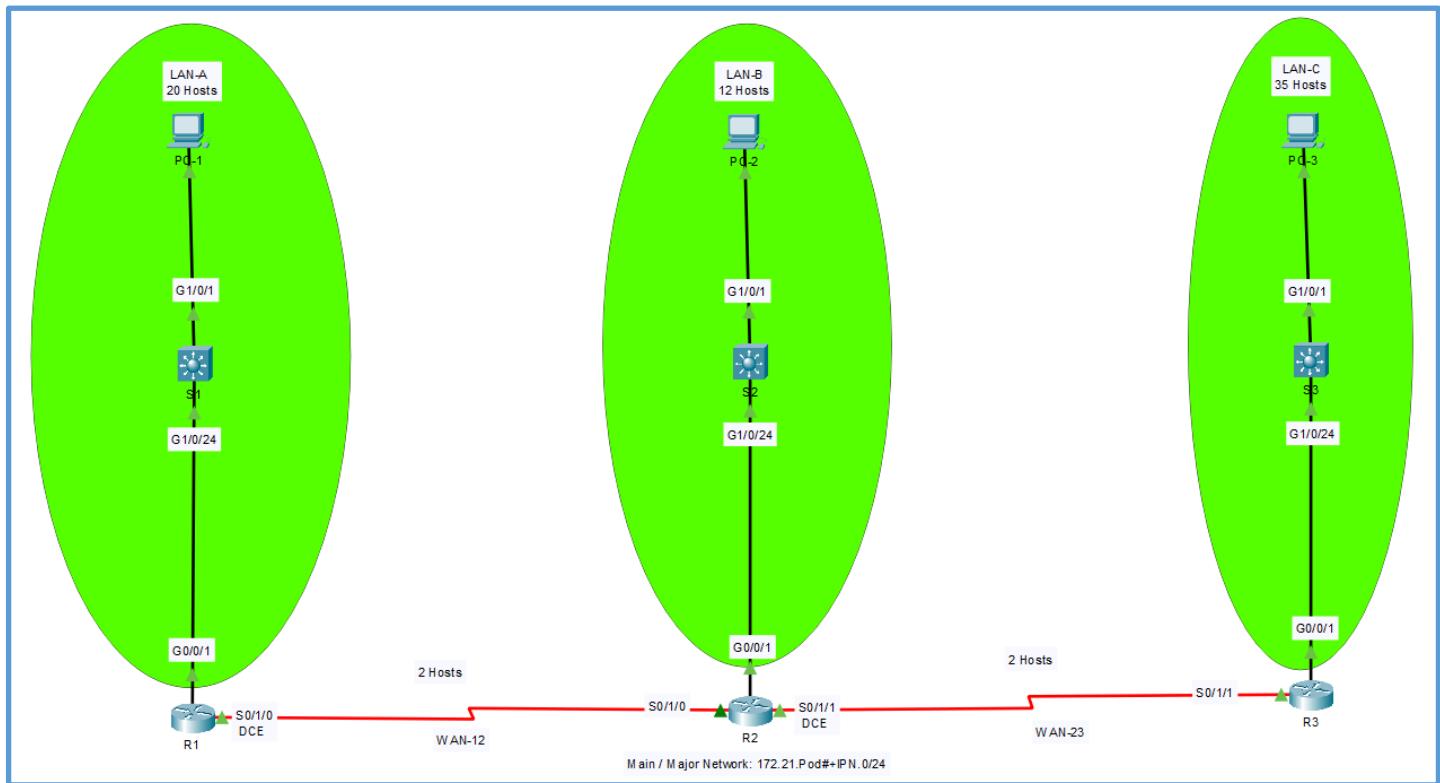


### Lab Activity – Subnetting:

- There are three LANs and two site-to-site WANs in the topology below. Please develop the following topology on the physical pod/rack in the lab room.



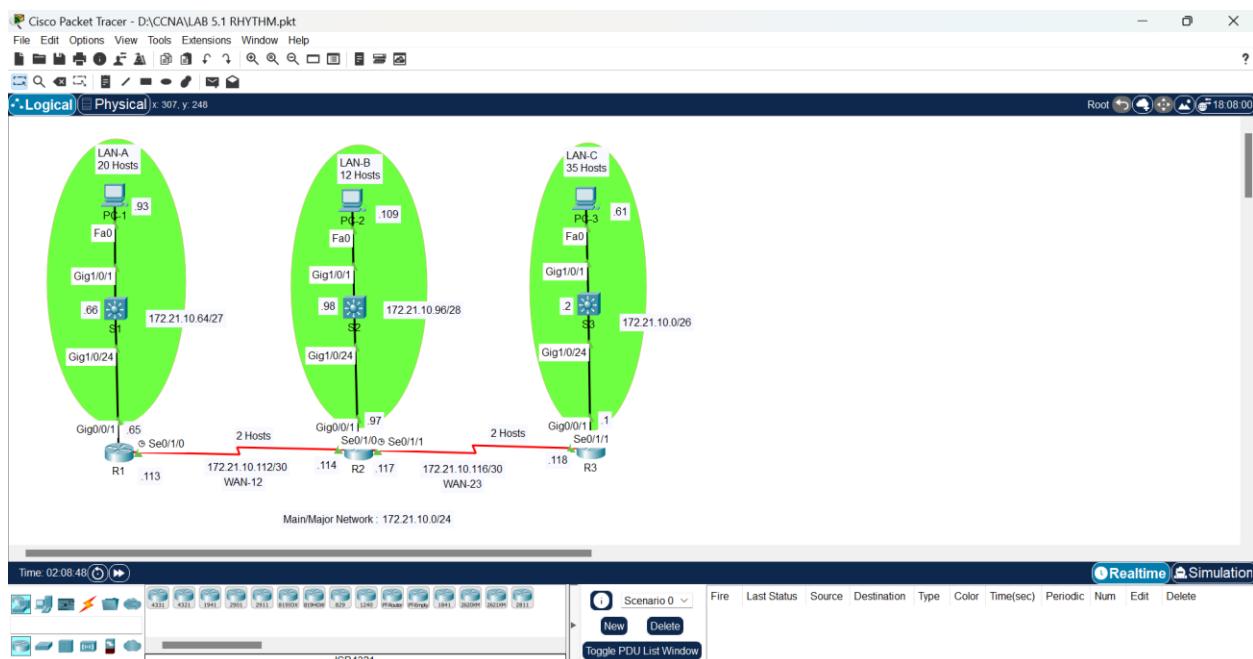
### Required Resources:

- Three Layer-3/Multilayer Switches (Cisco Catalyst 1000 Series with Cisco IOS Release 15.1+ image)
- Three Routers (Cisco 4221 with Cisco IOS Release 17.6+ image)
- Three PCs (Windows with Terminal Emulation Program)
- Cables:
  - Console cables to configure the Cisco IOS devices through the console port.
  - Ethernet and Serial cables as shown in the topology.

Addressing Table:

Device	Interface	IP Address	Subnet Mask / CIDR	Default Gateway
S1	VLAN1	172.21.10.66	255.255.255.224	172.21.10.65
S2	VLAN1	172.21.10.98	255.255.255.240	172.21.10.97
S3	VLAN1	172.21.10.2	255.255.255.192	172.21.10.1
R1	G0/0/1	172.21.10.65	255.255.255.224	N/A
	S0/1/0	172.21.10.113	255.255.255.252	N/A
R2	G0/0/1	172.21.10.97	255.255.255.240	N/A
	S0/1/0	172.21.10.114	255.255.255.252	N/A
	S0/1/1	172.21.10.117	255.255.255.252	N/A
R3	G0/0/1	172.21.10.1	255.255.255.192	N/A
	S0/1/1	172.21.10.118	255.255.255.252	N/A
PC-1	NIC	172.21.10.93	255.255.255.224	172.21.10.65
PC-2	NIC	172.21.10.109	255.255.255.240	172.21.10.97
PC-3	NIC	172.21.10.61	255.255.255.192	172.21.10.1

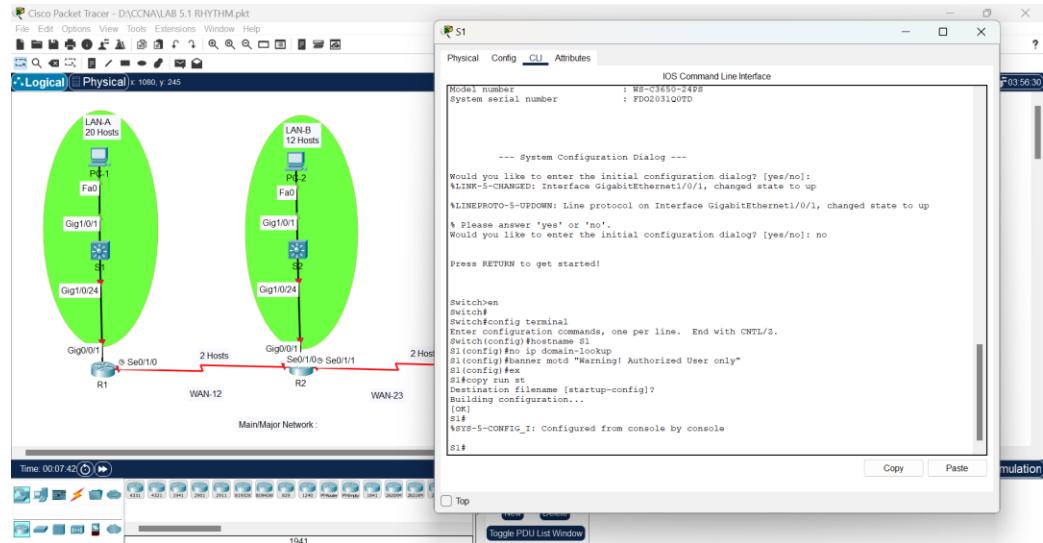
Develop the topology on the physical rack/pod by using all the devices mentioned above and then cabling them all together:



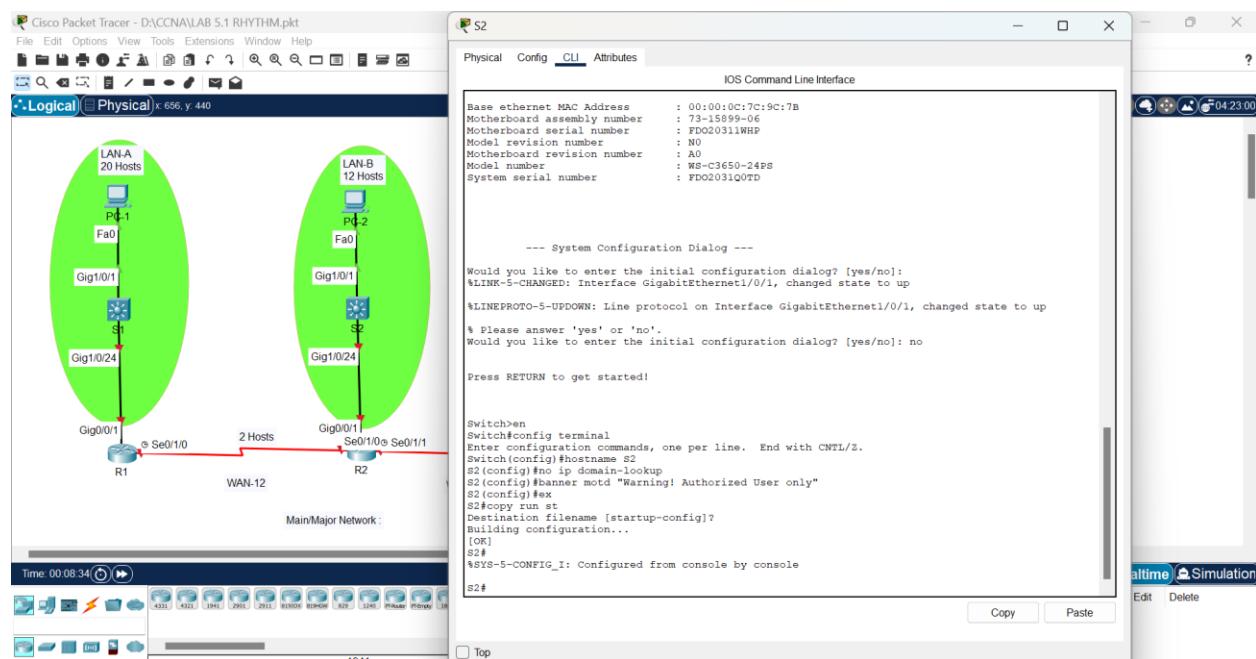
- Turn on the devices.
- Connect the switches with their default gateways (routers).
- Connect the PCs with their respective switches.
- Make sure all the lights are green on the switch ports where cables are connected.

### Step 3: Configure and verify basic switch settings on all switches.

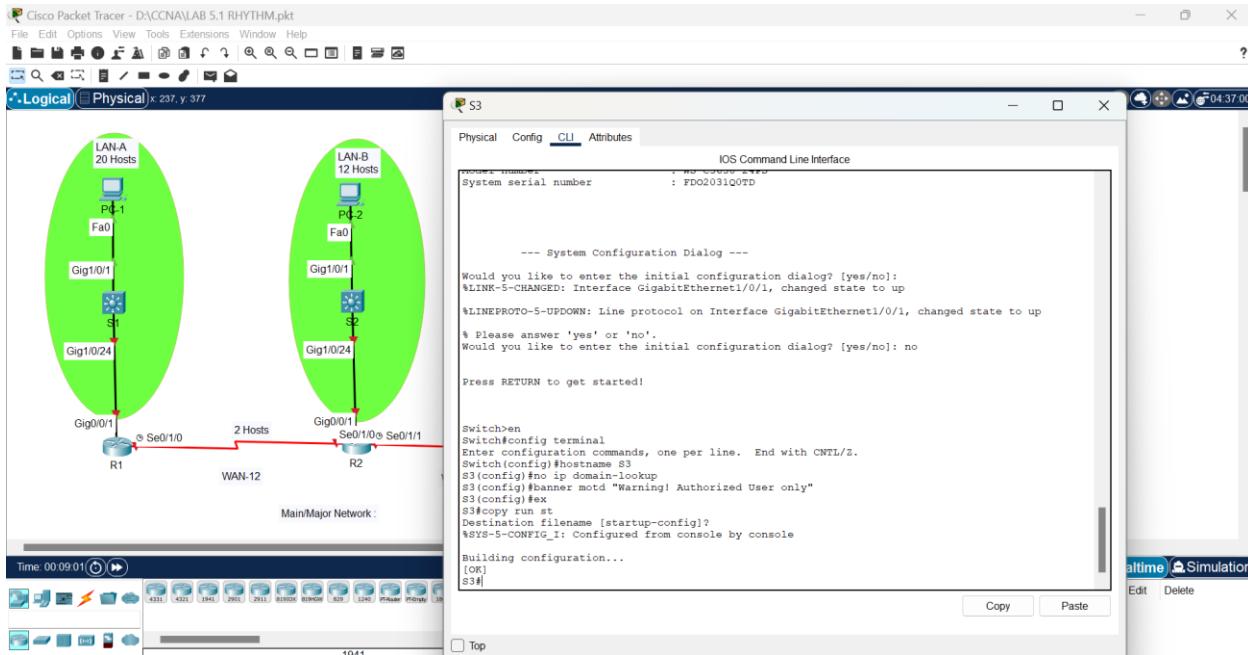
SW1



SW2

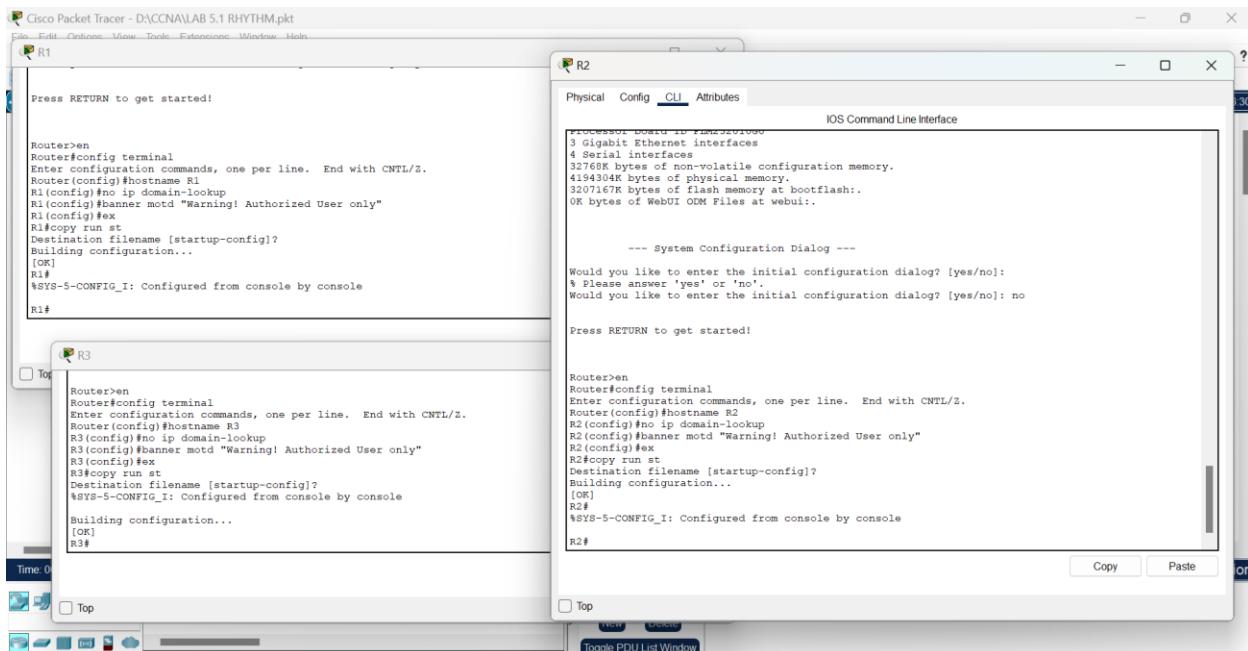


SW3



- Console into the switch and enter the global configuration mode:
  - Assign the switch with a name according to the addressing table.
  - Disable unwanted DNS lookup.
  - Enter a login MOTD banner to warn about illegal access.
  - Save the configuration.

#### Step 4: Configure and verify basic router settings on all routers.



- Console into the router and enter the global configuration mode:
  - Assign the router with a name according to the addressing table.

- Disable unwanted DNS lookup.
- Enter a login MOTD banner to warn about illegal access.
- Save the configuration.

## SOLUTION

In this activity, the main/major network address given to you is **172.21.21.0/24**, (**IPN** is Instructor Provided Number from the range of 1 to 100). You are required to subnet and provide the IP addressing for all the networks (LANs and site-to-site WANs shown in the topology). The required host addresses for each WAN and LAN link are also mentioned in the topology.

### **Part 1: IP Address Scheme – Designing:**

Step 1: The given main/major network address 172.21.21.0/24 (**IPN** is Instructor Provided Number from the range of 1 to 100) must be divided into multiple subnets based on the requirements. It is imperative to always start subnetting based on the maximum number of host requirements in any subnet. The required number of hosts for each network is mentioned in the topology diagram.

Answer the following questions:

1. How many subnets are required based on the given topology diagram?  
Answer 5 subnets
2. What are the recommended number of bits to be borrowed from the host portion to satisfy the maximum number of hosts required in any subnet in the topology?  
Answer

Answer Depend on Required Hosts

SR NO.	SUBNET	Number of hosts required	Bits to be borrowed
1	LAN -C	35 hosts	2 bits
2	LAN-A	20 hosts	3 bits
3	LAN-B	12 hosts	4 bits
4	R <sub>1</sub> to R <sub>2</sub>	02 hosts	6 bits
5	R <sub>2</sub> to R <sub>3</sub>	02 hosts	6 bits

3. How many host bits are remaining after the bits are borrowed to network portion for subnets creation?  
Answer: In VLSM we can borrow bits according to hosts. In this case, we have 135 hosts we can borrow from host bits from 2 to 7 bits
4. What is the formula to calculate the number of hosts based on remaining host bits?  
Answer: Number of Hosts=2<sup>(Number of remaining host bits)</sup>–2

**Note:** If your answer is less than the 35 maximum hosts required for the LAN-C, then you have borrowed too many bits from the host portion.

5. Calculate all the five subnets below by keeping the last octet as binary. The first subnet (subnet zero) is shown below:

Subnet 0:	172 . 21 . 10 .	0	0	0	0	0	0	0	0
Subnet 1:	172 . 21 . 10 .	0	1	0	0	0	0	0	0
Subnet 2:	172 . 21 . 10 .	0	1	1	0	0	0	0	0
Subnet 3:	172 . 21 . 10 .	0	1	1	1	0	0	0	0
Subnet 4:	172 . 21 . 10 .	0	1	1	1	0	1	0	0

6. What is the new prefix/subnet mask for the first subnet (subnet 0)? Express the new subnet mask in decimal and binary.

111111111.11111111.11111111.11000000

255 . . . 255 . . . 255 . . . 192

7. Complete the following subnet details table.

Subnet#	Network Address	Subnet mask / Prefix	First Valid Host IP Address	Last Valid Host IP Address	Broadcast Address
0	172.21.10.0	255.255.255.192/26	172.21.10.1	172.21.10.62	172.21.10.63
1	172.21.10.64	255.255.255.224 /27	172.21.10.65	172.21.10.94	172.21.10.95
2	172.21.10.96	255.255.255.240 /28	172.21.10.97	172.21.10.110	172.21.10.111
3	172.21.10.112	255.255.255.252/30	172.21.10.113	172.21.10.114	172.21.10.115
4	172.21.10.116	255.255.255.252/30	172.21.10.117	172.21.10.118	172.21.10.119

Step 2: Assign the subnets to the network shown in the topology.

When assigning the subnets, keep in mind that routing is necessary to allow information to be sent throughout the network. You may use RIP routing protocol in the entire network topology.

- a. Assign Subnet 0 to the LAN-C.
- b. Assign Subnet 1 to the LAN-A.
- c. Assign Subnet 2 to the LAN-B.
- d. Assign Subnet 3 to the WAN-12.
- e. Assign Subnet 4 to the WAN-23.

Step 3: Document the addressing scheme.

Complete the Addressing Table above using the following guidelines:

- a) Allocate the first valid IP address to routers for each of the LAN links.
- b) Allocate the second valid IP address to switches SVI for each of the LAN.
- c) For the WAN link between R1 and R2, allocate the first valid IP address to R1 and last valid IP address R2.
- d) For the WAN link between R2 and R3, allocate the first valid IP address to R2 and the last valid IP address to R3.
- e) Allocate the **second last** valid IP address to the hosts.
- f) Addressing Table:

Device	Interface	IP Address	Subnet Mask / CIDR	Default Gateway
S1	VLAN1	172.21.10.66	255.255.255.224	172.21.10.65
S2	VLAN1	172.21.10.98	255.255.255.240	172.21.10.97
S3	VLAN1	172.21.10.2	255.255.255.192	172.21.10.1
R1	G0/0/1	172.21.10.65	255.255.255.224	N/A
	S0/1/0	172.21.10.113	255.255.255.252	N/A
R2	G0/0/1	172.21.10.97	255.255.255.240	N/A
	S0/1/0	172.21.10.114	255.255.255.252	N/A
	S0/1/1	172.21.10.117	255.255.255.252	N/A
R3	G0/0/1	172.21.10.1	255.255.255.192	N/A
	S0/1/1	172.21.10.118	255.255.255.252	N/A
PC-1	NIC	172.21.10.93	255.255.255.224	172.21.10.65
PC-2	NIC	172.21.10.109	255.255.255.240	172.21.10.97
PC-3	NIC	172.21.10.61	255.255.255.192	172.21.10.1

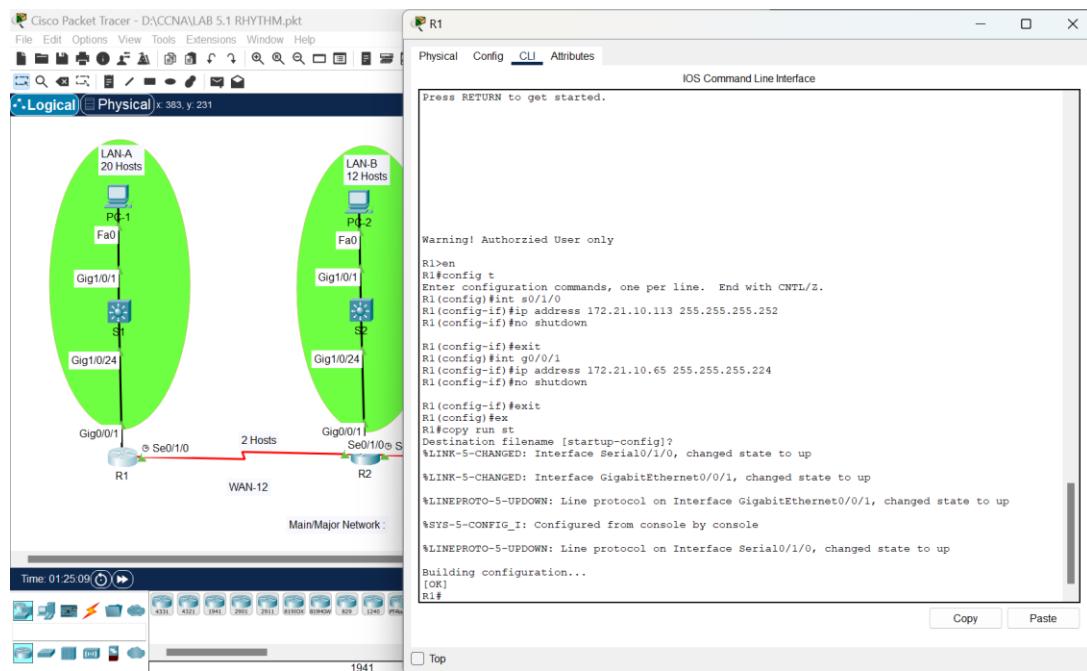
## Part 2: IP Address Scheme – Implementation:

Assign IP Addresses to all end devices and intermediary network devices. After the assignment of IP addresses, verify connectivity between all devices. If there are any connectivity issues, perform troubleshooting. It is imperative to check and verify the RIP routing is implemented appropriately on all the routers.

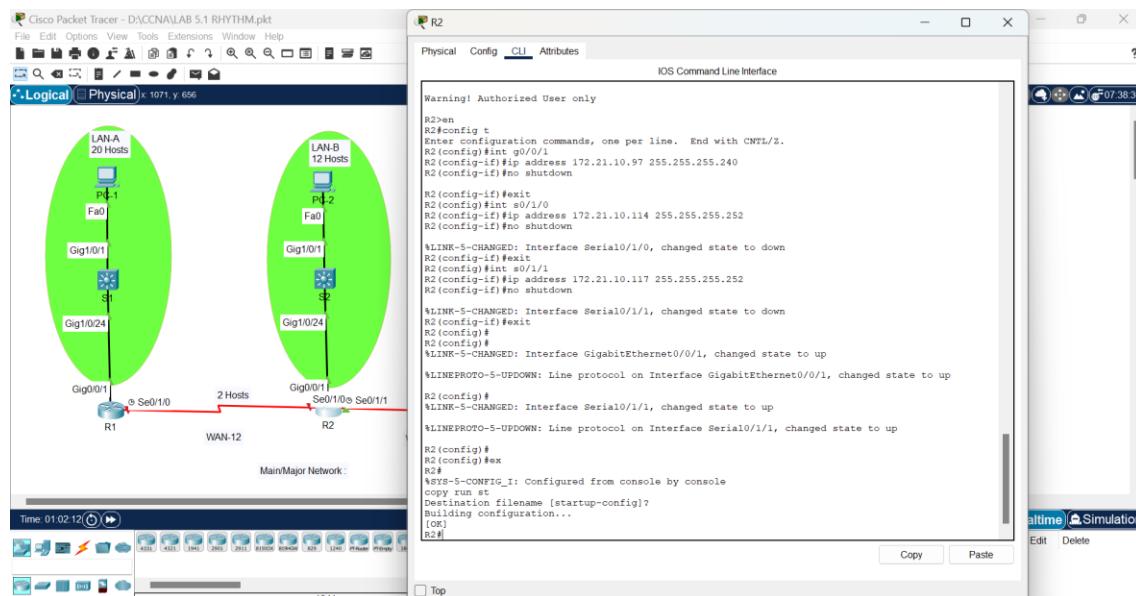
Implement the following steps to complete the IP addressing configuration.

Step 1: Configure IP addressing on all routers R1, R2, R3 LAN, and WAN interfaces, and activate the interfaces.

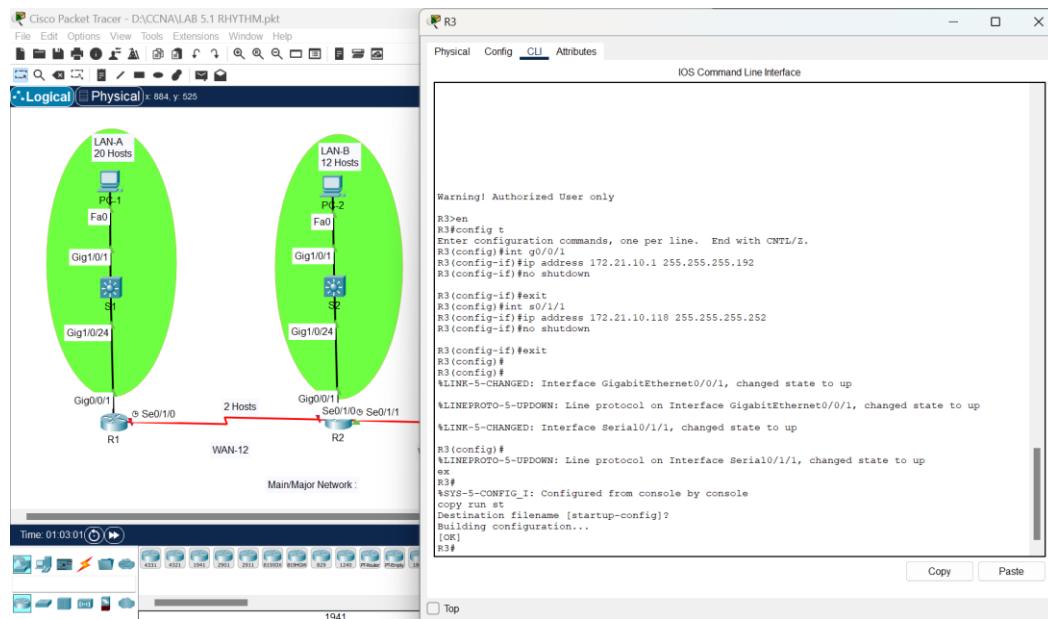
R1



R2

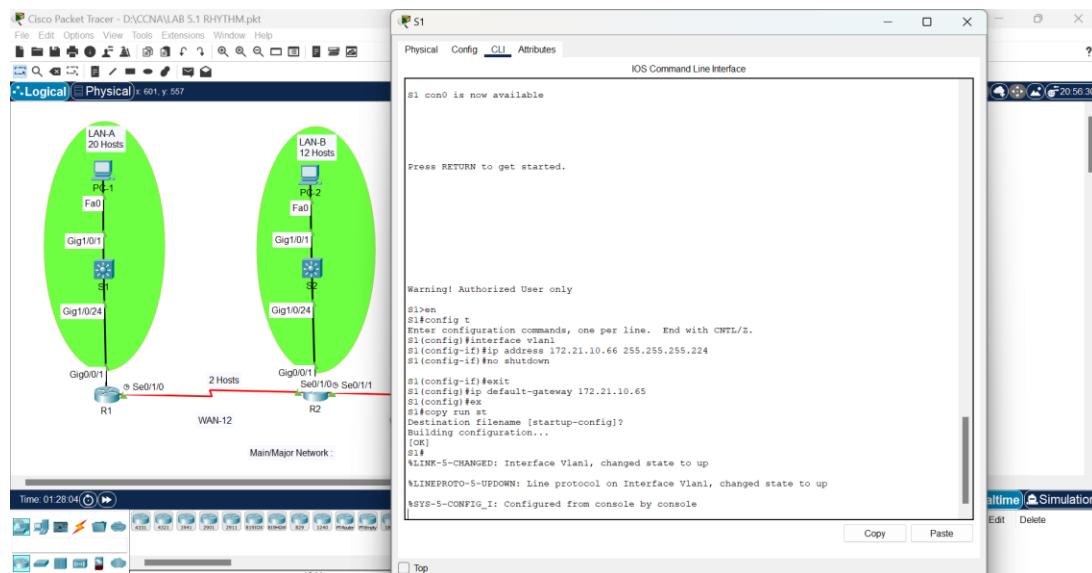


### R3

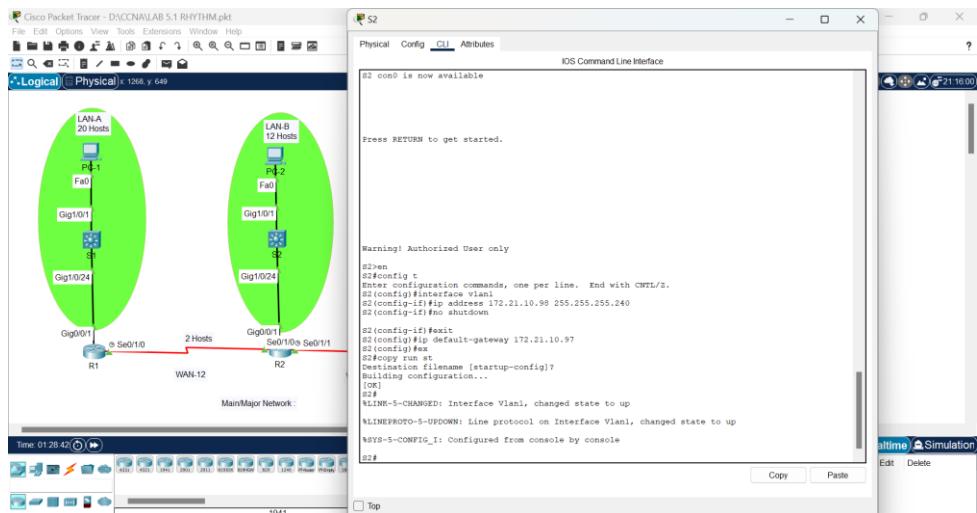


Step 2: Configure IP addressing on SVI interfaces of all switches S1, S2, and S3 including the appropriate default gateway.

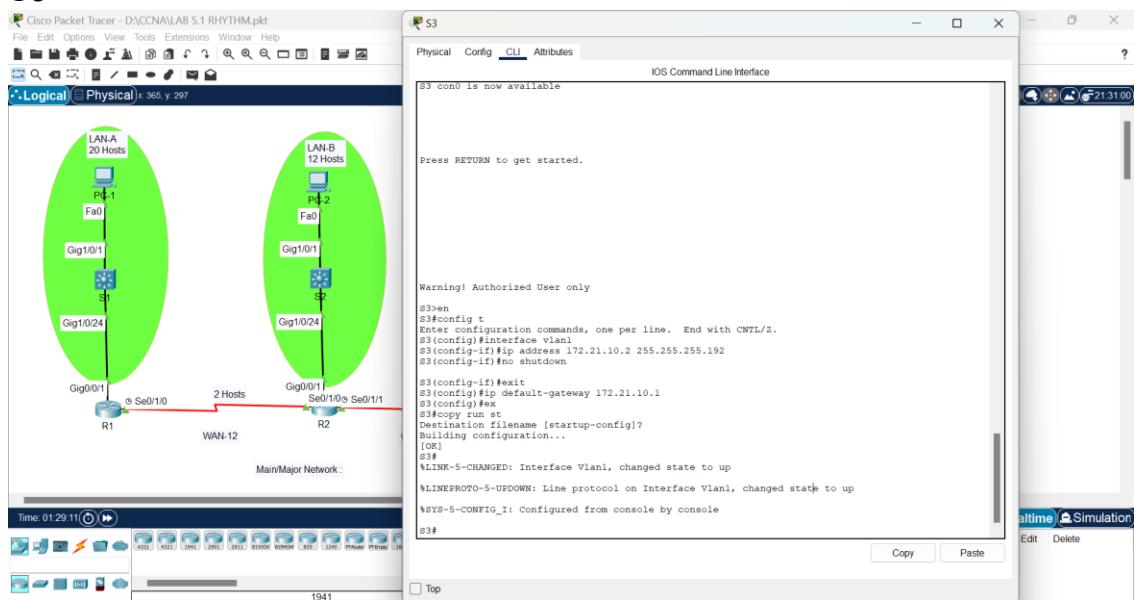
### S1



### S2

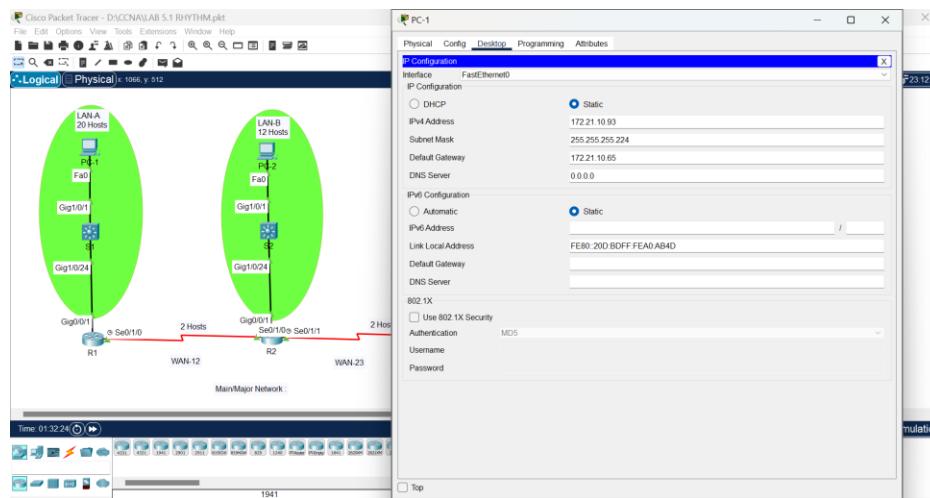


S3

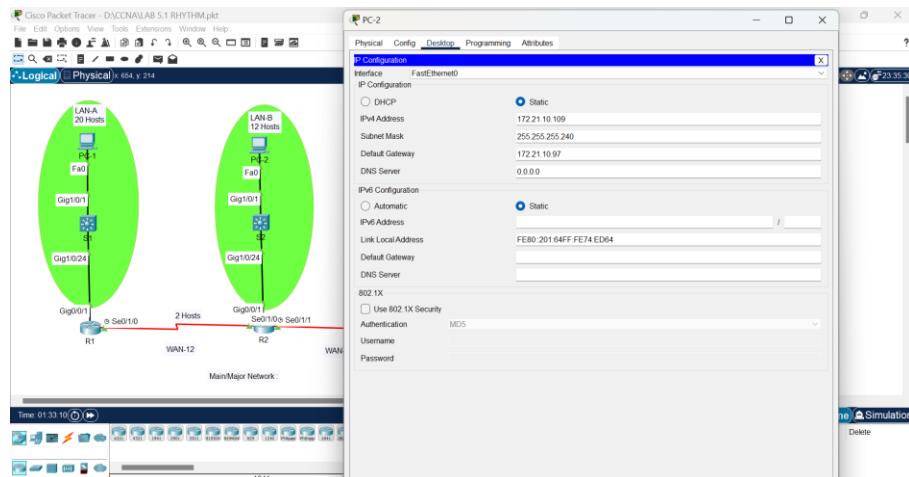


Step 3: Configure IP addressing on PC-1, PC-2, and PC-3 including the appropriate default gateway.

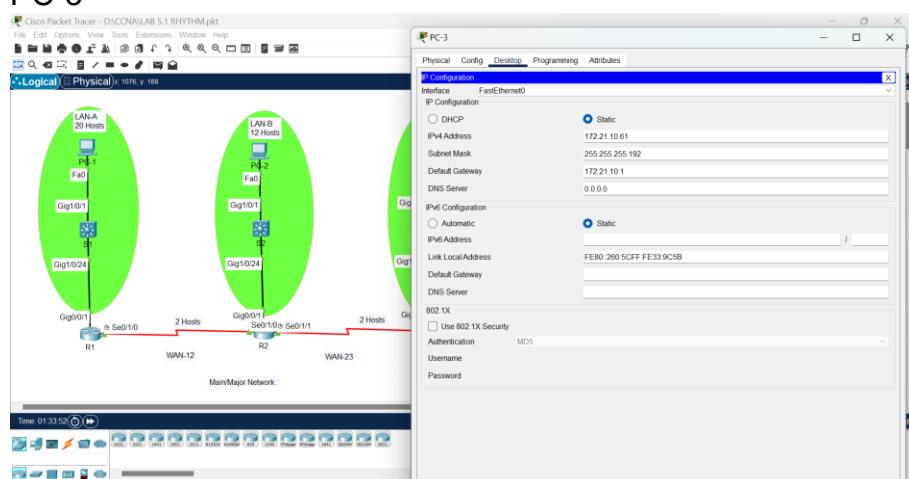
PC-1



PC-2

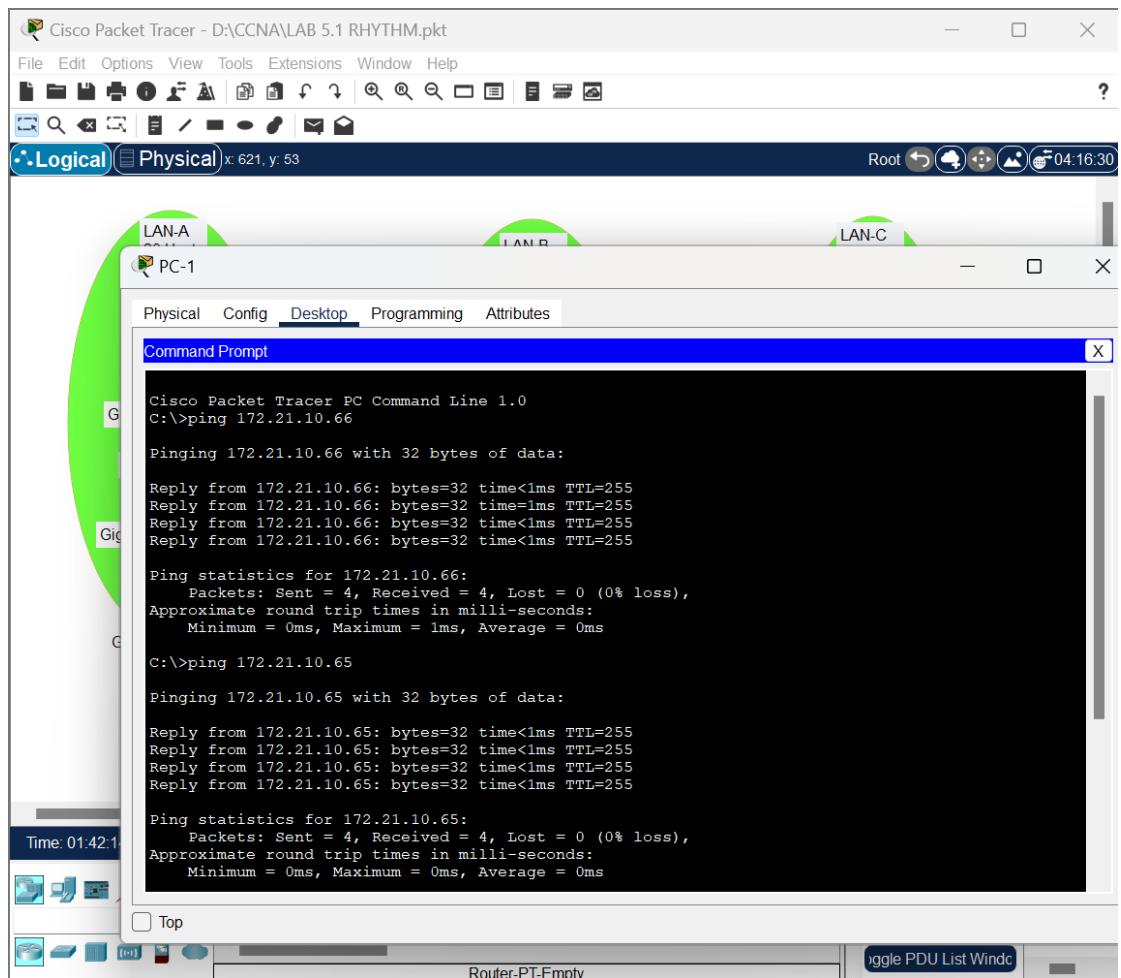


PC-3



Step 4: Verify connectivity.

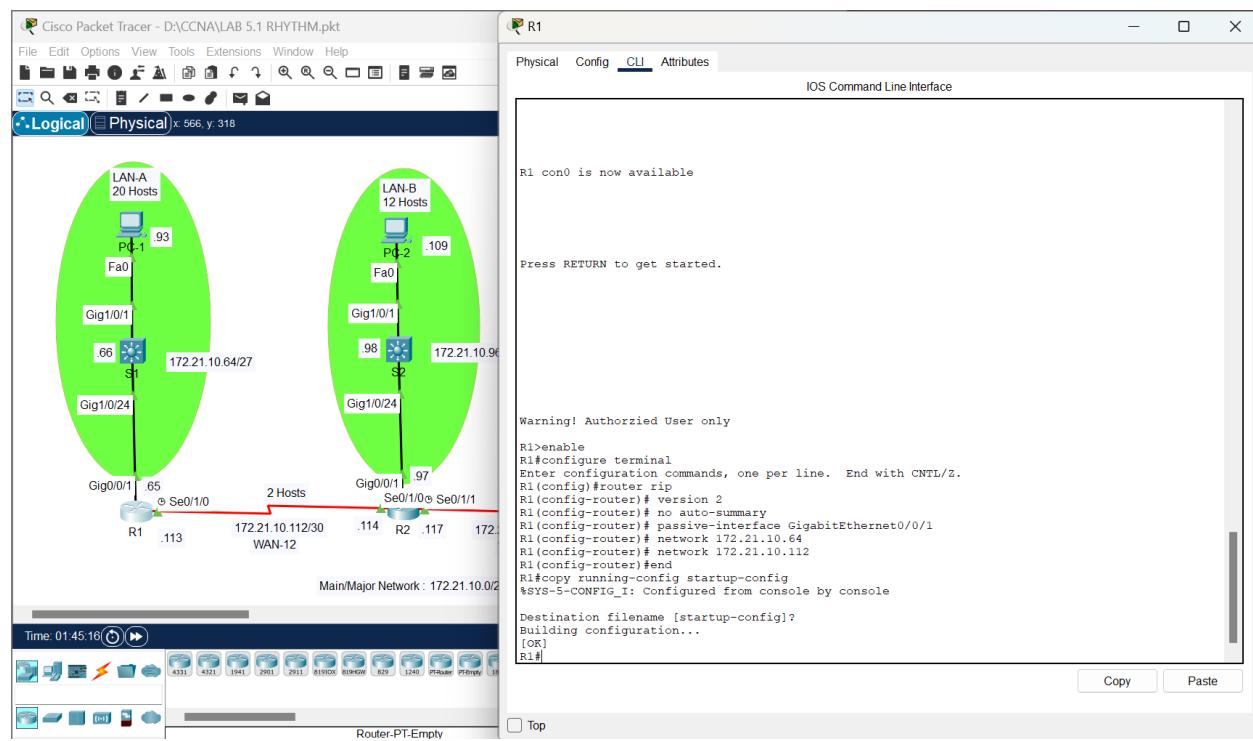
You should be able to ping every IP address listed in the Addressing Table above.



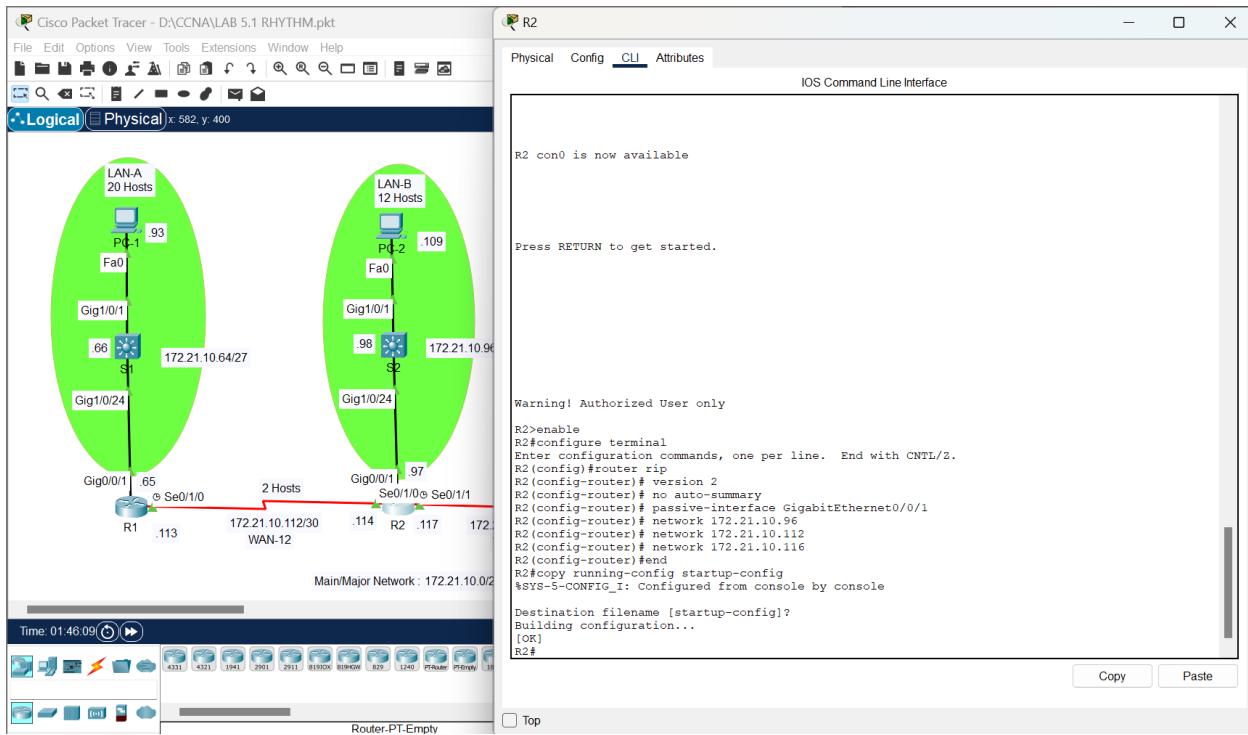
## Step 5: Configure dynamic routing (RIPv2) on all routers.

- Enter into RIP routing mode at (in the case of R1/R2/R3)
  - *enable*
  - *config terminal*
  - *router rip*
- Configure the following:
  - Enable RIP version 2.
    - *version 2*
  - Disable auto-summarization.
    - *no auto-summary*
  - Do not advertise RIP routes to LANs.
    - *passive-interface g0/0/1* (or as the case may be)
  - Advertise all directly connected networks on each router.
  - Save the configuration.
    - *end*
    - *copy running-config startup-config*

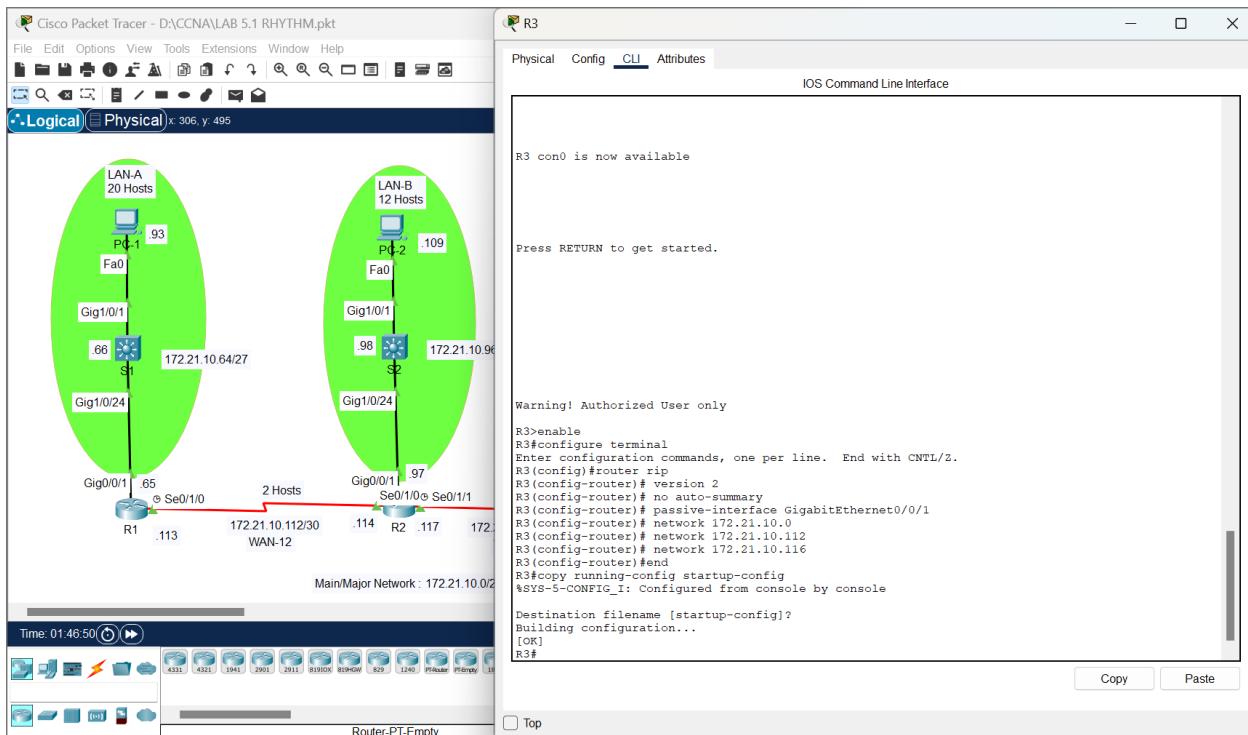
**R1**



## R2



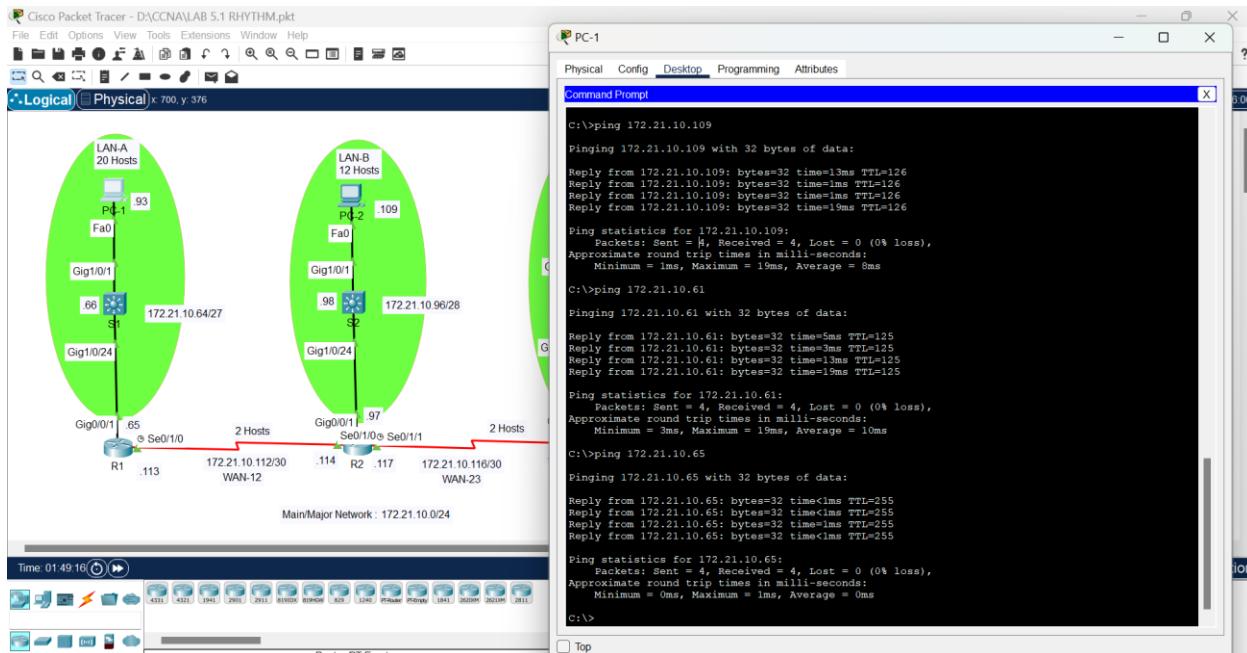
## R3



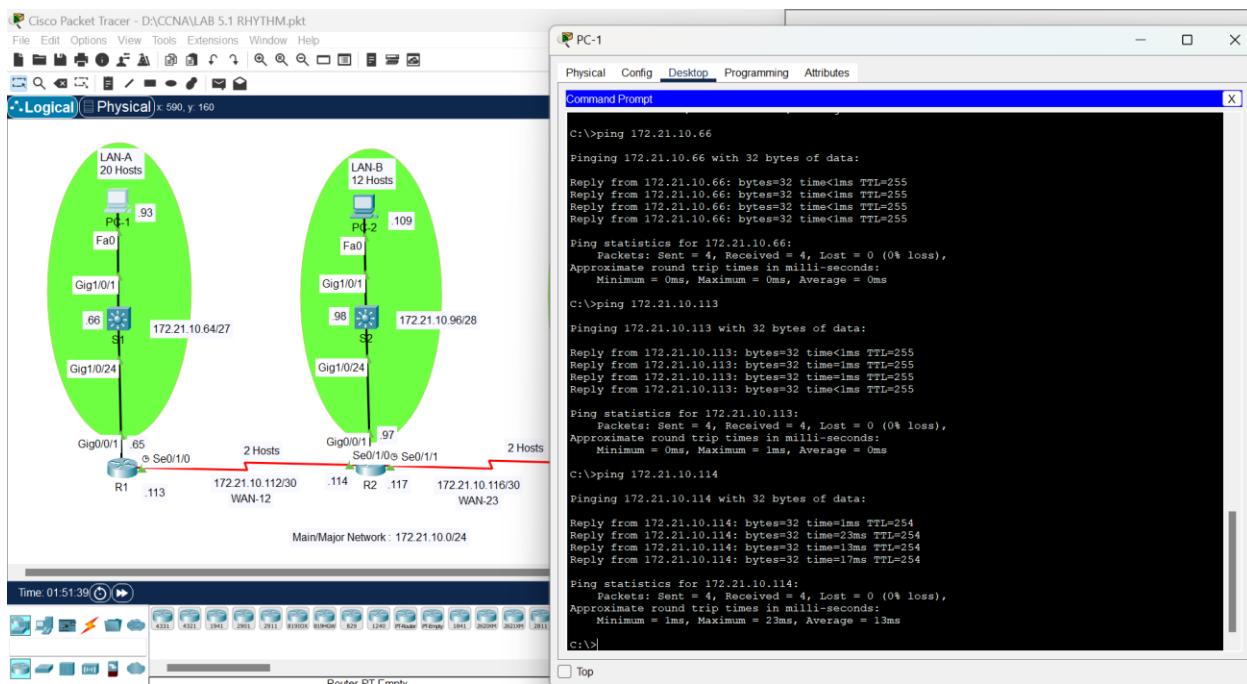
**NOTE:** Repeat Step 5 above for all the routers. While doing that, make sure to advertise only directly connected networks at each router.

## Step 6: Verify network connectivity.

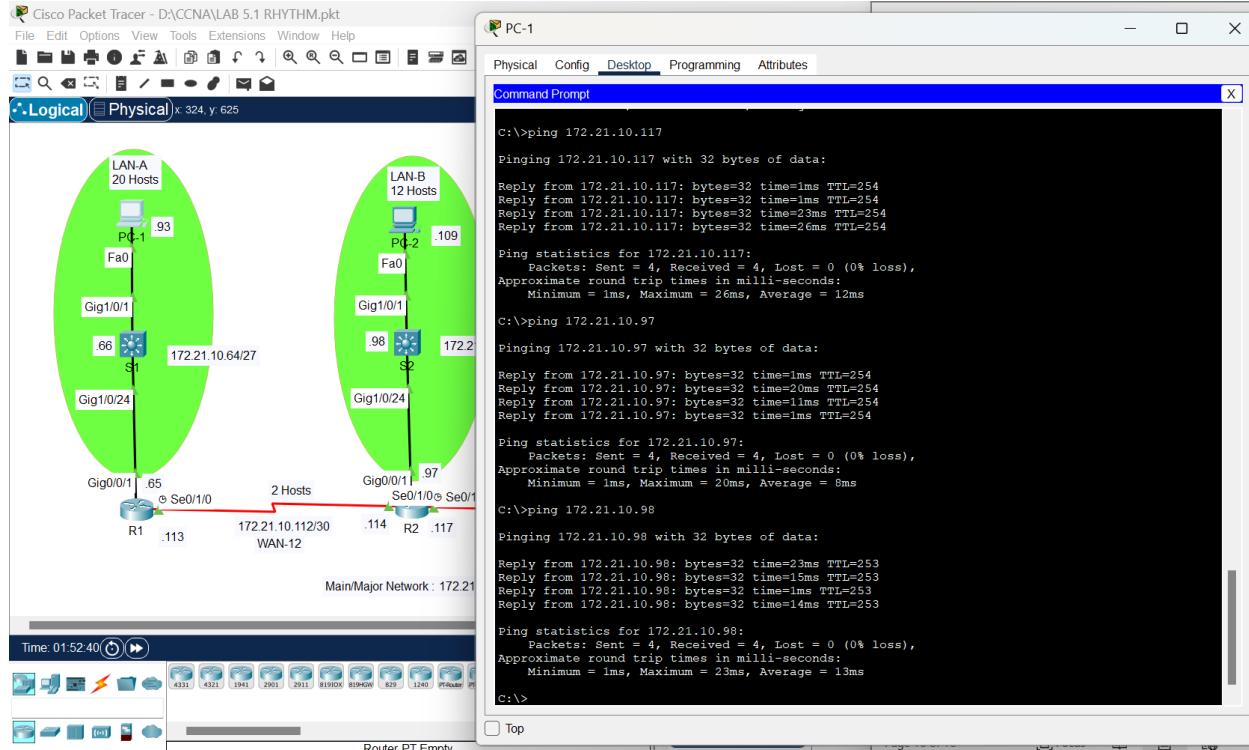
- Using the command line at PC-1, ping the IP address of PC-B.
- Using the command line at PC-1, ping the IP address of PC-C.
- Using the command line at PC-1, ping the IP address of G0/0/1 of router R1.



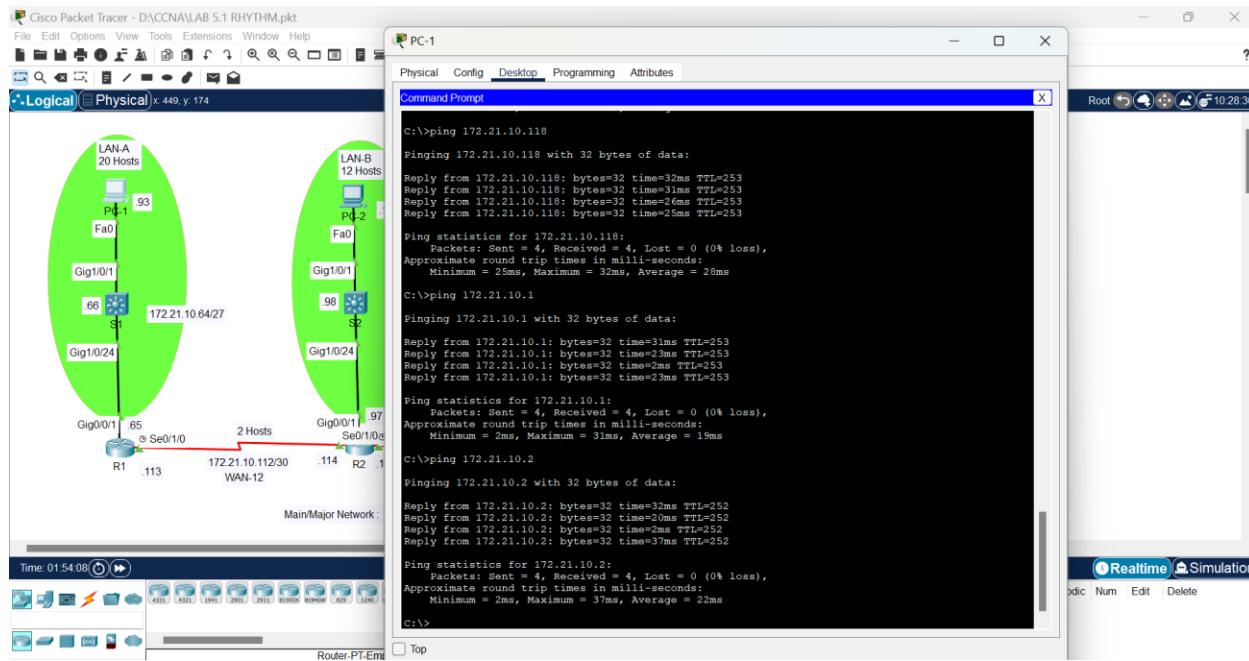
- Using the command line at PC-1, ping the IP address of SVI int. of switch S1
- Using the command line at PC-1, ping the IP address of S0/1/0 of router R1.
- Using the command line at PC-1, ping the IP address of S0/1/0 of router R2.



- Using the command line at PC-1, ping the IP address of S0/1/1 of router R2.
- Using the command line at PC-1, ping the IP address of G0/0/1 of router R2.
- Using the command line at PC-1, ping the IP address of SVI int. of switch S2.



- Using the command line at PC-1, ping the IP address of S0/1/1 of router R3.
- Using the command line at PC-1, ping the IP address of G0/0/1 of router R3.
- Using the command line at PC-1, ping the IP address of SVI int. of switch S3.

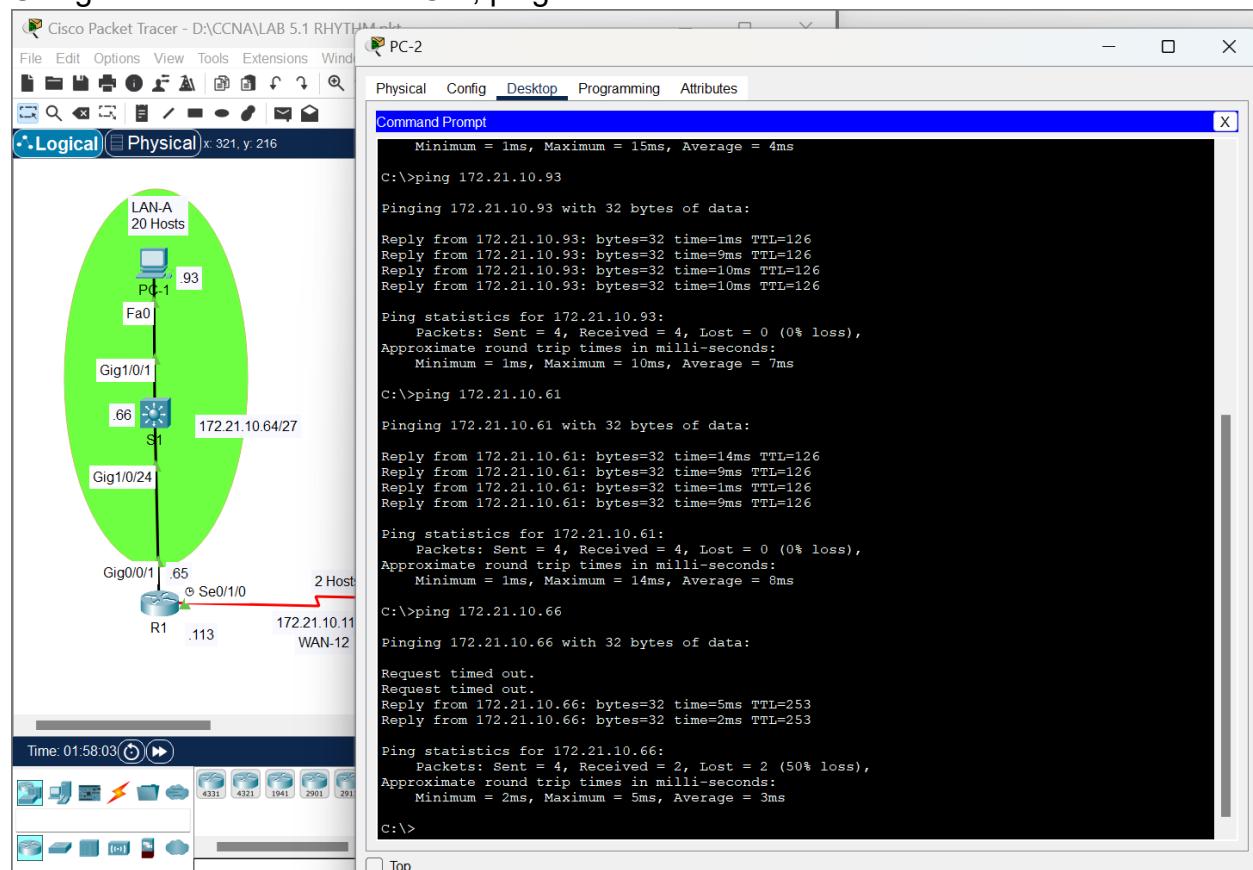


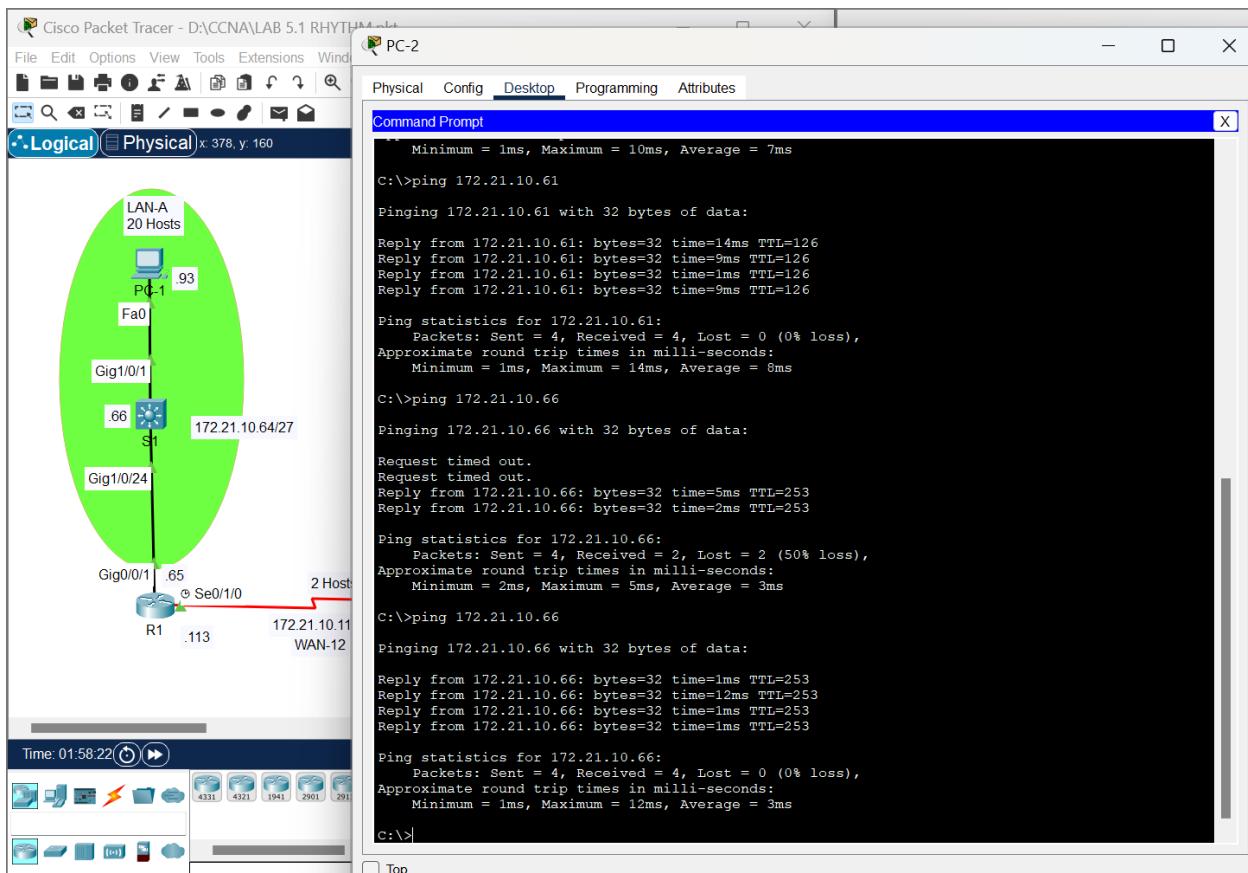
## For PC-2

Using the command line at PC-2, ping the IP address of PC-A.

Using the command line at PC-2, ping the IP address of PC-C.

Using the command line at PC-2, ping the IP address of SVI int. of switch S1.

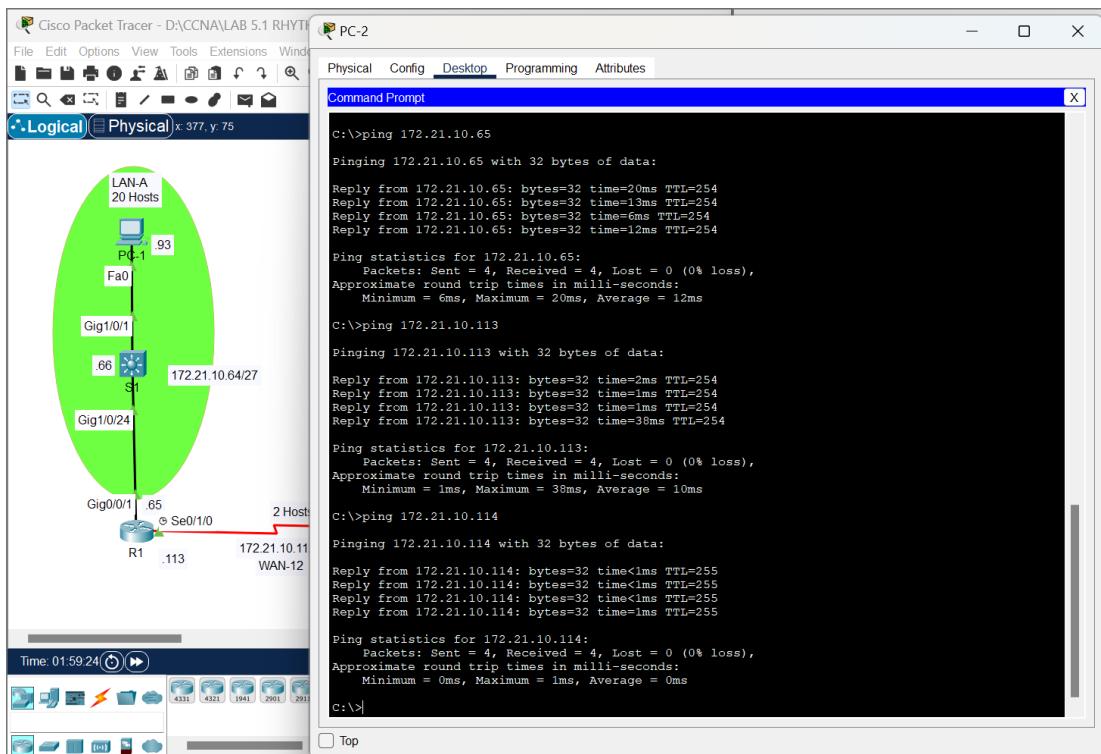




Using the command line at PC-2, ping the IP address of G0/0/1 of router R1.

Using the command line at PC-2, ping the IP address of S0/1/0 of router R1.

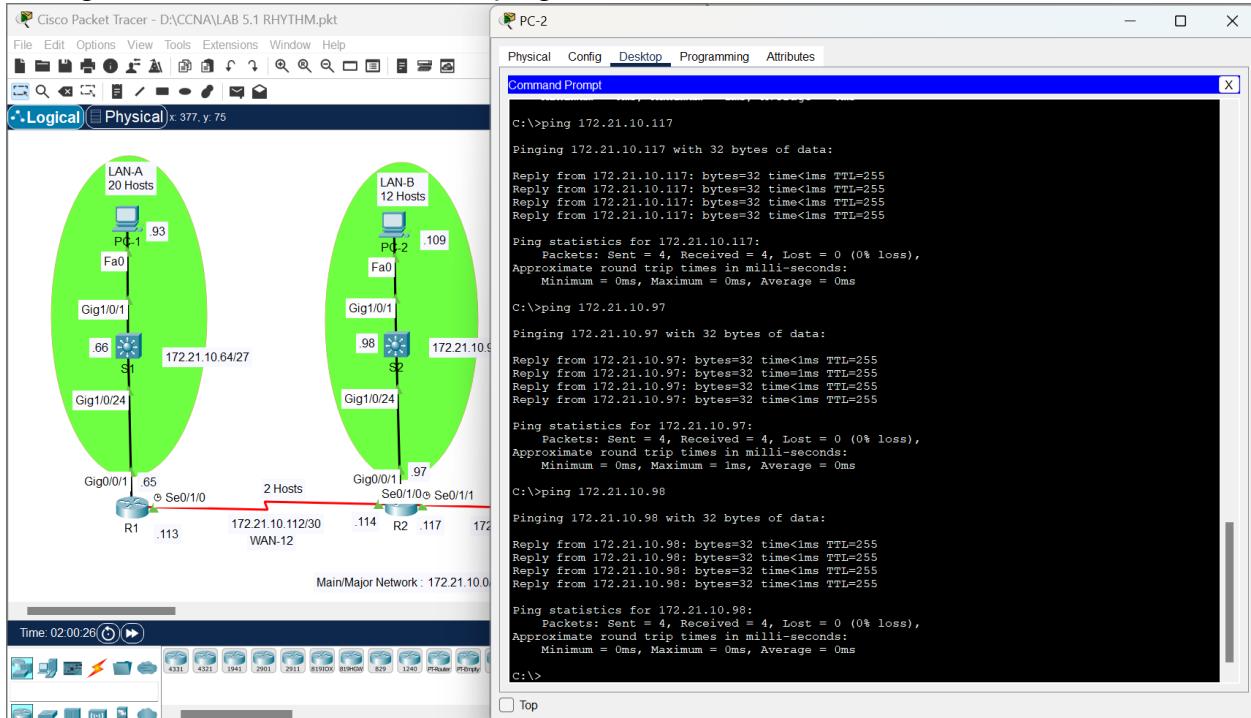
Using the command line at PC-2, ping the IP address of S0/1/0 of router R2.



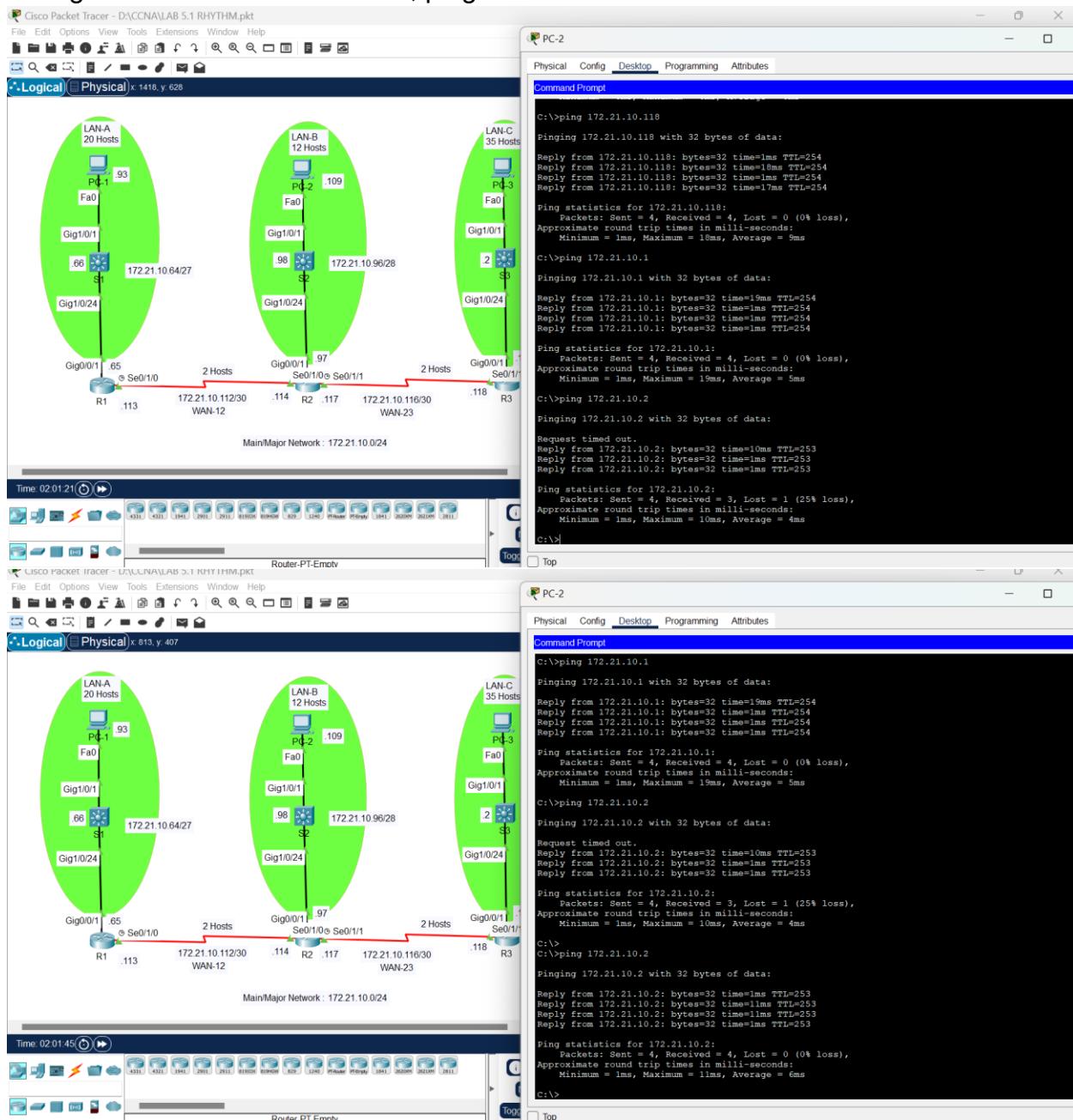
Using the command line at PC-2, ping the IP address of S0/1/1 of router R2.

Using the command line at PC-2, ping the IP address of G0/0/1 of router R2.

Using the command line at PC-2, ping the IP address of SVI int. of switch S2.



- Using the command line at PC-2, ping the IP address of S0/1/1 of router R3.  
 Using the command line at PC-2, ping the IP address of G0/0/1 of router R3.  
 Using the command line at PC-2, ping the IP address of SVI int. of switch S3

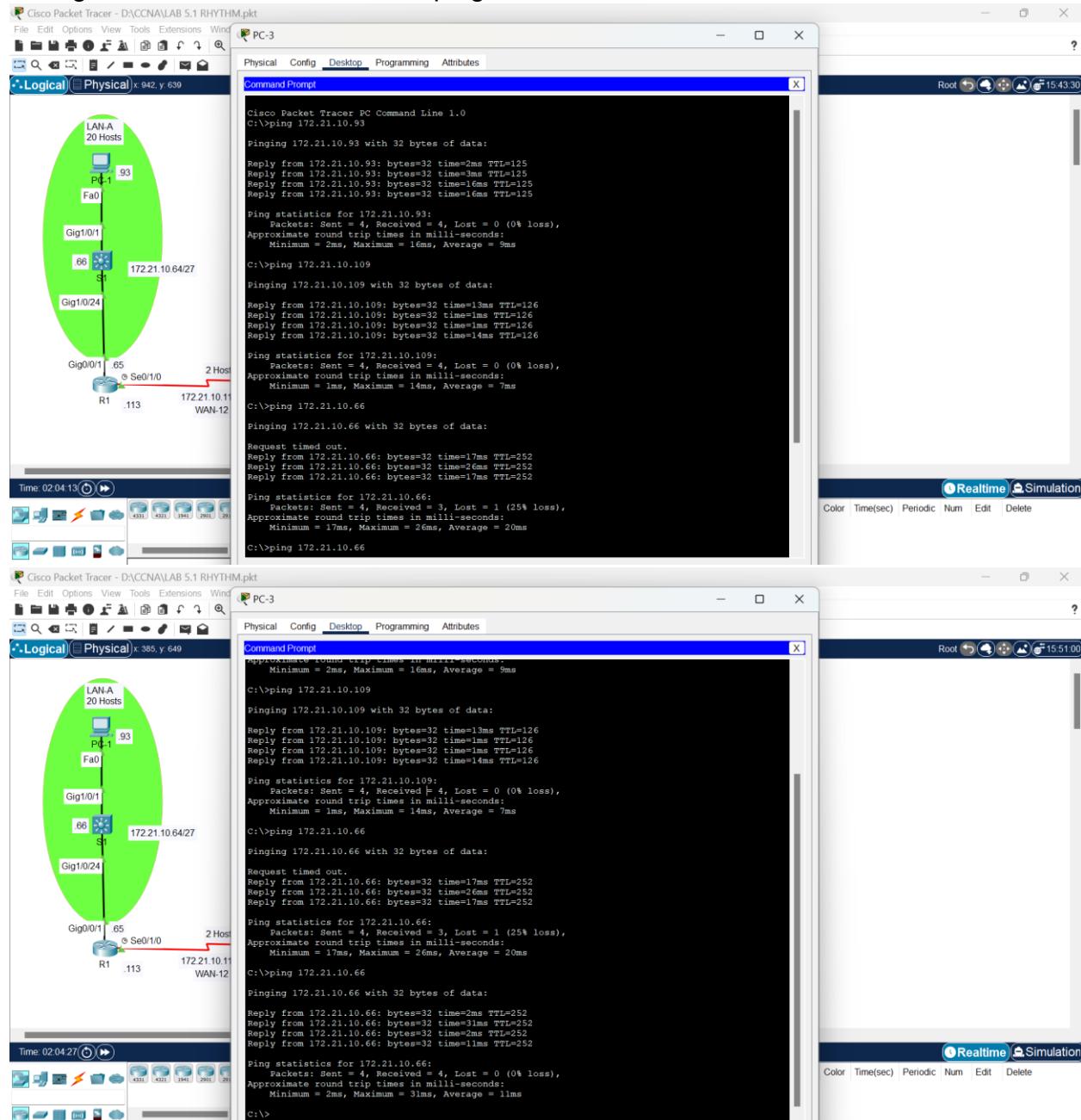


## For PC-3

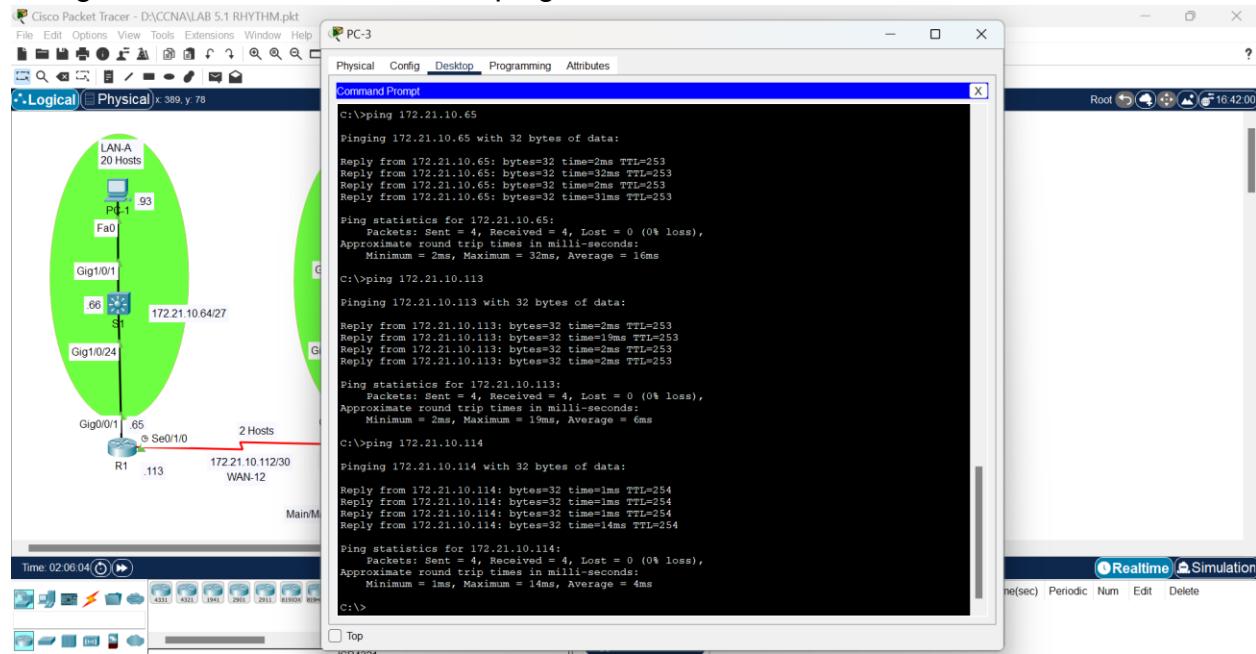
Using the command line at PC-C, ping the IP address of PC-A.

Using the command line at PC-C, ping the IP address of PC-B.

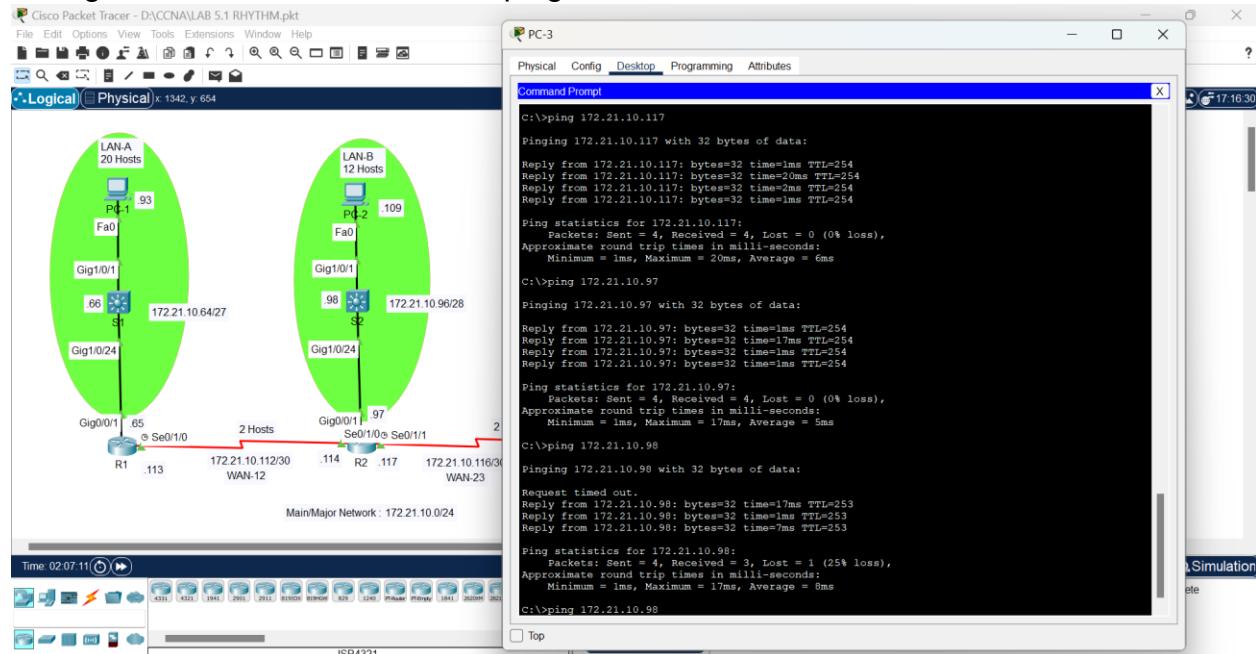
Using the command line at PC-C, ping the IP address of SVI int. of switch S1.

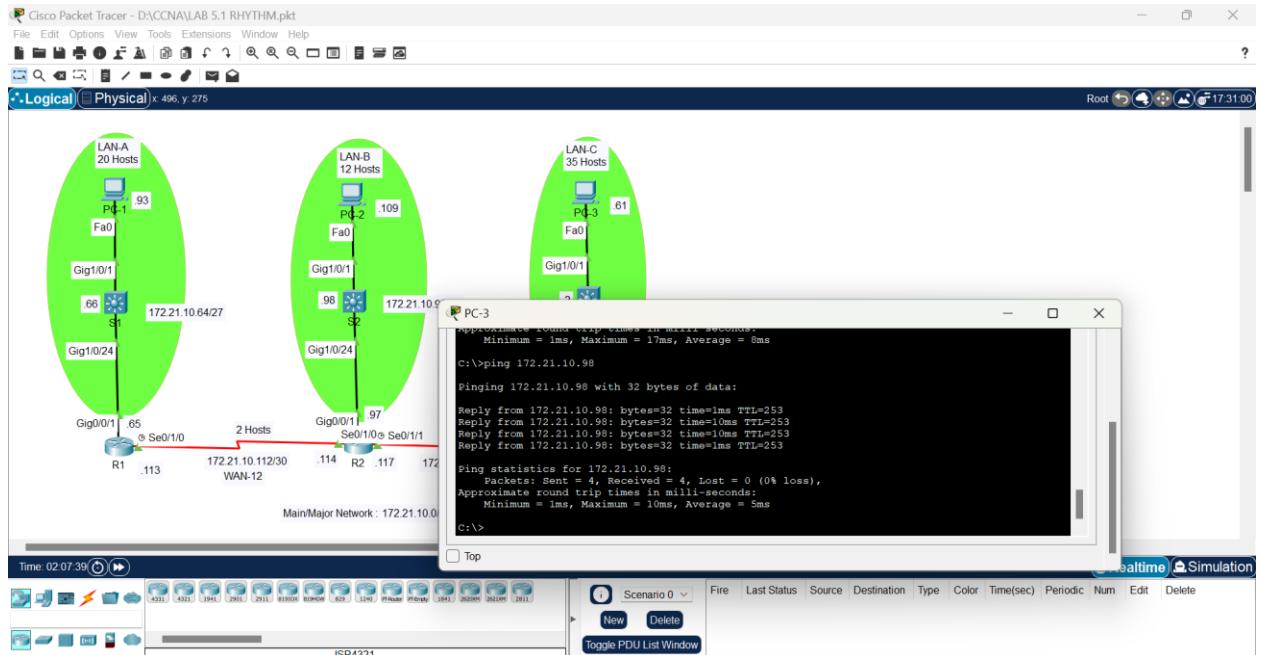


- Using the command line at PC-C, ping the IP address of G0/0/1 of router R1.  
 Using the command line at PC-C, ping the IP address of S0/1/0 of router R1.  
 Using the command line at PC-C, ping the IP address of S0/1/0 of router R2.



- Using the command line at PC-C, ping the IP address of S0/1/1 of router R2.  
 Using the command line at PC-C, ping the IP address of G0/0/1 of router R2.  
 Using the command line at PC-C, ping the IP address of SVI int. of switch S2.

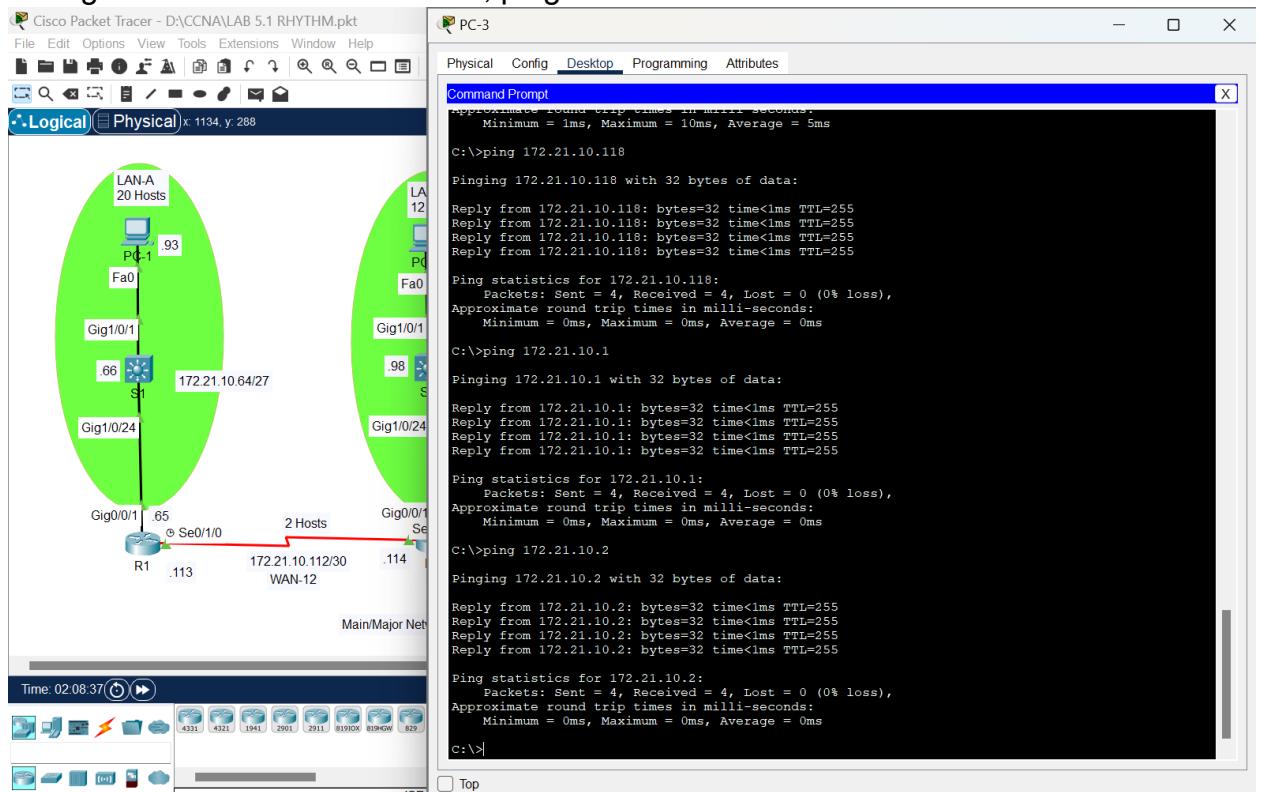




Using the command line at PC-C, ping the IP address of S0/1/1 of router R3.

Using the command line at PC-C, ping the IP address of G0/0/1 of router R3.

Using the command line at PC-C, ping the IP address of SVI int. of switch S3



NOTE: Use PC-2 and PC-3 to do all the above-mentioned pings. All the pings must be successful, otherwise troubleshooting must be done if any connectivity issues are found.