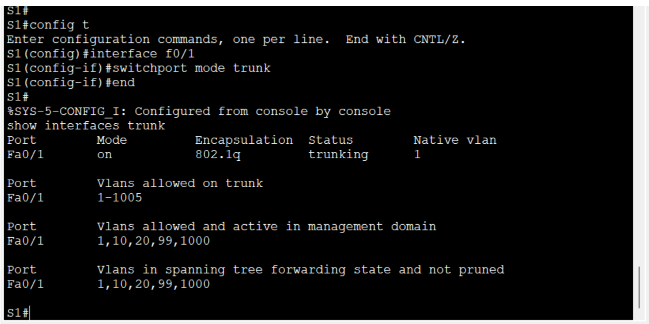
Open configuration window

S1(config)# **interface f0/1**

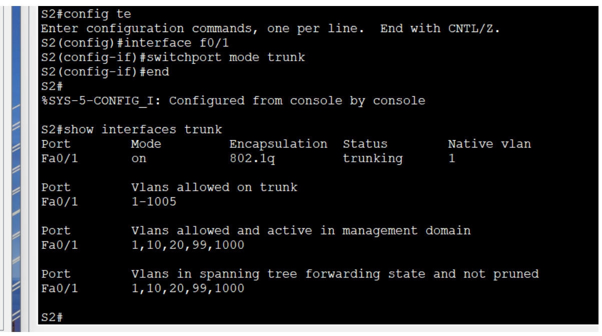
S1(config-if)# **switchport mode trunk**

b. Issue the **show interfaces trunk** command to view the trunk mode. Notice that the mode changed from **desirable** to **on**.

S1# **show interfaces trunk**



```
S1#
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface f0/1
S1(config-if)#switchport mode trunk
S1(config-if)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console
show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/1       1-1005

Port        Vlans allowed and active in management domain
Fa0/1       1,10,20,99,1000

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       1,10,20,99,1000

S1#
```



```
S2#config te
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#interface f0/1
S2(config-if)#switchport mode trunk
S2(config-if)#end
S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/1       1-1005

Port        Vlans allowed and active in management domain
Fa0/1       1,10,20,99,1000

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       1,10,20,99,1000

S2#
```

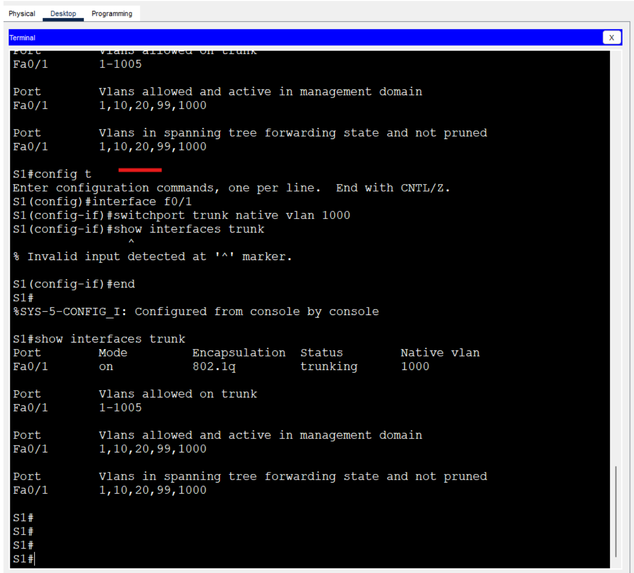
c. Modify the trunk configuration on both switches by changing the native VLAN from VLAN 1 to VLAN 1000.

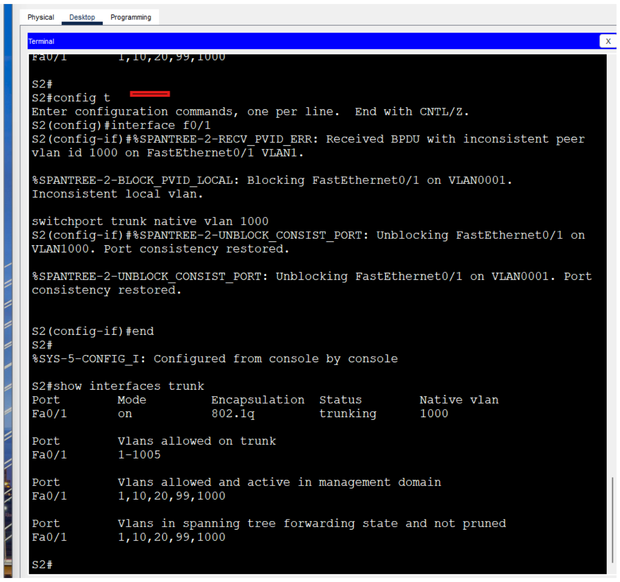
S1(config)# **interface f0/1**

S1(config-if)# **switchport trunk native vlan 1000**

d. Issue the **show interfaces trunk** command to view the trunk. Notice the Native VLAN information is updated.

S2# **show interfaces trunk**





Questions:

Why might you want to manually configure an interface to trunk mode instead of using DTP?

Answer = Not all equipment uses DTP. DTP is Cisco proprietary and using the switchport mode trunk command ensures that the port will become a trunk no matter what type of equipment is connected to the other end of the link.

Why might you want to change the native VLAN on a trunk?

Answer Using VLAN 1, the default VLAN, as the native VLAN is a security risk. All the different control protocols that are exchanged between switches are exchanged via the native VLAN 1 untagged, and that information could be exposed if default settings are used on ports that users connect to.

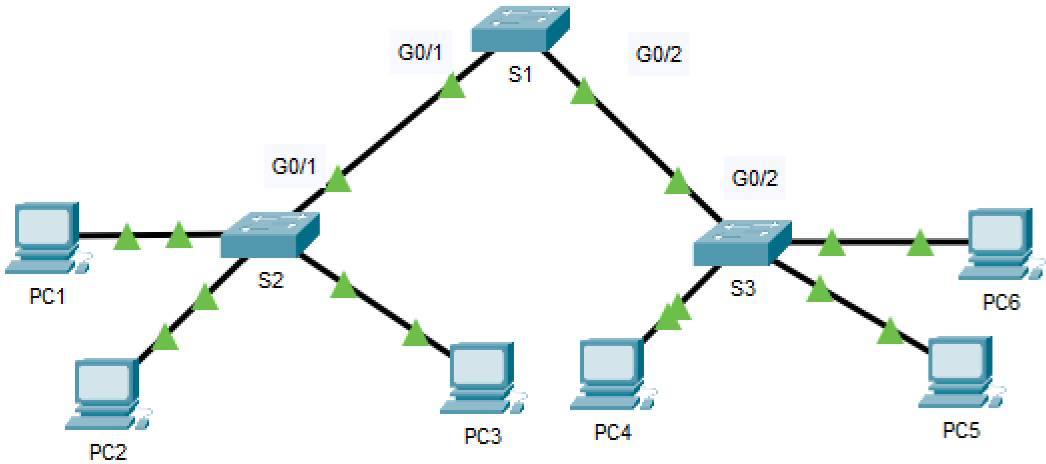
Reflection Questions

1. **What is needed to allow hosts on VLAN 10 to communicate to hosts on VLAN 99?**
   To allow Inter-VLAN routing requires a Layer 3 device is needed to route traffic between VLANs.
2. **What are some primary benefits that an organization can receive through effective use of VLANs?**
   VLAN benefits include better security, cost savings (efficient use of bandwidth and uplinks), higher performance (smaller broadcast domains), broadcast storm mitigation, improved IT staff efficiency, simpler project and application management.

3.6.5 Section 3.5. Dynamic Trunking Protocol

3.6.5.1Exercise 3.5.5 Packet Tracer - Configure DTP

3.6.5.1.1 Topology



3.6.5.1.2 Addressing Table

Device	Interface	IP Address	Subnet Mask
PC1	NIC	192.168.10.1	255.255.255.0
PC2	NIC	192.168.20.1	255.255.255.0
PC3	NIC	192.168.30.1	255.255.255.0
PC4	NIC	192.168.30.2	255.255.255.0
PC5	NIC	192.168.20.2	255.255.255.0
PC6	NIC	192.168.10.2	255.255.255.0
S1	VLAN 99	192.168.99.1	255.255.255.0
S2	VLAN 99	192.168.99.2	255.255.255.0
S3	VLAN 99	192.168.99.3	255.255.255.0

3.6.5.1.3 Objectives

- Configure static trunking
- Configure and Verify DTP

3.6.5.1.4 Background / Scenario

As the number of switches in a network increases, the administration necessary to manage the VLANs and trunks can be challenging. To ease some of the VLAN and trunking configurations, trunk negotiation between network devices is managed by the Dynamic Trunking Protocol (DTP), and is automatically enabled on Catalyst 2960 and Catalyst 3650 switches.

In this activity, you will configure trunk links between the switches. You will assign ports to VLANs and verify end-to-end connectivity between hosts in the same VLAN. You will configure trunk links between the switches, and you will configure VLAN 999 as the native VLAN.

3.6.5.1.5 Instructions

3.6.5.1.5.1 Part 1: Verify VLAN configuration.

Verify the configured VLANs on the switches.

a. On S1, go to privileged EXEC mode and enter the **show vlan brief** command to verify the VLANs that are present.

Open configuration window

S1# **show vlan brief**

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

99 Management active

999 Native active

1002 fddi-default active

1003 token-ring-default active

1004 fddinet-default active

1005 trnet-default active

```
S1>
S1>enable
S1#show vlan brief

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
99   Management                       active
999  Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

b. Repeat Step 1a on S2 and S3.

```
S2>enable
S2#show vlan brief

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
99   Management                       active
999  Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S2#
```

```
S3>
S3>enable
S3#show vlan brief

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
99   Management                       active
999  Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S3#
```

Question:

What VLANs are configured on the switches?

Answer - VLANs 99 and 999 are configured on all the switches.

3.6.5.1.5.2 Part 2: Create additional VLANs on S2 and S3.

a. On S2, create VLAN 10 and name it Red.

S2(config)# **vlan 10**

S2(config-vlan)# **name Red**

b. Create VLANs 20 and 30 according to the table below.

VLAN Number	VLAN Name
10	Red
20	Blue
30	Yellow

```
1005 trnet-default                    active
S2#confi t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#vlan 10
S2(config-vlan)#name Red
S2(config-vlan)#vlan 20
S2(config-vlan)#name Blue
S2(config-vlan)#vlan 30
S2(config-vlan)#name Yellow
S2(config-vlan)#
```

c. Verify the addition of the new VLANs. Enter **show vlan brief** at the privileged EXEC mode.

```
S2#show vlan brief

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
10   Red                              active
20   Blue                             active
30   Yellow                           active
99   Management                       active
999  Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S2#
```

Question:

In addition to the default VLANs, which VLANs are configured on S2?

Answer - VLAN 10 (Red), VLAN 20 (Blue), VLAN 30 (Yellow), VLAN 99 (Management) and VLAN 999 (Native)

d. Repeat the previous steps to create the additional VLANs on S3.

```
S3#
S3#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#vlan 10
S3(config-vlan)#name Red
S3(config-vlan)#vlan 20
S3(config-vlan)#name Blue
S3(config-vlan)#vlan 30
S3(config-vlan)#name Yellow
S3(config-vlan)#end
S3#
%SYS-5-CONFIG_I: Configured from console by console
```

```
S3#show vlan brief

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
10   Red                              active
20   Blue                             active
30   Yellow                           active
99   Management                       active
999  Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S3#
```

3.6.5.1.5.3 Part 3: Assign VLANs to Ports

Use the **switchport mode access** command to set access mode for the access links. Use the **switchport access vlan** *vlan-id* command to assign a VLAN to an access port.

Ports	Assignments	Network
S2 F0/1 – 8 S3 F0/1 – 8	VLAN 10 (Red)	192.168.10.0 /24
S2 F0/9 – 16 S3 F0/9 – 16	VLAN 20 (Blue)	192.168.20.0 /24
S2 F0/17 – 24 S3 F0/17 – 24	VLAN 30 (Yellow)	192.168.30.0 /24

a. Assign VLANs to ports on S2 using assignments from the table above.

S2(config-if)# **interface range f0/1 - 8**

S2(config-if-range)# **switchport mode access**

S2(config-if-range)# **switchport access vlan 10**

S2(config-if-range)# **interface range f0/9 -16**

S2(config-if-range)# **switchport mode access**

S2(config-if-range)# **switchport access vlan 20**

S2(config-if-range)# **interface range f0/17 - 24**

S2(config-if-range)# **switchport mode access**

S2(config-if-range)# **switchport access vlan 30**

```
S2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#interface range f0/1 - 8
S2(config-if-range)# switchport mode access
S2(config-if-range)# switchport access vlan 10
S2(config-if-range)# interface range f0/9 -16
S2(config-if-range)# switchport mode access
S2(config-if-range)# switchport access vlan 20
S2(config-if-range)# interface range f0/17 - 24
S2(config-if-range)# switchport mode access
S2(config-if-range)# switchport access vlan 30
S2(config-if-range)#
```

b. Assign VLANs to ports on S3 using the assignments from the table above.

```
S3#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#interface range f0/1 - 8
S3(config-if-range)# switchport mode access
S3(config-if-range)# switchport access vlan 10
S3(config-if-range)# interface range f0/9 -16
S3(config-if-range)# switchport mode access
S3(config-if-range)# switchport access vlan 20
S3(config-if-range)# interface range f0/17 - 24
S3(config-if-range)# switchport mode access
S3(config-if-range)# switchport access vlan 30
S3(config-if-range)#
```

Now that you have the ports assigned to VLANs, try to ping from **PC1** to **PC6**.

Question:

Was the ping successful? Explain.

Answer - No, the pings failed because the ports between the switches are in VLAN 1 and PC1 and PC6 are in VLAN 10.

3.6.5.1.5.4 Part 4: Configure Trunks on S1, S2, and S3.

Dynamic trunking protocol (DTP) manages the trunk links between Cisco switches. Currently, all the switchports are in the default trunking mode, which is dynamic auto. In this step, you will change the trunking mode to dynamic desirable for the link between switches S1 and S2. The link between switches S1 and S3 will be set as a static trunk. Use VLAN 999 as the native VLAN in this topology.

a. On switch S1, configure the trunk link to dynamic desirable on the GigabitEthernet 0/1 interface. The configuration of S1 is shown below.

S1(config)# **interface g0/1**

S1(config-if)# **switchport mode dynamic desirable**

```
S1>enable
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface g0/1
S1(config-if)#switchport mode dynamic desirable

S1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to dov

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up
```

Question:

What will be the result of trunk negotiation between S1 and S2?

Answer - Trunk link has been established between S1 and S2

b. On switch S2, verify that the trunk has been negotiated by entering the **show interfaces trunk** command. Interface GigabitEthernet 0/1 should appear in the output.

```
S2#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      auto         n-802.1q       trunking      1

Port        Vlans allowed on trunk
Gig0/1      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,10,20,30,99,999

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,10,20,30,99,999

S2#
```

Question:

What is the mode and status for this port?

Answer - Mode: Auto | Status: trunking

c. For the trunk link between S1 and S3, configure interface GigabitEthernet 0/2 as a static trunk link on S1. In addition, disable DTP negotiation on interface G0/2 on S1.

S1(config)# **interface g0/2**

S1(config-if)# **switchport mode trunk**

S1(config-if)# **switchport nonegotiate**

d. Use the **show dtp** command to verify the status of DTP.

S1# **show dtp**

Global DTP information

Sending DTP Hello packets every 30 seconds

Dynamic Trunk timeout is 300 seconds

1 interfaces using DTP

```
S1(config-if)#interface g0/2
S1(config-if)#switchport mode trunk

S1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

S1(config-if)#switchport nonegotiate
S1(config-if)#
S1(config-if)#show dtp
                ^
% Invalid input detected at '^' marker.

S1(config-if)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#show dtp
Global DTP information
    Sending DTP Hello packets every 30 seconds
    Dynamic Trunk timeout is 300 seconds
    2 interfaces using DTP
S1#
```

e. Verify trunking is enabled on all the switches using the **show interfaces trunk** command.

S1# **show interfaces trunk**

Port Mode Encapsulation Status Native vlan

Gig0/1 desirable n-802.1q trunking 1

Gig0/2 on 802.1q trunking 1

Port Vlans allowed on trunk

Gig0/1 1-1005

Gig0/2 1-1005

Port Vlans allowed and active in management domain

Gig0/1 1,99,999

Gig0/2 1,99,999

Port Vlans in spanning tree forwarding state and not pruned

Gig0/1 1,99,999

Gig0/2 1,99,999

```
    2 interfaces using DTP
S1#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      desirable    n-802.1q       trunking      1
Gig0/2      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Gig0/1      1-1005
Gig0/2      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,99,999
Gig0/2      1,99,999

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,99,999
Gig0/2      1,99,999

S1#
```

Question:

What is the native VLAN for these trunks currently?

Answer VLAN 1

f. Configure VLAN 999 as the native VLAN for the trunk links on S1.

S1(config)# **interface range g0/1 - 2**

S1(config-if-range)# **switchport trunk native vlan 999**

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface range g0/1 - 2
S1(config-if-range)#switchport trunk native vlan 999
S1(config-if-range)#%SPANTREE-2-RECV_PVID_ERR: Received BPDU with inconsistent peer vlan id 1 on GigabitEthernet0/1 VLAN999.

%SPANTREE-2-BLOCK_PVID_LOCAL: Blocking GigabitEthernet0/1 on VLAN0999. Inconsistent local vlan.


S1(config-if-range)#
S1(config-if-range)#
S1(config-if-range)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (999), with S2 GigabitEthernet0/1 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/2 (999), with S3 GigabitEthernet0/2 (1).
```

Question:

What messages did you receive on S1? How would you correct it?

Answer –

> *%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (999), with S2 GigabitEthernet0/1 (1).*
>
> *%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/2 (999), with S3 GigabitEthernet0/2 (1).*
>
> *%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (999), with S2 GigabitEthernet0/1 (1).*
>
> *%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/2 (999), with S3 GigabitEthernet0/2 (1).*

To correct native VLAN mismatch, configure VLAN 999 as the native VLAN on S2 and S3.

g. On S2 and S3, configure VLAN 999 as the native VLAN.

```
S2#
S2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#interface g0/1
S2(config-if)#switchport mode trunk
S2(config-if)#switchport trunk native vlan 999
S2(config-if)#
S2(config-if)#
```

```
S3>enable
S3#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#interface g0/2
S3(config-if)#switchport mode trunk

S3(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up
%SPANTREE-2-RECV_PVID_ERR: Received BPDU with inconsistent peer vlan id 999 on GigabitEthernet0/2 VLAN1.

%SPANTREE-2-BLOCK_PVID_LOCAL: Blocking GigabitEthernet0/2 on VLAN0001. Inconsistent local vlan.

switchport trunk native vlan 999
S3(config-if)#%SPANTREE-2-UNBLOCK_CONSIST_PORT: Unblocking GigabitEthernet0/2 on VLAN0999. Port consistency restored.

%SPANTREE-2-UNBLOCK_CONSIST_PORT: Unblocking GigabitEthernet0/2 on VLAN0001. Port consistency restored.


S3(config-if)#
S3(config-if)#
```

h. Verify trunking is successfully configured on all the switches. You should be able ping one switch from another switch in the topology using the IP addresses configured on the SVI.

i. Attempt to ping from PC1 to PC6.

Question:

Why was the ping unsuccessful?

The ping was unsuccessful because the VLAN on S1 was not set up correctly

(Hint: Look at the '**show vlan brief**' output from all three switches. Compare the outputs from the '**show interface trunk**' on all switches.)

```
S1#
S1#show vlan brief

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
99   Management                       active
999  Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
S1#
```

```
S1#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      desirable    n-802.1q       trunking      999
Gig0/2      on           802.1q         trunking      999

Port        Vlans allowed on trunk
Gig0/1      1-1005
Gig0/2      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,99,999
Gig0/2      1,99,999

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,99,999
Gig0/2      1,99,999

S1#
```

j. Correct the configuration as necessary.

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#vlan 10
S1(config-vlan)#name Red
S1(config-vlan)#vlan 20
S1(config-vlan)#name Blue
S1(config-vlan)#vlan 30
S1(config-vlan)#name Yellow
S1(config-vlan)#
```

```
S1#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      desirable    n-802.1q       trunking      999
Gig0/2      on           802.1q         trunking      999

Port        Vlans allowed on trunk
Gig0/1      1-1005
Gig0/2      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,10,20,30,99,999
Gig0/2      1,10,20,30,99,999

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,99,999
Gig0/2      1,99,999

S1#show vlan brief

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
10   Red                              active
20   Blue                             active
30   Yellow                           active
99   Management                       active
999  Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

```
C:\>ping 192.168.10.2

Pinging 192.168.10.2 with 32 bytes of data:

Reply from 192.168.10.2: bytes=32 time<1ms TTL=128
Reply from 192.168.10.2: bytes=32 time<1ms TTL=128
Reply from 192.168.10.2: bytes=32 time<1ms TTL=128
Reply from 192.168.10.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.10.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

3.6.5.1.5.5 Part 5: Reconfigure trunk on S3.

a. Issue the '**show interface trunk**' command on **S3**.

```
S3#
S3#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/2      on           802.1q         trunking      999

Port        Vlans allowed on trunk
Gig0/2      1-1005

Port        Vlans allowed and active in management domain
Gig0/2      1,10,20,30,99,999

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/2      1,10,20,30,99,999

S3#
```

Question:

What is the mode and encapsulation on G0/2?

Mode: on | Encapsulation: 802.1q

b. Configure **G0/2** to match **G0/2** on **S1**.

```
S3#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#interface g0/2
S3(config-if)#switchport nonegotiate
S3(config-if)#end
S3#
%SYS-5-CONFIG_I: Configured from console by console
show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/2      on           802.1q         trunking      999

Port        Vlans allowed on trunk
Gig0/2      1-1005

Port        Vlans allowed and active in management domain
Gig0/2      1,10,20,30,99,999

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/2      1,10,20,30,99,999

S3#
```

Question:

What is the mode and encapsulation on G0/2 after the change?

Mode: on | Encapsulation: 802.1q

c. Issue the command '**show interface G0/2 switchport**' on switch **S3**.

```
S3#show interfaces g0/2 switchport
Name: Gig0/2
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 999 (Native)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

Question:

What is the '**Negotiation of Trunking**' state displayed? Off

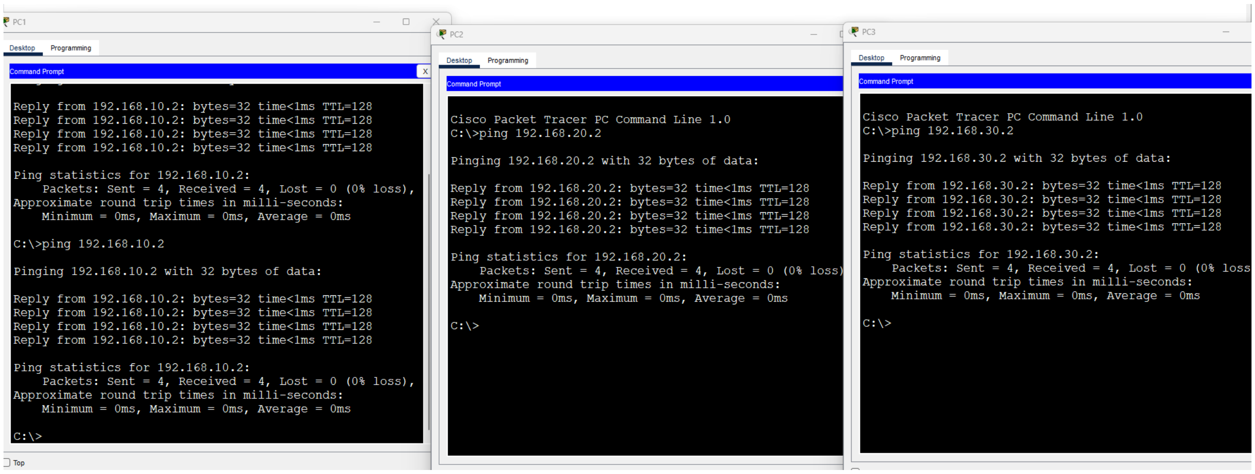
Close configuration window

3.6.5.1.5.6 Part 6: Verify end to end connectivity.

a. From PC1 ping PC6. - successful

b. From PC2 ping PC5. - successful

c. From PC3 ping PC4. - successful



3.6.5.1.6 Script

Switch S1

enable
config t
vlan 10
name Red
vlan 20
name Blue
vlan 30
name Yellow
interface g0/1
switchport mode dynamic desirable
switchport trunk native vlan 999
interface g0/2
switchport mode trunk
switchport trunk native vlan 999
switchport nonegotiate
end

Switch S2

enable
config t
vlan 10
name Red
vlan 20
name Blue
vlan 30
name Yellow
interface range f0/1 - 8
switchport mode access
switchport access vlan 10
interface range f0/9 - 16
switchport mode access
switchport access vlan 20

interface range f0/17 - 24
switchport mode access
switchport access vlan 30
interface GigabitEthernet0/1
switchport mode dynamic auto
switchport trunk native vlan 999
end

Switch S3

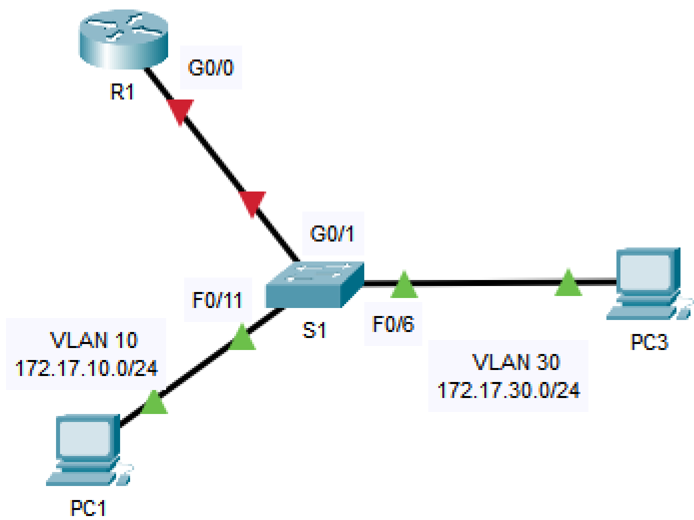
enable
config t
vlan 10
name Red
vlan 20
name Blue
vlan 30
name Yellow
interface range f0/1 - 8
switchport mode access
switchport access vlan 10
interface range f0/9 - 16
switchport mode access
switchport access vlan 20
interface range f0/17 - 24
switchport mode access
switchport access vlan 30
interface GigabitEthernet0/2
switchport trunk native vlan 999
switchport mode trunk
switchport nonegotiate
end

3.7 Netacad Module 4 - Inter-VLAN routing

3.7.1 Section 4.2 Router-on-a-Stick Inter-VLAN Routing

3.7.1.1 Exercise 4.2.7-Packet Tracer - Configure Router-on-a-Stick Inter-VLAN Routing

3.7.1.1.1 Topology



3.7.1.1.2 Addressing Table

Device	Interface	IPv4 Address	Subnet Mask	Default Gateway
R1	G0/0.10	172.17.10.1	255.255.255.0	N/A
R1	G0/0.30	172.17.30.1	255.255.255.0	N/A
PC1	NIC	172.17.10.10	255.255.255.0	172.17.10.1
PC3	NIC	172.17.30.10	255.255.255.0	172.17.30.1

3.7.1.1.3 Objectives

Part 1: Add VLANs to a Switch

Part 2: Configure Subinterfaces

Part 3: Test Connectivity with Inter-VLAN Routing

3.7.1.1.4 Scenario

In this activity, you will configure VLANs and inter-VLAN routing. You will then enable trunk interfaces and verify connectivity between VLANs.

3.7.1.1.5 Instructions

3.7.1.1.5.1 Part 1: Add VLANs to a Switch

3.7.1.1.5.1.1 Step 1: Create VLANs on S1.

Create VLAN 10 and VLAN 30 on **S1**.

```
S1>enable
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#
S1(config)#vlan 10
S1(config-vlan)#vlan 30
S1(config-vlan)#interface f0/11
S1(config-if)#switchport mode access
S1(config-if)#switchport access vlan 10
S1(config-if)#interface f0/6
S1(config-if)#switchport mode access
S1(config-if)#switchport access vlan 30
S1(config-if)#
```

3.7.1.1.5.1.2 Step 2: Assign VLANs to ports.

a. Configure interfaces F0/6 and F0/11 as access ports and assign VLANs.

· Assign the port connected to **PC1** to VLAN 10.

· Assign the port connected to **PC3** to VLAN 30.

b. Issue the **show vlan brief** command to verify VLAN configuration.

S1# **show vlan brief**

```
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, 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
10   VLAN0010                         active    Fa0/11
30   VLAN0030                         active    Fa0/6
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

VLAN Name Status Ports

---- -------------------------------- --------- -------------------------------

1 default active Fa0/1, Fa0/2, Fa0/3, Fa0/4

Fa0/5, Fa0/7, Fa0/8, Fa0/9

Fa0/10, 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

10 VLAN0010 active Fa0/11

30 VLAN0030 active Fa0/6

1002 fddi-default active

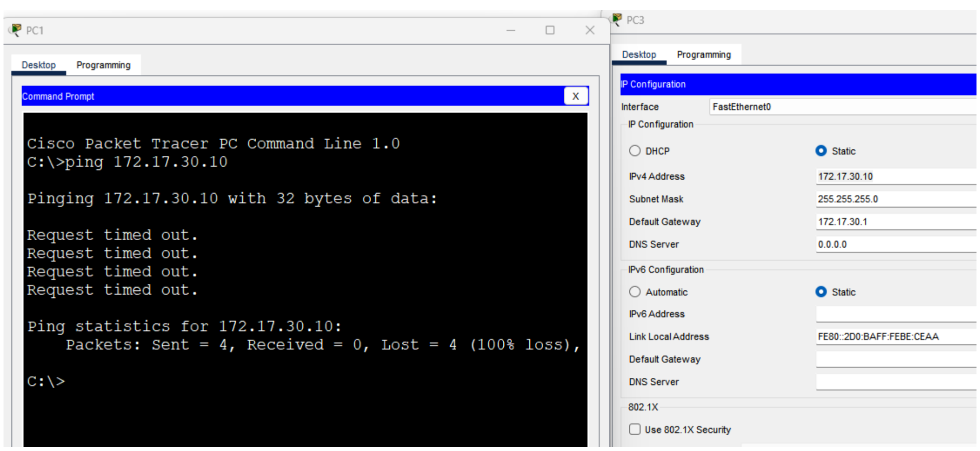
1003 token-ring-default active

1004 fddinet-default active

1005 trnet-default active

3.7.1.1.5.1.3 Step 3: Test connectivity between PC1 and PC3.

From **PC1**, ping **PC3**.



Question:

Were the pings successful? Why did you get this result?

Answer - The pings were not successful. The PCs are on different IP networks and require a router or a Layer 3 switch to provide communication between them.

3.7.1.1.5.2 Part 2: Configure Subinterfaces

3.7.1.1.5.2.1 Step 1: Configure subinterfaces on R1 using the 802.1Q encapsulation.

Open configuration window

a. Create the subinterface G0/0.10.

- Set the encapsulation type to 802.1Q and assign VLAN 10 to the subinterface.

- Refer to the **Address Table** and assign the correct IP address to the subinterface.

```
R1(config)# int g0/0.10
R1(config-subif)# encapsulation dot1Q 10
R1(config-subif)# ip address 172.17.10.1 255.255.255.0
```

b. Repeat for the G0/0.30 subinterface.

```
R1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#Interface g0/0
R1(config-if)#no shutdown
R1(config-if)#interface g0/0.10
R1(config-subif)#encapsulation dot1Q 10
R1(config-subif)#ip address 172.17.10.1 255.255.255.0
R1(config-subif)#no shutdown
R1(config-subif)#int g0/0.30
R1(config-subif)#encapsulation dot1Q 30
R1(config-subif)#ip address 172.17.30.1 255.255.255.0
R1(config-subif)#
R1(config-subif)#end
R1#
```

3.7.1.1.5.2.2 Step 2: Verify Configuration.

a. Use the **show ip interface brief** command to verify subinterface configuration. Both subinterfaces are down. Subinterfaces are virtual interfaces that are associated with a physical interface. Therefore, in order to enable subinterfaces, you must enable the physical interface that they are associated with.

b. Enable the G0/0 interface. Verify that the subinterfaces are now active.

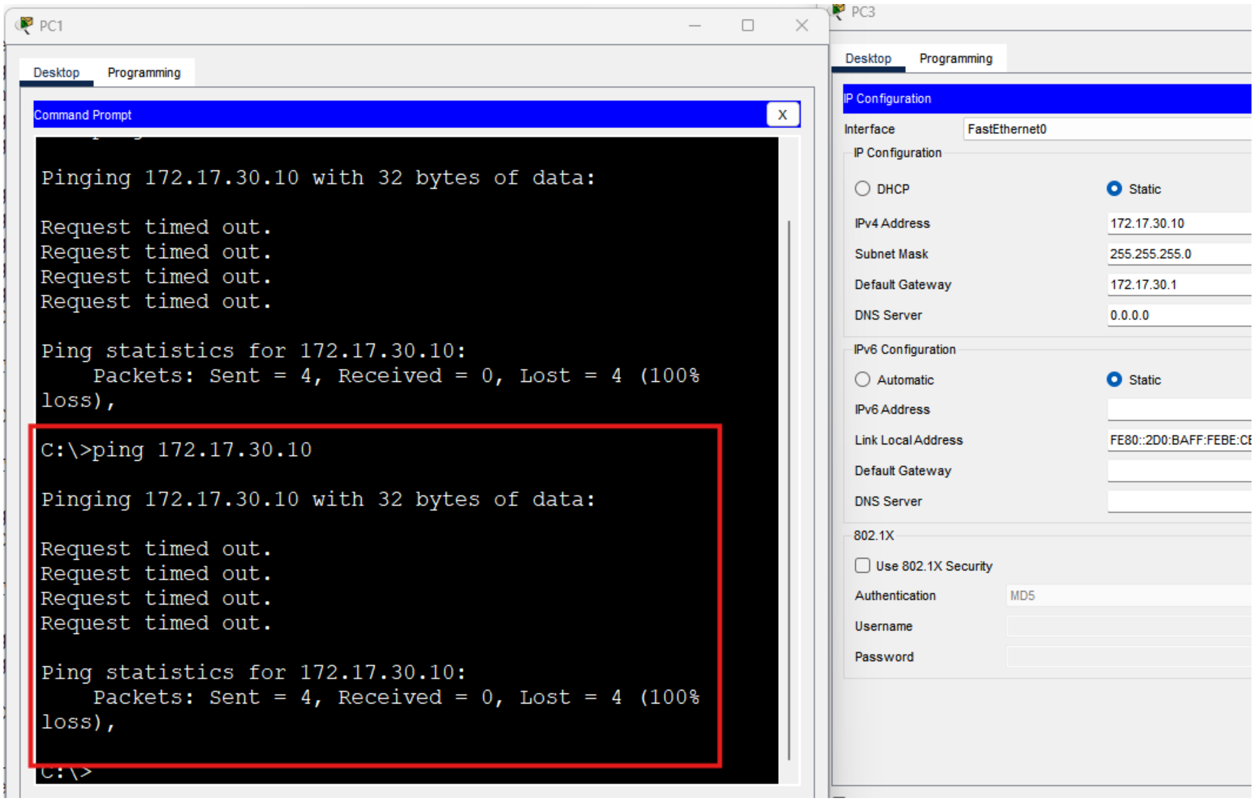
G0/0 is active because no shutdown was done at config

```
R1(config)#Interface g0/0
R1(config-if)#no shutdown
```

```
R1#
R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  up                    up
GigabitEthernet0/0.10  172.17.10.1     YES manual up                    up
GigabitEthernet0/0.30  172.17.30.1     YES manual up                    up
GigabitEthernet0/1     unassigned      YES unset  administratively down down
Vlan1                  unassigned      YES unset  administratively down down
R1#
```

3.7.1.1.5.3 Part 3: Test Connectivity with Inter-VLAN Routing

3.7.1.1.5.3.1 Step 1: Ping between PC1 and PC3.



Question:

From PC1, ping PC3. The pings should still fail. Explain.

Answer - The switch is not yet configured with a trunk port that is connected to the router.

3.7.1.1.5.3.2 Step 2: Enable trunking.

Open configuration window

a. On **S1**, issue the **show vlan** command.

```
S1#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, 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
10   VLAN0010                         active    Fa0/11
30   VLAN0030                         active    Fa0/6
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
S1#
```

Question:

What VLAN is G0/1 assigned to? Answer VLAN 1

b. Because the router was configured with multiple subinterfaces assigned to different VLANs, the switch port connecting to the router must be configured as a trunk. Enable trunking on interface G0/1.

```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface g0/1
S1(config-if)#switchport mode trunk

S1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

S1(config-if)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console
```

Question:

How can you determine that the interface is a trunk port using the show vlan command?

Answer - The interface is no longer listed in the command output. (only Gig0/2 appears)

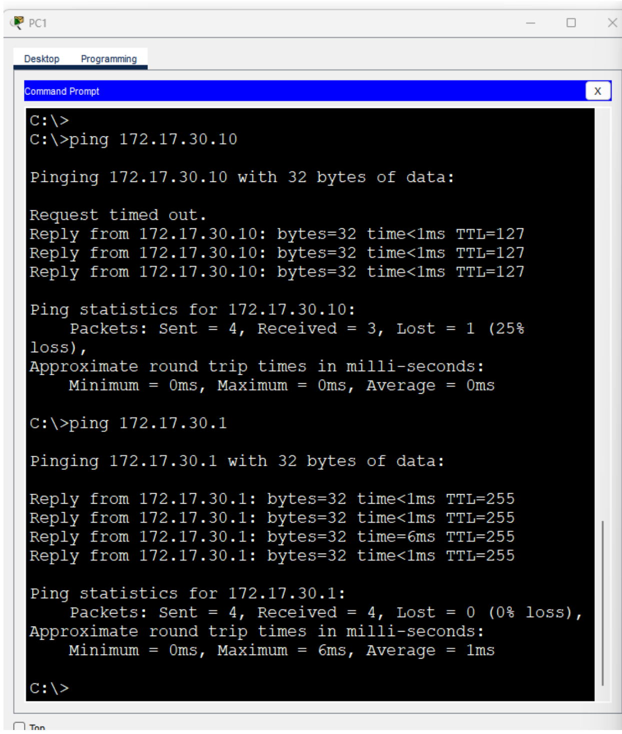
```
S1#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, 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, Gig0/2
10   VLAN0010                         active    Fa0/11
30   VLAN0030                         active    Fa0/6
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
S1#
```

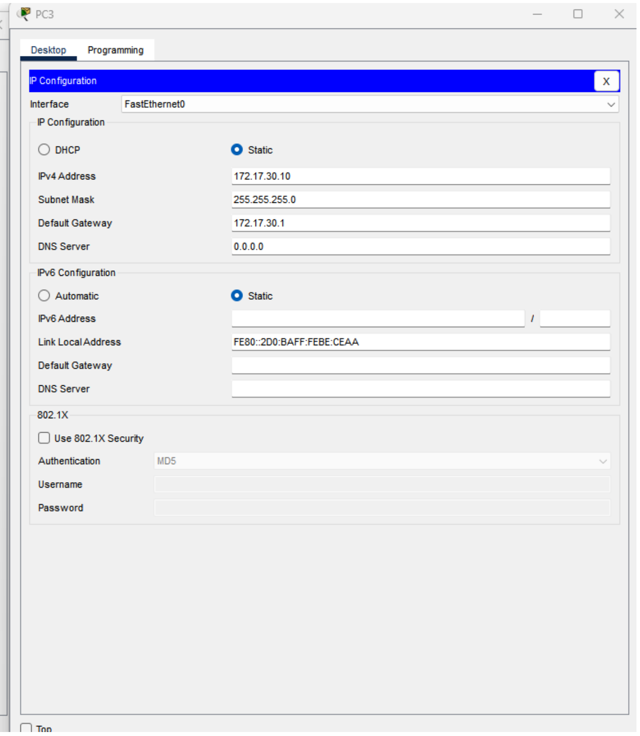
c. Issue the **show interface trunk** command to verify that the interface is configured as a trunk.

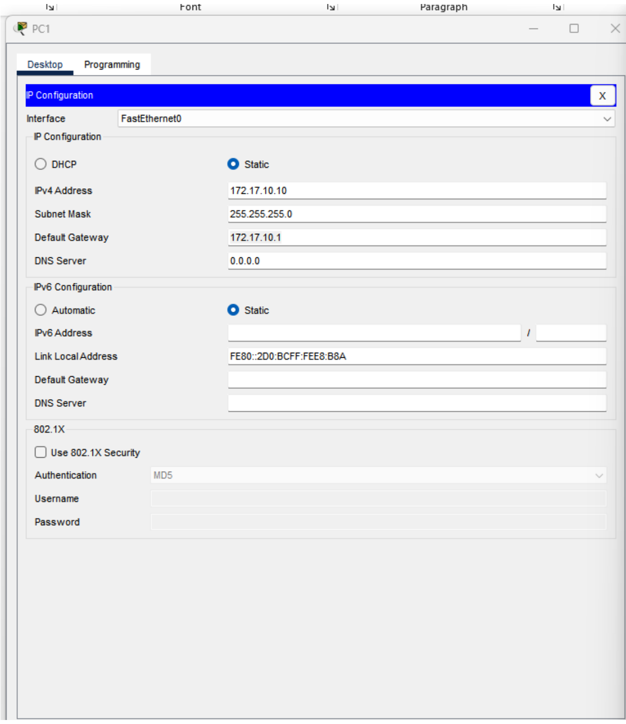
```
S1#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Gig0/1      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,10,30

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,10,30

S1#
S1#
```

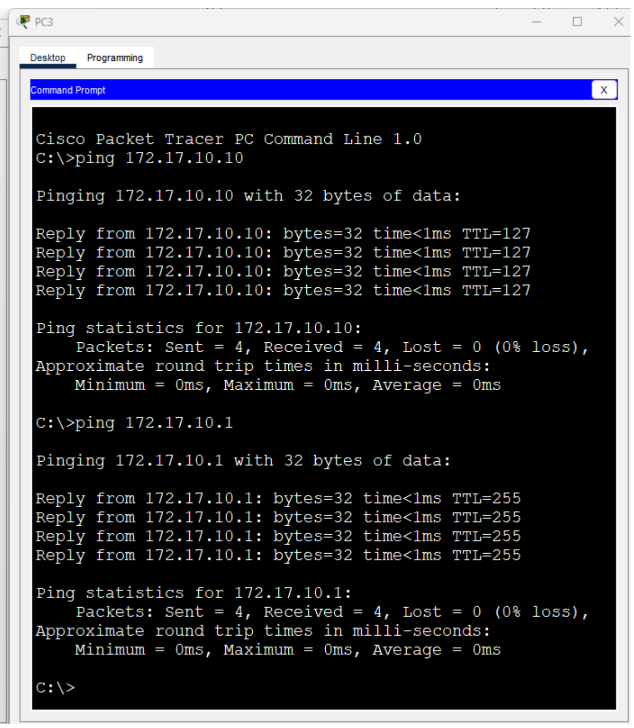
3.7.1.1.5.3.3 Step 3: Test Connectivity

If the configurations are correct, PC1 and PC3 should be able to ping their default gateways and each other.









Question:

What addresses do PC1 and PC3 use as their default gateway addresses?

Answer - They use the address of the sub interface.

3.7.1.1.6 Scripts

S1
vlan 10
vlan 30
interface f0/11
switchport mode access
switchport access vlan 10
interface f0/6
switchport mode access
switchport access vlan 30
interface g0/1
switchport mode trunk

show vlan brief	command to verify VLAN configuration
show vlan	
show ip interface brief	command to verify subinterface configuration
show interface trunk	command to verify that the interface is configured as a trunk

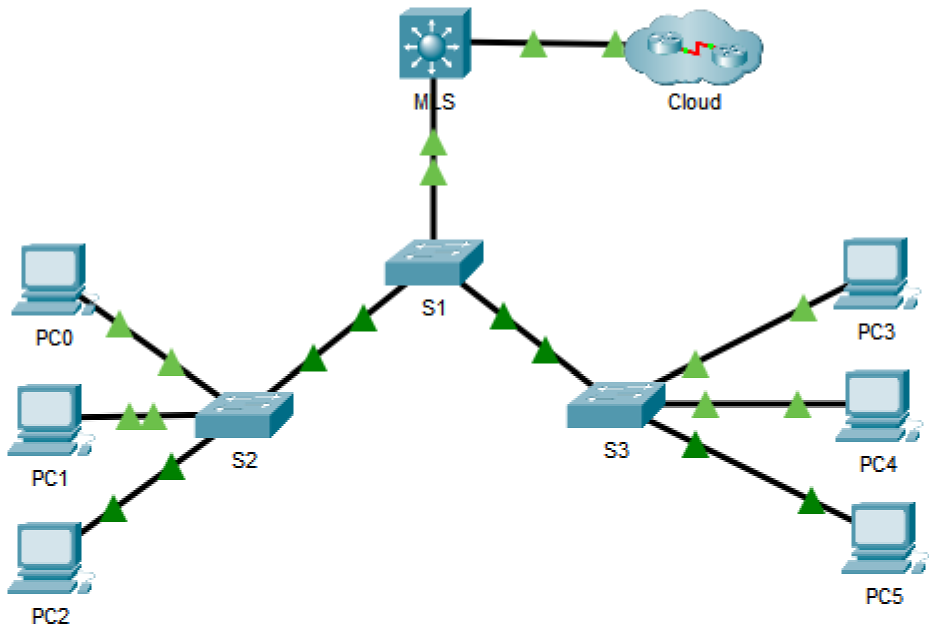
R1
Interface g0/0
no shutdown
interface g0/0.10
encapsulation dot1Q 10
ip address 172.17.10.1 255.255.255.0
no shutdown
int g0/0.30
encapsulation dot1Q 30
ip address 172.17.30.1 255.255.255.0

show ip interface brief	command to verify sub interface configuration
show vlan brief	command to verify VLAN configuration
show vlan	

3.7.2 Section 4.3. Inter-VLAN Routing using Layer 3 Switches

3.7.2.1 Exercise 4.3.8 - Packet Tracer - Configure Layer 3 Switching and Inter-VLAN Routing

3.7.2.1.1 Topology



3.7.2.1.2 Addressing Table

Device	Interface	IP Address / Prefix
MLS	VLAN 10	192.168.10.254 /24
		2001:db8:acad:10::1/64
	VLAN 20	192.168.20.254 /24
		2001:db8:acad:20::1/64
	VLAN 30	192.168.30.254/24
		2001:db8:acad:30::1/64
	VLAN 99	192.168.99.254/24
	G0/2	209.165.200.225
		2001:db8:acad:a::1/64
PC0	NIC	192.168.10.1
PC1	NIC	192.168.20.1
PC2	NIC	192.168.30.1
PC3	NIC	192.168.10.2/24
		2001:db8:acad:10::2/64

Device	Interface	IP Address / Prefix
PC4	NIC	192.168.20.2/24
		2001:db8:acad:20::2/64
PC5	NIC	192.168.30.2
		2001:db8:acad:30::2/64
S1	VLAN 99	192.168.99.1
S2	VLAN 99	192.168.99.2
S3	VLAN 99	192.168.99.3

3.7.2.1.3 Objectives

Part 1: Configure Layer 3 Switching
Part 2: Configure Inter-VLAN Routing
Part 3: Configure IPv6 Inter-VLAN Routing

3.7.2.1.4 Background / Scenario

A multilayer switch like the Cisco Catalyst 3650 is capable of both Layer 2 switching and Layer 3 routing. One of the advantages of using a multilayer switch is this dual functionality. A benefit for a small to medium-sized company would be the ability to purchase a single multilayer switch instead of separate switching and routing network devices. Capabilities of a multilayer switch include the ability to route from one VLAN to another using multiple switched virtual interfaces (SVIs), as well as the ability to convert a Layer 2 switchport to a Layer 3 interface.

3.7.2.1.5 Instructions

3.7.2.1.5.1 Part 1: Configure Layer 3 Switching

In Part 1, you will configure the GigabitEthernet 0/2 port on switch MLS as a routed port and verify that you can ping another Layer 3 address.

a. On MLS, configure G0/2 as a routed port and assign an IP address according to the Addressing Table.

MLS(config)# interface g0/2
MLS(config-if)# no switchport
MLS(config-if)# ip address 209.165.200.225 255.255.255.252
MLS(config-if)# ipv6 address 2001:DB8:ACAD:A::1/64

```
MLS#
MLS#config t
Enter configuration commands, one per line.  End with CNTL/Z.
MLS(config)#interface GigabitEthernet0/2
MLS(config-if)# no switchport
MLS(config-if)# ip address 209.165.200.225 255.255.255.252
MLS(config-if)# ipv6 address 2001:DB8:ACAD:A::1/64
MLS(config-if)#end
MLS#
%SYS-5-CONFIG_I: Configured from console by console

MLS#
```

b. Verify connectivity to Cloud by pinging 209.165.200.226.

MLS# ping 209.165.200.226

```
MLS#ping 209.165.200.226

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 209.165.200.226, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/1 ms

MLS#
```

3.7.2.1.5.2 Part 2: Configure Inter-VLAN Routing

Step 1: Add VLANs.

Add VLANs to MLS according to the table below. Packet Tracer scoring is case-sensitive, so type the names exactly as shown.

3.7.2.1.5.2.1 Step 1: Add VLANs.

Add VLANs to MLS according to the table below. Packet Tracer scoring is case-sensitive, so type the names exactly as shown.

VLAN Number	VLAN Name
10	Staff
20	Student
30	Faculty

```
MLS#
MLS#config t
Enter configuration commands, one per line.  End with CNTL/Z.
MLS(config)#vlan 10
MLS(config-vlan)# name Staff
MLS(config-vlan)#vlan 20
MLS(config-vlan)# name Student
MLS(config-vlan)#vlan 30
MLS(config-vlan)# name Faculty
MLS(config-vlan)#end
MLS#
%SYS-5-CONFIG_I: Configured from console by console

MLS#
```

3.7.2.1.5.2.2 Step 2: Configure SVI on MLS.

Configure and activate the SVI interfaces for VLANs 10, 20, 30, and 99 according to the Addressing Table. The configuration for VLAN 10 is shown below as an example.

MLS(config)# interface vlan 10
MLS(config-if)# ip address 192.168.10.254 255.255.255.0

```
MLS#config t
Enter configuration commands, one per line.  End with CNTL/Z.
MLS(config)#interface Vlan10
MLS(config-if)# ip address 192.168.10.254 255.255.255.0
MLS(config-if)# ipv6 address 2001:DB8:ACAD:10::1/64
MLS(config-if)# no shutdown
MLS(config-if)#interface Vlan20
MLS(config-if)# ip address 192.168.20.254 255.255.255.0
MLS(config-if)# ipv6 address 2001:DB8:ACAD:20::1/64
MLS(config-if)# no shutdown
MLS(config-if)#interface Vlan30
MLS(config-if)# ip address 192.168.30.254 255.255.255.0
MLS(config-if)# ipv6 address 2001:DB8:ACAD:30::1/64
MLS(config-if)# no shutdown
MLS(config-if)#interface Vlan99
MLS(config-if)# ip address 192.168.99.254 255.255.255.0
MLS(config-if)# no shutdown
MLS(config-if)#end
%LINK-5-CHANGED: Interface Vlan10, changed state to up

%LINK-5-CHANGED: Interface Vlan20, changed state to up

%LINK-5-CHANGED: Interface Vlan30, changed state to up

%LINK-5-CHANGED: Interface Vlan99, changed state to up

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

MLS#
MLS#
```

3.7.2.1.5.2.3 Step 3: Configure Trunking on MLS.

Trunk configuration differs slightly on a Layer 3 switch. On the Layer 3 switch, the trunking interface needs to be encapsulated with the dot1q protocol, however it is not necessary to specify VLAN numbers as it is when working with a router and subinterfaces.

a. On MLS, configure interface g0/1.

b. Make the interface a static trunk port.
MLS(config-if)# switchport mode trunk

c. Specify the native VLAN as 99.
MLS(config-if)# switchport trunk native vlan 99

d. Encapsulate the link with the dot1q protocol.
MLS(config-if)# switchport trunk encapsulation dot1q

Note: Packet Tracer may not score the trunk encapsulation.

```
MLS(config-if)#
MLS(config-if)#interface GigabitEthernet0/1
MLS(config-if)# switchport trunk native vlan 99
MLS(config-if)# switchport trunk encapsulation dot1q
MLS(config-if)# switchport mode trunk
MLS(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on GigabitEthernet0/1 (99), with S1 GigabitEthernet0/1 (1).

MLS(config-if)#
```

3.7.2.1.5.2.4 Step 4: Configure trunking on S1.

a. Configure interface g0/1 of S1 as a static trunk.

b. Configure the native VLAN on the trunk.

```
S1>enable
S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#int g0/1
S1(config-if)#switchport mode trunk

S1(config-if)#switchport trunk native vlan 99
S1(config-if)#end
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#
```

3.7.2.1.5.2.5 Step 5: Enable routing.

a. Use the show ip route command.

```
MLS#show ip route
Default gateway is not set

Host               Gateway           Last Use    Total Uses  Interface
ICMP redirect cache is empty

MLS#
MLS#
```

Question:

Are there any active routes?

Answer No

b. Enter the ip routing command to enable routing in global configuration mode.

MLS(config)# ip routing

```
MLS#
MLS#enable
MLS#config t
Enter configuration commands, one per line.  End with CNTL/Z.
MLS(config)#ip routing
MLS(config)#end
MLS#
```

c. Use the show ip route command to verify routing is enabled.

MLS# show ip route

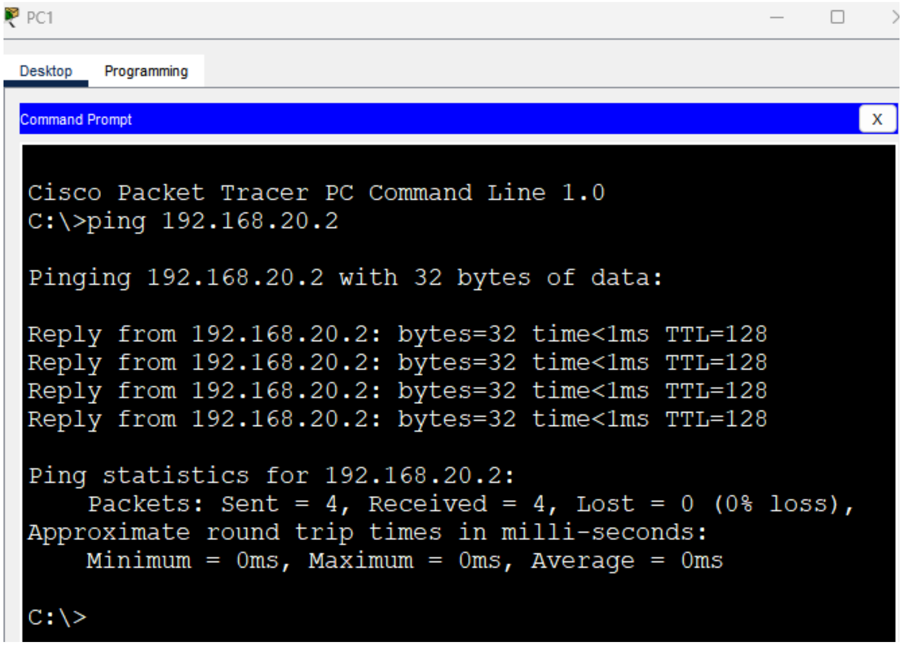
```
MLS#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.10.0/24 is directly connected, Vlan10
C    192.168.20.0/24 is directly connected, Vlan20
C    192.168.30.0/24 is directly connected, Vlan30
C    192.168.99.0/24 is directly connected, Vlan99
     209.165.200.0/30 is subnetted, 1 subnets
C       209.165.200.224 is directly connected, GigabitEthernet0/2

MLS#
```

3.7.2.1.5.2.6 Step 6: Verify end-to-end connectivity.

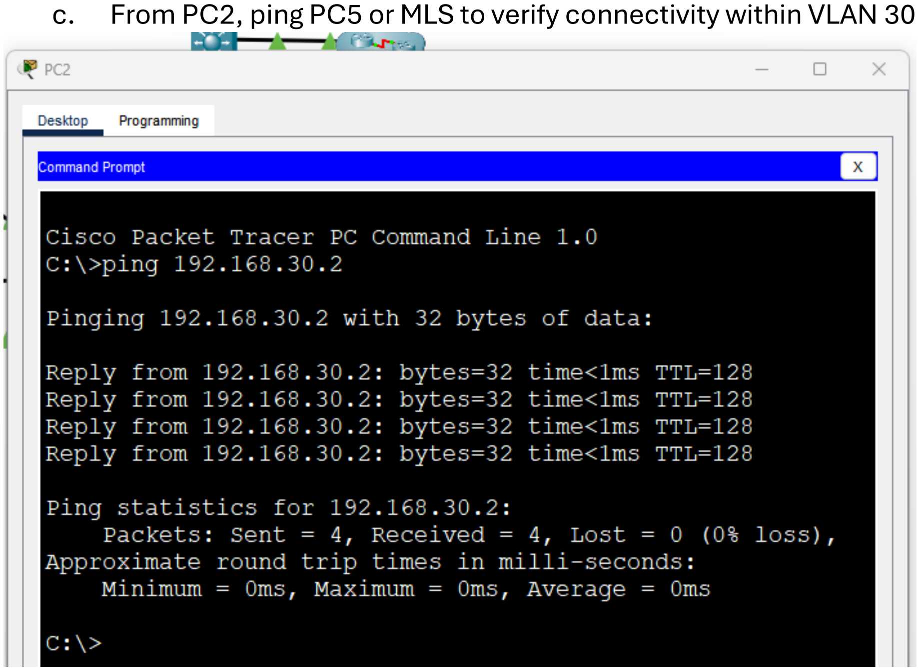
a. From PC0, ping PC3 or MLS to verify connectivity within VLAN 10.

```
C:\>ping 192.168.10.2

Pinging 192.168.10.2 with 32 bytes of data:

Reply from 192.168.10.2: bytes=32 time<1ms TTL=128
Reply from 192.168.10.2: bytes=32 time<1ms TTL=128
Reply from 192.168.10.2: bytes=32 time<1ms TTL=128
Reply from 192.168.10.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.10.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

b. From PC1, ping PC4 or MLS to verify connectivity within VLAN 20.



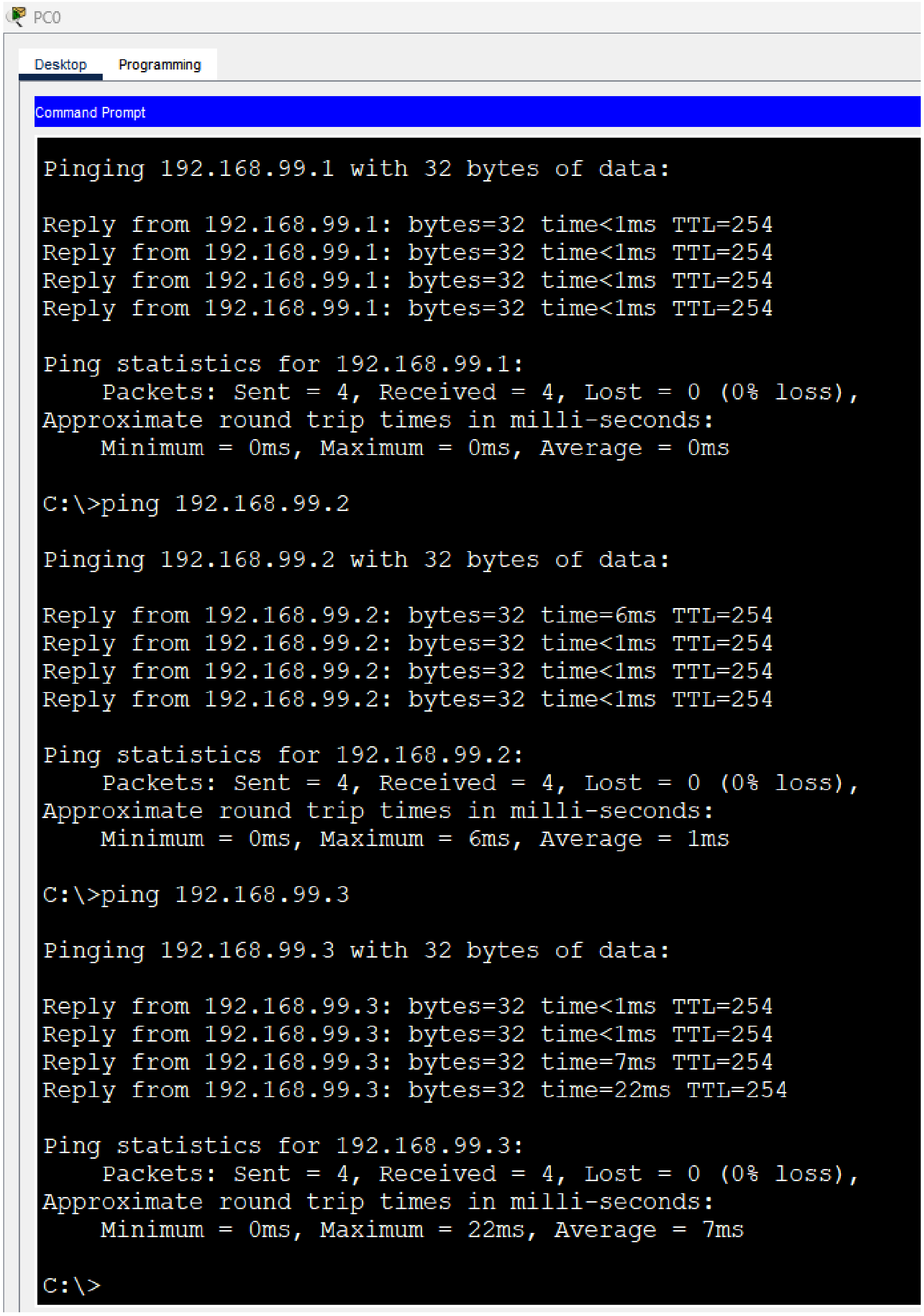
c. From PC2, ping PC5 or MLS to verify connectivity within VLAN 30.



d. From S1, ping S2, S3, or MLS to verify connectivity with VLAN 99.

```
S1>enable
S1#ping 192.168.99.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.99.2, timeout is 2 seconds:
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 192.168.99.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.99.3, timeout is 2 seconds:
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 0/2/7 ms

S1#ping 192.168.99.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.99.254, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

S1#
```

e. To verify inter-VLAN routing, ping devices outside the sender's VLAN.


PC0
Desktop
Programming
Command Prompt
Pinging 192.168.99.1 with 32 bytes of data:
Reply from 192.168.99.1: bytes=32 time<1ms TTL=254
Reply from 192.168.99.1: bytes=32 time<1ms TTL=254
Reply from 192.168.99.1: bytes=32 time<1ms TTL=254
Reply from 192.168.99.1: bytes=32 time<1ms TTL=254
Ping statistics for 192.168.99.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.99.2
Pinging 192.168.99.2 with 32 bytes of data:
Reply from 192.168.99.2: bytes=32 time=6ms TTL=254
Reply from 192.168.99.2: bytes=32 time<1ms TTL=254
Reply from 192.168.99.2: bytes=32 time<1ms TTL=254
Reply from 192.168.99.2: bytes=32 time<1ms TTL=254
Ping statistics for 192.168.99.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 6ms, Average = 1ms
C:\>ping 192.168.99.3
Pinging 192.168.99.3 with 32 bytes of data:
Reply from 192.168.99.3: bytes=32 time<1ms TTL=254
Reply from 192.168.99.3: bytes=32 time<1ms TTL=254
Reply from 192.168.99.3: bytes=32 time=7ms TTL=254
Reply from 192.168.99.3: bytes=32 time=22ms TTL=254
Ping statistics for 192.168.99.3:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 22ms, Average = 7ms
C:\>

```
MLS#ping 192.168.10.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

MLS#ping 192.168.20.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.20.1, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

MLS#ping 192.168.30.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.30.1, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/1 ms
```

```
MLS#ping 192.168.10.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.2, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

MLS#ping 192.168.20.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.20.2, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

MLS#ping 192.168.30.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.30.2, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/5/21 ms

MLS#
```

f. From any device, ping this address inside Cloud, 209.165.200.226.

```
MLS#ping 209.165.200.226

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 209.165.200.226, timeout is 2 seconds
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

MLS#
```

The Layer 3 switch is now routing between VLANs and providing routed connectivity to the cloud.

3.7.2.1.5.3 Part 3: Configure IPv6 Inter-VLAN Routing

Layer 3 switches also route between IPv6 networks.

3.7.2.1.5.3.1 Step 1: Enable IPv6 routing.

Open configuration window

Enter the ipv6 unicast-routing command to enable IPv6 routing in global configuration mode.

MLS(config)# ipv6 unicast-routing

3.7.2.1.5.3.2 Step 2: Configure SVI for IPv6 on MLS.

Configure IPv6 addressing on SVI for VLANs 10, 20, and 30 according to the Addressing Table. The configuration for VLAN 10 is shown below.

MLS(config)# interface vlan 10

MLS(config-if)# ipv6 address 2001:db8:acad:10::1/64

3.7.2.1.5.3.3 Step 3: Configure G0/2 with IPv6 on MLS.

a. Configure IPv6 addressing on G0/2.

MLS(config)# interface G0/2

MLS(config-if)# ipv6 address 2001:db8:acad:a::1/64

b. Use the show ipv6 route command to verify IPv6 connected networks.

MLS# show ipv6 route

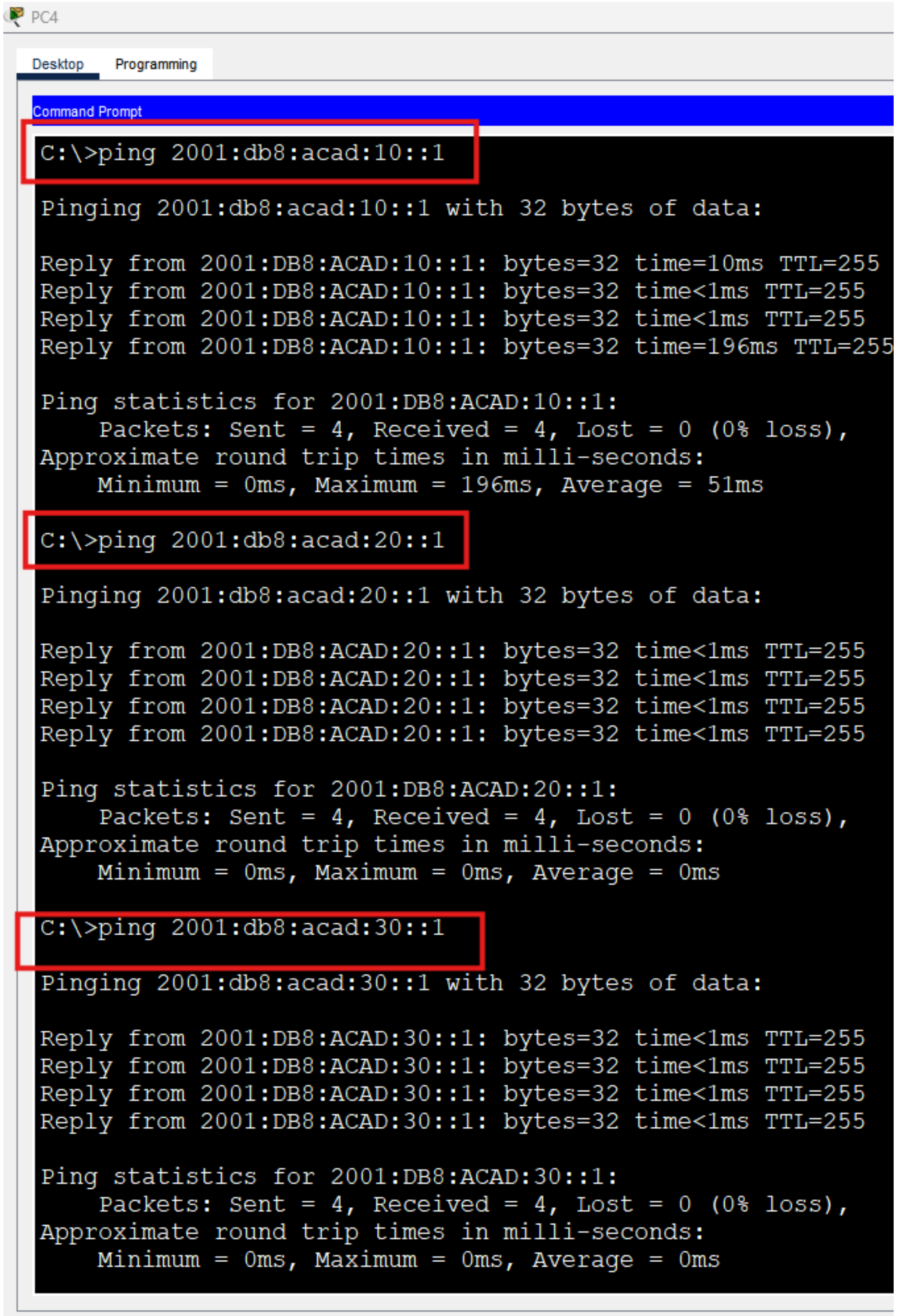
3.7.2.1.5.3.4 Step 4: Verify IPv6 connectivity.

Devices PC3, PC4, and PC5 have been configured with IPv6 addresses. Verify IPv6 inter-VLAN routing and connectivity to Cloud.

a. From PC3, ping MLS to verify connectivity within VLAN 10.

```
C:\>ping 2001:db8:acad:10::1

Pinging 2001:db8:acad:10::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:10::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:10::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:10::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:10::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:10::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:db8:acad:20::1

Pinging 2001:db8:acad:20::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:20::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:20::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:20::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:20::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:20::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:db8:acad:30::1

Pinging 2001:db8:acad:30::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:30::1: bytes=32 time=10ms TTL=255
Reply from 2001:DB8:ACAD:30::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:30::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:30::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:30::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

b. From PC4, ping MLS to verify connectivity within VLAN 20.



c. From PC5, ping MLS to verify connectivity within VLAN 30.

PC5

Desktop Programming

Command Prompt

```
C:\>ping 2001:db8:acad:10::1

Pinging 2001:db8:acad:10::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:10::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:10::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:10::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:10::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:10::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:db8:acad:20::1

Pinging 2001:db8:acad:20::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:20::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:20::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:20::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:20::1: bytes=32 time=8ms TTL=255

Ping statistics for 2001:DB8:ACAD:20::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 8ms, Average = 2ms

C:\>ping 2001:db8:acad:30::1

Pinging 2001:db8:acad:30::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:30::1: bytes=32 time=9ms TTL=255
Reply from 2001:DB8:ACAD:30::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:30::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:30::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:30::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

d. To *verify inter-VLAN routing, ping between devices PC3, PC4, and PC5.*

```
C:\>ping 2001:db8:acad:10::2

Pinging 2001:db8:acad:10::2 with 32 bytes of data:

Reply from 2001:DB8:ACAD:10::2: bytes=32 time=1ms TTL=127
Reply from 2001:DB8:ACAD:10::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:10::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:10::2: bytes=32 time=12ms TTL=127

Ping statistics for 2001:DB8:ACAD:10::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>ping 2001:db8:acad:30::2

Pinging 2001:db8:acad:30::2 with 32 bytes of data:

Reply from 2001:DB8:ACAD:30::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:30::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:30::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:30::2: bytes=32 time<1ms TTL=127

Ping statistics for 2001:DB8:ACAD:30::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

```
C:\>
C:\>ping 2001:db8:acad:10::2

Pinging 2001:db8:acad:10::2 with 32 bytes of data:

Reply from 2001:DB8:ACAD:10::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:10::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:10::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:10::2: bytes=32 time<1ms TTL=127

Ping statistics for 2001:DB8:ACAD:10::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:db8:acad:30::2

Pinging 2001:db8:acad:30::2 with 32 bytes of data:

Reply from 2001:DB8:ACAD:30::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:30::2: bytes=32 time=2ms TTL=127
Reply from 2001:DB8:ACAD:30::2: bytes=32 time<1ms TTL=127
Reply from 2001:DB8:ACAD:30::2: bytes=32 time<1ms TTL=127

Ping statistics for 2001:DB8:ACAD:30::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>
```

e. *From PC3 ping the address inside Cloud, 2001:db8:acad:a::2.*

```
C:\>ping 2001:db8:acad:a::2

Pinging 2001:db8:acad:a::2 with 32 bytes of data:

Reply from 2001:DB8:ACAD:A::2: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:A::2: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:A::2: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:A::2: bytes=32 time<1ms TTL=254

Ping statistics for 2001:DB8:ACAD:A::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

3.7.2.1.5.4 Scripts

MLS

```
enable
config t
ip routing
ipv6 unicast-routing
interface GigabitEthernet0/1
 switchport trunk native vlan 99
 switchport trunk encapsulation dot1q
 switchport mode trunk
interface GigabitEthernet0/2
 no switchport
 ip address 209.165.200.225 255.255.255.252
 ipv6 address 2001:DB8:ACAD:A::1/64
vlan 10
 name Staff
vlan 20
 name Student
vlan 30
 name Faculty
```

```
interface Vlan10
 ip address 192.168.10.254 255.255.255.0
 ipv6 address 2001:DB8:ACAD:10::1/64
 no shutdown
interface Vlan20
 ip address 192.168.20.254 255.255.255.0
 ipv6 address 2001:DB8:ACAD:20::1/64
 no shutdown
interface Vlan30
 ip address 192.168.30.254 255.255.255.0
 ipv6 address 2001:DB8:ACAD:30::1/64
 no shutdown
interface Vlan99
 ip address 192.168.99.254 255.255.255.0
 no shutdown
end
```

show ip route
show ipv6 route

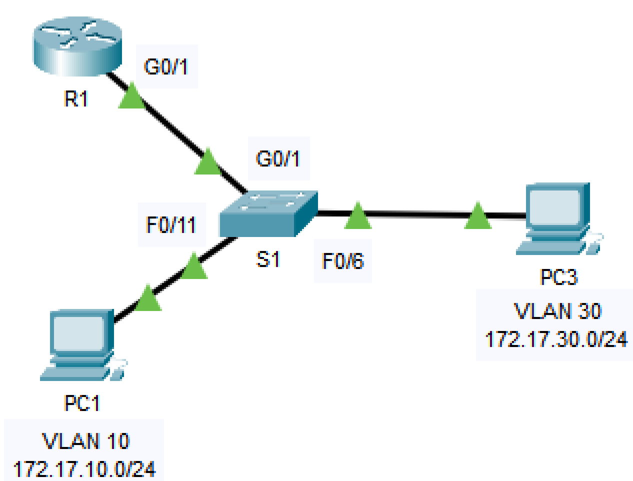
S1

```
enable
conf t
int g0/1
switchport mode trunk
switchport trunk native vlan 99
end
```

3.7.3 Section 4.4 Troubleshoot Inter-VLAN Routing

3.7.3.1 Exercise 4.4.8 -Packet Tracer - Troubleshoot Inter-VLAN Routing

3.7.3.1.1 Topology



3.7.3.1.2 Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway	VLAN
R1	G0/1.10	172.17.10.1	255.255.255.0	N/A	VLAN 10
	G0/1.30	172.17.30.1	255.255.255.0	N/A	VLAN 30
PC1	NIC	172.17.10.10	255.255.255.0	172.17.10.1	VLAN 10
PC3	NIC	172.17.30.10	255.255.255.0	172.17.30.1	VLAN 30

3.7.3.1.3 Objectives

Part 1: Locate Network Problems

Part 2: Implement the Solution

Part 3: Verify Network Connectivity

3.7.3.1.4 Scenario

In this activity, you will troubleshoot connectivity problems caused by improper configurations related to VLANs and inter-VLAN routing.

3.7.3.1.5 Instructions

3.7.3.1.5.1 Part 1: Locate the Network Problems

Examine the network and locate the source of any connectivity issues.

Commands you may find useful include:

```
R1# show ip interface brief
R1# show interface g0/1.10
R1# show interface g0/1.30
S1# show interface trunk
```

```
R1>enable
R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  administratively down down
GigabitEthernet0/1     unassigned      YES unset  up                    up
GigabitEthernet0/1.10  172.17.10.1     YES manual administratively down down
GigabitEthernet0/1.30  172.17.30.1     YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R1#
```

```
R1#show interface g0/1.10
GigabitEthernet0/1.10 is administratively down, line protocol is down (disabled)
  Hardware is PQUICC_FEC, address is 000d.bde7.0c02 (bia 000d.bde7.0c02)
  Internet address is 172.17.10.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID 30
  ARP type: ARPA, ARP Timeout 04:00:00,
  Last clearing of "show interface" counters never
```

```
R1#
R1#show interface g0/1.30
GigabitEthernet0/1.30 is up, line protocol is up (connected)
  Hardware is PQUICC_FEC, address is 000d.bde7.0c02 (bia 000d.bde7.0c02)
  Internet address is 172.17.30.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID 10
  ARP type: ARPA, ARP Timeout 04:00:00,
  Last clearing of "show interface" counters never
```

```
R1#
R1#show interface trunk


R1#
```

- Test connectivity and use the necessary **show** commands to verify configurations.
- Verify that all configured settings match the requirements shown in the Addressing Table.
- List all of the problems and possible solutions in the **Documentation Table**.

PROBLEM 1

1) Open PC1
   Verify IP comparing with table.
   IP's ok

2) Test connectivity
   Problem PC1 Can not reach gateway

```
PC1
Physical   Config   Desktop   Programming   Attributes
Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: FE80::2D0:BCFF:FEE8:B8A
   IPv6 Address....................: ::
   IPv4 Address....................: 172.17.10.10
   Subnet Mask.....................: 255.255.255.0
   Default Gateway.................: ::
                                     172.17.10.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: ::
   IPv6 Address....................: ::
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: ::
                                     0.0.0.0

C:\>ping 172.17.10.1

Pinging 172.17.10.1 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.17.10.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

R1
Problem GigabitEthernet0/1.10 is administratively down

```
R1#show interface g0/1.10
GigabitEthernet0/1.10 is administratively down, line protocol is down (disabled)
  Hardware is PQUICC_FEC, address is 000d.bde7.0c02 (bia 000d.bde7.0c02)
  Internet address is 172.17.10.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID 30
  ARP type: ARPA, ARP Timeout 04:00:00,
  Last clearing of "show interface" counters never
```

Verify show ip interface brief

Problem Printout shows The G0/1 physical interface is up but G0/1.10 subinterface is administratively down

GigabitEthernet0/1.10 172.17.10.1 YES manual administratively down down

```
R1>enable
R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  administratively down down
GigabitEthernet0/1     unassigned      YES unset  up                    up
GigabitEthernet0/1.10  172.17.10.1     YES manual administratively down down
GigabitEthernet0/1.30  172.17.30.1     YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R1#
```

SOLUTION PROBLEM 1

1) Implement the no shutdown command to enable the G0/1.10 subinterface..

```
interface g0/1.10
no shutdown
exit
```

2) show ip interface brief printout shows

```
GigabitEthernet0/1.10 172.17.10.1 YES manual up up
```

3) show interface g0/1.10 printout shows

```
GigabitEthernet0/1.10 is up
```

```
R1>enable
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface g0/1.10
R1(config-subif)#no shutdown

R1(config-subif)#exit
%LINK-5-CHANGED: Interface GigabitEthernet0/1.10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1.10, changed state to up

R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  administratively down down
GigabitEthernet0/1     unassigned      YES unset  up                    up
GigabitEthernet0/1.10  172.17.10.1     YES manual up                    up
GigabitEthernet0/1.30  172.17.30.1     YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R1#
R1#show interface g0/1.10
GigabitEthernet0/1.10 is up, line protocol is up (connected)
  Hardware is PQUICC_FEC, address is 000d.bde7.0c02 (bia 000d.bde7.0c02)
  Internet address is 172.17.10.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID 30
  ARP type: ARPA, ARP Timeout 04:00:00,
  Last clearing of "show interface" counters never

R1#
```

Still pinging to gateway in PC3 does not work

```
C:\>
C:\>ping 172.17.10.1

Pinging 172.17.10.1 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.17.10.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100%
loss),

C:\>
```

PROBLEM 2

When encapsulation is verified , it is discovered that Subinterface VLAN assignments are not correct on R1.

R1#show running-config

```
R1#show running-config
Building configuration...

Current configuration : 785 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
!
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!
!
!
license udi pid CISCO1941/K9 sn FTX1524PNZU
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
```

```
!
interface GigabitEthernet0/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface GigabitEthernet0/1
 no ip address
 duplex auto
 speed auto
!
interface GigabitEthernet0/1.10
 encapsulation dot1Q 30
 ip address 172.17.10.1 255.255.255.0
!
interface GigabitEthernet0/1.30
 encapsulation dot1Q 10
 ip address 172.17.30.1 255.255.255.0
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
```

```
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

We can see encapsulation parameters are not right

```
!
interface GigabitEthernet0/1.10
 encapsulation dot1Q 30
 ip address 172.17.10.1 255.255.255.0
!
interface GigabitEthernet0/1.30
 encapsulation dot1Q 10
 ip address 172.17.30.1 255.255.255.0
!
```

SOLUTION PROBLEM 2

Issue the no encapsulation dot1q command to remove the incorrect configuration. Then configure the subinterfaces with the correct encapsulation dot1q vlan_number command. Reenter the correct IP address information.

Delete encapsulation

```
interface g0/1.10
no encapsulation dot1Q

int g0/1.30
no encapsulation dot1Q
```

exit

```
R1>
R1>enable
R1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface g0/1.10
R1(config-subif)#no encapsulation dot1Q
R1(config-subif)#int g0/1.30
R1(config-subif)#no encapsulation dot1Q
R1(config-subif)#exit
R1(config)#
```

Configure encapsulation

```
int g0/1.10
encapsulation dot1Q 10
ip address 172.17.10.1 255.255.255.0

int g0/1.30
encapsulation dot1Q 30
ip address 172.17.30.1 255.255.255.0
```

```
R1(config)#
R1(config)#int g0/1.10
R1(config-subif)#encapsulation dot1Q 10
R1(config-subif)#ip address 172.17.10.1 255.255.255.0
R1(config-subif)#
R1(config-subif)#int g0/1.30
R1(config-subif)#encapsulation dot1Q 30
R1(config-subif)#ip address 172.17.30.1 255.255.255.0
R1(config-subif)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
```

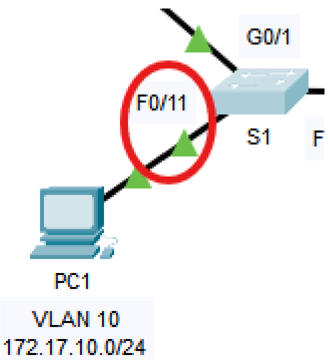
Ping still does not work, keep investigating

```
C:\>
C:\>ping 172.17.10.1

Pinging 172.17.10.1 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.17.10.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

The R1 config is fine so we will check S1

Switch

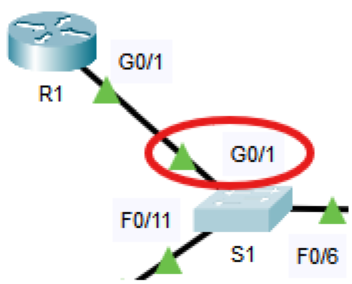
Verify connection with PC1



As per printout show interfaces fa0/11 switchport   everything is fine

```
S1>
S1>
S1>enable
S1#show interfaces fa0/11 swit
S1#show interfaces fa0/11 switchport
Name: Fa0/11
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 10 (Faculty/Staff)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none


S1#
```

Verify port towards R1



PROBLEM 3

As per printout for show interfaces g0/1 switchport the port is defined as “access” but should be defined ads trunk

```
S1#
S1#show interfaces g0/1
S1#show interfaces g0/1  swi
S1#show interfaces g0/1  switchport
Name: Gig0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

SOLUTION PROBLEM 3

Use the command switchport mode trunk to change the interface from access mode to trunk mode.

interface g0/1

switchport mode trunk

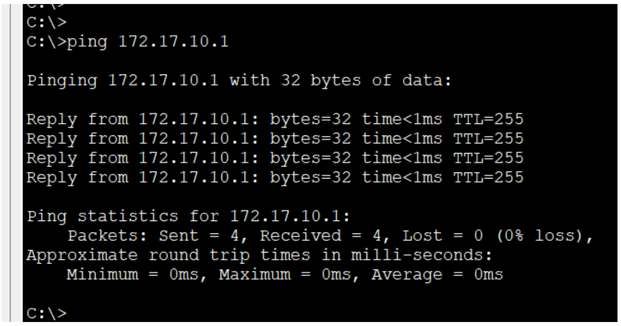
```
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface g0/1
S1(config-if)#switchport mode trunk

S1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

S1(config-if)#
S1(config-if)#end
S1#
```

```
%SYS-5-CONFIG_I: Configured from console by console
show interfaces g0/1  switchport
Name: Gig0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none


S1#
S1#
```

Command show interfaces trunk shows status Trunk

```
S1#
S1#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Gig0/1      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,10,30

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,10,30

S1#
S1#
```

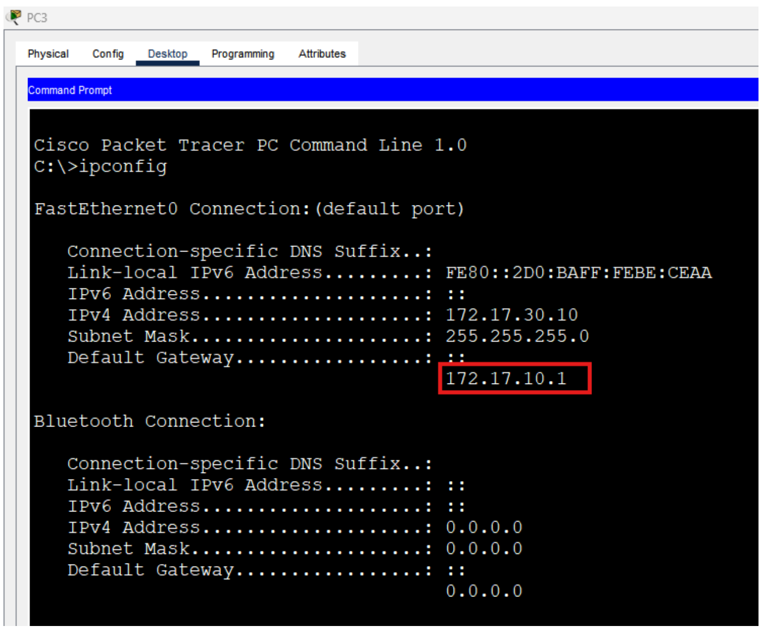
PC1 ping now is working



```
C:\>
C:\>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

C:\>
```

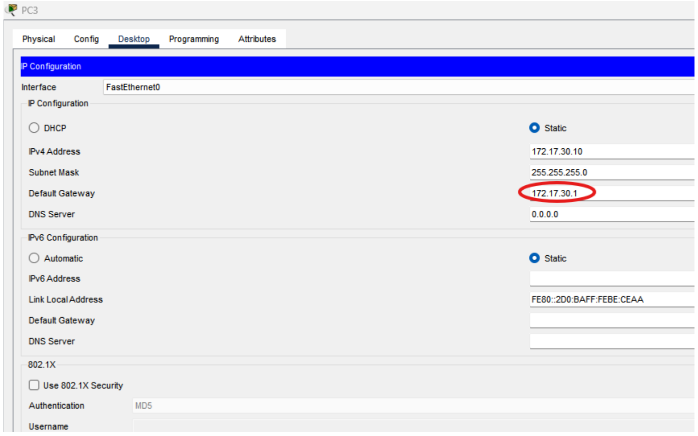
Verify PC3 connectivity

Verify configuration vs table. Default gateway is not correct

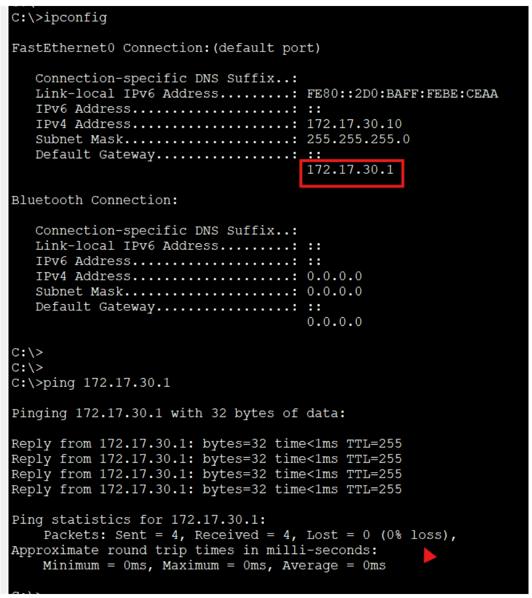



```
Cisco Packet Tracer PC Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: FE80::2D0:BAFF:FEBE:CEAA
   IPv6 Address....................: ::
   IPv4 Address....................: 172.17.30.10
   Subnet Mask.....................: 255.255.255.0
   Default Gateway.................: ::
                                     172.17.10.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: ::
   IPv6 Address....................: ::
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: ::
                                     0.0.0.0
```

Change default gateway for PC3



Verify ip for default ghateway in PC3 is correct and the ip is pingable



```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: FE80::2D0:BAFF:FEBE:CEAA
   IPv6 Address....................: ::
   IPv4 Address....................: 172.17.30.10
   Subnet Mask.....................: 255.255.255.0
   Default Gateway.................: ::
                                     172.17.30.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: ::
   IPv6 Address....................: ::
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: ::
                                     0.0.0.0

C:\>
C:\>
C:\>ping 172.17.30.1

Pinging 172.17.30.1 with 32 bytes of data:

Reply from 172.17.30.1: bytes=32 time<1ms TTL=255
Reply from 172.17.30.1: bytes=32 time<1ms TTL=255
Reply from 172.17.30.1: bytes=32 time<1ms TTL=255
Reply from 172.17.30.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.17.30.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Documentation Table

Problems	Solutions
The G0/1 physical interface is up but G0/1.10 subinterface is administratively down.	Implement the no shutdown command to enable the G0/1.10 subinterface.
Subinterface VLAN assignments are not correct on R1. The configured assignments do not match the ones shown in the Addressing Table..	Issue the no encapsulation dot1q command to remove the incorrect configuration. Then configure the subinterfaces with the correct encapsulation dot1q vlan_number command. Reenter the correct IP address information.
Interface G0/1 on S1 is configured as an access port instead of trunk port.	Use the command switchport mode trunk to change the interface from access mode to trunk mode.
PC3 is configured with the wrong default gateway address.	Change the default gateway on PC3 from 172.17.10.1 to 172.17.30.1

3.7.3.1.5.2 Part 2: Implement the Solutions

See above

3.7.3.1.5.3 Part 3: Verify Network Connectivity

Verify the PCs can ping each other and R1. If not, continue to troubleshoot until the pings are successful.

See above

3.7.3.1.6 Scripts

R1

```
 show ip interface brief
  show interface g0/1.10
  show interface g0/1.30
  show interface trunk

interface g0/1.10
no shutdown
exit

interface g0/1.10
no encapsulation dot1Q

int g0/1.30
no encapsulation dot1Q
exit

int g0/1.10
encapsulation dot1Q 10
ip address 172.17.10.1 255.255.255.0

int g0/1.30
encapsulation dot1Q 30
ip address 172.17.30.1 255.255.255.0
```

s1

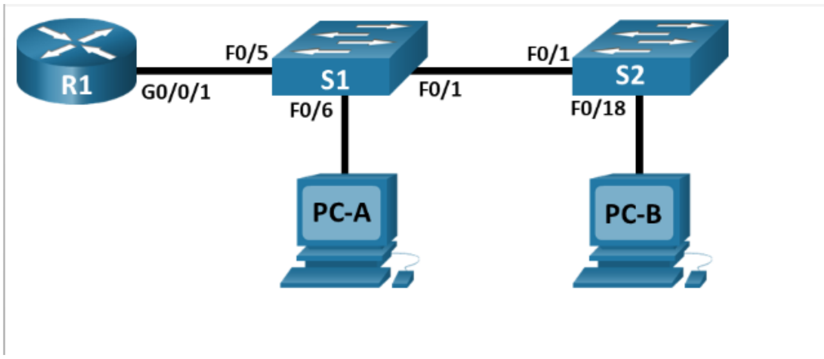
```
interface g0/1
switchport mode trunk
```

PCx command prompt

ipconfig
ping <ip default gateway>

3.7.3.2 *Exercise 4.4.9 Packet Tracer – Troubleshoot Inter-VLAN Routing – Physical Mode*

3.7.3.2.1 Topology



3.7.3.2.2 Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0/1.3	10.3.0.1	255.255.255.0	N/A
	G0/0/1.4	10.4.0.1	255.255.255.0	
	G0/0/1.13	10.13.0.1	255.255.255.0	
S1	VLAN 3	10.3.0.11	255.255.255.0	10.3.0.1
S2	VLAN 3	10.3.0.12	255.255.255.0	10.3.0.1
PC-A	NIC	10.4.0.50	255.255.255.0	10.4.0.1
PC-B	NIC	10.13.0.50	255.255.255.0	10.13.0.1

3.7.3.2.3 VLAN Table

VLAN	Name	Interface Assigned
3	Management	S1: VLAN 3 S2: VLAN 3
4	Operations	S1: F0/6
7	ParkingLot	S1: F0/2-4, F0/7-24, G0/1-2 S2: F0/2-17, F0/19-24, G0/1-2
8	Native	N/A
13	Maintenance	S2: F0/18

3.7.3.2.4 Objectives

Part 1: Evaluate Network Operation

Part 2: Gather Information, Create an Action Plan, and Implement Corrections

3.7.3.2.5 Background / Scenario

All the network devices in this Packet Tracer Physical Mode (PTPM) activity have been preconfigured to include intentional errors that are keeping the inter-VLAN routing from working. Your task is to evaluate the network, identify, and correct the configuration errors to restore full inter-VLAN connectivity. You may find errors with the configurations which are not directly related to inter-VLAN routing. These errors impact the ability of the network devices to perform this function.

Note: The design approach used in this activity is to assess your ability to configure and troubleshoot inter-VLAN routing only. This design may not reflect networking best practices.

3.7.3.2.6 Instructions

3.7.3.2.6.1 Part 1: Evaluate Network Operation

Requirements:

- No VLAN 7 traffic is allowed on the trunks because there are no devices in VLAN 7.
- VLAN 8 is the native VLAN.
- All trunks are static.
- End to end connectivity.

a. Use the laptop computer and appropriate cable to console into the network devices for testing and configuration purposes. The login password on all network devices is **"cisco"** and the enable password is **"class".** You can click and drag the console connection from the console port of one device to another, but you will have to start a new terminal session.

b. Use the **ping** command to test the following criteria and record the results in the table below.

From	To	Ping Results
R1	S1 VLAN 3 (10.3.0.11)	Unsuccessful
	S2 VLAN 3 (10.3.0.12)	Unsuccessful
	PC-A (10.4.0.50)	Unsuccessful
	PC-B (10.13.0.50)	Unsuccessful
S1	S2 VLAN 3 (10.3.0.12)	Unsuccessful
	PC-A (10.4.0.50)	Unsuccessful
	PC-B (10.13.0.50)	Unsuccessful
S2	PC-A (10.4.0.50)	Unsuccessful
	PC-B (10.13.0.50)	Unsuccessful

3.7.3.2.6.2 Part 2: Gather Information, Create an Action Plan, and Implement Corrections

a. For each requirement that is not met, gather information by examining the running configuration and the routing tables to develop a hypothesis for what is causing the malfunction.

b. Create an action plan that you think will fix the issue. Develop a list of all the commands you intend to issue to fix the issue, and a list of all the commands you need to revert the configuration, should your action plan fail to correct the issue.

   Hint: If you need to reset a switchport to default configuration, use the **default interface** *interface name* command.

   As an example for F0/10:

   S1(config)# **default interface f0/10**

c. Execute your action plans one at a time for each criterion that fails and record the fix actions.

3.7.3.2.7 SOLUTION

Verify configuration in R1, SW1and SW2

ROUTER

Check configuration on R1

R1	G0/0/1.3	10.3.0.1	255.255.255.0
	G0/0/1.4	10.4.0.1	255.255.255.0
	G0/0/1.13	10.13.0.1	255.255.255.0

VLAN	Name	Interface
3	Management	S1: VLAN 3 S2: VLAN 3
4	Operations	S1: F0/6
7	ParkingLot	S1: F0/2-4, F0/7-24, G0/1-2 S2: F0/2-17, F0/19-24, G0/1-2
8	Native	N/A
13	Maintenance	S2: F0/18

R1#show running-config

```
interface GigabitEthernet0/0/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface GigabitEthernet0/0/1
 no ip address
 duplex auto
 speed auto
!
interface GigabitEthernet0/0/1.3
 encapsulation dot1Q 3
 ip address 10.3.0.1 255.255.255.0
!
interface GigabitEthernet0/0/1.4
 encapsulation dot1Q 4 native
 ip address 10.4.0.1 255.255.255.0
!
interface GigabitEthernet0/0/1.8
 encapsulation dot1Q 8
 no ip address
!
interface GigabitEthernet0/0/1.13
 encapsulation dot1Q 13
 ip address 10.13.0.1 255.255.255.0
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
!
ip flow-export version 9
!
```

8 Must be native not 4

```
!
interface GigabitEthernet0/0/1.8
 encapsulation dot1Q 8
 no ip address
```

Modify configuration on R1

```
configure terminal
interface g0/0/1.8
encapsulation dot1q 8 native
exit
```

```
R1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface g0/0/1.8
R1(config-subif)#encapsulation dot1q 8 native
R1(config-subif)#exit
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
```

Post checks

Show running-config after changes

```
!
interface GigabitEthernet0/0/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface GigabitEthernet0/0/1
 no ip address
 duplex auto
 speed auto
!
interface GigabitEthernet0/0/1.3
 encapsulation dot1Q 3
 ip address 10.3.0.1 255.255.255.0
!
interface GigabitEthernet0/0/1.4
 encapsulation dot1Q 4
 ip address 10.4.0.1 255.255.255.0
!
interface GigabitEthernet0/0/1.8
 encapsulation dot1Q 8 native
 no ip address
!
interface GigabitEthernet0/0/1.13
 encapsulation dot1Q 13
 ip address 10.13.0.1 255.255.255.0
!
interface Vlan1
 no ip address
 shutdown
!
```

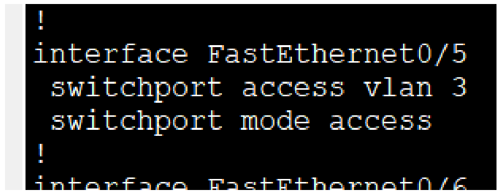
SWITCH 1

show running-config printout is reviewed comparing with specifications

VLAN	Name	Interface
3	Management	S1: VLAN 3 S2: VLAN 3
4	Operations	S1: F0/6
7	ParkingLot	S1: F0/2-4, F0/7-24, G0/1-2 S2: F0/2-17, F0/19-24, G0/1-2
8	Native	N/A
13	Maintenance	S2: F0/18

S1 – FastEthernet0/5

Connection with R1 must be trunk



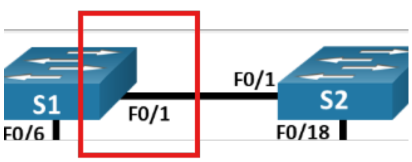
```
!
interface FastEthernet0/5
 switchport access vlan 3
 switchport mode access
!
interface FastEthernet0/6
```

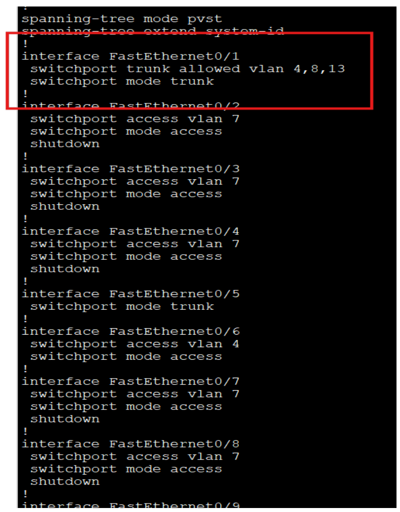
S1 – FastEthernet0/1

We need to add native vlan for int f0/1

It is a good practice to include all vlans except number 7 as it was stated is not used. As specified in requirements “No VLAN 7 traffic is allowed on the trunks because there are no devices in VLAN 7”

For – FastEthernet0/1 we need to add vlan 3 (switchport trunk allowed vlan 3-4,8,13)

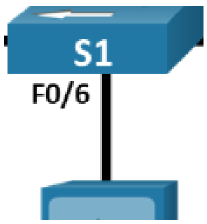




```
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
 switchport trunk allowed vlan 4,8,13
 switchport mode trunk
!
interface FastEthernet0/2
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/3
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/4
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/5
 switchport mode trunk
!
interface FastEthernet0/6
 switchport access vlan 4
 switchport mode access
!
interface FastEthernet0/7
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/8
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/9
```

S1 – FastEthernet0/6

It seems ok nothing to change




```
!
interface FastEthernet0/6
 switchport access vlan 4
 switchport mode access
!
interface FastEthernet0/7
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/8
 switchport access vlan 7
 switchport mode access
 shutdown
```

Review vlan table

VLAN	Name	Interface
3	Management	S1: VLAN 3 S2: VLAN 3
4	Operations	S1: F0/6
7	ParkingLot	S1: F0/2-4, F0/7-24, G0/1-2 S2: F0/2-17, F0/19-24, G0/1-2
8	Native	N/A
13	Maintenance	S2: F0/18

Compare table with printout in S1

show vlan brief

```
S1#
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active
3    Management                       active    Fa0/5
4    Operations                       active    Fa0/6
7    ParkingLot                       active    Fa0/2, Fa0/3, Fa0/4, 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
8    Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

Vlan 1,3,4,7 and 8 are defined but no vlan 13. Vlan 13 needs to be added

show ip interface brief

```
S1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/1        unassigned      YES manual up                    up
FastEthernet0/2        unassigned      YES manual administratively down down
FastEthernet0/3        unassigned      YES manual administratively down down
FastEthernet0/4        unassigned      YES manual administratively down down
FastEthernet0/5        unassigned      YES manual up                    up
FastEthernet0/6        unassigned      YES manual up                    up
FastEthernet0/7        unassigned      YES manual administratively down down
FastEthernet0/8        unassigned      YES manual administratively down down
FastEthernet0/9        unassigned      YES manual administratively down down
FastEthernet0/10       unassigned      YES manual administratively down down
FastEthernet0/11       unassigned      YES manual administratively down down
FastEthernet0/12       unassigned      YES manual administratively down down
FastEthernet0/13       unassigned      YES manual administratively down down
FastEthernet0/14       unassigned      YES manual administratively down down
FastEthernet0/15       unassigned      YES manual administratively down down
FastEthernet0/16       unassigned      YES manual administratively down down
FastEthernet0/17       unassigned      YES manual administratively down down
FastEthernet0/18       unassigned      YES manual administratively down down
FastEthernet0/19       unassigned      YES manual administratively down down
FastEthernet0/20       unassigned      YES manual administratively down down
FastEthernet0/21       unassigned      YES manual administratively down down
FastEthernet0/22       unassigned      YES manual administratively down down
FastEthernet0/23       unassigned      YES manual administratively down down
FastEthernet0/24       unassigned      YES manual administratively down down
GigabitEthernet0/1     unassigned      YES manual administratively down down
GigabitEthernet0/2     unassigned      YES manual administratively down down
Vlan1                  unassigned      YES manual administratively down down
Vlan3                  10.3.0.11       YES manual up                    up
S1#
```

Based on the analysis, the following configuration changes must be made:

SWITCH 1

```
configure terminal
default interface f0/5
interface f0/5
switchport mode trunk
switchport trunk native vlan 8
switchport trunk allowed vlan 3,4,8,13
interface f0/1
switchport trunk allowed vlan 3,4,8,13
switchport trunk native vlan 8
vlan 13
name Maintenance
exit
```

POST CHECKS

Verify vlan 13 is added

```
S1#
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active
3    Management                       active
4    Operations                       active    Fa0/6
7    ParkingLot                       active    Fa0/2, Fa0/3, Fa0/4, 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
8    Native                           active
13   Maintenance                      active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

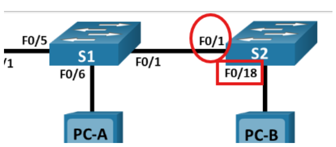
Check F0/1 F0/5 and F0/6

```
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
 switchport trunk native vlan 8
 switchport trunk allowed vlan 3-4,8,13
 switchport mode trunk
!
interface FastEthernet0/2
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/3
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/4
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/5
 switchport trunk native vlan 8
 switchport trunk allowed vlan 3-4,8,13
 switchport mode trunk
!
interface FastEthernet0/6
 switchport access vlan 4
 switchport mode access
```

SWITCH 2

show running-config printout is reviewed comparing with specifications

VLAN	Name	Interface
3	Management	S1: VLAN 3 S2: VLAN 3
4	Operations	S1: F0/6
7	ParkingLot	S1: F0/2-4, F0/7-24, G0/1-2 S2: F0/2-17, F0/19-24, G0/1-2
8	Native	N/A
13	Maintenance	S2: F0/18



S2 – FastEthernet0/1

Vlan 3, 4, 8 and 13 must be there. Only 4 and 8 are listed. We need to add the missing ones.

```
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
 switchport trunk native vlan 8
 switchport trunk allowed vlan 4,8
 switchport mode trunk
!
interface FastEthernet0/2
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/3
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/4
 switchport access vlan 7
 switchport mode access
 shutdown
!
```

S2 – FastEthernet0/18

`This vlan is ok, nothing to change`

```
!
interface FastEthernet0/18
 switchport access vlan 13
 switchport mode access
!
```

show ip interface brief

vlan3 must be reset so protocol comes back up

```
S2#
S2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/1        unassigned      YES manual up                    up
FastEthernet0/2        unassigned      YES manual administratively down down
FastEthernet0/3        unassigned      YES manual administratively down down
FastEthernet0/4        unassigned      YES manual administratively down down
FastEthernet0/5        unassigned      YES manual administratively down down
FastEthernet0/6        unassigned      YES manual administratively down down
FastEthernet0/7        unassigned      YES manual administratively down down
FastEthernet0/8        unassigned      YES manual administratively down down
FastEthernet0/9        unassigned      YES manual administratively down down
FastEthernet0/10       unassigned      YES manual administratively down down
FastEthernet0/11       unassigned      YES manual administratively down down
FastEthernet0/12       unassigned      YES manual administratively down down
FastEthernet0/13       unassigned      YES manual administratively down down
FastEthernet0/14       unassigned      YES manual administratively down down
FastEthernet0/15       unassigned      YES manual administratively down down
FastEthernet0/16       unassigned      YES manual administratively down down
FastEthernet0/17       unassigned      YES manual administratively down down
FastEthernet0/18       unassigned      YES manual up                    up
FastEthernet0/19       unassigned      YES manual administratively down down
FastEthernet0/20       unassigned      YES manual administratively down down
FastEthernet0/21       unassigned      YES manual administratively down down
FastEthernet0/22       unassigned      YES manual administratively down down
FastEthernet0/23       unassigned      YES manual administratively down down
FastEthernet0/24       unassigned      YES manual administratively down down
GigabitEthernet0/1     unassigned      YES manual administratively down down
GigabitEthernet0/2     unassigned      YES manual administratively down down
Vlan1                  unassigned      YES manual administratively down down
Vlan3                  10.3.0.12       YES manual up                    down
S2#
```

Based on analysis the changes to be made are

```
configure terminal
int vlan3
shutdown
no shutdown
interface f0/1
switchport trunk allowed vlan 3,4,8,13
exit
```

```
S2#
S2#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#int vlan3
S2(config-if)#shutdown

S2(config-if)#no shutdown

S2(config-if)#interface f0/1
S2(config-if)#switchport trunk allowed vlan 3,4,8,13
S2(config-if)#exit
S2(config)#
%LINK-5-CHANGED: Interface Vlan3, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan3, changed state to down

%LINK-5-CHANGED: Interface Vlan3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan3, changed state to up

S2(config)#
S2(config)#
S2(config)#end
S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#
```

POST CHECKS

show ip interface brief

```
S2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/1        unassigned      YES manual up                    up
FastEthernet0/2        unassigned      YES manual administratively down down
FastEthernet0/3        unassigned      YES manual administratively down down
FastEthernet0/4        unassigned      YES manual administratively down down
FastEthernet0/5        unassigned      YES manual administratively down down
FastEthernet0/6        unassigned      YES manual administratively down down
FastEthernet0/7        unassigned      YES manual administratively down down
FastEthernet0/8        unassigned      YES manual administratively down down
FastEthernet0/9        unassigned      YES manual administratively down down
FastEthernet0/10       unassigned      YES manual administratively down down
FastEthernet0/11       unassigned      YES manual administratively down down
FastEthernet0/12       unassigned      YES manual administratively down down
FastEthernet0/13       unassigned      YES manual administratively down down
FastEthernet0/14       unassigned      YES manual administratively down down
FastEthernet0/15       unassigned      YES manual administratively down down
FastEthernet0/16       unassigned      YES manual administratively down down
FastEthernet0/17       unassigned      YES manual administratively down down
FastEthernet0/18       unassigned      YES manual up                    up
FastEthernet0/19       unassigned      YES manual administratively down down
FastEthernet0/20       unassigned      YES manual administratively down down
FastEthernet0/21       unassigned      YES manual administratively down down
FastEthernet0/22       unassigned      YES manual administratively down down
FastEthernet0/23       unassigned      YES manual administratively down down
FastEthernet0/24       unassigned      YES manual administratively down down
GigabitEthernet0/1     unassigned      YES manual administratively down down
GigabitEthernet0/2     unassigned      YES manual administratively down down
Vlan1                  unassigned      YES manual administratively down down
Vlan3                  10.3.0.12       YES manual up                    up
S2#
```

show running-config

```
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
 switchport trunk native vlan 8
 switchport trunk allowed vlan 3-4,8,13
 switchport mode trunk
!
interface FastEthernet0/2
 switchport access vlan 7
 switchport mode access
 shutdown
!
interface FastEthernet0/3
 switchport access vlan 7
 switchport mode access
```

```
interface FastEthernet0/18
 switchport access vlan 13
 switchport mode access
!
```

VERIFY PINGS

PC-A

PC-A

Physical Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.3.0.1

Pinging 10.3.0.1 with 32 bytes of data:

Reply from 10.3.0.1: bytes=32 time<1ms TTL=255
Reply from 10.3.0.1: bytes=32 time<1ms TTL=255
Reply from 10.3.0.1: bytes=32 time<1ms TTL=255
Reply from 10.3.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.3.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.4.0.1

Pinging 10.4.0.1 with 32 bytes of data:

Reply from 10.4.0.1: bytes=32 time<1ms TTL=255
Reply from 10.4.0.1: bytes=32 time<1ms TTL=255
Reply from 10.4.0.1: bytes=32 time<1ms TTL=255
Reply from 10.4.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.4.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.13.0.1

Pinging 10.13.0.1 with 32 bytes of data:

Reply from 10.13.0.1: bytes=32 time<1ms TTL=255
Reply from 10.13.0.1: bytes=32 time<1ms TTL=255
Reply from 10.13.0.1: bytes=32 time<1ms TTL=255
Reply from 10.13.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.13.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
```

```
C:\>
C:\>ping 10.3.0.11

Pinging 10.3.0.11 with 32 bytes of data:

Reply from 10.3.0.11: bytes=32 time<1ms TTL=254
Reply from 10.3.0.11: bytes=32 time<1ms TTL=254
Reply from 10.3.0.11: bytes=32 time=4ms TTL=254
Reply from 10.3.0.11: bytes=32 time=3ms TTL=254

Ping statistics for 10.3.0.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 4ms, Average = 1ms

C:\>ping 10.3.0.12

Pinging 10.3.0.12 with 32 bytes of data:

Reply from 10.3.0.12: bytes=32 time<1ms TTL=254
Reply from 10.3.0.12: bytes=32 time<1ms TTL=254
Reply from 10.3.0.12: bytes=32 time<1ms TTL=254
Reply from 10.3.0.12: bytes=32 time<1ms TTL=254

Ping statistics for 10.3.0.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

```
C:\>
C:\>ping 10.13.0.50

Pinging 10.13.0.50 with 32 bytes of data:

Reply from 10.13.0.50: bytes=32 time<1ms TTL=127
Reply from 10.13.0.50: bytes=32 time=4ms TTL=127
Reply from 10.13.0.50: bytes=32 time=1ms TTL=127
Reply from 10.13.0.50: bytes=32 time<1ms TTL=127

Ping statistics for 10.13.0.50:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 4ms, Average = 1ms

C:\>
```

ROUTER 1

```
R1#ping 10.3.0.11

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.0.11, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

R1#ping 10.3.0.12

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.0.12, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/1/8 ms

R1#ping 10.4.0.50

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.0.50, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

R1#ping 10.13.0.50

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.13.0.50, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/1/8 ms

R1#
```

SWITCH 1

```
Terminal
S1#ping 10.3.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 10.4.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 10.13.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.13.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 10.3.0.12

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.0.12, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/2 ms

S1#ping 10.4.0.50

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.0.50, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 10.13.0.50

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.13.0.50, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

SWITCH 2

```
S2#ping 10.3.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S2#ping 10.4.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/2/12 ms

S2#ping 10.13.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.13.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

```
S2#ping 10.3.0.11

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.0.11, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S2#ping 10.3.0.12

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.0.12, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/4/10 ms

S2#ping 10.4.0.50

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.4.0.50, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S2#ping 10.13.0.50

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.13.0.50, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S2#
```

PC-B

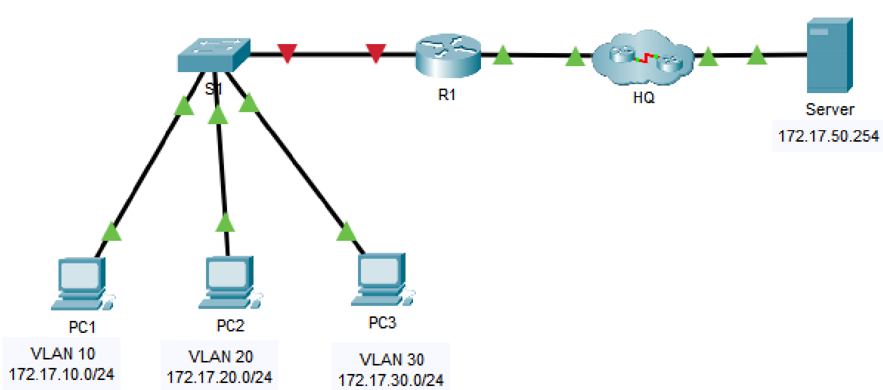
```
Pinging 10.3.0.1 with 32 bytes of data:

Reply from 10.3.0.1: bytes=32 time=12ms TTL=255
Reply from 10.3.0.1: bytes=32 time<1ms TTL=255
Reply from 10.3.0.1: bytes=32 time<1ms TTL=255
Reply from 10.3.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.3.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>ping 10.4.0.1

Pinging 10.4.0.1 with 32 bytes of data:

Reply from 10.4.0.1: bytes=32 time=12ms TTL=255
Reply from 10.4.0.1: bytes=32 time<1ms TTL=255
Reply from 10.4.0.1: bytes=32 time<1ms TTL=255
Reply from 10.4.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.4.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms

C:\>ping 10.13.0.1

Pinging 10.13.0.1 with 32 bytes of data:

Reply from 10.13.0.1: bytes=32 time<1ms TTL=255
Reply from 10.13.0.1: bytes=32 time<1ms TTL=255
Reply from 10.13.0.1: bytes=32 time<1ms TTL=255
Reply from 10.13.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.13.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
C:\>ping 10.3.0.11

Pinging 10.3.0.11 with 32 bytes of data:

Reply from 10.3.0.11: bytes=32 time<1ms TTL=254
Reply from 10.3.0.11: bytes=32 time<1ms TTL=254
Reply from 10.3.0.11: bytes=32 time<1ms TTL=254
Reply from 10.3.0.11: bytes=32 time<1ms TTL=254

Ping statistics for 10.3.0.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.3.0.12

Pinging 10.3.0.12 with 32 bytes of data:

Reply from 10.3.0.12: bytes=32 time<1ms TTL=254
Reply from 10.3.0.12: bytes=32 time<1ms TTL=254
Reply from 10.3.0.12: bytes=32 time<1ms TTL=254
Reply from 10.3.0.12: bytes=32 time=1ms TTL=254

Ping statistics for 10.3.0.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.4.0.50

Pinging 10.4.0.50 with 32 bytes of data:

Reply from 10.4.0.50: bytes=32 time<1ms TTL=127
Reply from 10.4.0.50: bytes=32 time<1ms TTL=127
Reply from 10.4.0.50: bytes=32 time=5ms TTL=127
Reply from 10.4.0.50: bytes=32 time<1ms TTL=127

Ping statistics for 10.4.0.50:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 5ms, Average = 1ms
```

3.7.4 Section 4.5. Module Practice and Quiz

3.7.4.1 Exercise 4.5.1 Packet Tracer - Inter-VLAN Routing Challenge

3.7.4.1.1 Topology



3.7.4.1.2 Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0	172.17.25.2	255.255.255.252	N/A
R1	G0/1.10	172.17.10.1	255.255.255.0	*N/A*

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/1.20	172.17.20.1	255.255.255.0	*N/A*
R1	G0/1.30	172.17.30.1	255.255.255.0	*N/A*
R1	G0/1.88	172.17.88.1	255.255.255.0	*N/A*
R1	G0/1.99	172.17.99.1	255.255.255.0	*N/A*
S1	VLAN 99	172.17.99.10	255.255.255.0	172.17.99.1
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

3.7.4.1.3 VLAN and Port Assignments Table

VLAN	Name	Interface
10	Faculty/Staff	F0/11-17
20	Students	F0/18-24
30	Guest(Default)	F0/6-10
88	Native	G0/1
99	Management	VLAN 99

3.7.4.1.4 Scenario

In this activity, you will demonstrate and reinforce your ability to implement inter-VLAN routing, including configuring IP addresses, VLANs, trunking, and subinterfaces.

3.7.4.1.5 Instructions

Configure the devices to meet the following requirements.

- Assign IP addressing to R1 and S1 based on the Addressing Table.
- Configure the default gateway on S1.
- Create, name, and assign VLANs on S1 based on the VLAN and Port Assignments Table. Ports should be in access mode. Your VLAN names should match the names in the table exactly.
- Configure G0/1 of S1 as a static trunk and assign the native VLAN.
- **All** ports that are not assigned to a VLAN should be disabled.

- Configure inter-VLAN routing on R1 based on the Addressing Table.
- Verify connectivity. R1, S1, and all PCs should be able to ping each other and the server.

3.7.4.1.6 Solution

3.7.4.1.6.1 Implementation

Do the Following configuration

```
Switch S1

en
config t
interface vlan 99
 ip address 172.17.99.10 255.255.255.0
 no shutdown
ip default-gateway 172.17.99.1
!Note: VLAN naming only requires the first letter be correct
vlan 10
 name Faculty/Staff
vlan 20
 name Students
vlan 30
  name Guest(Default)
vlan 88
 name Native
vlan 99
name Management
interface range f0/11 - 17
 switchport mode access
 switchport access vlan 10
interface range f0/18 - 24
 switchport mode access
 switchport access vlan 20
interface range f0/6 - 10
 switchport mode access
 switchport access vlan 30
interface g0/1
 switchport mode trunk
 switchport trunk native vlan 88
interface range f0/1-5,g0/2
 shutdown
end

Router R1

enable
conf t
interface GigabitEthernet0/1
 no shutdown
interface GigabitEthernet0/1.10
 encapsulation dot1Q 10
 ip address 172.17.10.1 255.255.255.0
interface GigabitEthernet0/1.20
 encapsulation dot1Q 20
 ip address 172.17.20.1 255.255.255.0
interface GigabitEthernet0/1.30
 encapsulation dot1Q 30
 ip address 172.17.30.1 255.255.255.0
```

```
interface GigabitEthernet0/1.88
 encapsulation dot1Q 88 native
 ip address 172.17.88.1 255.255.255.0
interface GigabitEthernet0/1.99
 encapsulation dot1Q 99
 ip address 172.17.99.1 255.255.255.0
end
```

3.7.4.1.6.2 Post implementation checks

Router R1 Check configuration

```
R1#show running-config
Building configuration...

Current configuration : 1140 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
!
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!
!
!
license udi pid CISCO1941/K9 sn FTX15240DK4
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface GigabitEthernet0/0
ip address 172.17.25.2 255.255.255.252
duplex auto
```

```
speed auto
!
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/1.10
encapsulation dot1Q 10
ip address 172.17.10.1 255.255.255.0
!
interface GigabitEthernet0/1.20
encapsulation dot1Q 20
ip address 172.17.20.1 255.255.255.0
!
interface GigabitEthernet0/1.30
encapsulation dot1Q 30
ip address 172.17.30.1 255.255.255.0
!
interface GigabitEthernet0/1.88
encapsulation dot1Q 88 native
ip address 172.17.88.1 255.255.255.0
!
interface GigabitEthernet0/1.99
encapsulation dot1Q 99
ip address 172.17.99.1 255.255.255.0
!
interface Vlan1
no ip address
shutdown
!
ip classless
ip route 0.0.0.0 0.0.0.0 GigabitEthernet0/0
!
ip flow-export version 9
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end
```

```
R1# show ip interface brief
Interface IP-Address OK? Method Status Protocol
GigabitEthernet0/0 172.17.25.2 YES manual up up
GigabitEthernet0/1 unassigned YES unset up up
```

```
GigabitEthernet0/1.10 172.17.10.1 YES manual up up
GigabitEthernet0/1.20 172.17.20.1 YES manual up up
GigabitEthernet0/1.30 172.17.30.1 YES manual up up
GigabitEthernet0/1.88 172.17.88.1 YES manual up up
GigabitEthernet0/1.99 172.17.99.1 YES manual up up
Vlan1 unassigned YES unset administratively down down
```

Switch S1

```
S1#show running-config
Building configuration...

Current configuration : 2258 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S1
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
shutdown
!
interface FastEthernet0/2
shutdown
!
interface FastEthernet0/3
shutdown
!
interface FastEthernet0/4
shutdown
!
interface FastEthernet0/5
shutdown
!
interface FastEthernet0/6
switchport access vlan 30
switchport mode access
!
interface FastEthernet0/7
switchport access vlan 30
switchport mode access
!
interface FastEthernet0/8
switchport access vlan 30
switchport mode access
```

```
!
interface FastEthernet0/9
switchport access vlan 30
switchport mode access
!
interface FastEthernet0/10
switchport access vlan 30
switchport mode access
!
interface FastEthernet0/11
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/12
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/13
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/14
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/15
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/16
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/17
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/18
switchport access vlan 20
switchport mode access
!
interface FastEthernet0/19
switchport access vlan 20
switchport mode access
!
interface FastEthernet0/20
switchport access vlan 20
switchport mode access
!
interface FastEthernet0/21
switchport access vlan 20
switchport mode access
!
interface FastEthernet0/22
switchport access vlan 20
switchport mode access
!
interface FastEthernet0/23
switchport access vlan 20
```

```
switchport mode access
!
interface FastEthernet0/24
switchport access vlan 20
switchport mode access
!
interface GigabitEthernet0/1
switchport trunk native vlan 88
switchport mode trunk
!
interface GigabitEthernet0/2
shutdown
!
interface Vlan1
no ip address
shutdown
!
interface Vlan99
ip address 172.17.99.10 255.255.255.0
!
ip default-gateway 172.17.99.1
!
!
!
!
!
!
line con 0
!
line vty 0 4
login
line vty 5 15
login
!
!
!
!
End
```

```
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Gig0/2
10   Faculty/Staff                    active    Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17
20   Students                         active    Fa0/18, Fa0/19, Fa0/20, Fa0/21
                                                Fa0/22, Fa0/23, Fa0/24
30   Guest(Default)                   active    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10
88   Native                           active
99   Management                       active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

```
S1# show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/1 unassigned YES manual administratively down down
FastEthernet0/2 unassigned YES manual administratively down down
FastEthernet0/3 unassigned YES manual administratively down down
FastEthernet0/4 unassigned YES manual administratively down down
FastEthernet0/5 unassigned YES manual administratively down down
FastEthernet0/6 unassigned YES manual up up
FastEthernet0/7 unassigned YES manual down down
FastEthernet0/8 unassigned YES manual down down
FastEthernet0/9 unassigned YES manual down down
FastEthernet0/10 unassigned YES manual down down
FastEthernet0/11 unassigned YES manual up up
FastEthernet0/12 unassigned YES manual down down
FastEthernet0/13 unassigned YES manual down down
FastEthernet0/14 unassigned YES manual down down
FastEthernet0/15 unassigned YES manual down down
FastEthernet0/16 unassigned YES manual down down
FastEthernet0/17 unassigned YES manual down down
FastEthernet0/18 unassigned YES manual up up
FastEthernet0/19 unassigned YES manual down down
FastEthernet0/20 unassigned YES manual down down
FastEthernet0/21 unassigned YES manual down down
FastEthernet0/22 unassigned YES manual down down
FastEthernet0/23 unassigned YES manual down down
FastEthernet0/24 unassigned YES manual down down
GigabitEthernet0/1 unassigned YES manual up up
GigabitEthernet0/2 unassigned YES manual administratively down down
Vlan1 unassigned YES manual administratively down down
Vlan99 172.17.99.10 YES manual up up
S1#
```

3.7.4.1.7 Test

PC1 pings

PC1

Desktop Programming

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.17.25.2

Pinging 172.17.25.2 with 32 bytes of data:

Reply from 172.17.25.2: bytes=32 time=2ms TTL=255
Reply from 172.17.25.2: bytes=32 time<1ms TTL=255
Reply from 172.17.25.2: bytes=32 time<1ms TTL=255
Reply from 172.17.25.2: bytes=32 time<1ms TTL=255

Ping statistics for 172.17.25.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>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 = 1ms, Average = 0ms
```

```
C:\>ping 172.17.20.1

Pinging 172.17.20.1 with 32 bytes of data:

Reply from 172.17.20.1: bytes=32 time<1ms TTL=255
Reply from 172.17.20.1: bytes=32 time<1ms TTL=255
Reply from 172.17.20.1: bytes=32 time<1ms TTL=255
Reply from 172.17.20.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.17.20.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.17.30.1

Pinging 172.17.30.1 with 32 bytes of data:

Reply from 172.17.30.1: bytes=32 time<1ms TTL=255
Reply from 172.17.30.1: bytes=32 time<1ms TTL=255
Reply from 172.17.30.1: bytes=32 time<1ms TTL=255
Reply from 172.17.30.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.17.30.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.17.88.1

Pinging 172.17.88.1 with 32 bytes of data:

Reply from 172.17.88.1: bytes=32 time<1ms TTL=255
Reply from 172.17.88.1: bytes=32 time<1ms TTL=255
Reply from 172.17.88.1: bytes=32 time<1ms TTL=255
Reply from 172.17.88.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.17.88.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
```

```
Pinging 172.17.99.1 with 32 bytes of data:

Reply from 172.17.99.1: bytes=32 time<1ms TTL=255
Reply from 172.17.99.1: bytes=32 time<1ms TTL=255
Reply from 172.17.99.1: bytes=32 time<1ms TTL=255
Reply from 172.17.99.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.17.99.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.17.99.10

Pinging 172.17.99.10 with 32 bytes of data:

Request timed out.
Request timed out.
Reply from 172.17.99.10: bytes=32 time<1ms TTL=254
Reply from 172.17.99.10: bytes=32 time<1ms TTL=254

Ping statistics for 172.17.99.10:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.17.20.22

Pinging 172.17.20.22 with 32 bytes of data:

Request timed out.
Reply from 172.17.20.22: bytes=32 time<1ms TTL=127
Reply from 172.17.20.22: bytes=32 time=1ms TTL=127
Reply from 172.17.20.22: bytes=32 time=7ms TTL=127

Ping statistics for 172.17.20.22:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 7ms, Average = 2ms

C:\>
```

```
C:\>ping 172.17.30.23

Pinging 172.17.30.23 with 32 bytes of data:

Request timed out.
Reply from 172.17.30.23: bytes=32 time<1ms TTL=127
Reply from 172.17.30.23: bytes=32 time<1ms TTL=127
Reply from 172.17.30.23: bytes=32 time<1ms TTL=127

Ping statistics for 172.17.30.23:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.17.50.254

Pinging 172.17.50.254 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Reply from 172.17.50.254: bytes=32 time<1ms TTL=126

Ping statistics for 172.17.50.254:
    Packets: Sent = 4, Received = 1, Lost = 3 (75% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.17.50.254

Pinging 172.17.50.254 with 32 bytes of data:

Reply from 172.17.50.254: bytes=32 time<1ms TTL=126
Reply from 172.17.50.254: bytes=32 time<1ms TTL=126
Reply from 172.17.50.254: bytes=32 time<1ms TTL=126
Reply from 172.17.50.254: bytes=32 time<1ms TTL=126

Ping statistics for 172.17.50.254:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
```

S1 PINGS

```
S1#ping 172.17.25.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.25.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/1/7 ms

S1#ping 172.17.10.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 172.17.20.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 172.17.30.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.30.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 172.17.88.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.88.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

```
S1#ping 172.17.99.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.99.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 172.17.99.10

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.99.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/7/13 ms

S1#ping 172.17.10.21

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.10.21, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

```
S1#ping 172.17.20.22

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.20.22, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#ping 172.17.30.23

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.30.23, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

S1#
```

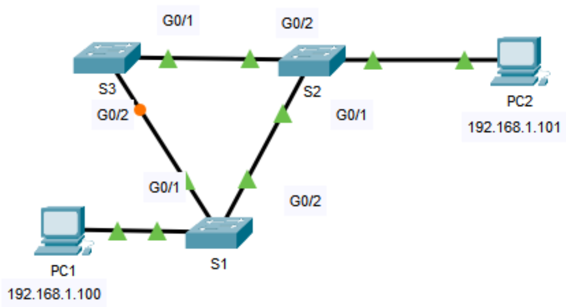
R1 PINGS

```
R1>enable
R1#ping 172.17.99.10

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.99.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

R1#ping 172.17.10.21

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.10.21, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

R1#ping 172.17.20.22

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.20.22, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

R1#ping 172.17.30.23

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.30.23, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/3 ms

R1#ping 172.17.50.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.50.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

R1#
```

3.8 Netacad Module 5 - STP Concepts

3.8.1 Exercise 5.1.9 Packet Tracer - Investigate STP Loop Prevention

3.8.1.1 Topology



3.8.1.2 Objectives

In this lab, you will observe spanning-tree port states and watch the spanning-tree convergence process.

- Describe the operation of Spanning Tree Protocol.
- Explain how Spanning Tree Protocol prevents switching loops while allowing redundancy in switched networks.

3.8.1.3 Background / Scenario

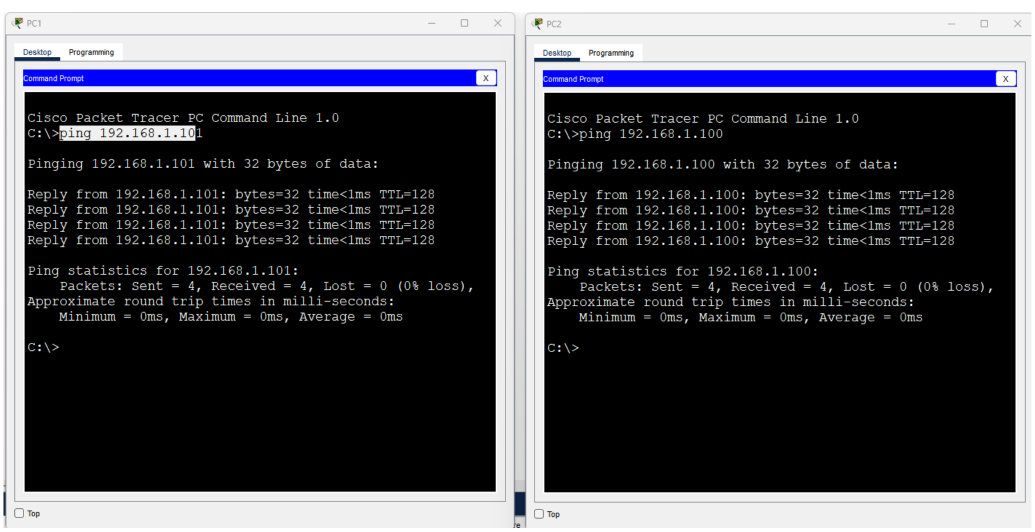
In this activity you will use Packet Tracer to observe the operation of Spanning Tree Protocol in a simple switched network that has redundant paths.

3.8.1.4 Instructions

3.8.1.4.1 Part 1: Observe a Converged Spanning-Tree Instance

Step 1: Verify Connectivity.

Ping from PC1 to PC2 to verify connectivity between the hosts. Your ping should be successful.



Step 2: View spanning-tree status on each switch.

Use the **show spanning-tree vlan 1** command to gather information about the spanning tree status of each switch. Complete the table. For the purposes of the activity, only consider information about the Gigabit trunk ports. The Fast

Ethernet ports are access ports that have end devices connected and are not part of the inter-switch trunk-based spanning tree.

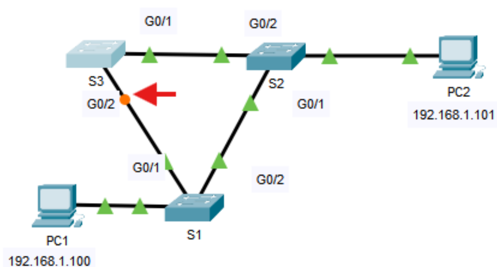
```
S1#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.6448.C6E7
             Cost        4
             Port        26(GigabitEthernet0/2)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000B.BE31.D3DA
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Gi0/1            Desg FWD 4         128.25   P2p
Gi0/2            Root FWD 4         128.26   P2p
```

```
S2#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.6448.C6E7
             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     0001.6448.C6E7
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Gi0/2            Desg FWD 4         128.26   P2p
Gi0/1            Desg FWD 4         128.25   P2p

S2#
```

```
S3#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.6448.C6E7
             Cost        4
             Port        25(GigabitEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000C.CF45.7534
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi0/1            Root FWD 4         128.25   P2p
Gi0/2            Altn BLK 4         128.26   P2p

S3#
```

Switch	Port	Status (FWD, BLK…)	Root Bridge?
S1	G0/1	*FWD*	*NO*
	G0/2	*FWD*	*NO*
S2	G0/1	*FWD*	*YES*
	G0/2	*FWD*	*YES*
S3	G0/1	*FWD*	*NO*
	G0/2	*BLK*	*NO*

Packet Tracer uses a different link light on one of the connections between the switches.



What do you think this this link light means?

ANSWER - It indicates that the port is not forwarding frames because it is in a spanning-tree state, in this case the blocking state.

What path will frames take from PC1 to PC2?

ANSWER - They will go from S1 to S2.

Why do the frames not travel through S3?

ANSWER - There main reason is that spanning tree has placed port G0/2 on S3 in blocking mode. No frames are sent or received on that port..

Why has spanning tree placed a port in blocking state?

ANSWER - If all ports could forward frames, a switching loop would exist in the network. Switching loops can degrade network performance and even cause a network to fail.

3.8.1.4.2 Part 2: Observe spanning-tree convergence

Step 1: Remove the connection between S1 and S2.

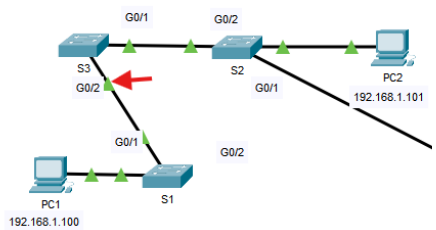
a. Open a CLI window on switch S3 and issue the command **show spanning-tree vlan 1**. Leave the CLI window open.

b. Select the delete tool from the menu bar and click the cable that connects S1 and S2.

Step 2: Observe spanning-tree convergence.

a. Quickly return to the CLI prompt on switch S3 and issue the **show spanning-tree vlan 1** command.

b. Use the up-arrow key to recall the **show spanning-tree vlan 1** command and issue it repeatedly until the orange link light on the cable turns green. Observe the status of port G0/2.



What do you see happen to the status of the G0/2 port during this process?

ANSWER - First it was BLK, it then became LSN (listening), then LRN (learning), and finally FWD for forwarding.

```
S3#
S3#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.6448.C6E7
             Cost        4
             Port        25(GigabitEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000C.CF45.7534
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- ------------------------
Gi0/1            Root FWD 4         128.25   P2p
Gi0/2            Altn BLK 4         128.26   P2p

S3#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.6448.C6E7
             Cost        4
             Port        25(GigabitEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000C.CF45.7534
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- ------------------------
Gi0/1            Root FWD 4         128.25   P2p
Gi0/2            Desg LRN 4         128.26   P2p
```

```
S3#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.6448.C6E7
             Cost        4
             Port        25(GigabitEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000C.CF45.7534
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- ------------------------
Gi0/1            Root FWD 4         128.25   P2p
Gi0/2            Desg LRN 4         128.26   P2p

S3#show spanning-tree vlan 1
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.6448.C6E7
             Cost        4
             Port        25(GigabitEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000C.CF45.7534
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- ------------------------
Gi0/1            Root FWD 4         128.25   P2p
Gi0/2            Desg FWD 4         128.26   P2p

S3#
```

You have observed the transition in port status that occurs as a spanning-tree port moves from blocking to forwarding state.

b. Verify Connectivity by pinging from PC1 to PC2. Your ping should be successful.

```
C:\>ping 192.168.1.101

Pinging 192.168.1.101 with 32 bytes of data:

Reply from 192.168.1.101: bytes=32 time=5ms TTL=128
Reply from 192.168.1.101: bytes=32 time<1ms TTL=128
Reply from 192.168.1.101: bytes=32 time<1ms TTL=128
Reply from 192.168.1.101: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.101:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 5ms, Average = 1ms

C:\>
```

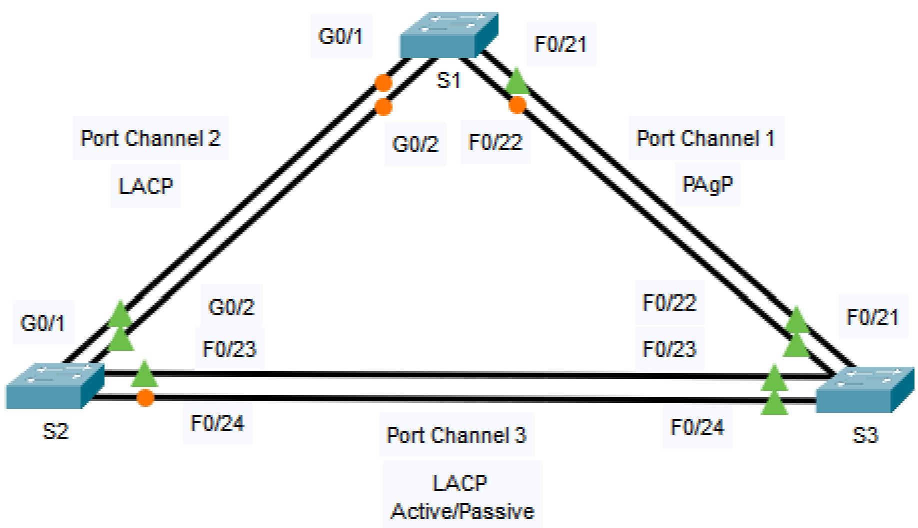
Are any ports showing an orange link light that indicates that the port is in a spanning-tree state other than forwarding? Why or why not?

ANSWER - No orange link lights are shown because they are no longer redundant paths in the network.

3.9 Netacad Module 6 - Etherchannel

3.9.1 Exercise 6.2.4 - Packet Tracer - Configure EtherChannel

3.9.1.1 Topology



Three switches (S1, S2, S3) connected as follows:

- S1 - S3: FastEthernet 21-22 (Port-Channel 1 - PAP)
- S1 - S2: GigabitEthernet 0/1-2 (Port-Channel 2 - LACP)
- S2 - S3: FastEthernet 23-24 (Port-Channel 3 - LACP - Passive/Active)

3.9.1.2 Objectives

Part 1: Configure Basic Switch Settings
Part 2: Configure an EtherChannel with Cisco PAgP
Part 3: Configure an 802.3ad LACP EtherChannel
Part 4: Configure a Redundant EtherChannel Link

3.9.1.3 Background

Three switches have just been installed. There are redundant uplinks between the switches. As configured, only one of these links can be used; otherwise, a bridging loop might occur. However, using only one link utilizes only half of the available bandwidth. EtherChannel allows up to eight redundant links to be bundled together into one logical link. In this lab, you will configure Port Aggregation Protocol (PAgP), a Cisco EtherChannel protocol, and Link Aggregation Control Protocol (LACP), an IEEE 802.3ad open standard version of EtherChannel.

Before beginning the configuration, review the EtherChannel Configuration Guidelines and Restrictions listed at the end of this activity.

Port Channel Table

Channel Group	Ports	Protocol
1	S1 F0/21. F0/22 S3 F0/21, F0/22	PAgP
2	S1 G0/1, G0/2 S2 G0/1, G0/2	LACP
3	S2 F0/23, F0/24 S3 F0/23, F0/24	Negotiated LACP

3.9.1.4 Instructions

3.9.1.4.1 Part 1: Configure Basic Switch Settings

a. Assign each switch a hostname according to the topology diagram.

```
! S1
enable
configure terminal
hostname S1

! S2
enable
configure terminal
hostname S2

! S3
enable
configure terminal
hostname S3
```

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

```
Switch>
Switch>
Switch>! S2
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S2
S2(config)#
S2(config)#
```

```
Switch>
Switch>
Switch>! S3
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S3
S3(config)#
```

b. Before beginning the link aggregation between switches, verify the existing configuration of the ports that connect the switches to ensure that the ports will successfully join the EtherChannels. Commands that provide information about the state of the switch ports include:

```
Sx# show interfaces | include Ethernet
Sx# show interface status
Sx# show interfaces trunk
```

S1

```
S1#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is down, line protocol is down (disabled)
FastEthernet0/24 is down, line protocol is down (disabled)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
S1#
```

```
S1#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    1          auto    auto  10/100BaseTX
Fa0/22                       connected    1          auto    auto  10/100BaseTX
Fa0/23                       notconnect   1          auto    auto  10/100BaseTX
Fa0/24                       notconnect   1          auto    auto  10/100BaseTX
Gig0/1                       connected    1          auto    auto  10/100BaseTX
Gig0/2                       connected    1          auto    auto  10/100BaseTX

S1#
```

```
S1#show interfaces trunk

S1#
```

S2

```
S2#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is down, line protocol is down (disabled)
FastEthernet0/22 is down, line protocol is down (disabled)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
S2#
```

```
S2#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       notconnect   1          auto    auto  10/100BaseTX
Fa0/22                       notconnect   1          auto    auto  10/100BaseTX
Fa0/23                       connected    1          auto    auto  10/100BaseTX
Fa0/24                       connected    1          auto    auto  10/100BaseTX
Gig0/1                       connected    1          auto    auto  10/100BaseTX
Gig0/2                       connected    1          auto    auto  10/100BaseTX
```

```
S2#show interfaces trunk
```

S3

```
S3#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is down, line protocol is down (disabled)
GigabitEthernet0/2 is down, line protocol is down (disabled)
```

```
S3#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    1          auto    auto  10/100BaseTX
Fa0/22                       connected    1          auto    auto  10/100BaseTX
Fa0/23                       connected    1          auto    auto  10/100BaseTX
Fa0/24                       connected    1          auto    auto  10/100BaseTX
Gig0/1                       notconnect   1          auto    auto  10/100BaseTX
Gig0/2                       notconnect   1          auto    auto  10/100BaseTX

S3#
```

```
S3#show interfaces trunk

S3#
```

c. Configure all ports that are required for the EtherChannels as static trunk ports.

Note: If the ports are configured with DTP dynamic auto mode, and you do not set the mode of the ports to trunk, the links do not form trunks and remain access ports. The default mode on a 2960 switch is for DTP to be enabled and set to dynamic auto. DTP can be disabled on interfaces with the **`switchport nonegotiate`** command.

3.9.1.4.2 Part 2: Configure an EtherChannel with Cisco PAgP

Note: When configuring EtherChannels, it is recommended to shut down the physical ports being grouped on both devices before configuring them into channel groups. Otherwise, EtherChannel Misconfig Guard may place these ports into err-disabled state. The ports and port channels can be re-enabled after EtherChannel is configured.

Step 1: Configure Port Channel 1.

a. The first EtherChannel that is created for this activity aggregates ports F0/21 and F0/22 between S1 and S3. Configure the ports on both switches as static trunk ports.

S1 - S3: FastEthernet 21-22 (Port-Channel 1 - PAP)

```
! S1
interface range f0/21-22
switchport mode trunk
switchport nonegotiate
```

```
CNTL/Z.
S1(config)#! S1
S1(config)#interface range f0/21-22
S1(config-if-range)#switchport mode trunk


S1(config-if-range)#switchport nonegotiate
S1(config-if-range)#
```

```
! S3
interface range f0/21-22
switchport mode trunk
switchport nonegotiate
```

```
S3(config)#interface range f0/21-22
S3(config-if-range)#switchport mode trunk


S3(config-if-range)#switchport nonegotiate
S3(config-if-range)#
```

b. Use the show interfaces trunk command to ensure that you have an active trunk link for those two links, and the native VLAN on both links is the same.

```
S1# show interfaces trunk
```

```
S1#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/21      on           802.1q         trunking      1
Fa0/22      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/21      1-1005
Fa0/22      1-1005

Port        Vlans allowed and active in management domain
Fa0/21      1
Fa0/22      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/21      1
Fa0/22      none

S1#
```

```
S3# show interfaces trunk
```

```
S3#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/21      on           802.1q         trunking      1
Fa0/22      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/21      1-1005
Fa0/22      1-1005

Port        Vlans allowed and active in management domain
Fa0/21      1
Fa0/22      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/21      1
Fa0/22      1
```

c. On S1 and S3, add ports F0/21 and F0/22 to Port Channel 1 with the channel-group 1 mode desirable command. The mode desirable option enables the switch to actively negotiate to form a PAgP link. Note: Interfaces must be shutdown before adding them to the channel group.

```
S1(config)# interface range f0/21 – 22
S1(config-if-range)# shutdown
S1(config-if-range)# channel-group 1 mode desirable
S1(config-if-range)# no shutdown
```

```
S3(config)#interface range f0/21 - 22
S3(config-if-range)# shutdown

S3(config-if-range)# channel-group 1 mode desirable
S3(config-if-range)# no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/21, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to down

%LINK-5-CHANGED: Interface FastEthernet0/22, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to down

Creating a port-channel interface Port-channel 1


S3(config-if-range)#
%LINK-5-CHANGED: Interface FastEthernet0/21, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to up

%LINK-5-CHANGED: Interface FastEthernet0/22, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to up

%LINK-5-CHANGED: Interface Port-channel1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state to up

S3(config-if-range)#
```

```
S3(config)# interface range f0/21 - 22
S3(config-if-range)# shutdown
S3(config-if-range)# channel-group 1 mode desirable
S3(config-if-range)# no shutdown
```

```
S3(config)#interface range f0/21 - 22
S3(config-if-range)# shutdown

S3(config-if-range)# channel-group 1 mode desirable
S3(config-if-range)# no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/21, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to down

%LINK-5-CHANGED: Interface FastEthernet0/22, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to down

Creating a port-channel interface Port-channel 1


S3(config-if-range)#
%LINK-5-CHANGED: Interface FastEthernet0/21, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to up

%LINK-5-CHANGED: Interface FastEthernet0/22, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to up

%LINK-5-CHANGED: Interface Port-channel1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state to up

S3(config-if-range)#
```

The message "Creating a port-channel interface Port-channel 1" should appear on both switches when the channel-group is configured. This interface designation will appear as Po1 in command output.

d. Configure the logical interface to become a trunk by first entering the interface port-channel *number* command and then the switchport mode trunk command. Add this configuration to both switches.

```
S1(config)# interface port-channel 1
S1(config-if)# switchport mode trunk
```

```
S1(config-if-range)#interface port-channel 1
S1(config-if)# switchport mode trunk
S1(config-if)#
```

```
S3(config)# interface port-channel 1
S3(config-if)# switchport mode trunk
```

```
S3(config-if-range)#interface port-channel 1
S3(config-if)# switchport mode trunk
S3(config-if)#
```

Step 2: Verify Port Channel 1 status.

a. Issue the show etherchannel summary command on S1 and S3 to verify that EtherChannel is working on both switches. This command displays the type of EtherChannel, the ports utilized, and the port states. Command output is shown for S1.
`S1# show etherchannel summary`

```
S1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------------------------

1      Po1(SU)           PAgP   Fa0/21(P)  Fa0/22(P)
S1#
```

`S3# show etherchannel summary`

```
S3#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------------------------

1      Po1(SU)           PAgP   Fa0/21(P)  Fa0/22(P)
S3#
```

b. If the EtherChannel does not come up, shut down the physical interfaces on both ends of the EtherChannel and then bring them back up again. The **`show interfaces trunk`** and **`show spanning-tree`** commands should show the port channel as one logical link.

```
S1#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005

Port        Vlans allowed and active in management domain
Po1         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1

S1#
```

```
S3#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005

Port        Vlans allowed and active in management domain
Po1         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1

S3#
```

c.

```
S1#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.436E.8494
             Cost        12
             Port        27(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000A.F313.2395
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Root FWD 12        128.27   Shr
Gi0/1            Desg FWD 4         128.25   P2p
Gi0/2            Desg FWD 4         128.26   P2p

S1#
```

```
S3#show spa
S3#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.436E.8494
             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     0001.436E.8494
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/23           Desg FWD 19        128.23   P2p
Fa0/24           Desg FWD 19        128.24   P2p
Po1              Desg FWD 12        128.27   Shr

S3#
```

3.9.1.4.3 Part 3: Configure an 802.3ad LACP EtherChannel

Step 1: Configure Port Channel 2.

a. In 2000, the IEEE released 802.3ad, which is an open standard version of EtherChannel. It is commonly referred to as LACP. Using the previous commands, configure the link between S1 and S2, using ports G0/1 and G0/2, as an LACP EtherChannel. You must use a different port channel number on S1 than 1, because you already used that in the previous step. To configure port channel 2 as LACP, use the interface configuration mode channel-group *2* mode active command. Active mode indicates that the switch actively tries to negotiate that link as LACP, as opposed to PAgP. The configuration of S1 is shown below.

S1 - S2: GigabitEthernet 0/1-2 (Port-Channel 2 - LACP)

```
S1(config)# interface range g0/1 - 2
S1(config-if-range)# shutdown
S1(config-if-range)# channel-group 2 mode active
S1(config-if-range)# no shutdown
S1(config-if-range)# interface port-channel 2
S1(config-if)# switchport mode trunk
```

```
S1(config)#interface range g0/1 - 2
S1(config-if-range)# switchport mode trunk

S1(config-if-range)# shutdown

S1(config-if-range)# channel-group 2 mode active
S1(config-if-range)# no shutdown

S1(config-if-range)#interface port-channel 2
S1(config-if)# switchport mode trunk
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

Creating a port-channel interface Port-channel 2

%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

S1(config-if)#
```

```
S2(config)# interface range g0/1 - 2
S2(config-if-range)# shutdown
S2(config-if-range)# channel-group 2 mode active
S2(config-if-range)# no shutdown
S2(config-if-range)# interface port-channel 2
S2(config-if)# switchport mode trunk
```

```
S2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#interface range g0/1 - 2
S2(config-if-range)# switchport mode trunk
S2(config-if-range)# shutdown


S2(config-if-range)# channel-group 2 mode active
S2(config-if-range)# no shutdown


S2(config-if-range)#interface port-channel 2
S2(config-if)# switchport mode trunk
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to dowr

%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to dowr

Creating a port-channel interface Port-channel 2

%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

%LINK-5-CHANGED: Interface Port-channel2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel2, changed state to up

S2(config-if)#
```

Step 2: Verify Port Channel 2 status.

Use the show commands from Part 1 Step 2 to verify the status of Port Channel 2. Look for the protocol used by each port.

```
S1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------
+----------------------------------------------

1      Po1(SU)           PAgP   Fa0/21(P) Fa0/22(P)
2      Po2(SU)           LACP   Gig0/1(P) Gig0/2(P)
S1#
```

```
S2#show etherch
S2#show etherchannel su
S2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------
+----------------------------------------------

2      Po2(SU)           LACP   Gig0/1(P) Gig0/2(P)
S2#
```

```
S1#
S1#
S1#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.436E.8494
             Cost        12
             Port        27(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000A.F313.2395
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Root FWD 12        128.27   Shr
Po2              Desg FWD 3         128.28   Shr

S1#
```

```
S2#show spa
S2#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.436E.8494
             Cost        15
             Port        27(Port-channel2)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0009.7CEC.E166
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/24           Altn BLK 19        128.24   P2p
Fa0/23           Altn BLK 19        128.23   P2p
Po2              Root FWD 3         128.27   Shr

S2#
```

```
S1#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po2         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005
Po2         1-1005

Port        Vlans allowed and active in management domain
Po1         1
Po2         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1
Po2         1

S1#
```

```
S2#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005

Port        Vlans allowed and active in management domain
Po2         1

Port        Vlans in spanning tree forwarding state and not pruned
Po2         1

S2#
S2#
S2#
S2#
S2#
```

3.9.1.4.4 Part 4: Configure a Redundant EtherChannel Link

Step 1: Configure Port Channel 3.

There are diverse options for the channel-group *number* mode command:

```
S2(config)# interface range f0/23 - 24
S2(config-if-range)# channel-group 3 mode ?
active Enable LACP unconditionally
auto Enable PAgP only if a PAgP device is detected
desirable Enable PAgP unconditionally
on Enable Etherchannel only
passive Enable LACP only if a LACP device is detected
```

a. On switch S2, add ports F0/23 and F0/24 to Port Channel 3 with the channel-group 3 mode passive command. The passive option indicates that you want the switch to use LACP only if another LACP device is detected. Statically configure Port Channel 3 as a trunk interface.

```
S2(config)# interface range f0/23 - 24
S2(config-if-range)# shutdown
S2(config-if-range)# channel-group 3 mode passive
S2(config-if-range)# no shutdown
S2(config-if-range)# interface port-channel 3
S2(config-if)# switchport mode trunk
```

```
S2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#interface range f0/23 - 24
S2(config-if-range)# channel-group 3 mode passive
S2(config-if-range)# no shutdown
S2(config-if-range)#interface port-channel 3
S2(config-if)# switchport mode trunk
S2(config-if)# end
Creating a port-channel interface Port-channel 3

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up

S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#
```

b. On S3, add ports F0/23 and F0/24 to Port Channel 3 with the channel-group 3 mode active command. The active option indicates that you want the switch to use LACP unconditionally. Statically configure Port Channel 3 as a trunk interface.

```
S3#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#interface range f0/23 - 24
S3(config-if-range)# shutdown

S3(config-if-range)# channel-group 3 mode active
S3(config-if-range)# no shutdown

S3(config-if-range)#interface port-channel 3
S3(config-if)# switchport mode trunk
S3(config-if)#end
%LINK-5-CHANGED: Interface FastEthernet0/23, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to dow

%LINK-5-CHANGED: Interface FastEthernet0/24, changed state to administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to dow

Creating a port-channel interface Port-channel 3

%LINK-5-CHANGED: Interface FastEthernet0/23, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up

%LINK-5-CHANGED: Interface FastEthernet0/24, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up

S3#
%SYS-5-CONFIG_I: Configured from console by console

%LINK-5-CHANGED: Interface Port-channel3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel3, changed state to up

S3#
```

Step 2: Verify Port Channel 3 status.

a. Use the show commands from Part 1 Step 2 to verify the status of Port Channel 3. Look for the protocol used by each port.

```
S2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------
+----------------------------------------------

2      Po2(SU)           LACP   Gig0/1(P) Gig0/2(P)
3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)
S2#
```

```
S3#show et
S3#show etherchannel summ
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------
+----------------------------------------------

1      Po1(SU)           PAgP   Fa0/21(P) Fa0/22(P)
3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)
S3#
```

```
S2#
S2#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1
Po3         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005
Po3         1-1005

Port        Vlans allowed and active in management domain
Po2         1
Po3         1

Port        Vlans in spanning tree forwarding state and not pruned
Po2         1
Po3         1

S2#
```

```
S3#show interfa
S3#show interfaces tru
S3#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po3         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005
Po3         1-1005

Port        Vlans allowed and active in management domain
Po1         1
Po3         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1
Po3         1

S3#
```

```
S2#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.436E.8494
             Cost        12
             Port        28(Port-channel3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0009.7CEC.E166
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

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

Po2              Desg FWD 3         128.27   Shr
Po3              Root FWD 12        128.28   Shr

S2#
S2#
S2#
S2#
```

```
S3#show spa
S3#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.436E.8494
             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     0001.436E.8494
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15
sec
             Aging Time  20

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

Po1              Desg FWD 12        128.27   Shr
Po3              Desg FWD 12        128.28   Shr

S3#
```

b. Creating EtherChannel links does not prevent Spanning Tree from detecting switching loops. View the spanning tree status of the active ports on S1.

S1# show spanning-tree active

```
S1#show spanning-tree active
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.436E.8494
             Cost        12
             Port        27(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     000A.F313.2395
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Root FWD 12        128.27   Shr
Po2              Altn BLK 3         128.28   Shr

S1#
```

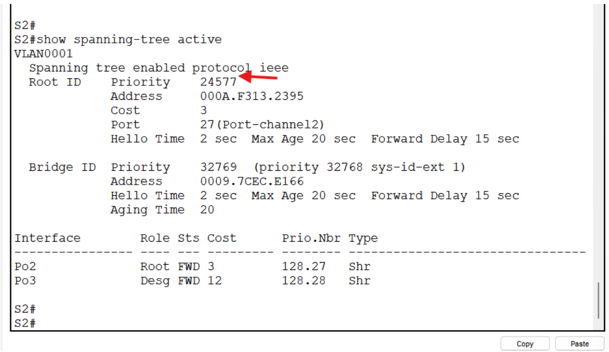
Port Channel 2 is not operative because Spanning Tree Protocol placed some ports into blocking mode. Unfortunately, those ports were the Gigabit ports. In this topology, you can restore these ports by configuring S1 to be primary root for VLAN 1. You could also set the priority to 24576.

S1(config)# spanning-tree vlan 1 root primary
or
S1(config)# spanning-tree vlan 1 priority 24576

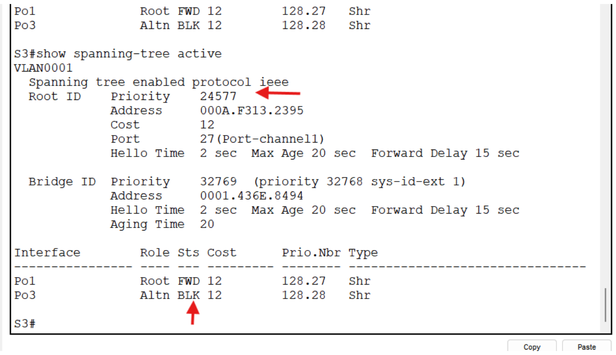
```
S1#enable
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#spanning-tree vlan 1 root primary
S1(config)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#
```

You may have to wait for STP to recalculate the tree topology. Press fast-forward if necessary. Use the show spanning-tree active command to verify that the Gigabit ports are now in the forwarding state.

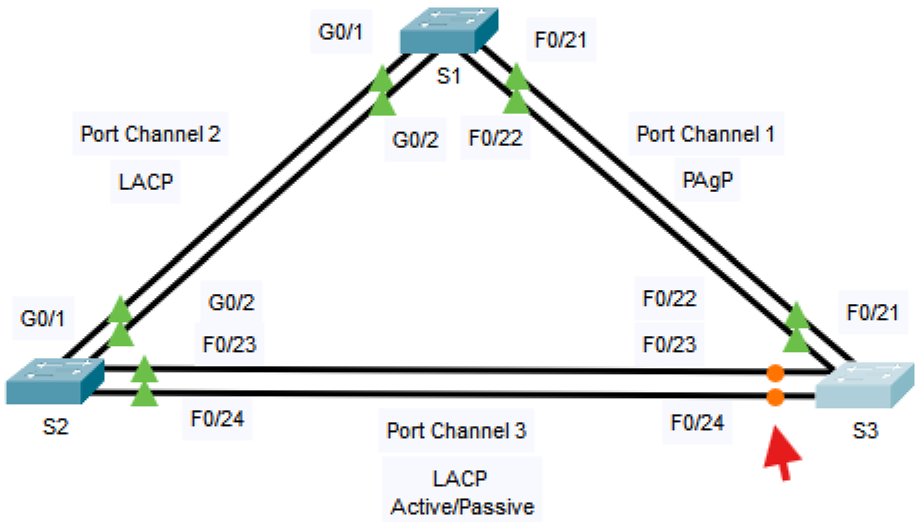
```
S1#show spanning-tree active
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     000A.F313.2395
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24577  (priority 24576 sys-id-ext 1)
             Address     000A.F313.2395
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Desg FWD 12        128.27   Shr
Po2              Desg FWD 3         128.28   Shr

S1#
```



```
S2#
S2#show spanning-tree active
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     000A.F313.2395
             Cost        3
             Port        27(Port-channel2)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0009.7CEC.E166
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po2              Root FWD 3         128.27   Shr
Po3              Desg FWD 12        128.28   Shr

S2#
S2#
```



```
Po1              Root FWD 12        128.27   Shr
Po3              Altn BLK 12        128.28   Shr

S3#show spanning-tree active
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     000A.F313.2395
             Cost        12
             Port        27(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0001.436E.8494
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Root FWD 12        128.27   Shr
Po3              Altn BLK 12        128.28   Shr

S3#
```



3.9.1.5 EtherChannel Configuration Guidelines and Restrictions

EtherChannel has some specific guidelines that must be followed in order to avoid configuration problems.

1) All Ethernet interfaces support EtherChannel up to a maximum of eight interfaces with no requirement that the interfaces be on the same interface module.
2) All interfaces within an EtherChannel must operate at the same speed and duplex.
3) EtherChannel links can function as either single VLAN access ports or as trunk links between switches.
4) All interfaces in a Layer 2 EtherChannel must be members of the same VLAN or be configured as trunks.
5) If configured as trunk links, Layer 2 EtherChannel must have the same native VLAN and have the same VLANs allowed on both switches connected to the trunk.
6) When configuring EtherChannel links, all interfaces should be shutdown prior to beginning the EtherChannel configuration. When configuration is complete, the links can be re-enabled.
7) After configuring the EtherChannel, verify that all interfaces are in the up/up state.
8) It is possible to configure an EtherChannel as static, or for it to use either PAgP or LACP to negotiate the EtherChannel connection. The determination of how an EtherChannel is setup is the value of the channel-group *number* mode command. Valid values are:

   active LACP is enabled unconditionally
   passive LACP is enabled only if another LACP-capable device is connected.
   desirable PAgP is enabled unconditionally
   auto PAgP is enabled only if another PAgP-capable device is connected.
   on EtherChannel is enabled, but without either LACP or PAgP.

9) LAN ports can form an EtherChannel using PAgP if the modes are compatible. Compatible PAgP modes are:

   desirable => desirable

desirable => auto

If both interfaces are in auto mode, an Etherchannel cannot form.

10) LAN ports can form an EtherChannel using LACP if the modes are compatible. Compatible LACP modes are:

    active => active

    active => passive

    If both interfaces are in passive mode, an EtherChannel cannot form using LACP.

11) Channel-group numbers are local to the individual switch. Although this activity uses the same Channel-group number on either end of the EtherChannel connection, it is not a requirement. Channel-group 1 (interface po1) on one switch can form an EtherChannel with Channel-group 5 (interface po5) on another switch.

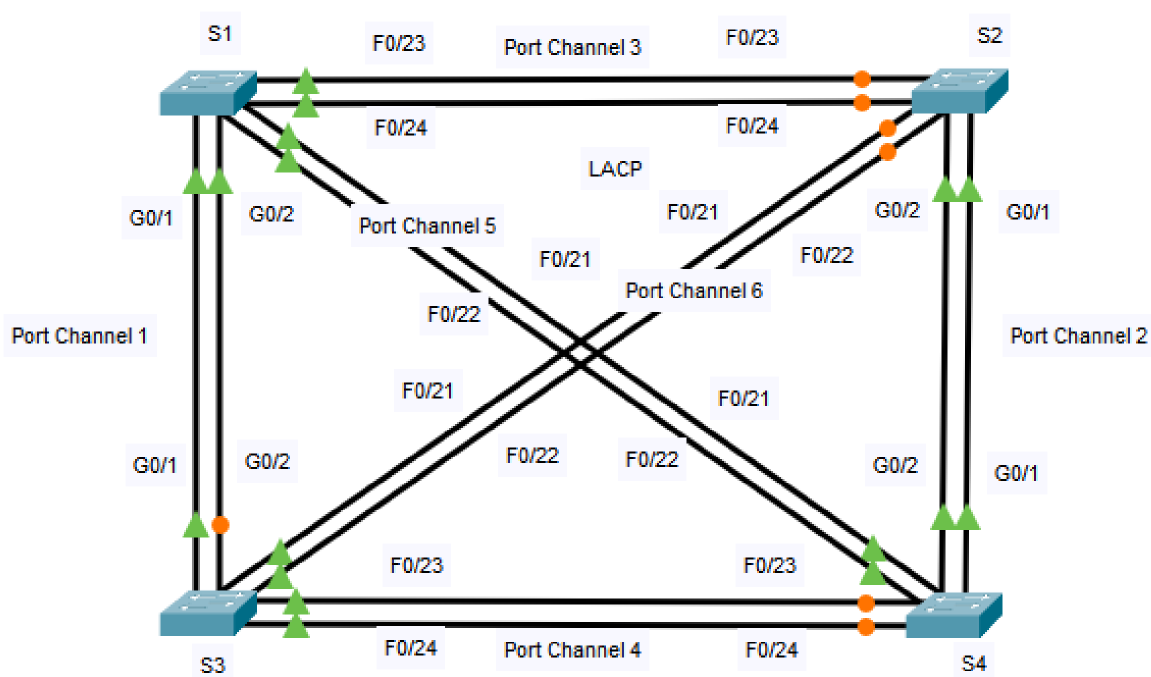
3.9.1.6 Scripts

```
!SW1
enable
config terminal
no ip domain-lookup
hostname S1
interface range f0/21 – 22
 switchport mode trunk
 shutdown
 channel-group 1 mode desirable
 no shutdown
interface port-channel 1
 switchport mode trunk
interface range g0/1 - 2
 switchport mode trunk
 shutdown
 channel-group 2 mode active
 no shutdown
interface port-channel 2
 switchport mode trunk
spanning-tree vlan 1 root primary
end
copy running-config startup-config


!SW2
enable
config terminal
no ip domain-lookup
hostname S2
interface range g0/1 - 2
 switchport mode trunk
 shutdown
 channel-group 2 mode active
 no shutdown
interface port-channel 2
 switchport mode trunk
interface range f0/23 - 24
 switchport mode trunk
 shutdown
 channel-group 3 mode passive
 no shutdown
interface port-channel 3
 switchport mode trunk
 end
copy running-config startup-config


!SW 3
enable
config terminal
no ip domain-lookup
hostname S3
interface range f0/21 – 22
 switchport mode trunk
 shutdown
 channel-group 1 mode desirable
 no shutdown
interface port-channel 1
```

```
 switchport mode trunk
interface range f0/23 - 24
 switchport mode trunk
 shutdown
 channel-group 3 mode active
 no shutdown
interface port-channel 3
 switchport mode trunk
end
copy running-config startup-config
```

3.9.2 Packet Tracer - Troubleshoot EtherChannel

3.9.2.1 Topology



3.9.2.2 Objectives

Part 1: Examine the Physical Layer and Correct Switch Port Mode Issues

Part 2: Identify and Correct Port Channel Assignment Issues

Part 3: Identify and Correct Port Channel Protocol Issues

3.9.2.3 Background

A junior technician recently configured four switches. Users are complaining that the network is running slowly, and they would like you to investigate.

3.9.2.4 Port Channel Table

Channel Group	Ports	Protocol
1	S1: G0/1, G0/2 S3: G0/1, G0/2	LACP active
2	S2: G0/1, G0/2 S4: G0/1, G0/2	LACP active
3	S1: F0/23, F0/24 S2: F0/23, F0/24	LACP active
4	S3: F0/23, F0/24 S4: F0/23, F0/24	LACP active
5	S1: F0/21, F0/22 S4: F0/21, F0/22	LACP active
6	S2: F0/21, F0/22 S3: F0/21, F0/22	LACP active

Device	Group	Ports
S1	1	G0/1, G0/2
	3	F0/23, F0/24
	5	F0/21, F0/22
S2	2	G0/1, G0/2
	3	F0/23, F0/24
	6	F0/21, F0/22
S3	1	G0/1, G0/2
	4	F0/23, F0/24
	6	F0/21, F0/22
S4	2	G0/1, G0/2
	4	F0/23, F0/24
	5	F0/21, F0/22

3.9.2.5 Instructions

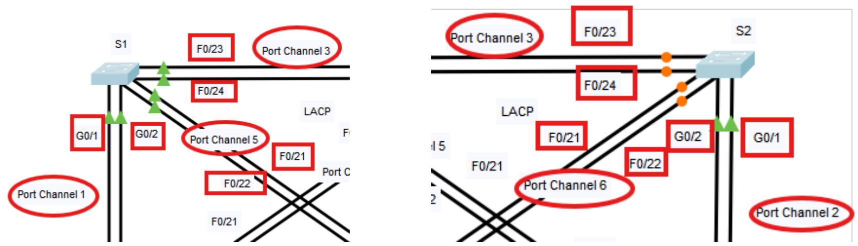
3.9.2.5.1 Part 1: Examine the Physical Layer and Correct Switch Port Mode Issues

Step 1: Look for access ports.

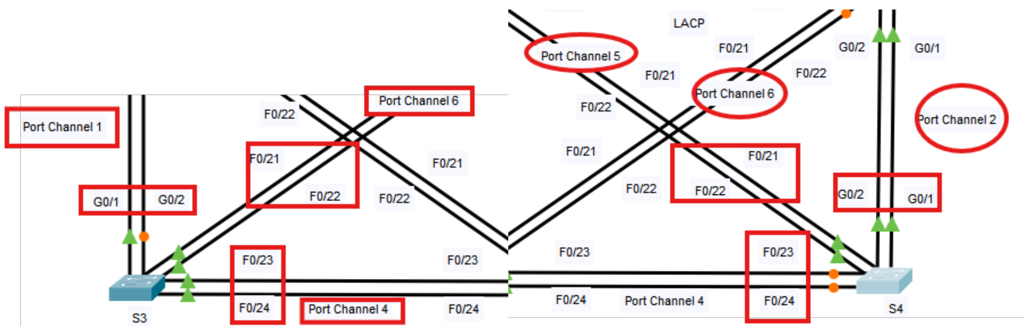
Examine the switches. When two or more redundant links connect the same switches, Spanning Tree protocol will only put one port in forwarding mode to prevent switching loops. You can see this in Packet Tracer. When physical ports are assigned to an EtherChannel port, they behave as one logical port. Each pair will either be operational or down.

Pre-checks

SW1 and SW2



SW3 and SW4



Step 2: Verify ports are in trunk mode.

Run command in each one of the switches:

```
show running-config
```

a. Verify that all physical ports in the topology are configured as trunks. Correct any ports that are in access mode.

SW1 – Ports defined as trunk. Nothing to change

SW2 – Ports defined as “access” should be defined as trunk

```
S2(config)#interface range f0/21-24, g0/1-2
S2(config-if-range)#switchport mode trunk
```

```
interface FastEthernet0/20
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 3 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 3 mode active
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 1 mode active
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 1 mode active
!
interface Vlan1
 no ip address
 shutdown
!
!
!
!
```

```
interface FastEthernet0/21
 switchport mode access
 channel-group 6 mode active
!
interface FastEthernet0/22
 switchport mode access
 channel-group 6 mode active
!
interface FastEthernet0/23
 switchport mode access
 channel-group 3 mode active
!
interface FastEthernet0/24
 switchport mode access
 channel-group 3 mode active
!
interface GigabitEthernet0/1
 switchport mode access
 channel-group 2 mode active
!
interface GigabitEthernet0/2
 switchport mode access
 channel-group 2 mode active
!
interface Vlan1
 no ip address
 shutdown
!
```

SW3 – Ports defined as trunk

Mode is wrong, “desirable” mode is used with the Port Aggregation Protocol (PAgP)

```
interface range g0/1 - 2
no channel-group
channel-group 1 mode active
interface range f0/21 - 22
no channel-group
channel-group 6 mode active
interface range f0/23 - 24
no channel-group
channel-group 4 mode active
```

SW4 – All ports defined as trunk

The channel group number for f0/21 and f0/22 is wrong . Must be port channel 5

```
interface FastEthernet0/21
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 5 mode active
!
```

```
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 6 mode desirable
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 6 mode desirable
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 4 mode desirable
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 4 mode desirable
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 1 mode desirable
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 1 mode desirable
!
interface Vlan1
 no ip address
 shutdown
!
!
```

```
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 4 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 4 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 4 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 4 mode active
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 2 mode active
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 2 mode active
!
interface Vlan1
 no ip address
 shutdown
!
!
!
```

b. Correct any EtherChannel ports that are not configured as trunks.

SW1 – Mode port channel is missing for Port-channel1

```
interface port-channel 1
switchport mode trunk
```

SW2 – Port-channel12 and 13 have mode port access need to be changed to trunk

Port-channel6 mode port is missing

```
interface port-channel 2
switchport mode trunk
interface port-channel 3
switchport mode trunk
interface port-channel 6
switchport mode trunk
```

```
S1#show running-config
Building configuration...

Current configuration : 1553 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S1
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
spanning-tree vlan 1 priority 4096
!
interface Port-channel1
!
interface Port-channel3
 switchport mode trunk
!
interface Port-channel5
 switchport mode trunk
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
```

```
hostname S2
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
spanning-tree vlan 1 priority 8192
!
interface Port-channel2
 switchport mode access
!
interface Port-channel3
 switchport mode access
!
interface Port-channel6
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
```

3.9.2.5.2 Part 2: Identify and Correct Port Channel Assignment Issues

Step 1: Examine port channel assignments.

The Packet Tracer topology and the Port Channel and Device tables provide details about the physical ports and their EtherChannel assignments. Use the **show etherchannel summary** command to learn how the EtherChannel links are configured. Verify that the switches are configured as shown in the documentation.

Step 2: Correct port channel assignments.

Correct any switch ports that are not assigned to the correct EtherChannel port.

3.9.2.5.3 Part 3: Identify and Correct Port Channel Protocol Issues

Step 1: Identify protocol issues.

In 2000, the IEEE released 802.3ad (LACP), which is an open standard version of EtherChannel. For compatibility reasons, the network design team chose to use LACP across the network. The design team has made it a requirement that all ports that participate in EtherChannel need to actively negotiate the link as LACP. Verify that the physical ports are configured as indicated in the topology and Port Channel Table.

Step 2: Correct Protocol issues.

a. Correct any switch ports that are not negotiating using LACP.

b. Reissue the **show etherchannel summary** command to verify that all EtherChannel links are now correctly configured.

3.9.2.6 Solution

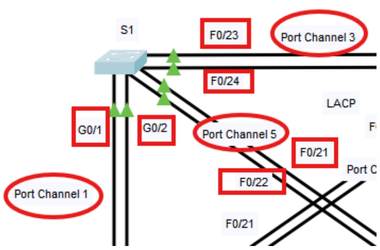
3.9.2.6.1 Pre-checks

For each switch issue the following commands

```
show running-config
```

```
show interfaces | include Ethernet
show interface status
show interfaces trunk
show etherchannel summary
show spanning-tree
```

SW1



show running-config

```
S1#show running-config
Building configuration...

Current configuration : 1553 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S1
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
spanning-tree vlan 1 priority 4096
!
interface Port-channel1
!
interface Port-channel3
 switchport mode trunk
!
interface Port-channel5
 switchport mode trunk
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
```

```
interface FastEthernet0/20
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 3 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 3 mode active
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 1 mode active
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 1 mode active
!
interface Vlan1
 no ip address
 shutdown
!
!
!
!
```

show interfaces | include Ethernet

```
S1>enable
S1#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
S1#
```

`show interface status`

```
S1# show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po1                          notconnect   1          auto    auto
Po3                          connected    trunk      auto    auto
Po5                          connected    trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX
S1#
```

`show interfaces trunk`

Po1 missing

```
S1#  show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po3         on           802.1q         trunking      1
Po5         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po3         1-1005
Po5         1-1005

Port        Vlans allowed and active in management domain
Po3         1
Po5         1

Port        Vlans in spanning tree forwarding state and not pruned
Po3         1
Po5         1

S1#
```

`show etherchannel summary`

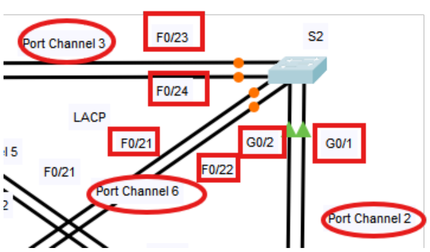
Group 1 port channel is down

```
S1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------

1      Po1(SD)           LACP   Gig0/1(I) Gig0/2(I)
3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)
5      Po5(SU)           LACP   Fa0/21(P) Fa0/22(P)
S1#
```

show spanning-tree

```
S1#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    4097
             Address     000A.F313.2395
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    4097  (priority 4096 sys-id-ext 1)
             Address     000A.F313.2395
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi0/1            Desg FWD 4         128.25   P2p
Gi0/2            Desg FWD 4         128.26   P2p
Po3              Desg FWD 12        128.28   Shr
Po5              Desg FWD 12        128.29   Shr

S1#
```

SW2



show running-config

```
hostname S2
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
spanning-tree vlan 1 priority 8192
!
interface Port-channel2
 switchport mode access
!
interface Port-channel3
 switchport mode access
!
interface Port-channel6
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
```

```
interface FastEthernet0/21
 switchport mode access
 channel-group 6 mode active
!
interface FastEthernet0/22
 switchport mode access
 channel-group 6 mode active
!
interface FastEthernet0/23
 switchport mode access
 channel-group 3 mode active
!
interface FastEthernet0/24
 switchport mode access
 channel-group 3 mode active
!
interface GigabitEthernet0/1
 switchport mode access
 channel-group 2 mode active
!
interface GigabitEthernet0/2
 switchport mode access
 channel-group 2 mode active
!
interface Vlan1
 no ip address
 shutdown
!
```

show interfaces | include Ethernet

```
S2#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
S2#
```

show interface status

```
S2#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po2                          connected    1          auto    auto
Po3                          connected    1          auto    auto
Po6                          notconnect   1          auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    1          auto    auto  10/100BaseTX
Fa0/22                       connected    1          auto    auto  10/100BaseTX
Fa0/23                       connected    1          auto    auto  10/100BaseTX
Fa0/24                       connected    1          auto    auto  10/100BaseTX
Gig0/1                       connected    1          auto    auto  10/100BaseTX
Gig0/2                       connected    1          auto    auto  10/100BaseTX

S2#
```

show interfaces trunk

Because ports are defined as access we have nothing here

```
S2#show interfaces trunk


S2#
```

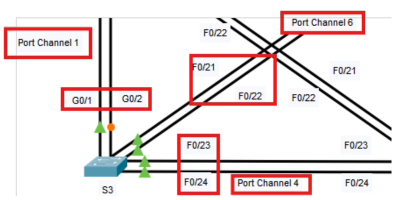
show etherchannel summary

```
S2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+------------------------

2      Po2(SU)          LACP   Gig0/1(P)  Gig0/2(P)
3      Po3(SU)          LACP   Fa0/23(P)  Fa0/24(P)
6      Po6(SD)          LACP   Fa0/21(I)  Fa0/22(I)
S2#
```

show spanning-tree

```
S2#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    4097
             Address     000A.F313.2395
             Cost        11
             Port        27(Port-channel2)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    8193  (priority 8192 sys-id-ext 1)
             Address     0030.A3E4.8326
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- ------------------------------
Fa0/22           Altn BLK 19        128.22   P2p
Fa0/21           Altn BLK 19        128.21   P2p
Po2              Root FWD 3         128.27   Shr
Po3              Altn BLK 12        128.28   Shr

S2#
```

SW3



show running-config

```
S3# show running-config
Building configuration...

Current configuration : 1559 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S3
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface Port-channel1
 switchport mode trunk
!
interface Port-channel4
 switchport mode trunk
!
interface Port-channel6
 switchport mode trunk
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
```

```
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 6 mode desirable
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 6 mode desirable
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 4 mode desirable
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 4 mode desirable
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 1 mode desirable
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 1 mode desirable
!
interface Vlan1
 no ip address
 shutdown
!
!
```

show interfaces | include Ethernet

```
S3>enable
S3#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
S3#
```

show interface status

```
S3>enable
S3#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po1                          notconnect   trunk      auto    auto
Po4                          notconnect   trunk      auto    auto
Po6                          notconnect   trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX

S3#
```

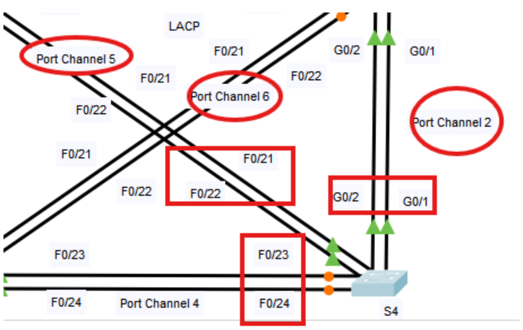
show interfaces trunk

```
S3#
S3#  show interfaces trunk
S3#
S3#  show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------

1      Po1(SD)          PAgP   Gig0/1(I) Gig0/2(I)
4      Po4(SD)          PAgP   Fa0/23(I) Fa0/24(I)
6      Po6(SD)          PAgP   Fa0/21(I) Fa0/22(I)
S3#
S3#
```

show spanning-tree

```
S3#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    4097
             Address     000A.F313.2395
             Cost        4
             Port        25(GigabitEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0009.7CEC.E166
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Fa0/24           Desg FWD 19        128.24   P2p
Gi0/1            Root FWD 4         128.25   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Fa0/23           Desg FWD 19        128.23   P2p
Gi0/2            Altn BLK 4         128.26   P2p
Fa0/21           Desg FWD 19        128.21   P2p

S3#
```

SW4



show running-config

```
S4# show running-config
Building configuration...

Current configuration : 1541 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S4
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface Port-channel2
 switchport mode trunk
!
interface Port-channel4
 switchport mode trunk
!
interface Port-channel5
 switchport mode trunk
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
```

Wrong Channel for F0/21 and F0/22

```
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 4 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 4 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 4 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 4 mode active
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 2 mode active
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 2 mode active
!
interface Vlan1
 no ip address
 shutdown
!
!
!
```

show interfaces | include Ethernet

```
S4>enable
S4#  show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
```

show interface status

```
S4#
S4#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po2                          connected    trunk      auto    auto
Po4                          connected    trunk      auto    auto
Po5                          notconnect   trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX

S4#
```

show interfaces trunk

```
S4#
S4#  show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1
Po4         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005
Po4         1-1005

Port        Vlans allowed and active in management domain
Po2         1
Po4         1

Port        Vlans in spanning tree forwarding state and not pruned
Po2         1
Po4         1
```

show etherchannel summary

```
S4#
S4#  show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------------------

2      Po2(SU)           LACP   Gig0/1(P) Gig0/2(P)
4      Po4(SU)           LACP   Fa0/21(P) Fa0/22(P) Fa0/23(I) Fa0/24(I)
5      Po5(SD)           -
S4#
```

show spanning-tree

```
S4#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    4097
             Address     000A.F313.2395
             Cost        8
             Port        28(Port-channel4)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0001.436E.8494
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Fa0/24           Altn BLK 19        128.24   P2p
Fa0/23           Altn BLK 19        128.23   P2p
Po2              Desg FWD 3         128.27   Shr
Po4              Root FWD 8         128.28   Shr

S4#
```

3.9.2.6.2 Corrections

SW1

```
! SW1
enable
config t
interface port-channel 1
       switchport mode trunk
end
```

```
S1>
S1>! SW1
S1>enable
S1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface port-channel 1
S1(config-if)#
S1(config-if)# switchport mode trunk
S1(config-if)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#
```

SW2

```
!SW 2
enable
config t
interface range f0/21-24, g0/1-2
    switchport mode trunk
interface port-channel 2
      switchport mode trunk
interface port-channel 3
      switchport mode trunk
interface port-channel 6
      switchport mode trunk
end
```

```
S2(config-if-range)#interface port-channel 2
S2(config-if)#
S2(config-if)# switchport mode trunk
S2(config-if)#interface port-channel 3
S2(config-if)#
S2(config-if)# switchport mode trunk
S2(config-if)#interface port-channel 6
S2(config-if)#
S2(config-if)# switchport mode trunk
S2(config-if)#end
S2#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to down

%EC-5-CANNOT_BUNDLE2: Fa0/21 is not compatible with Fa0/22 and will be suspended (dtp mode of Fa0/21 is on, Fa0/22is off )

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down

%EC-5-CANNOT_BUNDLE2: Fa0/23 is not compatible with Fa0/24 and will be suspended (dtp mode of Fa0/23 is on, Fa0/24is off )
```

```
%EC-5-CANNOT_BUNDLE2: Fa0/23 is not compatible with Fa0/24 and will be suspended (dtp mode of Fa0/23 is on, Fa0/24is off )

%LINK-3-UPDOWN: Interface Port-channel3, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel3, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%EC-5-CANNOT_BUNDLE2: Gig0/1 is not compatible with Gig0/2 and will be suspended (dtp mode of Gig0/1 is on, Gig0/2is off )

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%EC-5-CANNOT_BUNDLE2: Gig0/1 is not compatible with Gig0/2 and will be suspended (dtp mode of Gig0/1 is on, Gig0/2is off )

%LINK-3-UPDOWN: Interface Port-channel2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
```

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%SYS-5-CONFIG_I: Configured from console by console

S2#
%LINK-5-CHANGED: Interface Port-channel2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel2, changed state to up

%LINK-5-CHANGED: Interface Port-channel3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel3, changed state to up
```

SW3

```
!SW3
enable
conf t
interface range g0/1 - 2
no channel-group
channel-group 1 mode active
interface range f0/21 - 22
no channel-group
channel-group 6 mode active
interface range f0/23 - 24
no channel-group
channel-group 4 mode active
end
```

```
S3>enable
S3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#interface range g0/1 - 2
S3(config-if-range)#no channel-group
S3(config-if-range)#channel-group 1 mode active
S3(config-if-range)#interface range f0/21 - 22
S3(config-if-range)#no channel-group
S3(config-if-range)#channel-group 6 mode active
S3(config-if-range)#interface range f0/23 - 24
S3(config-if-range)#no channel-group
S3(config-if-range)#channel-group 4 mode active
S3(config-if-range)#end
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up

%LINK-5-CHANGED: Interface Port-channel6, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel6, changed state to up
```

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel6, changed state to up

%LINK-5-CHANGED: Interface Port-channel1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state to up

S3#
%SYS-5-CONFIG_I: Configured from console by console

S3#
```

SW 4

```
! SW4
```

```
enable
config t
interface range FastEthernet0/21 – 22
 channel-group 5 mode active
end
```

```
S4>! SW4
S4>enable
S4#config t
Enter configuration commands, one per line.  End with CNTL/Z.
S4(config)#interface range FastEthernet0/21-22
S4(config-if-range)# channel-group 5 mode active
S4(config-if-range)#end
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to up

%LINK-3-UPDOWN: Interface Port-channel4, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel4, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to up

%LINK-5-CHANGED: Interface Port-channel4, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel4, changed state to up

%LINK-5-CHANGED: Interface Port-channel5, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel5, changed state to up

S4#
%SYS-5-CONFIG_I: Configured from console by console

S4#
```

3.9.2.6.3 Post-checks

For each switch issue the following commands

```
show running-config
show interfaces | include Ethernet
show interface status
show interfaces trunk
show etherchannel summary
show spanning-tree
```

SW1

`show running-config`

```
!
hostname S1
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
spanning-tree vlan 1 priority 4096
!
interface Port-channel1
 switchport mode trunk
!
interface Port-channel3
 switchport mode trunk
!
interface Port-channel5
 switchport mode trunk
```

```
interface FastEthernet0/20
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 3 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 3 mode active
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 1 mode active
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 1 mode active
!
interface Vlan1
 no ip address
 shutdown
!
!
!
```

show interfaces | include Ethernet

```
S1#
S1#
S1#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
S1#
```

show interface status

```
S1#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po1                          connected    trunk      auto    auto
Po3                          connected    trunk      auto    auto
Po5                          connected    trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX

S1#
```

show interfaces trunk

```
S1# show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po3         on           802.1q         trunking      1
Po5         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005
Po3         1-1005
Po5         1-1005

Port        Vlans allowed and active in management domain
Po1         1
Po3         1
Po5         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1
Po3         1
Po5         1

S1#
```

show etherchannel summary

```
S1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------

1      Po1(SU)           LACP   Gig0/1(P) Gig0/2(P)
3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)
5      Po5(SU)           LACP   Fa0/21(P) Fa0/22(P)
S1#
```

show spanning-tree

```
S1#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    4097
             Address     000A.F313.2395
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    4097  (priority 4096 sys-id-ext 1)
             Address     000A.F313.2395
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- ---------------------------
Po1              Desg FWD 3         128.27   Shr
Po3              Desg FWD 12        128.28   Shr
Po5              Desg FWD 12        128.29   Shr

S1#
```

SW2

Show running-config

```
spanning-tree mode pvst
spanning-tree extend system-id
spanning-tree vlan 1 priority 8192
!
interface Port-channel2
 switchport mode trunk
!
interface Port-channel3
 switchport mode trunk
!
interface Port-channel6
 switchport mode trunk
!
```

```
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 6 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 6 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 3 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 3 mode active
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 2 mode active
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 2 mode active
!
```

```
S2#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
```

```
S2#
S2#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po2                          connected    trunk      auto    auto
Po3                          connected    trunk      auto    auto
Po6                          connected    trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX
```

```
S2#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1
Po3         on           802.1q         trunking      1
Po6         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005
Po3         1-1005
Po6         1-1005

Port        Vlans allowed and active in management domain
Po2         1
Po3         1
Po6         1

Port        Vlans in spanning tree forwarding state and not pruned
Po2         1
Po3         1
Po6         none
```

```
S2#
S2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------------------

2      Po2(SU)           LACP   Gig0/1(P) Gig0/2(P)
3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)
6      Po6(SU)           LACP   Fa0/21(P) Fa0/22(P)
```

```
S2#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    4097
             Address     000A.F313.2395
             Cost        12
             Port        28(Port-channel3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    8193  (priority 8192 sys-id-ext 1)
             Address     0030.A3E4.8326
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po6              Altn BLK 12        128.29   Shr
Po2              Desg FWD 3         128.27   Shr
Po3              Root FWD 12        128.28   Shr
```

SW3

show running-config

```
!
hostname S3
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface Port-channel1
 switchport mode trunk
!
interface Port-channel4
 switchport mode trunk
!
interface Port-channel6
 switchport mode trunk
!
interface FastEthernet0/1
!
```

```
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 6 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 6 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 4 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 4 mode active
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 1 mode active
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 1 mode active
!
```

show interfaces | include Ethernet

```
S3#  show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
S3#
```

show interface status

```
S3#
S3#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po1                          connected    trunk      auto    auto
Po4                          connected    trunk      auto    auto
Po6                          connected    trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX

S3#
```

show interfaces trunk

```
S3#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po4         on           802.1q         trunking      1
Po6         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005
Po4         1-1005
Po6         1-1005

Port        Vlans allowed and active in management domain
Po1         1
Po4         1
Po6         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1
Po4         1
Po6         1

S3#
```

show etherchannel summary

```
S3#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+------------------------

1      Po1(SU)           PAgP   Gig0/1(P) Gig0/2(P)
4      Po4(SU)           PAgP   Fa0/23(P) Fa0/24(P)
6      Po6(SU)           PAgP   Fa0/21(P) Fa0/22(P)
S3#
```

show spanning-tree

```
S3#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    4097
             Address     000A.F313.2395
             Cost        3
             Port        27(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0009.7CEC.E166
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- ------------------------
Po1              Root FWD 3         128.27   Shr
Po6              Desg FWD 12        128.29   Shr
Po4              Desg FWD 12        128.28   Shr
```

SW4

Show running-config

```
hostname S4
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface Port-channel2
 switchport mode trunk
!
interface Port-channel4
 switchport mode trunk
!
interface Port-channel5
 switchport mode trunk
!
```

```
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 5 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 4 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 4 mode active
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 2 mode active
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 2 mode active
!
interface Vlan1
 no ip address
 shutdown
!
```

show interfaces | include Ethernet

```
S4#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
```

show interface status

```
S4#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po2                          connected    trunk      auto    auto
Po4                          connected    trunk      auto    auto
Po5                          connected    trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX

S4#
```

show interfaces trunk

```
S4#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1
Po4         on           802.1q         trunking      1
Po5         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005
Po4         1-1005
Po5         1-1005

Port        Vlans allowed and active in management domain
Po2         1
Po4         1
Po5         1

Port        Vlans in spanning tree forwarding state and not pruned
Po2         none
Po4         none
Po5         1

S4#
```

show etherchannel summary

```
S4# show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------------------------

2      Po2(SU)           LACP   Gig0/1(P)  Gig0/2(P)
4      Po4(SU)           LACP   Fa0/23(P)  Fa0/24(I)
5      Po5(SU)           LACP   Fa0/21(P)  Fa0/22(P)
S4#
```

show spanning-tree

```
S4# show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority     4097
              Address      000A.F313.2395
              Cost         12
              Port         29(Port-channel5)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority     32769  (priority 32768 sys-id-ext 1)
              Address      0001.436E.8494
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time   20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Po2              Altn BLK 3         128.27   Shr
Po5              Root FWD 12        128.29   Shr
Po4              Altn BLK 12        128.28   Shr

S4#
```

3.9.3 Exercise 6.4.1 Packet Tracer - Implement EtherChannel

3.9.3.1 Objectives

3.9.3.1.1 Part 1: Build the network

3.9.3.1.2 Part 2: Configure EtherChannel

3.9.3.2 Background

You have been assigned the task of designing an EtherChannel implementation for a company that wants to improve the performance of their switch trunk links. You will try several different ways of implementing the EtherChannel links in order to evaluate which is the best for the company. You will build the topology, configure trunk ports, and implement LACP and PAgP EtherChannels.

3.9.3.3 Instructions

3.9.3.3.1 Part 1: Build the network.

Use the table below to build the switch topology.

Step 1: Obtain the devices that are required.

a. Click the **Network Devices** icon in the bottom tool bar.

b. Click the **Switches** entry in the submenu.

c. Locate the **2960** switch icon. Click and drag the icon for the 2960 switch into the topology area.

d. Repeat the step above so that there are **three** 2960 switches in the topology area.

e. Arrange the devices into a layout that you can work with by clicking and dragging.

Step 2: Name the devices.

The devices have default names that you will need to change. You will name the devices **SWA**, **SWB**, and **SWC**. You are changing the display names of the devices. This is the text label that appears below each device. It is **not** the host name. Your display names must match the names that are given in this step **exactly**. If a display name does not match, you will not be scored for your device configuration.

a. Click the device display name that is below the device icon. A text field should appear with a flashing insertion point. If the configuration window for the device appears, close it and try again by clicking a little further away from the device icon.

b. Replace the current display name with the appropriate display name.

c. Repeat until all devices are named.

Step 3: Connect the devices.

a. Click the orange lightning bolt Connections icon in the bottom toolbar.

b. Locate the Ethernet straight-through cable icon. It looks like a solid black diagonal line.

c. To connect the device, click the Ethernet straight-through cable icon and then click the first device that you want to connect. Select the correct port and then click the second device. Select the correct port and the devices will be connected.

d. Connect the devices as specified in the table below.

Port Channel	Devices	Port Connections	Type
1	SWA to SWB	G0/1 to G0/1	PAgP
1	*SWA to SWB*	G0/2 to G0/2	
2	SWA to SWC	F0/21 to F0/21	LACP
2	*SWA to SWC*	F0/22 to F0/22	
3	SWB to SWC	F0/23 to F0/23	LACP
3	*SWB to SWC*	F0/24 to F0/24	

3.9.3.3.2 Part 2: Configure EtherChannel

Open configuration window

On each switch, configure the ports that will be used in the Port Channels as static trunk ports.

Step 1: Configure a PAgP EtherChannel.

Follow the procedure that was used in previous activities to configure Port Channel 1 as a PAgP EtherChannel between SWA and SWB. Both sides should negotiate the EtherChannel.

Step 2: Configure a LACP EtherChannel.

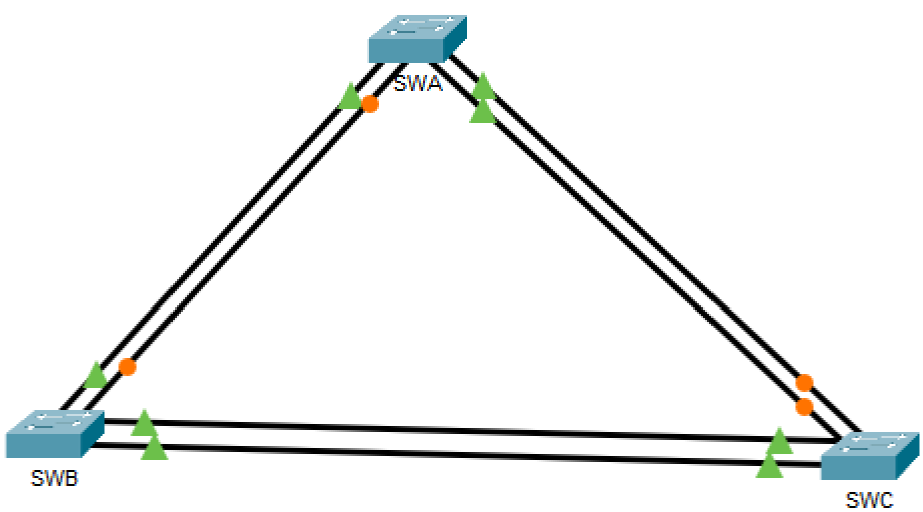
Configure Port Channel 2 as an LACP channel between SWA and SWC. Both sides should negotiate the EtherChannel.

Step 3: Configure a Backup LACP EtherChannel

Configure Port Channel 3 channel as an LACP channel between SWB and SWC. In this case, SWC initiates negotiation with SWB. SWB does not initiate negotiation of the channel.

3.9.3.4 Solution

3.9.3.4.1 Topology



3.9.3.4.2 Scripts

```
!SWA
ena
conf t
hostname SWA

interface GigabitEthernet0/1
switchport mode trunk
channel-group 1 mode desirable
```

```
interface GigabitEthernet0/2
switchport mode trunk
channel-group 1 mode desirable

interface FastEthernet0/21
switchport mode trunk
channel-group 2 mode active
interface FastEthernet0/22
switchport mode trunk
channel-group 2 mode active


end
```

!SWB

```
ena
conf t
hostname SWB

interface GigabitEthernet0/1
switchport mode trunk
channel-group 1 mode desirable
interface GigabitEthernet0/2
switchport mode trunk
channel-group 1 mode desirable

interface FastEthernet0/23
switchport mode trunk
channel-group 3 mode passive
interface FastEthernet0/24
switchport mode trunk
channel-group 3 mode passive

end
```

!SWC

```
ena
conf t
hostname SWC

interface FastEthernet0/21
switchport mode trunk
channel-group 2 mode active
interface FastEthernet0/22
switchport mode trunk
channel-group 2 mode active

interface FastEthernet0/23
switchport mode trunk
channel-group 3 mode active
interface FastEthernet0/24
switchport mode trunk
channel-group 3 mode active

end
```

3.9.3.4.3 Verify printouts

Print the following in each switch

```
show running-config
show interfaces | include Ethernet
show interface status
show interfaces trunk
show etherchannel summary
show spanning-tree
```

SWA

```
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface Port-channel1
 switchport mode trunk
!
interface Port-channel2
 switchport mode trunk
!
interface FastEthernet0/1
```

```
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 2 mode active
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 1 mode desirable
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 1 mode desirable
!
interface Vlan1
 no ip address
```

```
SWA#
SWA#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is down, line protocol is down (disabled)
FastEthernet0/24 is down, line protocol is down (disabled)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
SWA#
```

```
SWA#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po1                          connected    trunk      auto    auto
Po2                          connected    trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       notconnect   1          auto    auto  10/100BaseTX
Fa0/24                       notconnect   1          auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX

SWA#
```

```
SWA#  show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po2         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005
Po2         1-1005

Port        Vlans allowed and active in management domain
Po1         1
Po2         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1
Po2         1

SWA#
```

```
SWA#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------

1      Po1(SU)           PAgP   Gig0/1(P) Gig0/2(P)
2      Po2(SU)           LACP   Fa0/21(P) Fa0/22(P)
SWA#
```

```
SWA#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.C92A.BAA7
             Cost        3
             Port        27(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     00D0.978C.3B4E
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Po1              Root FWD 3         128.27   Shr
Po2              Desg FWD 12        128.28   Shr

SWA#
```

SWB

```
SWB#sho running-config
Building configuration...

Current configuration : 1391 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname SWB
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface Port-channel1
 switchport mode trunk
!
interface Port-channel3
 switchport mode trunk
!
interface FastEthernet0/1
!
```

```
interface FastEthernet0/23
 switchport mode trunk
 channel-group 3 mode passive
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 3 mode passive
!
interface GigabitEthernet0/1
 switchport mode trunk
 channel-group 1 mode desirable
!
interface GigabitEthernet0/2
 switchport mode trunk
 channel-group 1 mode desirable
```

```
SWB#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is down, line protocol is down (disabled)
FastEthernet0/22 is down, line protocol is down (disabled)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is up, line protocol is up (connected)
GigabitEthernet0/2 is up, line protocol is up (connected)
SWB#
```

```
SWB#
SWB#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po1                          connected    trunk      auto    auto
Po3                          connected    trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       notconnect   1          auto    auto  10/100BaseTX
Fa0/22                       notconnect   trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       connected    trunk      auto    auto  10/100BaseTX
Gig0/2                       connected    trunk      auto    auto  10/100BaseTX

SWB#
```

```
SWB#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po3         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-1005
Po3         1-1005

Port        Vlans allowed and active in management domain
Po1         1
Po3         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1
Po3         1

SWB#
```

```
SWB#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------

1      Po1(SU)           PAgP   Gig0/1(P) Gig0/2(P)
3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)
SWB#
```

```
SWB#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.C92A.BAA7
             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     0001.C92A.BAA7
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- -------------------------
Po1              Desg FWD 3         128.27   Shr
Po3              Desg FWD 12        128.28   Shr

SWB#
```

SWC

```
no service password-encryption
!
hostname SWC
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface Port-channel2
 switchport mode trunk
!
interface Port-channel3
 switchport mode trunk
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
```

```
!
interface FastEthernet0/21
 switchport mode trunk
 channel-group 2 mode active
!
interface FastEthernet0/22
 switchport mode trunk
 channel-group 2 mode active
!
interface FastEthernet0/23
 switchport mode trunk
 channel-group 3 mode active
!
interface FastEthernet0/24
 switchport mode trunk
 channel-group 3 mode active
```

```
SWC#show interfaces | include Ethernet
FastEthernet0/1 is down, line protocol is down (disabled)
FastEthernet0/2 is down, line protocol is down (disabled)
FastEthernet0/3 is down, line protocol is down (disabled)
FastEthernet0/4 is down, line protocol is down (disabled)
FastEthernet0/5 is down, line protocol is down (disabled)
FastEthernet0/6 is down, line protocol is down (disabled)
FastEthernet0/7 is down, line protocol is down (disabled)
FastEthernet0/8 is down, line protocol is down (disabled)
FastEthernet0/9 is down, line protocol is down (disabled)
FastEthernet0/10 is down, line protocol is down (disabled)
FastEthernet0/11 is down, line protocol is down (disabled)
FastEthernet0/12 is down, line protocol is down (disabled)
FastEthernet0/13 is down, line protocol is down (disabled)
FastEthernet0/14 is down, line protocol is down (disabled)
FastEthernet0/15 is down, line protocol is down (disabled)
FastEthernet0/16 is down, line protocol is down (disabled)
FastEthernet0/17 is down, line protocol is down (disabled)
FastEthernet0/18 is down, line protocol is down (disabled)
FastEthernet0/19 is down, line protocol is down (disabled)
FastEthernet0/20 is down, line protocol is down (disabled)
FastEthernet0/21 is up, line protocol is up (connected)
FastEthernet0/22 is up, line protocol is up (connected)
FastEthernet0/23 is up, line protocol is up (connected)
FastEthernet0/24 is up, line protocol is up (connected)
GigabitEthernet0/1 is down, line protocol is down (disabled)
GigabitEthernet0/2 is down, line protocol is down (disabled)
SWC#
```

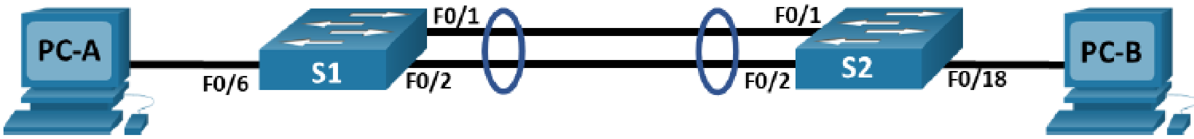
```
SWC#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po2                          connected    trunk      auto    auto
Po3                          connected    trunk      auto    auto
Fa0/1                        notconnect   1          auto    auto  10/100BaseTX
Fa0/2                        notconnect   1          auto    auto  10/100BaseTX
Fa0/3                        notconnect   1          auto    auto  10/100BaseTX
Fa0/4                        notconnect   1          auto    auto  10/100BaseTX
Fa0/5                        notconnect   1          auto    auto  10/100BaseTX
Fa0/6                        notconnect   1          auto    auto  10/100BaseTX
Fa0/7                        notconnect   1          auto    auto  10/100BaseTX
Fa0/8                        notconnect   1          auto    auto  10/100BaseTX
Fa0/9                        notconnect   1          auto    auto  10/100BaseTX
Fa0/10                       notconnect   1          auto    auto  10/100BaseTX
Fa0/11                       notconnect   1          auto    auto  10/100BaseTX
Fa0/12                       notconnect   1          auto    auto  10/100BaseTX
Fa0/13                       notconnect   1          auto    auto  10/100BaseTX
Fa0/14                       notconnect   1          auto    auto  10/100BaseTX
Fa0/15                       notconnect   1          auto    auto  10/100BaseTX
Fa0/16                       notconnect   1          auto    auto  10/100BaseTX
Fa0/17                       notconnect   1          auto    auto  10/100BaseTX
Fa0/18                       notconnect   1          auto    auto  10/100BaseTX
Fa0/19                       notconnect   1          auto    auto  10/100BaseTX
Fa0/20                       notconnect   1          auto    auto  10/100BaseTX
Fa0/21                       connected    trunk      auto    auto  10/100BaseTX
Fa0/22                       connected    trunk      auto    auto  10/100BaseTX
Fa0/23                       connected    trunk      auto    auto  10/100BaseTX
Fa0/24                       connected    trunk      auto    auto  10/100BaseTX
Gig0/1                       notconnect   1          auto    auto  10/100BaseTX
Gig0/2                       notconnect   1          auto    auto  10/100BaseTX

SWC#
```

```
SWC# show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1
Po3         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005
Po3         1-1005

Port        Vlans allowed and active in management domain
Po2         1
Po3         1

Port        Vlans in spanning tree forwarding state and not pruned
Po2         none
Po3         1

SWC#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------------------

2      Po2(SU)           LACP   Fa0/21(P) Fa0/22(P)
3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)
SWC#
```

```
SWC#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.C92A.BAA7
             Cost        12
             Port        28(Port-channel3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0060.2F19.4374
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Po3              Root FWD 12        128.28   Shr
Po2              Altn BLK 12        128.27   Shr

SWC#
```

3.9.4 Exercise 6.4.2 Lab - Implement EtherChannel

3.9.4.1 Topology



3.9.4.2 Addressing Table

Device	Interface	IP Address	Subnet Mask
S1	VLAN 10	192.168.10.11	255.255.255.0
S2	VLAN 10	192.168.10.12	255.255.255.0
PC-A	NIC	192.168.20.3	255.255.255.0
PC-B	NIC	192.168.20.4	255.255.255.0

3.9.4.3 VLAN table

VLAN	Name	Interface Assigned
10	Management	VLAN 10
20	Clients	S1: F0/6 S2: F0/18
999	Parking_Lot	S1: F0/3-5, F0/7-24, G0/1-2 S2: F0/3-17, F0/19-24, G0/1-2
1000	Native	N/A

3.9.4.4 Objectives

Part 1: Build the Network and Configure Basic Device Settings
Part 2: Create VLANs and Assign Switch Ports
Part 3: Configure 802.1Q Trunks between the Switches
Part 4: Implement and Verify an EtherChannel between the switches

3.9.4.5 Background / Scenario

Link aggregation allows the creation of logical links that are comprised of two or more physical links. This provides increased throughput beyond using only one physical link. Link aggregation also provides redundancy if one of the links fails.

In this lab, you will configure EtherChannel, a form of link aggregation used in switched networks. You will configure EtherChannel using Link Aggregation Control Protocol (LACP).

Note: LACP is a link aggregation protocol that is defined by IEEE 802.3ad, and it is not associated with any specific vendor.

LACP allows Cisco switches to manage Ethernet channels between switches that conform to the 802.3ad protocol. You can configure up to 16 ports to form a channel. Eight of the ports are in active mode and the other eight are in standby mode. When any of the active ports fail, a standby port becomes active. Standby mode works only for LACP, not for PAgP.

Note: The switches used with CCNA hands-on labs are Cisco Catalyst 2960s with Cisco IOS Release 15.2(2) (lanbasek9 image). Other switches and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs.
Note: Make sure that the switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

3.9.4.6 Required Resources

- 2 Switches (Cisco 2960 with Cisco IOS Release 15.2(2) lanbasek9 image or comparable)
- 2 PCs (Windows with a terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet cables as shown in the topology

3.9.4.7 Instructions

Part 1: Build the Network and Configure Basic Device Settings

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

Step 1: Cable the network as shown in the topology.

Attach the devices as shown in the topology diagram, and cable as necessary.

Step 2: Configure basic settings for each switch.

a. Assign a device name to the switch.
b. Open configuration window
c. Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were host names.
d. Assign class as the privileged EXEC encrypted password.
e. Assign cisco as the console password and enable login.
f. Assign cisco as the VTY password and enable login.
g. Encrypt the plaintext passwords.
h. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.
i. Save the running configuration to the startup configuration file.
j. Set the clock on the switch to today’s time and date.
k. Note: Use the question mark (?) to help with the correct sequence of parameters needed to execute this command.
l. Copy the running configuration to the startup configuration.

Step 3: Configure PC hosts.

Refer to the Addressing Table for PC host address information.

a. On both switches create and name the required VLANs from the VLAN Table above.
b. Configure and activate the management interface on each switch using the IP address information in the Addressing Table.
c. Assign all unused ports on the switch to the Parking_Lot VLAN, configure them for static access mode, and administratively deactivate them.
d. Assign used ports to the appropriate VLAN (specified in the VLAN table above) and configure them for static access mode.
e. Issue the **show vlan brief** command and verify that the VLANs are assigned to the correct ports.

Part 2: Create VLANs and Assign Switch Ports

In Part 2, you will create VLANs as specified in the table above on both switches. You will then assign the VLANs to the appropriate interface and verify your configuration settings. Complete the following tasks on each switch.

Step 1: Create VLANs on the switches.

Step 2: Assign VLANs to the correct switch interfaces.

a. Assign used ports to the appropriate VLAN (specified in the VLAN table above) and configure them for static access mode.
b. Issue the **show vlan brief** command and verify that the VLANs are assigned to the correct ports.

Part 3: Configure 802.1Q trunks between the switches.

In Part 3, you will manually configure interfaces F0/1 and F0/2 as 802.1Q trunks.

a. Change the switchport mode on the interfaces to force trunking. Use the interface range command to reduce the number of commands required. Make sure to do this on both switches.
b. Open configuration window
c. As a part of the trunk configuration, set the native VLAN to 1000 on both switches. You may see error messages temporarily while the two interfaces are configured for different native VLANs.
d. As another part of trunk configuration, specify that VLANs 10, 20, and 1000 are allowed to cross the trunk.
e. Issue the **show interfaces trunk** command to verify the trunking ports, Native VLAN and allowed VLANs across the trunk.

Question:

Why is the "Vlans in spanning tree forwarding state and not pruned" entry different for F0/1 and F0/2?

ANSWER –

Part 4: Implement and Verify an EtherChannel between the switches.

a. Create a LACP-based EtherChannel using F0/1 and F0/2 using group number 1, with both switches actively negotiating the EtherChannel protocol. Use the interface range command to reduce the number of commands required.
b. After the EtherChannel is configured, a virtual Port-Channel interface is automatically created. Now interface Port-Channel 1 represents the logical interface of the bundled physical ports F0/1 and F0/2. Additionally, the Port-Channel will inherit the configuration of the first physical port added to the EtherChannel.
c. Issue the **show interfaces trunk** command to verify trunking is still in place

Question:

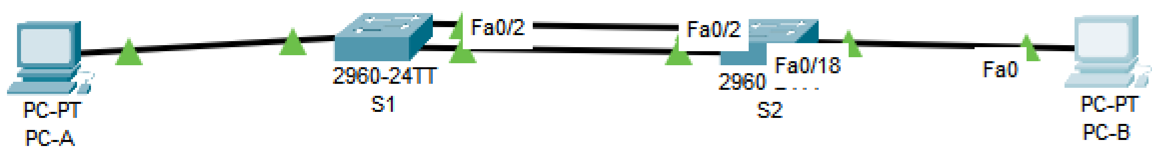
What does the port 'Po1' represent?

ANSWER - The logical grouping of physical interfaces F0/1 and F0/2 is now seen as Port-channel 1 or Po1.

d. Use the **show etherchannel summary** command to verify the EtherChannel configuration.

3.9.4.8 Solution

3.9.4.8.1 Topology



3.9.4.8.2 Scripts

S1 Script

```
! S1 Configuration

enable
clock set 23:10:00 Jan 8 2025

configure terminal
hostname S1
no ip domain-lookup
enable secret class
line console 0
 password cisco
 login
line vty 0 15
 password cisco
 login
banner motd ^CUnauthorized access is prohibited.^C
service password-encryption

! VLAN Configuration
vlan 10
 name Management
vlan 20
 name Clients
vlan 999
 name Parking_Lot
vlan 1000
 name Native

! Interface Configuration
interface vlan 10
 ip address 192.168.10.11 255.255.255.0
```

```
interface f0/6
 switchport mode access
 switchport access vlan 20

interface range f0/3-5
 switchport mode access
 switchport access vlan 999
shutdown
interface range f0/7-24
 switchport mode access
 switchport access vlan 999
shutdown
interface range g0/1-2
 switchport mode access
 switchport access vlan 999
 shutdown

! Create the Port-Channel interface FIRST
interface Port-channel 1
 switchport mode trunk
 switchport trunk allowed vlan 10,20,999,1000
 switchport trunk native vlan 1000

! EtherChannel Configuration (Now that Port-channel1 exists)
interface range FastEthernet0/1 - 2
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode active

end
write memory
```

S2 Script

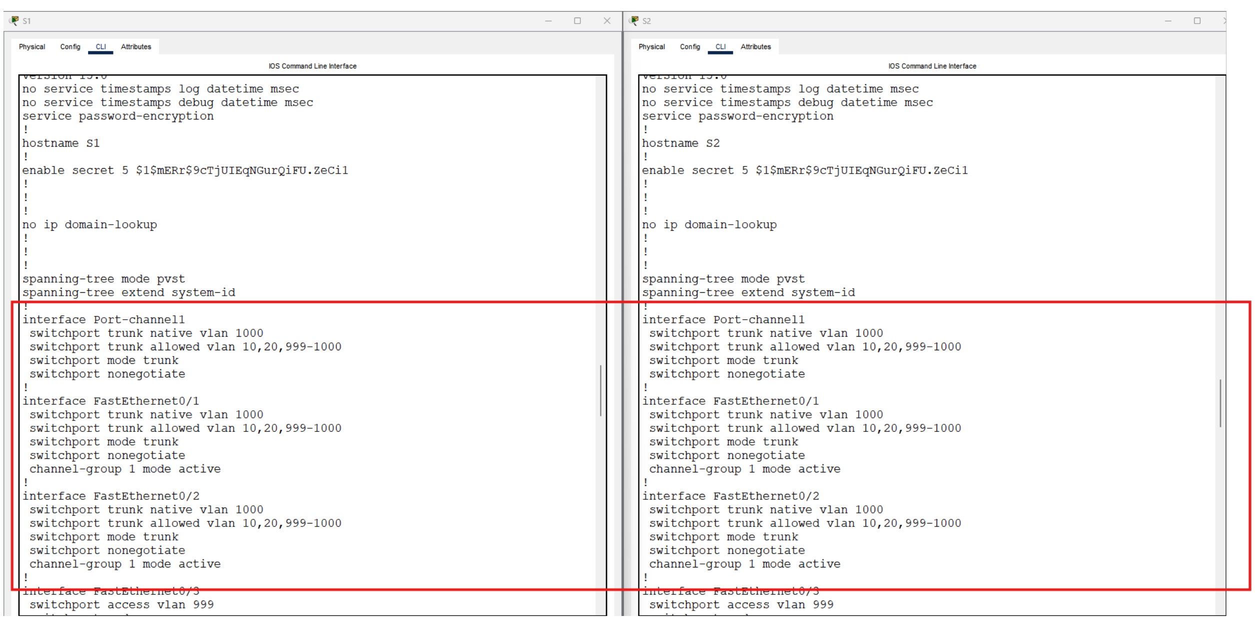
```
! S2 Configuration

enable
clock set 23:10:00 Jan 8 2025

configure terminal
hostname S2
```

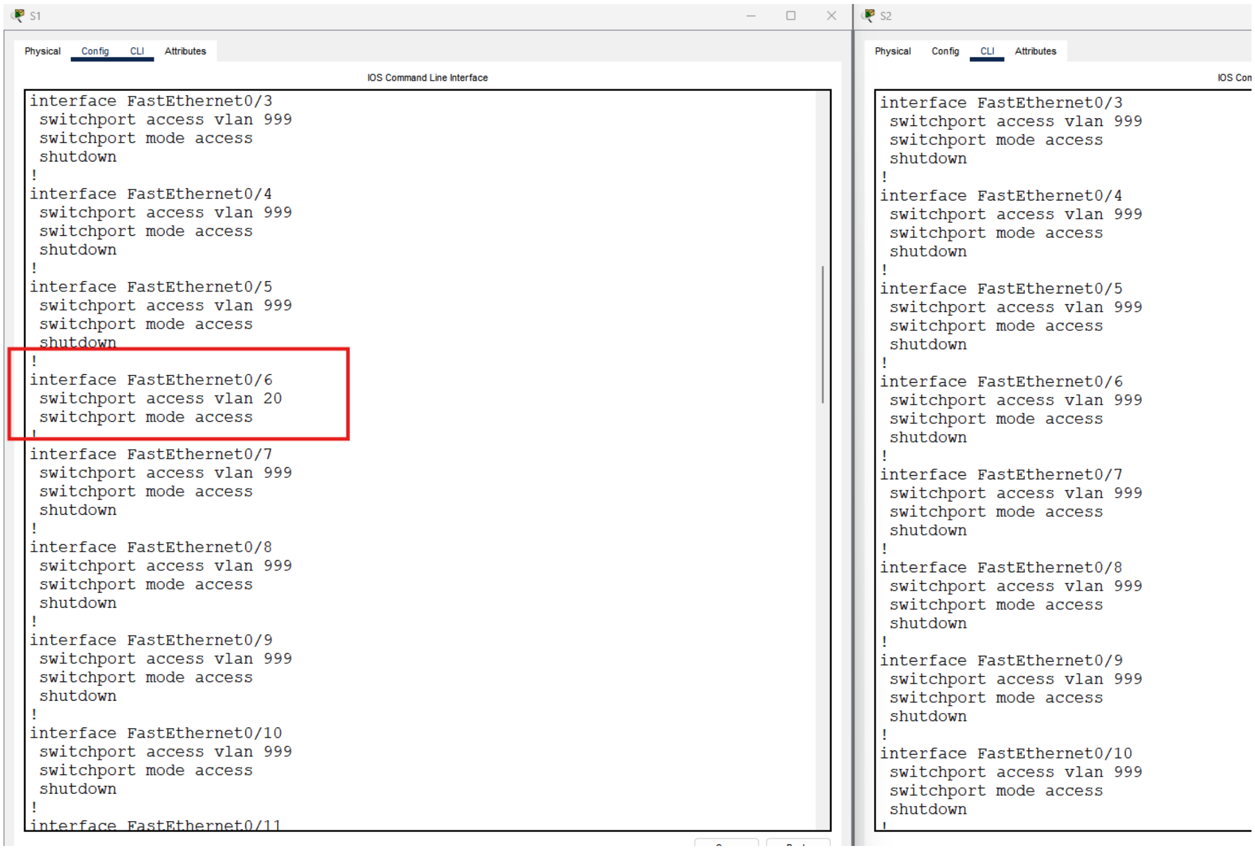
```
no ip domain-lookup
enable secret class
line console 0
 password cisco
 login
line vty 0 15
 password cisco
 login
banner motd ^CUnauthorized access is prohibited.^C
service password-encryption

! VLAN Configuration
vlan 10
 name Management
vlan 20
 name Clients
vlan 999
 name Parking_Lot
vlan 1000
 name Native

! Interface Configuration
interface vlan 10
 ip address 192.168.10.12 255.255.255.0

interface f0/18
 switchport mode access
 switchport access vlan 20

interface range f0/3-17
 switchport mode access
 switchport access vlan 999
 shutdown
interface range f0/19-24
 switchport mode access
 switchport access vlan 999
 shutdown
interface range g0/1-2
 switchport mode access
 switchport access vlan 999
 shutdown

! Create the Port-Channel interface FIRST
interface Port-channel 1
 switchport mode trunk
 switchport trunk allowed vlan 10,20,999,1000
 switchport trunk native vlan 1000


! EtherChannel Configuration (Now that Port-channel1 exists)
interface range FastEthernet0/1 - 2
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode active

end
write memory
```

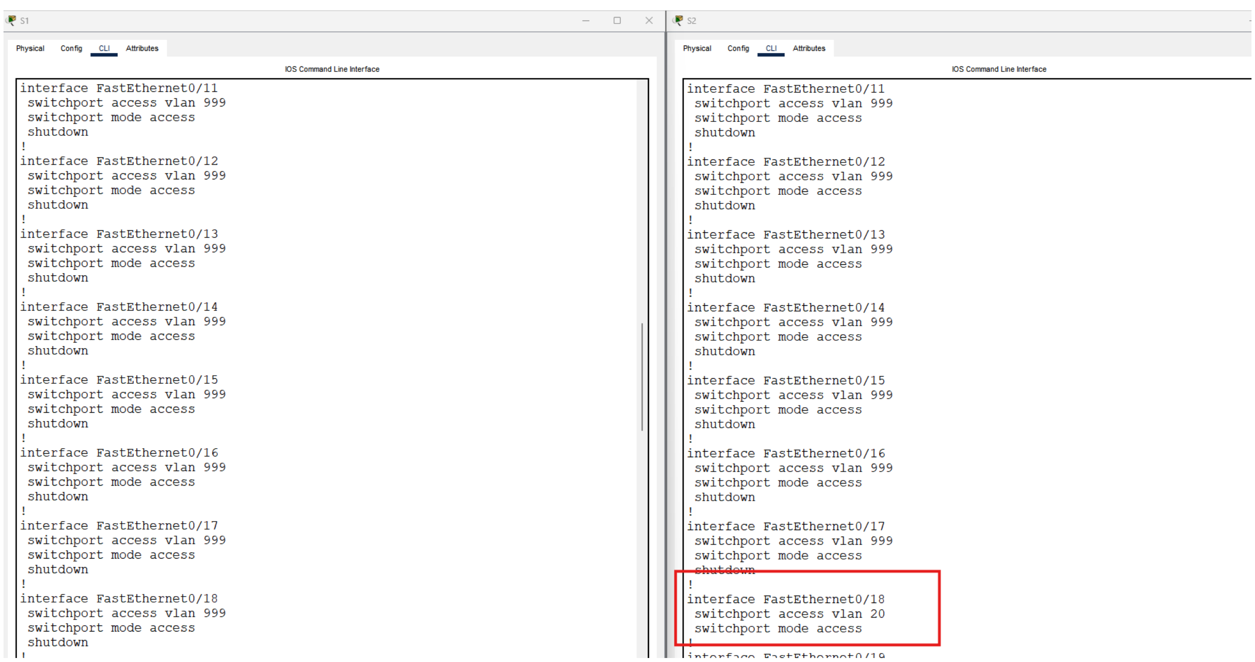
3.9.4.8.3 Verify

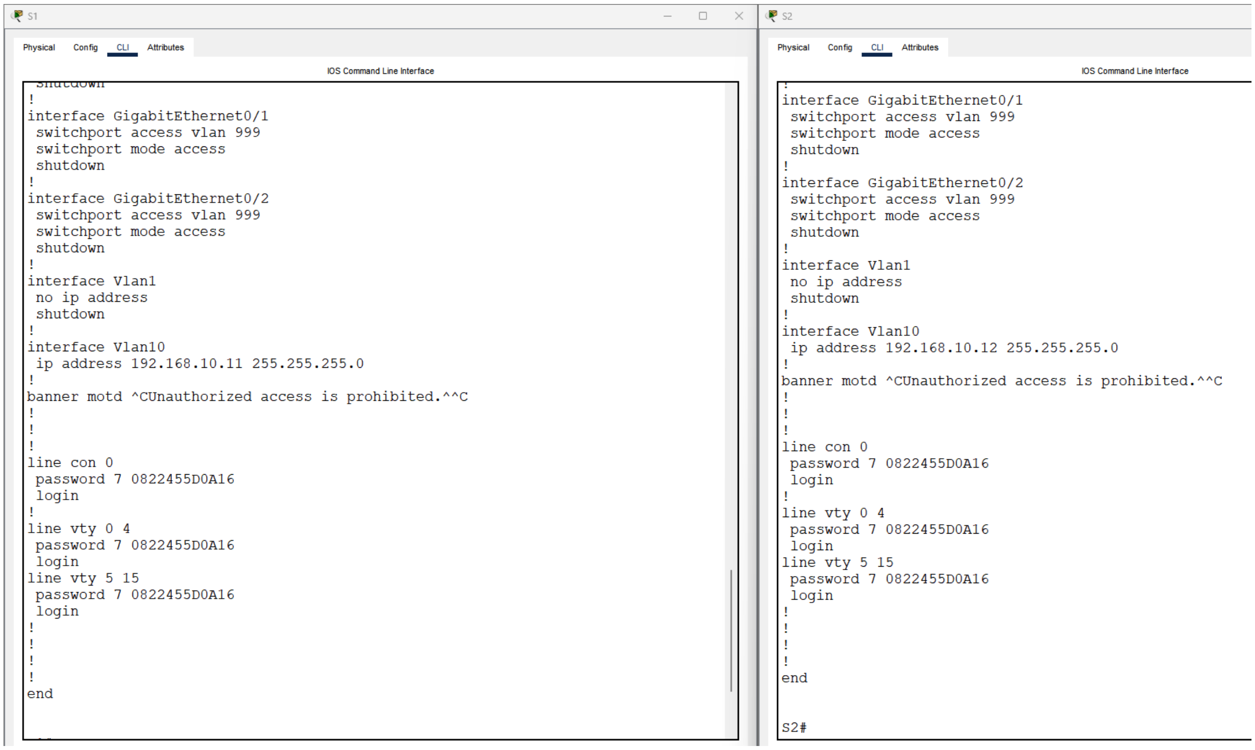
Print commands

```
show running-config
show vlan brief
show interfaces | include Ethernet
show interface status
show interfaces trunk
show etherchannel summary
show spanning-tree
show running-config
```

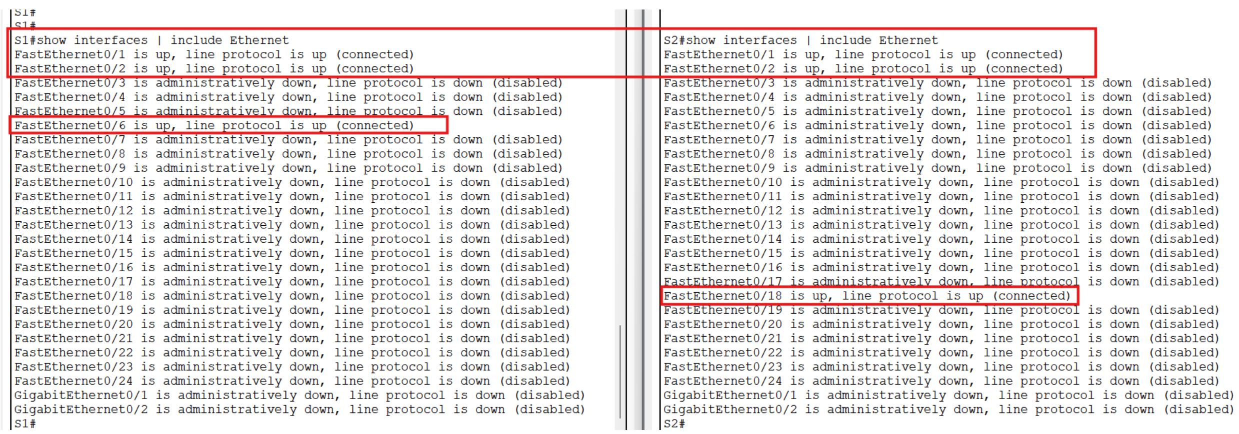



S1
Physical
Config
CLI
Attributes
IOS Command Line Interface
interface FastEthernet0/3
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/4
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/5
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/6
switchport access vlan 20
switchport mode access
!
interface FastEthernet0/7
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/8
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/9
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/10
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/11
S2
Physical
Config
CLI
Attributes
interface FastEthernet0/3
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/4
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/5
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/6
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/7
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/8
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/9
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/10
switchport access vlan 999
switchport mode access
shutdown


S1
Physical
Config
CLI
Attributes
IOS Command Line Interface
interface FastEthernet0/11
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/12
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/13
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/14
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/15
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/16
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/17
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/18
switchport access vlan 999
switchport mode access
shutdown
S2
Physical
Config
CLI
Attributes
IOS Command Line Interface
interface FastEthernet0/11
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/12
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/13
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/14
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/15
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/16
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/17
switchport access vlan 999
switchport mode access
shutdown
!
interface FastEthernet0/18
switchport access vlan 20
switchport mode access



show interfaces | include Ethernet



Show interface status

S1

Physical Config CLI Attributes

IOS Command Line Interface

```
FastEthernet0/20 is administratively down, line protocol is down (disabled)
FastEthernet0/21 is administratively down, line protocol is down (disabled)
FastEthernet0/22 is administratively down, line protocol is down (disabled)
FastEthernet0/23 is administratively down, line protocol is down (disabled)
FastEthernet0/24 is administratively down, line protocol is down (disabled)
GigabitEthernet0/1 is administratively down, line protocol is down (disabled)
GigabitEthernet0/2 is administratively down, line protocol is down (disabled)
S1#
S1#
S1#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po1                          connected    trunk      auto    auto
Fa0/1                        connected    trunk      auto    auto  10/100BaseTX
Fa0/2                        connected    trunk      auto    auto  10/100BaseTX
Fa0/3                        disabled 999            auto    auto  10/100BaseTX
Fa0/4                        disabled 999            auto    auto  10/100BaseTX
Fa0/5                        disabled 999            auto    auto  10/100BaseTX
Fa0/6                        connected    20         auto    auto  10/100BaseTX
Fa0/7                        disabled 999            auto    auto  10/100BaseTX
Fa0/8                        disabled 999            auto    auto  10/100BaseTX
Fa0/9                        disabled 999            auto    auto  10/100BaseTX
Fa0/10                       disabled 999            auto    auto  10/100BaseTX
Fa0/11                       disabled 999            auto    auto  10/100BaseTX
Fa0/12                       disabled 999            auto    auto  10/100BaseTX
Fa0/13                       disabled 999            auto    auto  10/100BaseTX
Fa0/14                       disabled 999            auto    auto  10/100BaseTX
Fa0/15                       disabled 999            auto    auto  10/100BaseTX
Fa0/16                       disabled 999            auto    auto  10/100BaseTX
Fa0/17                       disabled 999            auto    auto  10/100BaseTX
Fa0/18                       disabled 999            auto    auto  10/100BaseTX
Fa0/19                       disabled 999            auto    auto  10/100BaseTX
Fa0/20                       disabled 999            auto    auto  10/100BaseTX
Fa0/21                       disabled 999            auto    auto  10/100BaseTX
Fa0/22                       disabled 999            auto    auto  10/100BaseTX
Fa0/23                       disabled 999            auto    auto  10/100BaseTX
Fa0/24                       disabled 999            auto    auto  10/100BaseTX
Gig0/1                       disabled 999            auto    auto  10/100BaseTX
Gig0/2                       disabled 999            auto    auto  10/100BaseTX

S1#
```

S2

Physical Config CLI Attributes

IOS Command Line Interface

```
FastEthernet0/20 is administratively down, line protocol is down (disabled)
FastEthernet0/21 is administratively down, line protocol is down (disabled)
FastEthernet0/22 is administratively down, line protocol is down (disabled)
FastEthernet0/23 is administratively down, line protocol is down (disabled)
FastEthernet0/24 is administratively down, line protocol is down (disabled)
GigabitEthernet0/1 is administratively down, line protocol is down (disabled)
GigabitEthernet0/2 is administratively down, line protocol is down (disabled)
S2#
S2#
S2#show interface status
Port      Name               Status       Vlan       Duplex  Speed Type
Po1                          connected    trunk      auto    auto
Fa0/1                        connected    trunk      auto    auto  10/100BaseTX
Fa0/2                        connected    trunk      auto    auto  10/100BaseTX
Fa0/3                        disabled 999            auto    auto  10/100BaseTX
Fa0/4                        disabled 999            auto    auto  10/100BaseTX
Fa0/5                        disabled 999            auto    auto  10/100BaseTX
Fa0/6                        disabled 999            auto    auto  10/100BaseTX
Fa0/7                        disabled 999            auto    auto  10/100BaseTX
Fa0/8                        disabled 999            auto    auto  10/100BaseTX
Fa0/9                        disabled 999            auto    auto  10/100BaseTX
Fa0/10                       disabled 999            auto    auto  10/100BaseTX
Fa0/11                       disabled 999            auto    auto  10/100BaseTX
Fa0/12                       disabled 999            auto    auto  10/100BaseTX
Fa0/13                       disabled 999            auto    auto  10/100BaseTX
Fa0/14                       disabled 999            auto    auto  10/100BaseTX
Fa0/15                       disabled 999            auto    auto  10/100BaseTX
Fa0/16                       disabled 999            auto    auto  10/100BaseTX
Fa0/17                       disabled 999            auto    auto  10/100BaseTX
Fa0/18                       connected    20         auto    auto  10/100BaseTX
Fa0/19                       disabled 999            auto    auto  10/100BaseTX
Fa0/20                       disabled 999            auto    auto  10/100BaseTX
Fa0/21                       disabled 999            auto    auto  10/100BaseTX
Fa0/22                       disabled 999            auto    auto  10/100BaseTX
Fa0/23                       disabled 999            auto    auto  10/100BaseTX
Fa0/24                       disabled 999            auto    auto  10/100BaseTX
Gig0/1                       disabled 999            auto    auto  10/100BaseTX
Gig0/2                       disabled 999            auto    auto  10/100BaseTX

S2#
```

Show vlan brief

```
S1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active
10   Management                       active
20   Clients                          active    Fa0/6
999  Parking_Lot                      active    Fa0/3, Fa0/4, Fa0/5, 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
1000 Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S1#
```

```
S2# show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active
10   Management                       active
20   Clients                          active    Fa0/18
999  Parking_Lot                      active    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, Fa0/19
                                                Fa0/20, Fa0/21, Fa0/22, Fa0/23
                                                Fa0/24, Gig0/1, Gig0/2
1000 Native                           active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
S2#
```

Show interfaces trunk

```
S1#show interfaces trunk
Port        Mode          Encapsulation  Status        Native vlan
Po1         on            802.1q         trunking      1000

Port        Vlans allowed on trunk
Po1         10,20,999-1000

Port        Vlans allowed and active in management domain
Po1         10,20,999,1000

Port        Vlans in spanning tree forwarding state and not pruned
Po1         10,20,999,1000

S1#
```

```
S2#show interfaces trunk
Port        Mode          Encapsulation  Status        Native vlan
Po1         on            802.1q         trunking      1000

Port        Vlans allowed on trunk
Po1         10,20,999-1000

Port        Vlans allowed and active in management domain
Po1         10,20,999,1000

Port        Vlans in spanning tree forwarding state and not pruned
Po1         10,20,999

S2#
```

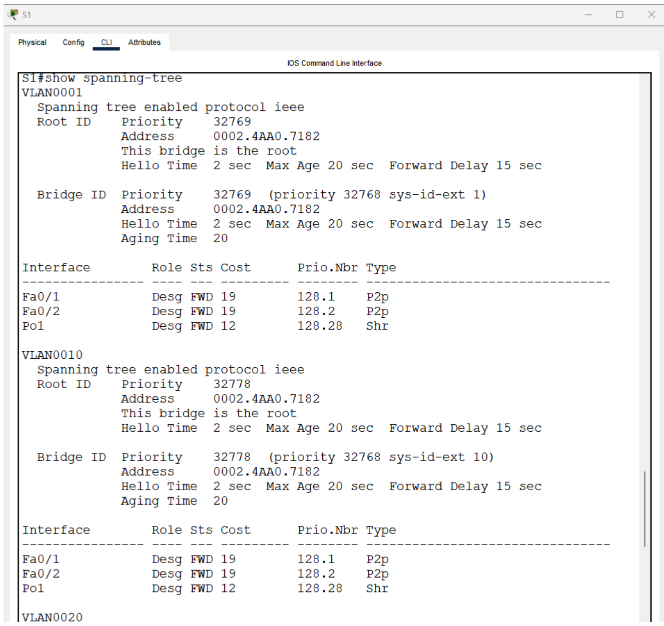
Show etherchannel summary

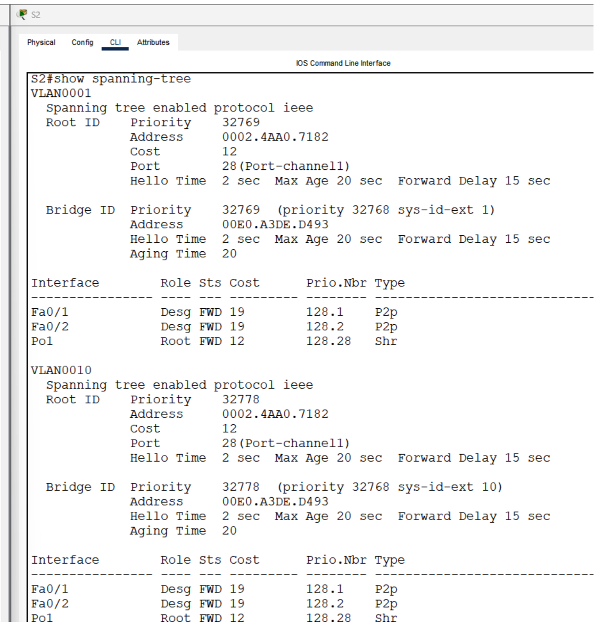
IOS Command Line Interface

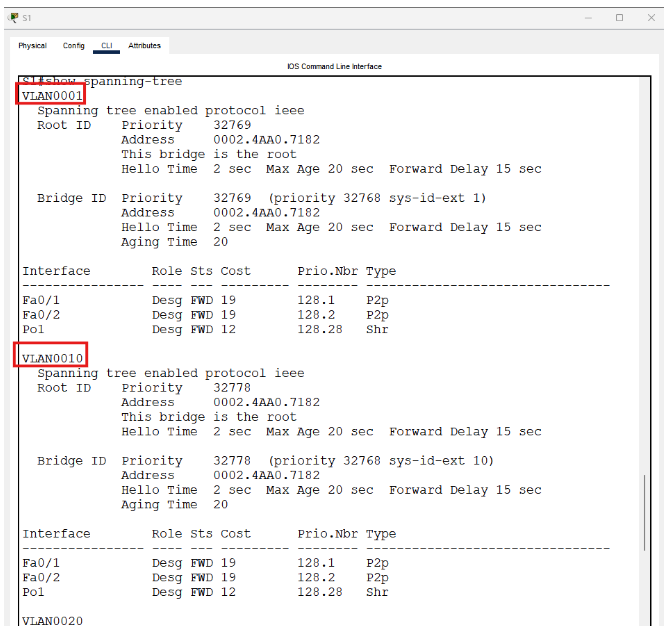
```
S1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------------------------

1      Po1(SU)           LACP   Fa0/1(P) Fa0/2(P)
S1#show sp
S1#show spanning-tree
```

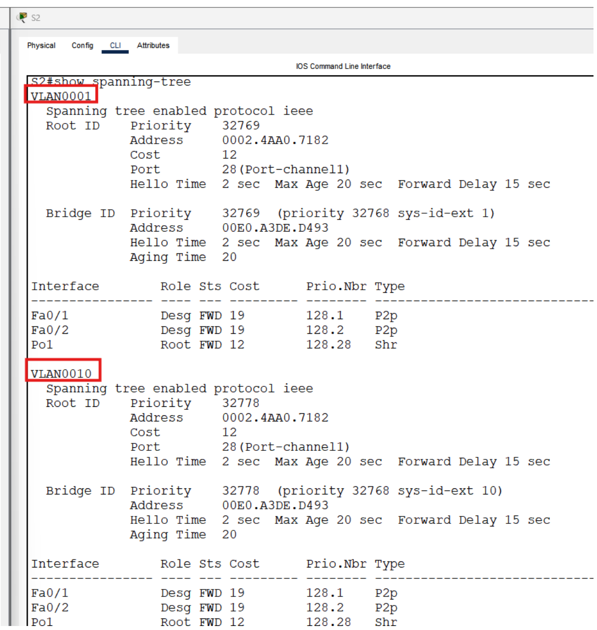
IOS Command Line Interface

```
S2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+----------------------------------------------

1      Po1(SU)           LACP   Fa0/1(P) Fa0/2(P)
S2#show sp
```


S1
Physical Config CLI Attributes
IOS Command Line Interface
S1#show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 32769
Address 0002.4AA0.7182
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 0002.4AA0.7182
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
Interface Role Sts Cost Prio.Nbr Type
Fa0/1 Desg FWD 19 128.1 P2p
Fa0/2 Desg FWD 19 128.2 P2p
Po1 Desg FWD 12 128.28 Shr
VLAN0010
Spanning tree enabled protocol ieee
Root ID Priority 32778
Address 0002.4AA0.7182
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 0002.4AA0.7182
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
Interface Role Sts Cost Prio.Nbr Type
Fa0/1 Desg FWD 19 128.1 P2p
Fa0/2 Desg FWD 19 128.2 P2p
Po1 Desg FWD 12 128.28 Shr
VLAN0020


S2
Physical Config CLI Attributes
IOS Command Line Interface
S2#show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 32769
Address 0002.4AA0.7182
Cost 12
Port 28(Port-channel1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
Address 00E0.A3DE.D493
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
Interface Role Sts Cost Prio.Nbr Type
Fa0/1 Desg FWD 19 128.1 P2p
Fa0/2 Desg FWD 19 128.2 P2p
Po1 Root FWD 12 128.28 Shr
VLAN0010
Spanning tree enabled protocol ieee
Root ID Priority 32778
Address 0002.4AA0.7182
Cost 12
Port 28(Port-channel1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 32778 (priority 32768 sys-id-ext 10)
Address 00E0.A3DE.D493
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
Interface Role Sts Cost Prio.Nbr Type
Fa0/1 Desg FWD 19 128.1 P2p
Fa0/2 Desg FWD 19 128.2 P2p
Po1 Root FWD 12 128.28 Shr


S1
Physical Config CLI Attributes
IOS Command Line Interface
S1#show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 32769
Address 0002.4AA0.7182
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 0002.4AA0.7182
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
Interface Role Sts Cost Prio.Nbr Type
Fa0/1 Desg FWD 19 128.1 P2p
Fa0/2 Desg FWD 19 128.2 P2p
Po1 Desg FWD 12 128.28 Shr
VLAN0010
Spanning tree enabled protocol ieee
Root ID Priority 32778
Address 0002.4AA0.7182
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 0002.4AA0.7182
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
Interface Role Sts Cost Prio.Nbr Type
Fa0/1 Desg FWD 19 128.1 P2p
Fa0/2 Desg FWD 19 128.2 P2p
Po1 Desg FWD 12 128.28 Shr
VLAN0020


S2
Physical Config CLI Attributes
IOS Command Line Interface
S2#show spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 32769
Address 0002.4AA0.7182
Cost 12
Port 28(Port-channel1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
Address 00E0.A3DE.D493
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
Interface Role Sts Cost Prio.Nbr Type
Fa0/1 Desg FWD 19 128.1 P2p
Fa0/2 Desg FWD 19 128.2 P2p
Po1 Root FWD 12 128.28 Shr
VLAN0010
Spanning tree enabled protocol ieee
Root ID Priority 32778
Address 0002.4AA0.7182
Cost 12
Port 28(Port-channel1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 32778 (priority 32768 sys-id-ext 10)
Address 00E0.A3DE.D493
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
Interface Role Sts Cost Prio.Nbr Type
Fa0/1 Desg FWD 19 128.1 P2p
Fa0/2 Desg FWD 19 128.2 P2p
Po1 Root FWD 12 128.28 Shr

```
S1
Physical  Config  CLI  Attributes
IOS Command Line Interface

VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    32788
             Address     0002.4AA0.7182
             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     0002.4AA0.7182
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/6            Desg FWD 19        128.6    P2p
Po1              Desg FWD 12        128.28   Shr

VLAN0999
  Spanning tree enabled protocol ieee
  Root ID    Priority    33767
             Address     0002.4AA0.7182
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    33767  (priority 32768 sys-id-ext 999)
             Address     0002.4AA0.7182
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Desg FWD 12        128.28   Shr

VLAN01000
  Spanning tree enabled protocol ieee
```

```
S2
Physical  Config  CLI  Attributes
IOS Command Line Interface

VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    32788
             Address     0002.4AA0.7182
             Cost        12
             Port        28(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32788  (priority 32768 sys-id-ext 20)
             Address     00E0.A3DE.D493
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/18           Desg FWD 19        128.18   P2p
Po1              Root FWD 12        128.28   Shr

VLAN0999
  Spanning tree enabled protocol ieee
  Root ID    Priority    33767
             Address     0002.4AA0.7182
             Cost        12
             Port        28(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    33767  (priority 32768 sys-id-ext 999)
             Address     00E0.A3DE.D493
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Root FWD 12        128.28   Shr
```

```
Po1              Desg FWD 12        128.28   Shr

VLAN01000
  Spanning tree enabled protocol ieee
  Root ID    Priority    33768
             Address     0002.4AA0.7182
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    33768  (priority 32768 sys-id-ext 1000)
             Address     0002.4AA0.7182
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Desg FWD 12        128.28   Shr

S1#
```

```
VLAN01000
  Spanning tree enabled protocol ieee
  Root ID    Priority    33768
             Address     0002.4AA0.7182
             Cost        12
             Port        28(Port-channel1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    33768  (priority 32768 sys-id-ext 1000)
             Address     00E0.A3DE.D493
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po1              Root FWD 12        128.28   Shr

S2#
```

3.9.4.8.4 Connectivity

Ping is working

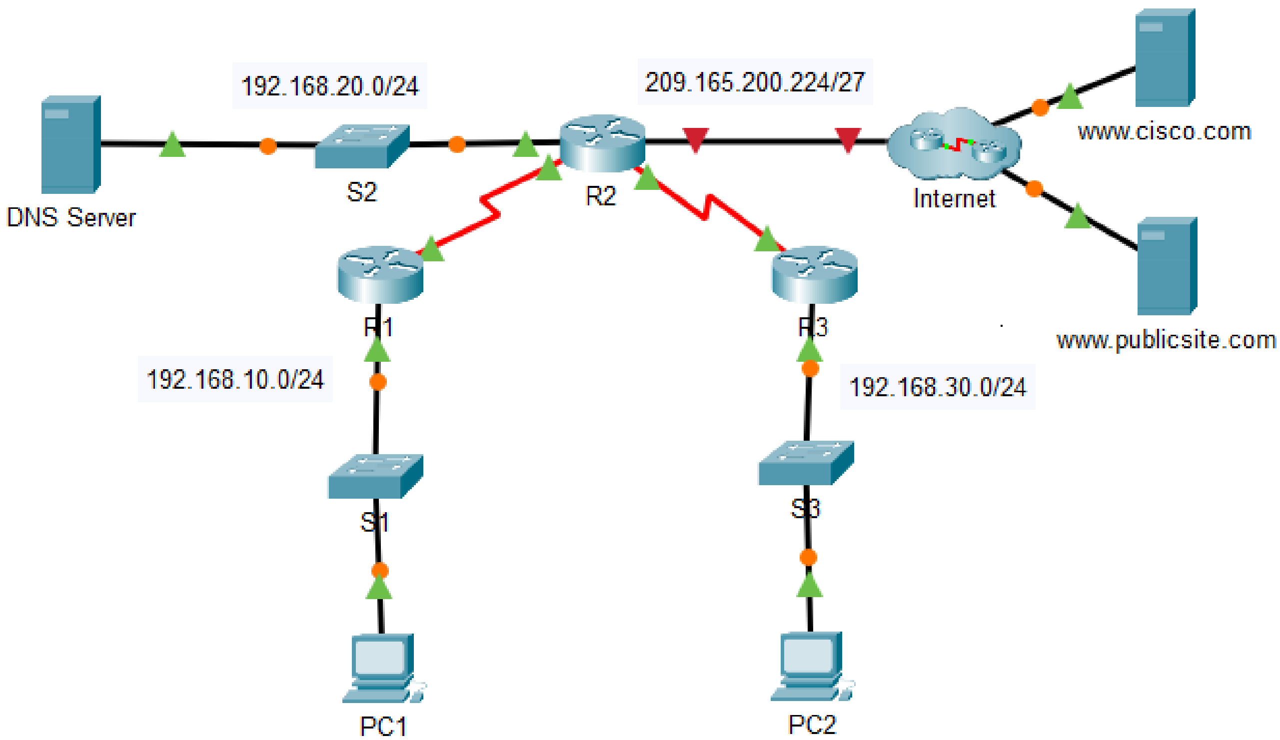
```
C:\>ping 192.168.20.4

Pinging 192.168.20.4 with 32 bytes of data:

Reply from 192.168.20.4: bytes=32 time=2ms TTL=128
Reply from 192.168.20.4: bytes=32 time<1ms TTL=128
Reply from 192.168.20.4: bytes=32 time<1ms TTL=128
Reply from 192.168.20.4: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.20.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>
```

```
C:\>ping 192.168.20.3

Pinging 192.168.20.3 with 32 bytes of data:

Reply from 192.168.20.3: bytes=32 time<1ms TTL=128
Reply from 192.168.20.3: bytes=32 time<1ms TTL=128
Reply from 192.168.20.3: bytes=32 time<1ms TTL=128
Reply from 192.168.20.3: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.20.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

3.10 Netacad Module 7 DHCPv4

3.10.1 Exercise 7.2.10 Packet Tracer - Configure DHCPv4

3.10.1.1 Topology



3.10.1.2 Addressing Table

Device	Interface	IPv4 Address	Subnet Mask	Default Gateway
R1	G0/0	192.168.10.1	255.255.255.0	N/A
	S0/0/0	10.1.1.1	255.255.255.252	N/A
R2	G0/0	192.168.20.1	255.255.255.0	N/A
	G0/1	DHCP Assigned	DHCP Assigned	N/A
	S0/0/0	10.1.1.2	255.255.255.252	N/A
	S0/0/1	10.2.2.2	255.255.255.252	N/A
R3	G0/0	192.168.30.1	255.255.255.0	N/A
	S0/0/1	10.2.2.1	255.255.255.0	N/A
PC1	NIC	DHCP Assigned	DHCP Assigned	DHCP Assigned
PC2	NIC	DHCP Assigned	DHCP Assigned	DHCP Assigned

DNS Server	NIC	192.168.20.254	255.255.255.0	192.168.20.1

3.10.1.3Objectives

Part 1: Configure a Router as a DHCP Server Part 2:

Configure DHCP Relay

Part 3: Configure a Router as a DHCP Client Part 4: Verify

DHCP and Connectivity

3.10.1.4Scenario

A dedicated DHCP server is scalable and relatively easy to manage but it can be costly to have one at every location in a network. However, a Cisco router can be configured to provide DHCP services without the need for a dedicated server. As the network technician for your company, you have been assigned the task of configuring a Cisco router as a DHCP server. You are also required to configure the edge router as a DHCP client so that it receives an IP address from the ISP network.

3.10.1.5Instructions

Part 1: Configure a Router as a DHCP Server

Step 1: Configure the excluded IPv4 addresses.

Addresses that have been statically assigned to devices in the networks that will use DHCP must be excluded from the DHCP pools. This avoids errors associated with duplicate IP addresses. In this case the IP addresses of the R1 and R3 LAN interfaces must be excluded from DHCP. In addition, nine other addresses are excluded for static assignment to other devices such servers and device management interfaces.

a. Configure **R2** to exclude the first 10 addresses from the R1 LAN.

R2(config)# **ip dhcp excluded-address 192.168.10.1 192.168.10.10**

b. Configure **R2** to exclude the first 10 addresses from R3 LAN.

Step 2: Create a DHCP pool on R2 for the R1 LAN.

a. Create a DHCP pool named **R1-LAN** (case-sensitive).

R2(config)# **ip dhcp pool R1-LAN**

b. Configure the DHCP pool to include the network address, the default gateway, and the IP address of the DNS server.

R2(dhcp-config)# **network 192.168.10.0 255.255.255.0**

R2(dhcp-config)# **default-router 192.168.10.1**

R2(dhcp-config)# **dns-server 192.168.20.254**

Step 3: Create a DHCP pool on R2 for the R3 LAN.

a. Create a DHCP pool named **R3-LAN** (case-sensitive).

b. Configure the DHCP pool to include the network address, the default gateway, and the IP address of the DNS server. Refer to the Addressing Table.

Part 2: Configure DHCP Relay

Step 1: Configure R1 and R3 as a DHCP relay agent.

For DHCP clients to obtain an address from a server on a different LAN segment, the interface that the clients are attached to must include a helper address pointing to the DHCP server. In this case, the hosts on the LANs that are attached to R1 and R3 will access the DHCP server that is configured on R2. The IP addresses of the R2 serial interfaces that are attached to R1 and R3 are used as the helper addresses. DHCP traffic from the hosts on the R1 and R3 LANs will be forwarded to these addresses and processed by the DHCP server that is configured on R2.

a. Configure the helper address for the LAN interface on R1.

   R1(config)# **interface g0/0**

   R1(config-if)# **ip helper-address 10.1.1.2**

b. Configure the helper address for the LAN interface on R3.

Step 2: Configure hosts to receive IP addressing information from DHCP.

a. Configure hosts PC1 and PC2 to receive their IP addresses from a DHCP server.

b. Verify that the hosts have received their addresses from the correct DHCP pools.

Part 3: Configure a Router as a DHCP Client

Just as a PC is able to receive an IPv4 address from a server, a router interface has the ability to do the same. Router **R2** needs to be configured to receive addressing from the ISP.

a. Configure the Gigabit Ethernet 0/1 interface on **R2** to receive IP addressing from DHCP and activate the interface.

   R2(config)# **interface g0/1**

   R2(config-if)# **ip address dhcp**

3.10.1.6 Configuration scripts

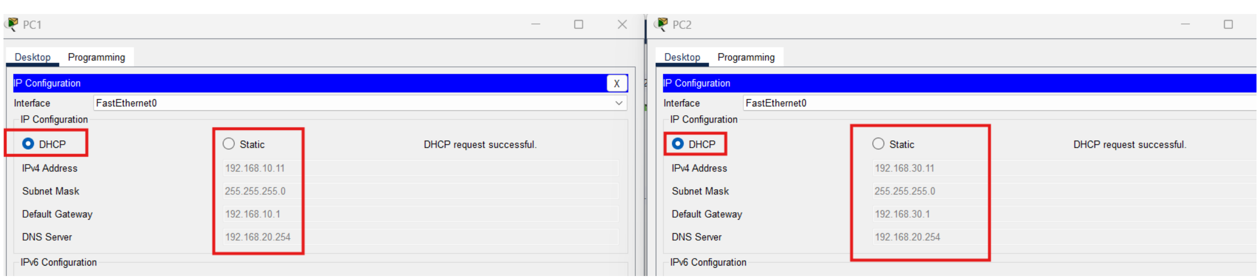
```
! ******************************************

! R1 Configuration

! ******************************************

enable

configure terminal


! Configure R1 as a DHCP relay agent for the R1 LAN

! Forward DHCP requests to R2's S0/0/0 interface

interface g0/0

 ip helper-address 10.1.1.2

 exit
```

```
! ****************************************
! R2 Configuration
! ****************************************
enable
configure terminal

! Exclude the first 10 IP addresses from the R1 LAN to prevent conflicts
ip dhcp excluded-address 192.168.10.1 192.168.10.10

! Exclude the first 10 IP addresses from the R3 LAN to prevent conflicts
ip dhcp excluded-address 192.168.30.1 192.168.30.10

! Create a DHCP pool for the R1 LAN
! Define the network for DHCP assignments
! Set the default gateway for clients
! Set the DNS server for clients
ip dhcp pool R1-LAN
 network 192.168.10.0 255.255.255.0
 default-router 192.168.10.1
 dns-server 192.168.20.254
 exit

! Create a DHCP pool for the R3 LAN
! Define the network for DHCP assignments
! Set the default gateway for clients
! Set the DNS server for clients
ip dhcp pool R3-LAN
 network 192.168.30.0 255.255.255.0
 default-router 192.168.30.1
 dns-server 192.168.20.254
 exit

! Configure the G0/1 interface to receive an IP address from DHCP (ISP)
```

```
! Enable DHCP on the interface
! Activate the interface
interface g0/1
 ip address dhcp
 no shutdown
 exit

! ******************************************
! R3 Configuration
! ******************************************
enable
configure terminal

! Configure R3 as a DHCP relay agent for the R3 LAN
! Forward DHCP requests to R2's S0/0/1 interface
interface g0/0
 ip helper-address 10.2.2.2
 exit
```

3.10.1.7Test

PC1 and PC2 have IP addresses

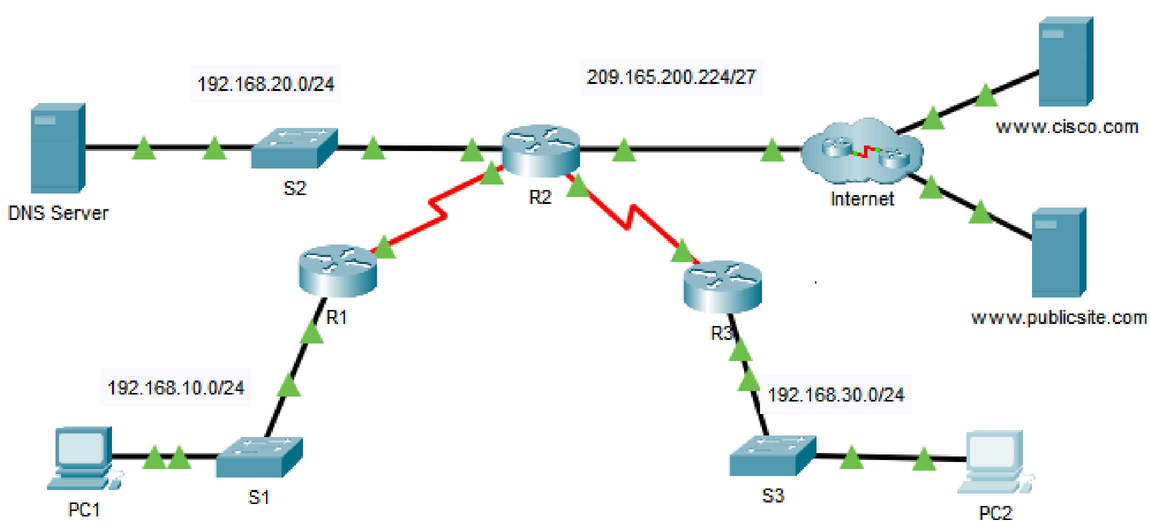


Show ip dhcp binding command

```
R2#
R2#show ip dhcp binding
IP address        Client-ID/              Lease expiration        Type
                  Hardware address
R2#
R2#
R2#
R2#
R2#show ip dhcp binding
IP address        Client-ID/              Lease expiration        Type
                  Hardware address
192.168.10.11     0002.4AA5.1470           --                     Automatic
192.168.30.11     0004.9A97.2535           --                     Automatic
R2#
```

3.10.2 Exercise 7.4.1 Packet Tracer - Implement DHCPv4

3.10.2.1 Topology



3.10.2.2 Addressing Table

Device	Interface	IPv4 Address	Subnet Mask	Default Gateway
R1	G0/0	192.168.10.1	255.255.255.0	N/A
	S0/0/0	10.1.1.1	255.255.255.252	
R2	G0/0	192.168.20.1	255.255.255.0	N/A

Device	Interface	IPv4 Address	Subnet Mask	Default Gateway
R1	G0/0	192.168.10.1	255.255.255.0	N/A
	S0/0/0	10.1.1.1	255.255.255.252	
	G0/1	DHCP Assigned	DHCP Assigned	
	S0/0/0	10.1.1.2	255.255.255.252	
	S0/0/1	10.2.2.2	255.255.255.252	
R3	G0/0	192.168.30.1	255.255.255.0	N/A
	S0/0/1	10.2.2.1	255.255.255.0	
PC1	NIC	DHCP Assigned	DHCP Assigned	DHCP Assigned
PC2	NIC	DHCP Assigned	DHCP Assigned	DHCP Assigned
DNS Server	NIC	192.168.20.254	255.255.255.0	192.168.20.1

3.10.2.3Objectives

Part 1: Configure a Router as a DHCP Server

Part 2: Configure DHCP Relay

Part 3: Configure a Router as a DHCP Client

3.10.2.4Scenario

As the network technician for your company, you are tasked with configuring a Cisco router as a DHCP server to provide dynamic allocation of addresses to clients on the network. You are also required to configure the edge router as a DHCP client so that it receives an IP address from the ISP network. Since the server is centralized, you will need to configure the two LAN routers to relay DHCP traffic between the LANs and the router that is serving as the DHCP server.

3.10.2.5Instructions

Part 1: Configure a Router as a DHCP Server

Step 1: Configure the excluded IPv4 addresses.

Configure **R2** to exclude the first 10 addresses from the R1 and R3 LANs. All other addresses should be available in the DHCP address pool.

Step 2: Create a DHCP pool on R2 for the R1 LAN.

a. Create a DHCP pool named **R1-LAN**. The pool name must match this value in order for you to get credit for your configuration.

b. Configure the DHCP pool to include the network address, the default gateway, and the IP address of the DNS server.

Step 3: Create a DHCP pool on R2 for the R3 LAN.

a. Create a DHCP pool named **R3-LAN** (case-sensitive).

b. Configure the DHCP pool to include the network address, the default gateway, and the IP address of the DNS server.

Part 2: Configure DHCP Relay

Step 1: Configure R1 and R3 as a DHCP relay agent.

Step 2: Set PC1 and PC2 to receive IP addressing information from DHCP.

Part 3: Configure R2 as a DHCP Client

Step 1: Configure the Gigabit Ethernet 0/1 interface on R2 to receive IP addressing from DHCP.

Step 2: Activate the interface.

3.10.2.6Solution

3.10.2.6.1 Scripts

R1

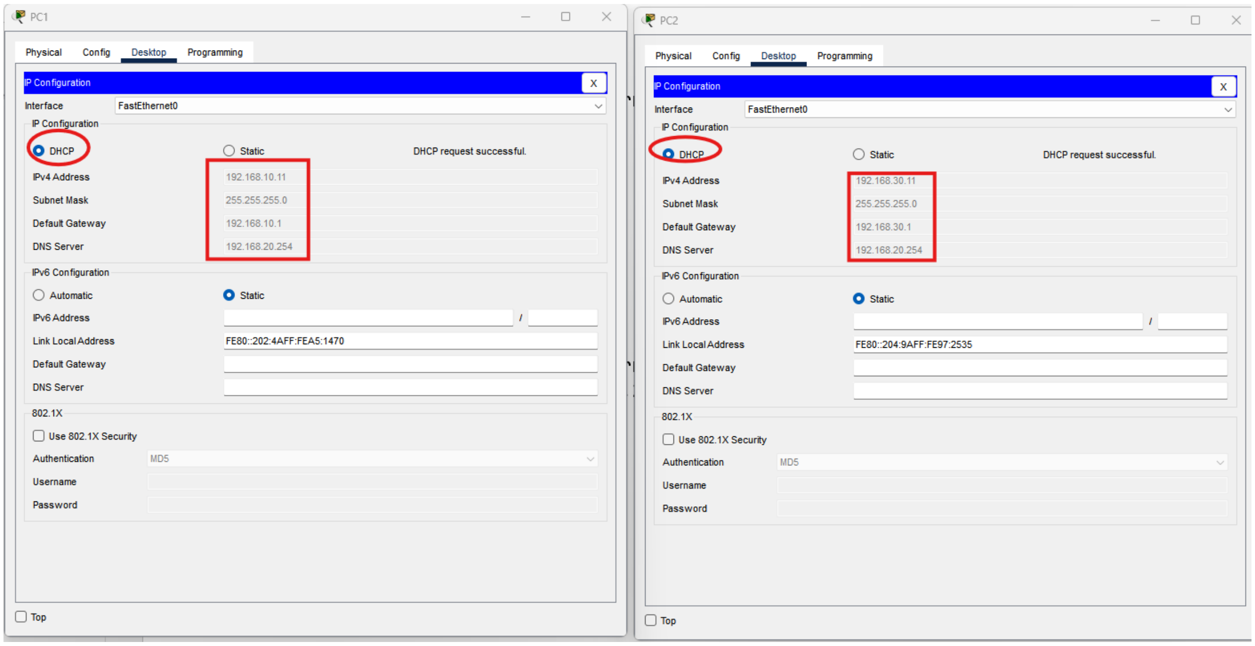
```
enable
conf t
interface GigabitEthernet0/0
 ip helper-address 10.1.1.2
end
```

R2

```
enable
conf t
ip dhcp excluded-address 192.168.10.1 192.168.10.10
ip dhcp excluded-address 192.168.30.1 192.168.30.10
ip dhcp pool R1-LAN
 network 192.168.10.0 255.255.255.0
 default-router 192.168.10.1
 dns-server 192.168.20.254
ip dhcp pool R3-LAN
 network 192.168.30.0 255.255.255.0
 default-router 192.168.30.1
 dns-server 192.168.20.254
interface GigabitEthernet0/1
 ip address dhcp
 no shutdown
end
```

R3

```
enable
conf t
interface GigabitEthernet0/0
 ip helper-address 10.2.2.2
end
```

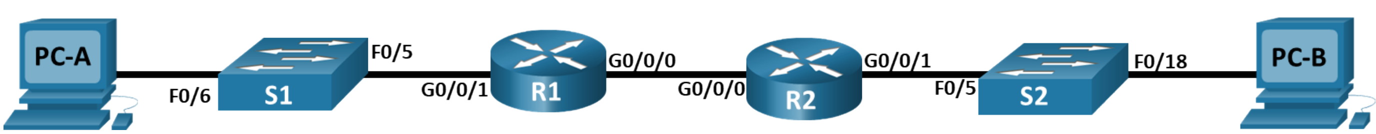


3.10.2.6.2 Test

```
R2>enable
R2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     192.168.20.1    YES manual up                    up
GigabitEthernet0/1     209.165.200.254 YES DHCP   up                    up
Serial0/0/0            10.1.1.2        YES manual up                    up
Serial0/0/1            10.2.2.2        YES manual up                    up
Serial0/1/0            unassigned      YES unset  down                  down
Serial0/1/1            unassigned      YES unset  down                  down
Vlan1                  unassigned      YES unset  administratively down down
R2#
R2#
```

3.10.3 Exercise 7.4.2 Packet Tracer - Lab - Implement DHCPv4

3.10.3.1 Topology



3.10.3.2 Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway

R1	G0/0/0	10.0.0.1	255.255.255.252	N/A
	G0/0/1	N/A	N/A	
	G0/0/1.100	192.168.1.1	255.255.255.192	
	G0/0/1.200	192.168.1.65	255.255.255.224	
	G0/0/1.1000	N/A	N/A	
R2	G0/0/0	10.0.0.2	255.255.255.252	N/A
	G0/0/1	192.168.1.97	255.255.255.240	
S1	VLAN 200	192.168.1.66	255.255.255.224	192.168.1.65
S2	VLAN 1	192.168.1.98	255.255.255.240	192.168.1.97
PC-A	NIC	DHCP	DHCP	DHCP
PC-B	NIC	DHCP	DHCP	DHCP

3.10.3.3VLAN Table

VLAN	Name	Interface Assigned
1	N/A	S2: F0/18
100	Clients	S1: F0/6
200	Management	S1: VLAN 200
999	Parking_Lot	S1: F0/1-4, F0/7-24, G0/1-2
1000	Native	N/A

3.10.3.4Objectives

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

Configure and verify two DHCPv4 Servers on R1

Part 3: Configure and verify a DHCP Relay on R2

3.10.3.5 Background / Scenario

The Dynamic Host Configuration Protocol (DHCP) is a network protocol that lets network administrators manage and automate the assignment of IP addresses. Without DHCP for IPv4, the administrator must manually assign and configure IP addresses, preferred DNS servers, and default gateways. As the network grows in size, this becomes an administrative problem when devices are moved from one internal network to another.

In this scenario, the company has grown in size, and the network administrators can no longer assign IP addresses to devices manually. Your job is to configure the R1 router to assign IPv4 addresses on two different subnets.
Note: The routers used with CCNA hands-on labs are Cisco 4221 with Cisco IOS XE Release 16.9.4 (universalk9 image). The switches used in the labs are Cisco Catalyst 2960s with Cisco IOS Release 15.2(2) (lanbasek9 image). Other routers, switches, and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and the output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of the lab for the correct interface identifiers.
Note: Ensure that the routers and switches have been erased and have no startup configurations. If you are unsure contact your instructor.

3.10.3.6 Required Resources

- 2 Routers (Cisco 4221 with Cisco IOS XE Release 16.9.4 universal image or comparable)
- 2 Switches (Cisco 2960 with Cisco IOS Release 15.2(2) lanbasek9 image or comparable)
- 2 PCs (Windows with a terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet cables as shown in the topology

3.10.3.7 Instructions

Part 1: Build the Network and Configure Basic Device Settings

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

Step 1: Establish an addressing scheme

Subnet the network 192.168.1.0/24 to meet the following requirements:

a. One subnet, “Subnet A”, supporting 58 hosts (the client VLAN at R1).

Subnet A: 192.168.1.0/26 (.1 -.63)

Record the first IP address in the Addressing Table for R1 G0/0/1.100.

b. One subnet, “Subnet B”, supporting 28 hosts (the management VLAN at R1).

Subnet B: 192.168.1.64/27 (.65-.95)

Record the first IP address in the Addressing Table for R1 G0/0/1.200. Record the second IP address in the Address Table for S1 VLAN 200 and enter the associated default gateway.

c. One subnet, “Subnet C”, supporting 12 hosts (the client network at R2).

Subnet C:192.168.1.96/28 (.97-.111)

Record the first IP address in the Addressing Table for R2 G0/0/1. Record the second IP address in the Address Table for S2 VLAN 1 and enter the associated default gateway.

Answer do subnetting

192.168.1.0/24

192.168.1.0 255.255.255.0

128	64	32	16	8	4	2	1
1	1	1	1	0	0	0	0

		First IP	Last IP	Boadcast
SUBNET A - 58	192.168.1.0/26	192.168.1.1	192.168.1.62	192.168.1.63
SUBNET B -28	192.168.1.64/27	192.168.1.65	192.168.1.94	192.168.1.95
SUBNET C - 12	192.168.1.96/28	192.168.1.97	192.168.1.110	192.168.1.111
	192.168.1.112			

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

Attach the devices as shown in the topology diagram, and cable as necessary.

Step 3: Configure basic settings for each router.

a. Assign a device name to the router.

b. Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were host names.

c. Assign **class** as the privileged EXEC encrypted password.

d. Assign **cisco** as the console password and enable login.

e. Assign **cisco** as the VTY password and enable login.

f. Encrypt the plaintext passwords.

g. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

h. Save the running configuration to the startup configuration file.

i. Set the clock on the router to today's time and date.

Note: Use the question mark (**?**) to help with the correct sequence of parameters needed to execute this command.

Step 4: Configure Inter-VLAN Routing on R1

a. Activate interface G0/0/1 on the router.

b. Configure sub-interfaces for each VLAN as required by the IP addressing table. All sub-interfaces use 802.1Q encapsulation and are assigned the first usable address from the IP address pool you have calculated. Ensure the sub-interface for the native VLAN does not have an IP address assigned. Include a description for each sub-interface.

c. Verify the sub-interfaces are operational.

Step 5: Configure G0/0/1 on R2, then G0/0/0 and static routing for both routers

a. Configure G0/0/1 on R2 with the first IP address of Subnet C you calculated earlier.

b. Configure interface G0/0/0 for each router based on the IP Addressing table above.

c. Configure a default route on each router pointed to the IP address of G0/0/0 on the other router.

d. Verify static routing is working by pinging R2's G0/0/1 address from R1.

e. Save the running configuration to the startup configuration file.

Step 6: Configure basic settings for each switch.

a. Assign a device name to the switch.

b. Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were host names.

c. Assign **class** as the privileged EXEC encrypted password.

d. Assign **cisco** as the console password and enable login.

e. Assign **cisco** as the VTY password and enable login.

f. Encrypt the plaintext passwords.

g. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

h. Save the running configuration to the startup configuration file.

i. Set the clock on the switch to today's time and date.

Note: Use the question mark (**?**) to help with the correct sequence of parameters needed to execute this command.

j. Copy the running configuration to the startup configuration.

Step 7: Create VLANs on S1.

Note: S2 is only configured with basic settings.

a. Create and name the required VLANs on switch 1 from the table above.

b. Configure and activate the management interface on S1 (VLAN 200) using the second IP address from the subnet calculated earlier. Additionally, set the default gateway on S1.

c. Configure and activate the management interface on S2 (VLAN 1) using the second IP address from the subnet calculated earlier. Additionally, set the default gateway on S2

d. Assign all unused ports on S1 to the Parking_Lot VLAN, configure them for static access mode, and administratively deactivate them. On S2, administratively deactivate all the unused ports.

Note: The interface range command is helpful to accomplish this task with as few commands as necessary.

Step 8: Assign VLANs to the correct switch interfaces.

a. Assign used ports to the appropriate VLAN (specified in the VLAN table above) and configure them for static access mode.

b. Verify that the VLANs are assigned to the correct interfaces.

Why is interface F0/5 listed under VLAN 1?

Step 9: Manually configure S1's interface F0/5 as an 802.1Q trunk.

a. Change the switchport mode on the interface to force trunking.

b. As a part of the trunk configuration, set the native VLAN to 1000.

c. As another part of trunk configuration, specify that VLANs 100, 200, and 1000 are allowed to cross the trunk.

d. Save the running configuration to the startup configuration file.

e. Verify trunking status.

At this point, what IP address would the PC's have if they were connected to the network using DHCP?
Answer They would self-configure with an Automatic Private IP Address (APIPA) address in the 169.254.x.x range.

Part 2: Configure and verify two DHCPv4 Servers on R1

In Part 2, you will configure and verify a DHCPv4 Server on R1. The DHCPv4 server will service two subnets, Subnet A and Subnet C.

Step 1: Configure R1 with DHCPv4 pools for the two supported subnets. Only the DHCP Pool for subnet A is given below

a. Exclude the first five useable addresses from each address pool.

b. Create the DHCP pool (Use a unique name for each pool).

c. Specify the network that this DHCP server is supporting.

d. Configure the domain name as ccna-lab.com

e. Configure the appropriate default gateway for each DHCP pool.

f. Configure the lease time for 2 days 12 hours and 30 minutes.

g. Next, configure the second DHCPv4 Pool using the pool name R2_Client_LAN and the calculated network, default-router and use the same domain name and lease time from the previous DHCP pool.

Step 2: Save your configuration

Save the running configuration to the startup configuration file.

Step 3: Verify the DHCPv4 Server configuration

a. Issue the command **show ip dhcp pool** to examine the pool details.

b. Issue the command **show ip dhcp bindings** to examine established DHCP address assignments.

c. Issue the command **show ip dhcp server statistics** to examine DHCP messages.

Step 4: Attempt to acquire an IP address from DHCP on PC-A

a. Open a command prompt on PC-A and issue the command **ipconfig /renew**.

b. Once the renewal process is complete, issue the command **ipconfig** to view the new IP information.

c. Test connectivity by pinging R1's G0/0/1 interface IP address.

Part 3: Configure and verify a DHCP Relay on R2

In Part 3, you will configure R2 to relay DHCP requests from the local area network on interface G0/0/1 to the DHCP server (R1).

Step 1: Configure R2 as a DHCP relay agent for the LAN on G0/0/1

a. Configure the **ip helper-address** command on G0/0/1 specifying R1's G0/0/0 IP address.

b. Save your configuration.

Step 2: Attempt to acquire an IP address from DHCP on PC-B

a. Open a command prompt on PC-B and issue the command **ipconfig /renew**.

b. Once the renewal process is complete, issue the command **ipconfig** to view the new IP information.

c. Test connectivity by pinging R1's G0/0/1 interface IP address.

d. Issue the **show ip dhcp binding** on R1 to verify DHCP bindings.

e. Issue the **show ip dhcp server statistics** on R1 and R2 to verify DHCP messages.

3.10.3.8 Scripts

```
!!!!!!!!!!!!!!!!!!!!!!!!!
! Configuration for S1
!!!!!!!!!!!!!!!!!!!!!!!!!
enable
configure terminal
hostname S1
no ip domain-lookup

! Line Configuration
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 login
exit

service password-encryption
banner motd # Authorized Users Only! #
```



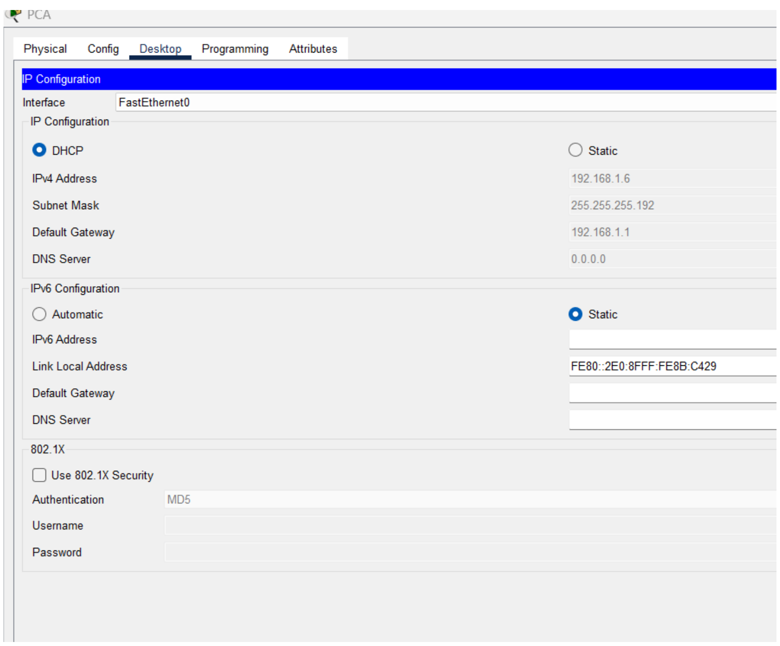
```
! VLAN Configuration
vlan 100
 name Clients
vlan 200
 name Management
vlan 999
 name Parking_Lot
vlan 1000
 name Native
exit

interface vlan 200
 ip address 192.168.1.66 255.255.255.224
 no shutdown
exit

! Default Gateway
ip default-gateway 192.168.1.65

interface FastEthernet0/5
 switchport trunk allowed vlan 100,200,1000
 switchport trunk native vlan 1000
 switchport mode trunk
exit

interface FastEthernet0/6
 switchport access vlan 100
 switchport mode access
exit

! Interface Configuration
interface range f0/1 - 4, f0/7 - 24
 switchport access vlan 999
 switchport mode access
 shutdown
exit

interface range GigabitEthernet0/1 - 2
 switchport access vlan 999
 switchport mode access
 shutdown
exit

! Security
enable secret class
banner motd # Authorized Users Only! #
end
clock set 00:10:00 23 February 2025
copy running-config startup-config

!!!!!!!!!!!!!!!!!!!!!!!!!
! Configuration for S2
!!!!!!!!!!!!!!!!!!!!!!!!!
enable
configure terminal

service password-encryption

hostname S2
```

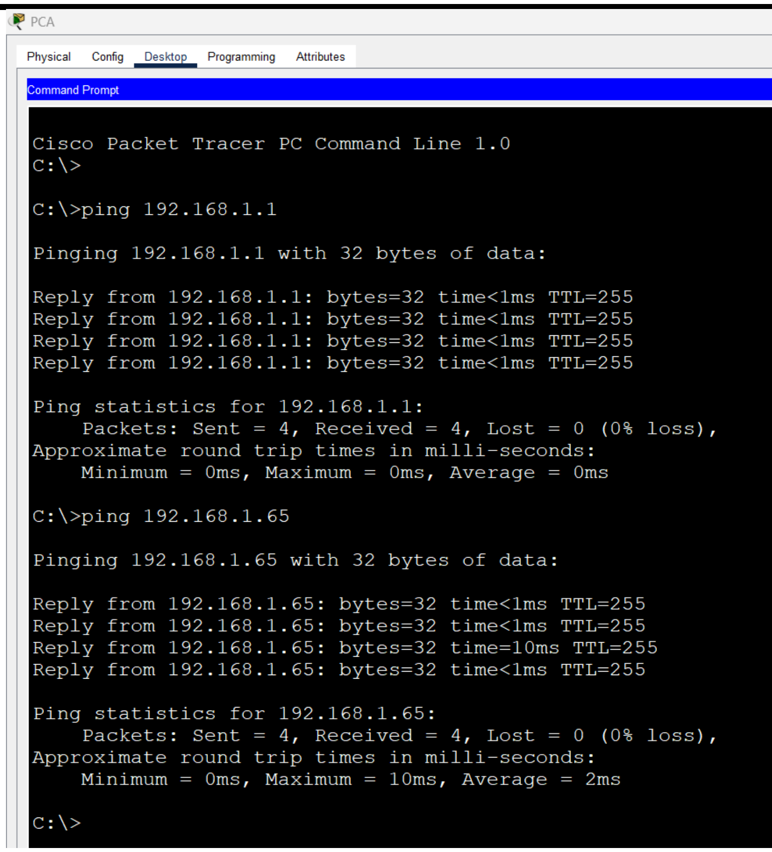
```
enable secret 5 class
no ip domain-lookup
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
line vty 5 15
 login


interface Vlan1
 ip address 192.168.1.98 255.255.255.240
interface FastEthernet0/18
 no shutdown
interface range f0/1 - 4, f0/6 - 17, f0/19 - 24, g0/1 - 2
  switchport mode access
  shutdown
exit

ip default-gateway 192.168.1.97

banner motd # Authorized Users Only! #
end
clock set 00:10:00 23 February 2025
copy running-config startup-config

!!!!!!!!!!!!!!!!!!!!!!!!!
! Configuration for R1
!!!!!!!!!!!!!!!!!!!!!!!!!
enable
configure terminal
hostname R1
no ip domain-lookup

enable secret class

line con 0
 password cisco
 login
exit
line vty 0 4
 password cisco
 login
end
service password-encryption
banner motd # Authorized Users Only! #

interface GigabitEthernet0/0/1
 no shutdown
exit

interface GigabitEthernet0/0/1.100
 description Connected to Client Network
 encapsulation dot1Q 100
 ip address 192.168.1.1 255.255.255.192
exit
```

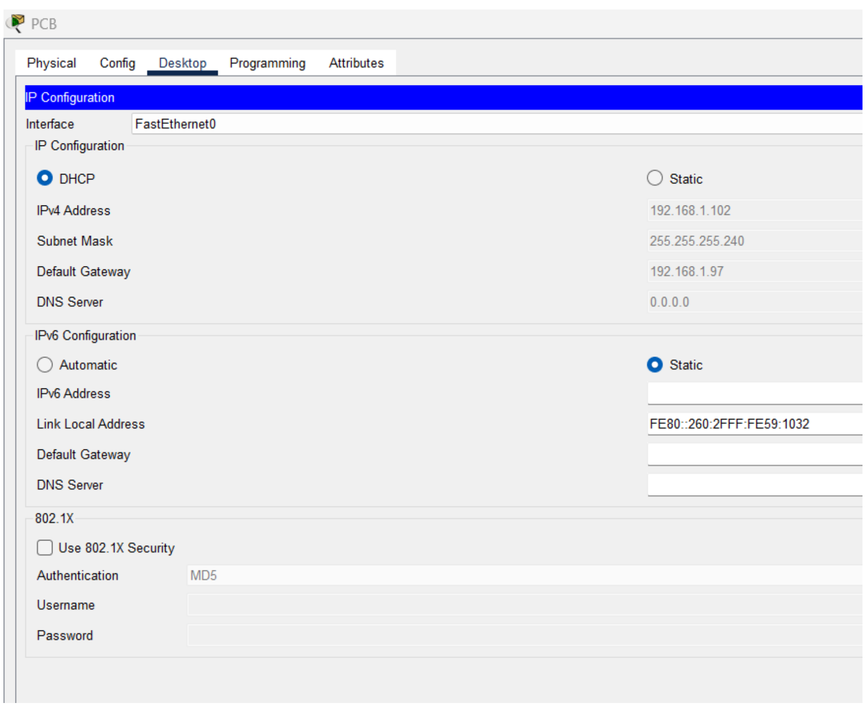
```
interface GigabitEthernet0/0/1.200
 description Connected to Management Network
 encapsulation dot1Q 200
 ip address 192.168.1.65 255.255.255.224
exit
interface GigabitEthernet0/0/1.1000
 description Connected to Native VLAN
 encapsulation dot1Q 1000 native
exit

ip dhcp excluded-address 192.168.1.1 192.168.1.5

ip dhcp pool R1_Client_LAN
 network 192.168.1.0 255.255.255.192
 domain-name ccna-lab.com
 default-router 192.168.1.1
 lease 2 12 30

ip dhcp excluded-address 192.168.1.97 192.168.1.101
ip dhcp pool R2_Client_LAN
 network 192.168.1.96 255.255.255.240
 default-router 192.168.1.97
 domain-name ccna-lab.com
 lease 2 12 30
exit

interface GigabitEthernet0/0/0
 ip address 10.0.0.1 255.255.255.252
 no shutdown
exit
ip forward-protocol nd

ip route 0.0.0.0 0.0.0.0 10.0.0.2
end
clock set 00:50:00 23 February 2025
copy running-config startup-config


!!!!!!!!!!!!!!!!!!!!!!!!
! Configuration for R2
!!!!!!!!!!!!!!!!!!!!!!!!
enable
configure terminal
hostname R2
no ip domain-lookup
enable secret class
line con 0
 password cisco
 login
exit

line vty 0 4
 password cisco
 login
exit

service password-encryption
banner motd # Authorized Users Only! #
```

```
interface GigabitEthernet0/0/1
 ip address 192.168.1.97 255.255.255.240
 no shutdown
 ip helper-address 10.0.0.1
exit

interface GigabitEthernet0/0/0
 ip address 10.0.0.2 255.255.255.252
 no shutdown
exit

ip route 0.0.0.0 0.0.0.0 10.0.0.1

end

clock set 00:55:00 23 February 2025
copy running-config startup-config
```

3.10.3.9 Test



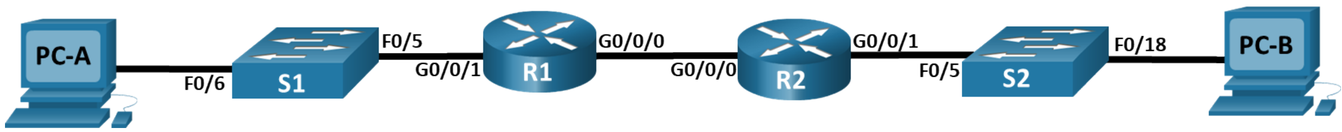

PCA
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>
C:\>ping 192.168.1.1
Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Ping statistics for 192.168.1.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.1.65
Pinging 192.168.1.65 with 32 bytes of data:
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255
Reply from 192.168.1.65: bytes=32 time=10ms TTL=255
Reply from 192.168.1.65: bytes=32 time<1ms TTL=255
Ping statistics for 192.168.1.65:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 10ms, Average = 2ms
C:\>

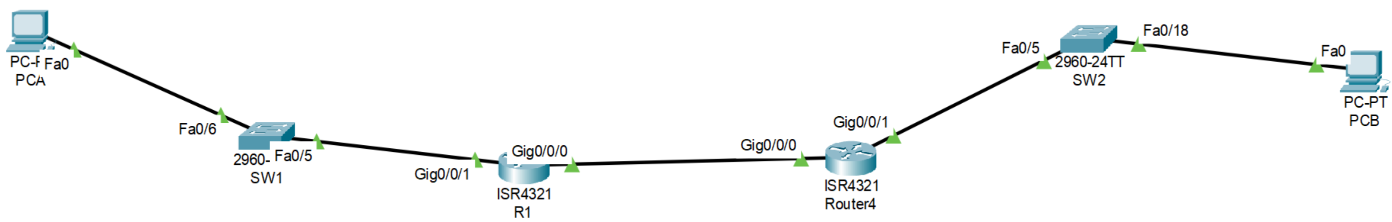

PCB
Physical
Config
Desktop
Programming
Attributes
IP Configuration
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.1.102
Subnet Mask
255.255.255.240
Default Gateway
192.168.1.97
DNS Server
0.0.0.0
IPv6 Configuration
Automatic
Static
IPv6 Address
Link Local Address
FE80::260:2FFF:FE59:1032
Default Gateway
DNS Server
802.1X
Use 802.1X Security
Authentication
MD5
Username
Password

3.11 Netacad Module 8 – SLAAC and DHCPv6

3.11.1 Exercise 8.5.1 Packet Tracer Lab - Configure DHCPv6

3.11.1.1 Topology





3.11.1.2 Addressing Table

Device	Interface	IPv6 Address
R1	G0/0/0	2001:db8:acad:2::1 /64
		fe80::1
	G0/0/1	2001:db8:acad:1::1/64
		fe80::1
R2	G0/0/0	2001:db8:acad:2::2/64
		fe80::2
	G0/0/1	2001:db8:acad:3::1 /64
		fe80::1
PC-A	NIC	DHCP
PC-B	NIC	DHCP

3.11.1.3 Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Verify SLAAC address assignment from R1

Part 3: Configure and verify a Stateless DHCPv6 Server on R1

Part 4: Configure and verify a Stateful DHCPv6 Server on R1

Part 5: Configure and verify a DHCPv6 Relay on R2

3.11.1.4 Background / Scenario

The dynamic assignment of IPv6 global unicast addresses (GUA) can be configured the following three ways:

- Stateless Address Autoconfiguration (SLAAC)
- Stateless Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
- Stateful DHCPv6

When using SLAAC to assign IPv6 addresses to hosts a DHCPv6 server is not used. Because a DHCPv6 server is not used when implementing SLAAC, hosts are unable to receive additional critical network information, including a domain name server (DNS) address as well as a domain name.

When using Stateless DHCPv6 to assign IPv6 addresses to host, a DHCPv6 server is used to assign the additional critical network information, however the IPv6 address is assigned using SLAAC.

When implementing Stateful DHCPv6, a DHCPv6 server assigns all network information, including the IPv6 address.
The determination of how hosts obtain they dynamic IPv6 addressing is dependent on flag setting contain within the router advertisement (RA) messages.
In this scenario, the company has grown in size, and the network administrators can no longer assign IP addresses to devices manually. Your job is to configure the R2 router to assign IPv6 addresses on two different subnets connected to router R1.

Note: The routers used with CCNA hands-on labs are Cisco 4221 with Cisco IOS XE Release 16.9.4 (universalk9 image). The switches used in the labs are Cisco Catalyst 2960s with Cisco IOS Release 15.2(2) (lanbasek9 image). Other routers, switches, and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and the output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of the lab for the correct interface identifiers.

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

Required Resources

- 2 Routers (Cisco 4221 with Cisco IOS XE Release 16.9.4 universal image or comparable)
- 2 Switches (Cisco 2960 with Cisco IOS Release 15.2(2) lanbasek9 image or comparable) - **Optional**
- 2 PCs (Windows with a terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet cables as shown in the topology

  (*) DOES NOT SUPPORTIPV6 DHCP RELAY

Instructions

Part 1: Build the Network and Configure Basic Device Settings

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

Step 1: Cable the network as shown in the topology.

Attach the devices as shown in the topology diagram, and cable as necessary.

Step 2: Configure basic settings for each switch. (Optional)

a. Assign a device name to the switch.

```
switch(config)# hostname S1
switch(config)# hostname S2
```

b. Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were host names.

```
S1(config)# no ip domain-lookup
S2(config)# no ip domain-lookup
```

c. Assign **class** as the privileged EXEC encrypted password.

```
S1(config)# enable secret class
S2(config)# enable secret class
```

d. Assign **cisco** as the console password and enable login.

```
S1(config)# line console 0
S1(config-line)# password cisco
S1(config-line)# login

S2(config)# line console 0
S2(config-line)# password cisco
S2(config-line)# login
```

e. Assign **cisco** as the VTY password and enable login.

```
S1(config)# line vty 0 4
S1(config-line)# password cisco
S1(config-line)# login

S2(config)# line vty 0 4
S2(config-line)# password cisco
S2(config-line)# login
```

f. Encrypt the plaintext passwords.

```
S1(config)# service password-encryption

S2(config)# service password-encryption
```

g. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

```
S1(config)# banner motd # Authorized Users Only! #

S2(config)# banner motd # Authorized Users Only! #
```

h. Shutdown all unused ports

```
S1(config)# interface range f0/1-4, f0/7-24, g0/1-2
S1(config-if-range)# shutdown

S2(config)# interface range f0/1-4, f0/7-17, f0/19-24, g0/1-2
S2(config-if-range)# shutdown
```

i. Save the running configuration to the startup configuration file.

```
S1# copy running-config startup-config

S2# copy running-config startup-config
```

Step 3: Configure basic settings for each router.

a. Assign a device name to the router.

```
router(config)# hostname R1

router(config)# hostname R2
```

b. Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were host names.

```
R1(config)# no ip domain-lookup

R2(config)# no ip domain-lookup
```

c. Assign **class** as the privileged EXEC encrypted password.

```
R1(config)# enable secret class
R2(config)# enable secret class
```

d. Assign **cisco** as the console password and enable login.

```
R1(config)# line console 0
R1(config-line)# password cisco
R1(config-line)# login

R2(config)# line console 0
R2(config-line)# password cisco
R2(config-line)# login
```

e. Assign **cisco** as the VTY password and enable login.

```
R1(config)# line vty 0 4
R1(config-line)# password cisco
R1(config-line)# login

R2(config)# line vty 0 4
R2(config-line)# password cisco
R2(config-line)# login
```

f. Encrypt the plaintext passwords.

```
R1(config)# service password-encryption

R2(config)# service password-encryption
```

g. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

```
R1(config)# banner motd $ Authorized Users Only! $

R2(config)# banner motd $ Authorized Users Only! $
```

h. Enable IPv6 Routing

```
R1(config)# ipv6 unicast-routing

R2(config)# ipv6 unicast-routing
```

i. Save the running configuration to the startup configuration file.

```
R1(config)# exit
R1# copy running-config startup-config

R2(config)# exit
R2# copy running-config startup-config
```

Step 4: Configure interfaces and routing for both routers.

a. Configure the G0/0/0 and G0/0/1 interfaces on R1 and R2 with the IPv6 addresses specified in the table above.

```
R1(config)# interface g0/0/1
```

```
R1(config-if)# ipv6 address fe80::1 link-local
R1(config-if)# ipv6 address 2001:db8:acad:1::1/64
R1(config-if)# no shutdown
R1(config)# interface g0/0/0
R1(config-if)# ipv6 address fe80::1 link-local
R1(config-if)# ipv6 address 2001:db8:acad:2::1/64
R1(config-if)# no shutdown

R2(config)# interface g0/0/1
R2(config-if)# ipv6 address fe80::1 link-local
R2(config-if)# ipv6 address 2001:db8:acad:3::1/64
R2(config-if)# no shutdown
R2(config)# interface g0/0/0
R2(config-if)# ipv6 address fe80::2 link-local
R2(config-if)# ipv6 address 2001:db8:acad:2::2/64
R2(config-if)# no shutdown
```

b. Configure a default route on each router pointed to the IP address of G0/0/0 on the other router using the following commands.

```
R1(config)# ipv6 route ::/0 2001:db8:acad:2::2
R2(config)# ipv6 route ::/0 2001:db8:acad:2::1
```

c. Verify routing is working by pinging R2's G0/0/1 address from R1.

```
R1#(config)# exit
R1# ping 2001:db8:acad:3::1
```

d. Save the running configuration to the startup configuration file.

```
R1# copy running-config startup-config
```

Part 2: Verify SLAAC Address Assignment from R1

In Part 2, you will verify that Host PC-A receives an IPv6 address using the SLAAC method.

a. Power up PC-A and ensure that the NIC is configured for IPv6 automatic configuration.

b. After a few moments, the results of the command **ipconfig** should show that PC-A has assigned itself an address from the 2001:db8:1::/64 network.

```
C:\Users\Student> ipconfig

Windows IP Configuration

Ethernet adapter Ethernet 2:


   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2001:db8:acad:1:5c43:ee7c:2959:da68
   Temporary IPv6 Address. . . . . . : 2001:db8:acad:1:3c64:e4f9:46e1:1f23
   Link-local IPv6 Address . . . . . : fe80::5c43:ee7c:2959:da68%6
   IPv4 Address. . . . . . . . . . . : 169.254.218.104
   Subnet Mask . . . . . . . . . . . : 255.255.0.0
   Default Gateway . . . . . . . . . : fe80::1%6
```

Where did the host-id portion of the address come from?

Answer will depend upon the operating system configuration. Either the host generates an EUI-64 address based on the interface MAC, or the host generates a random 64-bit address.

Part 3: Configure and Verify a DHCPv6 server on R1

In Part 3, you will configure and verify a stateless DHCP server on R1. The objective is to provide PC-A with DNS server and Domain information.

Step 1: Examine the configuration of PC-A in more detail.

a. Issue the command **ipconfig /all** on PC-A and take a look at the output.

```
C:\Users\Student> ipconfig /all

Windows IP Configuration


   Host Name . . . . . . . . . . . . : DESKTOP-3FR7RKA

   Primary Dns Suffix  . . . . . . . :

   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No

   WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter Ethernet0:


   Connection-specific DNS Suffix  . :

   Description . . . . . . . . . . . : Intel(R) 852574L Gigabit Network Connection
   Physical Address. . . . . . . . . : 00-50-56-83-63-6D

   IPv6 Address. . . . . . . . . . . : 2001:db8:acad:1:5c43:ee7c:2959:da68(Preferred)
   Temporary IPv6 Address. . . . . . : 2001:db8:acad:1:3c64:e4f9:46e1:1f23(Preferred)
   Link-local IPv6 Address . . . . . : fe80::5c43:ee7c:2959:da68%6(Preferred)

   IPv4 Address. . . . . . . . . . . : 169.254.218.104(Preferred)

   Subnet Mask . . . . . . . . . . . : 255.255.0.0

   Default Gateway . . . . . . . . . : fe80::1%6

   DHCPv6 IAID . . . . . . . . . . . : 50334761

   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-F5-CE-A2-00-50-56-B3-63-6D

   DNS Servers . . . . . . . . . . . : fec0:0:0:ffff::1%1

                                       fec0:0:0:ffff::2%1
                                       fec0:0:0:ffff::3%1

   NetBIOS over Tcpip. . . . . . . . : Enabled
```

b. Notice that there is no Primary DNS suffix. Also note that the DNS server addresses provided are "site local anycast" addresses, and not unicast addresses, as would be expected.

Step 2: Configure R1 to provide stateless DHCPv6 for PC-A.

a. Create an IPv6 DHCP pool on R1 named R1-STATELESS. As a part of that pool, assign the DNS server address as 2001:db8:acad::254 and the domain name as stateless.com.

```
R1(config)# ipv6 dhcp pool R1-STATELESS
R1(config-dhcp)# dns-server 2001:db8:acad::254
R1(config-dhcp)# domain-name STATELESS.com
```

b. Configure the G0/0/1 interface on R1 to provide the OTHER config flag to the R1 LAN, and specify the DHCP pool you just created as the DHCP resource for this interface.

```
R1(config)# interface g0/0/1

R1(config-if)# ipv6 nd other-config-flag

R1(config-if)# ipv6 dhcp server R1-STATELESS
```

c. Save the running configuration to the startup configuration file.

```
R1# copy running-config startup-config
```

d. Restart PC-A.

e. Examine the output of **ipconfig /all** and notice the changes.

```
C:\Users\Student> ipconfig /all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : DESKTOP-3FR7RKA

   Primary Dns Suffix  . . . . . . . :

   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No

   WINS Proxy Enabled. . . . . . . . : No

   DNS Suffix Search List. . . . . . : STATELESS.com

Ethernet adapter Ethernet0:

    Connection-specific DNS Suffix  . : STATELESS.com

   Description . . . . . . . . . . . : Intel(R) 82574L Gigabit Network Connection
   Physical Address. . . . . . . . . : 00-50-56-83-63-6D

   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

   IPv6 Address. . . . . . . . . . . : 2001:db8:acad:1:5c43:ee7c:2959:da68(Preferred)
   Temporary IPv6 Address. . . . . . : 2001:db8:acad:1:3c64:e4f9:46e1:1f23(Preferred)
   Link-local IPv6 Address . . . . . : fe80::5c43:ee7c:2959:da68%6(Preferred)

   IPv4 Address. . . . . . . . . . . : 169.254.218.104(Preferred)

   Subnet Mask . . . . . . . . . . . : 255.255.0.0

   Default Gateway . . . . . . . . . : fe80::1%6

   DHCPv6 IAID . . . . . . . . . . . : 50334761
```

```
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-F5-CE-A2-00-50-56-B3-63-6D
   DNS Servers . . . . . . . . . . . : 2001:db8:acad::254
   NetBIOS over Tcpip. . . . . . . . : Enabled
   Connection-specific DNS Suffix Search List :
                                       STATELESS.com
```

f. Test connectivity by pinging R2's G0/0/1 interface IP address

.

Part 4: Configure a stateful DHCPv6 server on R1

In Part 4, you will configure R1 to respond to DHCPv6 requests from the LAN on R2.

a. Create a DHCPv6 pool on R1 for the 2001:db8:acad:3:aaaa::/80 network. This will provide addresses to the LAN connected to interface G0/0/1 on R2. As a part of the pool, set the DNS server to 2001:db8:acad::254, and set the domain name to STATEFUL.com.

```
R1(config)# ipv6 dhcp pool R2-STATEFUL
R1(config-dhcp)# address prefix 2001:db8:acad:3:aaa::/80
R1(config-dhcp)# dns-server 2001:db8:acad::254
R1(config-dhcp)# domain-name STATEFUL.com
```

b. Assign the DHCPv6 pool you just created to interface g0/0/0 on R1.

```
R1(config)# interface g0/0/0
R1(config-if)# ipv6 dhcp server R2-STATEFUL
```

Part 5: Configure and verify DHCPv6 relay on R2.

In Part 5, you will configure and verify DHCPv6 relay on R2, allowing PC-B to receive an IPv6 Address.

The recommended router does not support relay a WA is provided

Step 1: Examine the SLAAC address.

a. Power on PC-B.

b. Examine the SLAAC address that is generated.

```
C:\Users\Student> ipconfig /all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : DESKTOP-3FR7RKA
   Primary Dns Suffix  . . . . . . . :
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
```

```
   WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter Ethernet0:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Intel(R) 82574L Gigabit Network Connection
   Physical Address. . . . . . . . . : 00-50-56-B3-7B-06
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv6 Address. . . . . . . . . . . : 2001:db8:acad:3:a0f3:3d39:f9fb:a020(Preferred)
   Temporary IPv6 Address. . . . . . : 2001:db8:acad:3:d4f3:7b16:eeee:b2b5(Preferred)
   Link-local IPv6 Address . . . . . : fe80::a0f3:3d39:f9fb:a020%6(Preferred)
   IPv4 Address. . . . . . . . . . . : 169.254.160.32(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.0.0
   Default Gateway . . . . . . . . . : fe80::1%6
   DHCPv6 IAID . . . . . . . . . . . : 50334761
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-F2-08-38-00-50-56-B3-7B-06
   DNS Servers . . . . . . . . . . . : fec0:0:0:ffff::1%1
                                       fec0:0:0:ffff::2%1
                                       fec0:0:0:ffff::3%1
   NetBIOS over Tcpip. . . . . . . . : Enabled
```

c. Notice in the output that the prefix used is 2001:db8:acad:3::

Step 2: Configure R2 as a DHCP relay agent for the LAN on G0/0/1.

a. Configure the **ipv6 dhcp relay** command on R2 interface G0/0/1, specifying the destination address of the G0/0/0 interface on R1. Also configure the **managed-config-flag** command.

```
R2(config)# interface g0/0/1
R2(config-if)# ipv6 nd managed-config-flag
R2(config-if)# ipv6 dhcp relay destination 2001:db8:acad:2::1 g0/0/0
```

b. Save your configuration.

```
R2# wr
```

Step 3: Attempt to acquire an IPv6 address from DHCPv6 on PC-B.

a. Restart PC-B.

b. Open a command prompt on PC-B and issue the command **ipconfig /all** and examine the output to see the results of the DHCPv6 relay operation.

```
C:\Users\Student> ipconfig /all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : DESKTOP-3FR7RKA
```

```
Primary Dns Suffix  . . . . . . . :

Node Type . . . . . . . . . . . . : Hybrid
IP Routing Enabled. . . . . . . . : No

WINS Proxy Enabled. . . . . . . . : No

DNS Suffix Search List. . . . . . : STATEFUL.com

Ethernet adapter Ethernet0:

 Connection-specific DNS Suffix  . : STATEFUL.com

Description . . . . . . . . . . . : Intel(R) 852574L Gigabit Network Connection
Physical Address. . . . . . . . . : 00-50-56-B3-7B-06

DHCP Enabled. . . . . . . . . . . : Yes
Autoconfiguration Enabled . . . . : Yes

IPv6 Address. . . . . . . . . . . : 2001:db8:acad3:aaaa:7104:8b7d:5402(Preferred)
Lease Obtained. . . . . . . . . . : Sunday, October 6, 2019 3:27:13 PM

Lease Expires . . . . . . . . . . : Tuesday, October 8, 2019 3:27:13 PM
Link-local IPv6 Address . . . . . : fe80::a0f3:3d39:f9fb:a020%6(Preferred)
IPv4 Address. . . . . . . . . . . : 169.254.160.32(Preferred)

Subnet Mask . . . . . . . . . . . : 255.255.0.0

Default Gateway . . . . . . . . . : fe80::2%6

DHCPv6 IAID . . . . . . . . . . . : 50334761

DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-24-F2-08-38-00-50-56-B3-7B-06

DNS Servers . . . . . . . . . . . : 2001:db8:acad::254
NetBIOS over Tcpip. . . . . . . . : Enabled

Connection-specific DNS Suffix Search List  :

                                    STATEFUL.com
```

c. Test connectivity by pinging R1's G0/0/1 interface IP address.

3.11.1.5 Router Interface Summary Table

Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
4221	Gigabit Ethernet 0/0/0 (G0/0/0)	Gigabit Ethernet 0/0/1 (G0/0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)

Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
4300	Gigabit Ethernet 0/0/0 (G0/0/0)	Gigabit Ethernet 0/0/1 (G0/0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

3.11.1.6Scripts

Scripts

```
! -----------------------------------
! Switch S1 Configuration
! Node: S1
! -----------------------------------
enable
configure terminal
 hostname S1

 service password-encryption
 enable secret ciscoS1Enable
 no ip domain-lookup
!
! VLAN Configuration
 vlan 10
  name USER_VLAN
 exit
 vlan 20
  name MGMT_VLAN
 exit
!

! Interface Configurations
 interface range FastEthernet0/1-4
  shutdown
  description UNUSED_PORTS
 exit
 interface FastEthernet0/5
  switchport mode access
  switchport access vlan 10
  description CONNECTED_TO_PC1
  no shutdown
 exit
 interface FastEthernet0/6
  switchport mode access
  switchport access vlan 10
  description CONNECTED_TO_PC2
  no shutdown
 exit
```

```
 interface range FastEthernet0/7-24
  shutdown
  description UNUSED_PORTS
 exit
 interface GigabitEthernet0/1
  switchport mode trunk
  switchport trunk allowed vlan 10,20
  description TRUNK_TO_R1
  no shutdown
 exit
 interface GigabitEthernet0/2
  shutdown
  description UNUSED_PORT
 exit
 interface Vlan20
  ip address 192.168.20.2 255.255.255.0
  description MANAGEMENT_VLAN
  no shutdown
 exit
!
! Management and Security
 banner motd # Authorized Users Only! #
 line con 0
  password ciscoCon
  login
 exit
 line vty 0 4
  password ciscoVty
  login
 exit
 line vty 5 15
  login
 exit
end
write memory

! ------------------------------------
! Switch S2 Configuration
! Node: S2
! ------------------------------------
enable
configure terminal
 hostname S2

 service password-encryption
 enable secret ciscoS2Enable
 no ip domain-lookup
! VLAN Configuration
 vlan 10
  name USER_VLAN
 exit
 vlan 20
  name MGMT_VLAN
 exit
!

! Interface Configurations
 interface range FastEthernet0/1-4
  shutdown
```

```
  description UNUSED_PORTS
 exit
 interface FastEthernet0/5
  switchport mode access
  switchport access vlan 10
  description CONNECTED_TO_PC3
  no shutdown
 exit
 interface FastEthernet0/18
  switchport mode access
  switchport access vlan 10
  description CONNECTED_TO_PC4
  no shutdown
 exit
 interface range FastEthernet0/6-17, FastEthernet0/19-24
  shutdown
  description UNUSED_PORTS
 exit
 interface GigabitEthernet0/1
  switchport mode trunk
  switchport trunk allowed vlan 10,20
  description TRUNK_TO_R2
  no shutdown
 exit
 interface GigabitEthernet0/2
  shutdown
  description UNUSED_PORT
 exit
 interface Vlan20
  ip address 192.168.20.3 255.255.255.0
  description MANAGEMENT_VLAN
  no shutdown
 exit
!
! Management and Security
 banner motd # Authorized Users Only! #
 line con 0
  password ciscoCon
  login
 exit
 line vty 0 4
  password ciscoVty
  login
 exit
 line vty 5 15
  login
 exit
end
write memory

! ----------------------------------
! Router R1 Configuration
! Node: R1
! ----------------------------------
enable
configure terminal
 hostname R1

 service password-encryption
```

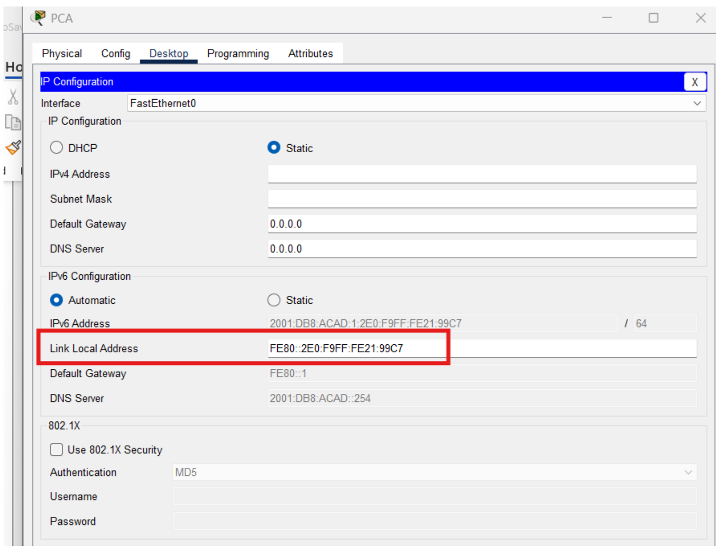
```
 enable secret ciscoR1Enable
 no ip domain-lookup
 ipv6 unicast-routing
!
! IPv6 DHCP Pools
 ipv6 dhcp pool R1-STATELESS
  dns-server 2001:DB8:ACAD::254
  domain-name STATELESS.com
 exit
 ipv6 dhcp pool R2-STATEFUL
  address prefix 2001:DB8:ACAD:3:AAAA::/80
  dns-server 2001:DB8:ACAD::254
  domain-name STATEFUL.com
 exit
!
! Interface Configurations
 interface GigabitEthernet0/0/0
  no ip address
  ipv6 address FE80::1 link-local
  ipv6 address 2001:DB8:ACAD:2::1/64
  ipv6 dhcp server R2-STATEFUL
  no shutdown
 exit
 interface GigabitEthernet0/0/1
  no ip address
  ipv6 address FE80::1 link-local
  ipv6 address 2001:DB8:ACAD:1::1/64
  ipv6 nd other-config-flag
  ipv6 dhcp server R1-STATELESS
  no shutdown
 exit
!
! Routing Configuration
 ipv6 route ::/0 2001:DB8:ACAD:2::2
!
! Management and Security

 banner motd # Authorized Users Only! #
 line con 0
  password ciscoCon
  login
exit
 line vty 0 4
  password ciscoVty
  login
 exit
end
write memory

! ------------------------------------
! Router R2 Configuration
! Node: R2
! ------------------------------------
enable
configure terminal
 hostname R2

 service password-encryption
 enable secret ciscoR2Enable
```

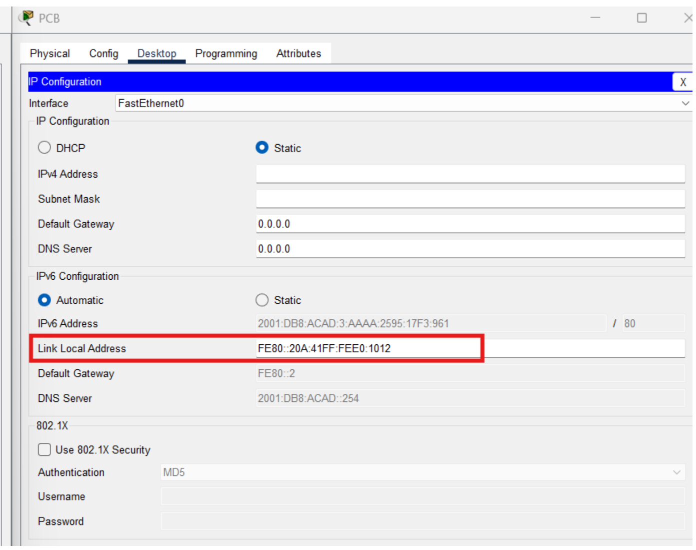
```
 no ip domain-lookup
 ipv6 unicast-routing
!
! Interface Configurations
 interface GigabitEthernet0/0/0
  ipv6 address FE80::2 link-local
  ipv6 address 2001:DB8:ACAD:2::2/64
  no shutdown
 exit
 interface GigabitEthernet0/0/1
  ipv6 address FE80::2 link-local
  ipv6 address 2001:DB8:ACAD:3::1/64
  ipv6 nd managed-config-flag
 !! ipv6 dhcp relay destination 2001:DB8:ACAD:2::1 g0/0/0
 ipv6 dhcp server R2-STATEFUL
 no shutdown
 exit
! this is done because relay does not work for this switch type in Packet router
 ipv6 dhcp pool R2-STATEFUL
  address prefix 2001:DB8:ACAD:3:AAAA::/80
  dns-server 2001:DB8:ACAD::254
  domain-name STATEFUL.com
 exit
! Routing Configuration
 ipv6 route ::/0 2001:DB8:ACAD:2::1
!
! Management and Security
 banner motd # Authorized Users Only! #
 line con 0
  password ciscoCon
  login
 exit
 line vty 0 4
  password ciscoVty
  login
 exit
end
write memory
```

3.11.1.7Test

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..: STATELESS.com
STATEFUL.com
   Link-local IPv6 Address.........:
FE80::2E0:F9FF:FE21:99C7
   IPv6 Address....................: 2001:DB8:ACAD:
1:2E0:F9FF:FE21:99C7
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: FE80::1
                                     0.0.0.0

Bluetooth Connection:

   Connection-specific DNS Suffix..: STATELESS.com
STATEFUL.com
   Link-local IPv6 Address.........: ::
   IPv6 Address....................: ::
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: ::
                                     0.0.0.0
```

```
                                     0.0.0.0

C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..: STATEFUL.com
   Link-local IPv6 Address.........: FE80::20A:
41FF:FEE0:1012
   IPv6 Address....................: 2001:DB8:ACAD:
3:AAAA:2595:17F3:961
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: FE80::2
                                     0.0.0.0

Bluetooth Connection:

   Connection-specific DNS Suffix..: STATEFUL.com
   Link-local IPv6 Address.........: ::
   IPv6 Address....................: ::
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: ::
                                     0.0.0.0
```






```
C:\>ping 2001:DB8:ACAD:1::1

Pinging 2001:DB8:ACAD:1::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:1::1: bytes=32 time=14ms
TTL=255
Reply from 2001:DB8:ACAD:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:1::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:1::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:1::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 14ms, Average = 3ms

C:\>ping 2001:DB8:ACAD:2::1

Pinging 2001:DB8:ACAD:2::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:2::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:2::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:2::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:2::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:2::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
                                     0.0.0.0

C:\>ping 2001:DB8:ACAD:1::1

Pinging 2001:DB8:ACAD:1::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:1::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:1::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:1::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:1::1: bytes=32 time<1ms TTL=254

Ping statistics for 2001:DB8:ACAD:1::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 2001:DB8:ACAD:2::1

Pinging 2001:DB8:ACAD:2::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:2::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:2::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:2::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:2::1: bytes=32 time<1ms TTL=254

Ping statistics for 2001:DB8:ACAD:2::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
C:\>ping 2001:DB8:ACAD:3::1

Pinging 2001:DB8:ACAD:3::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:3::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:3::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:3::1: bytes=32 time<1ms TTL=254
Reply from 2001:DB8:ACAD:3::1: bytes=32 time<1ms TTL=254

Ping statistics for 2001:DB8:ACAD:3::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

```
C:\>ping 2001:DB8:ACAD:3::1

Pinging 2001:DB8:ACAD:3::1 with 32 bytes of data:

Reply from 2001:DB8:ACAD:3::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:3::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:3::1: bytes=32 time<1ms TTL=255
Reply from 2001:DB8:ACAD:3::1: bytes=32 time<1ms TTL=255

Ping statistics for 2001:DB8:ACAD:3::1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

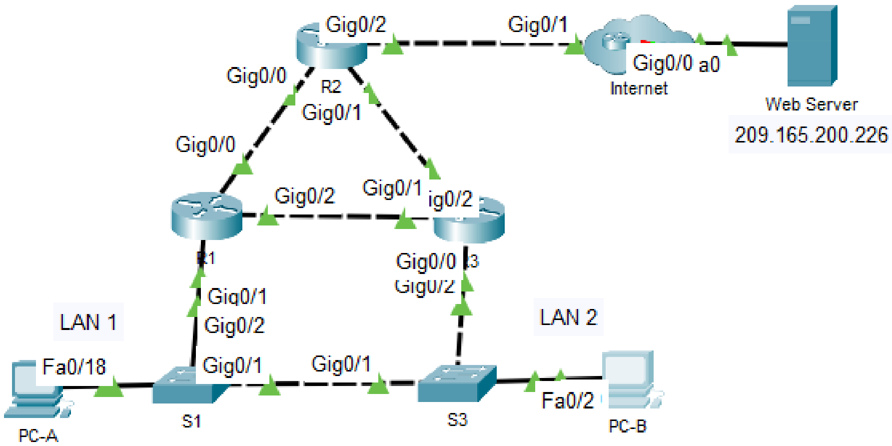
```
C:\>ping 2001:DB8:ACAD:3:AAAA:2595:17F3:961

Pinging 2001:DB8:ACAD:3:AAAA:2595:17F3:961 with 32 bytes
of data:

Reply from 2001:DB8:ACAD:3:AAAA:2595:17F3:961: bytes=32
time<1ms TTL=126
Reply from 2001:DB8:ACAD:3:AAAA:2595:17F3:961: bytes=32
time<1ms TTL=126
Reply from 2001:DB8:ACAD:3:AAAA:2595:17F3:961: bytes=32
time<1ms TTL=126
Reply from 2001:DB8:ACAD:3:AAAA:2595:17F3:961: bytes=32
time<1ms TTL=126

Ping statistics for 2001:DB8:ACAD:3:AAAA:2595:17F3:961:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

```
C:\>
C:\>ping 2001:DB8:ACAD:1:2E0:F9FF:FE21:99C7

Pinging 2001:DB8:ACAD:1:2E0:F9FF:FE21:99C7 with 32 bytes
of data:

Reply from 2001:DB8:ACAD:1:2E0:F9FF:FE21:99C7: bytes=32
time<1ms TTL=126
Reply from 2001:DB8:ACAD:1:2E0:F9FF:FE21:99C7: bytes=32
time<1ms TTL=126
Reply from 2001:DB8:ACAD:1:2E0:F9FF:FE21:99C7: bytes=32
time<1ms TTL=126
Reply from 2001:DB8:ACAD:1:2E0:F9FF:FE21:99C7: bytes=32
time<1ms TTL=126

Ping statistics for 2001:DB8:ACAD:1:2E0:F9FF:FE21:99C7:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

3.12 Netacad Module 9 – FHRP concepts

3.12.1 Exercise 9.3.3 Packet Tracer - HSRP Configuration Guide

3.12.1.1 Topology



3.12.1.2Addressing Table

Device	Interface	IP Address	Default Gateway
R1	G0/0	10.1.1.1/30	N/A
	G0/1	192.168.1.1/24	
	G0/2	10.1.1.9/30	
R2	G0/0	10.1.1.2/30	N/A
	G0/1	10.1.1.5/30	
	G0/2	10.100.100.1/30	
R3	G0/0	192.168.1.3/24	N/A
	G0/1	10.1.1.6/30	
	G0/2	10.1.1.10/30	
I-Net	G0/1	10.100.100.2/30	N/A
HSRP Virtual Gateway	Virtual	192.168.1.254/24	N/A
S1	VLAN 1	192.168.1.11/24	192.168.1.1
S3	VLAN 1	192.168.1.13/24	192.168.1.3
PC-A	NIC	192.168.1.101/24	192.168.1.1
PC-B	NIC	192.168.1.103/24	192.168.1.3
Web Server	NIC	209.165.200.226/27	209.165.100.225

Note: The I-Net router is present in the internet cloud and cannot be accessed in this activity.

3.12.1.3 Objectives

In this Packet Tracer activity, you will learn how to configure Hot Standby Router Protocol (HSRP) to provide redundant default gateway devices to hosts on LANs. After configuring HSRP, you will test the configuration to verify that hosts are able to use the redundant default gateway if the current gateway device becomes unavailable.

- Configure an HSRP active router.
- Configure an HSRP standby router.
- Verify HSRP operation.

3.12.1.4 Background / Scenario

Spanning Tree Protocol provides loop-free redundancy between switches within a LAN. However, it does not provide redundant default gateways for end-user devices within the network if a gateway router fails. First Hop Redundancy Protocols (FHRPs) provide redundant default gateways for end devices with no additional
end-user configuration necessary. By using a FHRP, two or more routers can share the same virtual IP address and MAC address and can act as a single virtual router. Hosts on the network are configured with a shared IP address as their default gateway. In this Packet Tracer activity, you will configure Cisco's Hot Standby Router Protocol (HSRP), which is an FHRP.

You will configure HSRP on routers R1 and R3, which serve as the default gateways for the hosts on LAN 1 and LAN 2. When you configure HSRP, you will create a virtual gateway that uses the same default gateway address for hosts in both LANs. If one gateway router becomes unavailable, the second router will take over using the same default gateway address that was used by the first router. Because the hosts on the LANs are configured with the IP address of the virtual gateway as the default gateway, the hosts will regain connectivity to remote networks after HSRP activates the remaining router.

3.12.1.5 Instructions

Part 1: Verify Connectivity

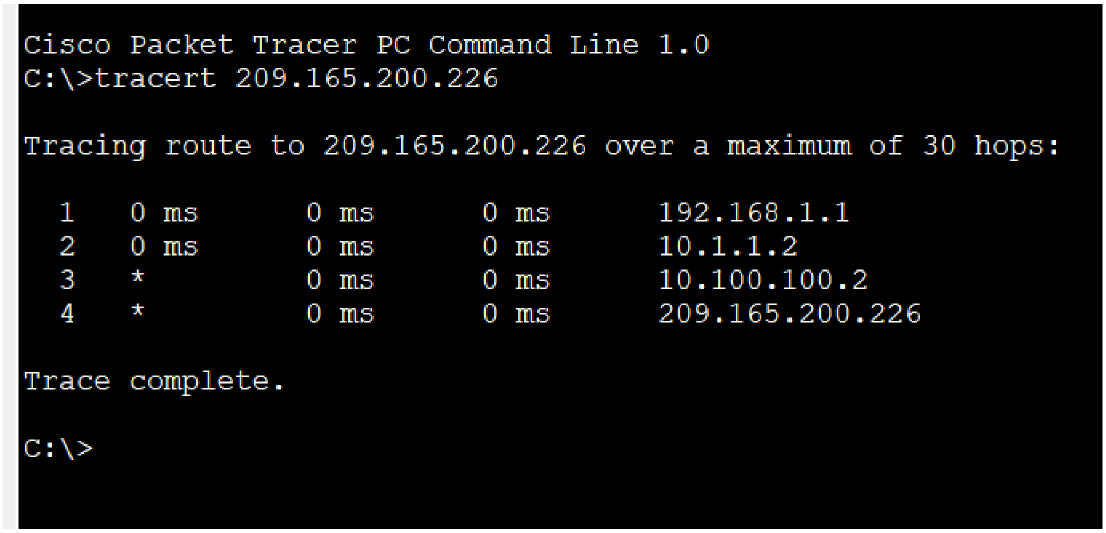
Step 1: Trace the path to the Web Server from PC-A.

a. Go to the desktop of PC-A and open a command prompt.

b. Trace the path from PC-A to the webserver by executing the **tracert 209.165.200.226** command.

   Which devices are on the path from PC-A to the Web Server? Use the addressing table to determine the device names.

   R1, R2 and I-Net



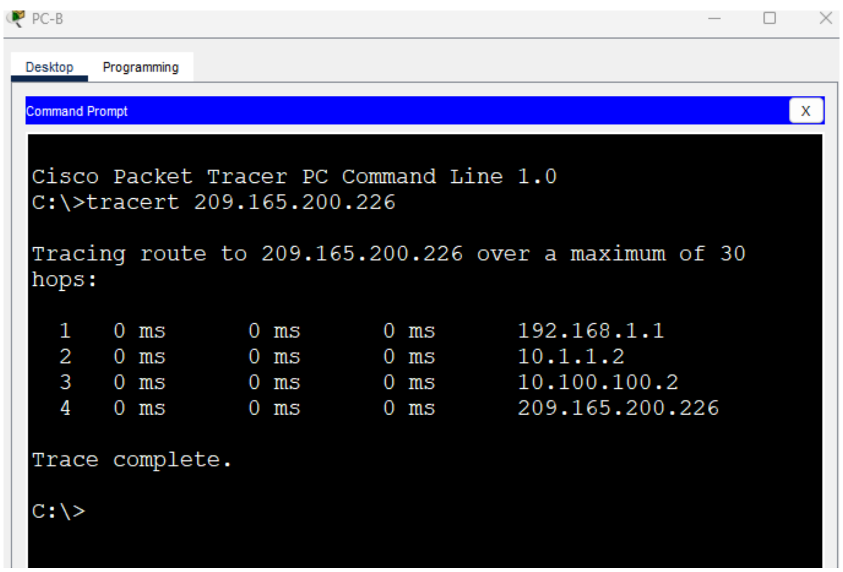
```
Cisco Packet Tracer PC Command Line 1.0
C:\>tracert 209.165.200.226

Tracing route to 209.165.200.226 over a maximum of 30 hops:

  1   0 ms      0 ms      0 ms      192.168.1.1
  2   0 ms      0 ms      0 ms      10.1.1.2
  3   *         0 ms      0 ms      10.100.100.2
  4   *         0 ms      0 ms      209.165.200.226

Trace complete.

C:\>
```

Step 2: Trace the path to the Web Server from PC-B.

Repeat the process in Step 1 from PC-B.

Which devices are on the path from PC-B to the Web Server?

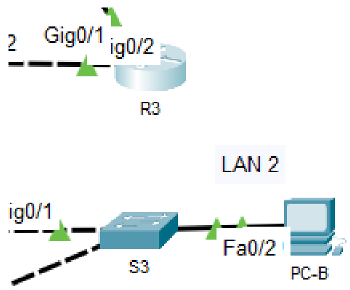
R3, R2 and I-Net




```
Cisco Packet Tracer PC Command Line 1.0
C:\>tracert 209.165.200.226

Tracing route to 209.165.200.226 over a maximum of 30
hops:

  1   0 ms     0 ms     0 ms     192.168.1.1
  2   0 ms     0 ms     0 ms     10.1.1.2
  3   0 ms     0 ms     0 ms     10.100.100.2
  4   0 ms     0 ms     0 ms     209.165.200.226

Trace complete.

C:\>
```

Step 3: Observe the network behavior when R3 becomes unavailable.

a. Select the delete tool from the Packet Tracer tool bar and delete the link between **R3** and **S3**.



b. Open a command prompt on PC-B. Execute the **tracert** command with the Web Server as the destination.

c. Compare the current output with the output of the command from Step 2.

   What are the results?

   The tracert command cannot determine the path to the Web Server because the path has been broken.

d. Click the **Connections** icon in the lower left corner of the PT window. Locate and select the **Copper Straight-Through** icon in the pallet of connection types.

e. Click on **S3** and select port **GigbitEthernet0/2**. Click **R3** and select port **GigabitEthernet0/0**.

f. After the link lights on the connection are both green, test the connection by pinging the Web Server. The ping should be successful.

Part 2: Configure HSRP Active and Standby Routers

Step 1: Configure HSRP on R1.

a. Configure HSRP on the G0/1 LAN interface of R1.

   R1(config)# **interface g0/1**

b. Specify the HSRP protocol version number. The most recent version is version **2**.

   Note: Standby version 1 only supports IPv4 addressing.

   R1(config-if)# **standby version 2**

c. Configure the IP address of the virtual default gateway. This address must be configured on any hosts that require the services of the default gateway. It replaces the physical interface address of the router that has been previously configured on the hosts.

   Multiple instances of HSRP can be configured on a router. You must specify the HSRP group number to identify the virtual interface between routers in a HSRP group. This number must be consistent between the routers in the group. The group number for this configuration is 1.

   R1(config-if)# **standby 1 ip 192.168.1.254**

d. Designate the active router for the HSRP group. It is the router that will be used as the gateway device unless it fails or the path to it becomes inactive or unusable. Specify the priority for the router interface. The default value is 100. A higher value will determine which router is the active router. If the priorities of the routers in the HSRP group are the same, then the router with the highest configured IP address will become the active router.

```
R1(config-if)# standby 1 priority 150
```

R1 will operate as the active router and traffic from the two LANs will use it as the default gateway.

e. If it is desirable that the active router resume that role when it becomes available again, configure it to preempt the service of the standby router. The active router will take over the gateway role when it becomes operable again.

```
R1(config-if)# standby 1 preempt
```

What will the HSRP priority of R3 be when it is added to HSRP group 1?
100, which is the default value.

Step 2: Configure HSRP on R3.

Configure R3 as the standby router.

a. Configure the R3 interface that is connected to LAN 2.

b. Repeat only steps 1b and 1c above.
R3(config)#int g0/0

R3(config-if)#sta

R3(config-if)#standby ver 2

R3(config-if)#standby 1 ip 192.168.1.254

Step 3: Verify HSRP Configuration

a. Verify HSRP by issuing the **show standby** command on R1 and R3. Verify the values for HSRP role, group, virtual IP address of the gateway, preemption, and priority. Note that HSRP also identifies the active and standby router IP addresses for the group.

```
R1# show standby

GigabitEthernet0/1 - Group 1 (version 2)
  State is Active

    4 state changes, last state change 00:00:30

  Virtual IP address is 192.168.1.254

  Active virtual MAC address is 0000.0C9F.F001
```

```
    Local virtual MAC address is 0000.0C9F.F001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.696 secs
  Preemption enabled
  Active router is local
  Standby router is 192.168.1.3
  Priority 150 (configured 150)
  Group name is "hsrp-Gi0/1-1" (default)
```

```
R3# show standby
GigabitEthernet0/0 - Group 1 (version 2)
  State is Standby
    4 state changes, last state change 00:02:29
  Virtual IP address is 192.168.1.254
  Active virtual MAC address is 0000.0C9F.F001
    Local virtual MAC address is 0000.0C9F.F001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.720 secs
  Preemption disabled
  Active router is 192.168.1.1
    MAC address is d48c.b5ce.a0c1
  Standby router is local
  Priority 100 (default 100)
  Group name is "hsrp-Gi0/0-1" (default)
```

Using the output shown above, answer the following questions:

Which router is the active router? R1

What is the MAC address for the virtual IP address? 0000.0C9F.F001

What is the IP address and priority of the standby router? The IP address is 192.168.1.3 and the priority is 100

b. Use the **show standby brief** command on R1 and R3 to view an HSRP status summary. Sample output is shown below.

R1# show standby brief

```
                     P indicates configured to preempt.
                     |
Interface    Grp  Pri P State   Active          Standby         Virtual IP
Gi0/1        1    150 P Active  local           192.168.1.3     192.168.1.254
```

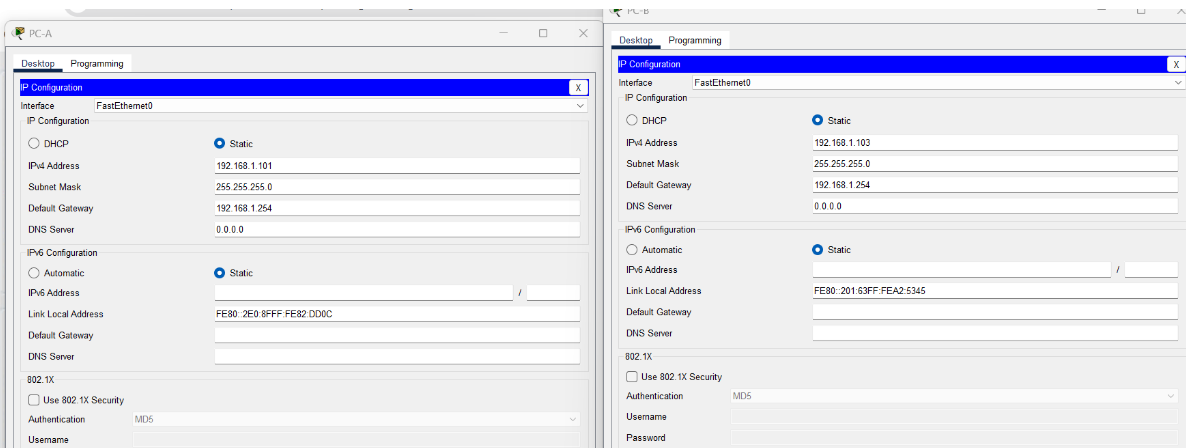
```
R3# show standby brief
                         P indicates configured to preempt.
                         |
   Interface    Grp  Pri P State    Active          Standby         Virtual IP
   Gi0/0       1     100   Standby 192.168.1.1     local           192.168.1.254
```

c. Change the default gateway address for PC-A, PC-C, S1, and S3.
192.168.1.254

```
S1(config)#ip default-gateway 192.168.1.254
S3(config)#ip default-gateway 192.168.1.254
```

Which address should you use?

Verify the new settings. Issue a ping from both PC-A and PC-C to the Web Server. Are the pings successful? yes




```
C:\>ping 192.168.1.103

Pinging 192.168.1.103 with 32 bytes of data:

Reply from 192.168.1.103: bytes=32 time<1ms TTL=128
Reply from 192.168.1.103: bytes=32 time<1ms TTL=128
Reply from 192.168.1.103: bytes=32 time<1ms TTL=128
Reply from 192.168.1.103: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.103:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 209.165.200.226

Tracing route to 209.165.200.226 over a maximum of 30
hops:

  1   0 ms      0 ms      0 ms      192.168.1.1
  2   0 ms      0 ms      0 ms      10.1.1.2
  3   1 ms      0 ms      0 ms      10.100.100.2
  4   0 ms      0 ms      0 ms      209.165.200.226

Trace complete.
```

Part 3: Observe HSRP Operation

Step 1: Make the active router become unavailable.

Open a command prompt on **PC-B** and enter the command **tracert 209.165.200.226**.

Does the path differ from the path used before HSRP was configured? Yes. The path now passes through R1 instead of R3.

```
Please check the name and try again.
C:\> tracert 209.165.200.226

Tracing route to 209.165.200.226 over a maximum of 30
hops:

  1   0 ms      0 ms      0 ms      192.168.1.1
  2   0 ms      0 ms      0 ms      10.1.1.2
  3   0 ms      0 ms      0 ms      10.100.100.2
  4   0 ms      0 ms      0 ms      209.165.200.226

Trace complete.
```

Step 2: Break the link to R1.

a. Select the delete tool from the Packet Tracer toolbar and delete the cable that connects R1 to S1.

b. Immediately return to PC-B and execute the **tracert 209.165.200.226** command again. Observe the output of the command until the command completes execution. You may need to repeat the trace to see the full path.

How was this trace different from the previous trace?

At first, the trace timed out. Eventually, the trace went through R3, R2, and I-Net. R3 was used as the first hop gateway in this trace instead of R1.

HSRP undergoes a process to determine which router should take over when the active router becomes unavailable. This process takes time. Once the process is complete, the R3 standby router becomes active and is used as the default gateway for hosts on LAN 1 and LAN 2.

```
C:\> tracert 209.165.200.226

Tracing route to 209.165.200.226 over a maximum of 30
hops:

  1   *         0 ms      0 ms      192.168.1.3
  2   *         *         *         Request timed out.
  3   *         0 ms      0 ms      10.100.100.2
  4   0 ms      0 ms      0 ms      209.165.200.226

Trace complete.

C:\> ping 209.165.200.226

Pinging 209.165.200.226 with 32 bytes of data:

Reply from 209.165.200.226: bytes=32 time<1ms TTL=124
Reply from 209.165.200.226: bytes=32 time=9ms TTL=124
Reply from 209.165.200.226: bytes=32 time<1ms TTL=124
Reply from 209.165.200.226: bytes=32 time<1ms TTL=124

Ping statistics for 209.165.200.226:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 9ms, Average = 2ms

C:\>
```

Step 3: Restore the link to R1.

a. Re-connect R1 to S1 with a copper straight-through cable.

b. Execute a trace from PC-B to the Web Server. You may need to repeat the trace to see the full path.

What path is used to reach the Web Server?

At first the trace fails. Eventually it begins using R1 as the gateway again.

If the preempt command was not configured for the HSRP group on R1, would the results have been the same?
No, R1 would not become the gateway again. The path through R3 would continue to be used.

```
C:\> tracert 209.165.200.226

Tracing route to 209.165.200.226 over a maximum of 30
hops:

  1   0 ms      0 ms      0 ms      192.168.1.1
  2   0 ms      0 ms      0 ms      10.1.1.2
  3   0 ms      0 ms      0 ms      10.100.100.2
  4   0 ms      0 ms      0 ms      209.165.200.226

Trace complete.

C:\> ping 209.165.200.226

Pinging 209.165.200.226 with 32 bytes of data:

Reply from 209.165.200.226: bytes=32 time<1ms TTL=125
Reply from 209.165.200.226: bytes=32 time<1ms TTL=125
Reply from 209.165.200.226: bytes=32 time<1ms TTL=125
Reply from 209.165.200.226: bytes=32 time<1ms TTL=125

Ping statistics for 209.165.200.226:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Sxripts

Router R1

```
enable
config t
interface g0/1
 standby version 2
 standby 1 ip 192.168.1.254
 standby 1 priority 150
 standby 1 preempt
end
```

Router R3

```
enable
config t
 interface g0/0
 standby version 2
 standby 1 ip 192.168.1.254
end
```

Switch S1

```
enable
config t
ip default-gateway 192.168.1.254
end
```

Switch S3

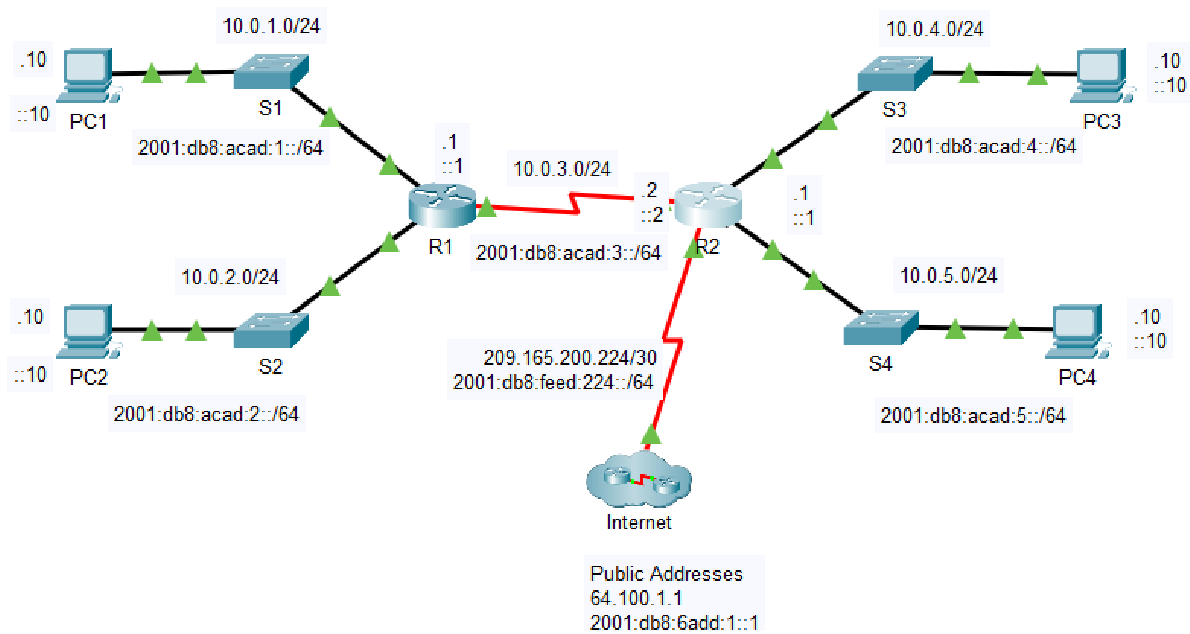
```
enable
config t
```

```
ip default-gateway 192.168.1.254
end
```

3.13 Netacad Module 14 – Routing concepts

3.13.1 Exercise 14.3.5 - Packet Tracer - Basic Router Configuration Review

3.13.1.1 Topology



3.13.1.2 Addressing Table

Device	Interface	IP Address / Prefix	Default Gateway
R2	G0/0/0	10.0.4.1 /24	N/A
		2001:db8:acad:4::1 /64	
		fe80::2:a	
	G0/0/1	10.0.5.1 /24	
		2001:db8:acad:5::1 /64	
		fe80::2:b	
	S0/1/0	10.0.3.2 /24	

		2001:db8:acad:3::2 /64	
		fe80::1:c	
	S0/1/1	209.165.200.225 /30	
		2001:db8:feed:224::1/64	
		fe80::1:d	
PC1	NIC	10.0.1.10 /24	10.0.1.1
		2001:db8:acad:1::10 /64	fe80::1:a
PC2	NIC	10.0.2.10 /24	10.0.2.1
		2001:db8:acad:2::10 /64	fe80::1:b
PC3	NIC	10.0.4.10 /24	10.0.4.1
		2001:db8:acad:4::10 /64	fe80::2:a
PC4	NIC	10.0.5.10 /24	10.0.5.1
		2001:db8:acad:5::10 /64	fe80::2:b

3.13.1.3 Objectives

Part 1: Configure Devices and Verify Connectivity

- Assign static IPv4 and IPv6 addresses to the PC interfaces.
- Configure basic router settings.
- Configure the router for SSH.
- Verify network connectivity.

Part 2: Display Router Information

- Retrieve hardware and software information from the router.
- Interpret the startup configuration.
- Interpret the routing table.
- Verify the status of the interfaces.

3.13.1.4 Background / Scenario

This activity requires you to configure the **R2** router using the settings from the Addressing Table and the specifications listed. The **R1** router and the devices connected to it have been configured. This is a comprehensive review of previously covered IOS router commands. In Part 1, you will complete basic configurations and interface settings on the router. In Part 2, you will use SSH to connect to the router remotely and utilize the IOS commands to retrieve information from the device to answer questions about the router. For review purposes, this lab provides the commands necessary for specific router configurations.

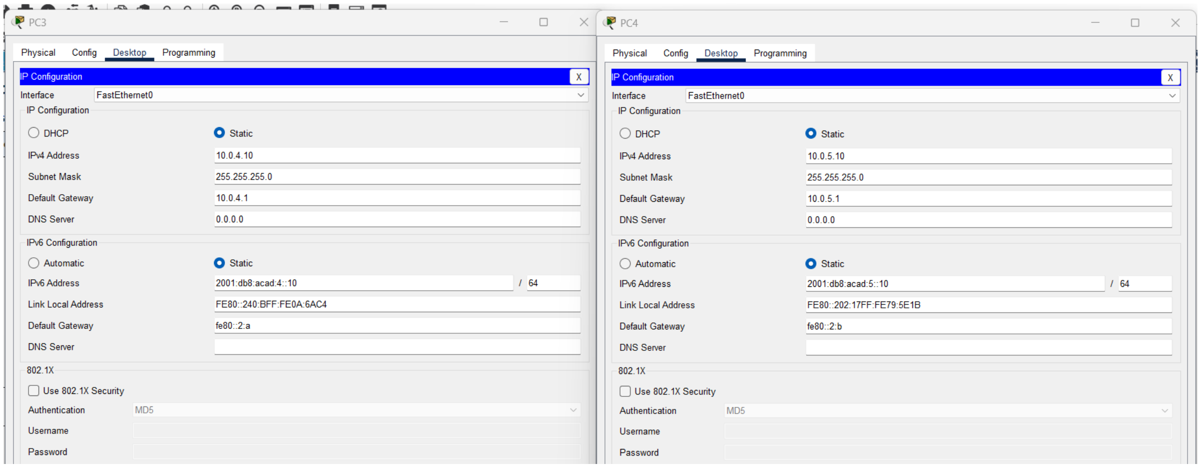
3.13.1.5 Instructions

Part 1: Configure Devices and Verify Connectivity

Step 1: Configure the PC interfaces.

a. Configure the IPv4 and IPv6 addresses on PC3 as listed in the Addressing Table.

b. Configure the IPv4 and IPv6 addresses on PC4 as listed in the Addressing Table.



Step 2: Configure the router.

a. On the **R2** router, open a terminal. Move to privileged EXEC mode.

```
Router> enable
```

b. Enter configuration mode.

```
Router# configure terminal
```

c. Assign a device name of **R2** to the router.

```
Router(config)# hostname R2
```

d. Configure **c1sco1234** as the encrypted privileged EXEC mode password.

```
R2(config)#enable secret c1sco1234
```

e. Set the domain name of the router to **ccna-lab.com**.

```
R2(config)# ip domain-name ccna-lab.com
```

f. Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were host names.

```
R2(config)# no ip domain lookup
```

g. Encrypt the plaintext passwords.

```
R2(config)# service password-encryption
```

h. Configure the username **SSHadmin** with an encrypted password of **55Hadm!n**.

```
R2(config)# username SSHadmin secret 55Hadm!n
```

i. Generate a set of crypto keys with a 1024 bit modulus.

```
R2(config)# crypto key generate rsa general-keys modulus 1024
```

j. Assign **cisco** as the console password, configure sessions to disconnect after six minutes of inactivity, and enable login. To prevent console messages from interrupting commands, use the **logging synchronous** command.

```
R2(config)# line console 0
R2(config-line)# password cisco
R2(config-line)# logging synchronous
R2(config-line)# exec-timeout 6 0
R2(config-line)# login
```

k. Assign **cisco** as the vty password, configure the vty lines to accept SSH connections only, configure sessions to disconnect after six minutes of inactivity, and enable login using the local database.

```
R2(config)# line vty 0 4
R2(config-line)# password cisco
R2(config-line)# exec-timeout 6 0
R2(config-line)# transport input ssh
```

R2(config-line)# login local

l. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

```
R2(config)# banner motd # WARNING Authorized Users Only! #
```

m. Enable IPv6 Routing.

```
R2(config)# ipv6 unicast-routing
```

n. Configure all four interfaces on the router with the IPv4 and IPv6 addressing information from the addressing table above. Configure all four interfaces with descriptions. Activate all four interfaces.

```
R2(config)# interface g0/0/0
R2(config-if)# description Connection to S3
R2(config-if)# ip address 10.0.4.1 255.255.255.0
R2(config-if)# ipv6 address fe80::2:a link-local
R2(config-if)# ipv6 address 2001:db8:acad:4::1/64
R2(config-if)# no shutdown
R2(config)# interface g0/0/1
R2(config-if)# description Connection to S4
R2(config-if)# ip address 10.0.5.1 255.255.255.0
R2(config-if)# ipv6 address fe80::2:b link-local
R2(config-if)# ipv6 address 2001:db8:acad:5::1/64
R2(config-if)# no shutdown
R2(config)# interface s0/1/0
R2(config-if)# description Link to R1
R2(config-if)# ip address 10.0.3.2 255.255.255.0
R2(config-if)# ipv6 address fe80::1:c link-local
R2(config-if)# ipv6 address 2001:db8:acad:3::2/64
R2(config-if)# no shutdown
R2(config-if)# interface s0/1/1
R2(config-if)# description Link to Internet
R2(config-if)# ip address 209.165.200.225 255.255.255.252
R2(config-if)# ipv6 address fe80::1:d link-local
R2(config-if)# ipv6 address 2001:db8:feed:224::1/64
R2(config-if)# no shutdown
```

o. Save the running configuration to the startup configuration file.

```
R2# copy running-config startup-config
```

Step 3: Verify network connectivity.

a. Using the command line at **PC3**, ping the IPv4 and IPv6 addresses for **PC4**.

```
C:\>ping 10.0.5.10

Pinging 10.0.5.10 with 32 bytes of data:

Reply from 10.0.5.10: bytes=32 time<1ms TTL=127
Reply from 10.0.5.10: bytes=32 time<1ms TTL=127
Reply from 10.0.5.10: bytes=32 time<1ms TTL=127
Reply from 10.0.5.10: bytes=32 time=10ms TTL=127

Ping statistics for 10.0.5.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

```
C:\>ping  2001:DB8:ACAD:5::10

Pinging 2001:DB8:ACAD:5::10 with 32 bytes of data:

Reply from 2001:DB8:ACAD:5::10: bytes=32 time=1ms
TTL=127
Reply from 2001:DB8:ACAD:5::10: bytes=32 time<1ms
TTL=127
Reply from 2001:DB8:ACAD:5::10: bytes=32 time=6ms
TTL=127
Reply from 2001:DB8:ACAD:5::10: bytes=32 time<1ms
TTL=127

Ping statistics for 2001:DB8:ACAD:5::10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 6ms, Average = 1ms
```

Were the pings successful? yes

b. From the CLI on **R2** ping the S0/1/1 address of **R1** for both IPv4 and IPv6. The addresses assigned to the S0/1/1 interface on R1 are:

IPv4 address = 10.0.3.1

IPv6 address = 2001:db8:acad:3::1

```
Password:
R2#ping 10.0.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.3.1, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/
max = 11/24/35 ms

R2#ping 2001:db8:acad:3::1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:db8:acad:3::1,
timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/
max = 4/12/28 ms

R2#
```

Were the pings successful? yes

From the command line of **PC3** ping the ISP address 209.165.200.226.

```
C:\>ping 209.165.200.226

Pinging 209.165.200.226 with 32 bytes of data:

Reply from 209.165.200.226: bytes=32 time=24ms TTL=254
Reply from 209.165.200.226: bytes=32 time=5ms TTL=254
Reply from 209.165.200.226: bytes=32 time=11ms TTL=254
Reply from 209.165.200.226: bytes=32 time=1ms TTL=254

Ping statistics for 209.165.200.226:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 24ms, Average = 10ms

C:\>
```

Were the pings successful? Yes

From **PC3** attempt to ping an address on the ISP for testing, 64.100.1.1.

```
C:\>ping 64.100.1.1

Pinging 64.100.1.1 with 32 bytes of data:

Reply from 10.0.4.1: Destination host unreachable.
Reply from 10.0.4.1: Destination host unreachable.
Reply from 10.0.4.1: Destination host unreachable.
Reply from 10.0.4.1: Destination host unreachable.

Ping statistics for 64.100.1.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

Were the pings successful? no

c. From the command line of **PC3** open an SSH session to the R2 G0/0/0 IPv4 address and log in as **SSHadmin** with the password **55Hadm!n.**

C:\> ssh -l SSHadmin 10.0.4.1

```
Password:
```

Was remote access successful? Yes

```
C:\>ssh -l SSHadmin 10.0.4.1

Password:

 WARNING Authorized Users Only!

R2>enable
```

Part 2: Display Router Information

In Part 2, you will use **show** commands from an SSH session to retrieve information from the router.

Step 1: Establish an SSH session to R2.

From the command line of PC3 open an SSH session to the **R2** G0/0/0 IPv6 address and log in as **SSHadmin** with the password **55Hadm!n**.

Step 2: Retrieve important hardware and software information.

a. Use the **show version** command to answer questions about the router.

```
R2#show version
Cisco IOS XE Software, Version 03.16.05.S - Extended Support Release
Cisco IOS Software, ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version Version 15.5 (3)S5, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2017 by Cisco Systems, Inc.
Compiled Thu 19-Jan-17 11:24 by mcpre

Cisco IOS-XE software, Copyright (c) 2005-2017 by cisco Systems, Inc.
All rights reserved.  Certain components of Cisco IOS-XE software are
licensed under the GNU General Public License ("GPL") Version 2.0.  The
software code licensed under GPL Version 2.0 is free software that comes
with ABSOLUTELY NO WARRANTY.  You can redistribute and/or modify such
GPL code under the terms of GPL Version 2.0.  For more details, see the
documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.


ROM: IOS-XE ROMMON

Router uptime is 54 minutes, 47 seconds
Uptime for this control processor is 54 minutes, 47 seconds
System returned to ROM by power-on
System image file is "bootflash:/isr4300-universalk9.03.16.05.S.155-3.S5-ext.SPA.bin"
Last reload reason: PowerOn


This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
```

What is the name of the IOS image that the router is running? Image

version isr4300-universalk9.03.16.05.S.155-3.S5-ext.SPA.bin.

How much non-volatile random-access memory (NVRAM) does the router have?
32768K bytes of NVRAM.

How much Flash memory does the router have?
3223551K bytes of flash memory.

b. The **show** commands often provide multiple screens of outputs. Filtering the output allows a user to display certain sections of the output. To enable the filtering command, enter a pipe (**|**) character after a **show** command, followed by a filtering parameter and a filtering expression. You can match the output to the filtering statement by using the **include** keyword to display all lines from the output that contain the filtering expression. Filter the **show version** command, using **show version | include register** to answer the following question.

```
R2#show version | include register
Configuration register is 0x2102
R2#
```

What is the boot process for the router on the next reload?

(0x2102), the router will undergo a normal boot, load the IOS from the Flash memory, and load the startup configuration from the NVRAM if present

Step 3: Display the running configuration.

Use the **show running-config** command on the router to answer the following questions filtering for lines containing the word “password”.

How are passwords presented in the output?

Passwords are encrypted due to the service password-encryption command.

```
R2#show running-config | include password
service password-encryption
 password 7 0822455D0A16
 password 7 0822455D0A16
R2#
```

Use the **show running-config | begin vty** command. What is

the result of using this command?

```
R2#show running-config | begin vty
line vty 0 4
 exec-timeout 6 0
 password 7 0822455D0A16
 login local
 transport input ssh
!
!
!
end
```

Note: A more specific command would be **show running-config | section vty**; however, the current version of Packet Tracer does not support the **section** filtering command.

Step 4: Display the routing table on the router.

Use the **show ip route** command on the router to answer the following questions.

```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       10.0.3.0/24 is directly connected, Serial0/1/0
L       10.0.3.2/32 is directly connected, Serial0/1/0
C       10.0.4.0/24 is directly connected, GigabitEthernet0/0/0
L       10.0.4.1/32 is directly connected, GigabitEthernet0/0/0
C       10.0.5.0/24 is directly connected, GigabitEthernet0/0/1
L       10.0.5.1/32 is directly connected, GigabitEthernet0/0/1
     209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C       209.165.200.224/30 is directly connected, Serial0/1/1
L       209.165.200.225/32 is directly connected, Serial0/1/1

R2#
```

What code is used in the routing table to indicate a directly connected network?

The C designates a directly connected subnet. An L designates a local interface. Both answers are correct.

How many route entries are coded with a C code in the routing table? 4

Step 5: Display a summary list of the interfaces on the router.

a. Use the **show ip interface brief** command on the router to answer the following question.

```
R2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   10.0.4.1        YES manual up                    up
GigabitEthernet0/0/1   10.0.5.1        YES manual up                    up
Serial0/1/0            10.0.3.2        YES manual up                    up
Serial0/1/1            209.165.200.225 YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   10.0.4.1        YES manual up                    up
GigabitEthernet0/0/1   10.0.5.1        YES manual up                    up
Serial0/1/0            10.0.3.2        YES manual up                    up
Serial0/1/1            209.165.200.225 YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R2#
```

What command changed the status of the Gigabit Ethernet ports from administratively down to up?
No shutdown

What filtering command would you use to display only the interfaces with addresses assigned?

show ip interface brief | exclude unassigned

```
R2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   10.0.4.1        YES manual up                    up
GigabitEthernet0/0/1   10.0.5.1        YES manual up                    up
Serial0/1/0            10.0.3.2        YES manual up                    up
Serial0/1/1            209.165.200.225 YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   10.0.4.1        YES manual up                    up
GigabitEthernet0/0/1   10.0.5.1        YES manual up                    up
Serial0/1/0            10.0.3.2        YES manual up                    up
Serial0/1/1            209.165.200.225 YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R2#show ip interface brief | exclude unassigned
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   10.0.4.1        YES manual up                    up
GigabitEthernet0/0/1   10.0.5.1        YES manual up                    up
Serial0/1/0            10.0.3.2        YES manual up                    up
Serial0/1/1            209.165.200.225 YES manual up                    up
R2#
```

b. Use the **show ipv6 int brief** command to verify IPv6 settings on R2.

```
R2#show ipv6 int brief
GigabitEthernet0/0/0       [up/up]
    FE80::2:A
    2001:DB8:ACAD:4::1
GigabitEthernet0/0/1       [up/up]
    FE80::2:B
    2001:DB8:ACAD:5::1
Serial0/1/0                [up/up]
    FE80::1:C
    2001:DB8:ACAD:3::2
Serial0/1/1                [up/up]
    FE80::1:D
    2001:DB8:FEED:224::1
Vlan1                      [administratively down/down]
    unassigned
R2#
```

c. What is the meaning of the [up/up] part of the output?

The [up/up] status reflects the Layer 1 and Layer 2 status of the interface

and does not rely on Layer 3 for status.

3.13.1.6Scripts

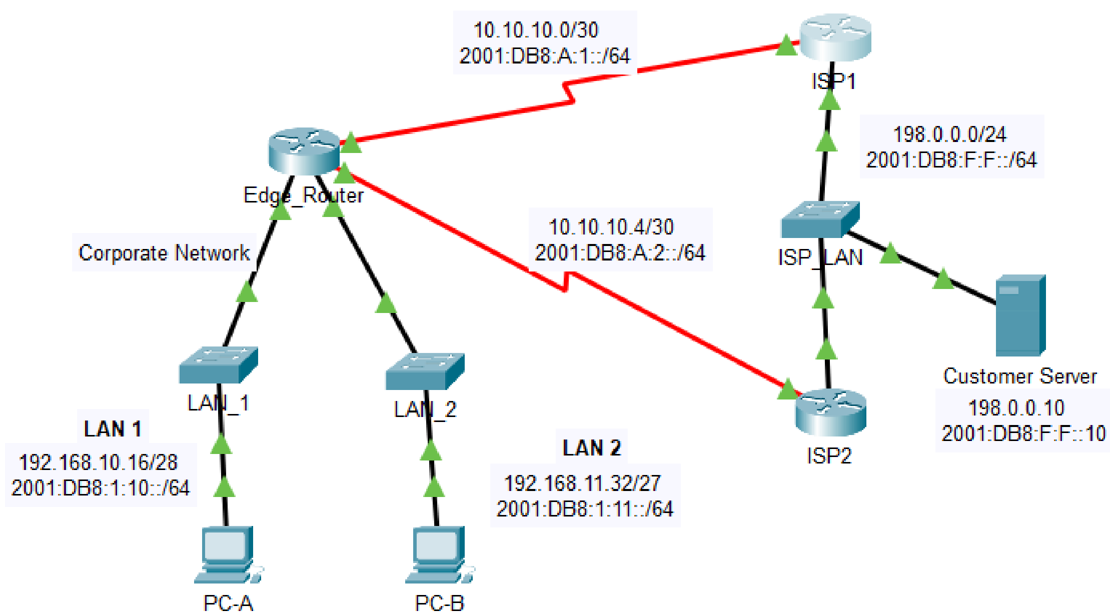
```
!!! ROUTER R2
enable
configure terminal
hostname R2
enable secret c1sco1234
ip domain-name ccna-lab.com
```

```
no ip domain lookup
service password-encryption
username SSHadmin secret 55Hadm!n
crypto key generate rsa general-keys modulus 1024


line console 0
password cisco
logging synchronous
exec-timeout 6 0
login

line vty 0 4
password cisco
exec-timeout 6 0
transport input ssh
login local

banner motd $ WARNING Authorized Users Only! $
ipv6 unicast-routing

interface g0/0/0
description Connection to S3
ip address 10.0.4.1 255.255.255.0
ipv6 address fe80::2:a link-local
ipv6 address 2001:db8:acad:4::1/64
no shutdown

interface g0/0/1
description Connection to S4
ip address 10.0.5.1 255.255.255.0
ipv6 address fe80::2:b link-local
ipv6 address 2001:db8:acad:5::1/64
no shutdown

interface s0/1/0
description Link to R1
ip address 10.0.3.2 255.255.255.0
ipv6 address fe80::1:c link-local
ipv6 address 2001:db8:acad:3::2/64
no shutdown

interface s0/1/1
description Link to Internet
ip address 209.165.200.225 255.255.255.252
ipv6 address fe80::1:d link-local
ipv6 address 2001:db8:feed:224::1/64
no shutdown

end
copy running-config startup-config
```

3.14 Netacad Module 15 – IP Static Routing

3.14.1 Exercise 15.6.1 - Packet Tracer - Configure IPv4 and IPv6 Static and Default Routes

3.14.1.1 Topology



3.14.1.2 Addressing Table

Device	Interface	IP Address / Prefix
Edge_Router	S0/0/0	10.10.10.2/30
		2001:db8:a:1::2/64
	S0/0/1	10.10.10.6/30
		2001:db8:a:2::2/64
	G0/0	192.168.10.17/28
		2001:db8:1:10::1/64
	G0/1	192.168.11.33/27
		2001:db8:1:11::1/64

ISP1	S0/0/0	10.10.10.1/30
		2001:db8:a:1::1/64
	G0/0	198.0.0.1/24
		2001:db8:f:f::1/64
ISP2	S0/0/1	10.10.10.5/30
		2001:db8:a:2::1/64
	G0/0	198.0.0.2/24
		2001:db8:f:f::2/64
PC-A	NIC	192.168.10.19/28
		2001:db8:1:10::19/64
PC-B	NIC	192.168.11.4/27
		2001:db8:1:11::45
Customer Server	NIC	198.0.0.10
		2001:db8:f:f::10

3.14.1.3 Objectives

In this Packet Tracer summary activity, you will configure static, default, and floating static routes for both the IPv4 and IPv6 protocols.

- Configure IPv4 Static and Floating Static Default Routes.
- Configure IPv6 static and floating static default routes.
- Configure IPv4 static and floating static routes to internal LANs.
- Configure IPv6 static and floating static routes to the internal LANS.
- Configure IPv4 host routes.
- Configure IPv6 host routes.

3.14.1.4 Background / Scenario

In this activity, you will configure IPv4 and IPv6 default static and floating static routes.

Note: The static routing approach that is used in this lab is used to assess your ability to configure different types of static routes only. This approach may not reflect networking best practices.

3.14.1.5 Instructions

Part 1: Configure IPv4 Static and Floating Static Default Routes

The PT network requires static routes to provide internet access to the internal LAN users through the ISPs. In addition, the ISP routers require static routes to reach the internal LANs. In this part of the activity, you will configure an IPv4 static default route and a floating default route to add redundancy to the network.

Step 1: Configure an IPv4 static default route.

On Edge_Router, configure a **directly connected** IPv4 default static route. This primary default route should

be through router **ISP1**.
Edge_Router(config)#ip route 0.0.0.0 0.0.0.0 s0/0/0

Step 2: Configure an IPv4 floating static default route.

On Edge_Router, configure a **directly connected** IPv4 floating static default route. This default route should be through router **ISP2**. It should have an administrative distance of **5**.
Edge_Router(config)#ip route 0.0.0.0 0.0.0.0 s0/0/1 5

Part 2: Configure IPv6 Static and Floating Static Default Routes

In this part of the activity, you will configure IPv6 static default and floating static default routes for IPv6.

Step 1: Configure an IPv6 static default route.

On Edge_Router, configure a **next hop** static default route. This primary default route should be through router **ISP1**.

Edge_Router(config)#ipv6 route ::/0 2001:db8:a:1::1

Step 2: Configure an IPv6 floating static default route.

On Edge_Router, configure a **next hop** IPv6 floating static default route. The route should be via router **ISP2**. Use an administrative distance of **5**.

Edge_Router(config)#ipv6 route ::/0 2001:db8:a:2::1 5

Part 3: Configure IPv4 Static and Floating Static Routes to the Internal LANs

In this part of the lab you will configure static and floating static routers from the ISP routers to the internal LANs.

Step 1: Configure IPv4 static routes to the internal LANs.

a. On ISP1, configure a **next hop** IPv4 static route to the **LAN 1** network through Edge_Router.
   ISP1(config)#ip route 192.168.10.16 255.255.255.240 10.10.10.2

b. On ISP1, configure a **next hop** IPv4 static route to the **LAN 2** network through Edge_Router.

   ISP1(config)#ip route 192.168.11.32 255.255.255.224 10.10.10.2

Step 2: Configure IPv4 floating static routes to the internal LANs.

a. On ISP1, configure a **directly connected** floating static route to LAN 1 through the ISP2 router. Use an administrative distance of **5**.
   ISP1(config)#ip route 192.168.10.16 255.255.255.240 g0/0 5
b. On ISP1, configure a **directly connected** ffloating static route to LAN 2 through the ISP2 router. Use an administrative distance of **5**.
   ISP1(config)#ip route 192.168.11.32 255.255.255.224 g0/0 5

Part 4: Configure IPv6 Static and Floating Static Routes to the Internal LANs.

Step 1: Configure IPv6 static routes to the internal LANs.

c. On ISP1, configure a **next hop** IPv6 static route to the **LAN 1** network through Edge_Router.
ISP1(config)#ipv6 route 2001:db8:1:10::/64 2001:db8:a:1::2

d. On ISP1, configure a **next hop** IPv6 static route to the **LAN 2** network through Edge_Router.
ISP1(config)#ipv6 route 2001:db8:1:11::/64 2001:db8:a:1::2

Step 2: Configure IPv6 floating static routes to the internal LANs.

a. On ISP1, configure a **next hop** IPv6 floating static route to LAN 1 through the ISP2 router. Use an administrative distance of **5**.
ISP1(config)#ipv6 route 2001:db8:1:10::/64 2001:db8:f:f::2 5

b. On ISP1, configure a **next hop** IPv6 floating static route to LAN 2 through the ISP2 router. Use an administrative distance of **5**.
ISP1(config)#ipv6 route 2001:db8:1:11::/64 2001:db8:f:f::2 5

If your configuration has been completed correctly, you should be able to ping the Web Server from the hosts on LAN 1 and LAN 2. In addition, if the primary route link is down, connectivity between the LAN hosts and the Web Server should still exist.

Part 5: Configure Host Routes

Users on the corporate network frequently access a server that is owned by an important customer. In this part of the activity, you will configure static host routes to the server. One route will be a floating static route to support the redundant ISP connections.

Step 1: Configure IPv4 host routes.

a. On Edge Router, configure an IPv4 **directly connected** host route to the customer server.
Edge_Router(config)#ip route 198.0.0.10 255.255.255.255 serial0/0/0

b. On Edger Router, configure an IPv4 **directly connected** floating host route to the customer server. Use an administrative distance of **5**.
Edge_Router(config)#ip route 198.0.0.10 255.255.255.255 serial0/0/1 5

Step 2: Configure IPv6 host routes.

a. On Edge Router, configure an IPv6 **next hop** host route to the customer server through the ISP1 router.
Edge_Router(config)#ipv6 route 2001:db8:f:f::10/128 2001:db8:a:1::1

b. On Edger Router, configure an IPv6 floating host route to the customer server through the ISP2 router. Use an administrative distance of **5**.

Edge_Router(config)#ipv6 route 2001:db8:f:f::10/128 s0/0/1 5

NOT CORRECT

Edge_Router(config)#~~ipv6 route 2001:db8:f:f::10/128 2001:db8:a:2::1 5~~

3.14.1.6Scripts

```
Router Edge_Router
enable
config terminal
ip route 0.0.0.0 0.0.0.0 s0/0/0
ip route 0.0.0.0 0.0.0.0 s0/0/1 5
ipv6 route ::/0 2001:db8:a:1::1
ipv6 route ::/0 2001:db8:a:2::1 5
ip route 198.0.0.10 255.255.255.255 serial0/0/0
ip route 198.0.0.10 255.255.255.255 serial0/0/1 5
```

```
ipv6 route 2001:db8:f:f::10/128 2001:db8:a:1::1
ipv6 route 2001:db8:f:f::10/128 s0/0/1 5
```

Before

```
Edge_Router#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C       10.10.10.0/30 is directly connected, Serial0/0/0
L       10.10.10.2/32 is directly connected, Serial0/0/0
C       10.10.10.4/30 is directly connected, Serial0/0/1
L       10.10.10.6/32 is directly connected, Serial0/0/1
     192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.10.16/28 is directly connected, GigabitEthernet0/0
L       192.168.10.17/32 is directly connected, GigabitEthernet0/0
     192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.11.32/27 is directly connected, GigabitEthernet0/1
L       192.168.11.33/32 is directly connected, GigabitEthernet0/1

Edge_Router#
```

After

```
Edge_Router#enable
Edge_Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Edge_Router(config)#ip route 0.0.0.0 0.0.0.0 s0/0/0
%Default route without gateway, if not a point-to-point interface, may impact performance
Edge_Router(config)#ip route 0.0.0.0 0.0.0.0 s0/0/1 5
Edge_Router(config)#ipv6 route ::/0 2001:db8:a:1::1
Edge_Router(config)#ipv6 route ::/0 2001:db8:a:2::1 5
Edge_Router(config)#ip route 198.0.0.10 255.255.255.255 serial0/0/0
Edge_Router(config)#ip route 198.0.0.10 255.255.255.255 serial0/0/1 5
Edge_Router(config)#ipv6 route 2001:db8:f:f::10/128 2001:db8:a:1::1
Edge_Router(config)#ipv6 route 2001:db8:f:f::10/128 s0/0/1 5
Edge_Router(config)#
Edge_Router(config)#ens
                     ^
% Invalid input detected at '^' marker.

Edge_Router(config)#end
Edge_Router#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Edge_Router#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C       10.10.10.0/30 is directly connected, Serial0/0/0
L       10.10.10.2/32 is directly connected, Serial0/0/0
C       10.10.10.4/30 is directly connected, Serial0/0/1
L       10.10.10.6/32 is directly connected, Serial0/0/1
     192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.10.16/28 is directly connected, GigabitEthernet0/0
L       192.168.10.17/32 is directly connected, GigabitEthernet0/0
     192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.11.32/27 is directly connected, GigabitEthernet0/1
L       192.168.11.33/32 is directly connected, GigabitEthernet0/1
     198.0.0.0/32 is subnetted, 1 subnets
S       198.0.0.10/32 is directly connected, Serial0/0/0
S*   0.0.0.0/0 is directly connected, Serial0/0/0

Edge_Router#
```

```
Router ISP1
enable
config terminal
ip route 192.168.10.16 255.255.255.240 10.10.10.2
ip route 192.168.11.32 255.255.255.224 10.10.10.2
ip route 192.168.10.16 255.255.255.240 g0/0 5
ip route 192.168.11.32 255.255.255.224 g0/0 5
ipv6 route 2001:db8:1:10::/64 2001:db8:a:1::2
ipv6 route 2001:db8:1:11::/64 2001:db8:a:1::2
ipv6 route 2001:db8:1:10::/64 2001:db8:f:f::2 5
ipv6 route 2001:db8:1:11::/64 2001:db8:f:f::2 5
```

Bedore

```
ISP1>
ISP1>enable
ISP1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.10.10.0/30 is directly connected, Serial0/0/0
L       10.10.10.1/32 is directly connected, Serial0/0/0
     198.0.0.0/24 is variably subnetted, 2 subnets, 2 masks
C       198.0.0.0/24 is directly connected, GigabitEthernet0/0
L       198.0.0.1/32 is directly connected, GigabitEthernet0/0

ISP1#
```

After

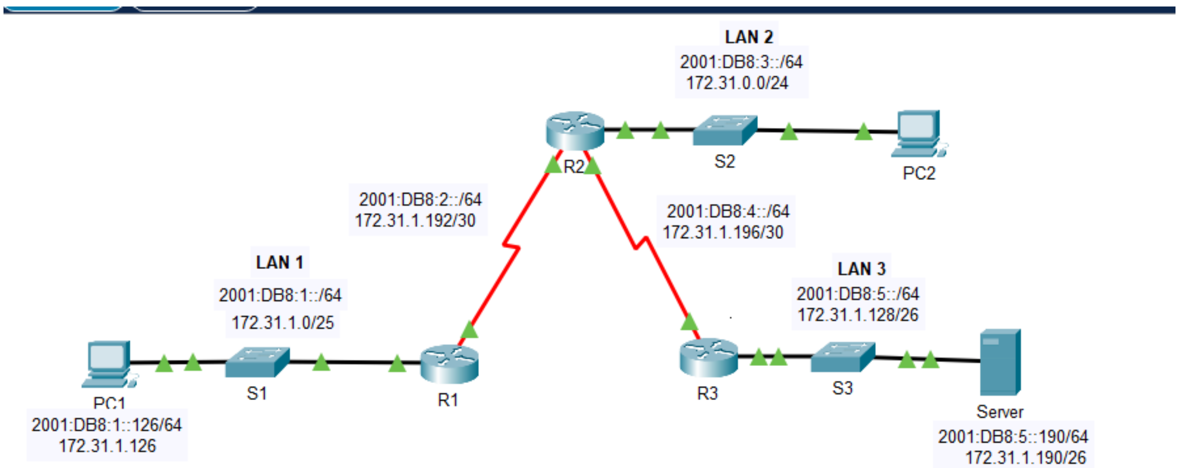
```
ISP1#enable
ISP1#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ISP1(config)#ip route 192.168.10.16 255.255.255.240 10.10.10.2
ISP1(config)#ip route 192.168.11.32 255.255.255.224 10.10.10.2
ISP1(config)#ip route 192.168.10.16 255.255.255.240 g0/0 5
ISP1(config)#ip route 192.168.11.32 255.255.255.224 g0/0 5
ISP1(config)#ipv6 route 2001:db8:1:10::/64 2001:db8:a:1::2
ISP1(config)#ipv6 route 2001:db8:1:11::/64 2001:db8:a:1::2
ISP1(config)#ipv6 route 2001:db8:1:10::/64 2001:db8:f:f::2 5
ISP1(config)#ipv6 route 2001:db8:1:11::/64 2001:db8:f:f::2 5
ISP1(config)#
ISP1(config)#end
ISP1#
%SYS-5-CONFIG_I: Configured from console by console
```

```
ISP1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.10.10.0/30 is directly connected, Serial0/0/0
L       10.10.10.1/32 is directly connected, Serial0/0/0
     192.168.10.0/28 is subnetted, 1 subnets
S       192.168.10.16/28 [1/0] via 10.10.10.2
     192.168.11.0/27 is subnetted, 1 subnets
S       192.168.11.32/27 [1/0] via 10.10.10.2
     198.0.0.0/24 is variably subnetted, 2 subnets, 2 masks
C       198.0.0.0/24 is directly connected, GigabitEthernet0/0
L       198.0.0.1/32 is directly connected, GigabitEthernet0/0

ISP1#
```

3.15 Netacad Module 16 – Troubleshoot Static and Default routes

3.15.1 Exercise 16.3.1 - Packet Tracer - Troubleshoot Static and Default Routes

3.15.1.1 Topology



3.15.1.2 Addressing Table

Device	Interface	IP Addresses
R1	G0/0	172.31.1.1/25
		2001:DB8:1::1/64
	S0/0/0	172.31.1.194/30
		2001:DB8:2::194/64
R2	G0/0	172.31.0.1/24
		2001:DB8:3::1/64
	S0/0/0	172.31.1.193/30
		2001:DB8:2::193/64
	S0/0/1	172.31.1.197/30
		2001:DB8:4::197/64
R3	G0/0	172.31.1.129/26
		2001:DB8:5::1/64
	S0/0/1	172.31.1.198/30
		2001:DB8:4::198/64

PC1	NIC	172.31.1.126/25
		2001:DB8:1::126/64
PC2	NIC	172.31.0.254/24
		2001:DB8:3::254/64
Server	NIC	172.31.1.190/26
		2001:DB8:5::190/64

3.15.1.3 Objectives

In this activity you will troubleshoot static and default routes and repair any errors that you find.

- Troubleshoot IPv4 static routes.
- Troubleshoot IPv4 default routes.
- Troubleshoot IPv6 static routes.
- Configure IPv4 static routes.
- Configure IPv4 default routes.
- Configure IPv6 static routes.

3.15.1.4 Background / Scenario

A newly hired network technician is attempting to preconfigure a simple topology that will be delivered to a customer. The technician has not been able to establish connectivity between the three LANs. You have been asked to troubleshoot the topology and verify connectivity between the hosts on the three LANs over IPv4 and IPv6.

3.15.1.5 Instructions

Step 1: Locate and document the problems.

Record your findings in a table like the one below.

Location	Problem	Solution
R1	IPv4 Default route next hop interface address is incorrect.	Change next hop address to 172.31.1.193
R2	IPv6 route to LAN 1 has the wrong network address for the destination network.	Change destination address from 2001:DB6:1::/64 to 2001:DB8:1::/64

R2	The next hop addresses in the two IPv4 routes are reversed.	Change the statements to ip route 172.31.1.0 255.255.255.128 172.31.1.194 and ip route 172.31.1.128 255.255.255.192 172.31.1.198
R3	The IPv6 route to LAN 1 is missing.	Configure a directly connected static route to 2001:DB8:1::/64
R3	The IPv4 route to LAN 1 has the wrong mask for the network.	Change the mask to 255.255.255.128

Step 2: Repair the problems.

Configure the devices so that full connectivity exists between the hosts on the LANs over IPv4 and IPv6.

Note: Your task is to establish connectivity using the existing static route design. Changing the types of static routes used will result in a loss of points.

3.15.1.6Scripts

Router R1

Removes the existing default route pointing to 172.31.1.195.
Adds a new default route pointing to 172.31.1.193.

```
enable
conf t
no ip route 0.0.0.0 0.0.0.0 172.31.1.195
ip route 0.0.0.0 0.0.0.0 172.31.1.193
end
```

Before

```
R1>enable
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 172.31.1.195 to network 0.0.0.0

     172.31.0.0/16 is variably subnetted, 4 subnets, 3 masks
C       172.31.1.0/25 is directly connected, GigabitEthernet0/0
L       172.31.1.1/32 is directly connected, GigabitEthernet0/0
C       172.31.1.192/30 is directly connected, Serial0/0/0
L       172.31.1.194/32 is directly connected, Serial0/0/0
S*   0.0.0.0/0 [1/0] via 172.31.1.195

R1#
```

```
R1#enable
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#no ip route 0.0.0.0 0.0.0.0 172.31.1.195
R1(config)#ip route 0.0.0.0 0.0.0.0 172.31.1.193
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 172.31.1.193 to network 0.0.0.0

     172.31.0.0/16 is variably subnetted, 4 subnets, 3 masks
C       172.31.1.0/25 is directly connected, GigabitEthernet0/0
L       172.31.1.1/32 is directly connected, GigabitEthernet0/0
C       172.31.1.192/30 is directly connected, Serial0/0/0
L       172.31.1.194/32 is directly connected, Serial0/0/0
S*   0.0.0.0/0 [1/0] via 172.31.1.193

R1#
```

Router R2

Removes specific routes pointing to 172.31.1.198 and 172.31.1.194.
Adds new routes for the same networks with different next hops.
Removes an IPv6 route pointing to 2001:DB6:1::/64.
Adds a new IPv6 route pointing to 2001:DB8:1::/64.

```
enable
conf t
no ip route 172.31.1.0 255.255.255.128 172.31.1.198
```

```
no ip route 172.31.1.128 255.255.255.192 172.31.1.194
ip route 172.31.1.0 255.255.255.128 172.31.1.194
ip route 172.31.1.128 255.255.255.192 172.31.1.198
no ipv6 route 2001:DB6:1::/64 2001:DB8:2::194
ipv6 route 2001:DB8:1::/64 2001:DB8:2::194
end
```

Before

```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter are
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.31.0.0/16 is variably subnetted, 8 subnets, 5 masks
C       172.31.0.0/24 is directly connected, GigabitEthernet0/0
L       172.31.0.1/32 is directly connected, GigabitEthernet0/0
S       172.31.1.0/25 [1/0] via 172.31.1.198
S       172.31.1.128/26 [1/0] via 172.31.1.194
C       172.31.1.192/30 is directly connected, Serial0/0/0
L       172.31.1.193/32 is directly connected, Serial0/0/0
C       172.31.1.196/30 is directly connected, Serial0/0/1
L       172.31.1.197/32 is directly connected, Serial0/0/1

R2#
```

After

```
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#no ip route 172.31.1.0 255.255.255.128 172.31.1.198
R2(config)#no ip route 172.31.1.128 255.255.255.192 172.31.1.194
R2(config)#ip route 172.31.1.0 255.255.255.128 172.31.1.194
R2(config)#ip route 172.31.1.128 255.255.255.192 172.31.1.198
R2(config)#no ipv6 route 2001:DB6:1::/64 2001:DB8:2::194
R2(config)#ipv6 route 2001:DB8:1::/64 2001:DB8:2::194
R2(config)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.31.0.0/16 is variably subnetted, 8 subnets, 5 masks
C       172.31.0.0/24 is directly connected, GigabitEthernet0/0
L       172.31.0.1/32 is directly connected, GigabitEthernet0/0
S       172.31.1.0/25 [1/0] via 172.31.1.194
S       172.31.1.128/26 [1/0] via 172.31.1.198
C       172.31.1.192/30 is directly connected, Serial0/0/0
L       172.31.1.193/32 is directly connected, Serial0/0/0
C       172.31.1.196/30 is directly connected, Serial0/0/1
L       172.31.1.197/32 is directly connected, Serial0/0/1

R2#
```

Router R3

Removes a specific route pointing to Serial0/0/1.

Adds a new route for a different subnet pointing to Serial0/0/1.

Adds an IPv6 route pointing to 2001:DB8:1::/64.

enable

conf t

no ip route 172.31.1.0 255.255.255.240 Serial0/0/1

ip route 172.31.1.0 255.255.255.128 Serial0/0/1

ipv6 route 2001:DB8:1::/64 Serial0/0/1

end

Before

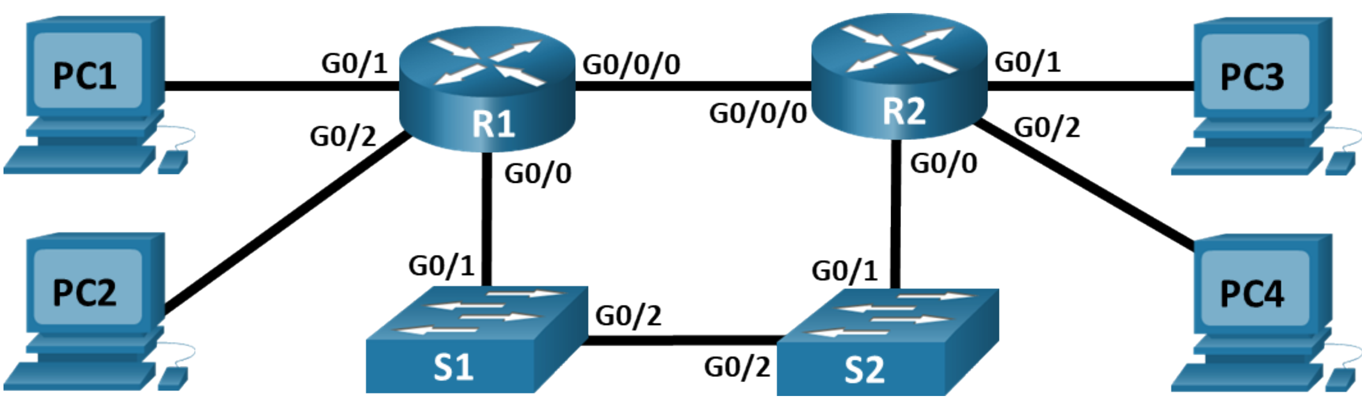
```
R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.31.0.0/16 is variably subnetted, 7 subnets, 5 masks
S       172.31.0.0/24 is directly connected, Serial0/0/1
S       172.31.1.0/28 is directly connected, Serial0/0/1
C       172.31.1.128/26 is directly connected, GigabitEthernet0/0
L       172.31.1.129/32 is directly connected, GigabitEthernet0/0
S       172.31.1.192/30 is directly connected, Serial0/0/1
C       172.31.1.196/30 is directly connected, Serial0/0/1
L       172.31.1.198/32 is directly connected, Serial0/0/1

R3#
```

After

```
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#no ip route 172.31.1.0 255.255.255.240 Serial0/0/1
R3(config)#ip route 172.31.1.0 255.255.255.128 Serial0/0/1
%Default route without gateway, if not a point-to-point interface, may impact performance
R3(config)#ipv6 route 2001:DB8:1::/64 Serial0/0/1
R3(config)#end
R3#
%SYS-5-CONFIG_I: Configured from console by console

R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.31.0.0/16 is variably subnetted, 7 subnets, 5 masks
S       172.31.0.0/24 is directly connected, Serial0/0/1
S       172.31.1.0/25 is directly connected, Serial0/0/1
C       172.31.1.128/26 is directly connected, GigabitEthernet0/0
L       172.31.1.129/32 is directly connected, GigabitEthernet0/0
S       172.31.1.192/30 is directly connected, Serial0/0/1
C       172.31.1.196/30 is directly connected, Serial0/0/1
L       172.31.1.198/32 is directly connected, Serial0/0/1

R3#
```

3.15.2 Exercise 16.3.2 - Packet Tracer - Troubleshoot IPv4 and IPv6 Static and Default Routes - Physical Mode

3.15.2.1 Topology



3.15.2.2 Addressing Table

Device	Interface	IP Address / Prefix	Default Gateway
R1	G0/0/0	192.168.0.1/28	N/A
		2001:db8:acad::1/64	
	G0/0	192.168.0.17/28	
		2001:db8:acad:16::1/64	

	G0/1	172.16.1.1/24	
		2001:db8:acad:171::1/64	
	G0/2	209.165.200.1 /25	
		2001:db8:acad:209::1/64	
R2	G0/0/0	192.168.0.14/28	N/A
		2001:db8:acad::14/64	
	G0/0	192.168.0.30/28	
		2001:db8:acad:16::2/64	
	G0/1	172.16.2.1/24	
		2001:db8:acad:172::1/64	
	G0/2	209.165.200.129/25	
		2001:db8:acad:210::1/64	
PC1	NIC	172.16.1.2 /24	172.16.1.1

Device	Interface	IP Address / Prefix	Default Gateway
		2001:db8:acad:171::2/64	fe80::1
PC2	NIC	209.165.200.2/25	209.165.200.1
		2001:db8:acad:209::2/64	fe80::1
PC3	NIC	172.16.2.2/24	172.16.2.1
		2001:db8:acad:172::2/64	fe80::2
PC4	NIC	209.165.200.130/25	209.265.200.129
		2001:db8:acad:210::2/64	fe80::2

3.15.2.3 Objectives

Part 1: Evaluate Network Operation

Part 2: Gather Information, Create an Action Plan, and Implement Corrections

3.15.2.4 Background / Scenario

All the network devices in this Packet Tracer Physical Mode (PTPM) activity have been preconfigured to include intentional errors that are preventing the network from routing as intended. Your task is to evaluate the network, identify, and correct the configuration errors to restore full connectivity. You may find errors with the route statements or with other configurations that impact the accuracy of the route statements.

Note: The static routing approach used in this activity is used to assess your ability to configure different types of static routes only. This approach may not reflect networking best practices.

3.15.2.5 Instructions

Part 1: Evaluate Network Operation

Use the **ping** and/or **traceroute** commands from the router to test the following criteria and record the results.

Note: Use the PCs in the wiring closet to gain console access to networking devices in order to explore and change the device configurations.

- Traffic from R1 to the 172.16.2.1 address on R2 uses the next hop 192.168.0.14.
- Traffic from R1 to the 209.165.200.129 address on R2 uses the next hop 192.168.0.30.
- When the G0/0/0 interface on R1 is shut down, traffic from R1 to the 172.16.2.1 address on R2 uses the next hop 192.168.0.30.
- Traffic from R2 to the 2001:db8:acad:171::1 address on R1 uses the next hop 2001:db8:acad::1.
- Traffic from R2 to the 2001:db8:acad:209::1 address on R1 uses the next hop 2001:db8:acad:16::1.
- When the G0/0/0 interface on R2 is shut down, traffic from R2 to the 2001:db8:acad:171::1 address on R1 uses the next hop 2001:db8:acad:16::1.

Part 2: Gather Information, Create an Action Plan, and Implement Corrections

a. For each criterion that is not met, gather information by examining the running configuration and routing tables to develop a hypothesis for what is causing the malfunction.

b. Create an action plan that you think will fix the issue. Develop a list of all the commands you intend to use to fix the issue, and a list of all the commands you need to revert the configuration, should your action plan fail to correct the issue.

c. Execute your action plans one at a time for each criterion that fails, and record the fix actions.

3.15.2.6Solution

Routing problems on both routers:

1. Wrong IP for next hop
2. AD set high versus default
3. Default AD used and wrong next hop IP

3.15.2.6.1 Scripts

Router 1

```
enable
config t
no ip route 209.165.200.128 255.255.255.128 192.168.0.3
ip route 209.165.200.128 255.255.255.128 192.168.0.30
no ip route 0.0.0.0 0.0.0.0 192.168.0.14 80
ip route 0.0.0.0 0.0.0.0 192.168.0.14
no ip route 0.0.0.0 0.0.0.0 192.168.0.3
ip route 0.0.0.0 0.0.0.0 192.168.0.30 80
```

Before

```
R1>enable
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 192.168.0.3 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/24 is directly connected, GigabitEthernet0/1
L       172.16.1.1/32 is directly connected, GigabitEthernet0/1
     192.168.0.0/24 is variably subnetted, 4 subnets, 2 masks
C       192.168.0.0/28 is directly connected, GigabitEthernet0/0/0
L       192.168.0.1/32 is directly connected, GigabitEthernet0/0/0
C       192.168.0.16/28 is directly connected, GigabitEthernet0/0
L       192.168.0.17/32 is directly connected, GigabitEthernet0/0
     209.165.200.0/24 is variably subnetted, 3 subnets, 2 masks
C       209.165.200.0/25 is directly connected, GigabitEthernet0/2
L       209.165.200.1/32 is directly connected, GigabitEthernet0/2
S       209.165.200.128/25 [1/0] via 192.168.0.3
S*   0.0.0.0/0 [1/0] via 192.168.0.3

R1#
```

After

```
R1#sho ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 192.168.0.14 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.1.0/24 is directly connected, GigabitEthernet0/1
L       172.16.1.1/32 is directly connected, GigabitEthernet0/1
     192.168.0.0/24 is variably subnetted, 4 subnets, 2 masks
C       192.168.0.0/28 is directly connected, GigabitEthernet0/0/0
L       192.168.0.1/32 is directly connected, GigabitEthernet0/0/0
C       192.168.0.16/28 is directly connected, GigabitEthernet0/0
L       192.168.0.17/32 is directly connected, GigabitEthernet0/0
     209.165.200.0/24 is variably subnetted, 3 subnets, 2 masks
C       209.165.200.0/25 is directly connected, GigabitEthernet0/2
L       209.165.200.1/32 is directly connected, GigabitEthernet0/2
S       209.165.200.128/25 [1/0] via 192.168.0.30
S*   0.0.0.0/0 [1/0] via 192.168.0.14
```

Router 2

```
enable
config t
```

```
no ipv6 route 2001:db8:acad:209::/64 2001:db7:acad:16::1
ipv6 route 2001:db8:acad:209::/64 2001:db8:acad:16::1
no ipv6 route ::/0 2001:db8:acad::1 90
ipv6 route ::/0 2001:db8:acad::1
no ipv6 route ::/0 2001:db8:acad:15::1
ipv6 route ::/0 2001:db8:acad:16::1 80
```

Before

```
R2>enable
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 192.168.0.17 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.2.0/24 is directly connected, GigabitEthernet0/1
L       172.16.2.1/32 is directly connected, GigabitEthernet0/1
     192.168.0.0/24 is variably subnetted, 4 subnets, 2 masks
C       192.168.0.0/28 is directly connected, GigabitEthernet0/0/0
L       192.168.0.14/32 is directly connected, GigabitEthernet0/0/0
C       192.168.0.16/28 is directly connected, GigabitEthernet0/0
L       192.168.0.30/32 is directly connected, GigabitEthernet0/0
     209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C       209.165.200.128/25 is directly connected, GigabitEthernet0/2
L       209.165.200.129/32 is directly connected, GigabitEthernet0/2
S*   0.0.0.0/0 [1/0] via 192.168.0.17

R2#
```

After

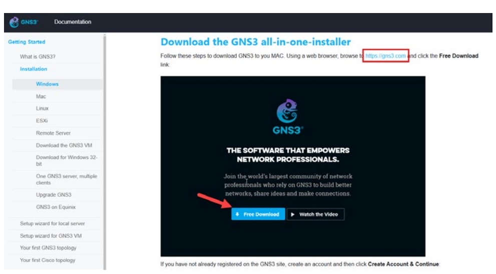
```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 192.168.0.17 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.2.0/24 is directly connected, GigabitEthernet0/1
L       172.16.2.1/32 is directly connected, GigabitEthernet0/1
     192.168.0.0/24 is variably subnetted, 4 subnets, 2 masks
C       192.168.0.0/28 is directly connected, GigabitEthernet0/0/0
L       192.168.0.14/32 is directly connected, GigabitEthernet0/0/0
C       192.168.0.16/28 is directly connected, GigabitEthernet0/0
L       192.168.0.30/32 is directly connected, GigabitEthernet0/0
     209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C       209.165.200.128/25 is directly connected, GigabitEthernet0/2
L       209.165.200.129/32 is directly connected, GigabitEthernet0/2
S*   0.0.0.0/0 [1/0] via 192.168.0.17
```

3.16 Install GNS3

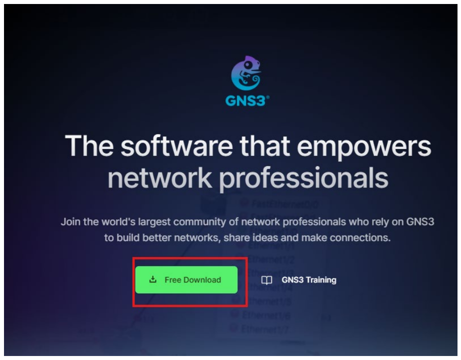
3.16.1 Download GNS3

A) Search for "GNS3 download" on Google.
B) Visit the GNS3 download page.

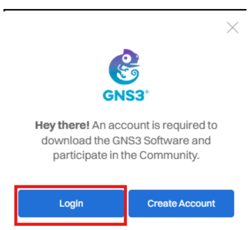
[GNS3 Windows Install | GNS3 Documentation](https://gns3.com/software/download)
https://gns3.com/software/download



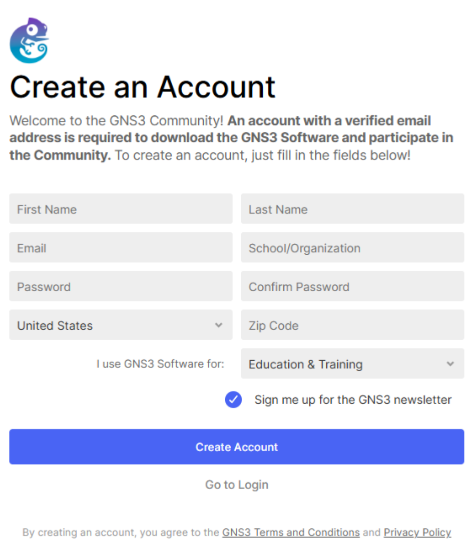
C) Click on the Windows version and download the binary file.

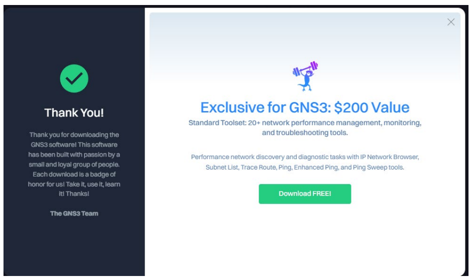


D) Log into your GNS3 account if prompted.

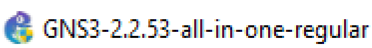


Or create a new account if needed



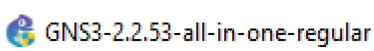


The file has been downloaded

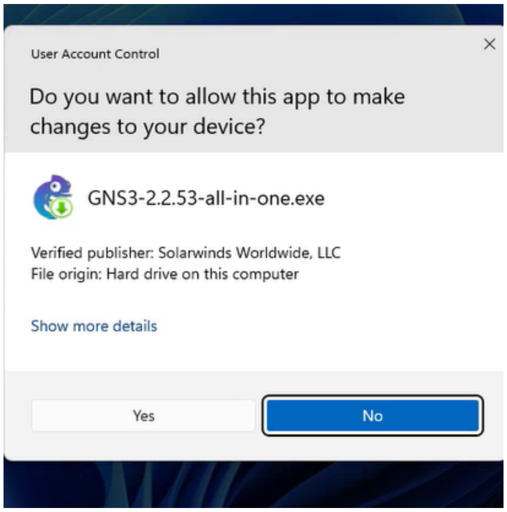


3.16.2 Install GNS3

A) Double-click the downloaded file.



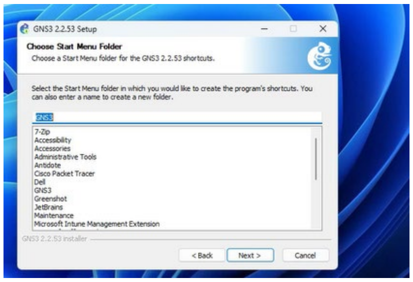
B) Click "Yes" to start the installation.



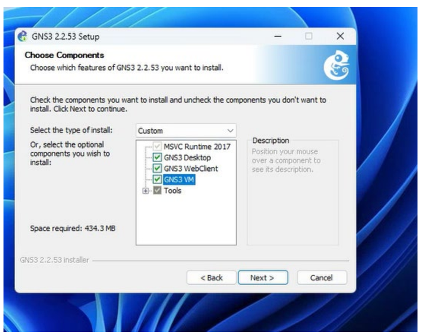
C) Follow the installation wizard , Click “Next”.

D) Agree to the license terms.

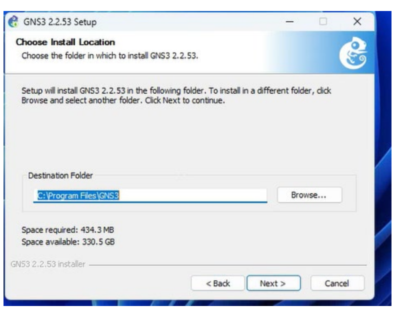
E) Click Next



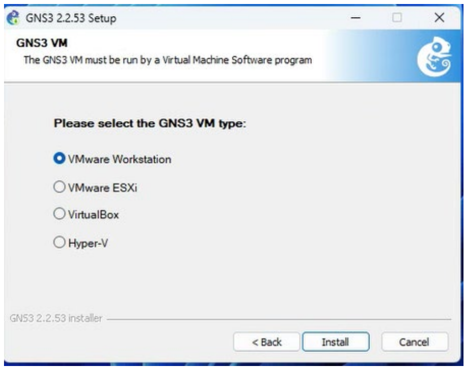
F) Select all components for installation, including the GNS3 virtual machine.



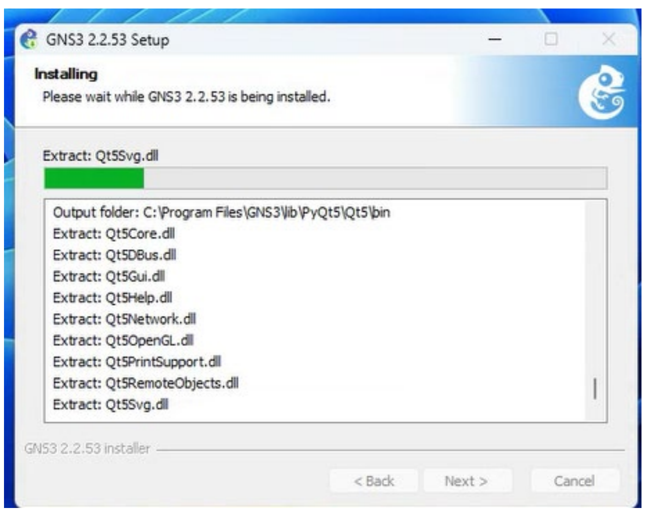
G) Choose the default locations for installation.



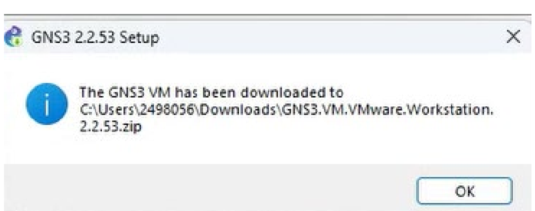
H) Select VMware Workstation for the virtual machine and click Install



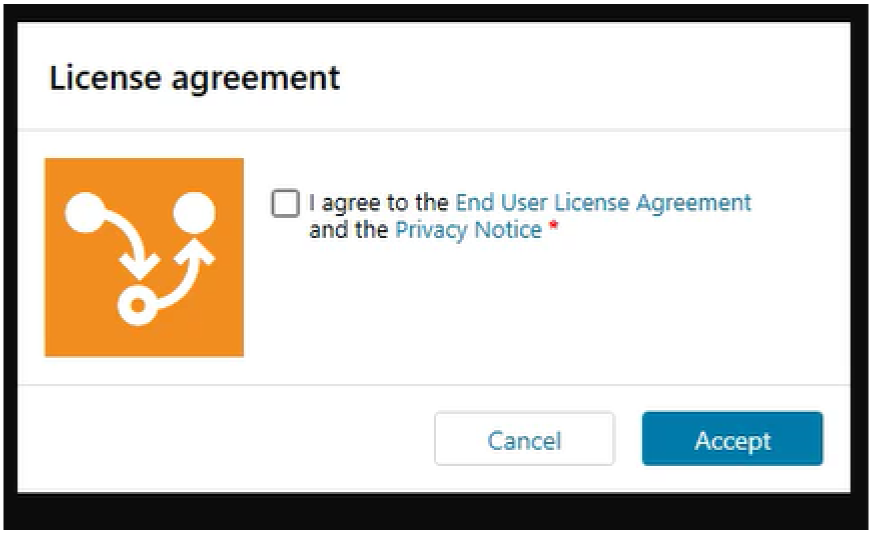
I) Installation is started



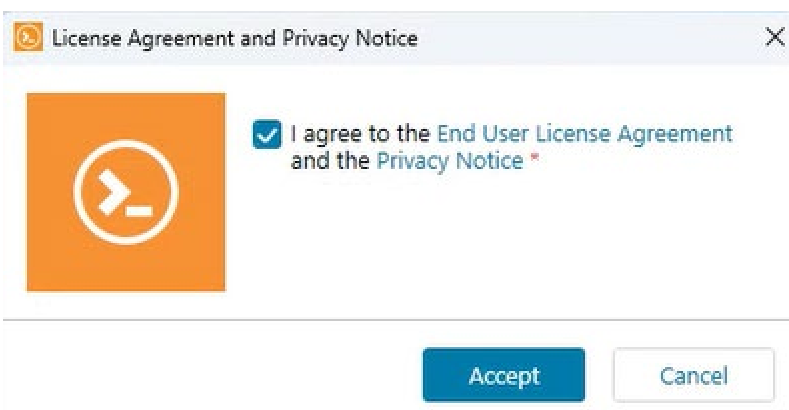
J) Select OK

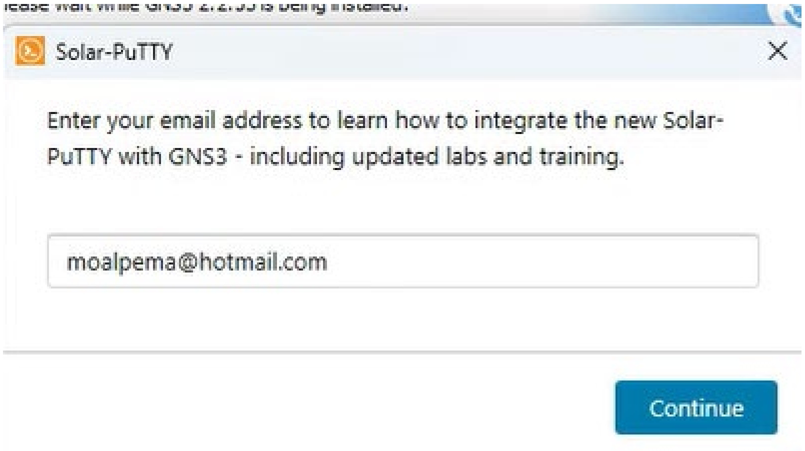


K) Give email and agree on license for TraceNg and Solar -Putty

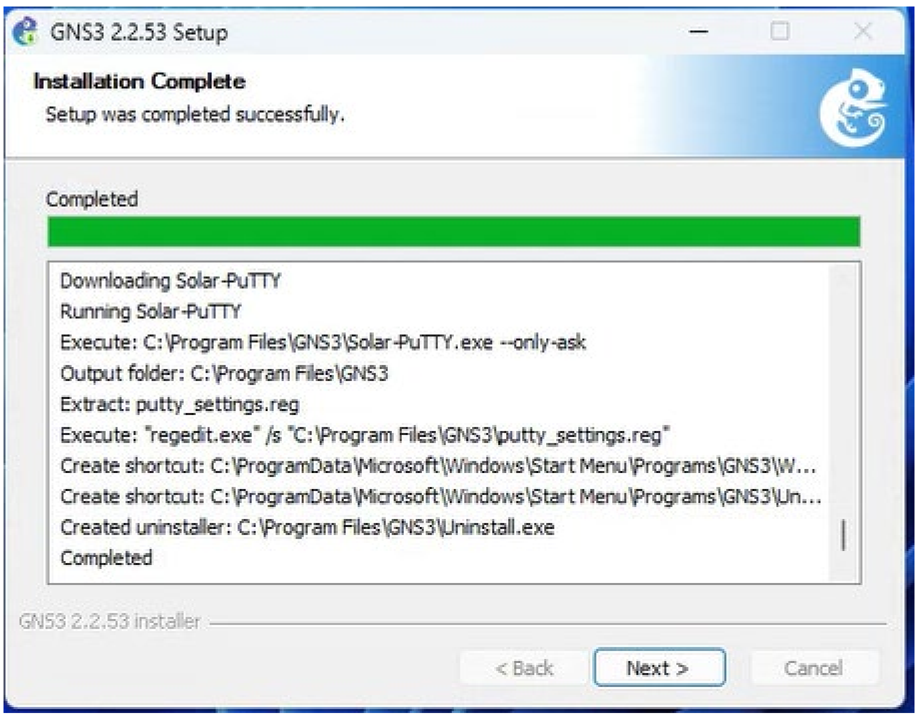

License agreement
I agree to the End User License Agreement and the Privacy Notice *
Cancel
Accept


TraceNG
Enter your email address to learn how to integrate the new TraceNG with GNS3 - including updated labs and training.
moalpema@hotmail.com
Continue

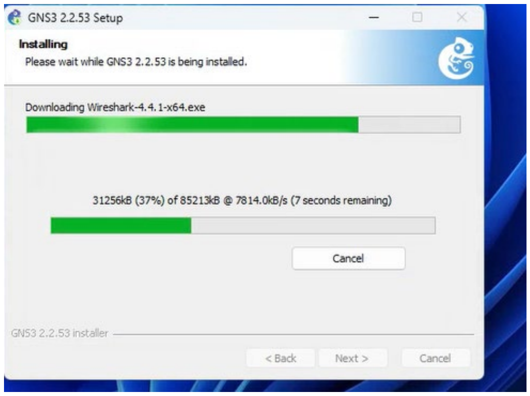

License Agreement and Privacy Notice
I agree to the End User License Agreement and the Privacy Notice *
Accept
Cancel



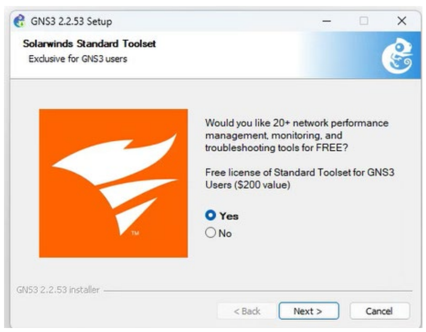
L) Click Nest when finished



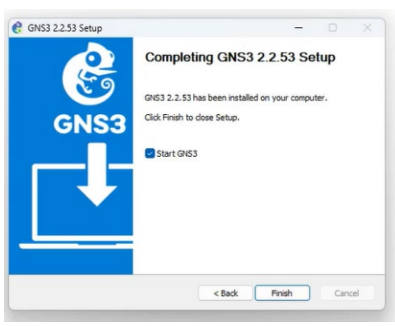
M) Click “Next” when finished.



N) Select "Yes", then click "Next".

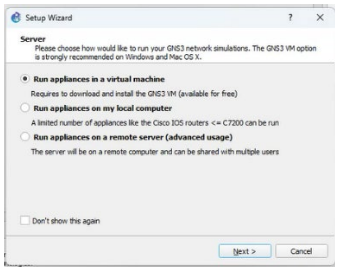


O) Click Finish to start GSN3

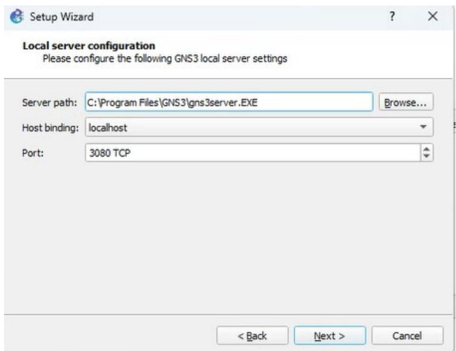


3.16.3 GSN3 Setup

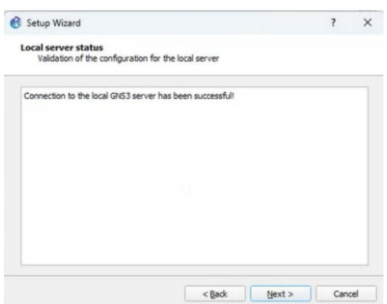
A) Select "Run appliances in a virtual machine", then click "Next".



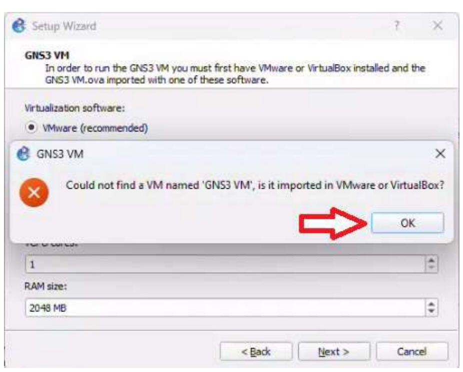
B) Click Next on Local Server configuration



C) Click Next on local server status

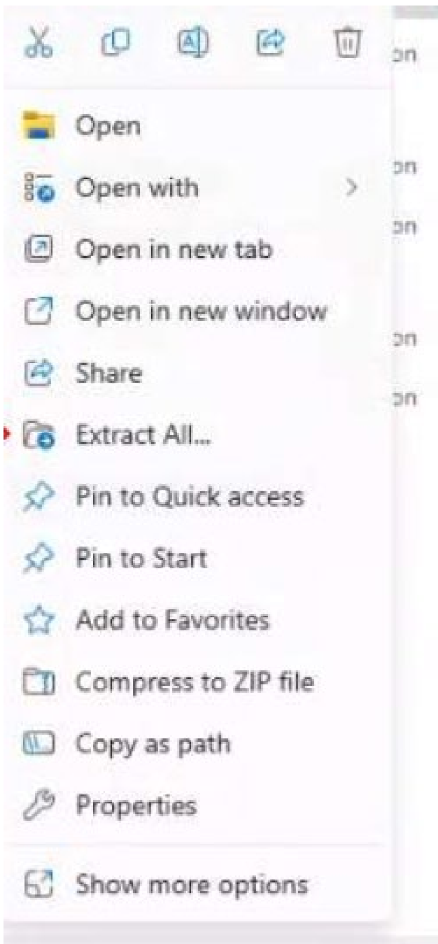


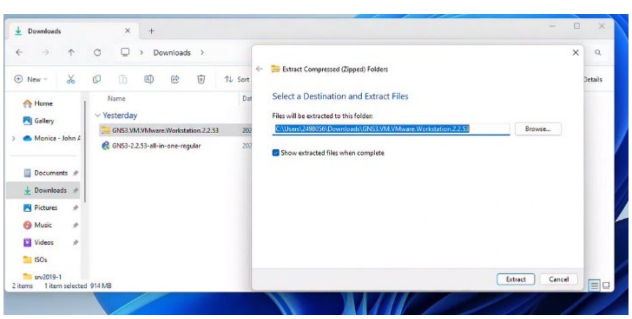
D) Click OK



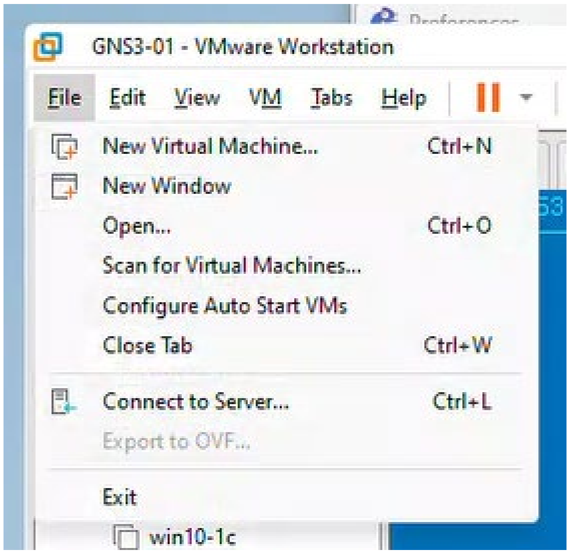
3.16.4 GNS3 VM

A) Go to Downloads folder > right click GNS3.VM.VMware.Workstation.2.2.44.1.zip file > Extract

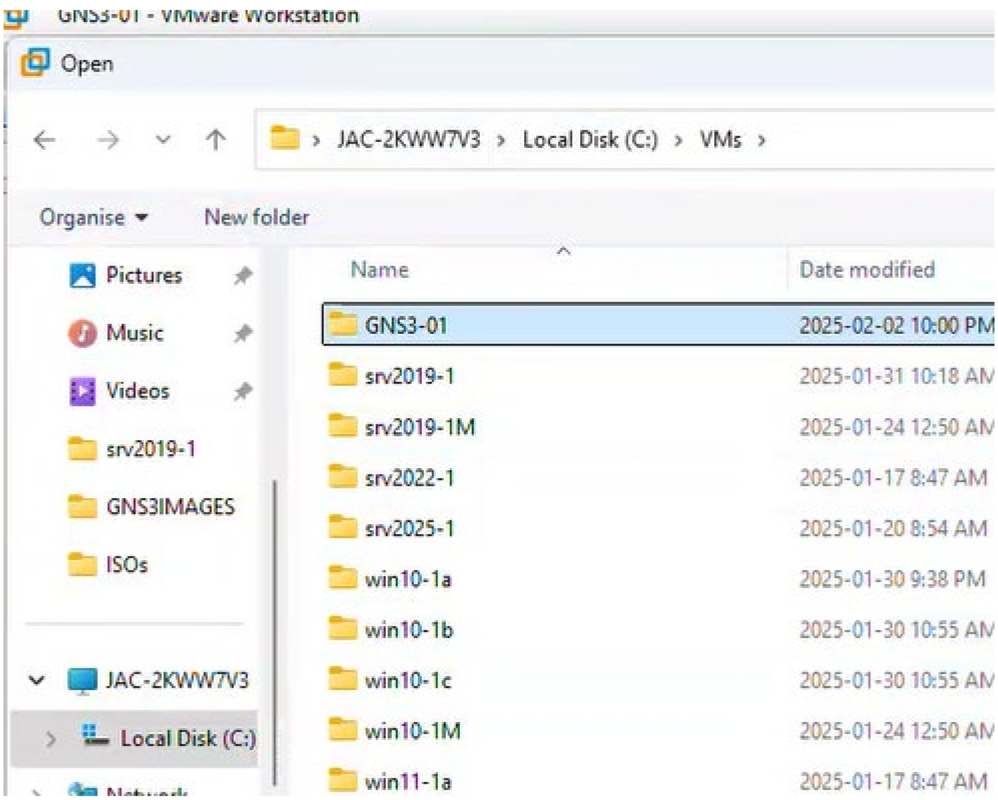




B) Open VMware Workstation - menu File > Open… Select GNS3 VM, then click “Open”.



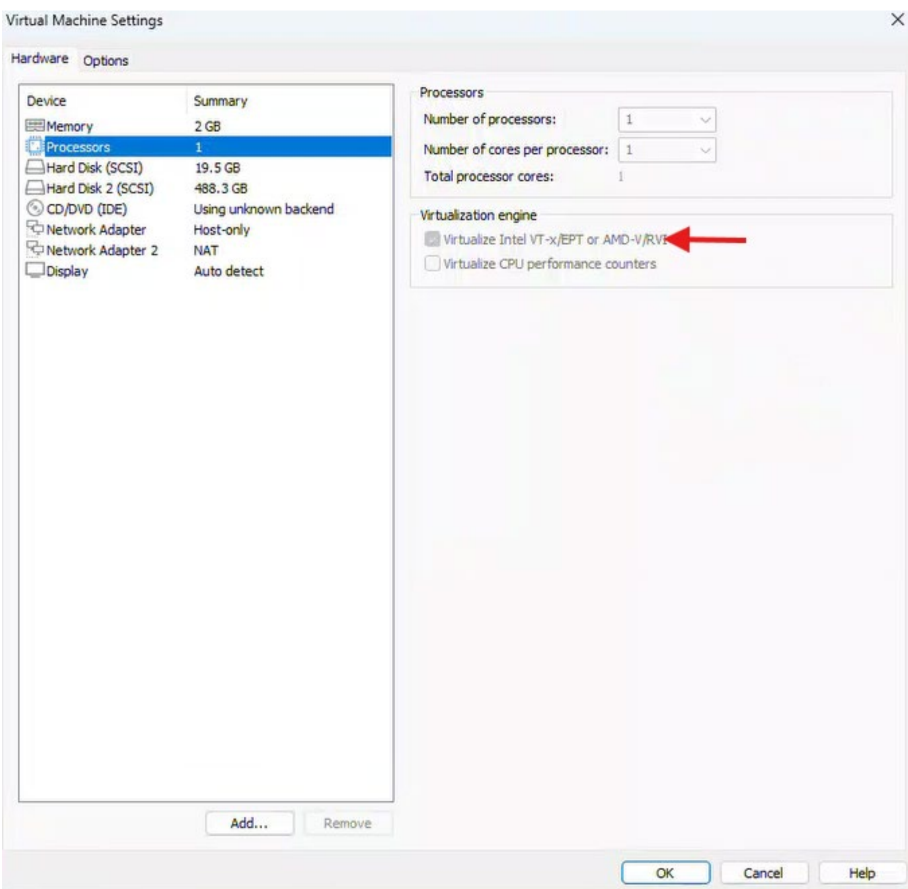
C) Go to Local C: drive > VMs folder. Click “Make New Folder”. Name it “GNS3-01”, then select it, and click “OK”.



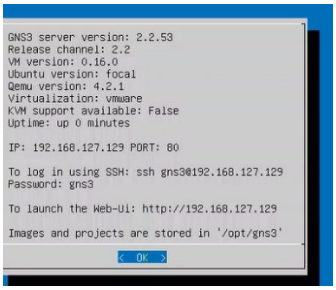
D) Click “Import”.

E) Click “Refresh”. You should now see “GNS3-01” below VM Name. Click “Next”.

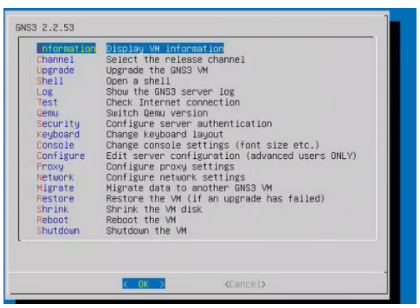
F) Go to VMware Worksation and select GNS3-01 VM. Click menu Edit > Virtual machine settings. Uncheck “Virtualize Intel VT-x-EPT or AMC-V-RVI”, then click “OK”. Power on GNS3-08 VM.



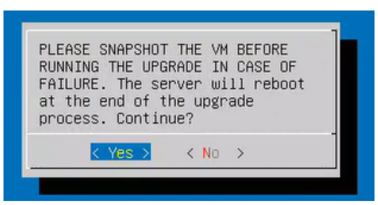
G) Press OK



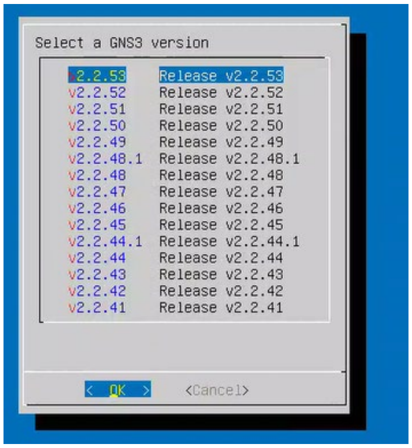
H) Use your keyboard down key until “Upgrade” is highlighted, then press <enter> to select “OK”.



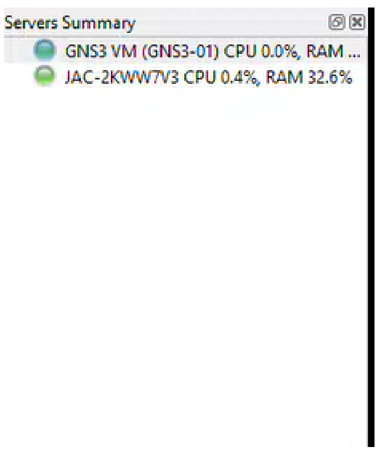
I) Press Yes



J) Select latest version at the top- 2.2.53 - then press <enter> to select “OK”. Allow some time to let the system download and install updates, and reboot.



K) Once the GNS3 VM has finished rebooting. Go to the GNS3 software app and verify that both green lights are up under Server Summary.

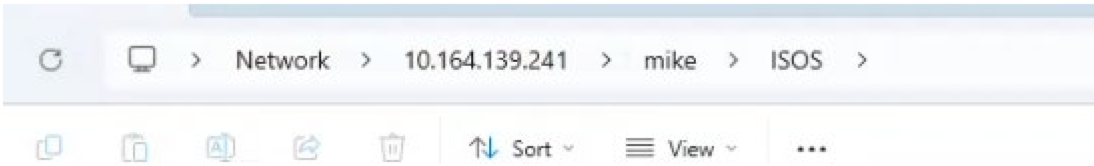


3.16.5 How to Set Up GNS3

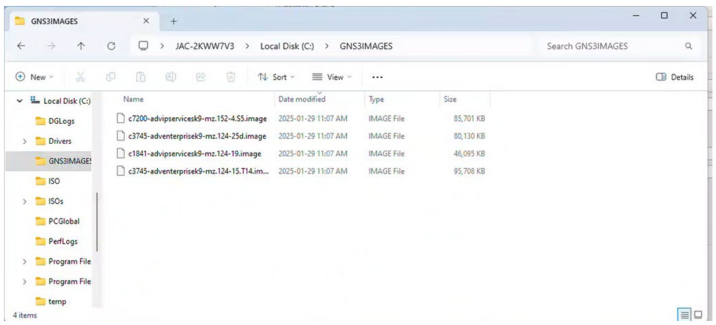
3.16.5.1 Prepare IOS Images:

Copy ISOS files to your C drive

From 10.164.139.241

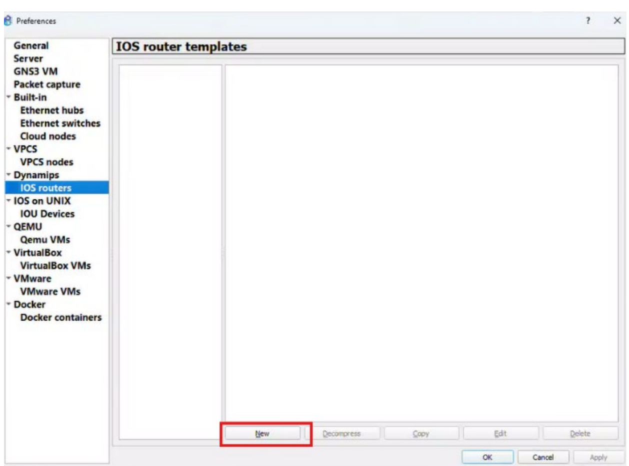


Ensure you have the IOS image files ready, typically stored in a folder on your C drive.

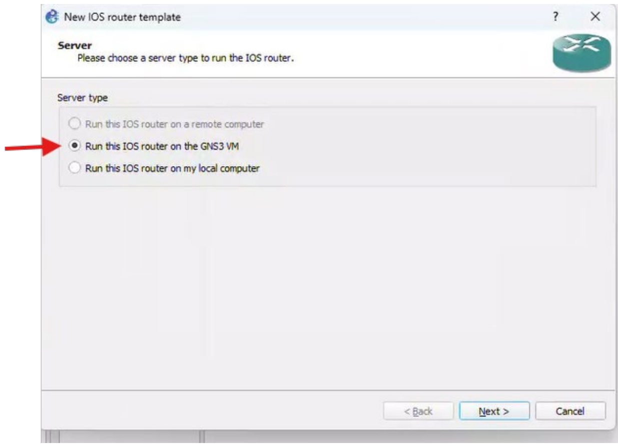


3.16.5.2C7200

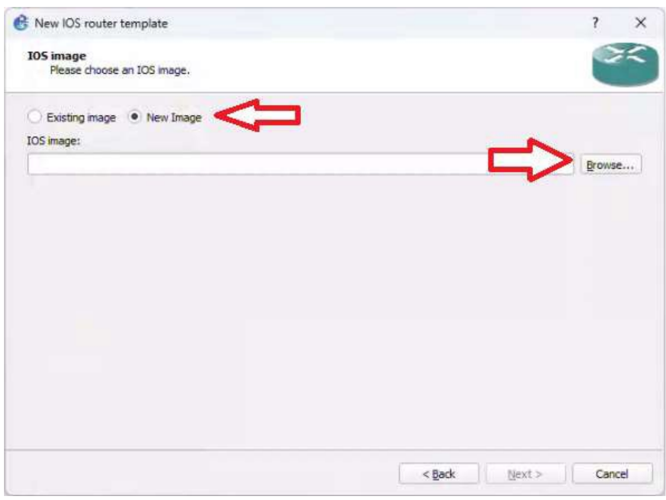
A) From the GNS3 menu Edit > Preferences. Click IOS routers then click “New”.



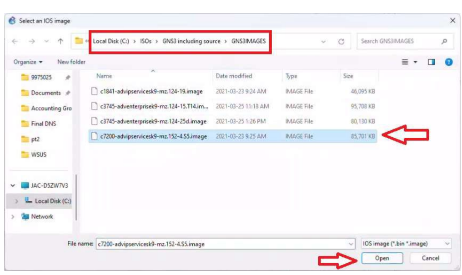
B) Select “Run this IOS router on the GNS3 VM” then click “Next”.



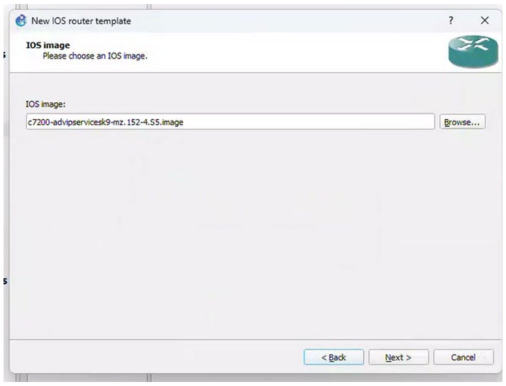
C) Select “New Image”, then click “Browse…”.



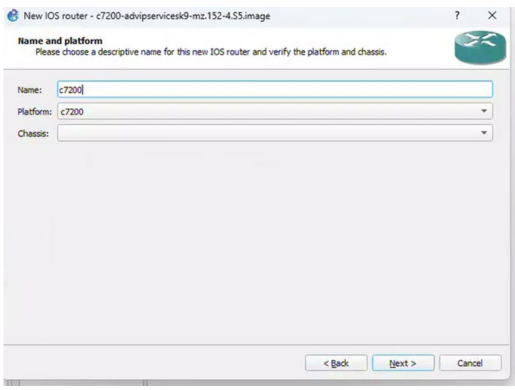
D) Go to C drive > ISOs > GNS3 including source > GNS3IMAGES > select c7200-advipservicesk9-mz.152- 4.S5.image, then click “Open”.



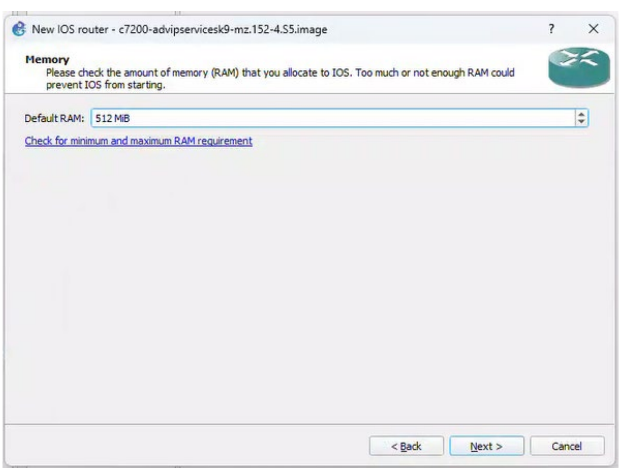
E) Click “Next”.



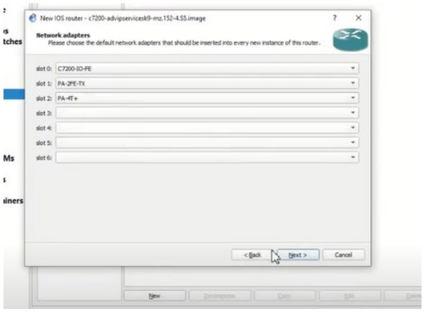
F) Click Next



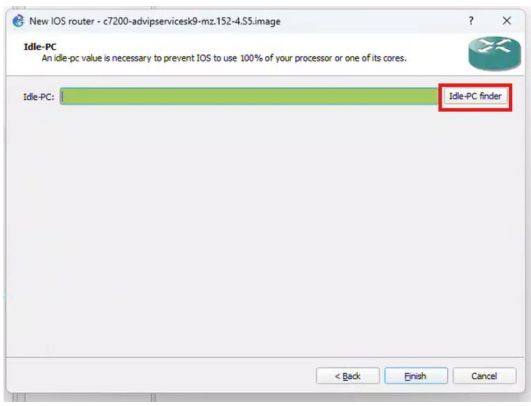
G) Click Next



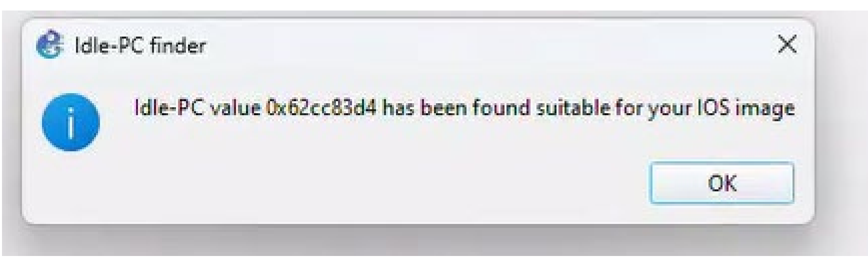
H) Add a PA-2FE-TX to slot 1 and a PA-4Tplus to slot 2, then click “Next”.



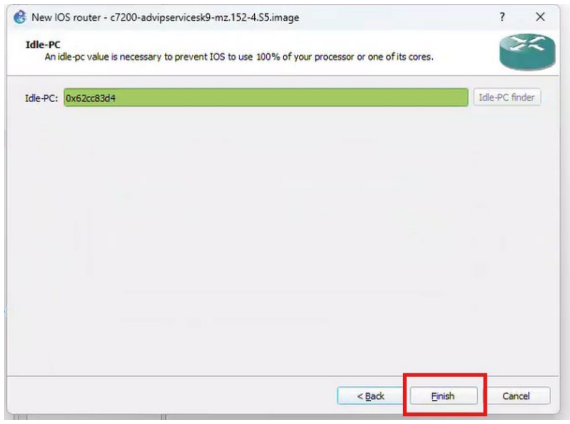
I) Click Idle-PC finder.



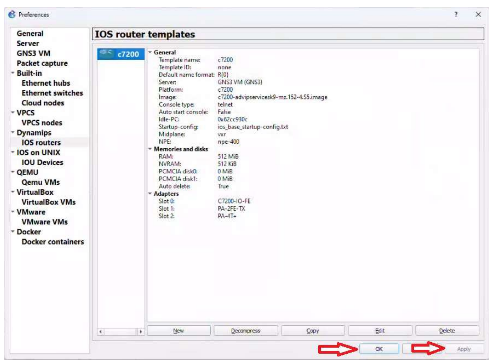
I) Click OK



J) Click “Finish”.

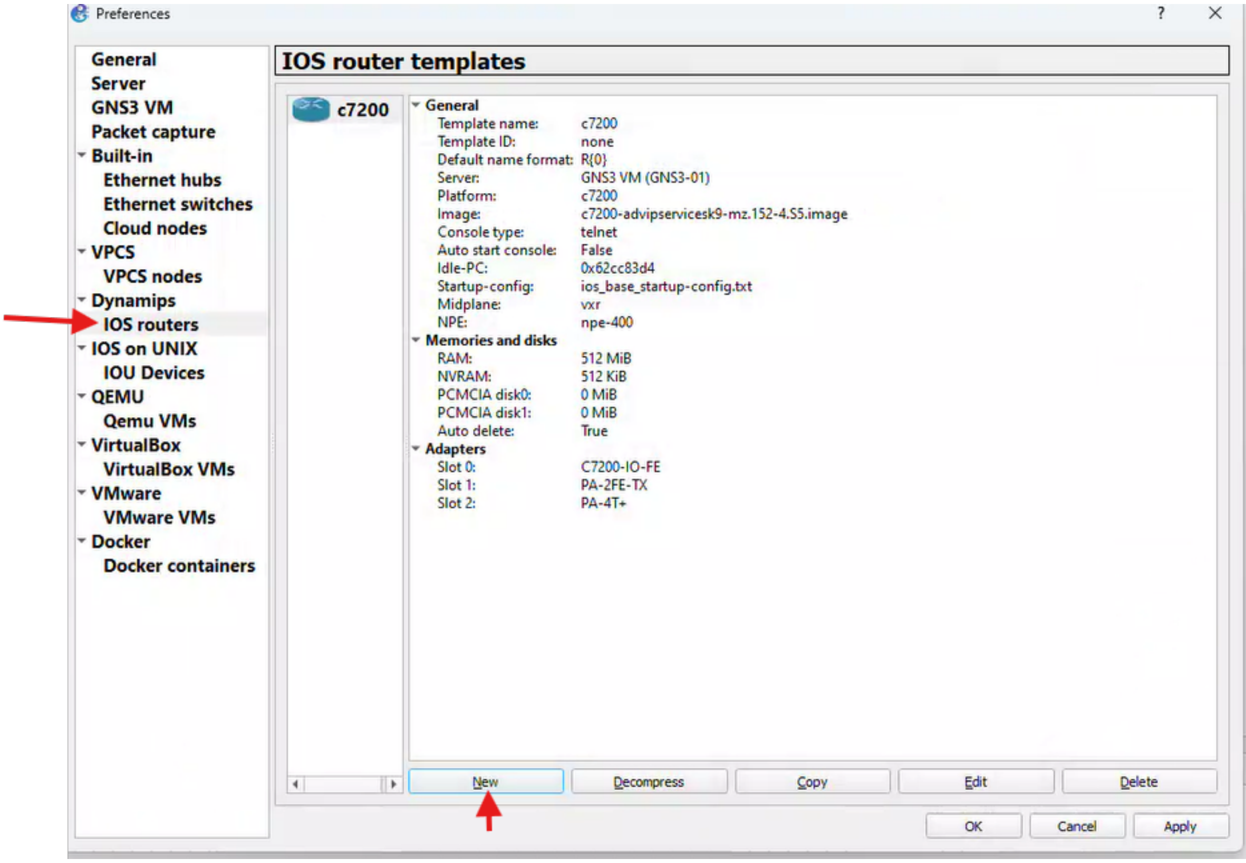


K) Click “OK and Apply”.

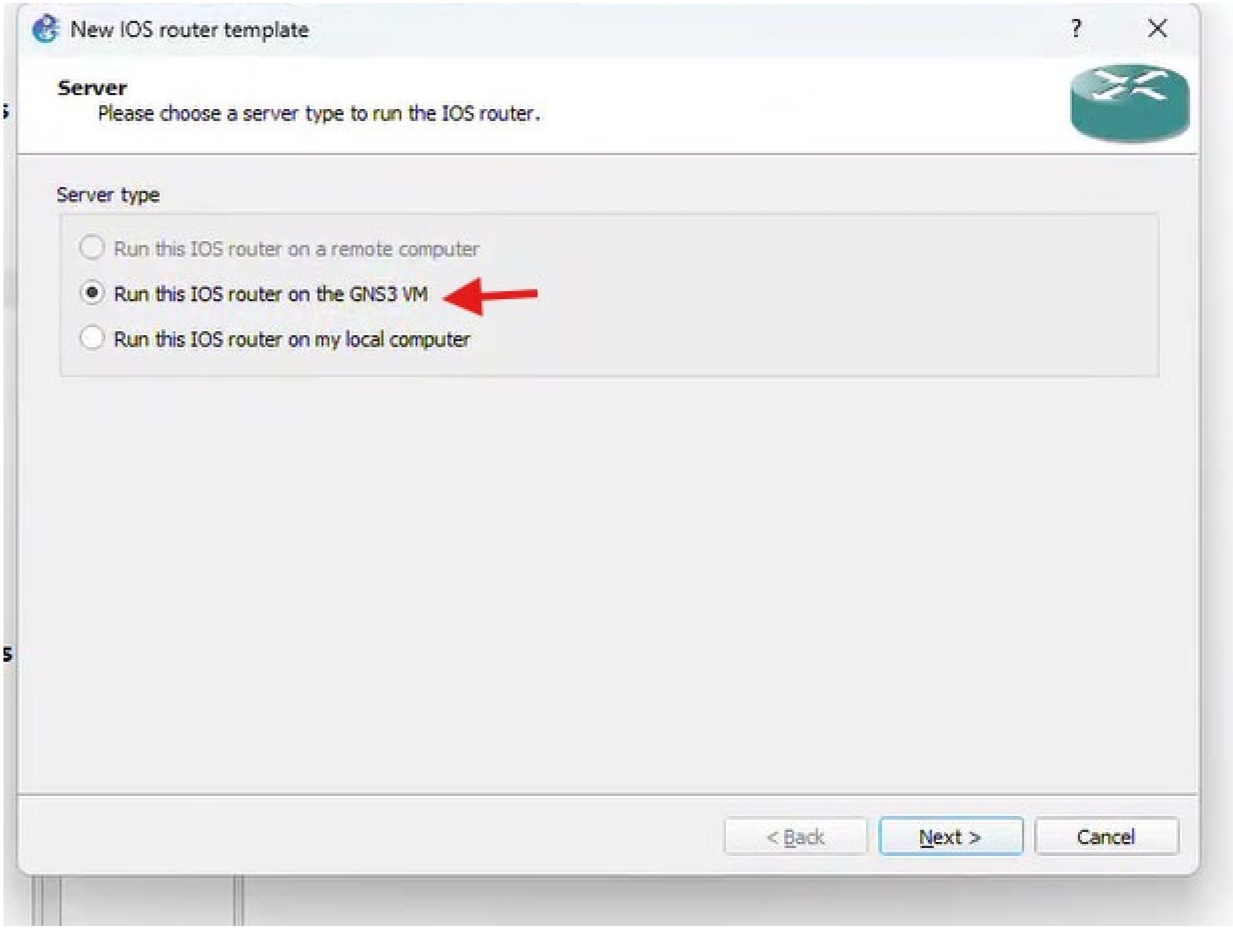


3.16.5.3C3745

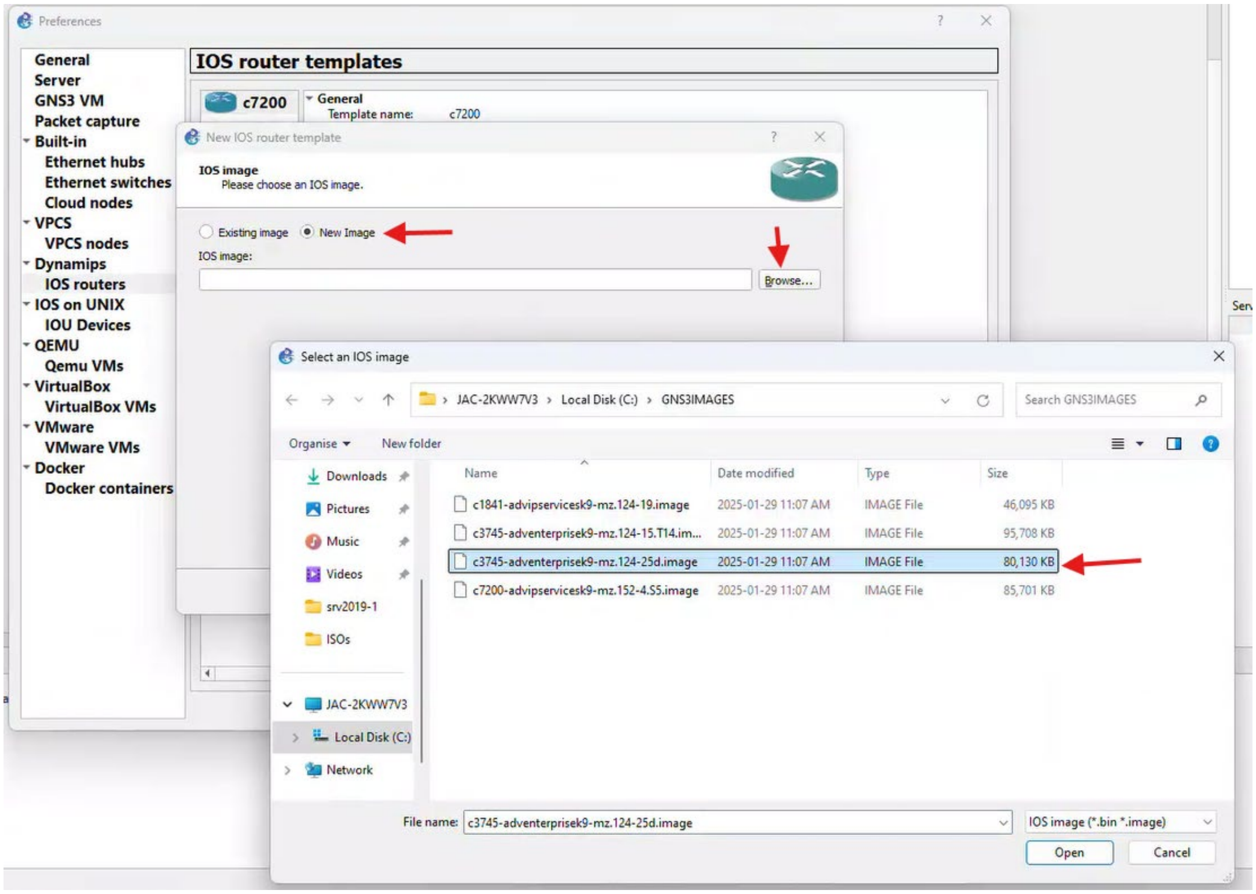
A) On IOS Routers click “New”



B) Select “Run this IOS router on the GNS3 VM”, then click “Next”.

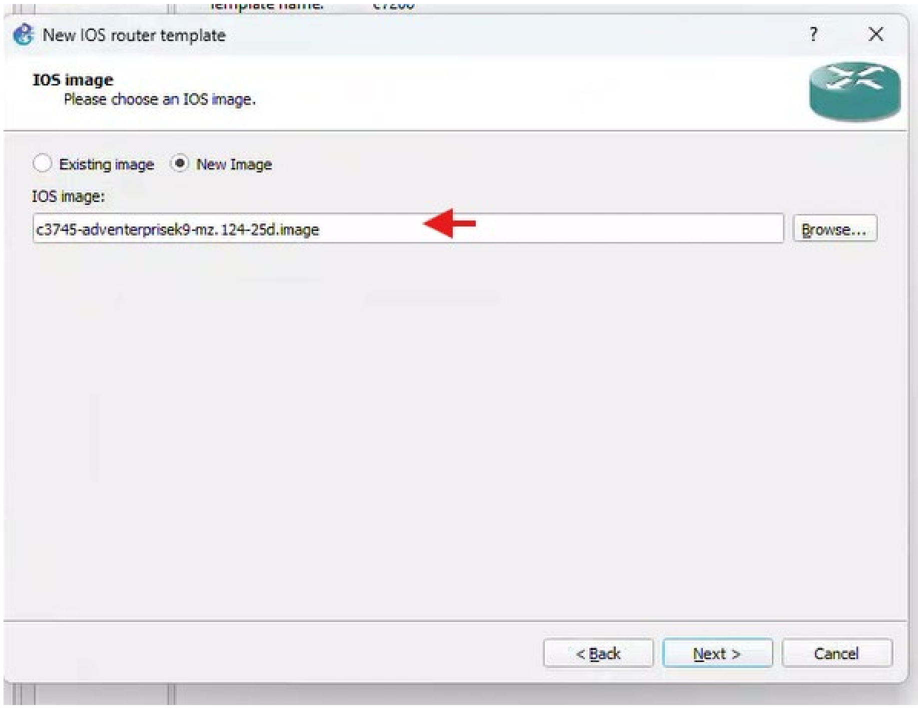


C) Select "New Image", then click "Browse…".Go to Local C: drive > ISOs > GNS3 including source > GNS3IMAGES > select c3745-adventerprisek9-mz.124.25d.image.

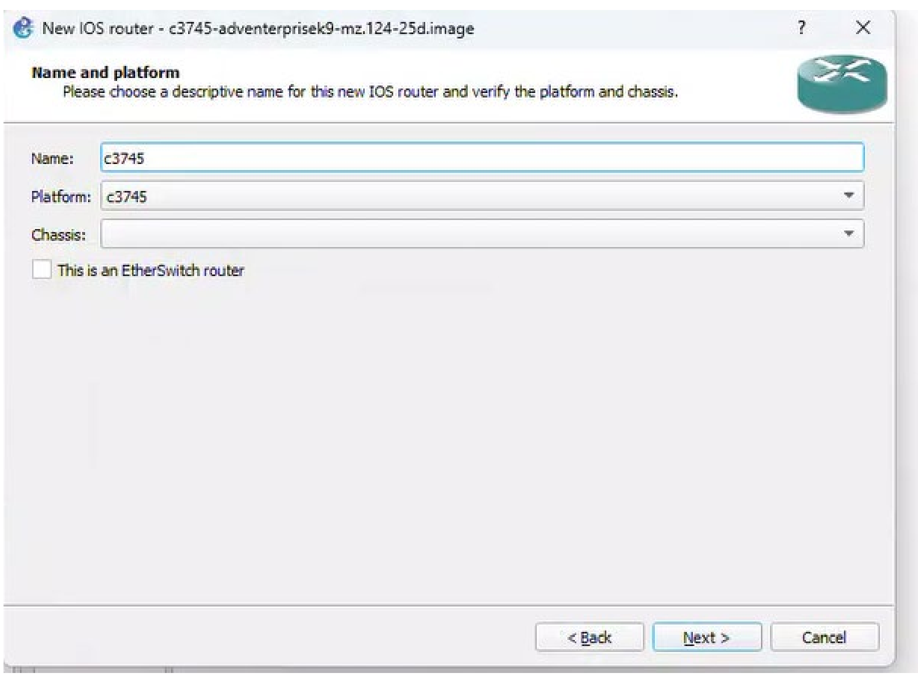


Preferences
General
Server
GNS3 VM
Packet capture
Built-in
Ethernet hubs
Ethernet switches
Cloud nodes
VPCS
VPCS nodes
Dynamips
IOS routers
IOS on UNIX
IOU Devices
QEMU
Qemu VMs
VirtualBox
VirtualBox VMs
VMware
VMware VMs
Docker
Docker containers
IOS router templates
c7200
General
Template name: c7200
New IOS router template
IOS image
Please choose an IOS image.
Existing image
New Image
IOS image:
Browse...
Select an IOS image
JAC-2KWW7V3 > Local Disk (C:) > GNS3IMAGES
Search GNS3IMAGES
Organise
New folder
Name
Date modified
Type
Size
Downloads
Pictures
Music
Videos
srv2019-1
ISOs
JAC-2KWW7V3
Local Disk (C:)
Network
c1841-advipservicesk9-mz.124-19.image 2025-01-29 11:07 AM IMAGE File 46,095 KB
c3745-adventerprisek9-mz.124-15.T14.im... 2025-01-29 11:07 AM IMAGE File 95,708 KB
c3745-adventerprisek9-mz.124-25d.image 2025-01-29 11:07 AM IMAGE File 80,130 KB
c7200-advipservicesk9-mz.152-4.S5.image 2025-01-29 11:07 AM IMAGE File 85,701 KB
File name: c3745-adventerprisek9-mz.124-25d.image
IOS image (*.bin *.image)
Open
Cancel

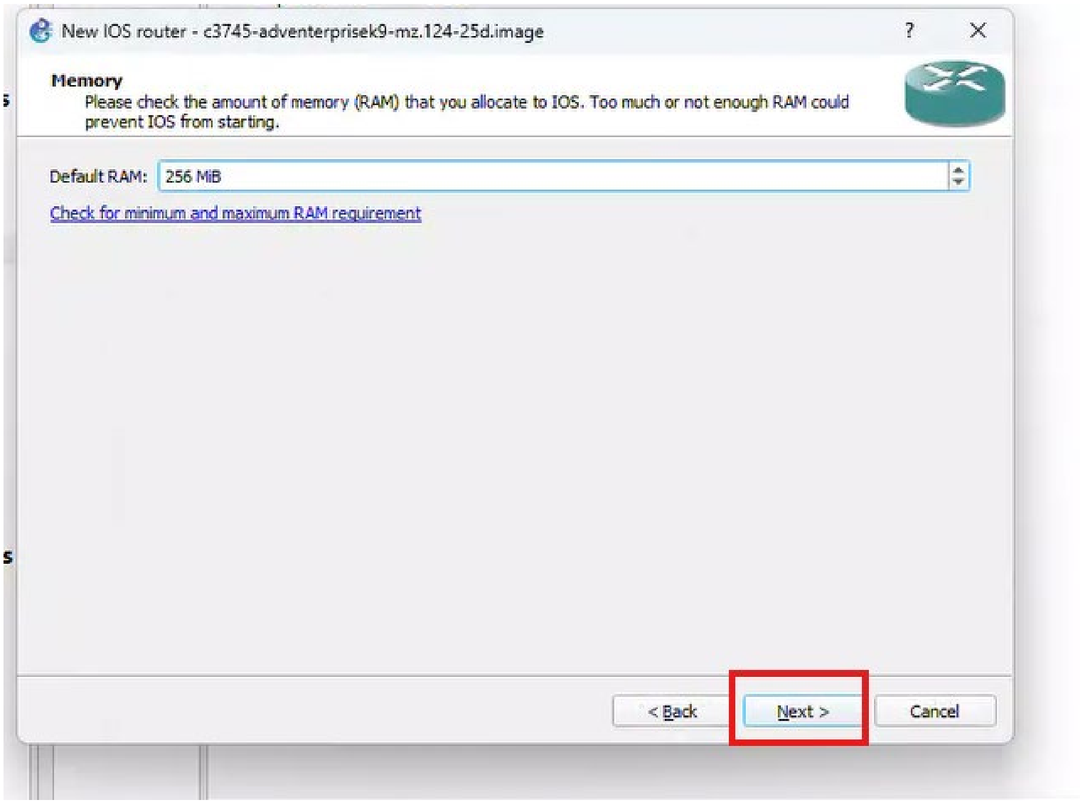
D) Click “Next”.



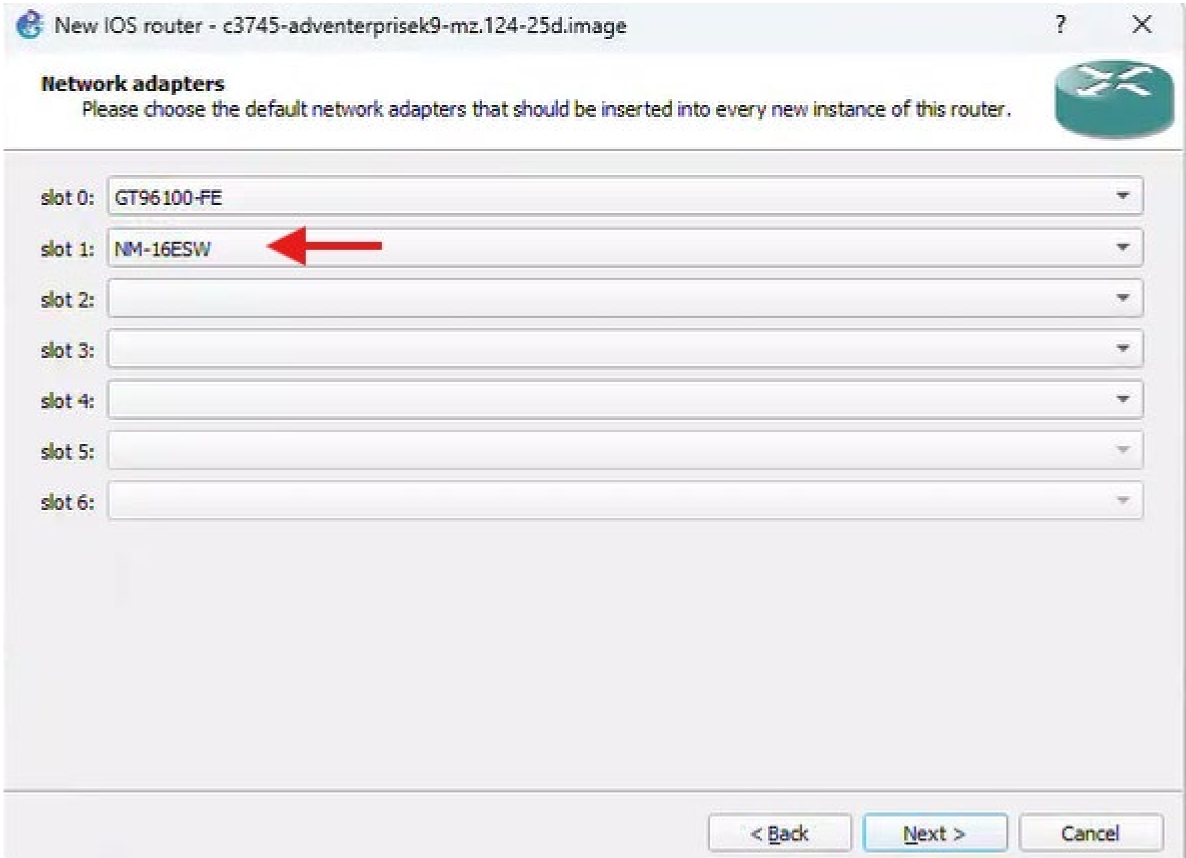
E) Click “Next”.



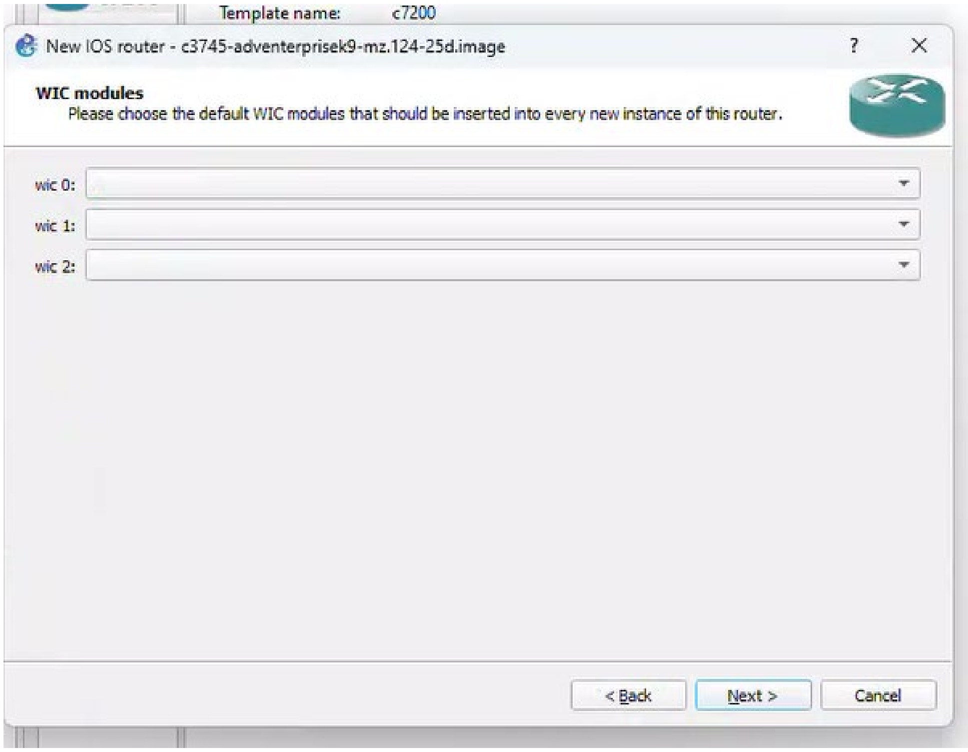
F) Click Next



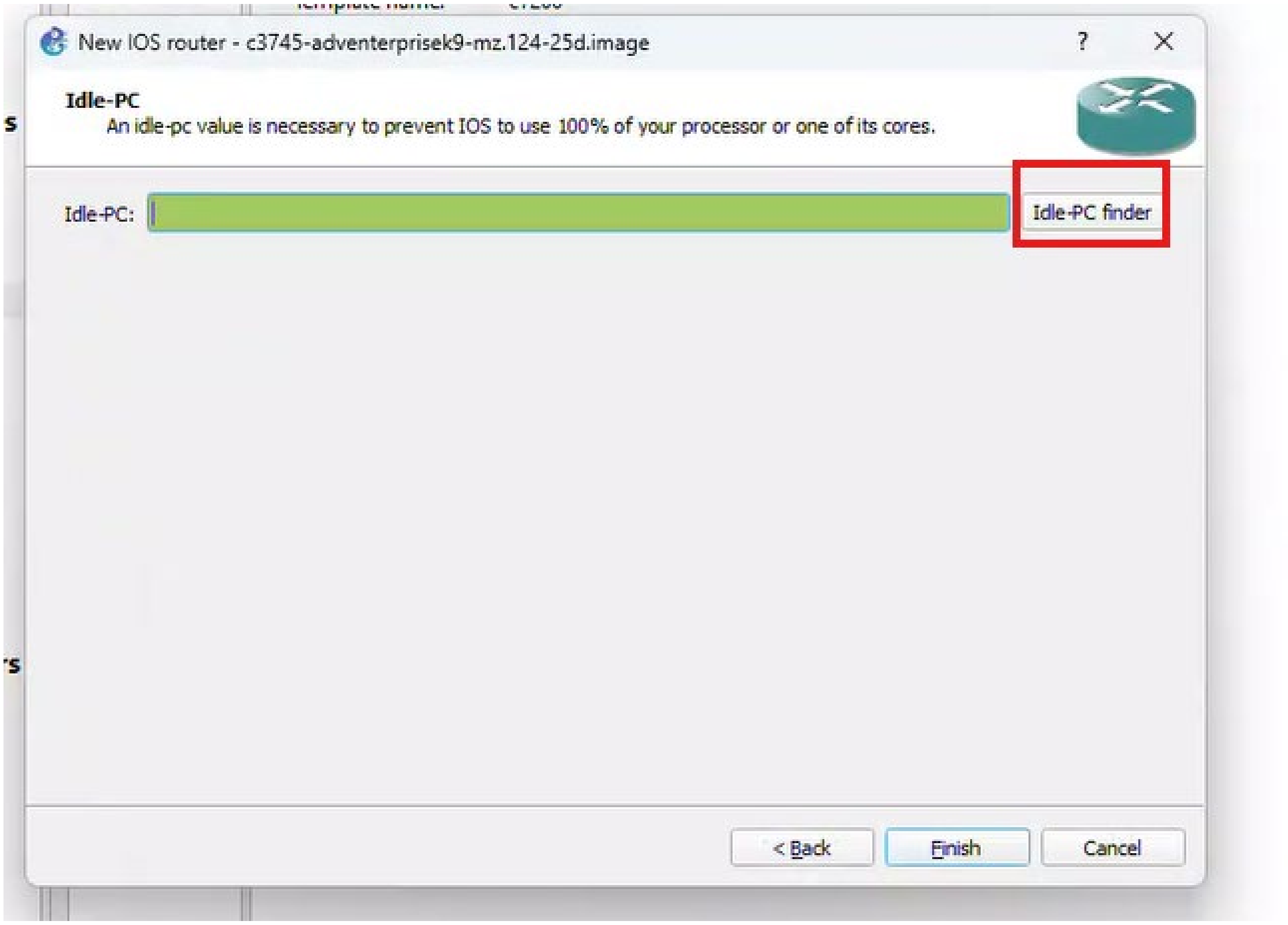
G) Add a NM-16ESW to slot 1, then click “Next”.


New IOS router - c3745-adventerprisek9-mz.124-25d.image
Network adapters
Please choose the default network adapters that should be inserted into every new instance of this router.
slot 0:
GT96100-FE
slot 1:
NM-16ESW
slot 2:
slot 3:
slot 4:
slot 5:
slot 6:
< Back
Next >
Cancel

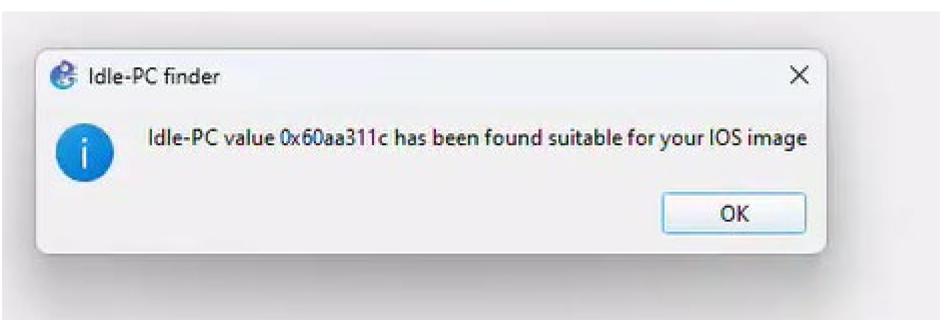
H) Click Next



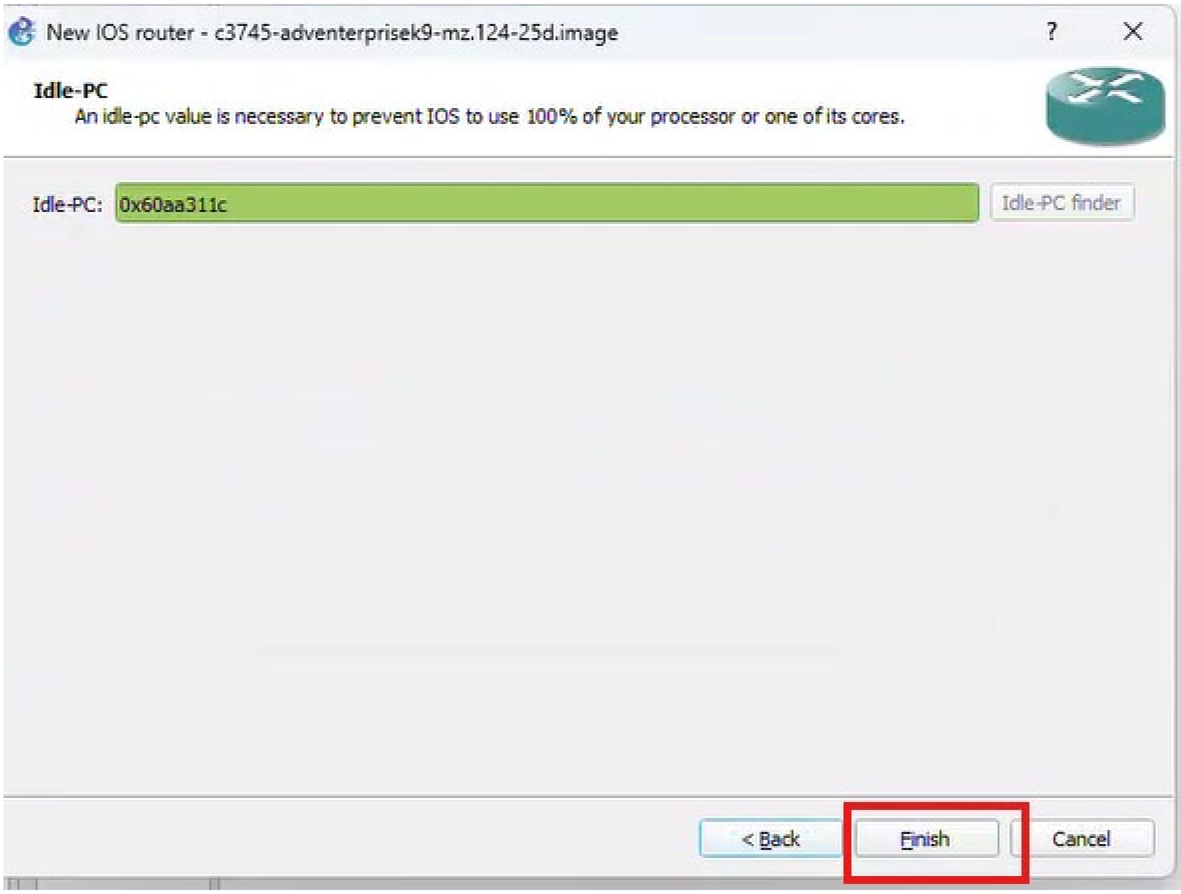
I) Click “Idle-PC finder”.



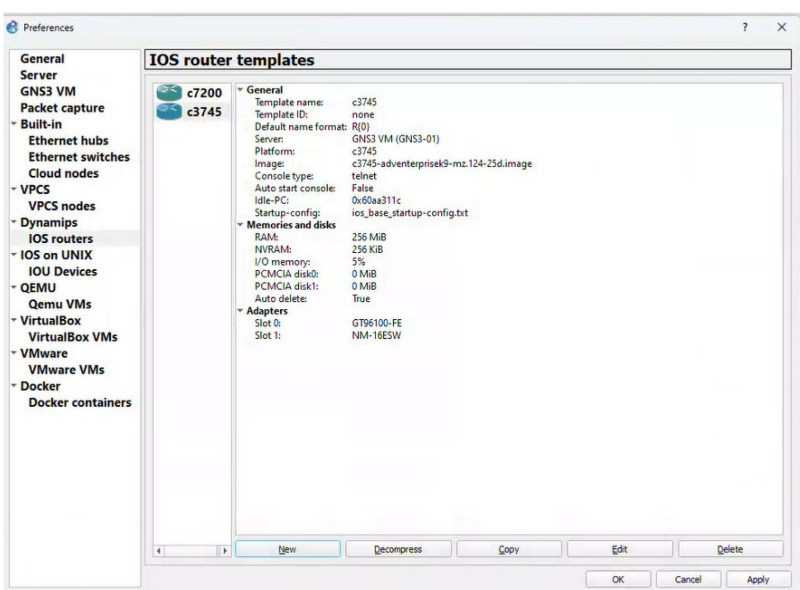
J) Click OK

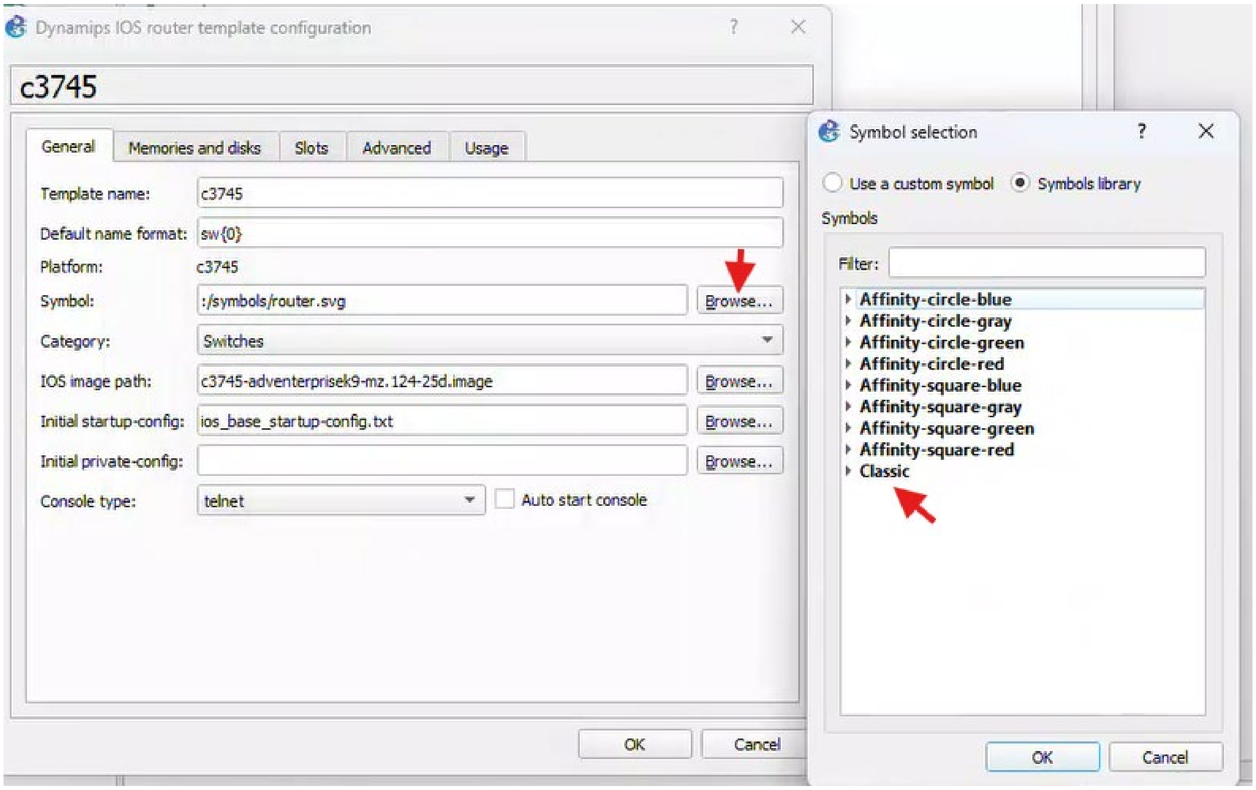


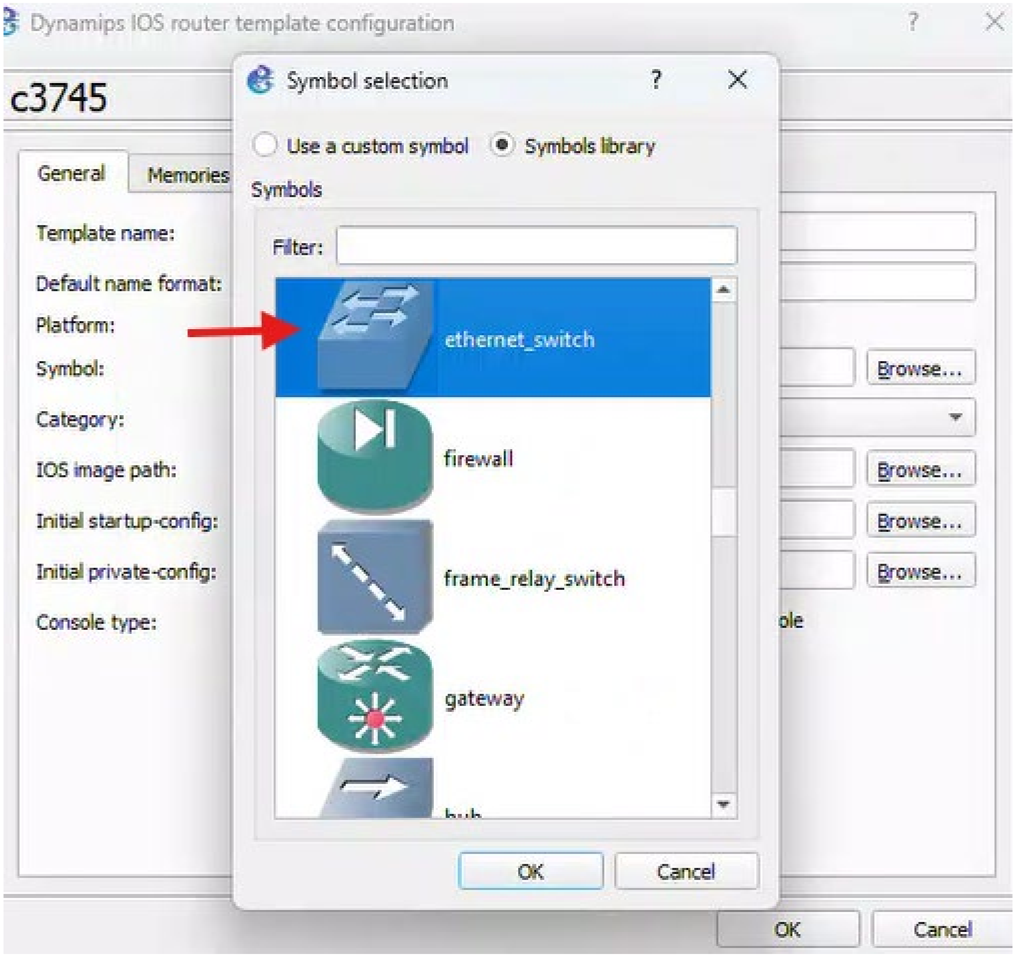
K) Click “Finish”.

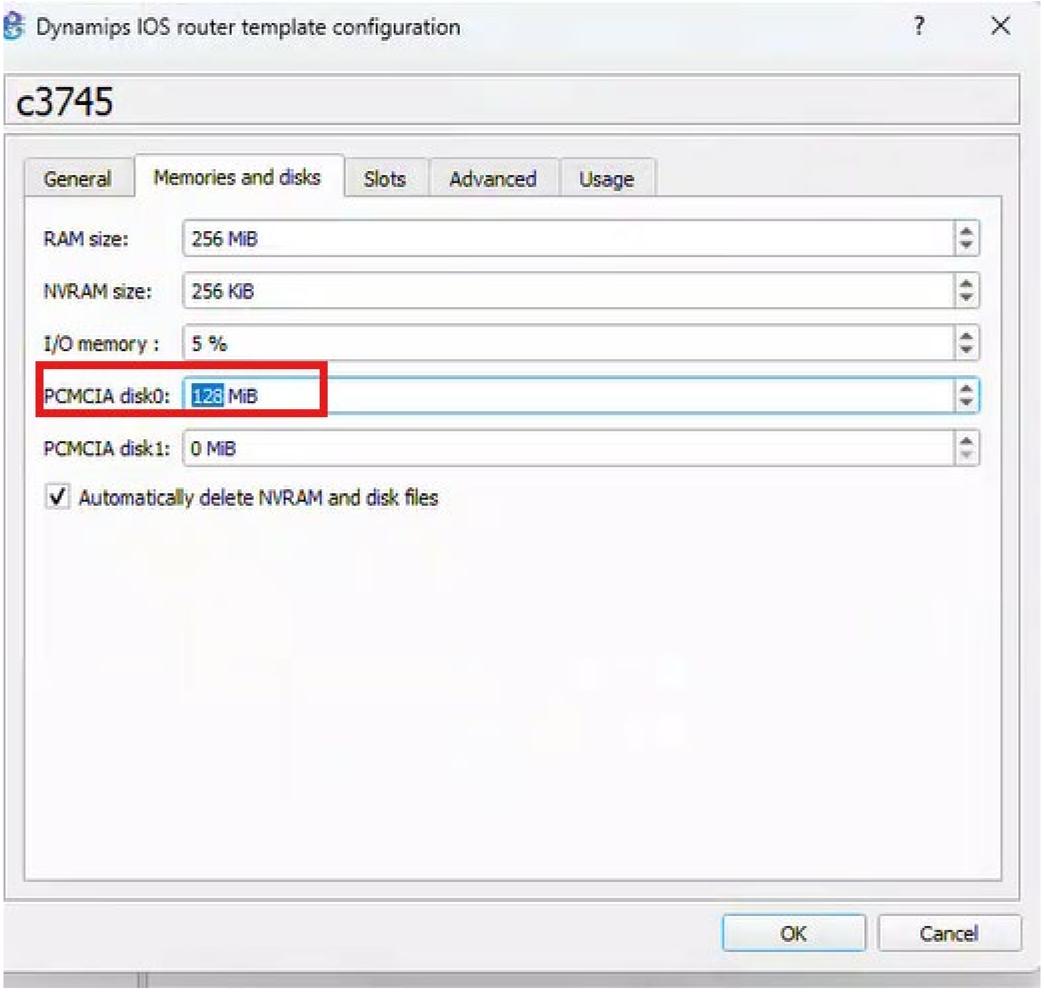


3.16.5.3.1 Setup C3745

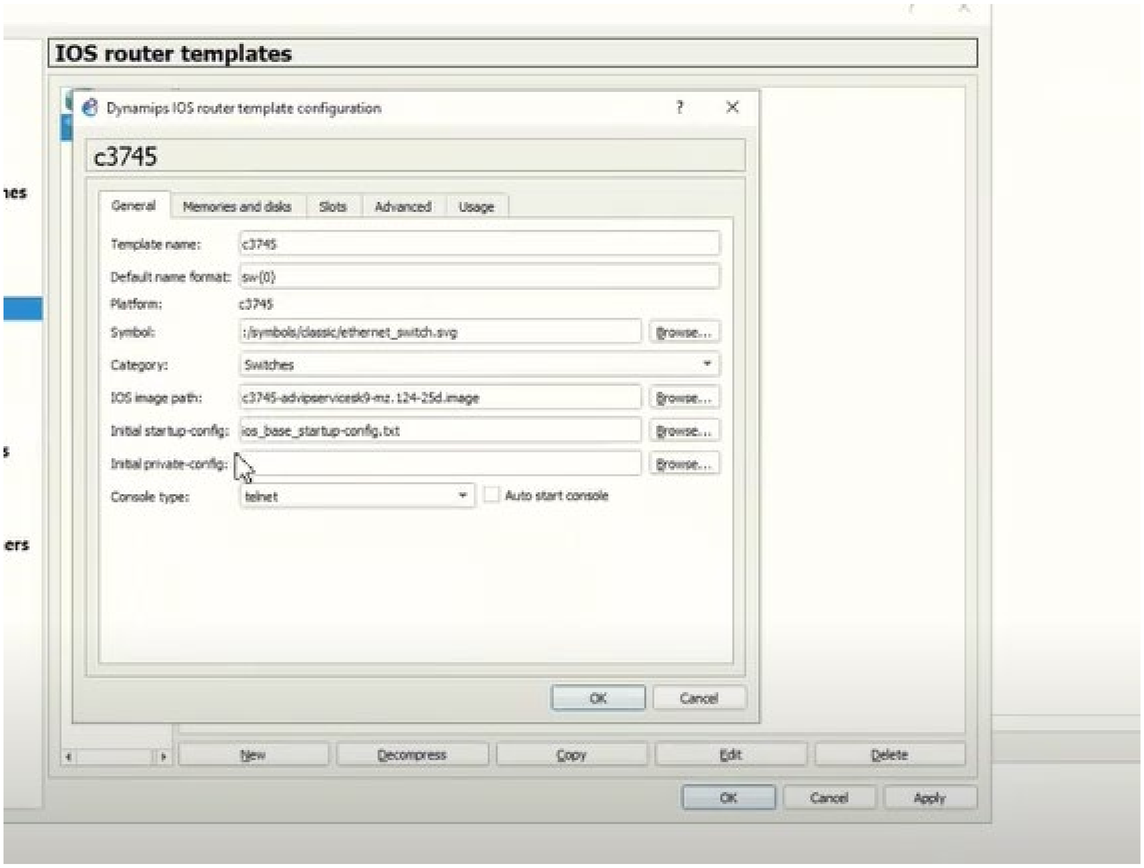



Dynamips IOS router template configuration
c3745
General
Memories and disks
Slots
Advanced
Usage
Template name:
c3745
Default name format:
sw{0}
Platform:
c3745
Symbol:
:/symbols/router.svg
Browse...
Category:
Switches
IOS image path:
c3745-adventerprisek9-mz.124-25d.image
Browse...
Initial startup-config:
ios_base_startup-config.txt
Browse...
Initial private-config:
Browse...
Console type:
telnet
Auto start console
OK
Cancel
Symbol selection
Use a custom symbol
Symbols library
Symbols
Filter:
Affinity-circle-blue
Affinity-circle-gray
Affinity-circle-green
Affinity-circle-red
Affinity-square-blue
Affinity-square-gray
Affinity-square-green
Affinity-square-red
Classic
OK
Cancel

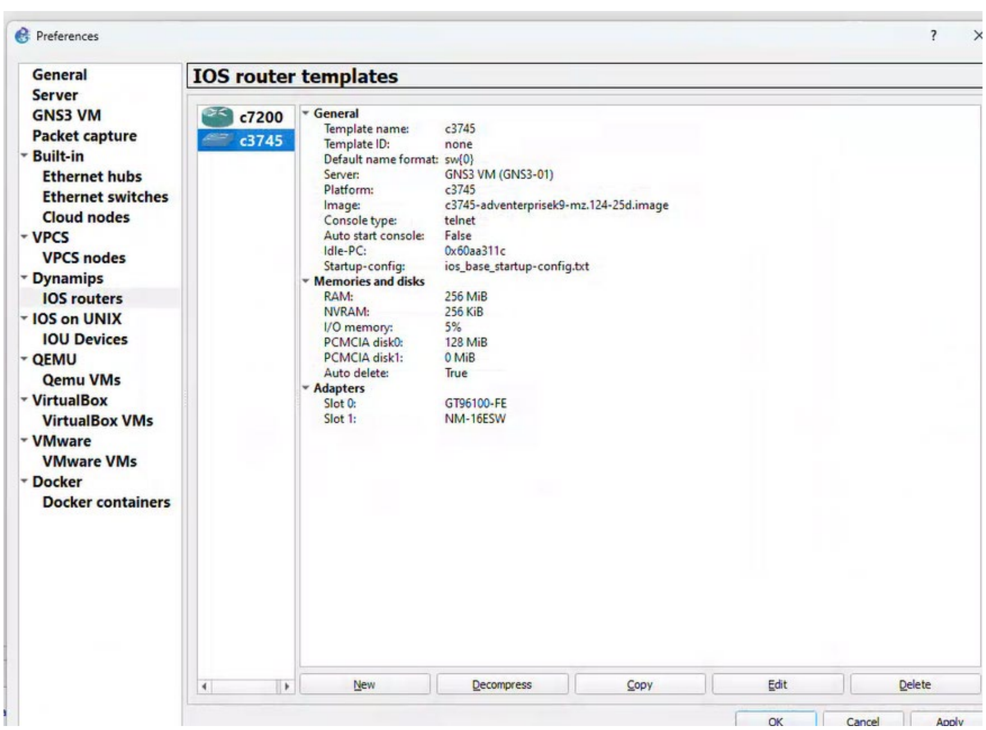

Dynamips IOS router template configuration
c3745
General
Memories
Template name:
Default name format:
Platform:
Symbol:
Category:
IOS image path:
Initial startup-config:
Initial private-config:
Console type:
Browse...
Browse...
Browse...
Browse...
ole
OK
Cancel
Symbol selection
Use a custom symbol
Symbols library
Symbols
Filter:
ethernet_switch
firewall
frame_relay_switch
gateway
OK
Cancel



Dynamips IOS router template configuration
c3745
General
Memories and disks
Slots
Advanced
Usage
RAM size:
256 MiB
NVRAM size:
256 KiB
I/O memory :
5 %
PCMCIA disk0:
128 MiB
PCMCIA disk1:
0 MiB
Automatically delete NVRAM and disk files
OK
Cancel



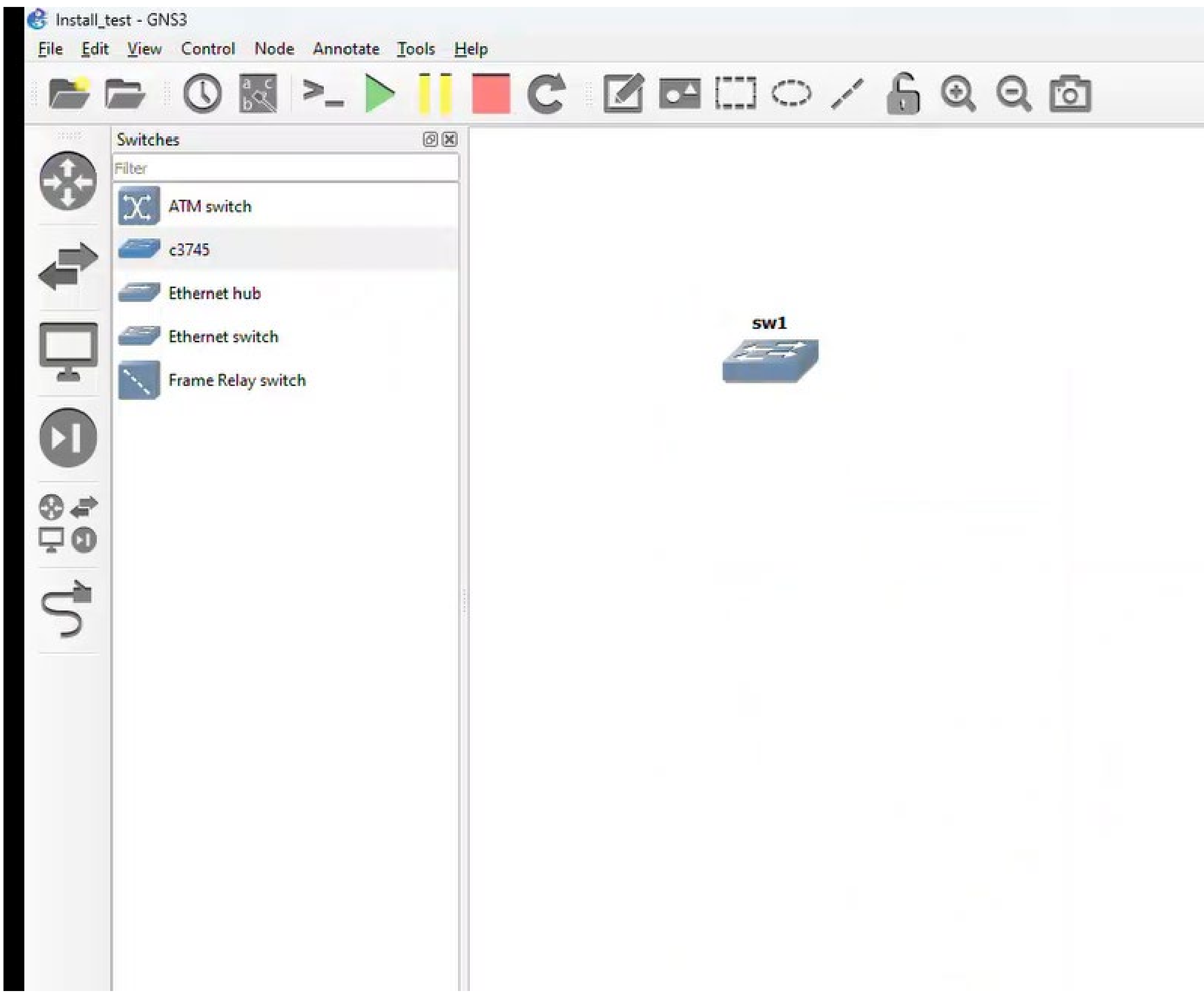
IOS router templates
Dynamips IOS router template configuration
c3745
General
Memories and disks
Slots
Advanced
Usage
Template name:
c3745
Default name format:
sw{0}
Platform:
c3745
Symbol:
:/symbols/classic/ethernet_switch.svg
Category:
Switches
IOS image path:
c3745-advipservicesk9-mz.124-25d.image
Initial startup-config:
ios_base_startup-config.txt
Initial private-config:
Console type:
telnet
Auto start console
Browse...
OK
Cancel
New
Decompress
Copy
Edit
Delete
Apply

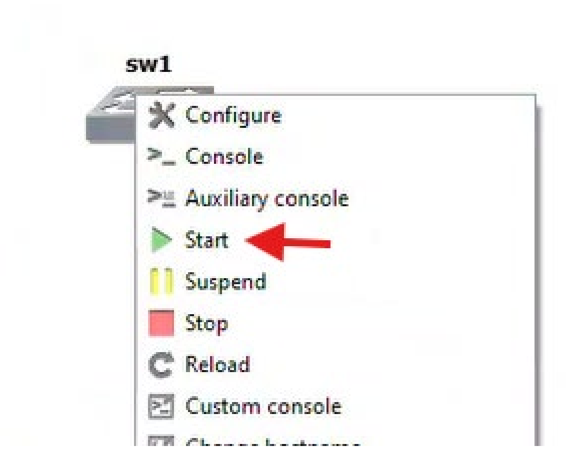


Preferences
General
Server
GNS3 VM
Packet capture
Built-in
Ethernet hubs
Ethernet switches
Cloud nodes
VPCS
VPCS nodes
Dynamips
IOS routers
IOS on UNIX
IOU Devices
QEMU
Qemu VMs
VirtualBox
VirtualBox VMs
VMware
VMware VMs
Docker
Docker containers
IOS router templates
c7200
c3745
General
Template name: c3745
Template ID: none
Default name format: sw{0}
Server: GNS3 VM (GNS3-01)
Platform: c3745
Image: c3745-adventerprisek9-mz.124-25d.image
Console type: telnet
Auto start console: False
Idle-PC: 0x60aa311c
Startup-config: ios_base_startup-config.txt
Memories and disks
RAM: 256 MiB
NVRAM: 256 KiB
I/O memory: 5%
PCMCIA disk0: 128 MiB
PCMCIA disk1: 0 MiB
Auto delete: True
Adapters
Slot 0: GT96100-FE
Slot 1: NM-16ESW
New
Decompress
Copy
Edit
Delete
OK
Cancel
Apply

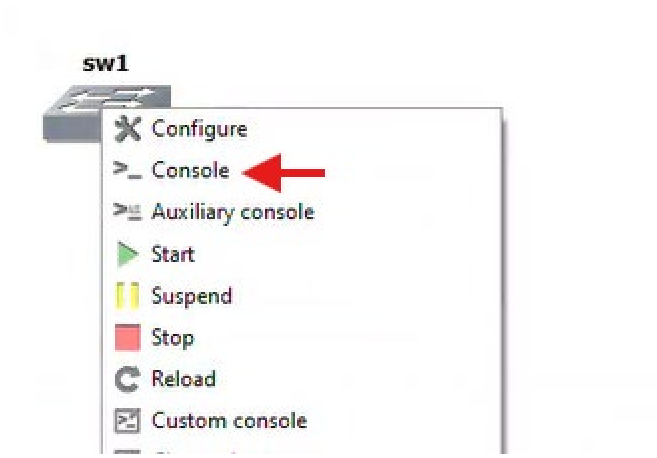
3.16.6 Test

Drag in a c3745 switch, right click the switch > Start

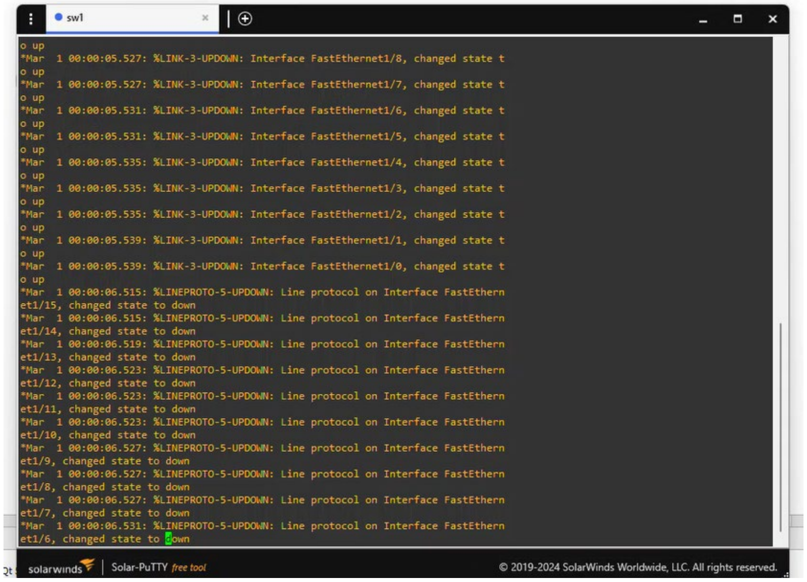




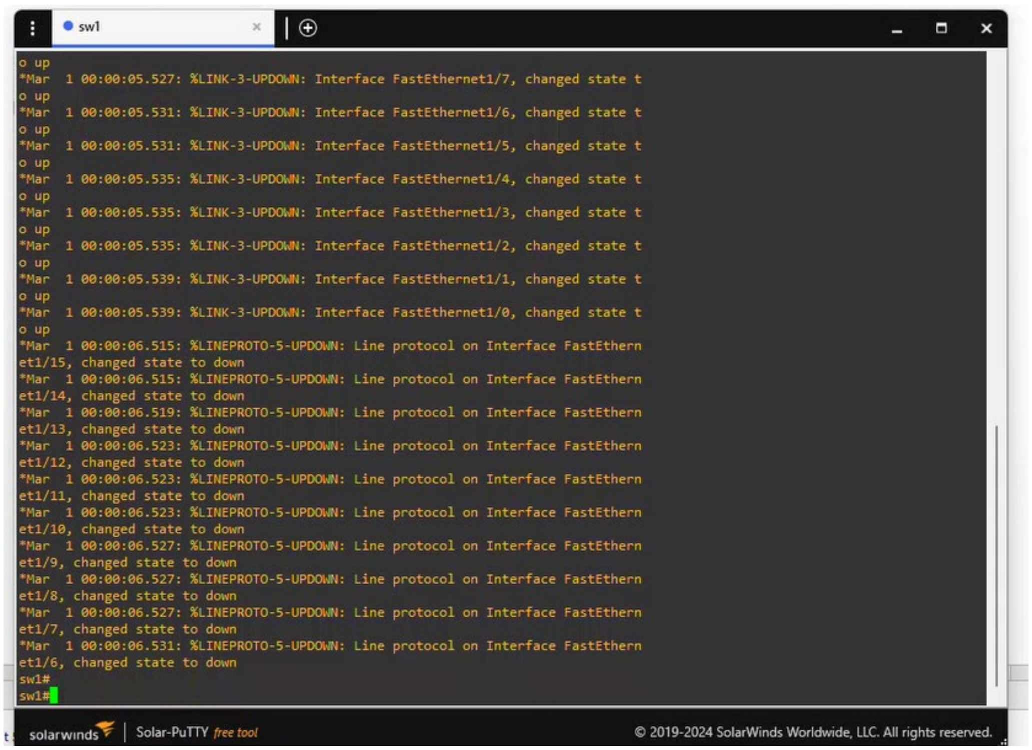
Right click the switch again > Console.

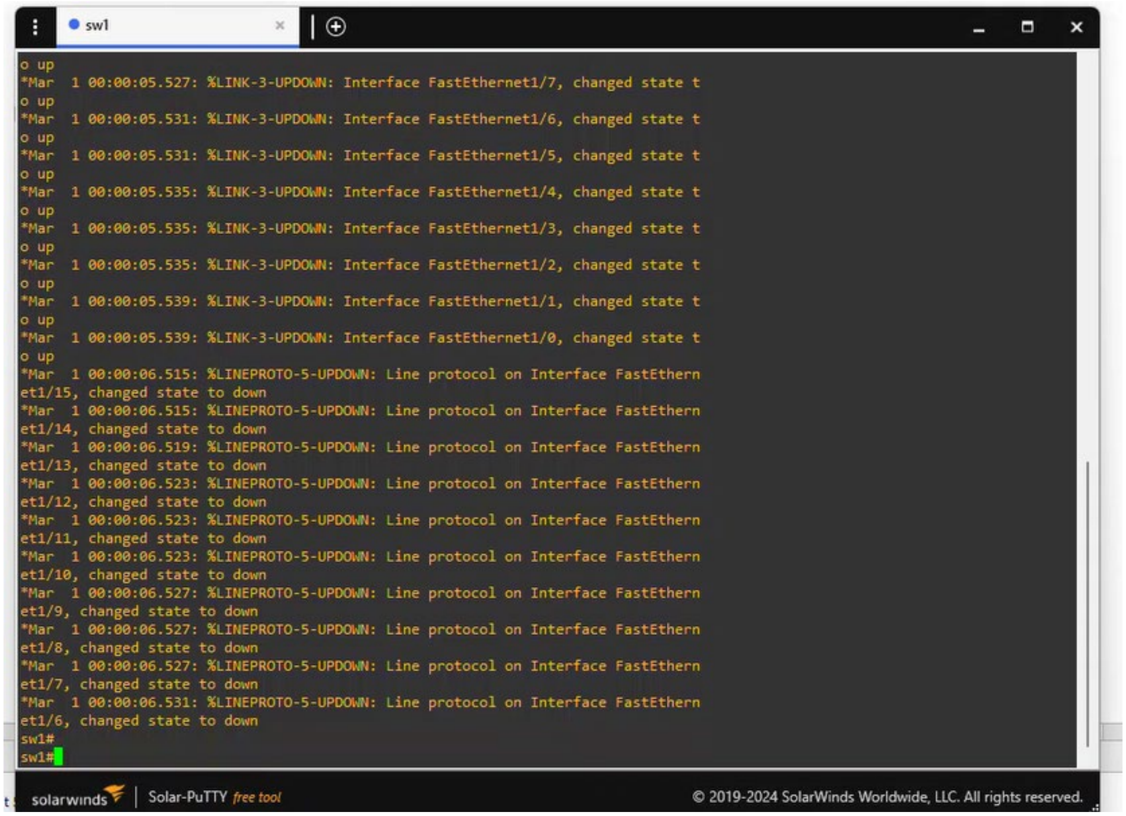


Close console window.



Hit <enter> to enter into privileged EXEC mode.





3.17 GNS3 Commands & Procedures Overview

3.17.1.1 Configure IP Address on a PC

3.17.1.1.1 Configure IPv4 address, subnet Mask and Default Gateway on a PC

```
ip ipv4-address subnet-mask default-gateway-ipv4-address
ip 192.168.10.10 255.255.255.0 192.168.10.1
save
```

3.17.1.1.2 Configure IPv6 address, Prefix Length and Default Gateway on a PC

```
ip ipv6-address/prefix-length default-gateway-ipv6-address
ip 2001:db8:acaa:1::10/64 2001:db8:acaa:1::1 save
```

3.17.1.1.3 Configure IP addresses on PCs using DHCPv4

```
ip dhcp
save
```

3.17.1.2 Configuring and Verifying VLANs

Step 1. Create and name VLANs on a switch.

```
vlan database
vlan 10
name Faculty/Staff
vlan  20
name  Students
vlan 30
name Guest
vlan 99
name Management&Native
vlan 150
name VOICE
exit
```

Step 2. Verify the VLAN configuration.

```
show vlan-switch
```

3.17.1.3- Configure Access and Assigning VLANs to Active Ports on a Switch

```
conf t
interface range f1/1 - 5
 switchport mode access
 switchport access vlan 10
 no shutdown
exit

interface range f1/6 - 10
 switchport mode access
 switchport access vlan 20
 no shutdown
exit
```

3.17.1.4- Configuring Trunks on a Switch

```
conf t
interface f1/1
```

```
 switchport mode trunk
 switchport trunk native vlan 99
 switchport trunk allowed vlan 1,10,20,30,99,1002-1005
 no shutdown
exit
```

3.17.1.5- Configuring Sub-Interfaces with Dot1Q Encapsulation on Routers for Router-on-a-Stick Inter-VLAN Routing

```
conf t
interface f1/0.10
 description Default Gateway for VLAN 10
 encapsulation dot1Q 10
 ip address 192.168.1.1 255.255.255.0
 exit

interface f1/0.20
 description Default Gateway for VLAN 20
 encapsulation dot1Q 20
 ip address 192.168.2.1 255.255.255.0
 exit

interface f1/0.99
 description Default Gateway
```

3.17.1.6- Configuring a Layer 3 Switch

Step 1. Create VLANS on a switch.

Step 2. Configure access ports to VLANs on a switch.

Step 3. Assign IP addresses to VLANs.

```
interface vlan 10
 ip address 192.168.10.1 255.255.255.0
 no shutdown
 exit

interface vlan 20
 ip address 192.168.20.1 255.255.255.0
 no shutdown
 exit
```

Step 4. Disable switchport mode on the interface connected to the router using the no switchport command, then use the ip routing command from global configuration mode to turn the switch in to a Layer 3 switch.

```
interface f1/11
```

```
 no switchport
 exit

ip routing
exit
```

Step 5. Assign an IP address on the interface where switchport mode was disabled.

```
int f1/11
  ip add 10.10.10.2 255.255.255.0
  no shut
```

Step 6. Configure OSPF 10 on the switch.

```
router ospf 10
 network 192.168.10.0 0.0.0.255 area 0
 network 192.168.20.0 0.0.0.255 area 0
 network 10.10.10.0 0.0.0.255 area 0
end
```

3.17.1.7- Configure an EtherChannel

Step 1. Create VLANS on each switch.

Step 2. Configure access ports to VLANs on each switch.

Step 3. Configure trunk ports on each switch on interfaces you will be grouping together.

SW1 & SW2

```
int f1/1
switchport mode access switchport access vlan 10 int f1/2
switchport mode access switchport access vlan 20 int f1/10
switchport mode trunk no shut
int f1/11
switchport mode trunk no shut
```

Step 4. Create channel group and configure EtherChannel on both sides.

SW1 & SW2

```
conf t
interface f1/1
 switchport mode access
 switchport access vlan 10
 exit

interface f1/2
```

```
 switchport mode access
 switchport access vlan 20
 exit

interface f1/10
 switchport mode trunk
 no shutdown
 exit

interface f1/11
 switchport mode trunk
 no shutdown
 exit
```

Step 5. Verify EtherChannel

```
show etherchannel summary
```

3.17.1.8- Configuring a Router as a DHCPv4 Server and Configuring DHCPv4 Relay on an Adjacent Router

Step 1. Configure basic router configurations and IPv4 addressing for interfaces on a router.

Step 2. Configure DHCPv4 on a router by configuring excluded addresses, naming the DHCP pool, assigning the network, assigning the default router, assigning a domain name and assigning a DNS server.

```
conf t
ip dhcp excluded-address 192.168.3.1 192.168.3.10
ip dhcp excluded-address 192.168.3.254
ip dhcp excluded-address 192.168.4.1 192.168.4.10
ip dhcp excluded-address 192.168.4.254

ip dhcp pool lanpool-3
 network 192.168.3.0 255.255.255.0
 default-router 192.168.3.1
 domain-name cisco.com
 dns-server 192.168.1.11
 exit

ip dhcp pool lanpool-4
 network 192.168.4.0 255.255.255.0
 default-router 192.168.4.1
 domain-name cisco.com
 dns-server 192.168.1.11
 exit
```

Step 3. Configure DHCPv4 relay on an interface of the adjacent router.

```
conf t
 int f0/0
 ip helper-address 192.168.2.2
```

Step 4. Auto address each PC with the ip dhcp command.

```
ip dhcp
```

3.17.1.9- Configure Hot Standby Routing Protocol (HSRP) on a router

Step 1. Configure HSRP on R1.

```
conf t
interface f0/0
 standby version 2
 standby 1 ip 192.168.1.254
 standby 1 priority 150
 standby 1 preempt
exit
```

Step 2. Configure HSRP on R3.

```
conf t
interface f0/0
 standby version 2
 standby 1 ip 192.168.1.254
 standby 1 priority 100
 standby 1 preempt
exit
```

Step 3. Verify the standby with the show standby command.

```
show standby
```

Step 4. Reconfigure IP address on PC1 & PC2 with the HSRP Virtual Gateway as the default gateway. Verify address change with the show command.

PC1

```
ip 192.168.1.101 255.255.255.0 192.168.1.254

save

show
```

PC2

```
ip 192.168.1.103 255.255.255.0 192.168.1.254

save

show
```

Step 5. Test out HSRP by going to R1 and shutting down interface f0/0.

R1

```
conf t
interface f0/0
 shutdown
exit
```

Step 6. Go to R3 and verify that it has been designated as the active router.

```
show standby
```

Step 7. Verify connectivity to the internet from PC1 by tracerouting to 8.8.8.8.

```
trace 8.8.8.8
```

3.17.1.10 - Configuring Router RIP for IPv4 and IPv6

Step 1. Configure basic router configurations.

Step 2. Enable IPv6 unicast routing and configure IPv4 and IPv6 addressing for interfaces on a router.

```
ipv6 unicast-routing

interface f0/0
 description Link to LAN 192.168.1.0
 ip address 192.168.1.1 255.255.255.0
 ipv6 enable
 ipv6 address 2001:db8:acaa:1::1/64
 no shutdown
 exit

interface f1/0
 description Link to LAN 192.168.2.0
 ip address 192.168.2.1 255.255.255.0
 ipv6 enable
 ipv6 address 2001:db8:acab:1::1/64
 no shutdown
 exit
```

Step 3. Configure router RIP for IPv4 and IPv6.

```
router rip
 network 192.168.1.0
 network 192.168.2.0
exit
```

```
ipv6 router rip riptest

interface f0/0
 ipv6 rip riptest enable
 exit

interface f1/0
 ipv6 rip riptest enable
 exit
```

Step 4. Verify routes with show ip route command.

```
show ip route

show ipv6 route
```

3.17.1.11 - Configuring Router RIPv2

Step 1. Configure basic router configurations.

Step 2. Enable IPv6 unicast routing and configure IPv4 and IPv6 addressing for interfaces on a router.

Step 3. Configure router RIPv2 for IPv4. Use RIP version 2 in a discontiguous network, in which packets sent between at least one subnet must pass through subnets of a different network.

```
conf t
no router rip

router rip
 version 2
 no auto-summary
 network 192.168.1.0
 network 172.16.2.0
 network 172.16.10.0
 network 172.16.20.0
 network 172.16.99.0
exit
```

Step 4. Configure router RIP for IPv6.

```
conf t
ipv6 unicast-routing
ipv6 router rip ripng
exit

interface f0/0
 ipv6 address 2001:db8:acad:1::1/64
 ipv6 rip ripng enable
 exit

interface f1/0
 ipv6 address 2001:db8:acad:2::1/64
 ipv6 rip ripng enable
 exit

This example enables IPv6 routing, configures the RIPng process named ripng, and
assigns IPv6 addresses to the interfaces f0/0 and f1/0, enabling RIPng on these
interfaces.
```

Step 5. Verify routes with show ip route and show ipv6 route commands.

3.17.1.12 - Configure OSPF 10

Step 1. Configure OSPF 10 on router connected to the cloud, then save configuration to NVRAM.

R1

```
conf t
router ospf 10
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.2.0 0.0.0.255 area 0
 network 10.0.0.0 0.0.0.255 area 0
 default-information originate
end
copy running-config startup-config
```

Step 2. Configure OSPF 10 on other routers, then save configuration to NVRAM.

R2

```
router ospf 10
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.2.0 0.0.0.255 area 0
 network 192.168.3.0 0.0.0.255 area 0
end
copy running-config startup-config
```

R3

```
router ospf 10
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.3.0 0.0.0.255 area 0
 network 192.168.4.0 0.0.0.255 area 0
end
copy running-config startup-config
```

3.17.1.13 - Configuring NAT and Connecting to the Internet

Step 1. Go to VMware Workstation, go to your GNS3 VM, menu VM > Settings > Network Adapter 2, set the Network connection to Bridged.

Step 2. Drag out the cloud, right click > Configure. Select "eth0" and click "Delete", then click "Apply", then click "OK".

Step 3. Cable cloud to intF1/1 on R1, then power on all devices.

Step 4. Auto configure DHCPv4 on int f1/1 on R1 using the ip address dhcp command.

```
conf t
interface f1/1
 ip address dhcp
 no shutdown
exit
```

Step 5. Verify interface F1-1 address on R1 with the show protocols command.

```
show protocols
```

Step 6. Configure NAT on the router connected to the cloud, by configuring the outside interface, configuring the inside interfaces, creating an access list and adding all networks to the list, and configuring overload on the outside interface to allow all networks to access the internet at the same time.

```
conf t

interface f1/1
 ip nat outside
 exit

interface f0/0
 ip nat inside
 exit

interface s2/0
 ip nat inside
 exit

interface s2/1
 ip nat inside
 exit

access-list 1 permit 192.168.1.0 0.0.0.255
access-list 1 permit 192.168.2.0 0.0.0.255
access-list 1 permit 10.10.10.0 0.0.0.255
access-list 1 permit 172.16.1.0 0.0.0.255
access-list 1 permit 172.16.2.0 0.0.0.255
access-list 1 permit 172.16.3.0 0.0.0.255
access-list 1 permit 172.16.4.0 0.0.0.255

ip nat inside source list 1 interface f1/1 overload
exit
```

Step 7. Configure OSPF 10 on the router connected to the cloud, then save running configuration to NVRAM.

```
conf t
router ospf 10
 default-information originate
end
copy running-config startup-config
```

3.17.1.14 - Configuring a DNS zone using a Windows Server VM

Step 1. Drag in a Windows Server 2019 VM and cable it to SW1, then power on all devices. Log into Windows Server 2019 on VMware Workstation.

Step 2. On Windows Server 2019, go to Server Manager > Ethernet0 > configure IP addresses:

IP address: 192.168.1.101

Subnet mask: 255.255.255.0

Default Gateway: 192.168.1.1 (IP address of connected router interface) DNS:

192.168.1.101 (same as srv2019 IP address)

Step 3. In GNS3, verify if port connecting srv2019vm to SW1 is active. Right click SW1 > console, and execute a show protocols command. If it is down, execute a no shut, then shut, followed by another no shut command.

```
show protocols

conf t
interface f1/6
 no shutdown
 shutdown
 no shutdown
exit
```

Step 4. Verify connectivity to each router from command prompt in Windows Server 2019 VM.

```
ping 192.168.1.1
ping 192.168.1.2
ping 192.168.1.3
```

Step 5. Go to your Windows Server 2019 VM in VMware Workstation. From Server Manager, go to Tools > DNS > Forward Lookup Zones > right click station8.com > New Host (A or AAAA). Create a host address for each router. Make sure to type names all in lower case, and to uncheck "Create associated pointer (PTR) record".

router1 > Ip address 192.168.1.1 router2 > Ip

address 192.168.1.2 router3 > Ip address

192.168.1.3

Step 6. Verify connectivity from command prompt by pinging router1.station8.com, router2.station8.com and router3.station8.com

```
ping    router1.station8.com    ping
router2.station8.com            ping
router3.station8.com
```

Step 7. Go to R1 in GNS3, and input the following command, then repeat om R2 and R3.

R1, R2 & R3

```
conf t
```

```
ip domain lookup

ip name-server 192.168.1.101 ip ospf name-

lookup
```

Step 8. Verify DNS functionality in R3 by pinging router1.station8.com. Verify DNS functionality in R2 by pinging router2.station8.com

R3

```
ping router2.station8.com
```

R2

```
ping router1.station8.com
```

3.17.1.15 - Configure SSH and Remote Access Router via PuTTY from a Windows 10 VM

Step 1. On R1, configure hostname to match domain name, configure secret password "cisco", configure crypto keys to 1024 bits, configure ip domain name to station8.com, create a local username and password, configure line vty password "vtp", enable ssh, login local, configure ssh time out to 60 seconds, and ssh authentication retries to 2. Then copy running config to NVRAM.

```
conf t
hostname router1
enable secret cisco
ip domain-name station8.com
crypto key generate rsa general-keys modulus 1024
username admin secret cisco
line vty 0 4
 password vtp
 transport input ssh
 login local
ip ssh time-out 60
ip ssh authentication-retries 2
end
copy running-config startup-config
```

Step 2. Drag in a Windows 10 VM, and cable it to SW1. Power it on. Log in through VMware Workstation. Got to your network card settings and configure IP addresses.

IP address: 192.168.1.102

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.1.1 (IP address of connected router interface) DNS Server:

192.168.1.101 (IP address of Windows Server 2019 VM)

Step 3. In GNS3, verify if port connecting Windows 10 VM to SW1 is active. Right click SW1 > console, and execute a show protocols command. If it is down, execute a no shut, then shut, followed by another no shut command.

SW1

```
show protocols


conf t int f1/7 no
shut shut
no shut
```

Step 4. From the command prompt in the Windows 10 VM, verify connectivity to domain by pinging station8.com.

```
ping station8.com
```

Step 5. Open PuTTY in the Windows 10 VM. In "Host Name (or IP address)", type in "router1.station8.com", then under "Saved Session", type in "router1", then click "Save", then select "router1" and click "Open".

Step 6. Login as "admin", enter password "cisco". Once logged in, type in "enable", then type in your password "cisco" to access privileged EXEC mode.

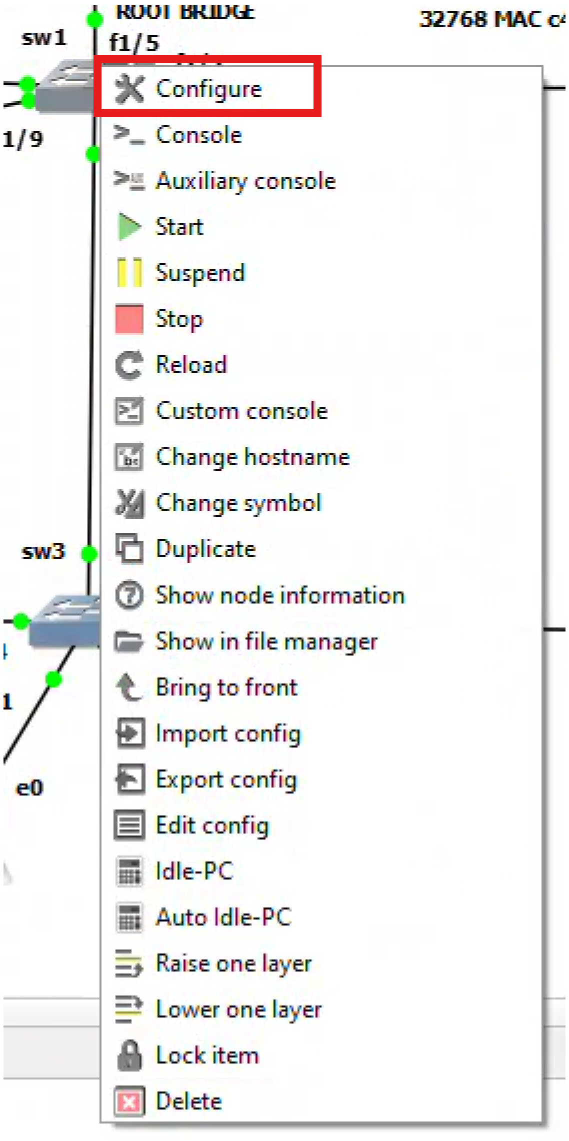
3.18 Work around to save VLANS into GNS3 projects

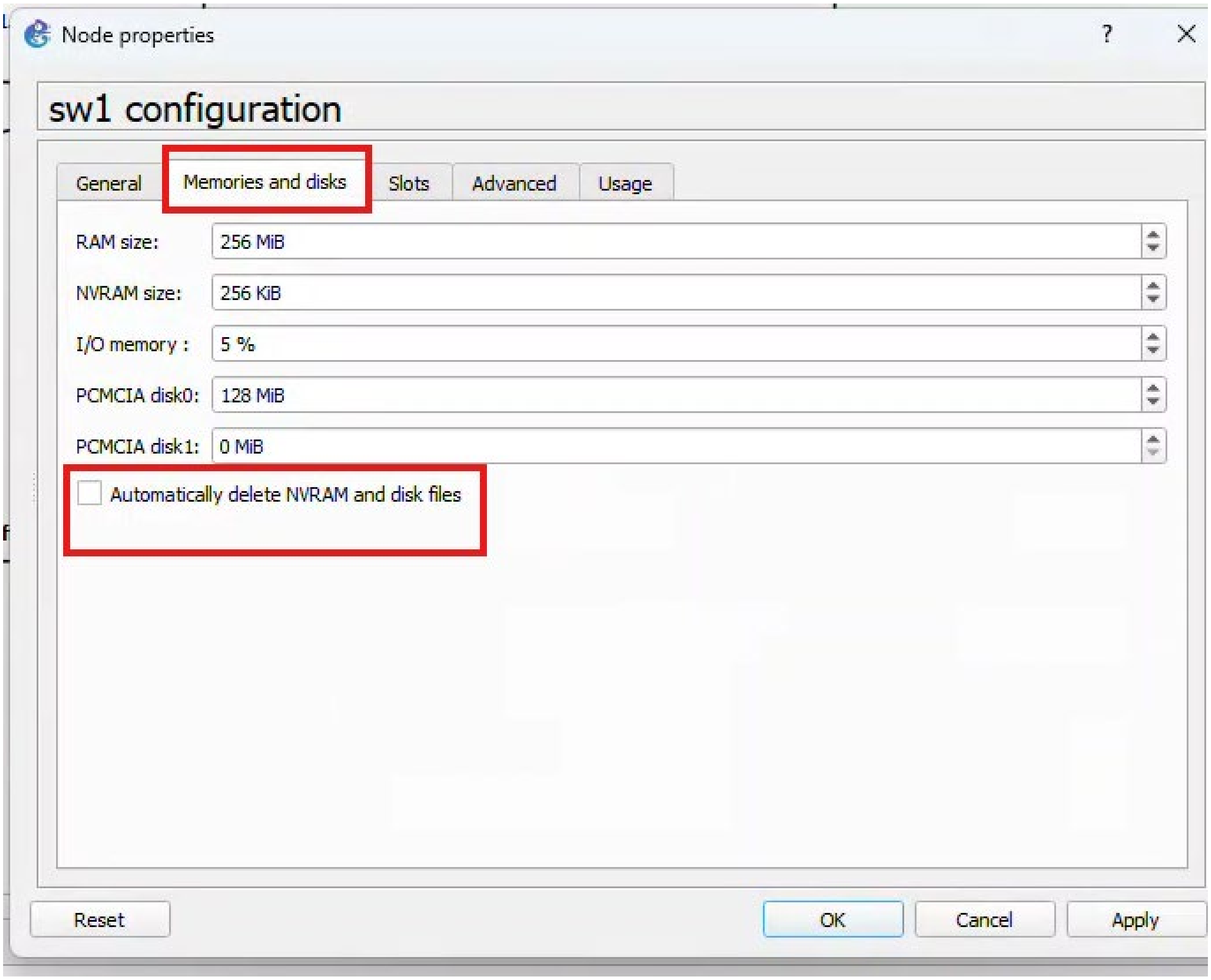
Modify GNS3 Settings:

NVRAM Settings:

Right-click on each switch in your GNS3 project, select "Configure", then go to "Memories and disks".

Uncheck the option "Automatically delete NVRAM and disk files" if it's checked. This ensures that the NVRAM files, which include your VLAN configurations, are not deleted when the switch is powered down or the project is closed.


ROOT BRIDGE
32768 MAC c
sw1
f1/5
1/9
sw3
1
e0
Configure
Console
Auxiliary console
Start
Suspend
Stop
Reload
Custom console
Change hostname
Change symbol
Duplicate
Show node information
Show in file manager
Bring to front
Import config
Export config
Edit config
Idle-PC
Auto Idle-PC
Raise one layer
Lower one layer
Lock item
Delete

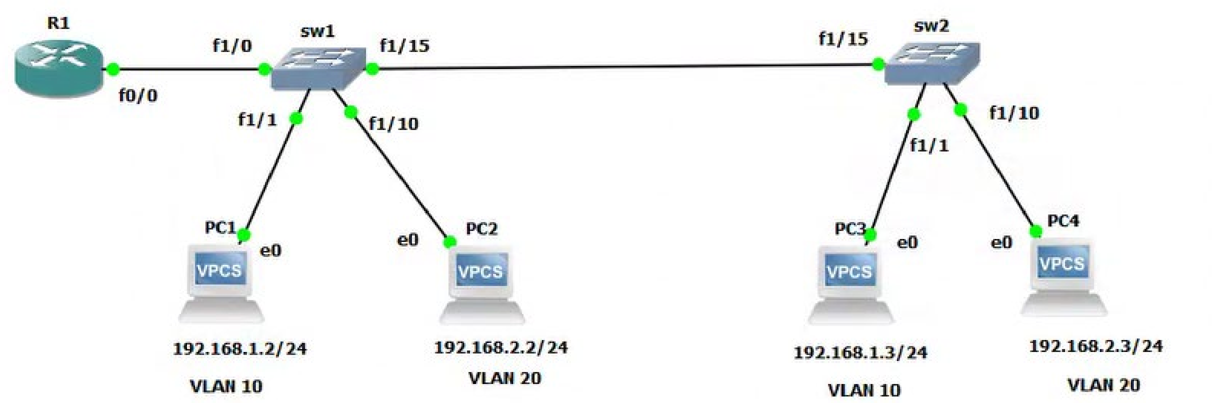


3.19 GNS3 Labs

3.19.1 GNS3 Intervlan Routing using Router on a stick - GNS3 Lab

The provided configuration describes a network setup that implements **Inter-VLAN Routing** using the **Router-on-a-Stick** method. This setup involves two switches (sw1 and sw2) and a router (R1) to enable communication between devices in different VLANs. Below is a detailed explanation of the network design and configuration:

3.19.1.1 Topology



Table

NE	Port	Mode	VLAN	Connected To	Description
SW1	FastEthernet1/0	Trunk	-	-	Trunk link
	FastEthernet1/1	Access	VLAN 10	PC1	Access port for VLAN 10
	FastEthernet1/2	Access	VLAN 999	-	Management VLAN
	FastEthernet1/3	Access	VLAN 999	-	Management VLAN
	FastEthernet1/4	Access	VLAN 999	-	Management VLAN
	FastEthernet1/5	Access	VLAN 999	-	Management VLAN
	FastEthernet1/6	Trunk	-	SW2 FastEthernet1/6	Trunk link
	FastEthernet1/7	Trunk	-	SW3 FastEthernet1/7	Trunk link
	FastEthernet1/8	Access	VLAN 999	-	Management VLAN
	FastEthernet1/9	Access	VLAN 999	-	Management VLAN
	FastEthernet1/10	Access	VLAN 20	PC2	Access port for VLAN 20
	FastEthernet1/11	Access	VLAN 999	-	Management VLAN
	FastEthernet1/12	Access	VLAN 999	-	Management VLAN
	FastEthernet1/13	Access	VLAN 999	-	Management VLAN
	FastEthernet1/14	Access	VLAN 999	-	Management VLAN
	FastEthernet1/15	Trunk	-	-	Trunk link
SW2	FastEthernet1/0	Shutdown	-	-	Port shutdown

	FastEthernet1/1	Access	VLAN 10	PC3	Access port for VLAN 10
	FastEthernet1/2	Access	VLAN 999	-	Management VLAN
	FastEthernet1/3	Access	VLAN 999	-	Management VLAN
	FastEthernet1/4	Access	VLAN 999	-	Management VLAN
	FastEthernet1/5	Access	VLAN 999	-	Management VLAN
	FastEthernet1/6	Trunk	-	SW1 FastEthernet1/6	Trunk link
	FastEthernet1/7	Trunk	-	SW4 FastEthernet1/7	Trunk link
	FastEthernet1/8	Access	VLAN 999	-	Management VLAN
	FastEthernet1/9	Access	VLAN 999	-	Management VLAN
	FastEthernet1/10	Access	VLAN 20	PC4	Access port for VLAN 20
	FastEthernet1/11	Access	VLAN 999	-	Management VLAN
	FastEthernet1/12	Access	VLAN 999	-	Management VLAN
	FastEthernet1/13	Access	VLAN 999	-	Management VLAN
	FastEthernet1/14	Access	VLAN 999	-	Management VLAN
	FastEthernet1/15	Trunk	-	-	Trunk link
SW3	FastEthernet1/2	Access	VLAN 999	-	Management VLAN
	FastEthernet1/3	Access	VLAN 999	-	Management VLAN
	FastEthernet1/4	Access	VLAN 999	-	Management VLAN
	FastEthernet1/5	Access	VLAN 999	-	Management VLAN
	FastEthernet1/6	Trunk	-	SW4 FastEthernet1/6	Trunk link
	FastEthernet1/7	Trunk	-	SW1 FastEthernet1/7	Trunk link
	FastEthernet1/8	Access	VLAN 999	-	Management VLAN
	FastEthernet1/9	Access	VLAN 999	-	Management VLAN
	FastEthernet1/10	Access	VLAN 20	-	Access port for VLAN 20
	FastEthernet1/11	Access	VLAN 999	-	Management VLAN
	FastEthernet1/12	Access	VLAN 999	-	Management VLAN
	FastEthernet1/13	Access	VLAN 999	-	Management VLAN
	FastEthernet1/14	Access	VLAN 999	-	Management VLAN
	FastEthernet1/15	Trunk	-	-	Trunk link

SW4	FastEthernet1/2	Access	VLAN 999	-	Management VLAN
	FastEthernet1/3	Access	VLAN 999	-	Management VLAN
	FastEthernet1/4	Access	VLAN 999	-	Management VLAN
	FastEthernet1/5	Access	VLAN 999	-	Management VLAN
	FastEthernet1/6	Trunk	-	SW3 FastEthernet1/6	Trunk link
	FastEthernet1/7	Trunk	-	SW2 FastEthernet1/7	Trunk link
	FastEthernet1/8	Access	VLAN 999	-	Management VLAN
	FastEthernet1/9	Access	VLAN 999	-	Management VLAN
	FastEthernet1/10	Access	VLAN 20	-	Access port for VLAN 20
	FastEthernet1/11	Access	VLAN 999	-	Management VLAN
	FastEthernet1/12	Access	VLAN 999	-	Management VLAN
	FastEthernet1/13	Access	VLAN 999	-	Management VLAN
	FastEthernet1/14	Access	VLAN 999	-	Management VLAN
	FastEthernet1/15	Trunk	-	-	Trunk link
R1	FastEthernet0/0.10	Sub-interface	VLAN 10	SW1 FastEthernet1/0	IP: 192.168.1.1/24
	FastEthernet0/0.20	Sub-interface	VLAN 20	SW2 FastEthernet1/0	IP: 192.168.2.1/24

PC's

PC1	SW1 FastEthernet1/1	IP: 192.168.1.2/24, Gateway: 192.168.1.1
PC2	SW1 FastEthernet1/10	IP: 192.168.2.2/24, Gateway: 192.168.1.1
PC3	SW2 FastEthernet1/1	IP: 192.168.1.3/24, Gateway: 192.168.1.1
PC4	SW2 FastEthernet1/10	IP: 192.168.2.3/24, Gateway: 192.168.1.1

3.19.1.2 Network Design Overview

1. **VLANs**:

- **VLAN 10**: Used for one group of devices.
- **VLAN 20**: Used for another group of devices.
- **VLAN 999**: Reserved for management purposes.

2. **Switches**:
   - **sw1** and **sw2** are Layer 2 switches configured to handle traffic for VLANs 10, 20, and 999.
   - Trunk ports are configured on both switches to carry traffic for multiple VLANs to the router (R1).
3. **Router**:
   - **R1** is configured with subinterfaces on its FastEthernet0/0 interface to perform Inter-VLAN routing.
   - Each subinterface is associated with a VLAN and assigned an IP address to serve as the default gateway for devices in that VLAN.
4. **Router-on-a-Stick**:
   - The router uses a single physical interface (FastEthernet0/0) with multiple subinterfaces to route traffic between VLANs.
   - VLAN tagging is achieved using the IEEE 802.1Q protocol.

3.19.1.3 Configuration Details

Switch 1 (sw1)

- **VLANs**:
  - VLANs 10, 20, and 999 are created.
  - VLAN 999 is named "Management."
- **Interfaces**:
  - FastEthernet1/0 and FastEthernet1/15 are configured as trunk ports to carry traffic for all VLANs to the router.
  - FastEthernet1/1 is assigned to VLAN 10.
  - FastEthernet1/10 is assigned to VLAN 20.
  - FastEthernet1/2-9 and FastEthernet1/11-14 are assigned to VLAN 999 but are shut down.

Switch 2 (sw2)

- **VLANs**:
  - VLANs 10, 20, and 999 are created.

- VLAN 999 is named "Management."

- **Interfaces**:
  - FastEthernet1/15 is configured as a trunk port to carry traffic for all VLANs to the router.
  - FastEthernet1/1 is assigned to VLAN 10.
  - FastEthernet1/10 is assigned to VLAN 20.
  - FastEthernet1/2-9 and FastEthernet1/11-14 are assigned to VLAN 999 but are shut down.

Router (R1)

- **Subinterfaces**:
  - FastEthernet0/0.10 is configured for VLAN 10 with IP address 192.168.1.1/24.
  - FastEthernet0/0.20 is configured for VLAN 20 with IP address 192.168.2.1/24.
- **Encapsulation**:
  - IEEE 802.1Q encapsulation is used to tag VLAN traffic on each subinterface.

3.19.1.4 Traffic Flow

1. **Intra-VLAN Communication**:
   - Devices within the same VLAN (e.g., VLAN 10) communicate directly through the switch without involving the router.
2. **Inter-VLAN Communication**:
   - When a device in VLAN 10 needs to communicate with a device in VLAN 20:
     - The traffic is forwarded to the router via the trunk link.
     - The router routes the traffic between the subinterfaces (FastEthernet0/0.10 and FastEthernet0/0.20).
     - The traffic is then sent back to the appropriate VLAN through the trunk link.

3.19.1.5 Key Points

- **Router-on-a-Stick** is a cost-effective solution for Inter-VLAN routing, as it uses a single physical interface on the router.
- **Trunk ports** on the switches ensure that VLAN-tagged traffic can be passed to the router.
- **Subinterfaces** on the router allow it to handle traffic for multiple VLANs simultaneously.

3.19.1.6Scripts

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!! Configuration for sw1 !!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
enable
vlan database
 vlan 10
 vlan 20
 vlan 999 name Management
exit
config t
! Set hostname
hostname sw1
! Disable IP domain lookup
no ip domain lookup
interface FastEthernet1/0
 switchport mode trunk
 no shutdown
interface FastEthernet1/1
 switchport access vlan 10
 no shutdown
interface range FastEthernet1/2 - 9
 switchport access vlan 999
 switchport mode access
 shutdown
interface FastEthernet1/10
 switchport access vlan 20
  no shutdown
interface range FastEthernet1/11 - 14
switchport access vlan 999
 switchport mode access
 shutdowninterface FastEthernet1/15
 switchport mode trunk
 no shutdown
end

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!! Configuration for sw2 !!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
enable
vlan database
 vlan 10
 vlan 20
 vlan 999 name Management
```

```
exit
config t
! Set hostname
hostname sw2
! Disable IP domain lookup
no ip domain lookup
interface FastEthernet1/0
 shutdown
interface FastEthernet1/1
 switchport access vlan 10
 no shutdown
interface range FastEthernet1/2 - 9
 switchport access vlan 999
 switchport mode access
 shutdown
interface FastEthernet1/10
 switchport access vlan 20
interface range FastEthernet1/11 - 14
 switchport access vlan 999
 switchport mode access
 shutdown
interface FastEthernet1/15
 switchport mode trunk
 no shutdown
end

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!! Configuration for R1 !!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Set hostname
hostname R1
! Disable IP domain lookup
no ip domain lookup
interface FastEthernet0/0.10
 encapsulation dot1Q 10
 ip address 192.168.1.1 255.255.255.0
interface FastEthernet0/0.20
 encapsulation dot1Q 20
 ip address 192.168.2.1 255.255.255.0
end
```

Set static IPV4 IP's for PC's

PC1

ip 192.168.1.2 255.255.255.0 192.168.1.1

save

PC2
ip 192.168.2.2 255.255.255.0 192.168.1.1
save
PC3
ip 192.168.1.3 255.255.255.0 192.168.1.1
save
PC4
ip 192.168.2.3 255.255.255.0 192.168.1.1
save

3.19.1.7Testing

Ping from PC1 ro VLANs

```
PC1> ping  192.168.1.1

84 bytes from 192.168.1.1 icmp_seq=1 ttl=255 time=28.761 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=255 time=14.670 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=255 time=11.254 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=255 time=6.617 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=255 time=10.694 ms

PC1> ping  192.168.2.1

84 bytes from 192.168.2.1 icmp_seq=1 ttl=255 time=9.000 ms
84 bytes from 192.168.2.1 icmp_seq=2 ttl=255 time=10.586 ms
84 bytes from 192.168.2.1 icmp_seq=3 ttl=255 time=9.600 ms
84 bytes from 192.168.2.1 icmp_seq=4 ttl=255 time=4.929 ms
84 bytes from 192.168.2.1 icmp_seq=5 ttl=255 time=7.731 ms
```

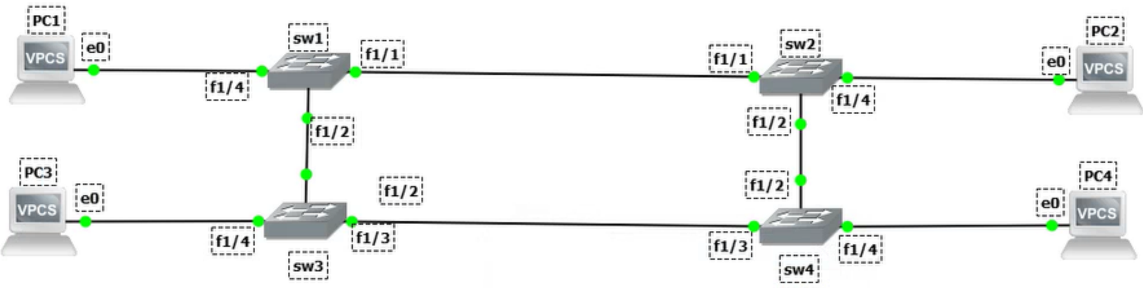
Ping PC1 to other PC’s

```
PC1> ping  192.168.2.2

84 bytes from 192.168.2.2 icmp_seq=1 ttl=63 time=59.108 ms
84 bytes from 192.168.2.2 icmp_seq=2 ttl=63 time=18.717 ms
84 bytes from 192.168.2.2 icmp_seq=3 ttl=63 time=15.145 ms
84 bytes from 192.168.2.2 icmp_seq=4 ttl=63 time=18.856 ms
84 bytes from 192.168.2.2 icmp_seq=5 ttl=63 time=16.955 ms

PC1> ping  192.168.1.3

84 bytes from 192.168.1.3 icmp_seq=1 ttl=64 time=0.356 ms
84 bytes from 192.168.1.3 icmp_seq=2 ttl=64 time=0.309 ms
84 bytes from 192.168.1.3 icmp_seq=3 ttl=64 time=0.273 ms
84 bytes from 192.168.1.3 icmp_seq=4 ttl=64 time=0.292 ms
84 bytes from 192.168.1.3 icmp_seq=5 ttl=64 time=0.293 ms

PC1> ping  192.168.2.3

84 bytes from 192.168.2.3 icmp_seq=1 ttl=63 time=34.439 ms
84 bytes from 192.168.2.3 icmp_seq=2 ttl=63 time=14.145 ms
84 bytes from 192.168.2.3 icmp_seq=3 ttl=63 time=19.124 ms
84 bytes from 192.168.2.3 icmp_seq=4 ttl=63 time=21.145 ms
84 bytes from 192.168.2.3 icmp_seq=5 ttl=63 time=15.767 ms
```

3.19.2 GNS3 - Spanning tree protocol - Initial Configuration and Port Types

A) Create the following topology in GNS3

Topology

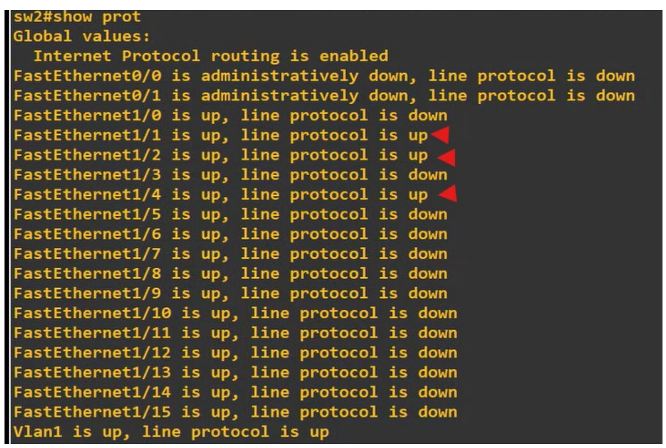


B) Execute a show protocol command on each switch. Verify enabled ports.

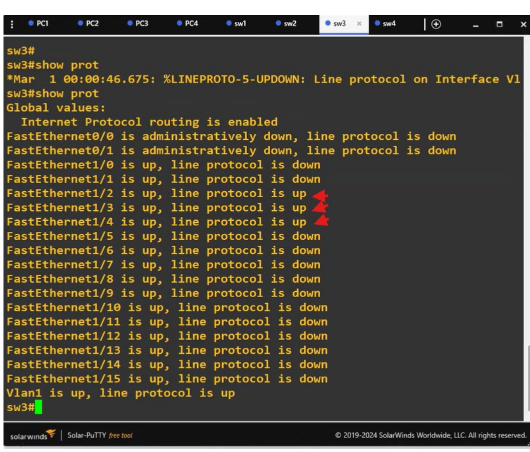
Verify inside switches the connected interfaces are all up

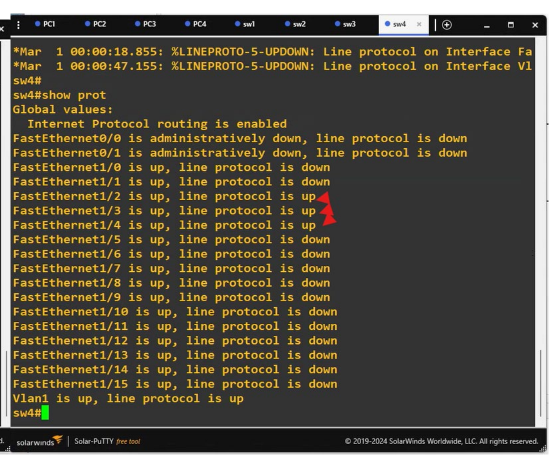
Command - show prot

SW1 and SW2



SW3 and SW4





C) Find Bridge Identifier priority and Mac address for each one of the switches with command: show spanning-tree

SW1

```
sw1#show spann
sw1#show spanning-tree

 VLAN1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address c401.0fa4.0000
  Configured hello time 2, max age 20, forward delay 15
  We are the root of the spanning tree
  Topology change flag not set, detected flag not set
  Number of topology changes 1 last change occurred 01:17:17 ago
```

SW2

```
sw2#show spanning-tree

 VLAN1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address c402.0fc2.0000
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 32768, address c401.0fa4.0000
  Root port is 42 (FastEthernet1/1), cost of root path is 19
  Topology change flag not set, detected flag not set
```

SW3

```
sw3#show spann
sw3#show spanning-tree

 VLAN1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address c403.0ff0.0000
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 32768, address c401.0fa4.0000
  Root port is 43 (FastEthernet1/2), cost of root path is 19
  Topology change flag not set, detected flag not set
  Number of topology changes 2 last change occurred 01:22:40 ago
```

SW 4

```
sw4#show span
sw4#show spanning-tree

 VLAN1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address c404.1013.0000
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 32768, address c401.0fa4.0000
  Root port is 43 (FastEthernet1/2), cost of root path is 38
  Topology change flag not set, detected flag not set
  Number of topology changes 1 last change occurred 01:22:48 ago
          from FastEthernet1/2
```

D) Based on the information tag the topology accordingly.
Identify

- **Bridge Identifier** - Each switch in the network has a Bridge Identifier, which includes a priority value and the switch's MAC address.

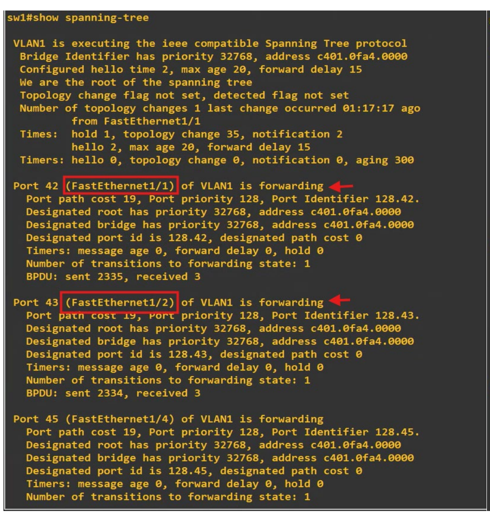
  As per printouts above have:

	Priority	MAC address
SW1	32768	c401.0fa4.0000
SW2	32768	c402.0fc2.0000
SW3	32768	c403.0ff0.0000
SW4	32768	c404.1013.0000

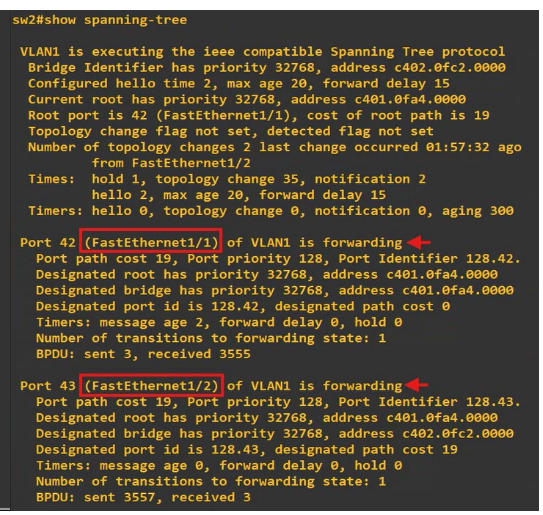
-

- **Root bridge** - The central point in the network from which all path calculations are made. The switch with the lowest Bridge Identifier becomes the root bridge.
  The addresses in ascending order:
  1. c401.0fa4.0000 – SW1 - lowest Bridge Identifier = Root bridge
  2. c402.0fc2.0000 – SW2
  3. c403.0ff0.0000 – SW3
  4. c404.1013.0000 – SW4

- **Designated ports** are connect to the root bridge.
  SW1 and SW2

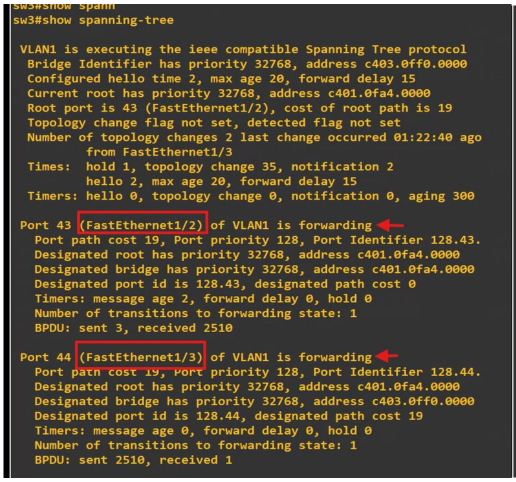


```
sw1#show spanning-tree

 VLAN1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address c401.0fa4.0000
  Configured hello time 2, max age 20, forward delay 15
  We are the root of the spanning tree
  Topology change flag not set, detected flag not set
  Number of topology changes 1 last change occurred 01:17:17 ago
          from FastEthernet1/1
  Times:  hold 1, topology change 35, notification 2
          hello 2, max age 20, forward delay 15
  Timers: hello 0, topology change 0, notification 0, aging 300

 Port 42 (FastEthernet1/1) of VLAN1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.42.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c401.0fa4.0000
   Designated port id is 128.42, designated path cost 0
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 2335, received 3

 Port 43 (FastEthernet1/2) of VLAN1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.43.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c401.0fa4.0000
   Designated port id is 128.43, designated path cost 0
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 2334, received 3

 Port 45 (FastEthernet1/4) of VLAN1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.45.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c401.0fa4.0000
   Designated port id is 128.45, designated path cost 0
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
```

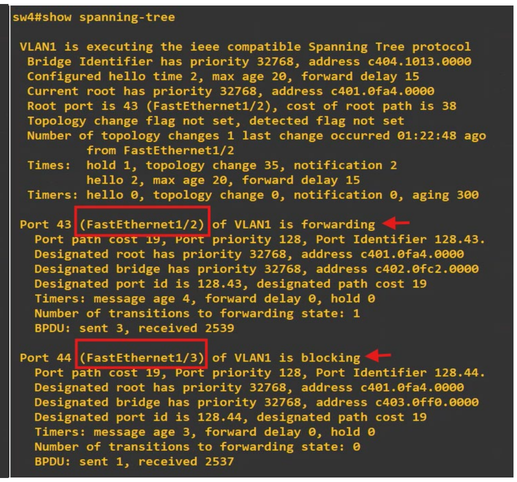


```
sw2#show spanning-tree

 VLAN1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address c402.0fc2.0000
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 32768, address c401.0fa4.0000
  Root port is 42 (FastEthernet1/1), cost of root path is 19
  Topology change flag not set, detected flag not set
  Number of topology changes 2 last change occurred 01:57:32 ago
          from FastEthernet1/2
  Times:  hold 1, topology change 35, notification 2
          hello 2, max age 20, forward delay 15
  Timers: hello 0, topology change 0, notification 0, aging 300

 Port 42 (FastEthernet1/1) of VLAN1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.42.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c401.0fa4.0000
   Designated port id is 128.42, designated path cost 0
   Timers: message age 2, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 3, received 3555

 Port 43 (FastEthernet1/2) of VLAN1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.43.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c402.0fc2.0000
   Designated port id is 128.43, designated path cost 19
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 3557, received 3
```

SW3 and SW4



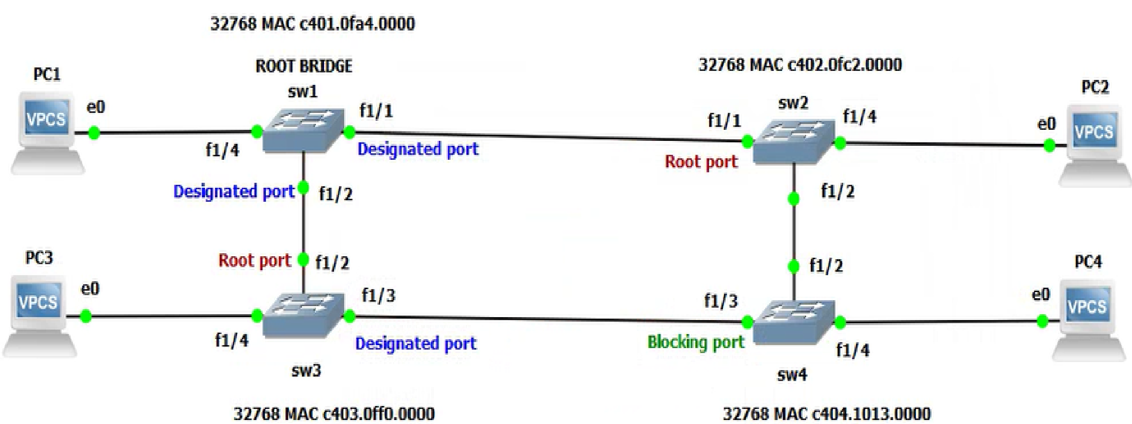
```
sw3#show spann
sw3#show spanning-tree

 VLAN1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address c403.0ff0.0000
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 32768, address c401.0fa4.0000
  Root port is 43 (FastEthernet1/2), cost of root path is 19
  Topology change flag not set, detected flag not set
  Number of topology changes 2 last change occurred 01:22:40 ago
          from FastEthernet1/3
  Times:  hold 1, topology change 35, notification 2
          hello 2, max age 20, forward delay 15
  Timers: hello 0, topology change 0, notification 0, aging 300

 Port 43 (FastEthernet1/2) of VLAN1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.43.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c401.0fa4.0000
   Designated port id is 128.43, designated path cost 0
   Timers: message age 2, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 3, received 2510

 Port 44 (FastEthernet1/3) of VLAN1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.44.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c403.0ff0.0000
   Designated port id is 128.44, designated path cost 19
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 2510, received 1
```



```
sw4#show spanning-tree

 VLAN1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address c404.1013.0000
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 32768, address c401.0fa4.0000
  Root port is 43 (FastEthernet1/2), cost of root path is 38
  Topology change flag not set, detected flag not set
  Number of topology changes 1 last change occurred 01:22:48 ago
          from FastEthernet1/2
  Times:  hold 1, topology change 35, notification 2
          hello 2, max age 20, forward delay 15
  Timers: hello 0, topology change 0, notification 0, aging 300

 Port 43 (FastEthernet1/2) of VLAN1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.43.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c402.0fc2.0000
   Designated port id is 128.43, designated path cost 19
   Timers: message age 4, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 3, received 2539

 Port 44 (FastEthernet1/3) of VLAN1 is blocking
   Port path cost 19, Port priority 128, Port Identifier 128.44.
   Designated root has priority 32768, address c401.0fa4.0000
   Designated bridge has priority 32768, address c403.0ff0.0000
   Designated port id is 128.44, designated path cost 19
   Timers: message age 3, forward delay 0, hold 0
   Number of transitions to forwarding state: 0
   BPDU: sent 1, received 2537
```

- **Root ports** have the lowest cost path to the root bridge.
- Ports not being root or designated are **alternate (blocking) ports**.
  Why is the blocked port on the right-hand side switch? The tiebreaker is the MAC address. The switch with the lower MAC address gets priority.

  After identified and tagged the topology look like this:



3.19.3 GNS3 - Configure Etherchannel Part 1

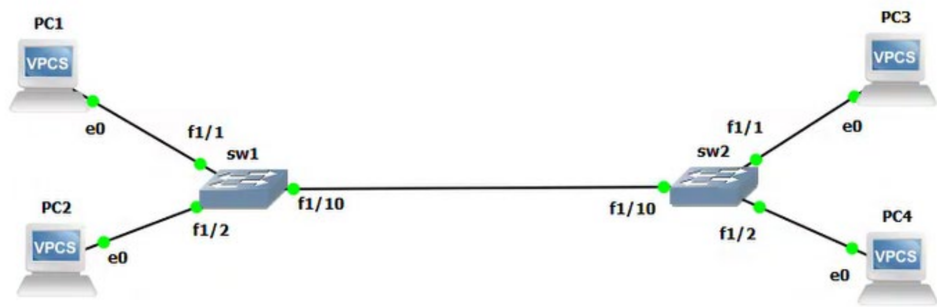
3.19.3.1 Topology

Create topology according to the following specifications:

Devices: Switch 1, Switch 2, PC1, PC2, PC3, PC4.

Connections:

Switch 1 FastEthernet 1/1 to PC1
Switch 1 FastEthernet 1/2 to PC2
Switch 2 FastEthernet 1/1 to PC3
Switch 2 FastEthernet 1/2 to PC4
Switch 1 FastEthernet 1/10 to Switch 2 FastEthernet 1/10 (Initial link)



3.19.3.2 Initial configuration

A) Power on all devices.
B) Assign IP Addresses to PC's and save it.
- PC1 (VLAN 10): 192.168.10.2/24 gateway 192.168.10.1
- PC2 (VLAN 20): 192.168.20.2/24 gateway 192.168.20.1
- PC3 (VLAN 10): 192.168.10.11/24 gateway 192.168.10.1
- PC4 (VLAN 20): 192.168.20.11/24 gateway 192.168.20.1

Commands

```
PC1> ip 192.168.10.2 255.255.255.0 192.168.10.1
PC1> save

PC2> ip 192.168.20.2 255.255.255.0 192.168.20.1
PC2> save

PC3> ip 192.168.10.11 255.255.255.0 192.168.10.1
PC3> save

PC4> ip 192.168.20.11 255.255.255.0 192.168.20.1
PC4> save
```

```
PC1> ip 192.168.10.2 255.255.255.0 192.168.10.1
Checking for duplicate address...
PC1 : 192.168.10.2 255.255.255.0 gateway 192.168.10.1

PC1> save
Saving startup configuration to startup.vpc
.  done
```

```
PC2> ip 192.168.20.2 255.255.255.0 192.168.20.1
Checking for duplicate address...
PC2 : 192.168.20.2 255.255.255.0 gateway 192.168.20.1

PC2> save
Saving startup configuration to startup.vpc
.  done

PC2>
```

```
PC3> ip 192.168.10.11 255.255.255.0 192.168.10.1
Checking for duplicate address...
PC3 : 192.168.10.11 255.255.255.0 gateway 192.168.10.1

PC3> save
Saving startup configuration to startup.vpc
.  done

PC3>
```

```
PC4> ip 192.168.20.11 255.255.255.0 192.168.20.1
Checking for duplicate address...
PC4 : 192.168.20.11 255.255.255.0 gateway 192.168.20.1

PC4> save
Saving startup configuration to startup.vpc
.  done

PC4>
```

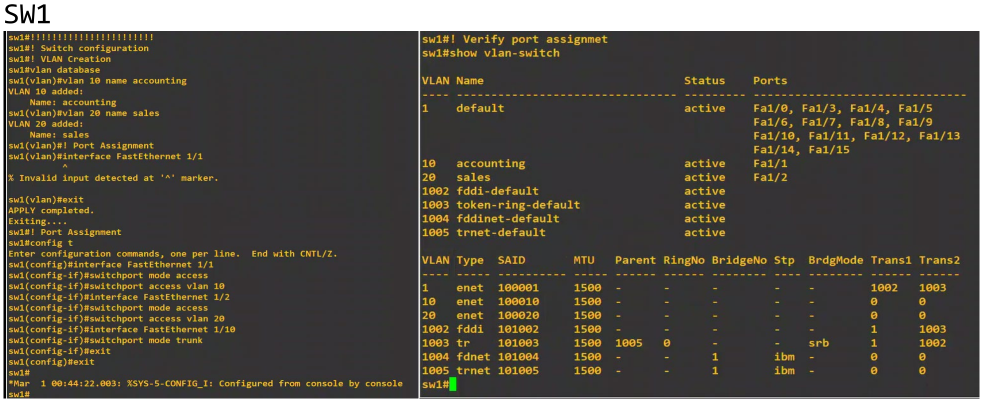
3.19.3.2.1 VLAN configuration

3.19.3.2.1.1 VLAN Creation and port assignment

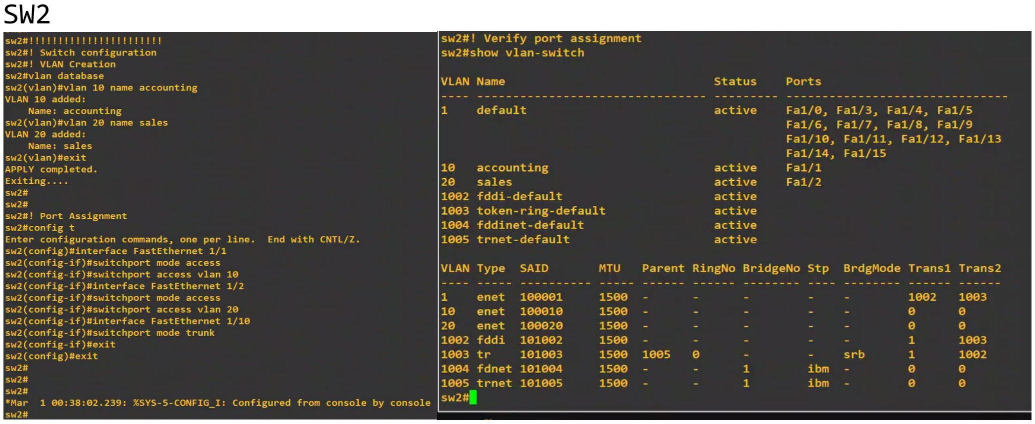
Run the following on Sw1 and SW2

```
!!!!!!!!!!!!!!!!!!!!!!!
! Switch configuration
! VLAN Creation
vlan database
vlan 10 name accounting
vlan 20 name sales
exit

! Port Assignment
config t
interface FastEthernet 1/1
switchport mode access
switchport access vlan 10
interface FastEthernet 1/2
switchport mode access
switchport access vlan 20
interface FastEthernet 1/10
switchport mode trunk
exit
exit


! Verify vlan configuration and port assignment
show vlan-switch
```

SW1



SW2



3.19.3.2.2 Connectivity testing

A) From PC3
Ping PC1 (should succeed)
`ping 192.168.10.2`
Ping PC2 (should fail due to no inter-VLAN routing).
`ping 192.168.10.2`

```
PC3> ping 192.168.10.2

84 bytes from 192.168.10.2 icmp_seq=1 ttl=64 time=0.227 ms
84 bytes from 192.168.10.2 icmp_seq=2 ttl=64 time=0.129 ms
84 bytes from 192.168.10.2 icmp_seq=3 ttl=64 time=0.470 ms
84 bytes from 192.168.10.2 icmp_seq=4 ttl=64 time=0.199 ms
84 bytes from 192.168.10.2 icmp_seq=5 ttl=64 time=0.136 ms

PC3> ping 192.168.20.2

host (192.168.10.1) not reachable

PC3>
```

B) From PC4 ping PC2 (should succeed).
`ping 192.168.20.2`

```
PC4> ping 192.168.20.2

84 bytes from 192.168.20.2 icmp_seq=1 ttl=64 time=0.199 ms
84 bytes from 192.168.20.2 icmp_seq=2 ttl=64 time=0.166 ms
84 bytes from 192.168.20.2 icmp_seq=3 ttl=64 time=0.169 ms
84 bytes from 192.168.20.2 icmp_seq=4 ttl=64 time=0.159 ms
84 bytes from 192.168.20.2 icmp_seq=5 ttl=64 time=0.182 ms

PC4>
```

C) Ping PC1 from PC2 (should fail due to no inter-VLAN routing).
`ping 192.168.10.2`

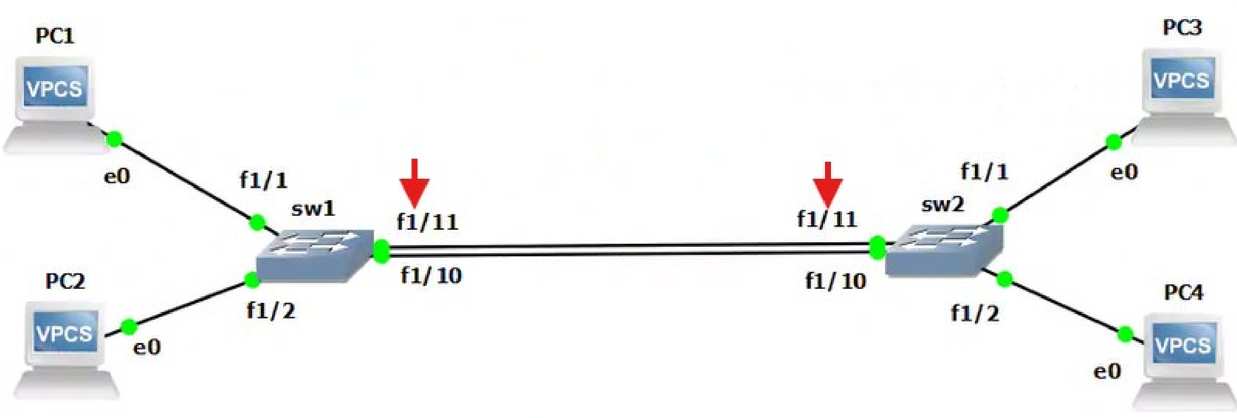
```
PC2> ping 192.168.10.2

host (192.168.20.1) not reachable

PC2>
```

3.19.3.3 EtherChannel Configuration

3.19.3.3.1 Modify topology

A) Add connection between SW1 and SW2
To increase the bandwidth across the switches another connection is added and then the two connections are placed into an EtherChannel.

Add one connection from FastEthernet 1/11 SW1 to FastEthernet 1/11 SW2



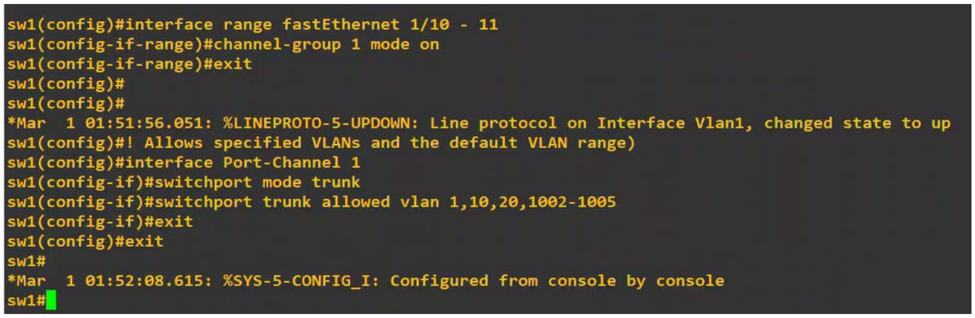
3.19.3.3.2 EtherChannel Switch Configuration

A) Configure EtherChannel

Run the following in Switch 1 & 2:

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! Put the new link into the EtherChannel
config t
interface range fastEthernet 1/10 - 11
channel-group 1 mode on
exit

! Allows specified VLANs and the default VLAN range)
interface Port-Channel 1
switchport mode trunk
switchport trunk allowed vlan 1,10,20,1002-1005
end
```

SW1



SW2

```
sw2#!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
sw2#! Put the new link into the EtherChannel
sw2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
sw2(config)#interface range fastEthernet 1/10 - 11
sw2(config-if-range)#channel-group 1 mode on
Creating a port-channel interface Port-channel1
sw2(config-if-range)#exit
*Mar  1 01:37:48.235: %EC-5-BUNDLE: Interface Fa1/10 joined port-channel Po1
*Mar  1 01:37:49.151: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
sw2(config-if-range)#exit
sw2(config)#
*Mar  1 01:37:50.955: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state to up
sw2(config)#
sw2(config)#
sw2(config)#! Allows specified VLANs and the default VLAN range)
sw2(config)#interface Port-Channel 1
sw2(config-if)#switchport mode trunk
sw2(config-if)#switchport trunk allowed vlan 1,10,20,1002-1005
sw2(config-if)#end
sw2#
*Mar  1 01:38:18.643: %SYS-5-CONFIG_I: Configured from console by console
*Mar  1 01:38:19.603: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up
sw2#
sw2#
sw2#
```

3.19.3.3.3 Etherchannel Verification

A) Verify that FastEthernet 1/10 and 1/11 are in the EtherChannel on SW1 and SW2

```
! Verify that FastEthernet 1/10 and 1/11 are in the EtherChannel
show etherchannel summary
```

SW1

```
sw1#! Verify that FastEthernet 1/10 and 1/11 are in the EtherChannel
sw1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        R - Layer3      S - Layer2
        U - in use
Group Port-channel  Ports
-----+-------------+-----------------------------------------------------------
1     Po1(SU)        Fa1/10(P)   Fa1/11(D)

sw1#
sw1#
```

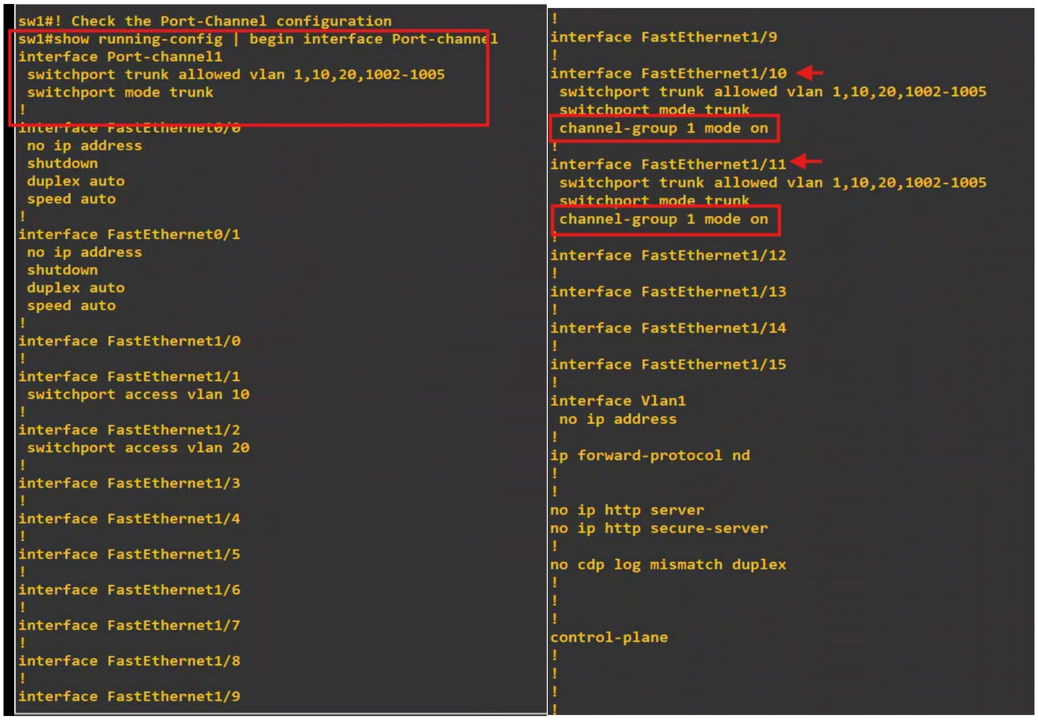
SW2

```
sw2#! Verify that FastEthernet 1/10 and 1/11 are in the EtherChannel
sw2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        R - Layer3      S - Layer2
        U - in use
Group Port-channel  Ports
-----+-------------+-----------------------------------------------------------
1     Po1(SU)        Fa1/10(P)   Fa1/11(D)

sw2#
```

B) Check the Port-Channel configuration on SW1 and SW2

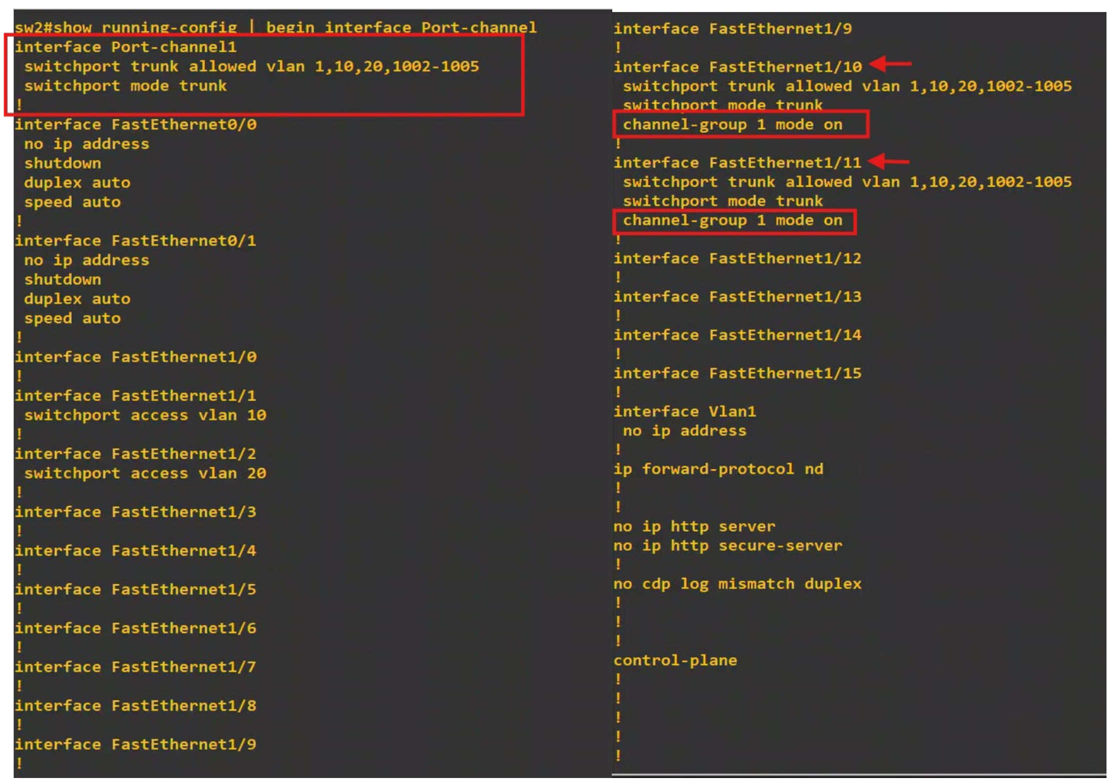
```
! Check the Port-Channel configuration
show running-config | begin interface Port-channel
```

SW1



```
sw1#! Check the Port-Channel configuration
sw1#show running-config | begin interface Port-channel
interface Port-channel1
 switchport trunk allowed vlan 1,10,20,1002-1005
 switchport mode trunk
!
interface FastEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet1/0
!
interface FastEthernet1/1
 switchport access vlan 10
!
interface FastEthernet1/2
 switchport access vlan 20
!
interface FastEthernet1/3
!
interface FastEthernet1/4
!
interface FastEthernet1/5
!
interface FastEthernet1/6
!
interface FastEthernet1/7
!
interface FastEthernet1/8
!
interface FastEthernet1/9
!
interface FastEthernet1/9
!
interface FastEthernet1/10
 switchport trunk allowed vlan 1,10,20,1002-1005
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet1/11
 switchport trunk allowed vlan 1,10,20,1002-1005
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet1/12
!
interface FastEthernet1/13
!
interface FastEthernet1/14
!
interface FastEthernet1/15
!
interface Vlan1
 no ip address
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
no cdp log mismatch duplex
!
!
!
control-plane
!
!
!
```

SW2



```
sw2#show running-config | begin interface Port-channel
interface Port-channel1
 switchport trunk allowed vlan 1,10,20,1002-1005
 switchport mode trunk
!
interface FastEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet1/0
!
interface FastEthernet1/1
 switchport access vlan 10
!
interface FastEthernet1/2
 switchport access vlan 20
!
interface FastEthernet1/3
!
interface FastEthernet1/4
!
interface FastEthernet1/5
!
interface FastEthernet1/6
!
interface FastEthernet1/7
!
interface FastEthernet1/8
!
interface FastEthernet1/9
!
interface FastEthernet1/9
!
interface FastEthernet1/10
 switchport trunk allowed vlan 1,10,20,1002-1005
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet1/11
 switchport trunk allowed vlan 1,10,20,1002-1005
 switchport mode trunk
 channel-group 1 mode on
!
interface FastEthernet1/12
!
interface FastEthernet1/13
!
interface FastEthernet1/14
!
interface FastEthernet1/15
!
interface Vlan1
 no ip address
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
no cdp log mismatch duplex
!
!
!
control-plane
!
!
!
!
!
```

C) Save configuration for SW1 and SW2

```
copy running-config startup-config
```

3.19.3.3.4 Final Testing

Re-test connectivity between VLANs after the EtherChannel is configured.

A) From PC3
Ping PC1 (should succeed)
`ping 192.168.10.2`
Ping PC2 (should fail due to no inter-VLAN routing).
`ping 192.168.20.2`

```
PC3> ping 192.168.10.2

84 bytes from 192.168.10.2 icmp_seq=1 ttl=64 time=0.227 ms
84 bytes from 192.168.10.2 icmp_seq=2 ttl=64 time=0.129 ms
84 bytes from 192.168.10.2 icmp_seq=3 ttl=64 time=0.470 ms
84 bytes from 192.168.10.2 icmp_seq=4 ttl=64 time=0.199 ms
84 bytes from 192.168.10.2 icmp_seq=5 ttl=64 time=0.136 ms

PC3> ping 192.168.20.2

host (192.168.10.1) not reachable

PC3>
```

B) From PC4 ping PC2 (should succeed).
`ping 192.168.20.2`

```
PC4> ping 192.168.20.2

84 bytes from 192.168.20.2 icmp_seq=1 ttl=64 time=0.199 ms
84 bytes from 192.168.20.2 icmp_seq=2 ttl=64 time=0.166 ms
84 bytes from 192.168.20.2 icmp_seq=3 ttl=64 time=0.169 ms
84 bytes from 192.168.20.2 icmp_seq=4 ttl=64 time=0.159 ms
84 bytes from 192.168.20.2 icmp_seq=5 ttl=64 time=0.182 ms

PC4>
```

C) Ping PC1 from PC2 (should fail due to no inter-VLAN routing).
`ping 192.168.10.2`

```
PC2> ping 192.168.10.2

host (192.168.20.1) not reachable

PC2>
```

3.19.4 GNS3 - Etherchannel TroubleShooting - Configure Etherchannel Part 2

3.19.4.1 Troubleshooting added interface is down

The Interface 1/11 is down in SW1 and SW 2

SW 1

```
sw1#show proto
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is administratively down, line protocol is down
FastEthernet0/1 is administratively down, line protocol is down
FastEthernet1/0 is up, line protocol is down
FastEthernet1/1 is up, line protocol is up
FastEthernet1/2 is up, line protocol is up
FastEthernet1/3 is up, line protocol is down
FastEthernet1/4 is up, line protocol is down
FastEthernet1/5 is up, line protocol is down
FastEthernet1/6 is up, line protocol is down
FastEthernet1/7 is up, line protocol is down
FastEthernet1/8 is up, line protocol is down
FastEthernet1/9 is up, line protocol is down
FastEthernet1/10 is up, line protocol is up
FastEthernet1/11 is up, line protocol is down
FastEthernet1/12 is up, line protocol is down
FastEthernet1/13 is up, line protocol is down
FastEthernet1/14 is up, line protocol is down
FastEthernet1/15 is up, line protocol is down
Port-channel1 is up, line protocol is up
Vlan1 is up, line protocol is up
sw1#
```

SW 2

```
sw2#show proto
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is administratively down, line protocol is down
FastEthernet0/1 is administratively down, line protocol is down
FastEthernet1/0 is up, line protocol is down
FastEthernet1/1 is up, line protocol is up
FastEthernet1/2 is up, line protocol is up
FastEthernet1/3 is up, line protocol is down
FastEthernet1/4 is up, line protocol is down
FastEthernet1/5 is up, line protocol is down
FastEthernet1/6 is up, line protocol is down
FastEthernet1/7 is up, line protocol is down
FastEthernet1/8 is up, line protocol is down
FastEthernet1/9 is up, line protocol is down
FastEthernet1/10 is up, line protocol is up
FastEthernet1/11 is up, line protocol is down
FastEthernet1/12 is up, line protocol is down
FastEthernet1/13 is up, line protocol is down
FastEthernet1/14 is up, line protocol is down
FastEthernet1/15 is up, line protocol is down
Port-channel1 is up, line protocol is up
Vlan1 is up, line protocol is up
```

To solve the issue run the following

A) Re Configure EtherChannel

Run the following in Switch 1 & 2:

```
enable
configure terminal
no interface port-channel 1 ! Remove any existing port-channel 1 configuration
interface range fastEthernet 1/10 - 11
channel-group 1 mode on
no shutdown
exit

! Configure switchport mode to trunk (if needed for inter-switch connection)
interface port-channel 1
switchport mode trunk
end
! Exit global configuration mode
```

SW1

```
sw1#enable
sw1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
sw1(config)#$nnel 1 ! Remove any existing port-channel 1 configuration
sw1(config)#interface range fastEthernet 1/10 - 11
sw1(config-if-range)#channel-group 1 mode on
Creating a port-channel interface Port-channel1
sw1(config-if-range)#no shutdown
sw1(config-if-range)#exit
sw1(config)#
sw1(config)#$t mode to trunk (if needed for inter-switch connection)
sw1(config)#int
*Mar  1 02:58:46.203: %EC-5-UNBUNDLE: Interface Fa1/10 left the port-channel Po1
*Mar  1 02:58:46.203: %EC-5-UNBUNDLE: Interface Fa1/11 left the port-channel Po1
*Mar  1 02:58:46.259: %EC-5-BUNDLE: Interface Fa1/10 joined port-channel Po1
*Mar  1 02:58:46.271: %EC-5-BUNDLE: Interface Fa1/11 joined port-channel Po1
*Mar  1 02:58:46.703: %DTP-5-NONTRUNKPORTON: Port Fa1/10-11 has become non-trunk
*Mar  1 02:58:46.759: %DTP-5-TRUNKPORTON: Port Fa1/10-11 has become dot1q trunk
*Mar  1 02:58:47.203: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to downerface port-channel 1
sw1(config-if)#switchport mode trunk
sw1(config-if)#end
sw1#! Exit global configuration mode
```

SW2

```
sw2#enable
sw2#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
sw2(config)#$nnel 1 ! Remove any existing port-channel 1 configuration
sw2(config)#interface range fastEthernet 1/10 - 11
sw2(config-if-range)#channel-group 1 mode on
Creating a port-channel interface Port-channel1
sw2(config-if-range)#no shutdown
sw2(config-if-range)#exit
sw2(config)#
sw2(config)#$t mode to trunk (if needed for inter-switch connection)
sw2(config)#interface port-channel 1
sw2(config-if)#switchport mode trunk
sw2(config-if)#end
sw2#! Exit global configuration mode
sw2#
*Mar  1 02:53:26.523: %EC-5-UNBUNDLE: Interface Fa1/10 left the port-channel Po1
*Mar  1 02:53:26.531: %EC-5-UNBUNDLE: Interface Fa1/11 left the port-channel Po1
*Mar  1 02:53:26.823: %EC-5-BUNDLE: Interface Fa1/10 joined port-channel Po1
*Mar  1 02:53:26.843: %EC-5-BUNDLE: Interface Fa1/11 joined port-channel Po1
*Mar  1 02:53:26.859: %SYS-5-CONFIG_I: Configured from console by console
*Mar  1 02:53:27.023: %DTP-5-NONTRUNKPORTON: Port Fa1/10-11 has become non-trunk
*Mar  1 02:53:27.319: %DTP-5-TRUNKPORTON: Port Fa1/10-11 has become dot1q trunk
sw2#
*Mar  1 02:53:27.527: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
sw2#
sw2#
*Mar  1 02:53:29.671: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state to up
```

B) Verify port channel status in Sw 1 and SW2

```
! Verify port-channel status
show etherchannel summary
```

SW1

```
sw1#! Verify port-channel status
sw1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        R - Layer3      S - Layer2
        U - in use
Group Port-channel  Ports
-----+------------+-----------------------------------------------------------
1     Po1(SU)     Fa1/10(P)  Fa1/11(P)

sw1#
```

SW2

```
sw2#! Verify port-channel status
sw2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        R - Layer3      S - Layer2
        U - in use
Group Port-channel  Ports
-----+------------+-----------------------------------------------------------
1     Po1(SU)     Fa1/10(P)  Fa1/11(P)

sw2#
```

C) Display the status of configured protocols on the device.

```
! Verify interfaces status
show protocols
```

SW1

```
sw1#! Verify interfaces status
sw1#show protocols
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is administratively down, line protocol is down
FastEthernet0/1 is administratively down, line protocol is down
FastEthernet1/0 is up, line protocol is down
FastEthernet1/1 is up, line protocol is up
FastEthernet1/2 is up, line protocol is up
FastEthernet1/3 is up, line protocol is down
FastEthernet1/4 is up, line protocol is down
FastEthernet1/5 is up, line protocol is down
FastEthernet1/6 is up, line protocol is down
FastEthernet1/7 is up, line protocol is down
FastEthernet1/8 is up, line protocol is down
FastEthernet1/9 is up, line protocol is down
FastEthernet1/10 is up, line protocol is up
FastEthernet1/11 is up, line protocol is up
FastEthernet1/12 is up, line protocol is down
FastEthernet1/13 is up, line protocol is down
FastEthernet1/14 is up, line protocol is down
FastEthernet1/15 is up, line protocol is down
Port-channel1 is up, line protocol is up
Vlan1 is up, line protocol is up
sw1#
```

SW2

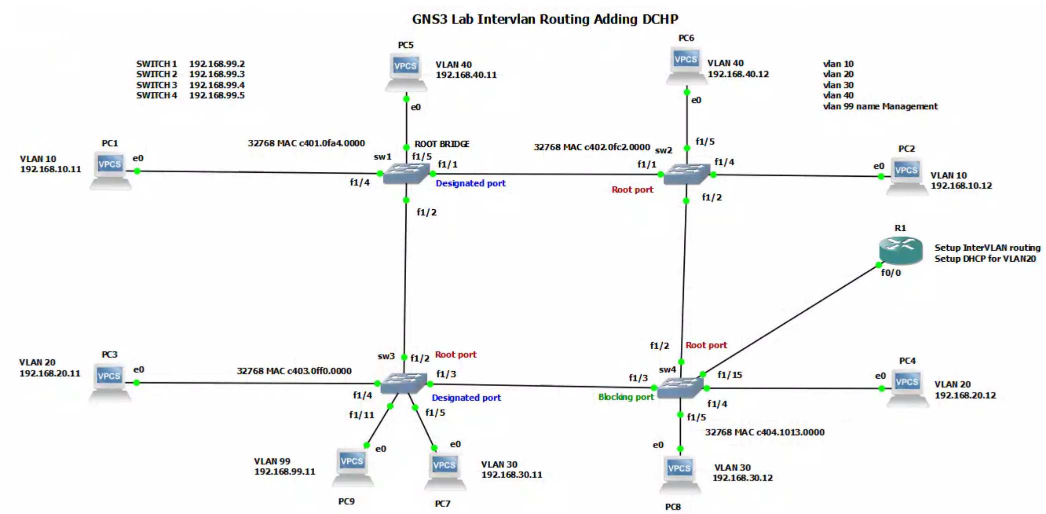
```
sw2#! Verify interfaces status
sw2#show protocols
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is administratively down, line protocol is down
FastEthernet0/1 is administratively down, line protocol is down
FastEthernet1/0 is up, line protocol is down
FastEthernet1/1 is up, line protocol is up
FastEthernet1/2 is up, line protocol is up
FastEthernet1/3 is up, line protocol is down
FastEthernet1/4 is up, line protocol is down
FastEthernet1/5 is up, line protocol is down
FastEthernet1/6 is up, line protocol is down
FastEthernet1/7 is up, line protocol is down
FastEthernet1/8 is up, line protocol is down
FastEthernet1/9 is up, line protocol is down
FastEthernet1/10 is up, line protocol is up
FastEthernet1/11 is up, line protocol is up
FastEthernet1/12 is up, line protocol is down
FastEthernet1/13 is up, line protocol is down
FastEthernet1/14 is up, line protocol is down
FastEthernet1/15 is up, line protocol is down
Port-channel1 is up, line protocol is up
Vlan1 is up, line protocol is up
sw2#
```

D) Save configuration

```
! Save the configuration (optional but recommended)
copy running-config startup-config
```

3.19.5 GNS3 - Lab Intervlan Routing Adding DCHP

3.19.5.1 Topology



3.19.5.2 Switches and VLANs Configuration

Element	VLAN	Port	Mode	IP Address
SWITCH 1	10	f1/4	Access	-
	40	f1/5	Access	-
	99	f1/1, f1/2, VLAN 99	Trunk/Native	192.168.99.2
SWITCH 2	10	f1/4	Access	-
	40	f1/5	Access	-
	99	f1/1, f1/2, VLAN 99	Trunk/Native	192.168.99.3
SWITCH 3	20	f1/4	Access	-
	30	f1/5	Access	-
	99	f1/2, f1/3, f1/11, VLAN 99	Trunk/Native	192.168.99.4
SWITCH 4	20	f1/4	Access	-
	30	f1/5	Access	-
	99	f1/2, f1/3, f1/15, VLAN 99	Trunk/Native	192.168.99.5

3.19.5.3 Router Sub-Interfaces and VLANs

Element	VLAN	Description	IP Address
ROUTER 1	10	Default Gateway for VLAN 10	192.168.10.1
	20	Default Gateway for VLAN 20	192.168.20.1
	30	Default Gateway for VLAN 30	192.168.30.1
	40	Default Gateway for VLAN 40	192.168.40.1

	99	Default Gateway for VLAN 99	192.168.99.1

3.19.5.4 PCs Configuration

PC	VLAN	IP Address	Subnet Mask	Default Gateway
PC1	10	192.168.10.11	255.255.255.0	192.168.10.1
PC2	10	192.168.10.12	255.255.255.0	192.168.10.1
PC3	20	192.168.20.11	255.255.255.0	192.168.20.1
PC4	20	192.168.20.12	255.255.255.0	192.168.20.1
PC5	40	192.168.40.11	255.255.255.0	192.168.40.1
PC6	40	192.168.40.12	255.255.255.0	192.168.40.1
PC7	30	192.168.30.11	255.255.255.0	192.168.30.1
PC8	30	192.168.30.12	255.255.255.0	192.168.30.1
PC9	99	192.168.99.11	255.255.255.0	192.168.99.1

3.19.5.5 Configuration

The configuration includes:

1) Spanning Tree Protocol
2) Router-on-a-Stick Inter-VLAN Routing
3) DHCP VLAN20 (ipv4& ipv6) having router as DHCP server

1. Configure IP addresses on each PC

```
PC1
ip 192.168.10.11 255.255.255.0 192.168.10.1
save
PC2
ip 192.168.10.12 255.255.255.0 192.168.10.1
save
```

```
PC3
ip 192.168.20.11 255.255.255.0 192.168.20.1
save
PC4
ip 192.168.20.12 255.255.255.0 192.168.20.1
save

PC5
ip 192.168.40.11 255.255.255.0 192.168.40.1
save
PC6
ip 192.168.40.12 255.255.255.0 192.168.40.1
save
PC7
ip 192.168.30.11 255.255.255.0 192.168.30.1
save
PC8
ip 192.168.30.12 255.255.255.0 192.168.30.1
save
PC9
ip 192.168.99.11 255.255.255.0 192.168.99.1
save
```

2. Configure Ip addresses, Intervlan routing and DHCP for IPV4 for VLAN20. As per topology the Spanning Tree Protocol is configured automatically.

Scripts

```
! SWITCH 1
clock set 16:30:00 Jan 11 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 10
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 40
 no shut
```

```
exit
interface f1/1
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.2 255.255.255.0
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

```
!SWITCH 2
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 10
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 40
 no shut
exit
interface f1/1
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
```

```
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.3 255.255.255.0
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

```
!SWITCH 3
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 20
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 30
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/3
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/11
```

```
 switchport mode access
 switchport access vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.4 255.255.255.0
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

```
!SWITCH 4
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 20
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 30
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/3
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.5 255.255.255.0
 no shut
exit
```

```
int f1/15
 description Trunk link to Router
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

3. Configure the router
   Note at the end of the script highlighted the DHCP IPV4 configuration that full fills requirement
   Setup DHCP for VLAN20

```
! ROUTER 1
config t
int f0/0.10
 description Default Gateway for VLAN 10
 encapsulation dot1Q 10
 ip address 192.168.10.1 255.255.255.0
exit
int f0/0.20
 description Default Gateway for VLAN 20
 encapsulation dot1Q 20
 ip address 192.168.20.1 255.255.255.0
exit
int f0/0.30
 description Default Gateway for VLAN 30
 encapsulation dot1Q 30
 ip address 192.168.30.1 255.255.255.0
exit
int f0/0.40
 description Default Gateway for VLAN 40
 encapsulation dot1Q 40
 ip address 192.168.40.1 255.255.255.0
exit
int f0/0.99
 description Default Gateway for VLAN 99
 encapsulation dot1Q 99 native
 ip address 192.168.99.1 255.255.255.0
exit
interface f0/0
 description Link R1 to SW4
 no shutdown
exit

!DHCP
```

```
ip dhcp excluded-address 192.168.20.1 192.168.20.10
ip dhcp pool R1-VLAN 20
network 192.168.20.0 255.255.255.0
default-router 192.168.20.1
dns-server 8.8.8.8
exit
end
copy running-config startup-config
```

3.19.5.6 Configuration verification

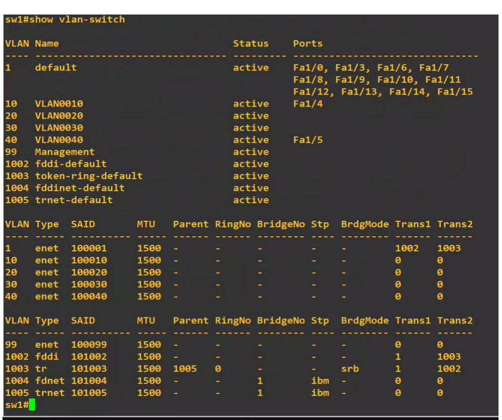
For switches do the following commands

```
!Switches
! Show VLANs
show vlan-switch

! Show IP Interface
show ip interface brief

! Show Interface Status
show interface status

! Show Trunk Interfaces
show interfaces trunk

! Show Spanning Tree
show spanning-tree
```

Verify vlans have ports assigned as per requirements

show vlan-switch

SW1



```
sw1#show vlan-switch

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa1/0, Fa1/3, Fa1/6, Fa1/7
                                                Fa1/8, Fa1/9, Fa1/10, Fa1/11
                                                Fa1/12, Fa1/13, Fa1/14, Fa1/15
10   VLAN0010                         active    Fa1/4
20   VLAN0020                         active
30   VLAN0030                         active
40   VLAN0040                         active    Fa1/5
99   Management                       active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        1002   1003
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
40   enet  100040     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        1      1003
1003 tr    101003     1500  1005   0      -        -    srb      1      1002
1004 fdnet 101004     1500  -      -      1        ibm  -        0      0
1005 trnet 101005     1500  -      -      1        ibm  -        0      0
sw1#
```

SW2

```
sw2#
sw2#show vlan-switch

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa1/0, Fa1/3, Fa1/6, Fa1/7
                                                Fa1/8, Fa1/9, Fa1/10, Fa1/11
                                                Fa1/12, Fa1/13, Fa1/14, Fa1/15
10   VLAN0010                         active    Fa1/4
20   VLAN0020                         active
30   VLAN0030                         active
40   VLAN0040                         active    Fa1/5
99   Management                       active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        1002   1003
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
40   enet  100040     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        1      1003
1003 tr    101003     1500  1005   0      -        -    srb      1      1002
1004 fdnet 101004     1500  -      -      1        ibm  -        0      0
1005 trnet 101005     1500  -      -      1        ibm  -        0      0
sw2#
```

SW 3

```
sw3#show vlan-switch

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa1/0, Fa1/1, Fa1/6, Fa1/7
                                                Fa1/8, Fa1/9, Fa1/10, Fa1/12
                                                Fa1/13, Fa1/14, Fa1/15
10   VLAN0010                         active
20   VLAN0020                         active    Fa1/4
30   VLAN0030                         active    Fa1/5
40   VLAN0040                         active
99   Management                       active    Fa1/11
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        1002   1003
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
40   enet  100040     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        1      1003
1003 tr    101003     1500  1005   0      -        -    srb      1      1002
1004 fdnet 101004     1500  -      -      1        ibm  -        0      0
1005 trnet 101005     1500  -      -      1        ibm  -        0      0
sw3#
```

SW4

```
sw4#show vlan-switch

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa1/0, Fa1/1, Fa1/6, Fa1/7
                                                Fa1/8, Fa1/9, Fa1/10, Fa1/11
                                                Fa1/12, Fa1/13, Fa1/14
10   VLAN0010                         active
20   VLAN0020                         active    Fa1/4
30   VLAN0030                         active    Fa1/5
40   VLAN0040                         active
99   Management                       active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        1002   1003
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
40   enet  100040     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        1      1003
1003 tr    101003     1500  1005   0      -        -    srb      1      1002
1004 fdnet 101004     1500  -      -      1        ibm  -        0      0
1005 trnet 101005     1500  -      -      1        ibm  -        0      0
sw4#
```

Verify interfaces are up

show ip interface

See the columns in the printout

- **Manual** in this context means the IP address was manually configured by an administrator.
- **unset** means no IP address has been assigned to the interface.
- The **Status** and **Protocol** columns indicate whether the interface is operational and communicating.

SW1

```
sw1#! Show IP Interface
sw1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
FastEthernet1/0        unassigned      YES unset  up                    down
FastEthernet1/1        unassigned      YES unset  up                    up
FastEthernet1/2        unassigned      YES unset  up                    up
FastEthernet1/3        unassigned      YES unset  up                    down
FastEthernet1/4        unassigned      YES unset  up                    up
FastEthernet1/5        unassigned      YES unset  up                    up
FastEthernet1/6        unassigned      YES unset  up                    down
FastEthernet1/7        unassigned      YES unset  up                    down
FastEthernet1/8        unassigned      YES unset  up                    down
FastEthernet1/9        unassigned      YES unset  up                    down
FastEthernet1/10       unassigned      YES unset  up                    down
FastEthernet1/11       unassigned      YES unset  up                    down
FastEthernet1/12       unassigned      YES unset  up                    down
FastEthernet1/13       unassigned      YES unset  up                    down
FastEthernet1/14       unassigned      YES unset  up                    down
FastEthernet1/15       unassigned      YES unset  up                    down
Vlan1                  unassigned      YES unset  up                    up
Vlan99                 192.168.99.2    YES manual up                    up
sw1#
```

SW2

```
sw2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
FastEthernet1/0        unassigned      YES unset  up                    down
FastEthernet1/1        unassigned      YES unset  up                    up
FastEthernet1/2        unassigned      YES unset  up                    up
FastEthernet1/3        unassigned      YES unset  up                    down
FastEthernet1/4        unassigned      YES unset  up                    up
FastEthernet1/5        unassigned      YES unset  up                    up
FastEthernet1/6        unassigned      YES unset  up                    down
FastEthernet1/7        unassigned      YES unset  up                    down
FastEthernet1/8        unassigned      YES unset  up                    down
FastEthernet1/9        unassigned      YES unset  up                    down
FastEthernet1/10       unassigned      YES unset  up                    down
FastEthernet1/11       unassigned      YES unset  up                    down
FastEthernet1/12       unassigned      YES unset  up                    down
FastEthernet1/13       unassigned      YES unset  up                    down
FastEthernet1/14       unassigned      YES unset  up                    down
FastEthernet1/15       unassigned      YES unset  up                    down
Vlan1                  unassigned      YES unset  up                    up
Vlan99                 192.168.99.3    YES manual up                    up
sw2#
```

SW3

```
sw3#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
FastEthernet1/0        unassigned      YES unset  up                    down
FastEthernet1/1        unassigned      YES unset  up                    down
FastEthernet1/2        unassigned      YES unset  up                    up
FastEthernet1/3        unassigned      YES unset  up                    up
FastEthernet1/4        unassigned      YES unset  up                    up
FastEthernet1/5        unassigned      YES unset  up                    up
FastEthernet1/6        unassigned      YES unset  up                    down
FastEthernet1/7        unassigned      YES unset  up                    down
FastEthernet1/8        unassigned      YES unset  up                    down
FastEthernet1/9        unassigned      YES unset  up                    down
FastEthernet1/10       unassigned      YES unset  up                    down
FastEthernet1/11       unassigned      YES unset  up                    up
FastEthernet1/12       unassigned      YES unset  up                    down
FastEthernet1/13       unassigned      YES unset  up                    down
FastEthernet1/14       unassigned      YES unset  up                    down
FastEthernet1/15       unassigned      YES unset  up                    down
Vlan1                  unassigned      YES unset  up                    up
Vlan99                 192.168.99.4    YES manual up                    up
sw3#
```

SW4

```
sw4#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
FastEthernet1/0        unassigned      YES unset  up                    down
FastEthernet1/1        unassigned      YES unset  up                    down
FastEthernet1/2        unassigned      YES unset  up                    up
FastEthernet1/3        unassigned      YES unset  up                    up
FastEthernet1/4        unassigned      YES unset  up                    up
FastEthernet1/5        unassigned      YES unset  up                    up
FastEthernet1/6        unassigned      YES unset  up                    down
FastEthernet1/7        unassigned      YES unset  up                    down
FastEthernet1/8        unassigned      YES unset  up                    down
FastEthernet1/9        unassigned      YES unset  up                    down
FastEthernet1/10       unassigned      YES unset  up                    down
FastEthernet1/11       unassigned      YES unset  up                    down
FastEthernet1/12       unassigned      YES unset  up                    down
FastEthernet1/13       unassigned      YES unset  up                    down
FastEthernet1/14       unassigned      YES unset  up                    down
FastEthernet1/15       unassigned      YES unset  up                    up
Vlan1                  unassigned      YES unset  up                    up
Vlan99                 192.168.99.5    YES manual up                    up
sw4#
```

Show interface status

```
! Show Interface Status
show interface status
```

See the required ports are connected, if vlan requested, see if vlan assigned is correct . Check trunk ports are correctly configured.

SW1

```
sw1#! Show Interface Status
sw1#show interface status

Port      Name               Status       Vlan       Duplex  Speed Type
Fa1/0                        notconnect   1            auto   auto 10/100BaseTX
Fa1/1                        connected    trunk      a-full  a-100 10/100BaseTX
Fa1/2                        connected    trunk      a-full  a-100 10/100BaseTX
Fa1/3                        notconnect   1            auto   auto 10/100BaseTX
Fa1/4                        connected    10         a-full  a-100 10/100BaseTX
Fa1/5                        connected    40         a-full  a-100 10/100BaseTX
Fa1/6                        notconnect   1            auto   auto 10/100BaseTX
Fa1/7                        notconnect   1            auto   auto 10/100BaseTX
Fa1/8                        notconnect   1            auto   auto 10/100BaseTX
Fa1/9                        notconnect   1            auto   auto 10/100BaseTX
Fa1/10                       notconnect   1            auto   auto 10/100BaseTX
Fa1/11                       notconnect   1            auto   auto 10/100BaseTX
Fa1/12                       notconnect   1            auto   auto 10/100BaseTX
Fa1/13                       notconnect   1            auto   auto 10/100BaseTX
Fa1/14                       notconnect   1            auto   auto 10/100BaseTX
Fa1/15                       notconnect   1            auto   auto 10/100BaseTX
sw1#
```

SW 2

```
sw2#! Show Interface Status
sw2#show interface status

Port      Name               Status       Vlan       Duplex  Speed Type
Fa1/0                        notconnect   1            auto   auto 10/100BaseTX
Fa1/1                        connected    trunk      a-full  a-100 10/100BaseTX
Fa1/2                        connected    trunk      a-full  a-100 10/100BaseTX
Fa1/3                        notconnect   1            auto   auto 10/100BaseTX
Fa1/4                        connected    10         a-full  a-100 10/100BaseTX
Fa1/5                        connected    40         a-full  a-100 10/100BaseTX
Fa1/6                        notconnect   1            auto   auto 10/100BaseTX
Fa1/7                        notconnect   1            auto   auto 10/100BaseTX
Fa1/8                        notconnect   1            auto   auto 10/100BaseTX
Fa1/9                        notconnect   1            auto   auto 10/100BaseTX
Fa1/10                       notconnect   1            auto   auto 10/100BaseTX
Fa1/11                       notconnect   1            auto   auto 10/100BaseTX
Fa1/12                       notconnect   1            auto   auto 10/100BaseTX
Fa1/13                       notconnect   1            auto   auto 10/100BaseTX
Fa1/14                       notconnect   1            auto   auto 10/100BaseTX
Fa1/15                       notconnect   1            auto   auto 10/100BaseTX
sw2#
```

SW3

```
sw3#! Show Interface Status
sw3#show interface status

Port     Name               Status       Vlan       Duplex Speed Type
Fa1/0                       notconnect   1            auto    auto 10/100BaseTX
Fa1/1                       notconnect   1            auto    auto 10/100BaseTX
Fa1/2                       connected    trunk      a-full   a-100 10/100BaseTX
Fa1/3                       connected    trunk      a-full   a-100 10/100BaseTX
Fa1/4                       connected    20         a-full   a-100 10/100BaseTX
Fa1/5                       connected    30         a-full   a-100 10/100BaseTX
Fa1/6                       notconnect   1            auto    auto 10/100BaseTX
Fa1/7                       notconnect   1            auto    auto 10/100BaseTX
Fa1/8                       notconnect   1            auto    auto 10/100BaseTX
Fa1/9                       notconnect   1            auto    auto 10/100BaseTX
Fa1/10                      notconnect   1            auto    auto 10/100BaseTX
Fa1/11                      connected    99         a-full   a-100 10/100BaseTX
Fa1/12                      notconnect   1            auto    auto 10/100BaseTX
Fa1/13                      notconnect   1            auto    auto 10/100BaseTX
Fa1/14                      notconnect   1            auto    auto 10/100BaseTX
Fa1/15                      notconnect   1            auto    auto 10/100BaseTX
sw3#
```

SW4

```
sw4#! Show Interface Status
sw4#show interface status

Port     Name               Status       Vlan       Duplex Speed Type
Fa1/0                       notconnect   1            auto    auto 10/100BaseTX
Fa1/1                       notconnect   1            auto    auto 10/100BaseTX
Fa1/2                       connected    trunk      a-full   a-100 10/100BaseTX
Fa1/3                       connected    trunk      a-full   a-100 10/100BaseTX
Fa1/4                       connected    20         a-full   a-100 10/100BaseTX
Fa1/5                       connected    30         a-full   a-100 10/100BaseTX
Fa1/6                       notconnect   1            auto    auto 10/100BaseTX
Fa1/7                       notconnect   1            auto    auto 10/100BaseTX
Fa1/8                       notconnect   1            auto    auto 10/100BaseTX
Fa1/9                       notconnect   1            auto    auto 10/100BaseTX
Fa1/10                      notconnect   1            auto    auto 10/100BaseTX
Fa1/11                      notconnect   1            auto    auto 10/100BaseTX
Fa1/12                      notconnect   1            auto    auto 10/100BaseTX
Fa1/13                      notconnect   1            auto    auto 10/100BaseTX
Fa1/14                      notconnect   1            auto    auto 10/100BaseTX
Fa1/15   Trunk link to Rout connected    trunk      a-full   a-100 10/100BaseTX
```

```
! Show Trunk Interfaces
show interfaces trunk
```

SW1

```
sw1#! Show Trunk Interfaces
sw1#show interfaces trunk

Port        Mode             Encapsulation  Status        Native vlan
Fa1/1       on               802.1q         trunking      99
Fa1/2       on               802.1q         trunking      99

Port        Vlans allowed on trunk
Fa1/1       1-1005
Fa1/2       1-1005

Port        Vlans allowed and active in management domain
Fa1/1       1,10,20,30,40,99
Fa1/2       1,10,20,30,40,99

Port        Vlans in spanning tree forwarding state and not pruned
Fa1/1       1,10,20,30,40,99
Fa1/2       1,10,20,30,40,99
sw1#
```

SW2

```
sw2#! Show Trunk Interfaces
sw2#show interfaces trunk

Port      Mode         Encapsulation  Status        Native vlan
Fa1/1     on           802.1q         trunking      99
Fa1/2     on           802.1q         trunking      99

Port      Vlans allowed on trunk
Fa1/1     1-1005
Fa1/2     1-1005

Port      Vlans allowed and active in management domain
Fa1/1     1,10,20,30,40,99
Fa1/2     1,10,20,30,40,99

Port      Vlans in spanning tree forwarding state and not pruned
Fa1/1     1,10,20,30,40,99
Fa1/2     1,10,20,30,40,99
sw2#
```

SW3

```
sw3#! Show Trunk Interfaces
sw3#show interfaces trunk

Port      Mode         Encapsulation  Status        Native vlan
Fa1/2     on           802.1q         trunking      99
Fa1/3     on           802.1q         trunking      99

Port      Vlans allowed on trunk
Fa1/2     1-1005
Fa1/3     1-1005

Port      Vlans allowed and active in management domain
Fa1/2     1,10,20,30,40,99
Fa1/3     1,10,20,30,40,99

Port      Vlans in spanning tree forwarding state and not pruned
Fa1/2     1,10,20,30,40,99
Fa1/3     1,10,20,30,40,99
sw3#
```

SW4

```
sw4#! Show Trunk Interfaces
sw4#show interfaces trunk

Port      Mode         Encapsulation  Status        Native vlan
Fa1/2     on           802.1q         trunking      99
Fa1/3     on           802.1q         trunking      99
Fa1/15    on           802.1q         trunking      99

Port      Vlans allowed on trunk
Fa1/2     1-1005
Fa1/3     1-1005
Fa1/15    1-1005

Port      Vlans allowed and active in management domain
Fa1/2     1,10,20,30,40,99
Fa1/3     1,10,20,30,40,99
Fa1/15    1,10,20,30,40,99

Port      Vlans in spanning tree forwarding state and not pruned
Fa1/2     1,10,20,30,40,99
Fa1/3     none
Fa1/15    1,10,20,30,40,99
sw4#
```

```
! Show Spanning Tree
show spanning-tree

Use this filters to identify the port status
conf t
do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
end

SW1
```

```
sw1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw1(config)#do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
 VLAN10 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN10 is forwarding
 Port 43 (FastEthernet1/2) of VLAN10 is forwarding
 Port 45 (FastEthernet1/4) of VLAN10 is forwarding
sw1(config)#do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
 VLAN20 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN20 is forwarding
 Port 43 (FastEthernet1/2) of VLAN20 is forwarding
sw1(config)#do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
 VLAN30 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN30 is forwarding
 Port 43 (FastEthernet1/2) of VLAN30 is forwarding
sw1(config)#do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
 VLAN40 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN40 is forwarding
 Port 43 (FastEthernet1/2) of VLAN40 is forwarding
 Port 46 (FastEthernet1/5) of VLAN40 is forwarding
sw1(config)#do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
 VLAN99 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN99 is forwarding
 Port 43 (FastEthernet1/2) of VLAN99 is forwarding
sw1(config)#end
sw1#
Jan 11 01:57:09.490: %SYS-5-CONFIG_I: Configured from console by console
sw1#
```

SW2

```
sw2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw2(config)#do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
 VLAN10 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN10 is forwarding
 Port 43 (FastEthernet1/2) of VLAN10 is forwarding
 Port 45 (FastEthernet1/4) of VLAN10 is forwarding
sw2(config)#do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
 VLAN20 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN20 is forwarding
 Port 43 (FastEthernet1/2) of VLAN20 is forwarding
sw2(config)#do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
 VLAN30 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN30 is forwarding
 Port 43 (FastEthernet1/2) of VLAN30 is forwarding
sw2(config)#do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
 VLAN40 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN40 is forwarding
 Port 43 (FastEthernet1/2) of VLAN40 is forwarding
 Port 46 (FastEthernet1/5) of VLAN40 is forwarding
sw2(config)#do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
 VLAN99 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN99 is forwarding
 Port 43 (FastEthernet1/2) of VLAN99 is forwarding
sw2(config)#end
sw2#
Jan 11 01:55:53.426: %SYS-5-CONFIG_I: Configured from console by console
sw2#
```

SW3

```
sw3(config)#end
sw3#
Jan 11 01:45:39.042: %SYS-5-CONFIG_I: Configured from console by console
sw3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw3(config)#do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
 VLAN10 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN10 is forwarding
 Port 44 (FastEthernet1/3) of VLAN10 is forwarding
sw3(config)#do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
 VLAN20 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN20 is forwarding
 Port 44 (FastEthernet1/3) of VLAN20 is forwarding
 Port 45 (FastEthernet1/4) of VLAN20 is forwarding
sw3(config)#do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
 VLAN30 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN30 is forwarding
 Port 44 (FastEthernet1/3) of VLAN30 is forwarding
 Port 46 (FastEthernet1/5) of VLAN30 is forwarding
sw3(config)#do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
 VLAN40 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN40 is forwarding
 Port 44 (FastEthernet1/3) of VLAN40 is forwarding
sw3(config)#do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
 VLAN99 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN99 is forwarding
 Port 44 (FastEthernet1/3) of VLAN99 is forwarding
 Port 52 (FastEthernet1/11) of VLAN99 is forwarding
sw3(config)#end
sw3#
sw3#
Jan 11 01:55:02.558: %SYS-5-CONFIG_I: Configured from console by console
```

SW4

```
sw4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw4(config)#do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
 VLAN10 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN10 is forwarding
 Port 44 (FastEthernet1/3) of VLAN10 is blocking
 Port 56 (FastEthernet1/15) of VLAN10 is forwarding
sw4(config)#do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
 VLAN20 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN20 is forwarding
 Port 44 (FastEthernet1/3) of VLAN20 is blocking
 Port 45 (FastEthernet1/4) of VLAN20 is forwarding
 Port 56 (FastEthernet1/15) of VLAN20 is forwarding
sw4(config)#do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
 VLAN30 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN30 is forwarding
 Port 44 (FastEthernet1/3) of VLAN30 is blocking
 Port 46 (FastEthernet1/5) of VLAN30 is forwarding
 Port 56 (FastEthernet1/15) of VLAN30 is forwarding
sw4(config)#do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
 VLAN40 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN40 is forwarding
 Port 44 (FastEthernet1/3) of VLAN40 is blocking
 Port 56 (FastEthernet1/15) of VLAN40 is forwarding
sw4(config)#do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
 VLAN99 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN99 is forwarding
 Port 44 (FastEthernet1/3) of VLAN99 is blocking
 Port 56 (FastEthernet1/15) of VLAN99 is forwarding
sw4(config)#end
```

Router

Issue the following commands

```
!Router
! Show IP Interface Brief
show ip interface brief

! Show IP Route
show ip route
!DHCP
show ip dhcp pool
```

show ip dhcp binding
! Display DHCP Configuration
show running-config | section dhcp

!Router

```
! Show IP Interface Brief
show ip interface brief
```

```
R1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  up                    up
FastEthernet0/0.10     192.168.10.1    YES manual up                    up
FastEthernet0/0.20     192.168.20.1    YES manual up                    up
FastEthernet0/0.30     192.168.30.1    YES manual up                    up
FastEthernet0/0.40     192.168.40.1    YES manual up                    up
FastEthernet0/0.99     192.168.99.1    YES manual up                    up
FastEthernet1/0        unassigned      YES unset  administratively down down
FastEthernet1/1        unassigned      YES unset  administratively down down
Serial2/0              unassigned      YES unset  administratively down down
Serial2/1              unassigned      YES unset  administratively down down
Serial2/2              unassigned      YES unset  administratively down down
Serial2/3              unassigned      YES unset  administratively down down
```

```
show ip route
```

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.10.0/24 is directly connected, FastEthernet0/0.10
L        192.168.10.1/32 is directly connected, FastEthernet0/0.10
      192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.20.0/24 is directly connected, FastEthernet0/0.20
L        192.168.20.1/32 is directly connected, FastEthernet0/0.20
      192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.30.0/24 is directly connected, FastEthernet0/0.30
L        192.168.30.1/32 is directly connected, FastEthernet0/0.30
      192.168.40.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.40.0/24 is directly connected, FastEthernet0/0.40
L        192.168.40.1/32 is directly connected, FastEthernet0/0.40
      192.168.99.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.99.0/24 is directly connected, FastEthernet0/0.99
L        192.168.99.1/32 is directly connected, FastEthernet0/0.99
R1#
```

3.19.5.7 Test connectivity

Verify connectivity between PCs within their respective VLANs using ping command.

For PC1

```
!PC's
ping 192.168.10.1
ping 192.168.20.1
ping 192.168.30.1
ping 192.168.40.1
ping 192.168.99.1
```

PC1

```
PC1> ping 192.168.10.1

84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=10.699 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=1.665 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=4.141 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=13.101 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=11.022 ms

PC1> ping 192.168.20.1

84 bytes from 192.168.20.1 icmp_seq=1 ttl=255 time=9.736 ms
84 bytes from 192.168.20.1 icmp_seq=2 ttl=255 time=9.164 ms
84 bytes from 192.168.20.1 icmp_seq=3 ttl=255 time=10.581 ms
84 bytes from 192.168.20.1 icmp_seq=4 ttl=255 time=5.755 ms
84 bytes from 192.168.20.1 icmp_seq=5 ttl=255 time=4.404 ms

PC1> ping 192.168.30.1

84 bytes from 192.168.30.1 icmp_seq=1 ttl=255 time=3.475 ms
84 bytes from 192.168.30.1 icmp_seq=2 ttl=255 time=16.966 ms
84 bytes from 192.168.30.1 icmp_seq=3 ttl=255 time=15.397 ms
84 bytes from 192.168.30.1 icmp_seq=4 ttl=255 time=7.777 ms
84 bytes from 192.168.30.1 icmp_seq=5 ttl=255 time=8.290 ms

PC1> ping 192.168.99.1

84 bytes from 192.168.99.1 icmp_seq=1 ttl=255 time=8.180 ms
84 bytes from 192.168.99.1 icmp_seq=2 ttl=255 time=2.645 ms
84 bytes from 192.168.99.1 icmp_seq=3 ttl=255 time=2.080 ms
84 bytes from 192.168.99.1 icmp_seq=4 ttl=255 time=4.745 ms
84 bytes from 192.168.99.1 icmp_seq=5 ttl=255 time=5.196 ms

PC1>
```

```
PC1> ping 192.168.40.1

84 bytes from 192.168.40.1 icmp_seq=1 ttl=255 time=9.097 ms
84 bytes from 192.168.40.1 icmp_seq=2 ttl=255 time=5.821 ms
84 bytes from 192.168.40.1 icmp_seq=3 ttl=255 time=2.413 ms
84 bytes from 192.168.40.1 icmp_seq=4 ttl=255 time=3.650 ms
84 bytes from 192.168.40.1 icmp_seq=5 ttl=255 time=6.922 ms

PC1>
```

Verify Inter-VLAN routing from PC1.

PC1

```
ping 192.168.20.12
ping 192.168.30.12
ping 192.168.40.12
ping 192.168.99.11
```

```
PC1> ping 192.168.20.12

84 bytes from 192.168.20.12 icmp_seq=1 ttl=63 time=31.637 ms
84 bytes from 192.168.20.12 icmp_seq=2 ttl=63 time=14.775 ms
84 bytes from 192.168.20.12 icmp_seq=3 ttl=63 time=16.708 ms
84 bytes from 192.168.20.12 icmp_seq=4 ttl=63 time=12.879 ms
84 bytes from 192.168.20.12 icmp_seq=5 ttl=63 time=14.469 ms

PC1> ping 192.168.30.12

84 bytes from 192.168.30.12 icmp_seq=1 ttl=63 time=29.273 ms
84 bytes from 192.168.30.12 icmp_seq=2 ttl=63 time=25.085 ms
84 bytes from 192.168.30.12 icmp_seq=3 ttl=63 time=17.243 ms
84 bytes from 192.168.30.12 icmp_seq=4 ttl=63 time=23.214 ms
84 bytes from 192.168.30.12 icmp_seq=5 ttl=63 time=14.880 ms

PC1> ping 192.168.40.12

84 bytes from 192.168.40.12 icmp_seq=1 ttl=63 time=38.204 ms
84 bytes from 192.168.40.12 icmp_seq=2 ttl=63 time=13.166 ms
84 bytes from 192.168.40.12 icmp_seq=3 ttl=63 time=20.173 ms
84 bytes from 192.168.40.12 icmp_seq=4 ttl=63 time=14.695 ms
84 bytes from 192.168.40.12 icmp_seq=5 ttl=63 time=20.358 ms
```

```
PC1> ping 192.168.99.11

84 bytes from 192.168.99.11 icmp_seq=1 ttl=63 time=33.082 ms
84 bytes from 192.168.99.11 icmp_seq=2 ttl=63 time=29.865 ms
84 bytes from 192.168.99.11 icmp_seq=3 ttl=63 time=19.116 ms
84 bytes from 192.168.99.11 icmp_seq=4 ttl=63 time=26.228 ms
84 bytes from 192.168.99.11 icmp_seq=5 ttl=63 time=21.999 ms

PC1>
```

3.19.5.8 DHCP test

Start Wireshark to see traffic for DHCP on interface between PC4 and router

Set PC3 and PC4 to receive IP addressing information from DHCP.

Show

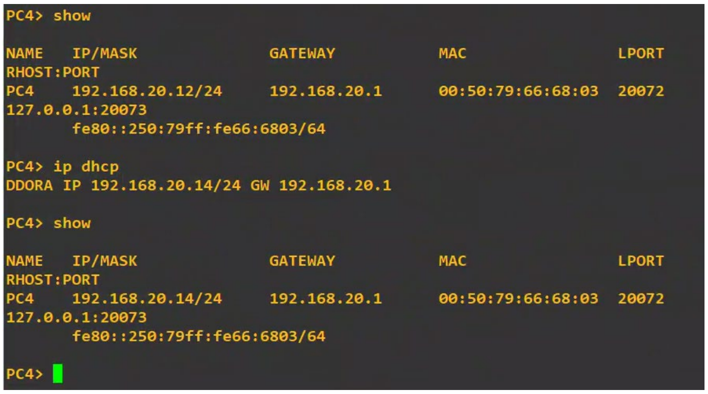
ip dhcp

show

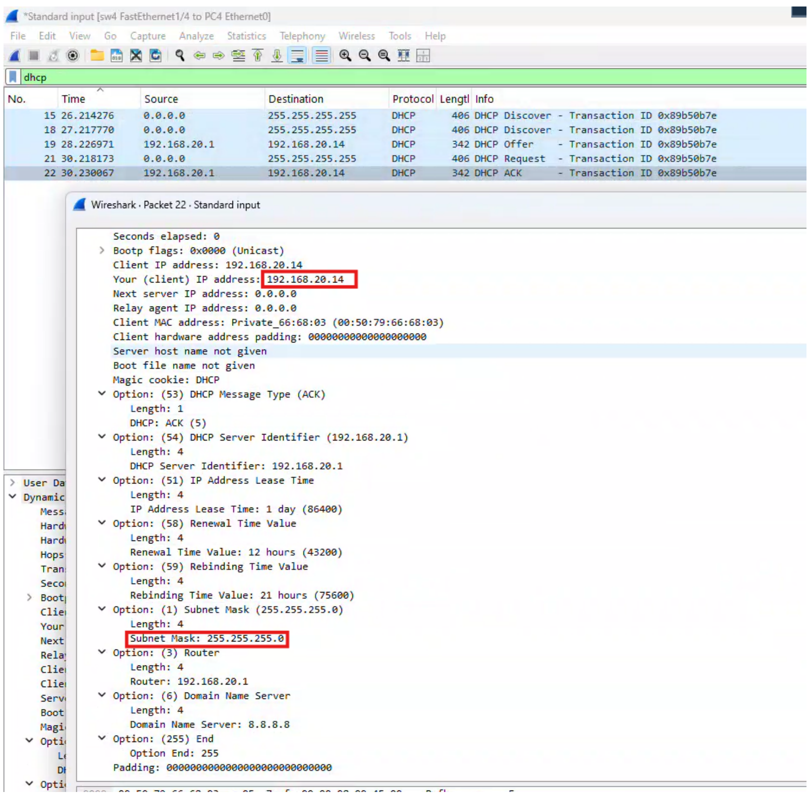
PC3

```
PC3> show

NAME   IP/MASK              GATEWAY           MAC                LPORT  RHOST:PORT
PC3    192.168.20.11/24     192.168.20.1      00:50:79:66:68:02  20070  127.0.0.1:20071
       fe80::250:79ff:fe66:6802/64

PC3> ip dhcp
DDORA IP 192.168.20.13/24 GW 192.168.20.1

PC3> show

NAME   IP/MASK              GATEWAY           MAC                LPORT  RHOST:PORT
PC3    192.168.20.13/24     192.168.20.1      00:50:79:66:68:02  20070  127.0.0.1:20071
       fe80::250:79ff:fe66:6802/64

PC3>
```

PC4



Wireshark messages related to DHCP. See the flow and what IP was assigned.



DHCP IPV4 printouts

```
!Router
!DHCP
show ip dhcp pool
show ip dhcp binding
! Show DHCP Server Statistics
show ip dhcp server statistics

 ! Display DHCP Configuration
show running-config | section dhcp
```

show ip dhcp pool
show ip dhcp binding

```
R1#show ip dhcp pool

Pool R1-VLAN 20 :
 Utilization mark (high/low)    : 100 / 0
 Subnet size (first/next)       : 0 / 0
 Total addresses                : 254
 Leased addresses               : 2
 Excluded addresses             : 12
 Pending event                  : none
 1 subnet is currently in the pool :
 Current index        IP address range                    Leased/Excluded/Total
 192.168.20.15        192.168.20.1     - 192.168.20.254    2     / 12     / 254
R1#show ip dhcp binding
Bindings from all pools not associated with VRF:
IP address      Client-ID/              Lease expiration        Type       State      Interface
                Hardware address/
                User name
192.168.20.13   0100.5079.6668.02       Feb 13 2025 01:06 AM    Automatic  Active     FastEthernet0/0.20
192.168.20.14   0100.5079.6668.03       Feb 13 2025 01:08 AM    Automatic  Active     FastEthernet0/0.20
R1#show ip dhcp server statistics
Memory usage          16117
Address pools         1
Database agents       0
```

```
! Show DHCP Server Statistics
show ip dhcp server statistics
```

```
R1#show ip dhcp server statistics
Memory usage             16117
Address pools            1
Database agents          0
Automatic bindings       2
Manual bindings          0
Expired bindings         0
Malformed messages       0
Secure arp entries       0
Renew messages           0
Workspace timeouts       0
Static routes            0
Relay bindings           0
Relay bindings active            0
Relay bindings terminated        0
Relay bindings selecting         0

Message                  Received
BOOTREQUEST              0
DHCPDISCOVER             4
DHCPREQUEST              2
DHCPDECLINE              0
DHCPRELEASE              0
DHCPINFORM               0
DHCPVENDOR               0
BOOTREPLY                0
DHCPOFFER                0
DHCPACK                  0
DHCPNAK                  0

Message                  Sent
BOOTREPLY                0
DHCPOFFER                2
DHCPACK                  2
DHCPNAK                  0

Message                  Forwarded
BOOTREQUEST              0
```

```
Message                  Sent
BOOTREPLY                0
DHCPOFFER                2
DHCPACK                  2
DHCPNAK                  0

Message                  Forwarded
BOOTREQUEST              0
DHCPDISCOVER             0
DHCPREQUEST              0
DHCPDECLINE              0
DHCPRELEASE              0
DHCPINFORM               0
DHCPVENDOR               0
BOOTREPLY                0
DHCPOFFER                0
DHCPACK                  0
DHCPNAK                  0

DHCP-DPM Statistics
Offer notifications sent         0
Offer callbacks received         0
Classname requests sent          0
Classname callbacks received     0

R1#
```

! Display DHCP Configuration

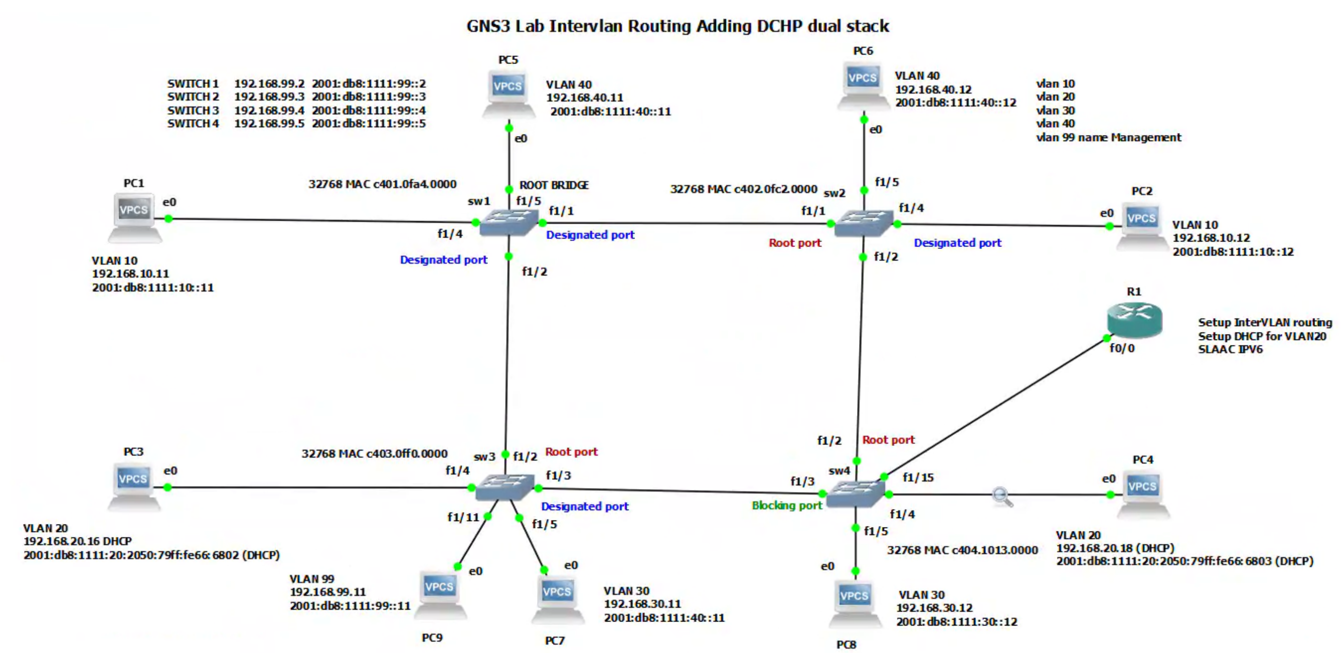
show running-config | section dhcp

```
R1#! Display DHCP Configuration
R1#show running-config | section dhcp
ip dhcp excluded-address 192.168.20.1 192.168.20.10
ip dhcp pool R1-VLAN 20
 network 192.168.20.0 255.255.255.0
 default-router 192.168.20.1
 dns-server 8.8.8.8
R1#
```

3.19.6 GNS3 - Dual stack configuration with DHCP

Based on configuration specified in section " 5.12.6 GNS3 - STP , Intervlan Routing Adding DCHP IPV4" add IPV6 to have dual stack configuration with DHCP for IPV6 .

3.19.6.1 Topology



3.19.6.1.1 Configuration table

Device	Interface	VLAN	IPv4 Address	IPv6 Address	Mode	Native VLAN	Default Gateway	IPv6 Default Route	Description

SWITCH 1	f1/4	10	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 10
	f1/5	40	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 40
	f1/1	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link
	f1/2	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link
	VLAN 99	99	192.168.99.2/24	2001:db8:1111:99::2/64	-	-	192.168.99.1	2001:db8:1111:99::1	Management VLAN
SWITCH 2	f1/4	10	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 10
	f1/5	40	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 40
	f1/1	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link
	f1/2	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link
	VLAN 99	99	192.168.99.3/24	2001:db8:1111:99::3/64	-	-	192.168.99.1	2001:db8:1111:99::1	Management VLAN
SWITCH 3	f1/4	20	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 20
	f1/5	30	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 30
	f1/2	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link
	f1/3	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link
	f1/11	99	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 99
	VLAN 99	99	192.168.99.4/24	2001:db8:1111:99::4/64	-	-	192.168.99.1	2001:db8:1111:99::1	Management VLAN
SWITCH 4	f1/4	20	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 20
	f1/5	30	-	-	Access	-	192.168.99.1	2001:db8:1111:99::1	Access port for VLAN 30
	f1/2	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link
	f1/3	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link
	f1/15	99	-	-	Trunk	99	192.168.99.1	2001:db8:1111:99::1	Trunk link to Router
	VLAN 99	99	192.168.99.5/24	2001:db8:1111:99::5/64	-	-	192.168.99.1	2001:db8:1111:99::1	Management VLAN
ROUTER R1	f0/0.10	10	192.168.10.1/24	2001:db8:1111:10::1/64	Subinterface	-	-	-	Default Gateway for VLAN 10
	f0/0.20	20	192.168.20.1/24	2001:db8:1111:20::1/64	Subinterface	-	-	-	Default Gateway for VLAN 20
	f0/0.30	30	192.168.30.1/24	2001:db8:1111:30::1/64	Subinterface	-	-	-	Default Gateway for VLAN 30
	f0/0.40	40	192.168.40.1/24	2001:db8:1111:40::1/64	Subinterface	-	-	-	Default Gateway for VLAN 40
	f0/0.99	99	192.168.99.1/24	2001:db8:1111:99::1/64	Subinterface	99	-	-	Default Gateway for VLAN 99
	f0/0	-	-	-	Interface	-	-	-	Link R1 to SW4

3.19.6.1.2 VLAN table

VLAN ID	VLAN Name	IPv4 Subnet	IPv6 Subnet	Description
10	-	192.168.10.0/24	2001:db8:1111:10::/64	VLAN for PCs (PC1, PC2)
20	-	192.168.20.0/24	2001:db8:1111:20::/64	VLAN for PCs (PC3, PC4) with DHCP
30	-	192.168.30.0/24	2001:db8:1111:30::/64	VLAN for PCs (PC6, PC8)
40	-	192.168.40.0/24	2001:db8:1111:40::/64	VLAN for PCs (PC5, PC7)
99	Management	192.168.99.0/24	2001:db8:1111:99::/64	Management VLAN for switches and router

3.19.6.1.3 Static IP's for PC's

PC	IPv4 Address	IPv4 Subnet Mask	IPv4 Gateway	IPv6 Address	IPv6 Prefix	IPv6 Gateway	VLAN
PC1	192.168.10.11	255.255.255.0	192.168.10.1	2001:db8:1111:10::11/64	/64	2001:db8:1111:10::1	10
PC2	192.168.10.12	255.255.255.0	192.168.10.1	2001:db8:1111:10::12/64	/64	2001:db8:1111:10::1	10
PC3	192.168.20.11	255.255.255.0	192.168.20.1	2001:db8:1111:20::11/64	/64	2001:db8:1111:20::1	20
PC4	192.168.20.12	255.255.255.0	192.168.20.1	2001:db8:1111:20::12/64	/64	2001:db8:1111:20::1	20
PC5	192.168.40.11	255.255.255.0	192.168.40.1	2001:db8:1111:40::11/64	/64	2001:db8:1111:40::1	40
PC6	192.168.30.11	255.255.255.0	192.168.30.1	2001:db8:1111:30::11/64	/64	2001:db8:1111:30::1	30
PC7	192.168.40.12	255.255.255.0	192.168.40.1	2001:db8:1111:40::12/64	/64	2001:db8:1111:40::1	40
PC8	192.168.30.12	255.255.255.0	192.168.30.1	2001:db8:1111:30::12/64	/64	2001:db8:1111:30::1	30
PC9	192.168.99.11	255.255.255.0	192.168.99.1	2001:db8:1111:99::11/64	/64	2001:db8:1111:99::1	99

3.19.6.2 Configuration

Scripts

The script only include the IPV6 part.

```
!
! SWITCH 1 Dualstack IPv6 Configuration
!
config t
int vlan 99
 ipv6 address 2001:db8:1111:99::2/64
 no shut
exit
ipv6 route ::/0 2001:db8:1111:99::1
end
!
```

```
!
! SWITCH 2 Dualstack IPv6 Configuration
!
config t
int vlan 99
 ipv6 address 2001:db8:1111:99::3/64
 no shut
exit
ipv6 route ::/0 2001:db8:1111:99::1
end
!
```

```
!
! SWITCH 3 Dualstack IPv6 Configuration
!
config t
int vlan 99
 ipv6 address 2001:db8:1111:99::4/64
 no shut
exit
ipv6 route ::/0 2001:db8:1111:99::1
end
!
```

```
!
! SWITCH 4 Dualstack IPv6 Configuration
!
config t
int vlan 99
 ipv6 address 2001:db8:1111:99::5/64
 no shut
exit
ipv6 route ::/0 2001:db8:1111:99::1
end
!
```

```
!
! ROUTER R1 IPv6 Configuration
!
config t
int f0/0.10
 description Default Gateway for VLAN 10
 encapsulation dot1Q 10
 ipv6 address 2001:db8:1111:10::1/64
exit

int f0/0.20
 description Default Gateway for VLAN 20
 encapsulation dot1Q 20
 ipv6 address 2001:db8:1111:20::1/64
exit

int f0/0.30
 description Default Gateway for VLAN 30
 encapsulation dot1Q 30
 ipv6 address 2001:db8:1111:30::1/64
exit

int f0/0.40
```

```
 description Default Gateway for VLAN 40
 encapsulation dot1Q 40
 ipv6 address 2001:db8:1111:40::1/64
exit

int f0/0.99
 description Default Gateway for VLAN 99
 encapsulation dot1Q 99 native
 ipv6 address 2001:db8:1111:99::1/64
exit

!
end
```

```
!
! IPv6 DHCP Configuration for VLAN 20
!
config t
ipv6 dhcp pool R1-VLAN-20-IPv6
 address prefix 2001:db8:1111:20::/64
 dns-server 2001:4860:4860::8888
 domain-name station1.com
exit

interface f0/0.20
 ipv6 dhcp server R1-VLAN-20-IPv6
exit
ipv6 unicast-routing
ipv6 route ::/0 2001:db8:2222::1
end
```

3.19.6.2.1.1 Configuration screen shots

SW1

```
sw1#!
sw1#! SWITCH 1 Dualstack IPv6 Configuration
sw1#!
sw1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
sw1(config)#int vlan 99
sw1(config-if)# ipv6 address 2001:db8:1111:99::2/64
sw1(config-if)# no shut
sw1(config-if)#exit
sw1(config)#ipv6 route ::/0 2001:db8:1111:99::1
sw1(config)#end
sw1#!
*Mar  1 00:05:04.207: %SYS-5-CONFIG_I: Configured from console by console
sw1#!
```

SW2

```
sw2#
sw2#!
sw2#! SWITCH 2 Dualstack IPv6 Configuration
sw2#!
sw2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
sw2(config)#int vlan 99
sw2(config-if)# ipv6 address 2001:db8:1111:99::3/64
sw2(config-if)# no shut
sw2(config-if)#exit
sw2(config)#ipv6 route ::/0 2001:db8:1111:99::1
sw2(config)#!
sw2(config)#end
sw2#
*Mar  1 00:05:49.403: %SYS-5-CONFIG_I: Configured from console by console
sw2#
```

SW3

```
sw3#!
sw3#! SWITCH 3 Dualstack IPv6 Configuration
sw3#!
sw3#config t
Enter configuration commands, one per line.  End with CNTL/Z.
sw3(config)#int vlan 99
sw3(config-if)# ipv6 address 2001:db8:1111:99::4/64
sw3(config-if)# no shut
sw3(config-if)#exit
sw3(config)#ipv6 route ::/0 2001:db8:1111:99::1
sw3(config)#end
sw3#!
*Mar  1 00:06:14.703: %SYS-5-CONFIG_I: Configured from console by console
sw3#!
sw3#
sw3#
```

SW4

```
sw4#
sw4#!
sw4#! SWITCH 4 Dualstack IPv6 Configuration
sw4#!
sw4#config t
Enter configuration commands, one per line.  End with CNTL/Z.
sw4(config)#int vlan 99
sw4(config-if)# ipv6 address 2001:db8:1111:99::5/64
sw4(config-if)# no shut
sw4(config-if)#exit
sw4(config)#ipv6 route ::/0 2001:db8:1111:99::1
sw4(config)#end
sw4#!
*Mar  1 00:06:22.815: %SYS-5-CONFIG_I: Configured from console by console
sw4#!
sw4#
sw4#
```

Router

```
R1#!
R1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int f0/0.10
R1(config-subif)# description Default Gateway for VLAN 10
R1(config-subif)# encapsulation dot1Q 10
R1(config-subif)# ipv6 address 2001:db8:1111:10::1/64
R1(config-subif)#exit
R1(config)#
R1(config)#int f0/0.20
R1(config-subif)# description Default Gateway for VLAN 20
R1(config-subif)# encapsulation dot1Q 20
R1(config-subif)# ipv6 address 2001:db8:1111:20::1/64
R1(config-subif)#exit
R1(config)#
R1(config)#int f0/0.30
R1(config-subif)# description Default Gateway for VLAN 30
R1(config-subif)# encapsulation dot1Q 30
R1(config-subif)# ipv6 address 2001:db8:1111:30::1/64
R1(config-subif)#exit
R1(config)#
R1(config)#int f0/0.40
R1(config-subif)# description Default Gateway for VLAN 40
R1(config-subif)# encapsulation dot1Q 40
R1(config-subif)# ipv6 address 2001:db8:1111:40::1/64
R1(config-subif)#exit
R1(config)#
R1(config)#int f0/0.99
R1(config-subif)# description Default Gateway for VLAN 99
R1(config-subif)# encapsulation dot1Q 99 native
R1(config-subif)# ipv6 address 2001:db8:1111:99::1/64
R1(config-subif)#exit
R1(config)#ipv6 unicast-routing
R1(config)#ipv6 route ::/0 2001:db8:2222::1
R1(config)#end
R1#
*Feb 13 02:08:26.739: %SYS-5-CONFIG_I: Configured from console by console
R1#
R1#
```

DHCP for IPV6

```
R1#
R1#!
R1#! IPv6 DHCP Configuration for VLAN 20
R1#!
R1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ipv6 dhcp pool R1-VLAN-20-IPv6
R1(config-dhcpv6)# address prefix 2001:db8:1111:20::/64
R1(config-dhcpv6)# dns-server 2001:4860:4860::8888
R1(config-dhcpv6)# domain-name example.com
R1(config-dhcpv6)#exit
R1(config)#
R1(config)#interface f0/0.20
R1(config-subif)# ipv6 dhcp server R1-VLAN-20-IPv6
R1(config-subif)#exit
R1(config)#end
R1#
*Feb 12 05:28:48.975: %SYS-5-CONFIG_I: Configured from console by console
R1#
R1#
```

Set static IPV6 IP's for PC's

```
PC1
ip 192.168.10.11 255.255.255.0 192.168.10.1
ip 2001:db8:1111:10::11/64 2001:db8:1111:10::1
save
PC2
ip 192.168.10.12 255.255.255.0 192.168.10.1
ipv6 2001:db8:1111:10::12/64 2001:db8:1111:10::1
save
PC3
```

```
ip 192.168.20.11 255.255.255.0 192.168.20.1
ipv6 2001:db8:1111:20::11/64 2001:db8:1111:20::1
save
PC4
ip 192.168.20.12 255.255.255.0 192.168.20.1
ipv6 2001:db8:1111:20::12/64 2001:db8:1111:20::1
save
PC5
ip 192.168.40.11 255.255.255.0 192.168.40.1
ipv6 2001:db8:1111:40::11/64 2001:db8:1111:40::1
save
PC6
ip 192.168.30.11 255.255.255.0 192.168.30.1
ipv6 2001:db8:1111:30::11/64 2001:db8:1111:30::1
save
PC7
ip 192.168.40.12 255.255.255.0 192.168.40.1
ipv6 2001:db8:1111:40::12/64 2001:db8:1111:40::1
save
PC8
ip 192.168.30.12 255.255.255.0 192.168.30.1
ipv6 2001:db8:1111:30::12/64 2001:db8:1111:30::1
save
PC9
ip 192.168.99.11 255.255.255.0 192.168.99.1
ipv6 2001:db8:1111:99::11/64 2001:db8:1111:99::1
save
```

3.19.6.3 Test

3.19.6.3.1 Testing connectivity

Test connectivity from PC1

```
!!! TEST !!!
! Ping Test (IPv4 + IPv6)
ping 192.168.10.1
ping 2001:db8:1111:10::1

ping 192.168.20.1
ping 2001:db8:1111:20::1

ping 192.168.30.1
ping 2001:db8:1111:30::1

ping 192.168.40.1
ping 2001:db8:1111:40::1

ping 192.168.99.1
ping 2001:db8:1111:99::1
```

```
PC1> ping 192.168.10.1

84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=30.828 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=11.550 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=11.912 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=10.280 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=6.215 ms

PC1> ping 2001:db8:1111:10::1

2001:db8:1111:10::1 icmp6_seq=1 ttl=64 time=10.254 ms
2001:db8:1111:10::1 icmp6_seq=2 ttl=64 time=5.120 ms
2001:db8:1111:10::1 icmp6_seq=3 ttl=64 time=10.899 ms
2001:db8:1111:10::1 icmp6_seq=4 ttl=64 time=3.268 ms
2001:db8:1111:10::1 icmp6_seq=5 ttl=64 time=6.626 ms

PC1> ping 192.168.20.1

84 bytes from 192.168.20.1 icmp_seq=1 ttl=255 time=5.635 ms
84 bytes from 192.168.20.1 icmp_seq=2 ttl=255 time=16.588 ms
84 bytes from 192.168.20.1 icmp_seq=3 ttl=255 time=2.793 ms
84 bytes from 192.168.20.1 icmp_seq=4 ttl=255 time=11.030 ms
84 bytes from 192.168.20.1 icmp_seq=5 ttl=255 time=9.133 ms

PC1> ping 2001:db8:1111:20::1

2001:db8:1111:20::1 icmp6_seq=1 ttl=64 time=21.208 ms
2001:db8:1111:20::1 icmp6_seq=2 ttl=64 time=1.363 ms
2001:db8:1111:20::1 icmp6_seq=3 ttl=64 time=11.976 ms
2001:db8:1111:20::1 icmp6_seq=4 ttl=64 time=5.246 ms
2001:db8:1111:20::1 icmp6_seq=5 ttl=64 time=10.609 ms
```

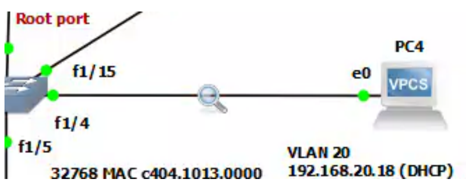
```
PC1> ping 192.168.30.1

84 bytes from 192.168.30.1 icmp_seq=1 ttl=255 time=9.719 ms
84 bytes from 192.168.30.1 icmp_seq=2 ttl=255 time=16.482 ms
84 bytes from 192.168.30.1 icmp_seq=3 ttl=255 time=12.358 ms
84 bytes from 192.168.30.1 icmp_seq=4 ttl=255 time=11.266 ms
84 bytes from 192.168.30.1 icmp_seq=5 ttl=255 time=11.207 ms

PC1> ping 2001:db8:1111:30::1

2001:db8:1111:30::1 icmp6_seq=1 ttl=64 time=14.016 ms
2001:db8:1111:30::1 icmp6_seq=2 ttl=64 time=8.188 ms
2001:db8:1111:30::1 icmp6_seq=3 ttl=64 time=1.765 ms
2001:db8:1111:30::1 icmp6_seq=4 ttl=64 time=4.224 ms
2001:db8:1111:30::1 icmp6_seq=5 ttl=64 time=12.184 ms

PC1> ping 192.168.40.1

84 bytes from 192.168.40.1 icmp_seq=1 ttl=255 time=8.199 ms
84 bytes from 192.168.40.1 icmp_seq=2 ttl=255 time=2.568 ms
84 bytes from 192.168.40.1 icmp_seq=3 ttl=255 time=10.602 ms
84 bytes from 192.168.40.1 icmp_seq=4 ttl=255 time=17.463 ms
84 bytes from 192.168.40.1 icmp_seq=5 ttl=255 time=6.172 ms

PC1> ping 2001:db8:1111:40::1

2001:db8:1111:40::1 icmp6_seq=1 ttl=64 time=3.019 ms
2001:db8:1111:40::1 icmp6_seq=2 ttl=64 time=15.916 ms
2001:db8:1111:40::1 icmp6_seq=3 ttl=64 time=3.261 ms
2001:db8:1111:40::1 icmp6_seq=4 ttl=64 time=10.043 ms
2001:db8:1111:40::1 icmp6_seq=5 ttl=64 time=6.775 ms
```

```
PC1> ping 192.168.99.1

84 bytes from 192.168.99.1 icmp_seq=1 ttl=255 time=9.179 ms
84 bytes from 192.168.99.1 icmp_seq=2 ttl=255 time=4.761 ms
84 bytes from 192.168.99.1 icmp_seq=3 ttl=255 time=11.170 ms
84 bytes from 192.168.99.1 icmp_seq=4 ttl=255 time=1.883 ms
84 bytes from 192.168.99.1 icmp_seq=5 ttl=255 time=3.852 ms

PC1> ping 2001:db8:1111:99::1

2001:db8:1111:99::1 icmp6_seq=1 ttl=64 time=22.459 ms
2001:db8:1111:99::1 icmp6_seq=2 ttl=64 time=1.114 ms
2001:db8:1111:99::1 icmp6_seq=3 ttl=64 time=11.283 ms
2001:db8:1111:99::1 icmp6_seq=4 ttl=64 time=7.240 ms
2001:db8:1111:99::1 icmp6_seq=5 ttl=64 time=2.460 ms

PC1>
```

3.19.6.3.2 Test DHCP for IPV6

Select a PC on VLAN 20

Start wireshark on the link between SW4 and PC4



Clean the IP's on PC4 with commands

```
clear ip
clear ipv6
```

Verify no ip's are assigned

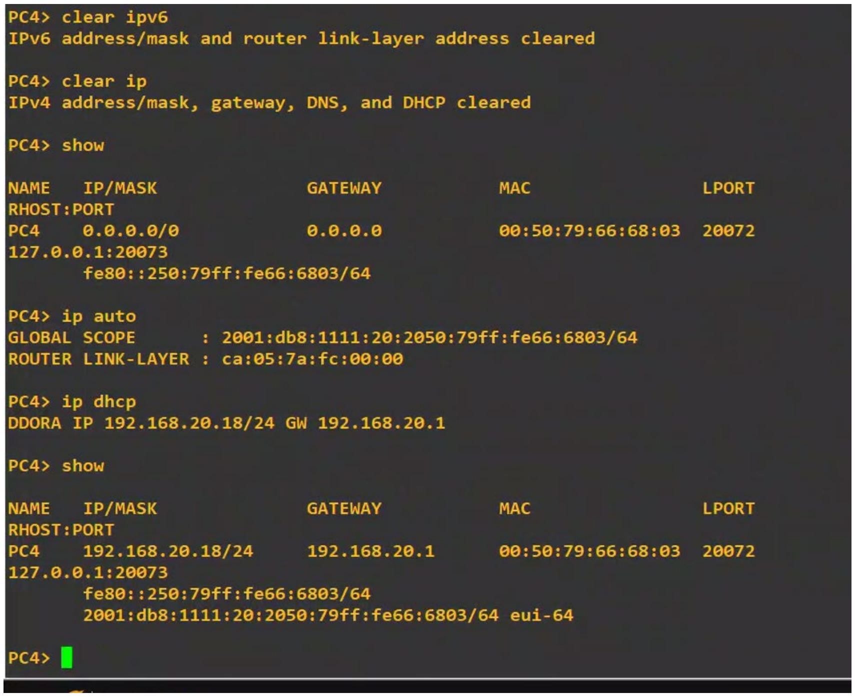
```
show
```

Get IP's

```
ip dhcp
ip auto
```

Verify ip's are assigned

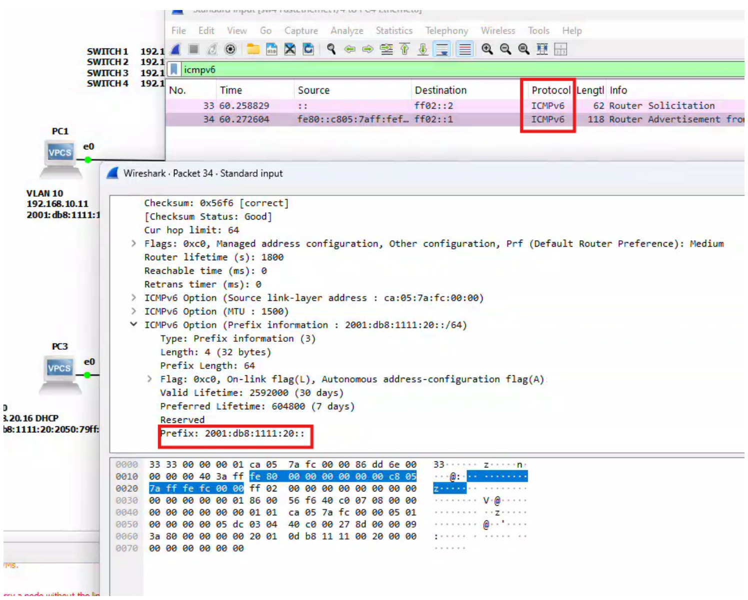
```
show
```



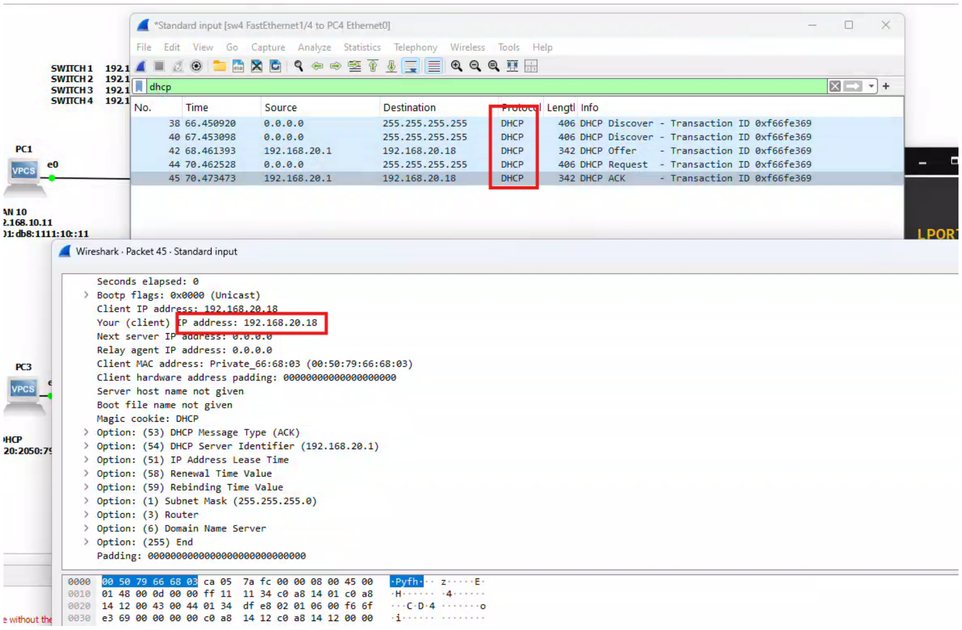
```
PC4> clear ipv6
IPv6 address/mask and router link-layer address cleared

PC4> clear ip
IPv4 address/mask, gateway, DNS, and DHCP cleared

PC4> show

NAME   IP/MASK              GATEWAY           MAC                LPORT
RHOST:PORT
PC4    0.0.0.0/0            0.0.0.0           00:50:79:66:68:03  20072
127.0.0.1:20073
       fe80::250:79ff:fe66:6803/64

PC4> ip auto
GLOBAL SCOPE      : 2001:db8:1111:20:2050:79ff:fe66:6803/64
ROUTER LINK-LAYER : ca:05:7a:fc:00:00

PC4> ip dhcp
DDORA IP 192.168.20.18/24 GW 192.168.20.1

PC4> show

NAME   IP/MASK              GATEWAY           MAC                LPORT
RHOST:PORT
PC4    192.168.20.18/24     192.168.20.1      00:50:79:66:68:03  20072
127.0.0.1:20073
       fe80::250:79ff:fe66:6803/64
       2001:db8:1111:20:2050:79ff:fe66:6803/64 eui-64

PC4>
```

Analyze wireshark output for protocols dhcp and ICMPV6

Filter on ICMPV6 for IPv6



Filter on dhcp for IPV4



3.19.6.3.3 Printouts in router for DHCP

No output for this since we are using S

```
! IPv6-Specific Verification
! Show IPv6 DHCP Bindings (DHCPv6)
show ipv6 dhcp binding
```

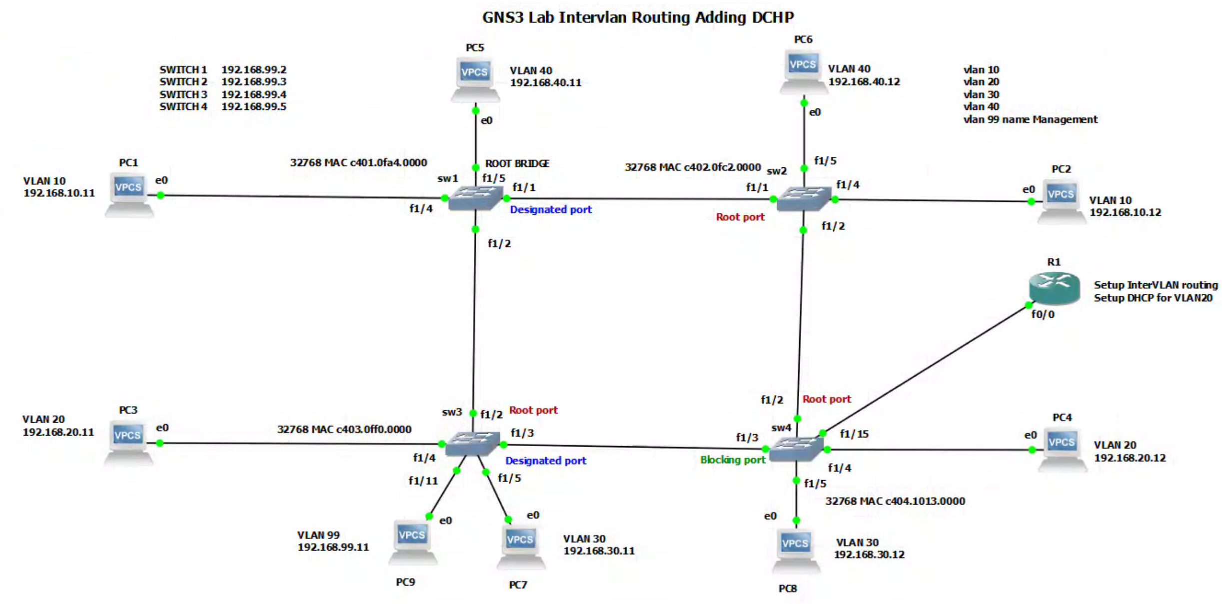
```
R1#! IPv6-Specific Verification
R1#! Show IPv6 DHCP Bindings (DHCPv6)
R1#show ipv6 dhcp binding
R1#
```

```
! Show IPv6 DHCP Pools (DHCPv6)
show ipv6 dhcp pool
```

```
R1#show ipv6 dhcp pool
DHCPv6 pool: R1-VLAN-20-IPv6
  Address allocation prefix: 2001:DB8:1111:20::/64 valid 172800 preferred 86400 (0 in use, 0 conflicts)
  DNS server: 2001:4860:4860::8888
  Domain name: station1.com
  Active clients: 0
R1#
R1#
```

3.19.7 GNS3 - STP , Intervlan Routing Adding DCHP IPV4

3.19.7.1 Topology



Switches and VLANs Configuration

Element	VLAN	Port	Mode	IP Address
SWITCH 1	10	f1/4	Access	-
	40	f1/5	Access	-
	99	f1/1, f1/2, VLAN 99	Trunk/Native	192.168.99.2
SWITCH 2	10	f1/4	Access	-
	40	f1/5	Access	-
	99	f1/1, f1/2, VLAN 99	Trunk/Native	192.168.99.3
SWITCH 3	20	f1/4	Access	-
	30	f1/5	Access	-
	99	f1/2, f1/3, f1/11, VLAN 99	Trunk/Native	192.168.99.4
SWITCH 4	20	f1/4	Access	-
	30	f1/5	Access	-
	99	f1/2, f1/3, f1/15, VLAN 99	Trunk/Native	192.168.99.5

Router Sub-Interfaces and VLANs

Element	VLAN	Description	IP Address
ROUTER 1	10	Default Gateway for VLAN 10	192.168.10.1
	20	Default Gateway for VLAN 20	192.168.20.1
	30	Default Gateway for VLAN 30	192.168.30.1
	40	Default Gateway for VLAN 40	192.168.40.1
	99	Default Gateway for VLAN 99	192.168.99.1

PCs Configuration

PC	VLAN	IP Address	Subnet Mask	Default Gateway
PC1	10	192.168.10.11	255.255.255.0	192.168.10.1
PC2	10	192.168.10.12	255.255.255.0	192.168.10.1
PC3	20	192.168.20.11	255.255.255.0	192.168.20.1
PC4	20	192.168.20.12	255.255.255.0	192.168.20.1
PC5	40	192.168.40.11	255.255.255.0	192.168.40.1
PC6	40	192.168.40.12	255.255.255.0	192.168.40.1
PC7	30	192.168.30.11	255.255.255.0	192.168.30.1
PC8	30	192.168.30.12	255.255.255.0	192.168.30.1

PC9	99	192.168.99.11	255.255.255.0	192.168.99.1

3.19.7.2 Configuration

The configuration includes:

4) Spanning Tree Protocol (per default in Cisco router as per topology, no commands included to setup, just verification commands)

5) Router-on-a-Stick Inter-VLAN Routing
6) DHCP VLAN20 (ipv4& ipv6) having router as DHCP server

4. Configure IP addresses on each PC

```
PC1
ip 192.168.10.11 255.255.255.0
192.168.10.1
save
PC2
ip 192.168.10.12 255.255.255.0
192.168.10.1
save
PC3
ip 192.168.20.11 255.255.255.0
192.168.20.1
save
PC4
ip 192.168.20.12 255.255.255.0
192.168.20.1
save


PC5
ip 192.168.40.11 255.255.255.0
192.168.40.1
save
PC6
ip 192.168.40.12 255.255.255.0
192.168.40.1
save
PC7
ip 192.168.30.11 255.255.255.0
192.168.30.1
save
PC8
ip 192.168.30.12 255.255.255.0
192.168.30.1
save
```

```
PC9
ip 192.168.99.11 255.255.255.0
192.168.99.1
save
```

5. Configure Ip addresses, Intervlan routing and DHCP for IPV4 for VLAN20. As per topology the Spanning Tree Protocol is configured automatically.

Scripts

```
! SWITCH 1
clock set 16:30:00 Jan 11 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 10
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 40
 no shut
exit
interface f1/1
 switchport mode trunk
 switchport trunk native vlan
99
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan
99
 no shut
exit
int vlan 99
 ip add 192.168.99.2
255.255.255.0
 no shut
exit
ip default-gateway 192.168.99.1
end
```

```
copy running-config startup-
config
```

```
!SWITCH 2
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 10
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 40
 no shut
exit
interface f1/1
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.3 255.255.255.0
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

```
!SWITCH 3
```

```
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 20
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 30
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan
99
 no shut
exit
interface f1/3
 switchport mode trunk
 switchport trunk native vlan
99
 no shut
exit
interface f1/11
 switchport mode access
 switchport access vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.4
255.255.255.0
 no shut
exit
ip default-gateway
192.168.99.1
end
copy running-config startup-
config
```

```
!SWITCH 4
```

```
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 20
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 30
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan
99
 no shut
exit
interface f1/3
 switchport mode trunk
 switchport trunk native vlan
99
 no shut
exit
int vlan 99
 ip add 192.168.99.5
255.255.255.0
 no shut
exit
int f1/15
 description Trunk link to
Router
 switchport mode trunk
 switchport trunk native vlan
99
 no shut
exit
ip default-gateway
192.168.99.1
end
copy running-config startup-
config
```

6. Configure the router
   Note at the end of the script highlighted the DHCP IPV4 configuration that full fills requirement
   Setup DHCP for VLAN20

```
! ROUTER 1
config t
int f0/0.10
 description Default Gateway for VLAN 10
 encapsulation dot1Q 10
 ip address 192.168.10.1 255.255.255.0
exit
int f0/0.20
 description Default Gateway for VLAN 20
 encapsulation dot1Q 20
 ip address 192.168.20.1 255.255.255.0
exit
int f0/0.30
 description Default Gateway for VLAN 30
 encapsulation dot1Q 30
 ip address 192.168.30.1 255.255.255.0
exit
int f0/0.40
 description Default Gateway for VLAN 40
 encapsulation dot1Q 40
 ip address 192.168.40.1 255.255.255.0
exit
int f0/0.99
 description Default Gateway for VLAN 99
 encapsulation dot1Q 99 native
 ip address 192.168.99.1 255.255.255.0
exit
interface f0/0
 description Link R1 to SW4
 no shutdown
exit

!DHCP
ip dhcp excluded-address 192.168.20.1
192.168.20.10
ip dhcp pool R1-VLAN 20
network 192.168.20.0 255.255.255.0
default-router 192.168.20.1
dns-server 8.8.8.8
exit
end
copy running-config startup-config
```

3.19.7.3 Configuration verification

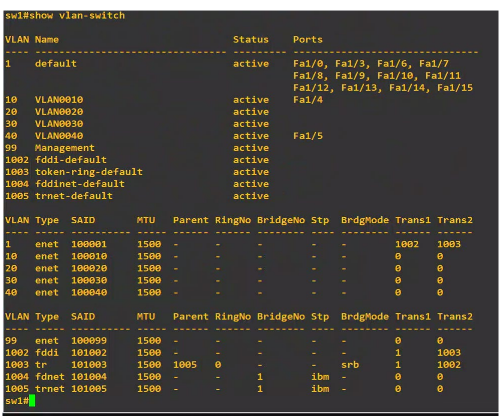
3.19.7.3.1 Switches

For switches do the following commands

```
!Switches
! Show VLANs
show vlan-switch

! Show IP Interface
show ip interface brief

! Show Interface Status
show interface status

! Show Trunk Interfaces
show interfaces trunk

! Show Spanning Tree
show spanning-tree
```

Verify vlans have ports assigned as per requirements
show vlan-switch

SW1



```
sw1#show vlan-switch

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa1/0, Fa1/3, Fa1/6, Fa1/7
                                                Fa1/8, Fa1/9, Fa1/10, Fa1/11
                                                Fa1/12, Fa1/13, Fa1/14, Fa1/15
10   VLAN0010                         active    Fa1/4
20   VLAN0020                         active
30   VLAN0030                         active
40   VLAN0040                         active    Fa1/5
99   Management                       active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        1002   1003
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
40   enet  100040     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        1      1003
1003 tr    101003     1500  1005   0      -        -    srb      1      1002
1004 fdnet 101004     1500  -      -      1        ibm  -        0      0
1005 trnet 101005     1500  -      -      1        ibm  -        0      0
sw1#
```

SW2

```
sw2#
sw2#show vlan-switch

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa1/0, Fa1/3, Fa1/6, Fa1/7
                                                Fa1/8, Fa1/9, Fa1/10, Fa1/11
                                                Fa1/12, Fa1/13, Fa1/14, Fa1/15
10   VLAN0010                         active    Fa1/4
20   VLAN0020                         active
30   VLAN0030                         active
40   VLAN0040                         active    Fa1/5
99   Management                       active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        1002   1003
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
40   enet  100040     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        1      1003
1003 tr    101003     1500  1005   0      -        -    srb      1      1002
1004 fdnet 101004     1500  -      -      1        ibm  -        0      0
1005 trnet 101005     1500  -      -      1        ibm  -        0      0
sw2#
```

SW 3

```
sw3#show vlan-switch

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa1/0, Fa1/1, Fa1/6, Fa1/7
                                                Fa1/8, Fa1/9, Fa1/10, Fa1/12
                                                Fa1/13, Fa1/14, Fa1/15
10   VLAN0010                         active
20   VLAN0020                         active    Fa1/4
30   VLAN0030                         active    Fa1/5
40   VLAN0040                         active
99   Management                       active    Fa1/11
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        1002   1003
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
40   enet  100040     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        1      1003
1003 tr    101003     1500  1005   0      -        -    srb      1      1002
1004 fdnet 101004     1500  -      -      1        ibm  -        0      0
1005 trnet 101005     1500  -      -      1        ibm  -        0      0
sw3#
```

SW4

```
sw4#show vlan-switch

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa1/0, Fa1/1, Fa1/6, Fa1/7
                                                Fa1/8, Fa1/9, Fa1/10, Fa1/11
                                                Fa1/12, Fa1/13, Fa1/14
10   VLAN0010                         active
20   VLAN0020                         active    Fa1/4
30   VLAN0030                         active    Fa1/5
40   VLAN0040                         active
99   Management                       active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        1002   1003
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
30   enet  100030     1500  -      -      -        -    -        0      0
40   enet  100040     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        1      1003
1003 tr    101003     1500  1005   0      -        -    srb      1      1002
1004 fdnet 101004     1500  -      -      1        ibm  -        0      0
1005 trnet 101005     1500  -      -      1        ibm  -        0      0
sw4#
```

Verify interfaces are up

show ip interface

See the columns in the printout

- **Manual** in this context means the IP address was manually configured by an administrator.
- **unset** means no IP address has been assigned to the interface.
- The **Status** and **Protocol** columns indicate whether the interface is operational and communicating.

SW1

```
sw1#! Show IP Interface
sw1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
FastEthernet1/0        unassigned      YES unset  up                    down
FastEthernet1/1        unassigned      YES unset  up                    up
FastEthernet1/2        unassigned      YES unset  up                    up
FastEthernet1/3        unassigned      YES unset  up                    down
FastEthernet1/4        unassigned      YES unset  up                    up
FastEthernet1/5        unassigned      YES unset  up                    up
FastEthernet1/6        unassigned      YES unset  up                    down
FastEthernet1/7        unassigned      YES unset  up                    down
FastEthernet1/8        unassigned      YES unset  up                    down
FastEthernet1/9        unassigned      YES unset  up                    down
FastEthernet1/10       unassigned      YES unset  up                    down
FastEthernet1/11       unassigned      YES unset  up                    down
FastEthernet1/12       unassigned      YES unset  up                    down
FastEthernet1/13       unassigned      YES unset  up                    down
FastEthernet1/14       unassigned      YES unset  up                    down
FastEthernet1/15       unassigned      YES unset  up                    down
Vlan1                  unassigned      YES unset  up                    up
Vlan99                 192.168.99.2    YES manual up                    up
sw1#
```

SW2

```
sw2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
FastEthernet1/0        unassigned      YES unset  up                    down
FastEthernet1/1        unassigned      YES unset  up                    up
FastEthernet1/2        unassigned      YES unset  up                    up
FastEthernet1/3        unassigned      YES unset  up                    down
FastEthernet1/4        unassigned      YES unset  up                    up
FastEthernet1/5        unassigned      YES unset  up                    up
FastEthernet1/6        unassigned      YES unset  up                    down
FastEthernet1/7        unassigned      YES unset  up                    down
FastEthernet1/8        unassigned      YES unset  up                    down
FastEthernet1/9        unassigned      YES unset  up                    down
FastEthernet1/10       unassigned      YES unset  up                    down
FastEthernet1/11       unassigned      YES unset  up                    down
FastEthernet1/12       unassigned      YES unset  up                    down
FastEthernet1/13       unassigned      YES unset  up                    down
FastEthernet1/14       unassigned      YES unset  up                    down
FastEthernet1/15       unassigned      YES unset  up                    down
Vlan1                  unassigned      YES unset  up                    up
Vlan99                 192.168.99.3    YES manual up                    up
sw2#
```

SW3

```
sw3#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
FastEthernet1/0        unassigned      YES unset  up                    down
FastEthernet1/1        unassigned      YES unset  up                    down
FastEthernet1/2        unassigned      YES unset  up                    up
FastEthernet1/3        unassigned      YES unset  up                    up
FastEthernet1/4        unassigned      YES unset  up                    up
FastEthernet1/5        unassigned      YES unset  up                    up
FastEthernet1/6        unassigned      YES unset  up                    down
FastEthernet1/7        unassigned      YES unset  up                    down
FastEthernet1/8        unassigned      YES unset  up                    down
FastEthernet1/9        unassigned      YES unset  up                    down
FastEthernet1/10       unassigned      YES unset  up                    down
FastEthernet1/11       unassigned      YES unset  up                    up
FastEthernet1/12       unassigned      YES unset  up                    down
FastEthernet1/13       unassigned      YES unset  up                    down
FastEthernet1/14       unassigned      YES unset  up                    down
FastEthernet1/15       unassigned      YES unset  up                    down
Vlan1                  unassigned      YES unset  up                    up
Vlan99                 192.168.99.4    YES manual up                    up
sw3#
```

SW4

```
sw4#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            unassigned      YES unset  administratively down down
FastEthernet0/1            unassigned      YES unset  administratively down down
FastEthernet1/0            unassigned      YES unset  up                    down
FastEthernet1/1            unassigned      YES unset  up                    down
FastEthernet1/2            unassigned      YES unset  up                    up
FastEthernet1/3            unassigned      YES unset  up                    up
FastEthernet1/4            unassigned      YES unset  up                    up
FastEthernet1/5            unassigned      YES unset  up                    up
FastEthernet1/6            unassigned      YES unset  up                    down
FastEthernet1/7            unassigned      YES unset  up                    down
FastEthernet1/8            unassigned      YES unset  up                    down
FastEthernet1/9            unassigned      YES unset  up                    down
FastEthernet1/10           unassigned      YES unset  up                    down
FastEthernet1/11           unassigned      YES unset  up                    down
FastEthernet1/12           unassigned      YES unset  up                    down
FastEthernet1/13           unassigned      YES unset  up                    down
FastEthernet1/14           unassigned      YES unset  up                    down
FastEthernet1/15           unassigned      YES unset  up                    up
Vlan1                      unassigned      YES unset  up                    up
Vlan99                     192.168.99.5    YES manual up                    up
sw4#
```

Show interface status

```
! Show Interface Status
show interface status
```

See the required ports are connected, if vlan requested, see if vlan assigned is correct . Check trunk ports are correctly configured.

SW1

```
sw1#! Show Interface Status
sw1#show interface status

Port    Name               Status       Vlan       Duplex Speed Type
Fa1/0                      notconnect   1            auto   auto 10/100BaseTX
Fa1/1                      connected    trunk      a-full  a-100 10/100BaseTX
Fa1/2                      connected    trunk      a-full  a-100 10/100BaseTX
Fa1/3                      notconnect   1            auto   auto 10/100BaseTX
Fa1/4                      connected    10         a-full  a-100 10/100BaseTX
Fa1/5                      connected    40         a-full  a-100 10/100BaseTX
Fa1/6                      notconnect   1            auto   auto 10/100BaseTX
Fa1/7                      notconnect   1            auto   auto 10/100BaseTX
Fa1/8                      notconnect   1            auto   auto 10/100BaseTX
Fa1/9                      notconnect   1            auto   auto 10/100BaseTX
Fa1/10                     notconnect   1            auto   auto 10/100BaseTX
Fa1/11                     notconnect   1            auto   auto 10/100BaseTX
Fa1/12                     notconnect   1            auto   auto 10/100BaseTX
Fa1/13                     notconnect   1            auto   auto 10/100BaseTX
Fa1/14                     notconnect   1            auto   auto 10/100BaseTX
Fa1/15                     notconnect   1            auto   auto 10/100BaseTX
sw1#
```

SW 2

```
sw2#! Show Interface Status
sw2#show interface status

Port    Name               Status       Vlan       Duplex Speed Type
Fa1/0                      notconnect   1            auto   auto 10/100BaseTX
Fa1/1                      connected    trunk      a-full  a-100 10/100BaseTX
Fa1/2                      connected    trunk      a-full  a-100 10/100BaseTX
Fa1/3                      notconnect   1            auto   auto 10/100BaseTX
Fa1/4                      connected    10         a-full  a-100 10/100BaseTX
Fa1/5                      connected    40         a-full  a-100 10/100BaseTX
Fa1/6                      notconnect   1            auto   auto 10/100BaseTX
Fa1/7                      notconnect   1            auto   auto 10/100BaseTX
Fa1/8                      notconnect   1            auto   auto 10/100BaseTX
Fa1/9                      notconnect   1            auto   auto 10/100BaseTX
Fa1/10                     notconnect   1            auto   auto 10/100BaseTX
Fa1/11                     notconnect   1            auto   auto 10/100BaseTX
Fa1/12                     notconnect   1            auto   auto 10/100BaseTX
Fa1/13                     notconnect   1            auto   auto 10/100BaseTX
Fa1/14                     notconnect   1            auto   auto 10/100BaseTX
Fa1/15                     notconnect   1            auto   auto 10/100BaseTX
sw2#
```

SW3

```
sw3#! Show Interface Status
sw3#show interface status

Port     Name               Status       Vlan       Duplex Speed Type
Fa1/0                       notconnect   1            auto    auto 10/100BaseTX
Fa1/1                       notconnect   1            auto    auto 10/100BaseTX
Fa1/2                       connected    trunk      a-full   a-100 10/100BaseTX
Fa1/3                       connected    trunk      a-full   a-100 10/100BaseTX
Fa1/4                       connected    20         a-full   a-100 10/100BaseTX
Fa1/5                       connected    30         a-full   a-100 10/100BaseTX
Fa1/6                       notconnect   1            auto    auto 10/100BaseTX
Fa1/7                       notconnect   1            auto    auto 10/100BaseTX
Fa1/8                       notconnect   1            auto    auto 10/100BaseTX
Fa1/9                       notconnect   1            auto    auto 10/100BaseTX
Fa1/10                      notconnect   1            auto    auto 10/100BaseTX
Fa1/11                      connected    99         a-full   a-100 10/100BaseTX
Fa1/12                      notconnect   1            auto    auto 10/100BaseTX
Fa1/13                      notconnect   1            auto    auto 10/100BaseTX
Fa1/14                      notconnect   1            auto    auto 10/100BaseTX
Fa1/15                      notconnect   1            auto    auto 10/100BaseTX
sw3#
```

SW4

```
sw4#! Show Interface Status
sw4#show interface status

Port     Name               Status       Vlan       Duplex Speed Type
Fa1/0                       notconnect   1            auto    auto 10/100BaseTX
Fa1/1                       notconnect   1            auto    auto 10/100BaseTX
Fa1/2                       connected    trunk      a-full   a-100 10/100BaseTX
Fa1/3                       connected    trunk      a-full   a-100 10/100BaseTX
Fa1/4                       connected    20         a-full   a-100 10/100BaseTX
Fa1/5                       connected    30         a-full   a-100 10/100BaseTX
Fa1/6                       notconnect   1            auto    auto 10/100BaseTX
Fa1/7                       notconnect   1            auto    auto 10/100BaseTX
Fa1/8                       notconnect   1            auto    auto 10/100BaseTX
Fa1/9                       notconnect   1            auto    auto 10/100BaseTX
Fa1/10                      notconnect   1            auto    auto 10/100BaseTX
Fa1/11                      notconnect   1            auto    auto 10/100BaseTX
Fa1/12                      notconnect   1            auto    auto 10/100BaseTX
Fa1/13                      notconnect   1            auto    auto 10/100BaseTX
Fa1/14                      notconnect   1            auto    auto 10/100BaseTX
Fa1/15   Trunk link to Rout connected    trunk      a-full   a-100 10/100BaseTX
```

```
! Show Trunk Interfaces
show interfaces trunk
```

SW1

```
sw1#! Show Trunk Interfaces
sw1#show interfaces trunk

Port        Mode             Encapsulation  Status        Native vlan
Fa1/1       on               802.1q         trunking      99
Fa1/2       on               802.1q         trunking      99

Port        Vlans allowed on trunk
Fa1/1       1-1005
Fa1/2       1-1005

Port        Vlans allowed and active in management domain
Fa1/1       1,10,20,30,40,99
Fa1/2       1,10,20,30,40,99

Port        Vlans in spanning tree forwarding state and not pruned
Fa1/1       1,10,20,30,40,99
Fa1/2       1,10,20,30,40,99
sw1#
```

SW2

```
sw2#! Show Trunk Interfaces
sw2#show interfaces trunk

Port      Mode         Encapsulation  Status        Native vlan
Fa1/1     on           802.1q         trunking      99
Fa1/2     on           802.1q         trunking      99

Port      Vlans allowed on trunk
Fa1/1     1-1005
Fa1/2     1-1005

Port      Vlans allowed and active in management domain
Fa1/1     1,10,20,30,40,99
Fa1/2     1,10,20,30,40,99

Port      Vlans in spanning tree forwarding state and not pruned
Fa1/1     1,10,20,30,40,99
Fa1/2     1,10,20,30,40,99
sw2#
```

SW3

```
sw3#! Show Trunk Interfaces
sw3#show interfaces trunk

Port      Mode         Encapsulation  Status        Native vlan
Fa1/2     on           802.1q         trunking      99
Fa1/3     on           802.1q         trunking      99

Port      Vlans allowed on trunk
Fa1/2     1-1005
Fa1/3     1-1005

Port      Vlans allowed and active in management domain
Fa1/2     1,10,20,30,40,99
Fa1/3     1,10,20,30,40,99

Port      Vlans in spanning tree forwarding state and not pruned
Fa1/2     1,10,20,30,40,99
Fa1/3     1,10,20,30,40,99
sw3#
```

SW4

```
sw4#! Show Trunk Interfaces
sw4#show interfaces trunk

Port      Mode         Encapsulation  Status        Native vlan
Fa1/2     on           802.1q         trunking      99
Fa1/3     on           802.1q         trunking      99
Fa1/15    on           802.1q         trunking      99

Port      Vlans allowed on trunk
Fa1/2     1-1005
Fa1/3     1-1005
Fa1/15    1-1005

Port      Vlans allowed and active in management domain
Fa1/2     1,10,20,30,40,99
Fa1/3     1,10,20,30,40,99
Fa1/15    1,10,20,30,40,99

Port      Vlans in spanning tree forwarding state and not pruned
Fa1/2     1,10,20,30,40,99
Fa1/3     none
Fa1/15    1,10,20,30,40,99
sw4#
```

```
! Show Spanning Tree
show spanning-tree

Use this filters to identify the port status
conf t
do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
end
```

SW1

```
sw1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw1(config)#do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
 VLAN10 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN10 is forwarding
 Port 43 (FastEthernet1/2) of VLAN10 is forwarding
 Port 45 (FastEthernet1/4) of VLAN10 is forwarding
sw1(config)#do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
 VLAN20 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN20 is forwarding
 Port 43 (FastEthernet1/2) of VLAN20 is forwarding
sw1(config)#do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
 VLAN30 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN30 is forwarding
 Port 43 (FastEthernet1/2) of VLAN30 is forwarding
sw1(config)#do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
 VLAN40 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN40 is forwarding
 Port 43 (FastEthernet1/2) of VLAN40 is forwarding
 Port 46 (FastEthernet1/5) of VLAN40 is forwarding
sw1(config)#do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
 VLAN99 is executing the ieee compatible Spanning Tree protocol
 Port 42 (FastEthernet1/1) of VLAN99 is forwarding
 Port 43 (FastEthernet1/2) of VLAN99 is forwarding
sw1(config)#end
sw1#
Jan 11 01:57:09.490: %SYS-5-CONFIG_I: Configured from console by console
sw1#
```

SW2

```
sw2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw2(config)#do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
 VLAN10 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN10 is forwarding
 Port 43 (FastEthernet1/2) of VLAN10 is forwarding
 Port 45 (FastEthernet1/4) of VLAN10 is forwarding
sw2(config)#do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
 VLAN20 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN20 is forwarding
 Port 43 (FastEthernet1/2) of VLAN20 is forwarding
sw2(config)#do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
 VLAN30 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN30 is forwarding
 Port 43 (FastEthernet1/2) of VLAN30 is forwarding
sw2(config)#do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
 VLAN40 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN40 is forwarding
 Port 43 (FastEthernet1/2) of VLAN40 is forwarding
 Port 46 (FastEthernet1/5) of VLAN40 is forwarding
sw2(config)#do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
 VLAN99 is executing the ieee compatible Spanning Tree protocol
  Root port is 42 (FastEthernet1/1), cost of root path is 19
 Port 42 (FastEthernet1/1) of VLAN99 is forwarding
 Port 43 (FastEthernet1/2) of VLAN99 is forwarding
sw2(config)#end
sw2#
Jan 11 01:55:53.426: %SYS-5-CONFIG_I: Configured from console by console
sw2#
```

SW3

```
sw3(config)#end
sw3#
Jan 11 01:45:39.042: %SYS-5-CONFIG_I: Configured from console by console
sw3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw3(config)#do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
 VLAN10 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN10 is forwarding
 Port 44 (FastEthernet1/3) of VLAN10 is forwarding
sw3(config)#do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
 VLAN20 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN20 is forwarding
 Port 44 (FastEthernet1/3) of VLAN20 is forwarding
 Port 45 (FastEthernet1/4) of VLAN20 is forwarding
sw3(config)#do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
 VLAN30 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN30 is forwarding
 Port 44 (FastEthernet1/3) of VLAN30 is forwarding
 Port 46 (FastEthernet1/5) of VLAN30 is forwarding
sw3(config)#do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
 VLAN40 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN40 is forwarding
 Port 44 (FastEthernet1/3) of VLAN40 is forwarding
sw3(config)#do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
 VLAN99 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 19
 Port 43 (FastEthernet1/2) of VLAN99 is forwarding
 Port 44 (FastEthernet1/3) of VLAN99 is forwarding
 Port 52 (FastEthernet1/11) of VLAN99 is forwarding
sw3(config)#end
sw3#
sw3#
Jan 11 01:55:02.558: %SYS-5-CONFIG_I: Configured from console by console
sw3#
```

SW4

```
sw4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw4(config)#do show spanning-tree vlan 10 | include VLAN|Root|Role|Sts
 VLAN10 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN10 is forwarding
 Port 44 (FastEthernet1/3) of VLAN10 is blocking
 Port 56 (FastEthernet1/15) of VLAN10 is forwarding
sw4(config)#do show spanning-tree vlan 20 | include VLAN|Root|Role|Sts
 VLAN20 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN20 is forwarding
 Port 44 (FastEthernet1/3) of VLAN20 is blocking
 Port 45 (FastEthernet1/4) of VLAN20 is forwarding
 Port 56 (FastEthernet1/15) of VLAN20 is forwarding
sw4(config)#do show spanning-tree vlan 30 | include VLAN|Root|Role|Sts
 VLAN30 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN30 is forwarding
 Port 44 (FastEthernet1/3) of VLAN30 is blocking
 Port 46 (FastEthernet1/5) of VLAN30 is forwarding
 Port 56 (FastEthernet1/15) of VLAN30 is forwarding
sw4(config)#do show spanning-tree vlan 40 | include VLAN|Root|Role|Sts
 VLAN40 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN40 is forwarding
 Port 44 (FastEthernet1/3) of VLAN40 is blocking
 Port 56 (FastEthernet1/15) of VLAN40 is forwarding
sw4(config)#do show spanning-tree vlan 99 | include VLAN|Root|Role|Sts
 VLAN99 is executing the ieee compatible Spanning Tree protocol
  Root port is 43 (FastEthernet1/2), cost of root path is 38
 Port 43 (FastEthernet1/2) of VLAN99 is forwarding
 Port 44 (FastEthernet1/3) of VLAN99 is blocking
 Port 56 (FastEthernet1/15) of VLAN99 is forwarding
sw4(config)#end
```

3.19.7.3.2 Router

Issue the following commands

```
!Router
! Show IP Interface Brief
show ip interface brief
! Show IP Route
show ip route
!DHCP
show ip dhcp pool
show ip dhcp binding
```

!Router

! Show IP Interface Brief
show ip interface brief

```
R1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        unassigned      YES unset  up                    up
FastEthernet0/0.10     192.168.10.1    YES manual up                    up
FastEthernet0/0.20     192.168.20.1    YES manual up                    up
FastEthernet0/0.30     192.168.30.1    YES manual up                    up
FastEthernet0/0.40     192.168.40.1    YES manual up                    up
FastEthernet0/0.99     192.168.99.1    YES manual up                    up
FastEthernet1/0        unassigned      YES unset  administratively down down
FastEthernet1/1        unassigned      YES unset  administratively down down
Serial2/0              unassigned      YES unset  administratively down down
Serial2/1              unassigned      YES unset  administratively down down
Serial2/2              unassigned      YES unset  administratively down down
Serial2/3              unassigned      YES unset  administratively down down
```

show ip route

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.10.0/24 is directly connected, FastEthernet0/0.10
L        192.168.10.1/32 is directly connected, FastEthernet0/0.10
      192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.20.0/24 is directly connected, FastEthernet0/0.20
L        192.168.20.1/32 is directly connected, FastEthernet0/0.20
      192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.30.0/24 is directly connected, FastEthernet0/0.30
L        192.168.30.1/32 is directly connected, FastEthernet0/0.30
      192.168.40.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.40.0/24 is directly connected, FastEthernet0/0.40
L        192.168.40.1/32 is directly connected, FastEthernet0/0.40
      192.168.99.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.99.0/24 is directly connected, FastEthernet0/0.99
L        192.168.99.1/32 is directly connected, FastEthernet0/0.99
R1#
```

3.19.7.3.3 Test

Verify connectivity between PCs within their respective VLANs using ping command.

For PC1

```
!PC's
ping 192.168.10.1
ping 192.168.20.1
ping 192.168.30.1
ping 192.168.40.1
ping 192.168.99.1
```

PC1

```
PC1> ping 192.168.10.1

84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=10.699 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=1.665 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=4.141 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=13.101 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=11.022 ms

PC1> ping 192.168.20.1

84 bytes from 192.168.20.1 icmp_seq=1 ttl=255 time=9.736 ms
84 bytes from 192.168.20.1 icmp_seq=2 ttl=255 time=9.164 ms
84 bytes from 192.168.20.1 icmp_seq=3 ttl=255 time=10.581 ms
84 bytes from 192.168.20.1 icmp_seq=4 ttl=255 time=5.755 ms
84 bytes from 192.168.20.1 icmp_seq=5 ttl=255 time=4.404 ms

PC1> ping 192.168.30.1

84 bytes from 192.168.30.1 icmp_seq=1 ttl=255 time=3.475 ms
84 bytes from 192.168.30.1 icmp_seq=2 ttl=255 time=16.966 ms
84 bytes from 192.168.30.1 icmp_seq=3 ttl=255 time=15.397 ms
84 bytes from 192.168.30.1 icmp_seq=4 ttl=255 time=7.777 ms
84 bytes from 192.168.30.1 icmp_seq=5 ttl=255 time=8.290 ms

PC1> ping 192.168.99.1

84 bytes from 192.168.99.1 icmp_seq=1 ttl=255 time=8.180 ms
84 bytes from 192.168.99.1 icmp_seq=2 ttl=255 time=2.645 ms
84 bytes from 192.168.99.1 icmp_seq=3 ttl=255 time=2.080 ms
84 bytes from 192.168.99.1 icmp_seq=4 ttl=255 time=4.745 ms
84 bytes from 192.168.99.1 icmp_seq=5 ttl=255 time=5.196 ms

PC1>
```

```
PC1> ping 192.168.40.1

84 bytes from 192.168.40.1 icmp_seq=1 ttl=255 time=9.097 ms
84 bytes from 192.168.40.1 icmp_seq=2 ttl=255 time=5.821 ms
84 bytes from 192.168.40.1 icmp_seq=3 ttl=255 time=2.413 ms
84 bytes from 192.168.40.1 icmp_seq=4 ttl=255 time=3.650 ms
84 bytes from 192.168.40.1 icmp_seq=5 ttl=255 time=6.922 ms

PC1>
```

Verify Inter-VLAN routing from PC1.

PC1

```
ping 192.168.20.12
ping 192.168.30.12
ping 192.168.40.12
ping 192.168.99.11
```

```
PC1> ping 192.168.20.12

84 bytes from 192.168.20.12 icmp_seq=1 ttl=63 time=31.637 ms
84 bytes from 192.168.20.12 icmp_seq=2 ttl=63 time=14.775 ms
84 bytes from 192.168.20.12 icmp_seq=3 ttl=63 time=16.708 ms
84 bytes from 192.168.20.12 icmp_seq=4 ttl=63 time=12.879 ms
84 bytes from 192.168.20.12 icmp_seq=5 ttl=63 time=14.469 ms

PC1> ping 192.168.30.12

84 bytes from 192.168.30.12 icmp_seq=1 ttl=63 time=29.273 ms
84 bytes from 192.168.30.12 icmp_seq=2 ttl=63 time=25.085 ms
84 bytes from 192.168.30.12 icmp_seq=3 ttl=63 time=17.243 ms
84 bytes from 192.168.30.12 icmp_seq=4 ttl=63 time=23.214 ms
84 bytes from 192.168.30.12 icmp_seq=5 ttl=63 time=14.880 ms

PC1> ping 192.168.40.12

84 bytes from 192.168.40.12 icmp_seq=1 ttl=63 time=38.204 ms
84 bytes from 192.168.40.12 icmp_seq=2 ttl=63 time=13.166 ms
84 bytes from 192.168.40.12 icmp_seq=3 ttl=63 time=20.173 ms
84 bytes from 192.168.40.12 icmp_seq=4 ttl=63 time=14.695 ms
84 bytes from 192.168.40.12 icmp_seq=5 ttl=63 time=20.358 ms
```

```
PC1> ping 192.168.99.11

84 bytes from 192.168.99.11 icmp_seq=1 ttl=63 time=33.082 ms
84 bytes from 192.168.99.11 icmp_seq=2 ttl=63 time=29.865 ms
84 bytes from 192.168.99.11 icmp_seq=3 ttl=63 time=19.116 ms
84 bytes from 192.168.99.11 icmp_seq=4 ttl=63 time=26.228 ms
84 bytes from 192.168.99.11 icmp_seq=5 ttl=63 time=21.999 ms

PC1>
```

3.19.7.3.4 DHCP IPV4 test

A) Start wireshark to see traffic for DHCP on interface between PC4 and router

Set PC3 and PC4 to receive IP addressing information from DHCP.

```
show
ip dhcp
show
```

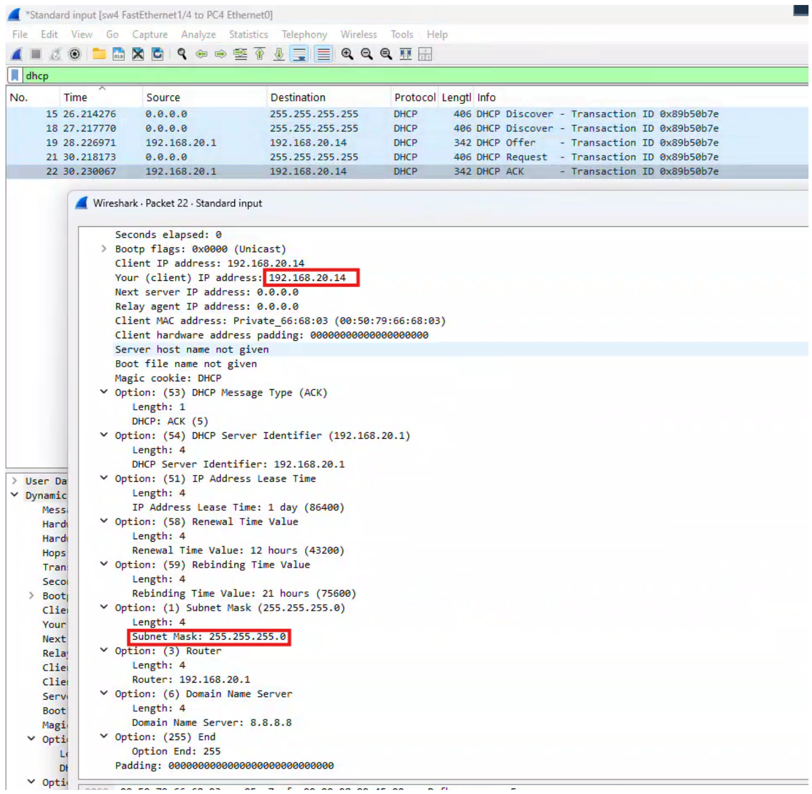
PC3

```
PC3> show

NAME   IP/MASK              GATEWAY           MAC                LPORT  RHOST:PORT
PC3    192.168.20.11/24     192.168.20.1      00:50:79:66:68:02  20070  127.0.0.1:20071
       fe80::250:79ff:fe66:6802/64

PC3> ip dhcp
DDORA IP 192.168.20.13/24 GW 192.168.20.1

PC3> show

NAME   IP/MASK              GATEWAY           MAC                LPORT  RHOST:PORT
PC3    192.168.20.13/24     192.168.20.1      00:50:79:66:68:02  20070  127.0.0.1:20071
       fe80::250:79ff:fe66:6802/64

PC3>
```

PC4

```
PC4> show

NAME   IP/MASK              GATEWAY           MAC                LPORT
RHOST:PORT
PC4    192.168.20.12/24     192.168.20.1      00:50:79:66:68:03  20072
127.0.0.1:20073
       fe80::250:79ff:fe66:6803/64

PC4> ip dhcp
DDORA IP 192.168.20.14/24 GW 192.168.20.1

PC4> show

NAME   IP/MASK              GATEWAY           MAC                LPORT
RHOST:PORT
PC4    192.168.20.14/24     192.168.20.1      00:50:79:66:68:03  20072
127.0.0.1:20073
       fe80::250:79ff:fe66:6803/64

PC4>
```

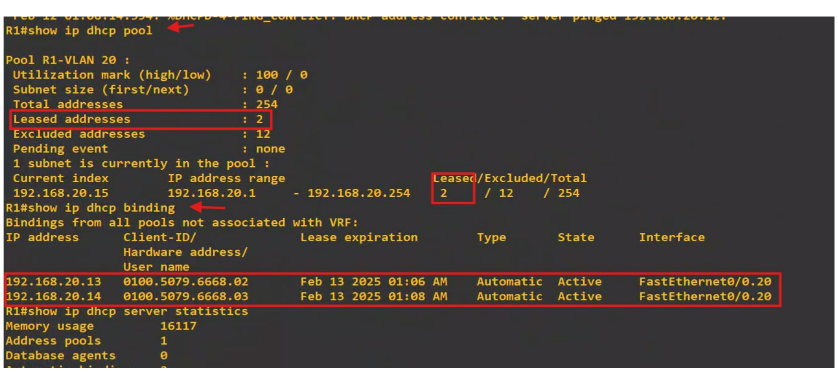
B) Wireshark messages related to DHCP . See the flow and what IP was assigned.



3.19.7.3.5 DHCP IPV4 printouts

```
!Router
!DHCP
show ip dhcp pool
show ip dhcp binding
! Show DHCP Server Statistics
show ip dhcp server statistics

 ! Display DHCP Configuration
show running-config | section dhcp
```

show ip dhcp pool
show ip dhcp binding



```
! Show DHCP Server Statistics
show ip dhcp server statistics
```

```
R1#show ip dhcp server statistics
Memory usage           16117
Address pools          1
Database agents        0
Automatic bindings     2
Manual bindings        0
Expired bindings       0
Malformed messages     0
Secure arp entries     0
Renew messages         0
Workspace timeouts     0
Static routes          0
Relay bindings         0
Relay bindings active          0
Relay bindings terminated      0
Relay bindings selecting       0

Message                Received
BOOTREQUEST            0
DHCPDISCOVER           4
DHCPREQUEST            2
DHCPDECLINE            0
DHCPRELEASE            0
DHCPINFORM             0
DHCPVENDOR             0
BOOTREPLY              0
DHCPOFFER              0
DHCPACK                0
DHCPNAK                0

Message                Sent
BOOTREPLY              0
DHCPOFFER              2
DHCPACK                2
DHCPNAK                0

Message                Forwarded
BOOTREQUEST            0
```

```
Message                Sent
BOOTREPLY              0
DHCPOFFER              2
DHCPACK                2
DHCPNAK                0

Message                Forwarded
BOOTREQUEST            0
DHCPDISCOVER           0
DHCPREQUEST            0
DHCPDECLINE            0
DHCPRELEASE            0
DHCPINFORM             0
DHCPVENDOR             0
BOOTREPLY              0
DHCPOFFER              0
DHCPACK                0
DHCPNAK                0

DHCP-DPM Statistics
Offer notifications sent        0
Offer callbacks received        0
Classname requests sent         0
Classname callbacks received    0

R1#
```

! Display DHCP Configuration

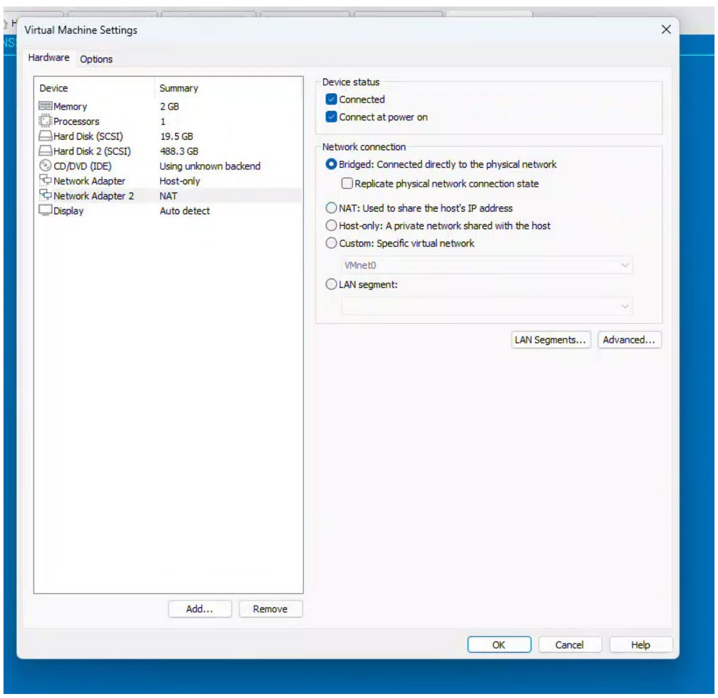
show running-config | section dhcp

```
R1#! Display DHCP Configuration
R1#show running-config | section dhcp
ip dhcp excluded-address 192.168.20.1 192.168.20.10
ip dhcp pool R1-VLAN 20
 network 192.168.20.0 255.255.255.0
 default-router 192.168.20.1
 dns-server 8.8.8.8
R1#
```

3.19.8 GSN3 - HSRP-OSPF-Default Route - Connect to Internet–NAT

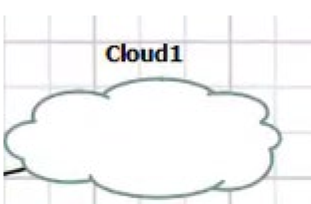
3.19.8.1 Preparation

Go to VMware Workstation, select your GNS3 VM, go to menu VM > settings. Go to the second network card, and set the Network Connection to "Bridged" in order for the cloud to be able to connect to the internet, then click “OK”.

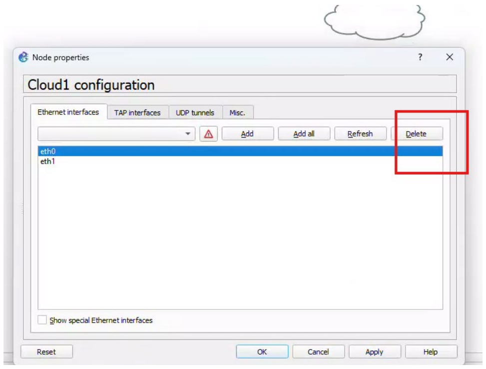


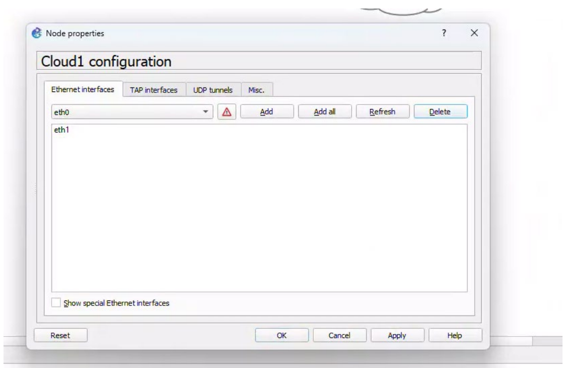
Cloud

Drag the cloud into a workspace in GSN3

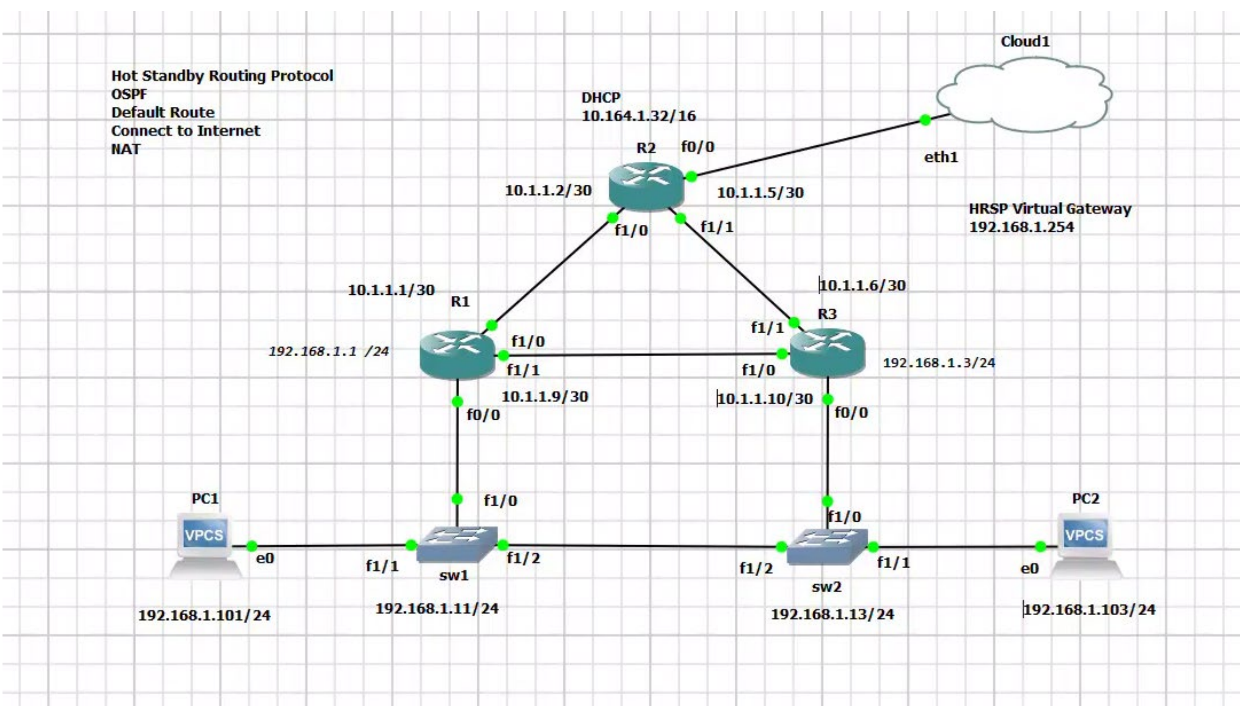


Right click the Cloud > Configure, then delete eth0. Click "Apply" then "OK". Power on all devices.





3.19.8.2 Topology

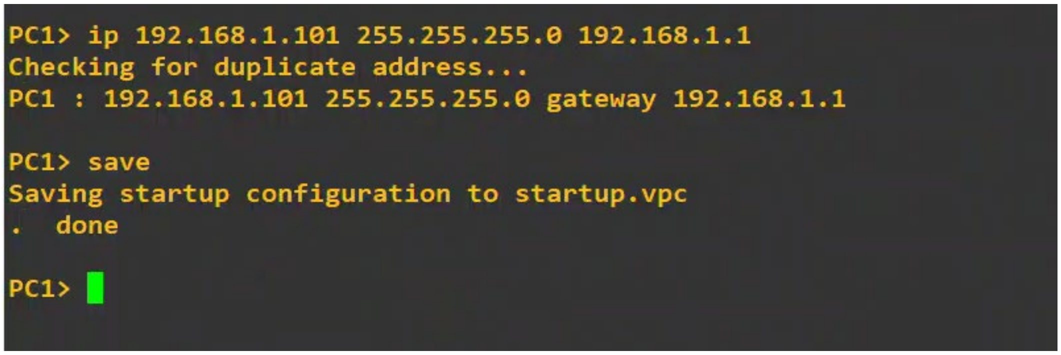


3.19.8.3 IP Configuration

1. Configure PC addresses on PC1 and PC2

PC1

ip 192.168.1.101 255.255.255.0 192.168.1.1
save



```
PC1> ip 192.168.1.101 255.255.255.0 192.168.1.1
Checking for duplicate address...
PC1 : 192.168.1.101 255.255.255.0 gateway 192.168.1.1

PC1> save
Saving startup configuration to startup.vpc
.  done

PC1>
```

PC2

ip 192.168.1.103 255.255.255.0 192.168.1.3

save

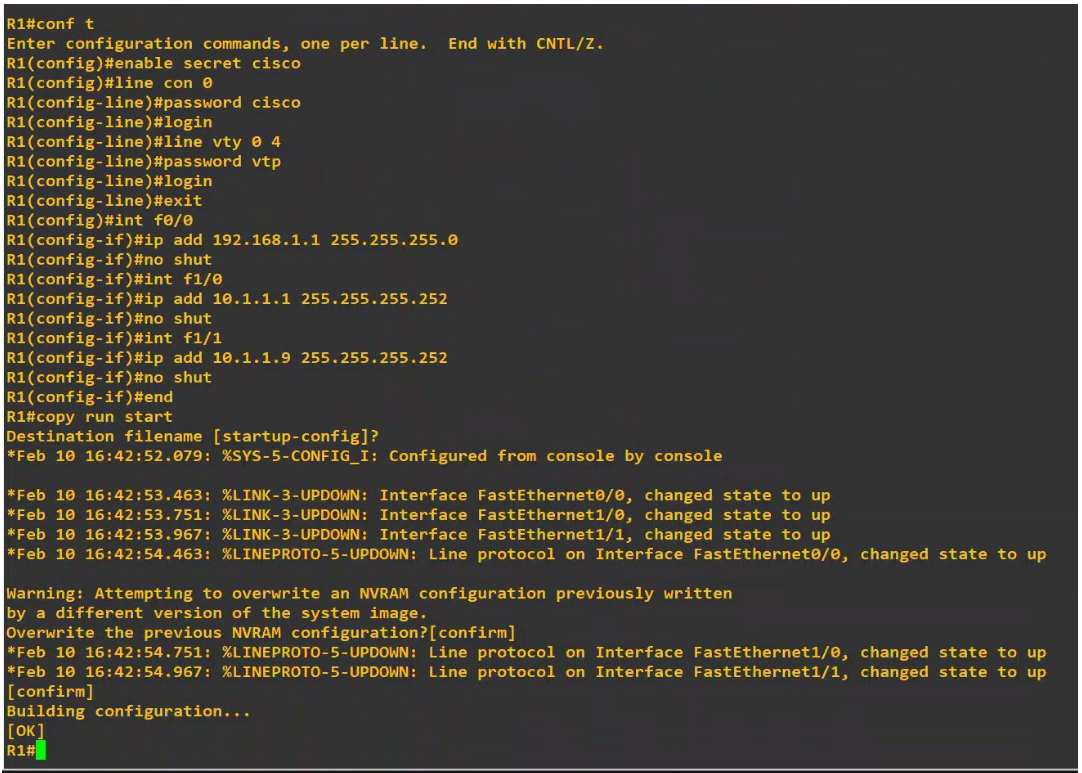
```
PC2> ip 192.168.1.103 255.255.255.0 192.168.1.3
Checking for duplicate address...
PC2 : 192.168.1.103 255.255.255.0 gateway 192.168.1.3

PC2> save
Saving startup configuration to startup.vpc
.  done

PC2>
```

2. Configure R1, then save running config to NVRAM.

R1

```
conf t
enable secret cisco
line con 0
password cisco
login
line vty 0 4
password vtp
login
exit
int f0/0
ip add 192.168.1.1 255.255.255.0
no shut
int f1/0
ip add 10.1.1.1 255.255.255.252
```

no shut
int f1/1
ip add 10.1.1.9 255.255.255.252
no shut
end
copy run start



```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#enable secret cisco
R1(config)#line con 0
R1(config-line)#password cisco
R1(config-line)#login
R1(config-line)#line vty 0 4
R1(config-line)#password vtp
R1(config-line)#login
R1(config-line)#exit
R1(config)#int f0/0
R1(config-if)#ip add 192.168.1.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#int f1/0
R1(config-if)#ip add 10.1.1.1 255.255.255.252
R1(config-if)#no shut
R1(config-if)#int f1/1
R1(config-if)#ip add 10.1.1.9 255.255.255.252
R1(config-if)#no shut
R1(config-if)#end
R1#copy run start
Destination filename [startup-config]?
*Feb 10 16:42:52.079: %SYS-5-CONFIG_I: Configured from console by console

*Feb 10 16:42:53.463: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Feb 10 16:42:53.751: %LINK-3-UPDOWN: Interface FastEthernet1/0, changed state to up
*Feb 10 16:42:53.967: %LINK-3-UPDOWN: Interface FastEthernet1/1, changed state to up
*Feb 10 16:42:54.463: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Warning: Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
*Feb 10 16:42:54.751: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to up
*Feb 10 16:42:54.967: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/1, changed state to up
[confirm]
Building configuration...
[OK]
R1#
```

3. Configure R3, then save running config to NVRAM.

```
R3
conf t
enable secret cisco
line con 0
password cisco
login
line vty 0 4
password vtp
login
exit
int f1/1
ip add 10.1.1.6 255.255.255.252
no shut
int f0/0
ip add 192.168.1.3 255.255.255.0
no shut
end
copy run start
```

```
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#enable secret cisco
R3(config)#line con 0
R3(config-line)#password cisco
R3(config-line)#login
R3(config-line)#line vty 0 4
R3(config-line)#password vtp
R3(config-line)#login
R3(config-line)#exit
R3(config)#int f1/1
R3(config-if)#ip add 10.1.1.6 255.255.255.252
R3(config-if)#no shut
R3(config-if)#int f0/0
R3(config-if)#ip add 192.168.1.3 255.255.255.0
R3(config-if)#no shut
R3(config-if)#end
R3#copy run start
Jan 10 18:22:12.638: %SYS-5-CONFIG_I: Configured from console by console
R3#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
R3#
```

4. Configure R2, then save running config to NVRAM.

   R2

```
conf t
enable secret cisco
line con 0
password cisco
login
line vty 0 4
password vtp
login
exit
int f1/0
ip add 10.1.1.2 255.255.255.252
no shut
int f1/1
ip add 10.1.1.5 255.255.255.252
no shut
int f0/0
ip add dhcp
no shut
end
copy run start
```

```
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#enable secret cisco
R2(config)#line con 0
R2(config-line)#password cisco
R2(config-line)#login
R2(config-line)#line vty 0 4
R2(config-line)#password vtp
R2(config-line)#login
R2(config-line)#exit
R2(config)#int f1/0
R2(config-if)#ip add 10.1.1.2 255.255.255.252
R2(config-if)#no shut
R2(config-if)#int f1/1
R2(config-if)#ip add 10.1.1.5 255.255.255.252
R2(config-if)#no shut
R2(config-if)#int f0/0
R2(config-if)#ip add dhcp
R2(config-if)#no shut
R2(config-if)#end
R2#copy run start
Destination filename [startup-config]?
*Feb 10 16:49:37.875: %SYS-5-CONFIG_I: Configured from console by console

*Feb 10 16:49:42.015: %DHCP-6-ADDRESS_ASSIGN: Interface FastEthernet0/0 assigned DHCP address 10.164.1.32, mask 255.255.0.0, hostname R2


Building configuration...
[OK]
R2#
```

Take note of IP DHCP assigned IP address and add a label to the topography

DHCP address 10.164.1.32, mask 255.255.0.0, hostname R2

```
*Feb 10 16:49:42.015: %DHCP-6-ADDRESS_ASSIGN: Interface FastEthernet0/0 assigned DHCP address 10.164.1.32, mask 255.255.0.0, hostname R2


Building configuration...
[OK]
R2#
```

5. Configure basic configurations for SW1, assign an IP address for VLAN 1, then save running config to NVRAM

SW1
```
conf t
enable secret cisco
line con 0
password cisco
login
line vty 0 15
password vtp
login
exit
int vlan 1
ip add 192.168.1.11 255.255.255.0
no shut
ip default-gateway 192.168.1.1
end
copy run start
```

```
sw1#
sw1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw1(config)#enable secret cisco
sw1(config)#line con 0
sw1(config-line)#password cisco
sw1(config-line)#login
sw1(config-line)#line vty 0 15
sw1(config-line)#password vtp
sw1(config-line)#login
sw1(config-line)#exit
sw1(config)#int vlan 1
sw1(config-if)#ip add 192.168.1.11 255.255.255.0
sw1(config-if)#no shut
sw1(config-if)#ip default-gateway 192.168.1.1
sw1(config)#end
sw1#copy run start
Destination filename [startup-config]?
*Mar  1 00:09:19.975: %SYS-5-CONFIG_I: Configured from console by console

Building configuration...
[OK]
sw1#
```

6. Configure basic configurations for SW2, assign an IP address for VLAN 1, then save running config to NVRAM

   SW2

   ```
   conf t
   enable secret cisco
   line con 0
   password cisco
   login
   line vty 0 15
   password vtp
   login
   exit
   int vlan 1
   ip add 192.168.1.13 255.255.255.0
   no shut
   ip default-gateway 192.168.1.3
   end
   copy run start
   ```

```
sw2#
sw2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
sw2(config)#enable secret cisco
sw2(config)#line con 0
sw2(config-line)#password cisco
sw2(config-line)#login
sw2(config-line)#line vty 0 15
sw2(config-line)#password vtp
sw2(config-line)#login
sw2(config-line)#exit
sw2(config)#int vlan 1
sw2(config-if)#ip add 192.168.1.13 255.255.255.0
sw2(config-if)#no shut
sw2(config-if)#ip default-gateway 192.168.1.3
sw2(config)#end
sw2#copy run start
*Mar  1 00:16:42.603: %SYS-5-CONFIG_I: Configured from console by console
sw2#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
sw2#
```

3.19.8.4Setup ospf on r1 r2 r3

1. Configure OSPF 10 and static route on R1, then save running config to NVRAM.

R1

```
conf t
router ospf 10
network 10.1.1.0 0.0.0.3 area 0
network 10.1.1.8 0.0.0.3 area 0
network 192.168.1.0 0.0.0.255 area 0
exit
ip route 0.0.0.0 0.0.0.0 10.1.1.2
end
copy run start
```

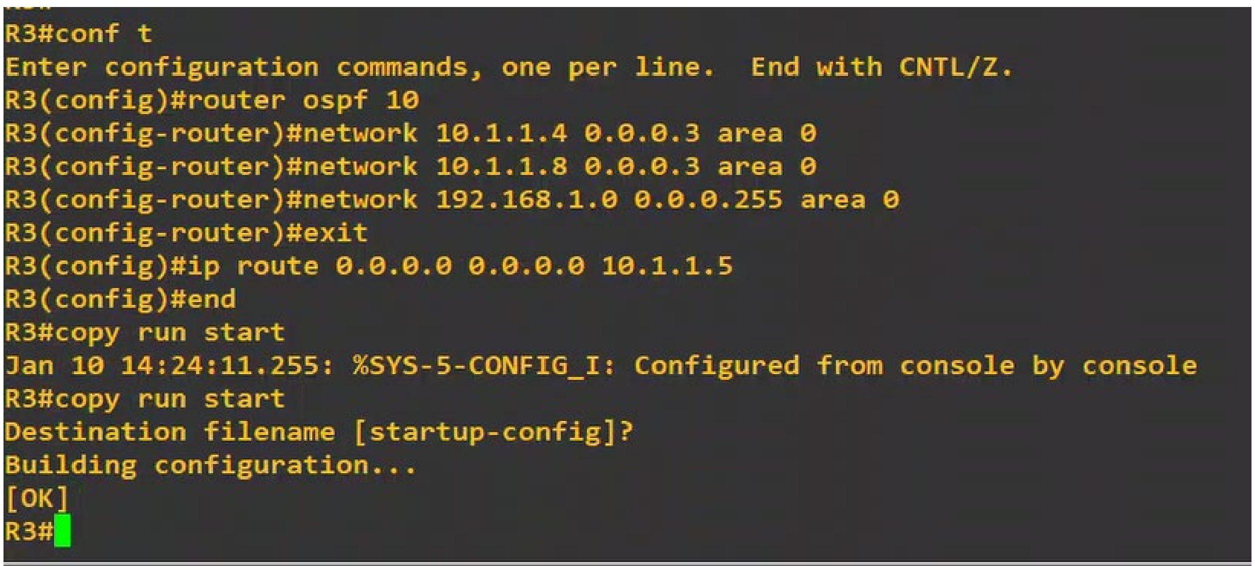
Note: gateway of last resort is assigned to the next hop outside of the router

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#router ospf 10
R1(config-router)#network 10.1.1.0 0.0.0.3 area 0
R1(config-router)#network 10.1.1.8 0.0.0.3 area 0
R1(config-router)#network 192.168.1.0 0.0.0.255 area 0
R1(config-router)#exit
R1(config)#ip route 0.0.0.0 0.0.0.0 10.1.1.2
R1(config)#end
R1#copy run start
Destination filename [startup-config]?
Jan 10 14:15:23.403: %SYS-5-CONFIG_I: Configured from console by console

Building configuration...
[OK]
R1#
```

2. Configure OSPF 10 and static route on R3, then save running config to NVRAM.

R3

```
conf t
router ospf 10
network 10.1.1.4 0.0.0.3 area 0
network 10.1.1.8 0.0.0.3 area 0
network 192.168.1.0 0.0.0.255 area 0
exit
ip route 0.0.0.0 0.0.0.0 10.1.1.5
end
copy run start
```



```
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#router ospf 10
R3(config-router)#network 10.1.1.4 0.0.0.3 area 0
R3(config-router)#network 10.1.1.8 0.0.0.3 area 0
R3(config-router)#network 192.168.1.0 0.0.0.255 area 0
R3(config-router)#exit
R3(config)#ip route 0.0.0.0 0.0.0.0 10.1.1.5
R3(config)#end
R3#copy run start
Jan 10 14:24:11.255: %SYS-5-CONFIG_I: Configured from console by console
R3#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
R3#
```

3. Configure OSPF 10, static route and NAT on R2, then save running config to NVRAM.

R2

```
conf t
router ospf 10
network 10.1.1.0 0.0.0.3 area 0
network 10.1.1.4 0.0.0.3 area 0
default-information originate
exit
ip route 0.0.0.0 0.0.0.0 10.164.0.1
end
copy run start
```

```
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#router ospf 10
R2(config-router)#network 10.1.1.0 0.0.0.3 area 0
R2(config-router)#network 10.1.1.4 0.0.0.3 area 0
R2(config-router)#default-information originate
R2(config-router)#exit
R2(config)#ip route 0.0.0.0 0.0.0.0 10.164.0.1
R2(config)#end
R2#copy run start
Destination filename [startup-config]?
Jan 10 18:30:38.178: %SYS-5-CONFIG_I: Configured from console by consol

Building configuration...
[OK]
R2#
R2#
```

4. Verify routes for OSPF

   Verify routes on each router with show ip route command.

   R1

   show ip route

```
R1#
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 10.1.1.2 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 10.1.1.2
      10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C        10.1.1.0/30 is directly connected, FastEthernet1/0
L        10.1.1.1/32 is directly connected, FastEthernet1/0
O        10.1.1.4/30 [110/2] via 192.168.1.3, 00:09:54, FastEthernet0/0
                     [110/2] via 10.1.1.2, 00:03:23, FastEthernet1/0
C        10.1.1.8/30 is directly connected, FastEthernet1/1
L        10.1.1.9/32 is directly connected, FastEthernet1/1
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, FastEthernet0/0
L        192.168.1.1/32 is directly connected, FastEthernet0/0
R1#
```

   R2

   show ip route

```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 10.164.0.1 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 10.164.0.1
      10.0.0.0/8 is variably subnetted, 8 subnets, 3 masks
C        10.1.1.0/30 is directly connected, FastEthernet1/0
L        10.1.1.2/32 is directly connected, FastEthernet1/0
C        10.1.1.4/30 is directly connected, FastEthernet1/1
L        10.1.1.5/32 is directly connected, FastEthernet1/1
O        10.1.1.8/30 [110/2] via 10.1.1.1, 04:05:08, FastEthernet1/0
S        10.162.240.52/32 [254/0] via 10.164.0.1, FastEthernet0/0
C        10.164.0.0/16 is directly connected, FastEthernet0/0
L        10.164.1.32/32 is directly connected, FastEthernet0/0
O     192.168.1.0/24 [110/2] via 10.1.1.6, 00:11:43, FastEthernet1/1
                     [110/2] via 10.1.1.1, 00:11:43, FastEthernet1/0
R2#
```

R3

show ip route

```
R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 10.1.1.5 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 10.1.1.5
      10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O        10.1.1.0/30 [110/2] via 192.168.1.1, 00:12:28, FastEthernet0/0
                     [110/2] via 10.1.1.5, 00:12:28, FastEthernet1/1
C        10.1.1.4/30 is directly connected, FastEthernet1/1
L        10.1.1.6/32 is directly connected, FastEthernet1/1
O        10.1.1.8/30 [110/2] via 192.168.1.1, 00:12:28, FastEthernet0/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, FastEthernet0/0
L        192.168.1.3/32 is directly connected, FastEthernet0/0
R3#
```

3.19.8.5 Configure NAT on R2

1. Configure NAT on R2 by configuring inside and outside interfaces, creating access list 1, and adding the 192.168.0.0 and 10.1.1.0 networks, then save running config to NVRAM.

R2

```
conf t
int f0/0
ip nat outside
int f1/0
ip nat inside
int f1/1
```

```
ip nat inside
exit
access-list 1 permit 192.168.0.0 0.0.255.255
access-list 1 permit 10.1.1.0 0.0.0.255
ip nat inside source list 1 int f0/0 over
end
copy run start
```

```
R2#
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#int f0/0
R2(config-if)#ip nat outside
R2(config-if)#int f1/0
R2(config-if)#ip nat inside
R2(config-if)#int f1/1
R2(config-if)#ip nat inside
R2(config-if)#exit
R2(config)#access-list 1 permit 192.168.0.0 0.0.255.255
R2(config)#access-list 1 permit 10.1.1.0 0.0.0.255
R2(config)#ip nat inside source list 1 int f0/0 over
R2(config)#end
R2#copy run start
Destination filename [startup-config]?
Jan 10 15:14:42.083: %SYS-5-CONFIG_I: Configured from console by console
```

2. Verify connectivity to the internet from PC1 and PC2 by pinging and tracerouting to 8.8.8.8.

```
PC1> ping 8.8.8.8

PC1> trace 8.8.8.8
```

```
PC1> ping 8.8.8.8

8.8.8.8 icmp_seq=1 timeout
84 bytes from 8.8.8.8 icmp_seq=2 ttl=116 time=42.240 ms
84 bytes from 8.8.8.8 icmp_seq=3 ttl=116 time=44.440 ms
84 bytes from 8.8.8.8 icmp_seq=4 ttl=116 time=40.064 ms
84 bytes from 8.8.8.8 icmp_seq=5 ttl=116 time=51.541 ms

PC1> traceroute 8.8.8.8
Bad command: "traceroute 8.8.8.8". Use ? for help.

PC1> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   18.952 ms  10.083 ms  9.826 ms
 2   10.1.1.2   29.741 ms  30.298 ms  30.005 ms
 3   10.164.0.1   54.248 ms  73.374 ms  42.629 ms
 4   207.162.58.2   72.580 ms  61.583 ms  55.390 ms
 5   132.202.51.245   40.156 ms  41.484 ms  45.495 ms
 6   132.202.100.33   53.559 ms  60.004 ms  50.626 ms
 7     *  *  *
 8   192.77.55.209   43.533 ms  40.276 ms  48.698 ms

PC1>
```

```
PC2> ping 8.8.8.8

PC2> trace 8.8.8.8
```

```
PC2> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1     *192.168.1.3   12.355 ms  19.545 ms
 2   10.1.1.5   36.579 ms  43.277 ms  43.333 ms
 3   10.164.0.1   92.887 ms  41.049 ms  40.114 ms
 4   207.162.58.2   54.833 ms  53.047 ms  64.000 ms
 5   132.202.51.245   54.299 ms  85.513 ms  118.927 ms
 6   132.202.100.33   47.341 ms  56.328 ms  41.514 ms
 7     *  *  *
 8   192.77.55.209   58.936 ms  52.717 ms  40.490 ms

PC2> ping 8.8.8.8

84 bytes from 8.8.8.8 icmp_seq=1 ttl=116 time=82.353 ms
84 bytes from 8.8.8.8 icmp_seq=2 ttl=116 time=38.905 ms
84 bytes from 8.8.8.8 icmp_seq=3 ttl=116 time=52.797 ms
84 bytes from 8.8.8.8 icmp_seq=4 ttl=116 time=49.683 ms
84 bytes from 8.8.8.8 icmp_seq=5 ttl=116 time=53.555 ms

PC2>
```

3.19.8.6 Hot Standby Routing Protocol

1. To configure Hot Standby Routing, first we'll shutdown interface f0/0 on R3.

```
R3
conf t
int f0/0
shut
```

```
R3#!!!! HSBR !!!!!!
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#int f0/0
R3(config-if)#shut
R3(config-if)#
Jan 10 18:50:09.150: %OSPF-5-ADJCHG: Process 10, Nbr 192.168.1.1 on FastEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
R3(config-if)#
Jan 10 18:50:11.122: %LINK-5-CHANGED: Interface FastEthernet0/0, changed state to administratively down
Jan 10 18:50:12.122: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to down
R3(config-if)#
```

2. Try doing a tracerout on PC2 to 8.8.8.8.

```
PC2 > trace 8.8.8.8
```

It should fail after reaching the switch.

```
PC2> ping 8.8.8.8

host (192.168.1.3) not reachable

PC2>
```

```
PC2> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
host (192.168.1.3) not reachable

PC2>
```

3. Re-enable interface f0/0 on R3.

R3

no shut

```
3(config-if)#
3(config-if)#no shut
3(config-if)#
an 10 18:53:35.802: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
an 10 18:53:36.802: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
3(config-if)#
an 10 18:53:41.658: %OSPF-5-ADJCHG: Process 10, Nbr 192.168.1.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
3(config-if)#
```

This time we have success

```
PC2> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1     *192.168.1.3   16.616 ms  20.591 ms
 2   10.1.1.5   55.806 ms  27.040 ms  31.028 ms
 3   10.164.0.1   129.537 ms  39.466 ms  39.734 ms
 4   207.162.58.2   66.865 ms  41.089 ms  42.577 ms
 5   132.202.51.245   41.326 ms  55.022 ms  41.845 ms
 6   132.202.100.33   57.463 ms  61.269 ms  59.916 ms
 7     *  *  *
 8   192.77.55.209   56.476 ms  66.185 ms  52.479 ms
```

4. Configure Hot Standby Routing on R1.

```
R1
conf t
int f0/0
standby version 2
standby 1 ip 192.168.1.254
standby 1 priority 150
standby 1 preempt
exit
```

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int f0/0
R1(config-if)#standby version 2
R1(config-if)#standby 1 ip 192.168.1.254
R1(config-if)#standby 1 priority 150
R1(config-if)#standby 1 preempt
R1(config-if)#exit
```

Note: 192.168.1.254 is virtual gateway. Use the command preempt if you wanted to establish it as the active router.

5. Verify the standby with the show stanby command.

```
show standby
```

```
R1#show standby
FastEthernet0/0 - Group 1 (version 2)
  State is Active
    2 state changes, last state change 00:00:12
  Virtual IP address is 192.168.1.254
  Active virtual MAC address is 0000.0c9f.f001 (MAC In Use)
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.928 secs
  Preemption enabled
  Active router is local
  Standby router is unknown
  Priority 150 (configured 150)
  Group name is "hsrp-Fa0/0-1" (default)
R1#
```

6. Configure Hot Standby Routing on R3.

R3

```
conf t
int f0/0
standby version 2
standby 1 ip 192.168.1.254
standby 1 priority 100
standby 1 preempt
exit
```

```
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#int f0/0
R3(config-if)#standby version 2
R3(config-if)#standby 1 ip 192.168.1.254
R3(config-if)#standby 1 priority 100
R3(config-if)#standby 1 preempt
R3(config-if)#exit
R3(config)#
R3(config)#end
R3#
R3#
R3#
```

R3

```
show standby
```

R3 is standby router

```
R3#
R3#show standby
FastEthernet0/0 - Group 1 (version 2)
  State is Standby
    1 state change, last state change 00:00:18
  Virtual IP address is 192.168.1.254
  Active virtual MAC address is 0000.0c9f.f001 (MAC Not In Use)
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.240 secs
  Preemption enabled
  Active router is 192.168.1.1, priority 150 (expires in 9.904 sec)
    MAC address is ca01.2f5e.0000
  Standby router is local
  Priority 100 (default 100)
  Group name is "hsrp-Fa0/0-1" (default)
R3#
```

R1 is the active router

```
R1#show standby
FastEthernet0/0 - Group 1 (version 2)
  State is Active
    2 state changes, last state change 00:08:14
  Virtual IP address is 192.168.1.254
  Active virtual MAC address is 0000.0c9f.f001 (MAC In Use)
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.472 secs
  Preemption enabled
  Active router is local
  Standby router is 192.168.1.3, priority 100 (expires in 11.152 sec)
  Priority 150 (configured 150)
  Group name is "hsrp-Fa0/0-1" (default)
R1#
```

3.19.8.7Test

1. Reconfigure IP address on PC1 & PC2 with the HSRP Virtual Gateway as the default gateway. Verify address change with the show command.
   PC1

   ip 192.168.1.101 255.255.255.0 192.168.1.254

   save

   show

```
PC1> ip 192.168.1.101 255.255.255.0 192.168.1.254
Checking for duplicate address...
PC1 : 192.168.1.101 255.255.255.0 gateway 192.168.1.254

PC1> save
Saving startup configuration to startup.vpc
.  done

PC1> show

NAME   IP/MASK              GATEWAY           MAC                LPORT  RHOST:PORT
PC1    192.168.1.101/24     192.168.1.254     00:50:79:66:68:00  20042  127.0.0.1:20043
       fe80::250:79ff:fe66:6800/64

PC1>
```

PC2

ip 192.168.1.103 255.255.255.0 192.168.1.254

save

show

```
PC2> ip 192.168.1.103 255.255.255.0 192.168.1.254
Checking for duplicate address...
PC2 : 192.168.1.103 255.255.255.0 gateway 192.168.1.254

PC2> dave
Bad command: "dave". Use ? for help.

PC2> save
Saving startup configuration to startup.vpc
.  done

PC2> show

NAME   IP/MASK              GATEWAY           MAC                LPORT  RHOST:PORT
PC2    192.168.1.103/24     192.168.1.254     00:50:79:66:68:01  20044  127.0.0.1:20045
       fe80::250:79ff:fe66:6801/64

PC2>
```

2. Verify connectivity to the internet from PC1 and PC2 by pinging and tracerouting to 8.8.8.8.
   PC1> ping 8.8.8.8
   PC1> trace 8.8.8.8
   PC2> ping 8.8.8.8
   PC2> trace 8.8.8.8

```
PC1> ping 8.8.8.8

84 bytes from 8.8.8.8 icmp_seq=1 ttl=116 time=100.959 ms
84 bytes from 8.8.8.8 icmp_seq=2 ttl=116 time=51.750 ms
84 bytes from 8.8.8.8 icmp_seq=3 ttl=116 time=68.769 ms
84 bytes from 8.8.8.8 icmp_seq=4 ttl=116 time=43.542 ms
84 bytes from 8.8.8.8 icmp_seq=5 ttl=116 time=41.026 ms

PC1> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1    23.975 ms  9.890 ms  12.281 ms
 2   10.1.1.2    46.599 ms  44.927 ms  34.084 ms
 3   10.164.0.1    59.440 ms  99.297 ms  100.093 ms
 4   207.162.58.2    66.128 ms  40.805 ms  68.316 ms
 5   132.202.51.245    68.411 ms  43.635 ms  59.353 ms
 6   132.202.100.33    61.950 ms  55.260 ms  62.075 ms
 7     *  *  *
 8   192.77.55.209    49.860 ms  49.123 ms  51.333 ms

PC1>
```

```
PC2> ping 8.8.8.8

84 bytes from 8.8.8.8 icmp_seq=1 ttl=116 time=41.174 ms
84 bytes from 8.8.8.8 icmp_seq=2 ttl=116 time=37.472 ms
84 bytes from 8.8.8.8 icmp_seq=3 ttl=116 time=71.573 ms
84 bytes from 8.8.8.8 icmp_seq=4 ttl=116 time=42.149 ms
84 bytes from 8.8.8.8 icmp_seq=5 ttl=116 time=33.403 ms

PC2> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   7.023 ms  9.338 ms  10.358 ms
 2   10.1.1.2   29.025 ms  30.631 ms  32.834 ms
 3   10.164.0.1   71.677 ms  55.675 ms  42.507 ms
 4   207.162.58.2   56.272 ms  51.451 ms  58.601 ms
 5   132.202.51.245   66.931 ms  41.736 ms  41.859 ms
 6   132.202.100.33   39.711 ms  57.265 ms  39.391 ms
 7     *  *  *
 8   192.77.55.209   59.610 ms  71.380 ms  42.572 ms

PC2>
```

solarwinds | Solar-PuTTY *free tool*

3. Test out HSRP by going to R1 and shutting down interface f0/0.

   R1

   conf t

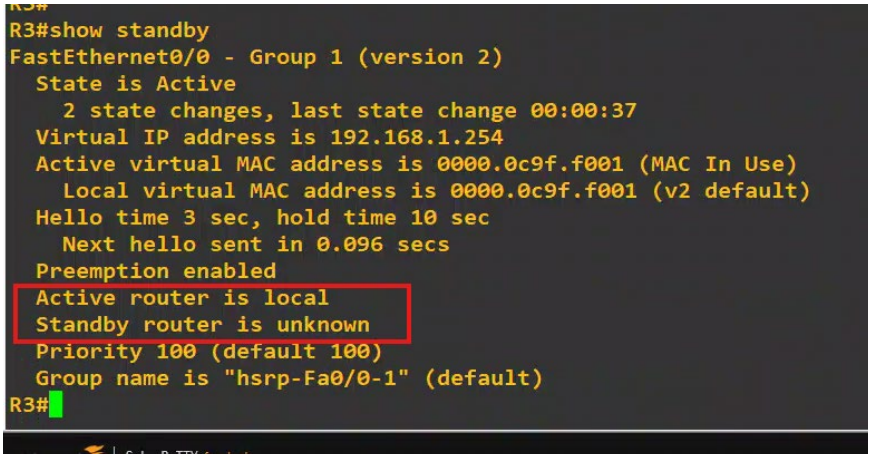
   int f0/0

   shut

```
R1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface f0/0
R1(config-if)#shut
R1(config-if)#
Jan 10 19:17:05.646: %HSRP-5-STATECHANGE: FastEthernet0/0 Grp 1 state Active -> Init
Jan 10 19:17:05.678: %OSPF-5-ADJCHG: Process 10, Nbr 192.168.1.3 on FastEthernet0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
R1(config-if)#
Jan 10 19:17:07.634: %LINK-5-CHANGED: Interface FastEthernet0/0, changed state to administratively down
Jan 10 19:17:08.634: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to down
R1(config-if)#
```

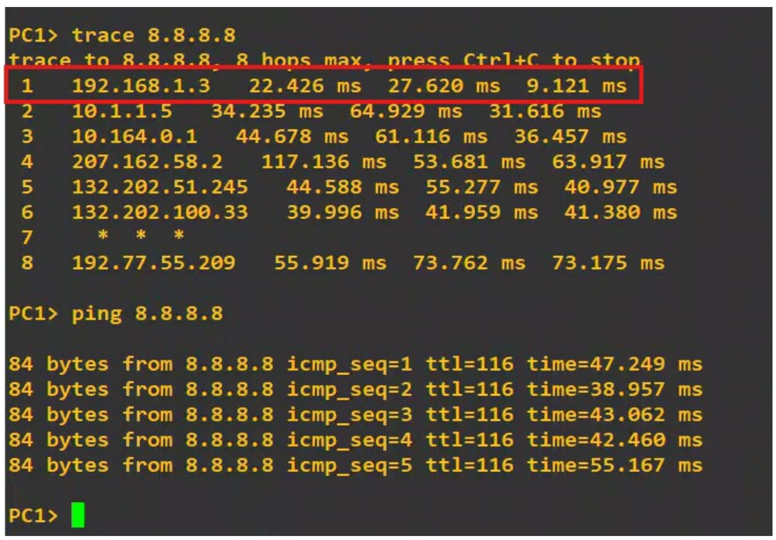
4. Go to R3 and verify that is is the active router.

   show standby

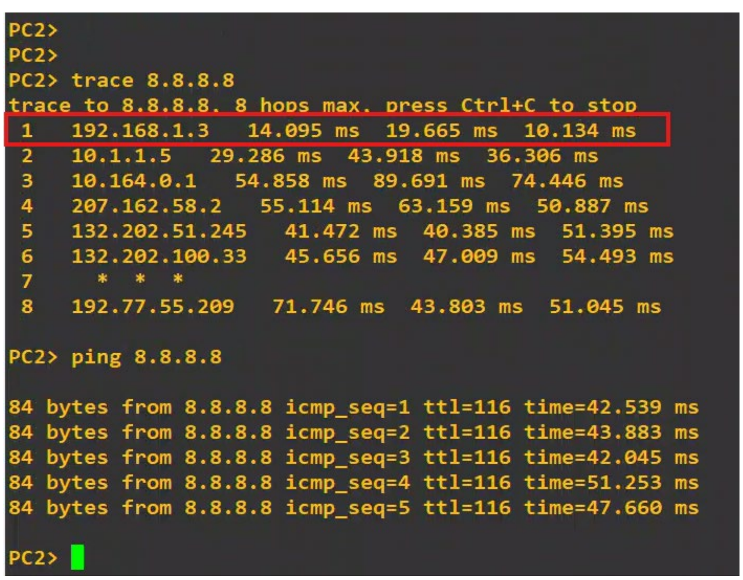


```
R3#show standby
FastEthernet0/0 - Group 1 (version 2)
  State is Active
    2 state changes, last state change 00:00:37
  Virtual IP address is 192.168.1.254
  Active virtual MAC address is 0000.0c9f.f001 (MAC In Use)
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.096 secs
  Preemption enabled
  Active router is local
  Standby router is unknown
  Priority 100 (default 100)
  Group name is "hsrp-Fa0/0-1" (default)
R3#
```

5. Verify connectivity to the internet from PC1 by tracerouting to 8.8.8.8.



```
PC1> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.3   22.426 ms  27.620 ms  9.121 ms
 2   10.1.1.5   34.235 ms  64.929 ms  31.616 ms
 3   10.164.0.1   44.678 ms  61.116 ms  36.457 ms
 4   207.162.58.2   117.136 ms  53.681 ms  63.917 ms
 5   132.202.51.245   44.588 ms  55.277 ms  40.977 ms
 6   132.202.100.33   39.996 ms  41.959 ms  41.380 ms
 7     *  *  *
 8   192.77.55.209   55.919 ms  73.762 ms  73.175 ms

PC1> ping 8.8.8.8

84 bytes from 8.8.8.8 icmp_seq=1 ttl=116 time=47.249 ms
84 bytes from 8.8.8.8 icmp_seq=2 ttl=116 time=38.957 ms
84 bytes from 8.8.8.8 icmp_seq=3 ttl=116 time=43.062 ms
84 bytes from 8.8.8.8 icmp_seq=4 ttl=116 time=42.460 ms
84 bytes from 8.8.8.8 icmp_seq=5 ttl=116 time=55.167 ms

PC1>
```



```
PC2>
PC2>
PC2> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.3   14.095 ms  19.665 ms  10.134 ms
 2   10.1.1.5   29.286 ms  43.918 ms  36.306 ms
 3   10.164.0.1   54.858 ms  89.691 ms  74.446 ms
 4   207.162.58.2   55.114 ms  63.159 ms  50.887 ms
 5   132.202.51.245   41.472 ms  40.385 ms  51.395 ms
 6   132.202.100.33   45.656 ms  47.009 ms  54.493 ms
 7     *  *  *
 8   192.77.55.209   71.746 ms  43.803 ms  51.045 ms

PC2> ping 8.8.8.8

84 bytes from 8.8.8.8 icmp_seq=1 ttl=116 time=42.539 ms
84 bytes from 8.8.8.8 icmp_seq=2 ttl=116 time=43.883 ms
84 bytes from 8.8.8.8 icmp_seq=3 ttl=116 time=42.045 ms
84 bytes from 8.8.8.8 icmp_seq=4 ttl=116 time=51.253 ms
84 bytes from 8.8.8.8 icmp_seq=5 ttl=116 time=47.660 ms

PC2>
```

6. Restore R1

```
R1(config-if)#no shut
R1(config-if)#end
R1#
Jan 10 19:21:21.246: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
Jan 10 19:21:21.866: %SYS-5-CONFIG_I: Configured from console by console
R1#
Jan 10 19:21:22.246: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R1#
Jan 10 19:21:22.714: %HSRP-5-STATECHANGE: FastEthernet0/0 Grp 1 state Listen -> Active
R1#
Jan 10 19:21:27.214: %OSPF-5-ADJCHG: Process 10, Nbr 192.168.1.3 on FastEthernet0/0 from LOADING to FULL, Loading Done
R1#
```

7. Trace in PC1 goes again on 1.1

```
PC1> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1     *192.168.1.1   8.977 ms  9.909 ms
 2   10.1.1.2   90.528 ms  34.882 ms  38.610 ms
 3   10.164.0.1   76.457 ms  43.081 ms  43.320 ms
 4   207.162.58.2   87.503 ms  50.962 ms  53.276 ms
 5   132.202.51.245   59.218 ms  75.358 ms  44.658 ms
 6   132.202.100.33   46.497 ms  47.310 ms  41.424 ms
 7     *  *  *
 8   192.77.55.209   51.821 ms  44.565 ms  43.495 ms

PC1>
```

8. Print standby R1

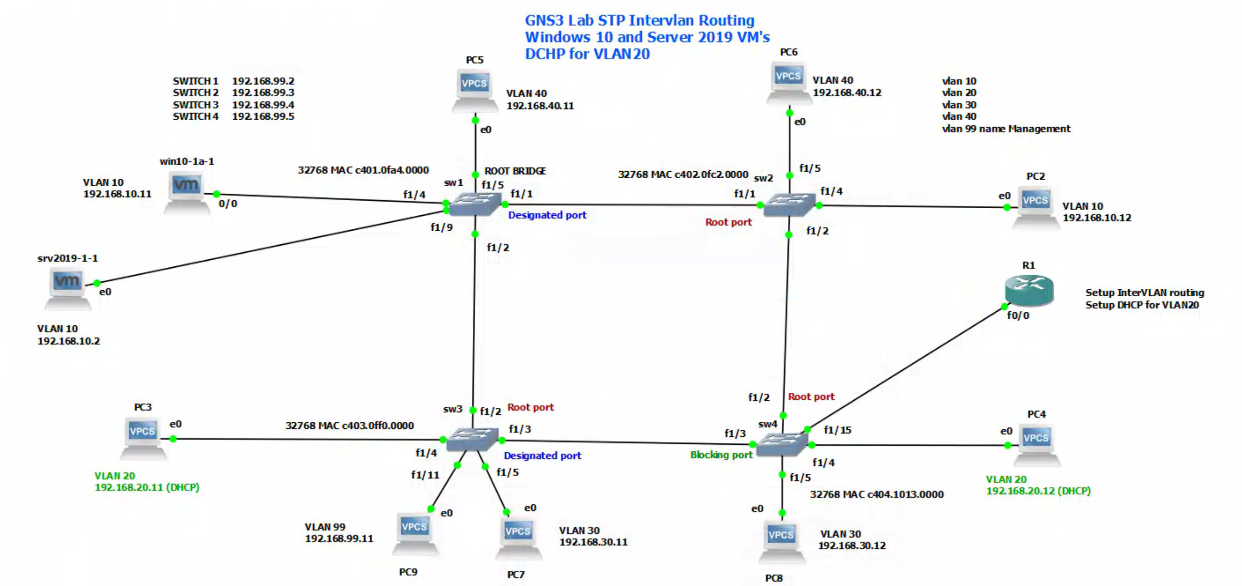
```
R1#show standby
FastEthernet0/0 - Group 1 (version 2)
  State is Active
    4 state changes, last state change 00:01:51
  Virtual IP address is 192.168.1.254
  Active virtual MAC address is 0000.0c9f.f001 (MAC In Use)
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.464 secs
  Preemption enabled
  Active router is local
  Standby router is 192.168.1.3, priority 100 (expires in 9.136 sec)
  Priority 150 (configured 150)
  Group name is "hsrp-Fa0/0-1" (default)
R1#
```

9. Print standby R3

```
R3#show standby
FastEthernet0/0 - Group 1 (version 2)
  State is Standby
    4 state changes, last state change 00:02:25
  Virtual IP address is 192.168.1.254
  Active virtual MAC address is 0000.0c9f.f001 (MAC Not In Use)
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.064 secs
  Preemption enabled
  Active router is 192.168.1.1, priority 150 (expires in 9.168 sec)
    MAC address is ca01.2f5e.0000
  Standby router is local
  Priority 100 (default 100)
  Group name is "hsrp-Fa0/0-1" (default)
R3#
```

3.19.9 GNS3 - Lab STP Intervlan Routing ,DHCP IPV4, Windows 10 and Server 2019 VM's

3.19.9.1 Topology



3.19.9.1.1 Switches and VLANs Configuration

Element	VLAN	Port	Mode	IP Address
SWITCH 1	10	f1/4, f1/9	Access	-

	40	f1/5	Access	-
	99	f1/1, f1/2, VLAN 99	Trunk/Native	192.168.99.2
SWITCH 2	10	f1/4	Access	-
	40	f1/5	Access	-
	99	f1/1, f1/2, VLAN 99	Trunk/Native	192.168.99.3
SWITCH 3	20	f1/4	Access	-
	30	f1/5	Access	-
	99	f1/2, f1/3, f1/11, VLAN 99	Trunk/Native	192.168.99.4
SWITCH 4	20	f1/4	Access	-
	30	f1/5	Access	-
	99	f1/2, f1/3, f1/15, VLAN 99	Trunk/Native	192.168.99.5

Router Sub-Interfaces and VLANs

Element	VLAN	Description	IP Address
ROUTER 1	10	Default Gateway for VLAN 10	192.168.10.1
	20	Default Gateway for VLAN 20	192.168.20.1
	30	Default Gateway for VLAN 30	192.168.30.1
	40	Default Gateway for VLAN 40	192.168.40.1
	99	Default Gateway for VLAN 99	192.168.99.1

PCs Configuration

PC	VLAN	IP Address	Subnet Mask	Default Gateway
win101a-1	10	192.168.10.11	255.255.255.0	192.168.10.1
srv2019-1-1	10	192.168.10.2	255.255.255.0	192.168.10.1
PC2	10	192.168.10.12	255.255.255.0	192.168.10.1
PC3	20	192.168.20.11 (DHCP)	255.255.255.0	192.168.20.1
PC4	20	192.168.20.12 (DHCP)	255.255.255.0	192.168.20.1
PC5	40	192.168.40.11	255.255.255.0	192.168.40.1
PC6	40	192.168.40.12	255.255.255.0	192.168.40.1
PC7	30	192.168.30.11	255.255.255.0	192.168.30.1
PC8	30	192.168.30.12	255.255.255.0	192.168.30.1
PC9	99	192.168.99.11	255.255.255.0	192.168.99.1

The configuration includes:

1) Spanning Tree Protocol
2) Router-on-a-Stick Inter-VLAN Routing
3) DHCP VLAN20 (ipv4& ipv6) having router as DHCP server
4) Connection to windows 10 and windows server 2019 (see below how to add windows VM's to the topology)

3.19.9.1.2 Configure network

Setup the topology using the following scripts

3.19.9.1.2.1 SW1

```
! SWITCH 1
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
```

```
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 10
 no shut
exit
int f1/9
 switchport mode access
 switchport access vlan 10
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 40
 no shut
exit
interface f1/1
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.2 255.255.255.0
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

3.19.9.1.2.2 SW2

```
!SWITCH 2
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
```

```
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 10
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 40
 no shut
exit
interface f1/1
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.3 255.255.255.0
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

3.19.9.1.2.3 SW3

```
!SWITCH 3
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
```

```
 switchport access vlan 20
 no shut
exit
int f1/5
 switchport mode access
 switchport access vlan 30
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/3
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/11
 switchport mode access
 switchport access vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.4 255.255.255.0
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

3.19.9.1.2.4 SW4

```
!SWITCH 4
clock set 21:30:00 Jan 10 2025
vlan database
 vlan 10
 vlan 20
 vlan 30
 vlan 40
 vlan 99 name Management
exit
config t
no ip domain-lookup
int f1/4
 switchport mode access
 switchport access vlan 20
 no shut
```

```
exit
int f1/5
 switchport mode access
 switchport access vlan 30
 no shut
exit
interface f1/2
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
interface f1/3
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
int vlan 99
 ip add 192.168.99.5 255.255.255.0
 no shut
exit
int f1/15
 description Trunk link to Router
 switchport mode trunk
 switchport trunk native vlan 99
 no shut
exit
ip default-gateway 192.168.99.1
end
copy running-config startup-config
```

3.19.9.1.2.5 R1

```
! ROUTER 1
config t
int f0/0.10
 description Default Gateway for VLAN 10
 encapsulation dot1Q 10
 ip address 192.168.10.1 255.255.255.0
exit
int f0/0.20
 description Default Gateway for VLAN 20
 encapsulation dot1Q 20
 ip address 192.168.20.1 255.255.255.0
exit
int f0/0.30
 description Default Gateway for VLAN 30
 encapsulation dot1Q 30
 ip address 192.168.30.1 255.255.255.0
```

```
exit
int f0/0.40
 description Default Gateway for VLAN 40
 encapsulation dot1Q 40
 ip address 192.168.40.1 255.255.255.0
exit
int f0/0.99
 description Default Gateway for VLAN 99
 encapsulation dot1Q 99 native
 ip address 192.168.99.1 255.255.255.0
exit
interface f0/0
 description Link R1 to SW4
 no shutdown
exit

!DHCP
ip dhcp excluded-address 192.168.20.1
192.168.20.10
ip dhcp pool R1-VLAN 20
network 192.168.20.0 255.255.255.0
default-router 192.168.20.1
dns-server 8.8.8.8
exit
end
copy running-config startup-config
```

3.19.9.1.2.6 IP Address for PC's

win10-1a-1
ip 192.168.10.11 255.255.255.0 192.168.10.1
(set from windows 10)
srv2019-1-1
ip 192.168.10.2 255.255.255.0 192.168.10.1
(set from windows server)
PC2
ip 192.168.10.12 255.255.255.0 192.168.10.1
save
PC3
ip 192.168.20.11 255.255.255.0 192.168.20.1 (
save
PC4
ip 192.168.20.12 255.255.255.0 192.168.20.1
save
PC5
ip 192.168.40.11 255.255.255.0 192.168.40.1
save
PC6

ip 192.168.40.12 255.255.255.0 192.168.40.1
save
PC7
ip 192.168.30.11 255.255.255.0 192.168.30.1
save
PC8
ip 192.168.30.12 255.255.255.0 192.168.30.1
save
PC9
ip 192.168.99.11 255.255.255.0 192.168.99.1
save

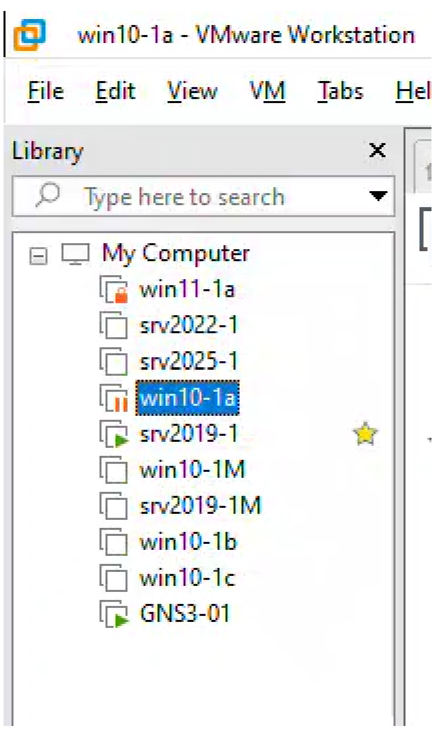
3.19.9.1.3 Connect a Vm to GNS3

3.19.9.1.3.1 Add a virtual machine to GNS3

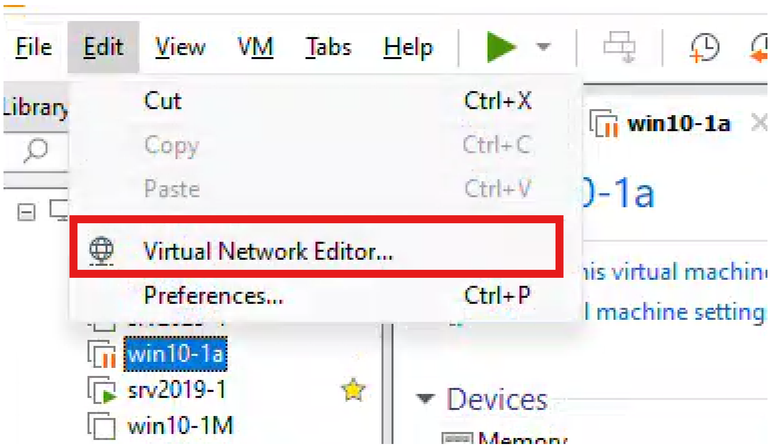
Once you have installed and configured your virtual machine in VMware Workstation, you are ready to integrate the VM with GNS3.

VMWare

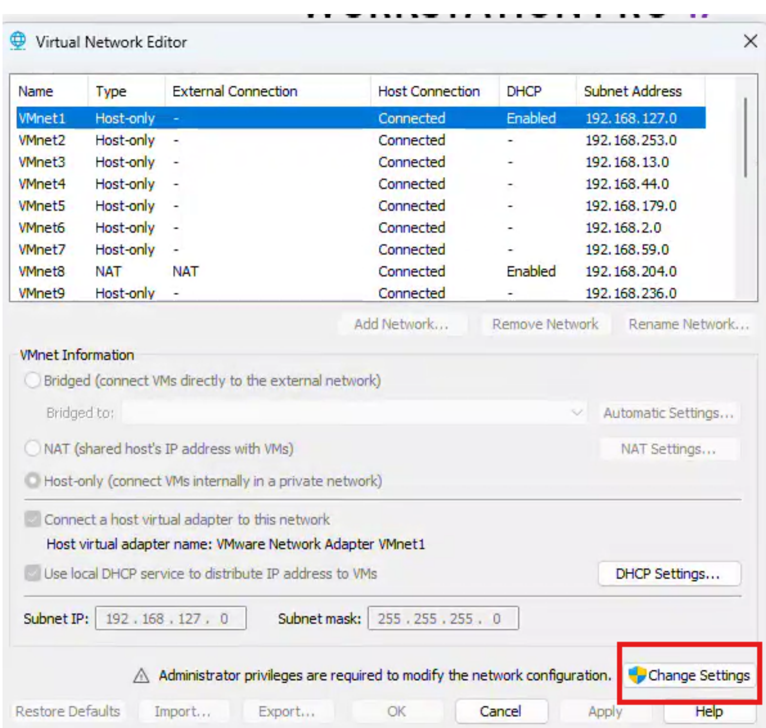
In VMWare select the VM to be added in GNS3 (win10-1a / srv2019-1)



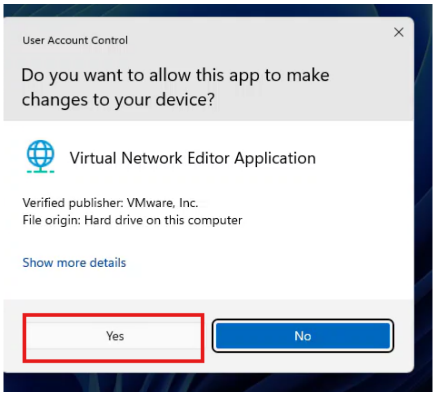
In VMWare select Edit/Virtual Network Editor



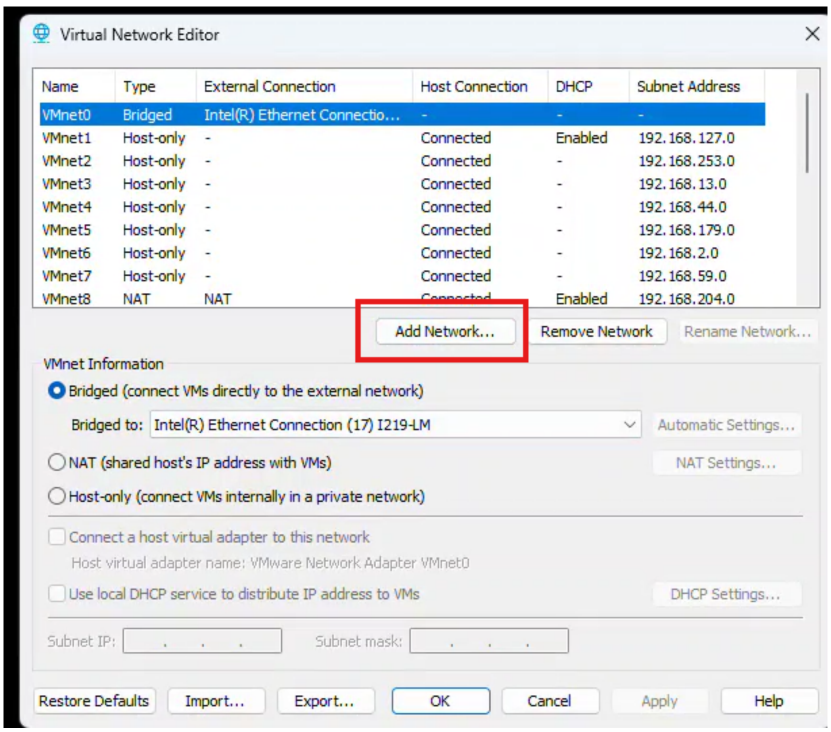
In Virtual Network Editor select change Settings



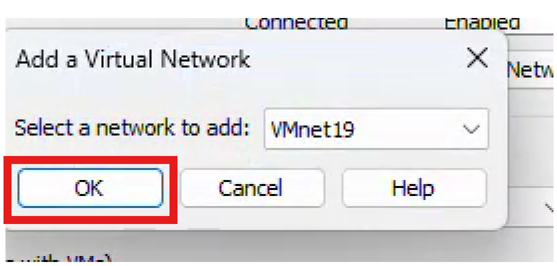
Select Yes



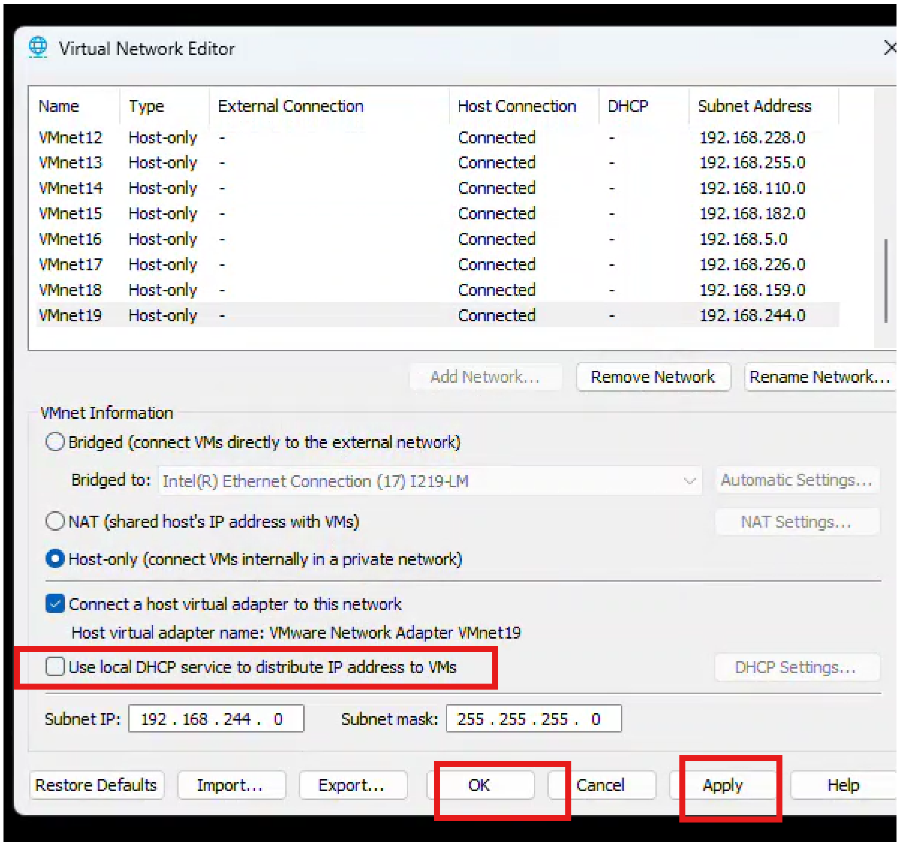
Select Add Network



Select Network to add (next number)



Unselect “Use Local DHCP service…”. Press Apply and Ok

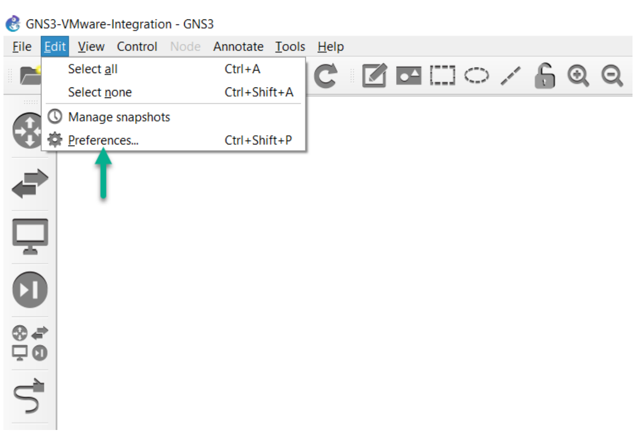


Repeat the procedure to create a virtual Network for srv 2019

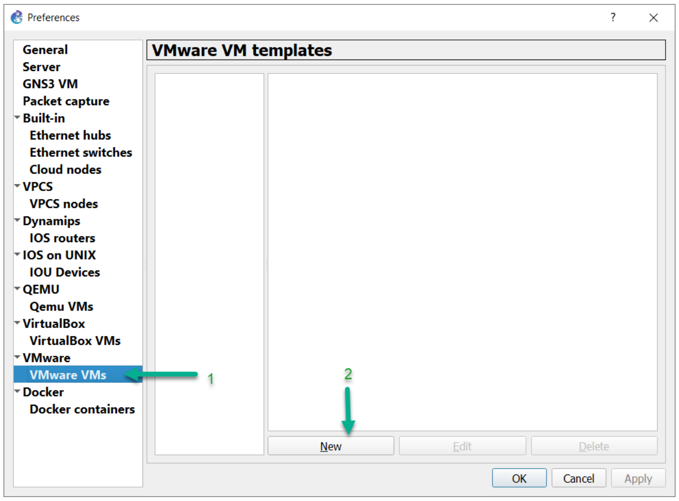
3.19.9.1.3.2 Add Windows VM to GNS3

Inside of GNS3 project

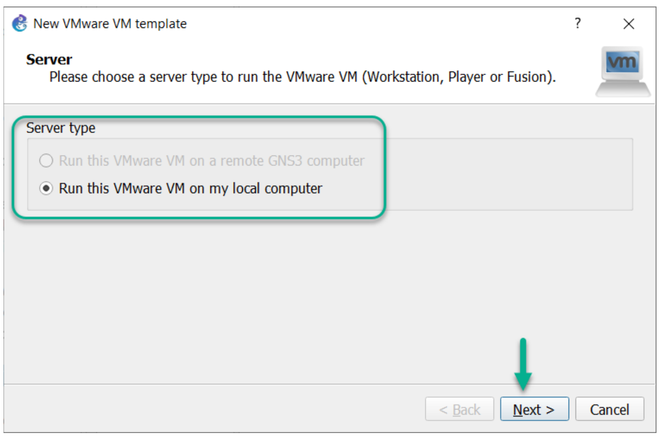
Click **Edit** and then **Preferences**



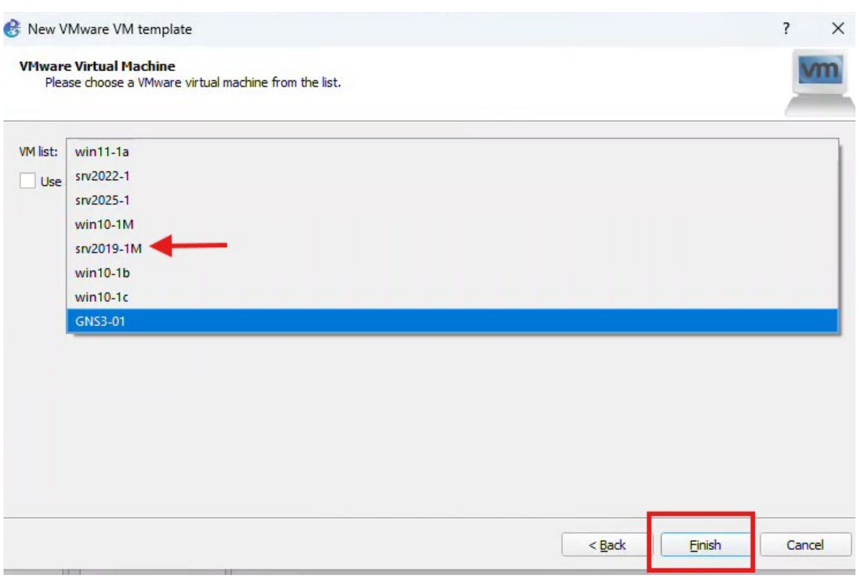
Click VMware VMs and New, to add a new VMware virtual machine:



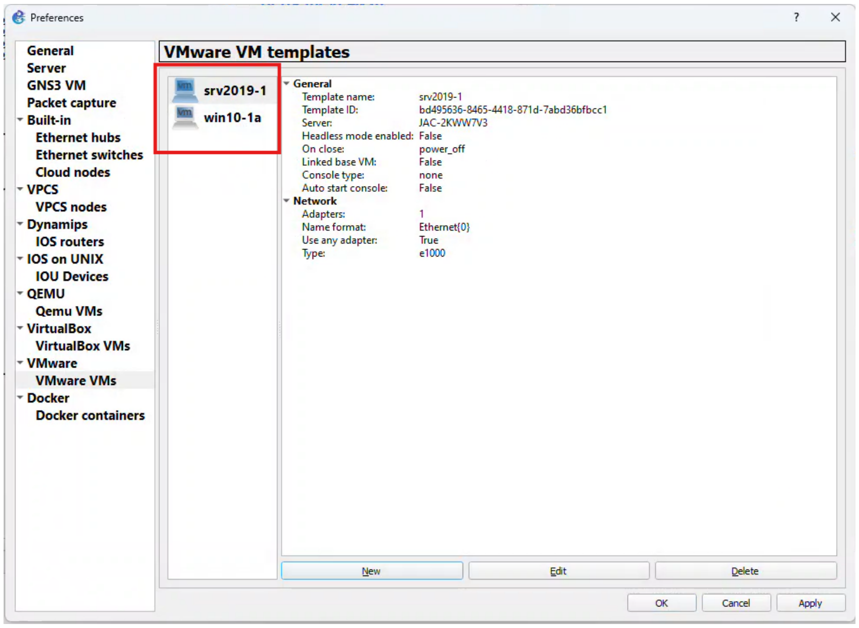
You will be prompted which server type to use, to run this virtual machine. As this article uses the local server, the remote server option is greyed out. Click Next>:



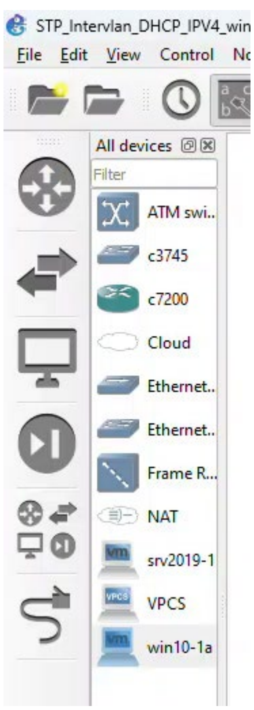
Select the VMWare Virtual Machine form the list and click Finish



VMWare appears

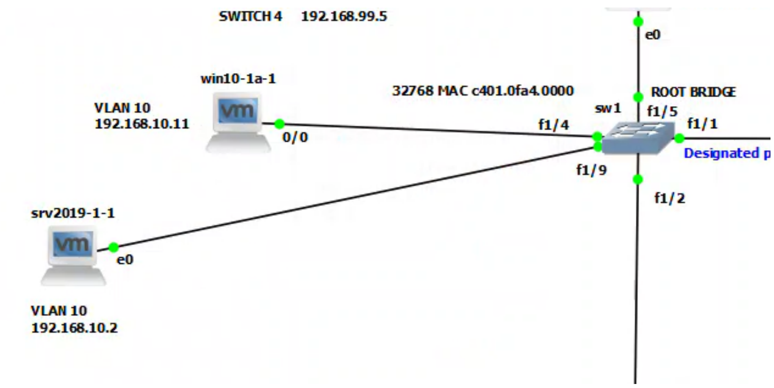


Machines appear on the GNS3 bar



VM's are ready to be dropped in the topology. Add as needed. Make sure the VN are powered off in VMWare

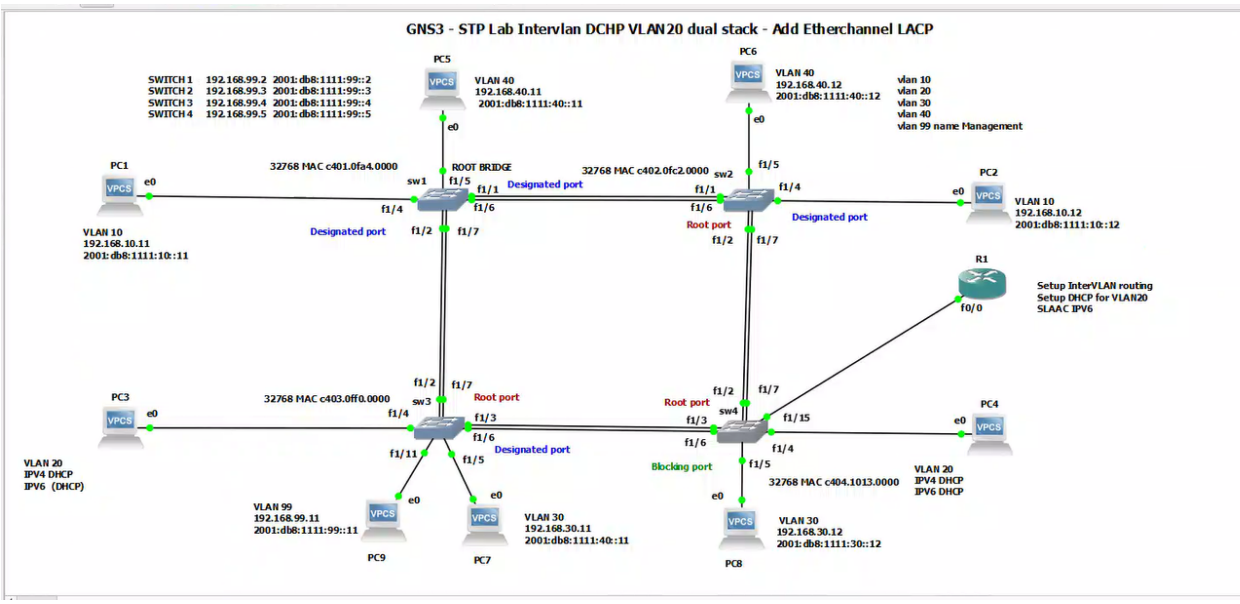
For our case. Connect the machines, when turned on the machine will power on automatically on VMWare



3.19.10 GNS3 - STP Lab Intervlan DCHP VLAN20 dual stack - Add Etherchannel LACP

Add EtherChannel to the configuration on 5.12.9 "GNS3 -Dual Stack Configuration with DHCP" According to the instructions below.

3.19.10.1 Topology



3.19.10.2 EtherChannel Configuration

EtherChannel Group	Connected Switches	Interfaces on SW1	Interfaces on SW2	Interfaces on SW3	Interfaces on SW4	Description
EtherChannel Group 1	SW1 <-> SW2	f1/1, f1/6	f1/1, f1/6	-	-	EtherChannel between SW1 and SW2
EtherChannel Group 2	SW1 <-> SW3	f1/2, f1/7	-	f1/2, f1/7	-	EtherChannel between SW1 and SW3
EtherChannel Group 3	SW2 <-> SW4	-	f1/2, f1/7	-	f1/2, f1/7	EtherChannel between SW2 and SW4
EtherChannel Group 4	SW4 <-> SW3	-	-	f1/3, f1/6	f1/3, f1/6	EtherChannel between SW4 and SW3

3.19.10.3 Scripts

```
! SW1 Configuration
enable
config t
! SW1 Configuration
! EtherChannel Group 1 (SW1 <-> SW2)
interface range  fastEthernet 1/1 , fastEthernet 1/6
 channel-group 1 mode on
 no shutdown

interface Port-channel 1
 switchport mode trunk
```

```
 switchport trunk native vlan 99
 description EtherChannel to SW2 (f1/1, f1/6)
 no shutdown

! EtherChannel Group 2 (SW1 <-> SW3)
interface range fastEthernet 1/2 , fastEthernet 1/7
 channel-group 2 mode on
 no shutdown

interface Port-channel 2
 switchport mode trunk
 switchport trunk native vlan 99
 description EtherChannel to SW3 (f1/2, f1/7)
 no shutdown
end
copy running-configuration startup-configuration
```

```
! SW2 Configuration
enable
config t
! EtherChannel Group 1 (SW2 <-> SW1)
interface range fastEthernet 1/1 , fastEthernet 1/6
 channel-group 1 mode on
 no shutdown

interface Port-channel 1
 switchport mode trunk
 switchport trunk native vlan 99
 description EtherChannel to SW1 (f1/1, f1/6)
 no shutdown

! EtherChannel Group 3 (SW2 <-> SW4)
interface range fastEthernet 1/2 , fastEthernet 1/7
 channel-group 3 mode on
 no shutdown

interface Port-channel 3
 switchport mode trunk
 switchport trunk native vlan 99
 description EtherChannel to SW4 (f1/2, f1/7)
 no shutdown
end
copy running-configuration startup-configuration
```

```
! SW3 Configuration
enable
config t
! EtherChannel Group 2 (SW3 <-> SW1)
interface range fastEthernet 1/2 , fastEthernet 1/7
 channel-group 2 mode on
 no shutdown

interface Port-channel 2
 switchport mode trunk
 switchport trunk native vlan 99
 description EtherChannel to SW1 (f1/2, f1/7)
 no shutdown

! EtherChannel Group 4 (SW3 <-> SW4)
interface range fastEthernet 1/3 , fastEthernet 1/6
 channel-group 4 mode on
 no shutdown

interface Port-channel 4
 switchport mode trunk
 switchport trunk native vlan 99
 description EtherChannel to SW4 (f1/3, f1/6)
 no shutdown
end
copy running-configuration startup-configuration
```

```
! SW4 Configuration
enable
config t
! EtherChannel Group 3 (SW4 <-> SW2)
interface range fastEthernet 1/2 , fastEthernet 1/7
 channel-group 3 mode on
 no shutdown

interface Port-channel 3
 switchport mode trunk
 switchport trunk native vlan 99
 description EtherChannel to SW2 (f1/2, f1/7)
 no shutdown

! EtherChannel Group 4 (SW4 <-> SW3)
interface range fastEthernet 1/3 , fastEthernet 1/6
 channel-group 4 mode on
 no shutdown

interface Port-channel 4
 switchport mode trunk
 switchport trunk native vlan 99
```

```
 description EtherChannel to SW3 (f1/3, f1/6)
 no shutdown
end
copy running-configuration startup-configuration
```

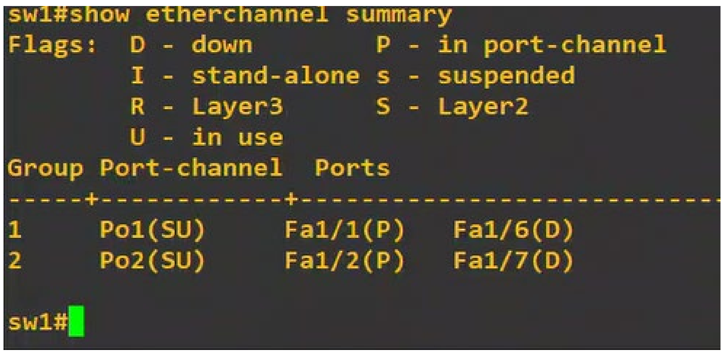
3.19.10.4 Verification Commands

After configuring EtherChannel, use the following commands to verify the setup:

1. **Show EtherChannel Summary:**

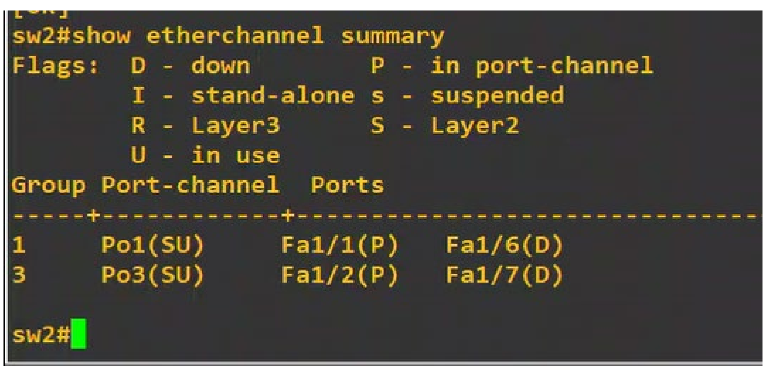
show etherchannel summary

SW1



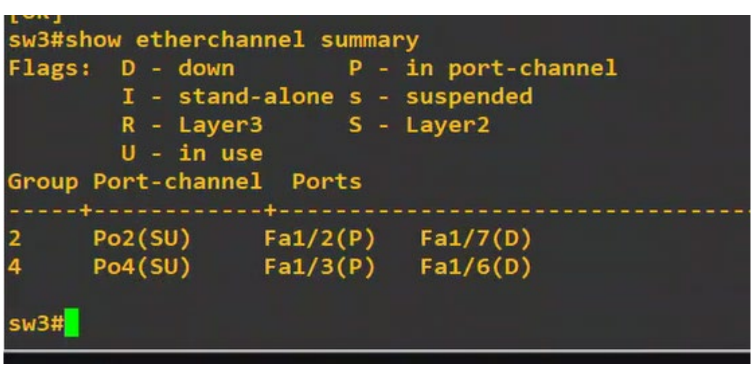
```
sw1#show etherchannel summary
Flags:  D - down         P - in port-channel
        I - stand-alone s - suspended
        R - Layer3       S - Layer2
        U - in use
Group Port-channel  Ports
-----+------------+---------------------------
1     Po1(SU)      Fa1/1(P)   Fa1/6(D)
2     Po2(SU)      Fa1/2(P)   Fa1/7(D)

sw1#
```

SW2



```
sw2#show etherchannel summary
Flags:  D - down         P - in port-channel
        I - stand-alone s - suspended
        R - Layer3       S - Layer2
        U - in use
Group Port-channel  Ports
-----+------------+------------------------------
1     Po1(SU)      Fa1/1(P)   Fa1/6(D)
3     Po3(SU)      Fa1/2(P)   Fa1/7(D)

sw2#
```

SW3



```
sw3#show etherchannel summary
Flags:  D - down         P - in port-channel
        I - stand-alone s - suspended
        R - Layer3       S - Layer2
        U - in use
Group Port-channel  Ports
-----+------------+-------------------------------
2     Po2(SU)      Fa1/2(P)   Fa1/7(D)
4     Po4(SU)      Fa1/3(P)   Fa1/6(D)

sw3#
```

SW4

```
sw4#show etherchannel summary
Flags:  D - down         P - in port-channel
        I - stand-alone s - suspended
        R - Layer3       S - Layer2
        U - in use
Group Port-channel  Ports
-----+------------+-----------------------------
3     Po3(SU)      Fa1/2(P)    Fa1/7(D)
4     Po4(SU)      Fa1/3(P)    Fa1/6(D)

sw4#
```

2. **Show Interface Port-Channel:**

show proto

Sw1

```
sw1# show proto
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is administratively down, line protocol is down
FastEthernet0/1 is administratively down, line protocol is down
FastEthernet1/0 is up, line protocol is down
FastEthernet1/1 is up, line protocol is up
FastEthernet1/2 is up, line protocol is up
FastEthernet1/3 is up, line protocol is down
FastEthernet1/4 is up, line protocol is up
FastEthernet1/5 is up, line protocol is up
FastEthernet1/6 is up, line protocol is down
FastEthernet1/7 is up, line protocol is down
FastEthernet1/8 is up, line protocol is down
FastEthernet1/9 is up, line protocol is down
FastEthernet1/10 is up, line protocol is down
FastEthernet1/11 is up, line protocol is down
FastEthernet1/12 is up, line protocol is down
FastEthernet1/13 is up, line protocol is down
FastEthernet1/14 is up, line protocol is down
FastEthernet1/15 is up, line protocol is down
Port-channel1 is up, line protocol is up
Port-channel2 is up, line protocol is up
Vlan1 is up, line protocol is up
Vlan99 is up, line protocol is up
  Internet address is 192.168.99.2/24
sw1#
```

SW2

```
sw2#show proto
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is administratively down, line protocol is down
FastEthernet0/1 is administratively down, line protocol is down
FastEthernet1/0 is up, line protocol is down
FastEthernet1/1 is up, line protocol is up
FastEthernet1/2 is up, line protocol is up
FastEthernet1/3 is up, line protocol is down
FastEthernet1/4 is up, line protocol is up
FastEthernet1/5 is up, line protocol is up
FastEthernet1/6 is up, line protocol is down
FastEthernet1/7 is up, line protocol is down
FastEthernet1/8 is up, line protocol is down
FastEthernet1/9 is up, line protocol is down
FastEthernet1/10 is up, line protocol is down
FastEthernet1/11 is up, line protocol is down
FastEthernet1/12 is up, line protocol is down
FastEthernet1/13 is up, line protocol is down
FastEthernet1/14 is up, line protocol is down
FastEthernet1/15 is up, line protocol is down
Port-channel1 is up, line protocol is up
Port-channel3 is up, line protocol is up
Vlan1 is up, line protocol is up
Vlan99 is up, line protocol is up
  Internet address is 192.168.99.3/24
sw2#
sw2#
```

SW3

```
sw3#show proto
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is administratively down, line protocol is down
FastEthernet0/1 is administratively down, line protocol is down
FastEthernet1/0 is up, line protocol is down
FastEthernet1/1 is up, line protocol is down
FastEthernet1/2 is up, line protocol is up
FastEthernet1/3 is up, line protocol is up
FastEthernet1/4 is up, line protocol is up
FastEthernet1/5 is up, line protocol is up
FastEthernet1/6 is up, line protocol is down
FastEthernet1/7 is up, line protocol is down
FastEthernet1/8 is up, line protocol is down
FastEthernet1/9 is up, line protocol is down
FastEthernet1/10 is up, line protocol is down
FastEthernet1/11 is up, line protocol is up
FastEthernet1/12 is up, line protocol is down
FastEthernet1/13 is up, line protocol is down
FastEthernet1/14 is up, line protocol is down
FastEthernet1/15 is up, line protocol is down
Port-channel2 is up, line protocol is up
Port-channel4 is up, line protocol is up
Vlan1 is up, line protocol is up
Vlan99 is up, line protocol is up
  Internet address is 192.168.99.4/24
sw3#
```

SW4

```
sw4#show proto
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is administratively down, line protocol is down
FastEthernet0/1 is administratively down, line protocol is down
FastEthernet1/0 is up, line protocol is down
FastEthernet1/1 is up, line protocol is down
FastEthernet1/2 is up, line protocol is up
FastEthernet1/3 is up, line protocol is up
FastEthernet1/4 is up, line protocol is up
FastEthernet1/5 is up, line protocol is up
FastEthernet1/6 is up, line protocol is down
FastEthernet1/7 is up, line protocol is down
FastEthernet1/8 is up, line protocol is down
FastEthernet1/9 is up, line protocol is down
FastEthernet1/10 is up, line protocol is down
FastEthernet1/11 is up, line protocol is down
FastEthernet1/12 is up, line protocol is down
FastEthernet1/13 is up, line protocol is down
FastEthernet1/14 is up, line protocol is down
FastEthernet1/15 is up, line protocol is up
Port-channel3 is up, line protocol is up
Port-channel4 is up, line protocol is up
Vlan1 is up, line protocol is up
Vlan99 is up, line protocol is up
  Internet address is 192.168.99.5/24
sw4#
```

3. **Show Interface Trunk:**

This will verify that the EtherChannel is operating as a trunk and carrying the correct VLANs.

show interfaces trunk

SW1

```
sw1#show interfaces trunk

Port      Mode         Encapsulation  Status        Native vlan
Po1       on           802.1q         trunking      99
Po2       on           802.1q         trunking      99

Port      Vlans allowed on trunk
Po1       1-1005
Po2       1-1005

Port      Vlans allowed and active in management domain
Po1       1,10,20,30,40,99
Po2       1,10,20,30,40,99

Port      Vlans in spanning tree forwarding state and not pruned
Po1       1,10,20,30,40,99
Po2       1,10,20,30,40,99
sw1#
```

SW2

```
sw2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      99
Po3         on           802.1q         trunking      99

Port        Vlans allowed on trunk
Po1         1-1005
Po3         1-1005

Port        Vlans allowed and active in management domain
Po1         1,10,20,30,40,99
Po3         1,10,20,30,40,99

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1,10,20,30,40,99
Po3         1,10,20,30,40,99
sw2#
```

SW3

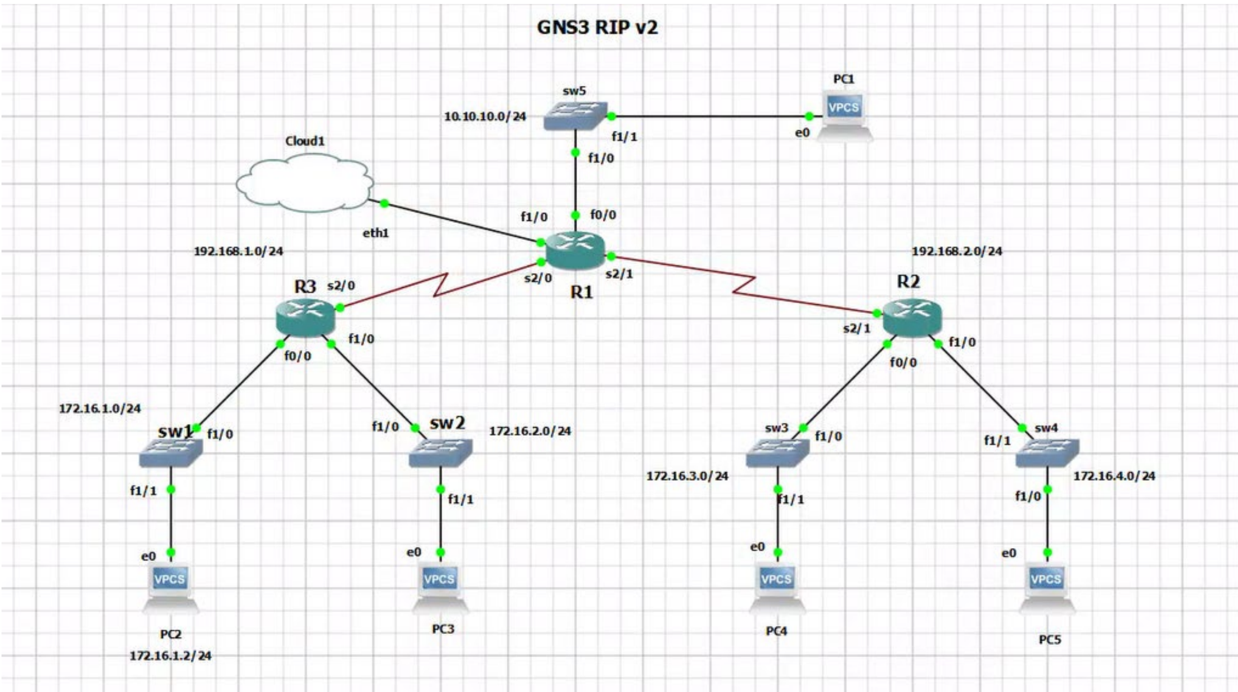
```
sw3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      99
Po4         on           802.1q         trunking      99

Port        Vlans allowed on trunk
Po2         1-1005
Po4         1-1005

Port        Vlans allowed and active in management domain
Po2         1,10,20,30,40,99
Po4         1,10,20,30,40,99

Port        Vlans in spanning tree forwarding state and not pruned
Po2         1,10,20,30,40,99
Po4         1,10,20,30,40,99
sw3#
```

SW4

```
sw4#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa1/15      on           802.1q         trunking      99
Po3         on           802.1q         trunking      99
Po4         on           802.1q         trunking      99

Port        Vlans allowed on trunk
Fa1/15      1-1005
Po3         1-1005
Po4         1-1005

Port        Vlans allowed and active in management domain
Fa1/15      1,10,20,30,40,99
Po3         1,10,20,30,40,99
Po4         1,10,20,30,40,99

Port        Vlans in spanning tree forwarding state and not pruned
Fa1/15      1,10,20,30,40,99
Po3         1,10,20,30,40,99
Po4         none
sw4#
```

3.19.11 GNS3 - Lab RIP v2

3.19.11.1 Topology



Router connections

Router	Connected To	Interface
R1	sw5	FastEthernet0/0
	Cloud	FastEthernet1/0
	R2	Serial2/1
	R3	Serial2/0
R2	sw3	FastEthernet0/0
	sw4	FastEthernet1/0
	R1	Serial2/1
R3	sw1	FastEthernet0/0
	sw2	FastEthernet1/0
	R2	Serial2/0

Switch connections

sw1	R3	FastEthernet1/0
sw1	PC2	FastEthernet1/1
sw2	R3	FastEthernet1/0
sw2	PC2	FastEthernet1/1
sw3	R2	FastEthernet1/0
sw3	PC4	FastEthernet1/1
sw4	R2	FastEthernet1/1

sw4	PC5	FastEthernet1/0
sw5	R1	FastEthernet1/0
sw5	PC1	FastEthernet1/1

PC connections

PC	Connected To	Interface
PC1	sw5	Ethernet0
PC2	sw1	Ethernet0
PC2	sw2	Ethernet0
PC4	sw3	Ethernet0
PC5	sw4	Ethernet0

3.19.11.2 Scripts

Scripts to define RIP v2

```
! RIP Version 2 script

!!!! R1! !!!!!!!
enable
configure terminal

! Set hostname
hostname R1

! Disable unnecessary services
no ip domain lookup

! Configure interfaces
interface FastEthernet0/0
 description Connected to sw5
 ip address 10.10.10.1 255.255.255.0
 no shutdown

interface FastEthernet1/0
 description Connected to cloud
 ip address 172.16.4.1 255.255.255.0
 no shutdown

interface Serial2/0
 description Connected to R3
 ip address 192.168.1.1 255.255.255.0
 no shutdown

interface Serial2/1
 description Connected to R2
 ip address 192.168.2.1 255.255.255.0
 no shutdown
```

```
! Configure RIP
router rip
 version 2
 network 10.0.0.0
 network 172.16.0.0
 network 192.168.1.0
 network 192.168.2.0
 no auto-summary

! Save configuration
end
write memory


!!!! R2!!!!!!!

enable
configure terminal

! Set hostname
hostname R2

! Disable unnecessary services
no ip domain lookup

! Configure interfaces
interface FastEthernet0/0
 description Connected to sw3
 ip address 172.16.3.1 255.255.255.0
 no shutdown

interface FastEthernet1/0
 description Connected to sw4
 ip address 172.16.4.1 255.255.255.0
 no shutdown

interface Serial2/1
 description Connected to R1
 ip address 192.168.2.2 255.255.255.0
 no shutdown

! Configure RIP
router rip
 version 2
 network 172.16.0.0
 network 192.168.2.0
 no auto-summary

! Configure console and VTY lines
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
 stopbits 1

line vty 0 4
 login

! Save configuration
end
write memory
```

```
!!!! R3 !!!!!!!
enable
configure terminal

! Set hostname
hostname R3

! Disable unnecessary services
no ip domain lookup

! Configure interfaces
interface FastEthernet0/0
 description Connected to sw1
 ip address 172.16.1.1 255.255.255.0
 no shutdown

interface FastEthernet1/0
 description Connected to sw2
 ip address 172.16.2.1 255.255.255.0
 no shutdown

interface Serial2/0
 description Connected to R1
 ip address 192.168.1.2 255.255.255.0
 no shutdown

! Configure RIP
router rip
 version 2
 network 172.16.0.0
 network 192.168.1.0
 no auto-summary

! Save configuration
end
write memory


! ===================================================
! SW1 Interface Configuration
! ===================================================
enable
configure terminal
interface FastEthernet1/0
 description Connected to R3
 no shutdown

interface FastEthernet1/1
 description Connected to PC2
 no shutdown
! Save configuration
end
write memory

! ===================================================
! SW2 Interface Configuration
! ===================================================
enable
configure terminal
interface FastEthernet1/0
```

```
 description Connected to R3
 no shutdown

interface FastEthernet1/1
 description Connected to PC3
 no shutdown
! Save configuration
end
write memory


! ===================================================
! SW3 Interface Configuration
! ===================================================
enable
configure terminal

interface FastEthernet1/0
 description Connected to R2
 no shutdown

interface FastEthernet1/1
 description Connected to PC4
 no shutdown
! Save configuration
end
write memory


! ===================================================
! SW4 Interface Configuration
! ===================================================
enable
configure terminal

interface FastEthernet1/0
 description Connected to R2
 no shutdown

interface FastEthernet1/1
 description Connected to PC5
 no shutdown
! Save configuration
end
write memory

! ===================================================
! SW5 Interface Configuration
! ===================================================
enable
configure terminal

interface FastEthernet1/0
 description Connected to R1
 no shutdown

interface FastEthernet1/1
 description Connected to PC1
 no shutdown
! Save configuration
end
```

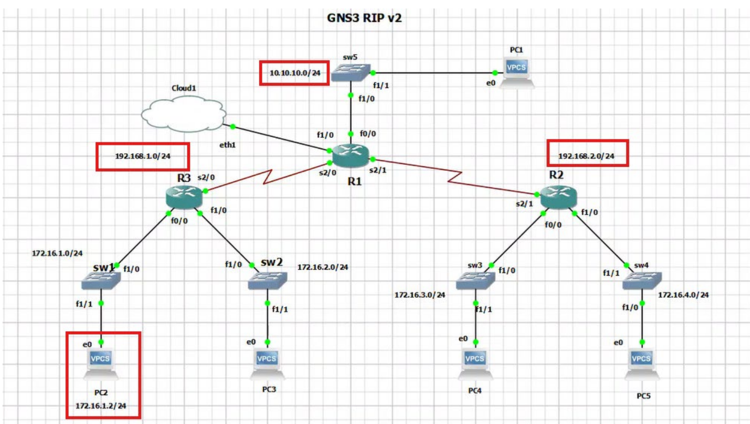
```
write memory

PC2
!! ip ipv4-address subnet-mask default-gateway-ipv4-address
ip 172.16.1.2 255.255.255.0 172.16.1.1
save
```

```
PC2> show

NAME   IP/MASK              GATEWAY          MAC                LPORT  RHOST:PORT
PC2    172.16.1.2/24        172.16.1.1       00:50:79:66:68:01  20068  127.0.0.1:20069
       fe80::250:79ff:fe66:6801/64

PC2>
```

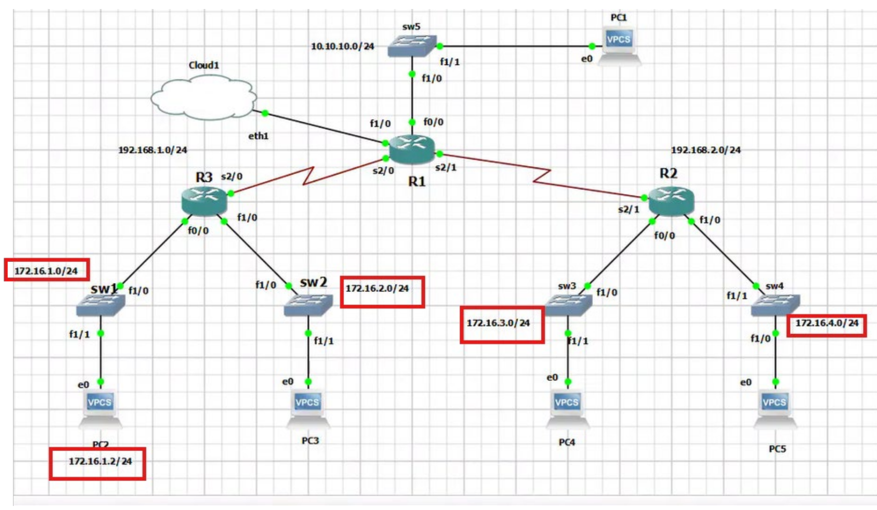
3.19.11.3 Testing

Ping from PC2

PC2> ping 192.168.1.1
PC2> ping 192.168.2.1
PC2> ping 10.10.10.1



```
PC2> ping 192.168.1.1

84 bytes from 192.168.1.1 icmp_seq=1 ttl=254 time=68.107 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=254 time=50.715 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=254 time=28.615 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=254 time=28.657 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=254 time=24.560 ms

PC2> ping 192.168.2.1

84 bytes from 192.168.2.1 icmp_seq=1 ttl=254 time=33.704 ms
84 bytes from 192.168.2.1 icmp_seq=2 ttl=254 time=28.700 ms
84 bytes from 192.168.2.1 icmp_seq=3 ttl=254 time=16.707 ms
84 bytes from 192.168.2.1 icmp_seq=4 ttl=254 time=24.220 ms
84 bytes from 192.168.2.1 icmp_seq=5 ttl=254 time=85.332 ms

PC2> ping 10.10.10.1

84 bytes from 10.10.10.1 icmp_seq=1 ttl=254 time=42.144 ms
84 bytes from 10.10.10.1 icmp_seq=2 ttl=254 time=45.497 ms
84 bytes from 10.10.10.1 icmp_seq=3 ttl=254 time=42.914 ms
84 bytes from 10.10.10.1 icmp_seq=4 ttl=254 time=27.586 ms
84 bytes from 10.10.10.1 icmp_seq=5 ttl=254 time=36.437 ms
```



PC2> ping 172.16.1.1
PC2> ping 172.16.2.1
PC2> ping 172.16.3.1
PC2> ping 172.16.4.1

```
PC2> ping 172.16.1.1

84 bytes from 172.16.1.1 icmp_seq=1 ttl=255 time=20.573 ms
84 bytes from 172.16.1.1 icmp_seq=2 ttl=255 time=3.770 ms
84 bytes from 172.16.1.1 icmp_seq=3 ttl=255 time=7.179 ms
84 bytes from 172.16.1.1 icmp_seq=4 ttl=255 time=8.663 ms
84 bytes from 172.16.1.1 icmp_seq=5 ttl=255 time=10.795 ms

PC2> ping 172.16.2.1

84 bytes from 172.16.2.1 icmp_seq=1 ttl=255 time=9.957 ms
84 bytes from 172.16.2.1 icmp_seq=2 ttl=255 time=10.967 ms
84 bytes from 172.16.2.1 icmp_seq=3 ttl=255 time=13.696 ms
84 bytes from 172.16.2.1 icmp_seq=4 ttl=255 time=6.222 ms
84 bytes from 172.16.2.1 icmp_seq=5 ttl=255 time=4.335 ms

PC2> ping 172.16.3.1

84 bytes from 172.16.3.1 icmp_seq=1 ttl=253 time=41.363 ms
84 bytes from 172.16.3.1 icmp_seq=2 ttl=253 time=53.033 ms
84 bytes from 172.16.3.1 icmp_seq=3 ttl=253 time=48.298 ms
84 bytes from 172.16.3.1 icmp_seq=4 ttl=253 time=56.432 ms
84 bytes from 172.16.3.1 icmp_seq=5 ttl=253 time=68.034 ms

PC2> ping 172.16.4.1

84 bytes from 172.16.4.1 icmp_seq=1 ttl=254 time=63.289 ms
84 bytes from 172.16.4.1 icmp_seq=2 ttl=254 time=44.372 ms
84 bytes from 172.16.4.1 icmp_seq=3 ttl=254 time=53.681 ms
84 bytes from 172.16.4.1 icmp_seq=4 ttl=254 time=36.650 ms
84 bytes from 172.16.4.1 icmp_seq=5 ttl=254 time=51.968 ms

PC2>
```

3.19.11.4 Printouts

Routing tables and interfaces

R1

```
R1#
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.10.10.0/24 is directly connected, FastEthernet0/0
L        10.10.10.1/32 is directly connected, FastEthernet0/0
      172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
R        172.16.1.0/24 [120/1] via 192.168.1.2, 00:00:06, Serial2/0
R        172.16.2.0/24 [120/1] via 192.168.1.2, 00:00:06, Serial2/0
R        172.16.3.0/24 [120/1] via 192.168.2.2, 00:00:01, Serial2/1
C        172.16.4.0/24 is directly connected, FastEthernet1/0
L        172.16.4.1/32 is directly connected, FastEthernet1/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Serial2/0
L        192.168.1.1/32 is directly connected, Serial2/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Serial2/1
L        192.168.2.1/32 is directly connected, Serial2/1
R1#
```

show ip route rip

```
R1#show ip route rip
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
R        172.16.1.0/24 [120/1] via 192.168.1.2, 00:00:06, Serial2/0
R        172.16.2.0/24 [120/1] via 192.168.1.2, 00:00:06, Serial2/0
R        172.16.3.0/24 [120/1] via 192.168.2.2, 00:00:22, Serial2/1
R1#
```

Show ip protocols

```
R1#show ip pro
R1#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 15 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       2     2
    FastEthernet1/0       2     2
    Serial2/0             2     2
    Serial2/1             2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    10.0.0.0
    172.16.0.0
    192.168.1.0
    192.168.2.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    Gateway         Distance      Last Update
    192.168.2.2          120      00:00:03
    192.168.1.2          120      00:00:07
  Distance: (default is 120)

R1#
```

```
R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        10.10.10.1      YES NVRAM  up                    up
FastEthernet1/0        172.16.4.1      YES manual up                    up
FastEthernet1/1        unassigned      YES NVRAM  administratively down down
Serial2/0              192.168.1.1     YES manual up                    up
Serial2/1              192.168.2.1     YES NVRAM  up                    up
Serial2/2              unassigned      YES NVRAM  administratively down down
Serial2/3              unassigned      YES NVRAM  administratively down down
R1#
```

R2

show ip route

```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
R        10.10.10.0 [120/1] via 192.168.2.1, 00:00:11, Serial2/1
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
R        172.16.1.0/24 [120/2] via 192.168.2.1, 00:00:11, Serial2/1
R        172.16.2.0/24 [120/2] via 192.168.2.1, 00:00:11, Serial2/1
C        172.16.3.0/24 is directly connected, FastEthernet0/0
L        172.16.3.1/32 is directly connected, FastEthernet0/0
C        172.16.4.0/24 is directly connected, FastEthernet1/0
L        172.16.4.1/32 is directly connected, FastEthernet1/0
R     192.168.1.0/24 [120/1] via 192.168.2.1, 00:00:11, Serial2/1
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Serial2/1
L        192.168.2.2/32 is directly connected, Serial2/1
R2#
```

show ip route rip

```
R2#show ip route rip
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
R        10.10.10.0 [120/1] via 192.168.2.1, 00:00:23, Serial2/1
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
R        172.16.1.0/24 [120/2] via 192.168.2.1, 00:00:23, Serial2/1
R        172.16.2.0/24 [120/2] via 192.168.2.1, 00:00:23, Serial2/1
R     192.168.1.0/24 [120/1] via 192.168.2.1, 00:00:23, Serial2/1
R2#
```

Show ip protocols

```
R2#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 28 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       2     2
    FastEthernet1/0       2     2
    Serial2/1             2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    172.16.0.0
    192.168.2.0
    198.168.2.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.1          120      00:00:19
  Distance: (default is 120)

R2#
```

Show ip interface brief

```
R2#show ip inte
R2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        172.16.3.1      YES NVRAM  up                    up
FastEthernet1/0        172.16.4.1      YES NVRAM  up                    up
FastEthernet1/1        unassigned      YES NVRAM  administratively down down
Serial2/0              unassigned      YES NVRAM  administratively down down
Serial2/1              192.168.2.2     YES NVRAM  up                    up
Serial2/2              unassigned      YES NVRAM  administratively down down
Serial2/3              unassigned      YES NVRAM  administratively down down
R2#
```

R3

```
R3#
R3#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 21 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       2     2
    FastEthernet1/0       2     2
    Serial2/0             2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    172.16.0.0
    192.168.1.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.1.1          120      00:00:08
  Distance: (default is 120)

R3#
```
solarwinds | Solar-PuTTY free tool

Show ip route rip

```
R3#show ip ro
R3#show ip route rip
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
R        10.10.10.0 [120/1] via 192.168.1.1, 00:00:21, Serial2/0
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
R        172.16.3.0/24 [120/2] via 192.168.1.1, 00:00:21, Serial2/0
R        172.16.4.0/24 [120/1] via 192.168.1.1, 00:00:21, Serial2/0
R     192.168.2.0/24 [120/1] via 192.168.1.1, 00:00:21, Serial2/0
R3#
```

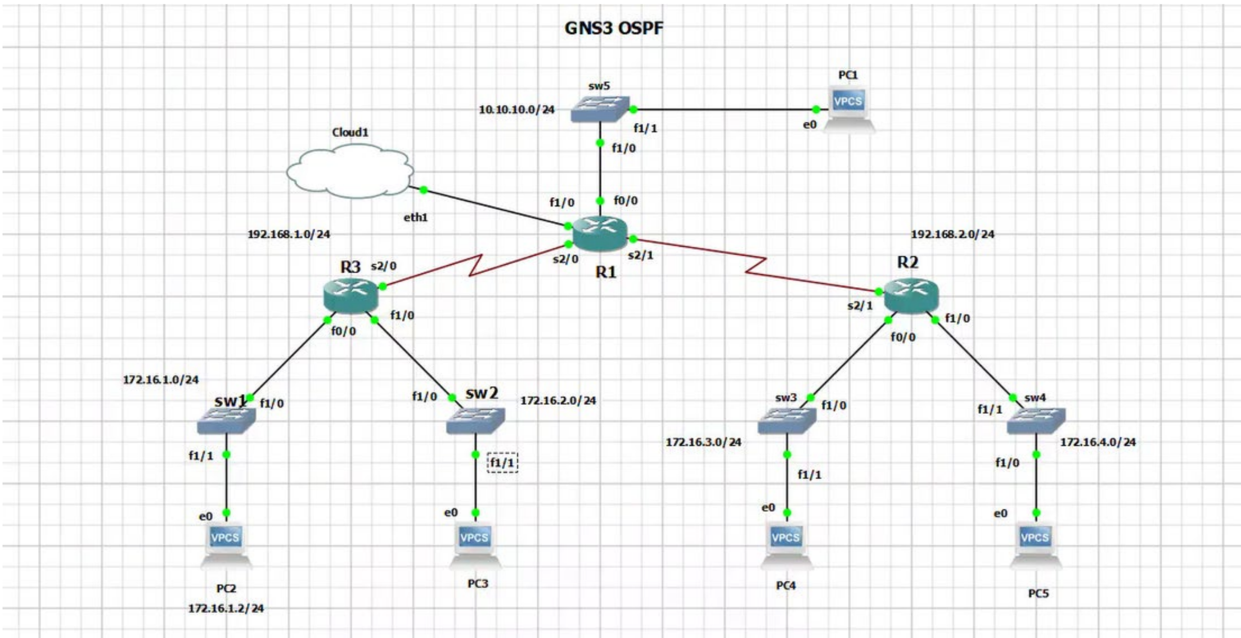
```
R3#
R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
R        10.10.10.0 [120/1] via 192.168.1.1, 00:00:23, Serial2/0
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
C        172.16.1.0/24 is directly connected, FastEthernet0/0
L        172.16.1.1/32 is directly connected, FastEthernet0/0
C        172.16.2.0/24 is directly connected, FastEthernet1/0
L        172.16.2.1/32 is directly connected, FastEthernet1/0
R        172.16.3.0/24 [120/2] via 192.168.1.1, 00:00:23, Serial2/0
R        172.16.4.0/24 [120/1] via 192.168.1.1, 00:00:23, Serial2/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Serial2/0
L        192.168.1.2/32 is directly connected, Serial2/0
R     192.168.2.0/24 [120/1] via 192.168.1.1, 00:00:23, Serial2/0
R3#
```

Show ip interface brief

```
R3#show ip interface brie
R3#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        172.16.1.1      YES NVRAM  up                    up
FastEthernet1/0        172.16.2.1      YES NVRAM  up                    up
FastEthernet1/1        unassigned      YES NVRAM  administratively down down
Serial2/0              192.168.1.2     YES manual up                    up
Serial2/1              unassigned      YES NVRAM  administratively down down
Serial2/2              unassigned      YES NVRAM  administratively down down
Serial2/3              unassigned      YES NVRAM  administratively down down
R3#
```

3.19.12 GNS3 - Lab OSPF

3.19.12.1 Topology



Based on RIP V2 configuration remove RIP V2 and convert to OSPF
RIP Removal: The no router rip command is used to remove the RIP configuration before enabling OSPF.
Interfaces and IP Addresses: The IP addresses and interfaces remain the same as in the RIP configuration. Only the routing protocol is changed.
OSPF Network Statements: The network commands in OSPF are updated to match the exact IP subnets of the interfaces. The wildcard mask (0.0.0.255) is used to match the subnet.
Area 0: All networks are placed in the backbone area (area 0) for simplicity.

3.19.12.2 Scripts

```
! Remove RIP Version 2 and convert to OSPF

!!!! R1 !!!!!!!
enable
configure terminal

! Remove RIP configuration
no router rip

! Configure OSPF
router ospf 1
 network 10.10.10.0 0.0.0.255 area 0
 network 172.16.4.0 0.0.0.255 area 0
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.2.0 0.0.0.255 area 0

! Save configuration
end
write memory

!!!! R2 !!!!!!!
enable
configure terminal
```

```
! Remove RIP configuration
no router rip

! Configure OSPF
router ospf 1
 network 172.16.3.0 0.0.0.255 area 0
 network 172.16.4.0 0.0.0.255 area 0
 network 192.168.2.0 0.0.0.255 area 0

! Save configuration
end
write memory


!!!! R3 !!!!!!!
enable
configure terminal

! Remove RIP configuration
no router rip

! Configure OSPF
router ospf 1
 network 172.16.1.0 0.0.0.255 area 0
 network 172.16.2.0 0.0.0.255 area 0
 network 192.168.1.0 0.0.0.255 area 0

! Save configuration
end
write memory
```

Configurations R1

```
R1#
R1#! Remove RIP Version 2 and convert to OSPF
R1#
R1#!!!! R1 !!!!!!!
R1#enable
R1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#! Remove RIP configuration
R1(config)#no router rip
R1(config)#
R1(config)#! Configure OSPF
R1(config)#router ospf 1
R1(config-router)# network 10.10.10.0 0.0.0.255 area 0
R1(config-router)# network 172.16.4.0 0.0.0.255 area 0
R1(config-router)# network 192.168.1.0 0.0.0.255 area 0
R1(config-router)# network 192.168.2.0 0.0.0.255 area 0
R1(config-router)#
R1(config-router)#! Save configuration
R1(config-router)#end
R1#write memory
Warning: Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
*Feb 20 23:03:15.095: %SYS-5-CONFIG_I: Configured from console by console
[confirm]
Building configuration...
[OK]
R1#
```

Configurations R2

```
R2#
R2#!!!! R2 !!!!!!!
R2#enable
R2#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#
R2(config)#! Remove RIP configuration
R2(config)#no router rip
R2(config)#
R2(config)#! Configure OSPF
R2(config)#router ospf 1
R2(config-router)# network 172.16.3.0 0.0.0.255 area 0
R2(config-router)# network 172.16.4.0 0.0.0.255 area 0
R2(config-router)# network 192.168.2.0 0.0.0.255 area 0
R2(config-router)#
R2(config-router)#! Save configuration
R2(config-router)#end
R2#write memory
*Feb 20 23:03:33.603: %SYS-5-CONFIG_I: Configured from console by console
*Feb 20 23:03:33.751: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.1 on Serial2/1 from LOADING to FULL, Loading Done
R2#write memory
Warning: Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
R2#
```

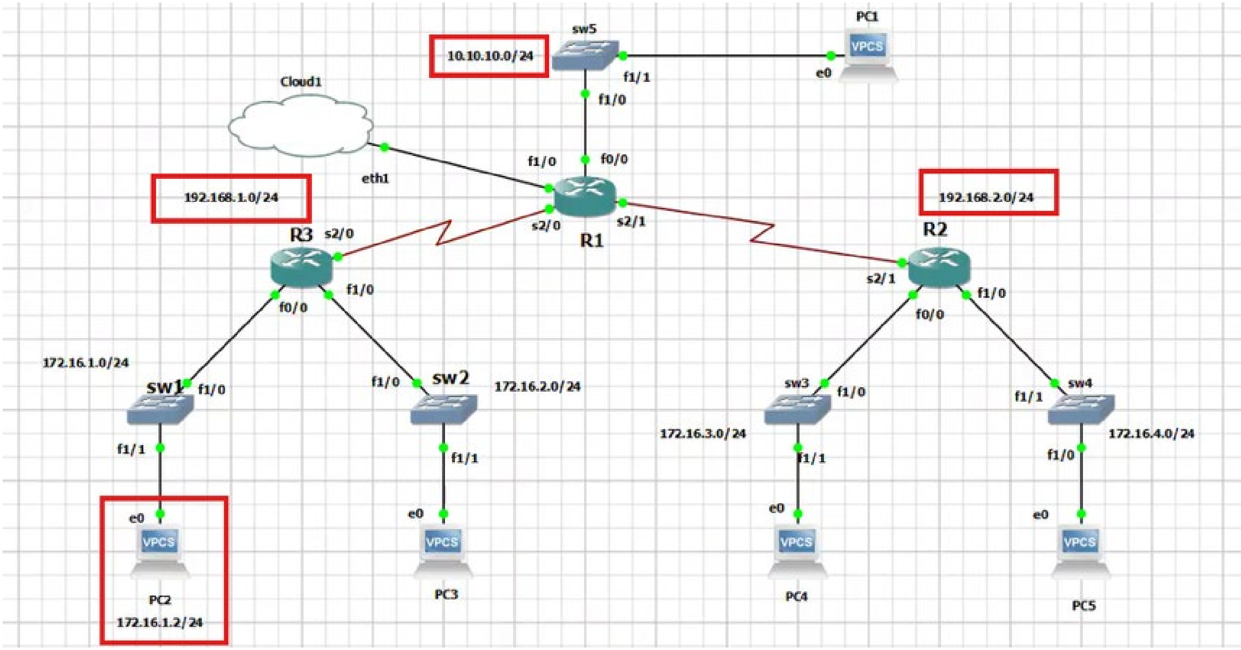
Configurations R3

```
R3#
R3#!!!! R3 !!!!!!!
R3#enable
R3#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#
R3(config)#! Remove RIP configuration
R3(config)#no router rip
R3(config)#
R3(config)#! Configure OSPF
R3(config)#router ospf 1
R3(config-router)# network 172.16.1.0 0.0.0.255 area 0
R3(config-router)# network 172.16.2.0 0.0.0.255 area 0
R3(config-router)# network 192.168.1.0 0.0.0.255 area 0
R3(config-router)#
R3(config-router)#! Save configuration
R3(config-router)#end
R3#write memory
Warning: Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
*Feb 20 23:03:49.451: %SYS-5-CONFIG_I: Configured from console by console
*Feb 20 23:03:49.607: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.1 on Serial2/0 from LOADING to FULL, Loading Done
[confirm]
Building configuration...
[OK]
```

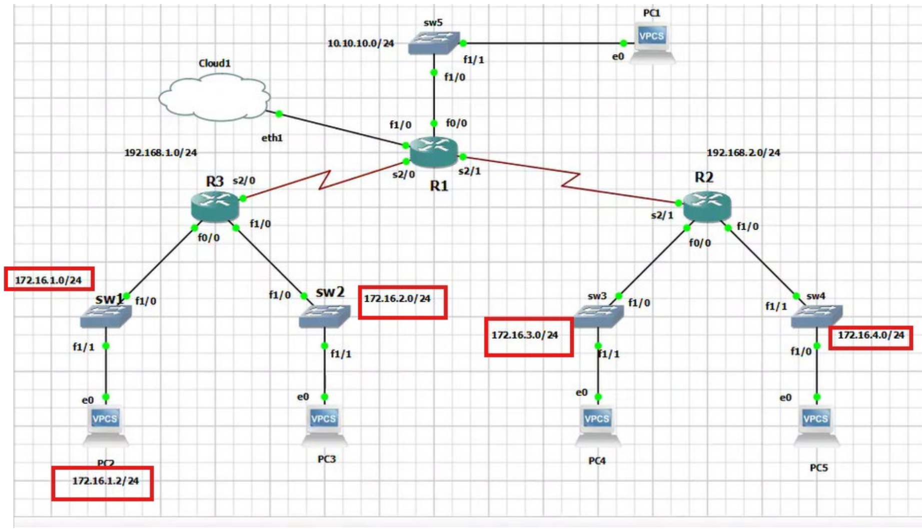
3.19.12.3 Testing

Ping from PC2

PC2> ping 192.168.1.1
PC2> ping 192.168.2.1
PC2> ping 10.10.10.1




```
PC2> show

NAME   IP/MASK              GATEWAY           MAC                LPORT  RHOST:PORT
PC2    172.16.1.2/24        172.16.1.1        00:50:79:66:68:01  20068  127.0.0.1:20069
       fe80::250:79ff:fe66:6801/64

PC2> ping 192.168.1.1

192.168.1.1 icmp_seq=1 timeout
84 bytes from 192.168.1.1 icmp_seq=2 ttl=254 time=26.987 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=254 time=28.963 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=254 time=29.605 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=254 time=32.420 ms

PC2> ping 192.168.2.1

84 bytes from 192.168.2.1 icmp_seq=1 ttl=254 time=48.686 ms
84 bytes from 192.168.2.1 icmp_seq=2 ttl=254 time=31.813 ms
84 bytes from 192.168.2.1 icmp_seq=3 ttl=254 time=44.602 ms
84 bytes from 192.168.2.1 icmp_seq=4 ttl=254 time=27.127 ms
84 bytes from 192.168.2.1 icmp_seq=5 ttl=254 time=36.986 ms

PC2> ping 10.10.10.1

84 bytes from 10.10.10.1 icmp_seq=1 ttl=254 time=52.035 ms
84 bytes from 10.10.10.1 icmp_seq=2 ttl=254 time=52.174 ms
84 bytes from 10.10.10.1 icmp_seq=3 ttl=254 time=27.389 ms
84 bytes from 10.10.10.1 icmp_seq=4 ttl=254 time=61.255 ms
84 bytes from 10.10.10.1 icmp_seq=5 ttl=254 time=30.744 ms
```



PC2> ping 172.16.1.1
PC2> ping 172.16.2.1
PC2> ping 172.16.3.1
PC2> ping 172.16.4.1

```
PC2>
PC2>
PC2> ping 172.16.1.1

84 bytes from 172.16.1.1 icmp_seq=1 ttl=255 time=19.117 ms
84 bytes from 172.16.1.1 icmp_seq=2 ttl=255 time=20.154 ms
84 bytes from 172.16.1.1 icmp_seq=3 ttl=255 time=31.792 ms
84 bytes from 172.16.1.1 icmp_seq=4 ttl=255 time=11.649 ms
84 bytes from 172.16.1.1 icmp_seq=5 ttl=255 time=22.747 ms

PC2> ping 172.16.2.1

84 bytes from 172.16.2.1 icmp_seq=1 ttl=255 time=7.578 ms
84 bytes from 172.16.2.1 icmp_seq=2 ttl=255 time=12.871 ms
84 bytes from 172.16.2.1 icmp_seq=3 ttl=255 time=6.097 ms
84 bytes from 172.16.2.1 icmp_seq=4 ttl=255 time=12.037 ms
84 bytes from 172.16.2.1 icmp_seq=5 ttl=255 time=10.748 ms

PC2> ping 172.16.3.1

84 bytes from 172.16.3.1 icmp_seq=1 ttl=253 time=66.863 ms
84 bytes from 172.16.3.1 icmp_seq=2 ttl=253 time=55.773 ms
84 bytes from 172.16.3.1 icmp_seq=3 ttl=253 time=47.652 ms
84 bytes from 172.16.3.1 icmp_seq=4 ttl=253 time=78.342 ms
84 bytes from 172.16.3.1 icmp_seq=5 ttl=253 time=87.385 ms

PC2> ping 172.16.4.1

84 bytes from 172.16.4.1 icmp_seq=1 ttl=254 time=33.035 ms
84 bytes from 172.16.4.1 icmp_seq=2 ttl=254 time=29.672 ms
84 bytes from 172.16.4.1 icmp_seq=3 ttl=254 time=21.950 ms
84 bytes from 172.16.4.1 icmp_seq=4 ttl=254 time=44.848 ms
84 bytes from 172.16.4.1 icmp_seq=5 ttl=254 time=29.793 ms

PC2>
```

3.19.12.4 Printouts

After applying the OSPF configuration, use the following commands to verify OSPF operation:

- show ip route: Verify routes in the routing table, OSPF routes have “O”
- show ip route ospf: Verify OSPF routes in the routing table.
- show ip protocols: Provides a summary of the IP routing protocols that are currently configured and running on the router
- show ip ospf neighbor: Check OSPF neighbor adjacencies.
- show ip ospf interface: Check OSPF-enabled interfaces and their status.

R1

show ip route

```
L        192.168.2.1/32 is directly connected, Serial2/1
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.10.10.0/24 is directly connected, FastEthernet0/0
L        10.10.10.1/32 is directly connected, FastEthernet0/0
      172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
O        172.16.1.0/24 [110/65] via 192.168.1.2, 00:00:18, Serial2/0
O        172.16.2.0/24 [110/65] via 192.168.1.2, 00:00:18, Serial2/0
O        172.16.3.0/24 [110/65] via 192.168.2.2, 00:00:34, Serial2/1
C        172.16.4.0/24 is directly connected, FastEthernet1/0
L        172.16.4.1/32 is directly connected, FastEthernet1/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Serial2/0
L        192.168.1.1/32 is directly connected, Serial2/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Serial2/1
L        192.168.2.1/32 is directly connected, Serial2/1
```

show ip route ospf

```
L        192.168.2.1/32 is directly connected, Serial2/1
R1#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
O        172.16.1.0/24 [110/65] via 192.168.1.2, 00:00:27, Serial2/0
O        172.16.2.0/24 [110/65] via 192.168.1.2, 00:00:27, Serial2/0
O        172.16.3.0/24 [110/65] via 192.168.2.2, 00:00:43, Serial2/1
R1#
R1#
R1#
R1#
R1#show ip protocols
```

Show ip protocols

```
R1#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.2.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.10.10.0 0.0.0.255 area 0
    172.16.4.0 0.0.0.255 area 0
    192.168.1.0 0.0.0.255 area 0
    192.168.2.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.2          110      00:00:54
    192.168.1.2          110      00:00:39
  Distance: (default is 110)

R1#
```

show ip ospf interface brief

show ip ospf neighbor

```
R1#show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Se2/1        1     0               192.168.2.1/24     64    P2P   1/1
Se2/0        1     0               192.168.1.1/24     64    P2P   1/1
Fa1/0        1     0               172.16.4.1/24      1     DR    0/0
Fa0/0        1     0               10.10.10.1/24      1     DR    0/0
R1#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.2.2       0   FULL/  -        00:00:36    192.168.2.2     Serial2/1
192.168.1.2       0   FULL/  -        00:00:34    192.168.1.2     Serial2/0
R1#
```

R2

show ip route

```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
O        10.10.10.0 [110/65] via 192.168.2.1, 00:22:02, Serial2/1
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
O        172.16.1.0/24 [110/129] via 192.168.2.1, 00:21:46, Serial2/1
O        172.16.2.0/24 [110/129] via 192.168.2.1, 00:21:46, Serial2/1
C        172.16.3.0/24 is directly connected, FastEthernet0/0
L        172.16.3.1/32 is directly connected, FastEthernet0/0
C        172.16.4.0/24 is directly connected, FastEthernet1/0
L        172.16.4.1/32 is directly connected, FastEthernet1/0
O     192.168.1.0/24 [110/128] via 192.168.2.1, 00:22:02, Serial2/1
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Serial2/1
L        192.168.2.2/32 is directly connected, Serial2/1
R2#
```

show ip route ospf

```
R2#
R2#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
O        10.10.10.0 [110/65] via 192.168.2.1, 00:01:19, Serial2/1
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
O        172.16.1.0/24 [110/129] via 192.168.2.1, 00:01:03, Serial2/1
O        172.16.2.0/24 [110/129] via 192.168.2.1, 00:01:03, Serial2/1
O     192.168.1.0/24 [110/128] via 192.168.2.1, 00:01:19, Serial2/1
```

Show ip protocols

```
R2#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.2.2
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.3.0 0.0.0.255 area 0
    172.16.4.0 0.0.0.255 area 0
    192.168.2.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.1.2          110      00:01:15
    192.168.2.1          110      00:01:31
  Distance: (default is 110)

R2#
```

show ip ospf interface brief

show ip ospf neighbor

```
R2#show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Se2/1        1     0               192.168.2.2/24     64    P2P   1/1
Fa1/0        1     0               172.16.4.1/24      1     DR    0/0
Fa0/0        1     0               172.16.3.1/24      1     DR    0/0
R2#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.2.1       0   FULL/  -        00:00:39    192.168.2.1     Serial2/1
R2#
```

R3

show ip route

```
R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
O        10.10.10.0 [110/65] via 192.168.1.1, 00:02:02, Serial2/0
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
C        172.16.1.0/24 is directly connected, FastEthernet0/0
L        172.16.1.1/32 is directly connected, FastEthernet0/0
C        172.16.2.0/24 is directly connected, FastEthernet1/0
L        172.16.2.1/32 is directly connected, FastEthernet1/0
O        172.16.3.0/24 [110/129] via 192.168.1.1, 00:02:02, Serial2/0
O        172.16.4.0/24 [110/65] via 192.168.1.1, 00:02:02, Serial2/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Serial2/0
L        192.168.1.2/32 is directly connected, Serial2/0
O     192.168.2.0/24 [110/128] via 192.168.1.1, 00:02:02, Serial2/0
R3#
```

show ip route ospf

```
R3#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
O        10.10.10.0 [110/65] via 192.168.1.1, 00:01:58, Serial2/0
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
O        172.16.3.0/24 [110/129] via 192.168.1.1, 00:01:58, Serial2/0
O        172.16.4.0/24 [110/65] via 192.168.1.1, 00:01:58, Serial2/0
O     192.168.2.0/24 [110/128] via 192.168.1.1, 00:01:58, Serial2/0
```

Show ip protocols

```
R3#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.1.2
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.1.0 0.0.0.255 area 0
    172.16.2.0 0.0.0.255 area 0
    192.168.1.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.2          110      00:01:42
    192.168.2.1          110      00:01:42
  Distance: (default is 110)
```

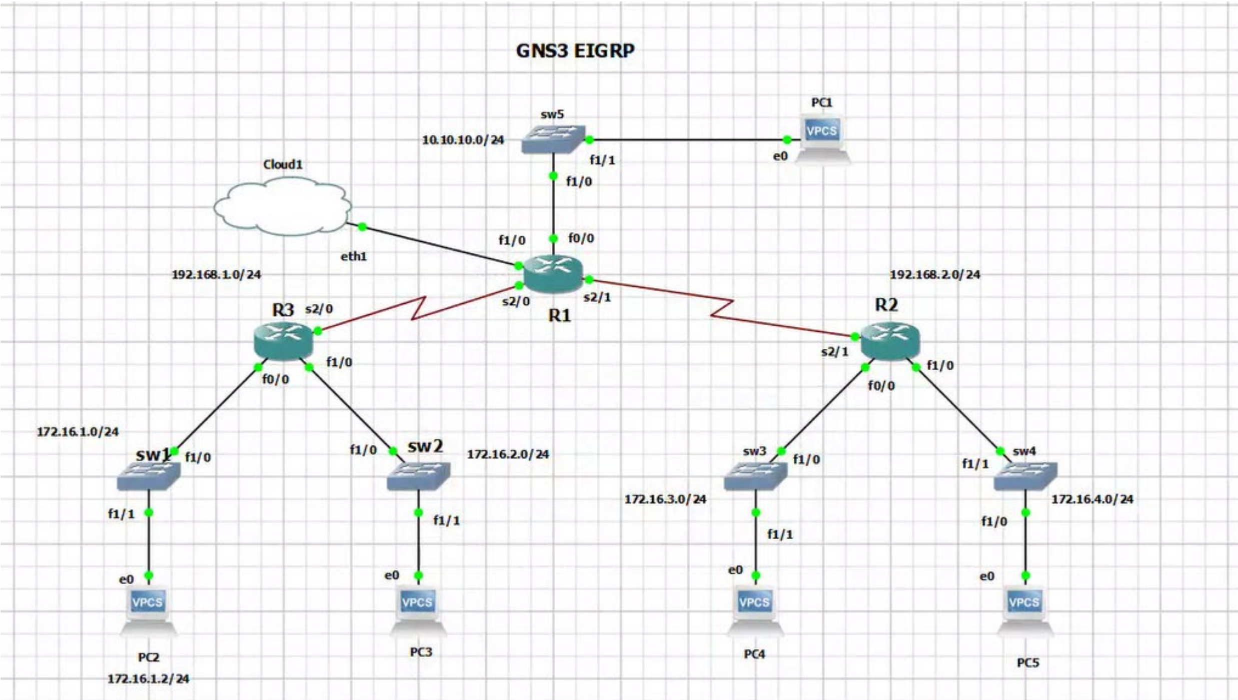
show ip ospf interface brief

show ip ospf neighbor

```
R3#show ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Se2/0        1     0               192.168.1.2/24     64    P2P   1/1
Fa1/0        1     0               172.16.2.1/24      1     DR    0/0
Fa0/0        1     0               172.16.1.1/24      1     DR    0/0
R3#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.2.1       0   FULL/  -        00:00:39    192.168.1.1     Serial2/0
R3#
R3#
```

3.19.13 GNS3 - Lab EIGRP

3.19.13.1 Topology



Based on OSPF configuration remove OSPF and convert to EIGRP
OSPF Removal: The no router ospf 1 command is used to remove the OSPF configuration before enabling EIGRP.
IGRP AS Number: All routers must use the same Autonomous System (AS) number (e.g., 100) to form EIGRP adjacencies.
Network Statements: The network commands in EIGRP specify which interfaces will participate in EIGRP. Wildcard masks can be used, but for simplicity, classful network statements are used here.
No Auto-Summary: The no auto-summary command is used to disable automatic summarization at classful boundaries, which is recommended for modern networks.

3.19.13.2 Scripts

```
!R1 Configuration
enable
configure terminal

! Remove OSPF configuration
no router ospf 1

! Configure EIGRP (AS number 100)
router eigrp 100
 network 10.10.10.0 0.0.0.255
 network 172.16.4.0 0.0.0.255
 network 192.168.1.0
 network 192.168.2.0
 no auto-summary

! Save configuration
end
write memory
```

```
!R2 Configuration
enable
configure terminal

! Remove OSPF configuration
no router ospf 1

! Configure EIGRP (AS number 100)
router eigrp 100
 network 172.16.3.0 0.0.0.255
 network 172.16.4.0 0.0.0.255
 network 192.168.2.0
 no auto-summary

! Save configuration
end
write memory

! R3 Configuration
enable
configure terminal

! Remove OSPF configuration
no router ospf 1

! Configure EIGRP (AS number 100)
router eigrp 100
 network 172.16.1.0 0.0.0.255
 network 172.16.2.0 0.0.0.255
 network 192.168.1.0
 no auto-summary

! Save configuration
end
write memory
```

Configurations R1

```
No action taken because command was not confirmed
R1#R1 Configuration
    ^
% Invalid input detected at '^' marker.

R1#enable
R1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#! Remove OSPF configuration
R1(config)#no router ospf 1
R1(config)#
R1(config)#! Configure EIGRP (AS number 100)
R1(config)#router eigrp 100
R1(config-router)# network 10.10.10.0 0.0.0.255
R1(config-router)# network 172.16.4.0 0.0.0.255
R1(config-router)# network 192.168.1.0
R1(config-router)# network 192.168.2.0
R1(config-router)# no auto-summary
R1(config-router)#
R1(config-router)#! Save configuration
R1(config-router)#end
R1#write memory
Warning: Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
*Feb 21 01:31:03.383: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.2 on Serial2/1 from FULL to DOWN, Neighbor Down: Interface down or detached
*Feb 21 01:31:03.387: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.2 on Serial2/0 from FULL to DOWN, Neighbor Down: Interface down or detached
*Feb 21 01:31:03.647: %SYS-5-CONFIG_I: Configured from console by console
*Feb 21 01:31:03.895: %SYS-5-CONFIG_I: Configured from console by console
[confirm]
Building configuration...
[OK]
R1#
```

Configurations R2

```
Building configuration...
[OK]
R2#
*Feb 21 01:32:55.147: %SYS-5-CONFIG_I: Configured from console by console
R2#!R2 Configuration
R2#enable
R2#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#
R2(config)#! Remove OSPF configuration
R2(config)#no router ospf 1
R2(config)#
R2(config)#! Configure EIGRP (AS number 100)
R2(config)#router eigrp 100
R2(config-router)# network 172.16.3.0 0.0.0.255
R2(config-router)# network 172.16.4.0 0.0.0.255
R2(config-router)# network 192.168.2.0
R2(config-router)# no auto-summary
R2(config-router)#
R2(config-router)#! Save configuration
R2(config-router)#end
R2#write memory
Building configuration...

*Feb 21 01:33:16.867: %SYS-5-CONFIG_I: Configured from console by console[OK]
R2#
```

Configurations R3

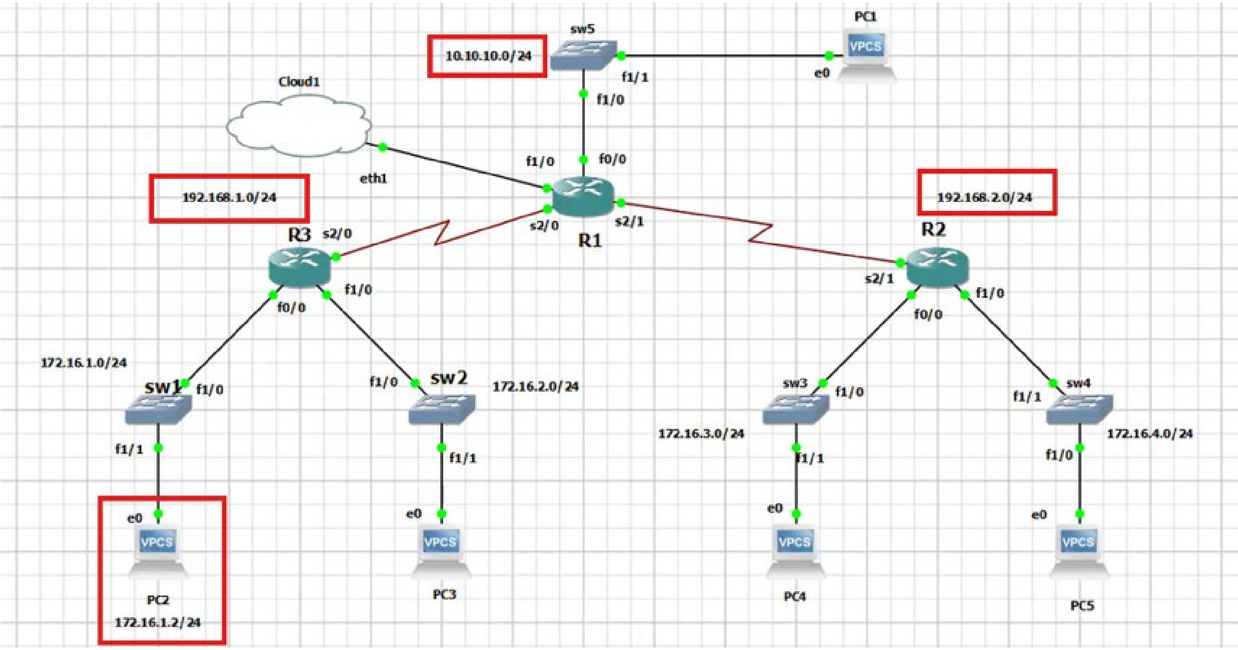
```
R3#
*Feb 21 01:31:43.483: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.1 on Seri
al2/0 from FULL to DOWN, Neighbor Down: Dead timer expired
R3#! R3 Configuration
R3#enable
R3#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#
R3(config)#! Remove OSPF configuration
R3(config)#no router ospf 1
R3(config)#
R3(config)#! Configure EIGRP (AS number 100)
R3(config)#router eigrp 100
R3(config-router)# network 172.16.1.0 0.0.0.255
R3(config-router)# network 172.16.2.0 0.0.0.255
R3(config-router)# network 192.168.1.0
R3(config-router)# no auto-summary
R3(config-router)#
R3(config-router)#! Save configuration
R3(config-router)#end
R3#write memory
Warning: Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
*Feb 21 01:33:35.943: %SYS-5-CONFIG_I: Configured from console by console
*Feb 21 01:33:35.963: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 192.168.1.1 (Serial2/0) is up: new adjacency
[confirm]
Building configuration...
[OK]
R3#
R3#
```

3.19.13.3 Testing

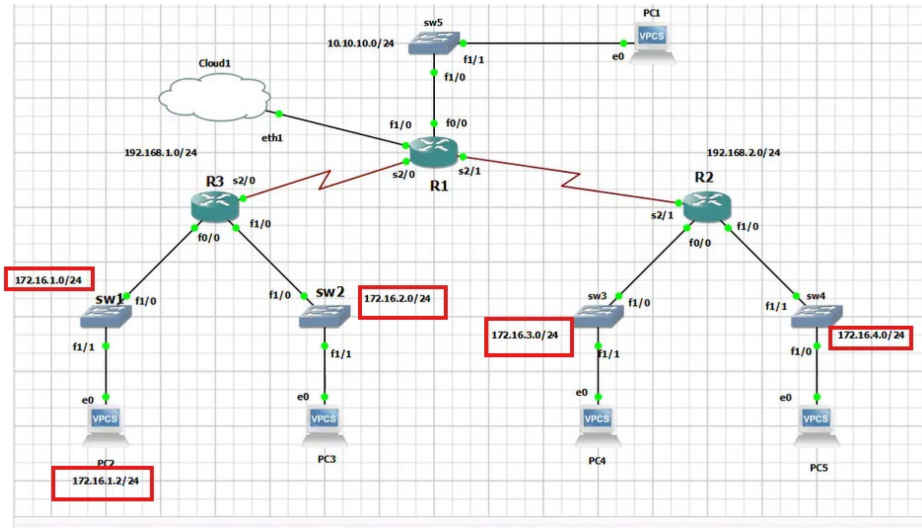
Ping from PC2

PC2> ping 192.168.1.1

PC2> ping 192.168.2.1
PC2> ping 10.10.10.1




```
PC2> ping 192.168.1.1

84 bytes from 192.168.1.1 icmp_seq=1 ttl=254 time=40.287 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=254 time=55.448 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=254 time=29.821 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=254 time=39.099 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=254 time=42.246 ms

PC2> ping 192.168.2.1

84 bytes from 192.168.2.1 icmp_seq=1 ttl=254 time=27.900 ms
84 bytes from 192.168.2.1 icmp_seq=2 ttl=254 time=27.828 ms
84 bytes from 192.168.2.1 icmp_seq=3 ttl=254 time=26.439 ms
84 bytes from 192.168.2.1 icmp_seq=4 ttl=254 time=28.366 ms
84 bytes from 192.168.2.1 icmp_seq=5 ttl=254 time=68.699 ms

PC2> ping 10.10.10.1

84 bytes from 10.10.10.1 icmp_seq=1 ttl=254 time=30.662 ms
84 bytes from 10.10.10.1 icmp_seq=2 ttl=254 time=40.539 ms
84 bytes from 10.10.10.1 icmp_seq=3 ttl=254 time=31.662 ms
84 bytes from 10.10.10.1 icmp_seq=4 ttl=254 time=26.118 ms
84 bytes from 10.10.10.1 icmp_seq=5 ttl=254 time=37.324 ms

PC2>
```



PC2> ping 172.16.1.1
PC2> ping 172.16.2.1
PC2> ping 172.16.3.1
PC2> ping 172.16.4.1

```
PC2> ping 172.16.1.1

84 bytes from 172.16.1.1 icmp_seq=1 ttl=255 time=33.049 ms
84 bytes from 172.16.1.1 icmp_seq=2 ttl=255 time=4.240 ms
84 bytes from 172.16.1.1 icmp_seq=3 ttl=255 time=2.540 ms
84 bytes from 172.16.1.1 icmp_seq=4 ttl=255 time=22.337 ms
84 bytes from 172.16.1.1 icmp_seq=5 ttl=255 time=17.109 ms

PC2> ping 172.16.2.1

84 bytes from 172.16.2.1 icmp_seq=1 ttl=255 time=17.359 ms
84 bytes from 172.16.2.1 icmp_seq=2 ttl=255 time=7.768 ms
84 bytes from 172.16.2.1 icmp_seq=3 ttl=255 time=8.162 ms
84 bytes from 172.16.2.1 icmp_seq=4 ttl=255 time=4.660 ms
84 bytes from 172.16.2.1 icmp_seq=5 ttl=255 time=15.883 ms

PC2> ping 172.16.3.1

84 bytes from 172.16.3.1 icmp_seq=1 ttl=253 time=77.168 ms
84 bytes from 172.16.3.1 icmp_seq=2 ttl=253 time=53.424 ms
84 bytes from 172.16.3.1 icmp_seq=3 ttl=253 time=52.368 ms
84 bytes from 172.16.3.1 icmp_seq=4 ttl=253 time=53.683 ms
84 bytes from 172.16.3.1 icmp_seq=5 ttl=253 time=49.661 ms

PC2> ping 172.16.4.1

84 bytes from 172.16.4.1 icmp_seq=1 ttl=254 time=24.362 ms
84 bytes from 172.16.4.1 icmp_seq=2 ttl=254 time=61.630 ms
84 bytes from 172.16.4.1 icmp_seq=3 ttl=254 time=25.277 ms
84 bytes from 172.16.4.1 icmp_seq=4 ttl=254 time=26.720 ms
84 bytes from 172.16.4.1 icmp_seq=5 ttl=254 time=54.154 ms

PC2>
```

3.19.13.4 Printouts

After applying the EIGRP configuration, use the following commands to verify operation:

- show ip route: Verify routes in the routing table, EIGRP routes have “D”
- show ip route eigrp: Verify EIGRP routes in the routing table.
- show ip protocols: Provides a summary of the IP routing protocols that are currently configured and running on the router
- show ip eigrp neighbors: Check EIGRP neighbor adjacencies.
- show ip eigrp interfaces: Check EIGRP-enabled interfaces and their status

R1
show ip route

```
R1#
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.10.10.0/24 is directly connected, FastEthernet0/0
L        10.10.10.1/32 is directly connected, FastEthernet0/0
      172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
D        172.16.1.0/24 [90/2172416] via 192.168.1.2, 00:04:11, Serial2/0
D        172.16.2.0/24 [90/2172416] via 192.168.1.2, 00:04:11, Serial2/0
D        172.16.3.0/24 [90/2172416] via 192.168.2.2, 00:04:31, Serial2/1
C        172.16.4.0/24 is directly connected, FastEthernet1/0
L        172.16.4.1/32 is directly connected, FastEthernet1/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Serial2/0
L        192.168.1.1/32 is directly connected, Serial2/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Serial2/1
L        192.168.2.1/32 is directly connected, Serial2/1
```

show ip route eigrp

```
R1#show ip route eigrp
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
D        172.16.1.0/24 [90/2172416] via 192.168.1.2, 00:05:52, Serial2/0
D        172.16.2.0/24 [90/2172416] via 192.168.1.2, 00:05:52, Serial2/0
D        172.16.3.0/24 [90/2172416] via 192.168.2.2, 00:06:12, Serial2/1
R1#h^@
```

```
L        192.168.2.1/32 is directly connected, Serial2/1
R1#show ip route ospf
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
O        172.16.1.0/24 [110/65] via 192.168.1.2, 00:00:27, Serial2/0
O        172.16.2.0/24 [110/65] via 192.168.1.2, 00:00:27, Serial2/0
O        172.16.3.0/24 [110/65] via 192.168.2.2, 00:00:43, Serial2/1
R1#
R1#
R1#
R1#
R1#show ip protocols
```

Show ip protocols

```
L        192.168.2.1/32 is directly connected, Serial2/1
R1#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "eigrp 100"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP-IPv4 Protocol for AS(100)
    Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
    NSF-aware route hold timer is 240
    Router-ID: 192.168.2.1
    Topology : 0 (base)
      Active Timer: 3 min
      Distance: internal 90 external 170
      Maximum path: 4
      Maximum hopcount 100
      Maximum metric variance 1

  Automatic Summarization: disabled
  Maximum path: 4
  Routing for Networks:
    10.10.10.0/24
    172.16.4.0/24
    192.168.1.0
    192.168.2.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.2           90      00:04:40
    192.168.1.2           90      00:04:40
  Distance: internal 90 external 170
```

show ip eigrp interface

show ip eigrp neighbor

```
R1#"
R1#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(100)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
1   192.168.1.2             Se2/0                    14 00:06:14   53   318  0  3
0   192.168.2.2             Se2/1                    11 00:07:30   37   222  0  5
R1#show ip eigrp inte
R1#show ip eigrp interfaces
EIGRP-IPv4 Interfaces for AS(100)
                              Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Fa0/0                    0        0/0         0/0          0       0/0            0           0
Fa1/0                    0        0/0         0/0          0       0/0            0           0
Se2/0                    1        0/0         0/0         53       0/16         264           0
Se2/1                    1        0/0         0/0         37       0/16         164           0
```

R2

show ip route

```
*Feb 21 01:33:16.867: %SYS-5-CONFIG_I: Configured from console by console[OK]
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
D        10.10.10.0 [90/2172416] via 192.168.2.1, 00:11:02, Serial2/1
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
D        172.16.1.0/24 [90/2684416] via 192.168.2.1, 00:09:45, Serial2/1
D        172.16.2.0/24 [90/2684416] via 192.168.2.1, 00:09:45, Serial2/1
C        172.16.3.0/24 is directly connected, FastEthernet0/0
L        172.16.3.1/32 is directly connected, FastEthernet0/0
C        172.16.4.0/24 is directly connected, FastEthernet1/0
L        172.16.4.1/32 is directly connected, FastEthernet1/0
D     192.168.1.0/24 [90/2681856] via 192.168.2.1, 00:11:02, Serial2/1
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Serial2/1
L        192.168.2.2/32 is directly connected, Serial2/1
R2#
```

solarwinds | Solar-PuTTY free tool

show ip route eigrp

```
R2#show ip route eigrp
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
D        10.10.10.0 [90/2172416] via 192.168.2.1, 00:11:36, Serial2/1
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
D        172.16.1.0/24 [90/2684416] via 192.168.2.1, 00:10:19, Serial2/1
D        172.16.2.0/24 [90/2684416] via 192.168.2.1, 00:10:19, Serial2/1
D     192.168.1.0/24 [90/2681856] via 192.168.2.1, 00:11:36, Serial2/1
R2#
```

show ip protocols

```
R2#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "eigrp 100"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP-IPv4 Protocol for AS(100)
    Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
    NSF-aware route hold timer is 240
    Router-ID: 192.168.2.2
    Topology : 0 (base)
      Active Timer: 3 min
      Distance: internal 90 external 170
      Maximum path: 4
      Maximum hopcount 100
      Maximum metric variance 1

  Automatic Summarization: disabled
  Maximum path: 4
  Routing for Networks:
    10.10.10.0/24
    172.16.3.0/24
    172.16.4.0/24
    192.168.1.0
    192.168.2.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.1           90      00:10:53
  Distance: internal 90 external 170

R2#
```

show ip eigrp interface

show ip eigrp neighbor

```
R2#show ip eigrp neighbor
EIGRP-IPv4 Neighbors for AS(100)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)        Cnt Num
0   192.168.2.1             Se2/1                    10 00:12:51   48    288  0  7
R2#show ip eigrp interface
EIGRP-IPv4 Interfaces for AS(100)
                              Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Fa1/0                    0        0/0         0/0          0       0/0            0           0
Se2/1                    1        0/0         0/0         48       0/16         224           0
Fa0/0                    0        0/0         0/0          0       0/0            0           0
R2#show ip eigrp neighbor
EIGRP-IPv4 Neighbors for AS(100)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)        Cnt Num
0   192.168.2.1             Se2/1                    10 00:13:05   48    288  0  7
R2#
R2#
```

R3

show ip route

```
R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
D        10.10.10.0 [90/2172416] via 192.168.1.1, 00:12:23, Serial2/0
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
C        172.16.1.0/24 is directly connected, FastEthernet0/0
L        172.16.1.1/32 is directly connected, FastEthernet0/0
C        172.16.2.0/24 is directly connected, FastEthernet1/0
L        172.16.2.1/32 is directly connected, FastEthernet1/0
D        172.16.3.0/24 [90/2684416] via 192.168.1.1, 00:12:23, Serial2/0
D        172.16.4.0/24 [90/2172416] via 192.168.1.1, 00:12:23, Serial2/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Serial2/0
L        192.168.1.2/32 is directly connected, Serial2/0
D     192.168.2.0/24 [90/2681856] via 192.168.1.1, 00:12:23, Serial2/0
R3#
```

show ip route eigrp

```
R3#show ip route eigrp
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
D        10.10.10.0 [90/2172416] via 192.168.1.1, 00:12:55, Serial2/0
      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
D        172.16.3.0/24 [90/2684416] via 192.168.1.1, 00:12:55, Serial2/0
D        172.16.4.0/24 [90/2172416] via 192.168.1.1, 00:12:55, Serial2/0
D     192.168.2.0/24 [90/2681856] via 192.168.1.1, 00:12:55, Serial2/0
R3#
```

show ip protocols

```
R3#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "eigrp 100"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP-IPv4 Protocol for AS(100)
    Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
    NSF-aware route hold timer is 240
    Router-ID: 192.168.1.2
    Topology : 0 (base)
      Active Timer: 3 min
      Distance: internal 90 external 170
      Maximum path: 4
      Maximum hopcount 100
      Maximum metric variance 1

  Automatic Summarization: disabled
  Maximum path: 4
  Routing for Networks:
    172.16.1.0/24
    172.16.2.0/24
    192.168.1.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.1.1           90      00:13:18
  Distance: internal 90 external 170

R3#
```

show ip eigrp interface

show ip eigrp neighbor

```
R3#
R3#show ip eigrp interface
EIGRP-IPv4 Interfaces for AS(100)
                              Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Fa0/0                    0        0/0         0/0          0       0/0            0           0
Fa1/0                    0        0/0         0/0          0       0/0            0           0
Se2/0                    1        0/0         0/0         62       0/16         308           0
R3#show ip eigrp neighbor
EIGRP-IPv4 Neighbors for AS(100)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
0   192.168.1.1             Se2/0                    14 00:14:28   62    372  0  6
R3#
```