Table of Contents

Logbook Activity 1: Number Systems

1. Colour Representation in Digital Media

In digital media, colours are often represented using hexadecimal numbers. Web developers and graphic designers use these codes to specify colours in HTML, CSS, and other design tools.

How It Works:

- Colours are a combination of Red, Green, and Blue (RGB) components.
- Each component can have a value ranging from 0 to 255 in decimal, which translates to 00 to FF in hexadecimal.
- A full colour code is a concatenation of the hex values of these three components.

Example:

The colour white has the maximum value for all components.

- Red: 255 (decimal) → FF (hex)
- Green: 255 (decimal) → FF (hex)
- Blue: 255 (decimal) → FF (hex)
- Colour Code: #FFFFFF

Convert the following RGB decimal values to a hexadecimal colour code and identify the colour.

- Red: 173
- Green: 216
- Blue: 230

Instructions:

1. Convert each component to hexadecimal
2. Combine the hex values
3. Identify the colour

TYAH: Type your answer here

Answer:

Task 1.1. Convert Red component to hexadecimal

	Quotient	Remainder	Hexadecimal
16	173		
16	10	0.8125	D
	0	0.625	A

Red Component in hex	AD

Task 1.2. Convert Green component to hexadecimal

	Quotient	Remainder	Hexadecimal
16	216		
16	13	0.5	8
	0	0.8125	D

Green Component in hex	D8

Task 1.3. Convert Blue component to hexadecimal

	Quotient	Remainder	Hexadecimal
16	230		
16	14	0.375	6
	0	0.875	E

Blue Component in hex	E6

Task 1.4. Record the hex value for all components

Component	Decimal	Hex
Red	173	AD
Green	216	D8
Blue	230	E6

Task 1.5. Combine the hex values

Colour Code	ADD8E6

Task 1.6. Identify the colour in your own words (using a colour chart and digital tool)

The colour is	Light Blue

2. Number Systems in Networking

Networking relies heavily on number systems for addressing devices. IPv4 addresses are typically represented in decimal, but understanding their binary representation is crucial for subnetting and network configuration.

Task 2: An IPv4 address is given as 192.168.100.10. Convert this IP address into its 32-bit binary form.

Answer:

Task 2.1. Convert each octet into binary, ensuring the result is formatted as an 8-bit binary number (octet format)

	Quotient	Remainder
2	192	
2	96	0
2	48	0
2	24	0
2	12	0
2	6	0
2	3	0
2	1	1
	0	1

192 in Binary	11000000

	Quotient	Remainder
2	168	
2	84	0
2	42	0
2	21	0
2	10	1
2	5	0
2	2	1
2	1	0
	0	1

168 in Binary	10101000

	Quotient	Remainder
2	100	
2	50	0
2	25	0
2	12	1
2	6	0
2	3	0
2	1	1
	0	1

100 in Binary	01100100

	Quotient	Remainder
2	10	
2	5	0
2	2	1
2	1	0
	0	1

10 in Binary	00001010

Task 2.2. Result

Binary IP Address:	**11000000 • 10101000 • 01100100 • 00001010**

3. High-Resolution Image Storage

You are a software engineer working for a company that specialises in cloud-based storage solutions for professional photographers. One of your clients uploads large, high-resolution images from their photoshoots, and they require these images to be stored uncompressed to maintain the original quality for printing purposes.

The client frequently uploads images with the following characteristics:

- Resolution: 1920x1080 pixels
- Colour Depth: 24 bits per pixel (8 bits for each of the red, green, and blue colour channels)
- Compression: None, as they require uncompressed storage for quality preservation

Your task is to calculate the file size of each image in order to estimate the total storage space required if the client uploads one thousand photographs.

Answer:

First, calculate the original size of the image without any compression. Since each pixel is represented by 24 bits and the image has 1920x1080 pixels, use the following process:

Task 3.1. Calculate the Total number of Pixels

1920	×	1080	=	2,073,600 pixels

Task 3.2. Convert Total Bits Required

2,073,600 pixels	×	24 bits/pixel	=	49,766,400 bits

Task 3.3. Convert Bits to Bytes

49,766,400 bits	÷	8	=	6,220,800 bytes

Task 3.4. Convert Bytes to Megabytes

6,220,800 bytes	÷	1,048,576	≈	5.93 MB

Task 3.5. Result

The size of uncompressed image is

5.93 MB

If the client uploads 1,000 images, the total storage required is:

5.93 MB	×	1,000	=	5,930 MB	5.93 GB

4. Disk Storage

A solid-state drive (SSD) advertises its capacity as 256 GB. However, your operating system reports the capacity as less than 256 GB. Explain why this discrepancy occurs and calculate the actual capacity reported by the OS.

Answer:

Task 4.1: Manufacturers use IEC standard decimal gigabytes (GB), where

1 GB	=	1,000,000,000 bytes

Task 4.2: Operating systems use IEC standard binary gibibytes (GiB), where

1 GiB	=	1,073,741,824 bytes

Task 4.3: Total Bytes According to Manufacturer

256	×	1,000,000,000	=	256,000,000,000 bytes

Task 4.4: Convert Bytes to GiB

256,000,000,000	÷	1,073,741,824	≈	238.4 GiB

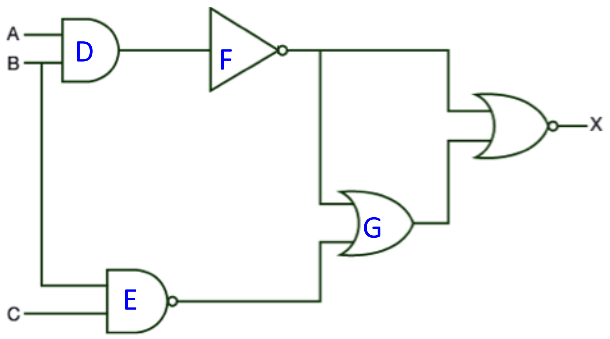
Result:

The operating system reports approximately 238.4 GiB, which explains the discrepancy.

Logbook activity 2: Logic Gates

1. Creating truth tables from existing logic diagrams

Complete the truth tables for the following logic diagrams. [40 marks]



A	B	C	D	E	F	G	X
0	0	0	0	1	1	1	0
1	0	0	0	1	1	1	0
0	1	0	0	1	1	1	0
0	0	1	0	1	1	1	0
1	1	0	1	1	0	1	0
1	0	1	0	1	1	1	0
0	1	1	0	0	1	1	0
1	1	1	1	0	0	0	1

2. Creating logic diagrams and truth tables from real-life scenarios

A nuclear power station has a safety system based on three inputs to a logic network. A warning signal (S = 1) is produced when certain conditions in the nuclear power station occur based on these three inputs:

Inputs	Binary values	Description of plant status
T	1	Temperature > 115°C
	0	Temperature <= 115°C
P	1	Reactor pressure > 15 bar
	0	Reactor pressure <= 15 bar
W	1	Cooling water > 120 litres/hour
	0	Cooling water <= 120 litres/hour

A warning signal (S = 1) will be produced when either a) OR b) are TRUE:

a) Temperature > 115°C AND Cooling water <= 120 litres/hour

b) Temperature <= 115°C AND (Reactor pressure > 15 bar OR Cooling water <= 120 litres/hour)

Draw a logic diagram and truth table to show all the possible situations when the warning signal (S) could be received. [45 marks]

Go to https://online.visual-paradigm.com/diagrams/features/logic-diagram-software/, to draw logic diagrams online.

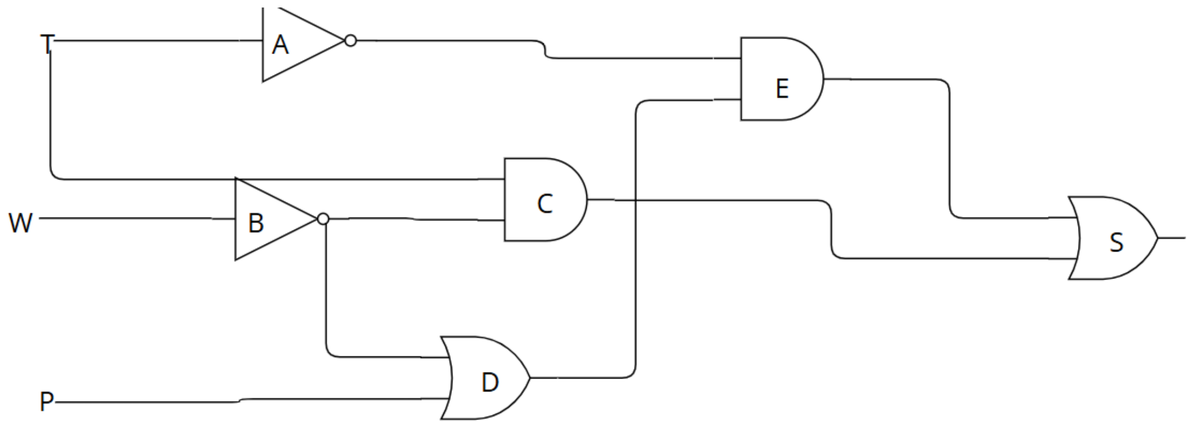
Instruction: You must present a circuit diagram for each individual statement. Then, show the combined final circuit, followed by a truth table. For each step, provide a detailed explanation, following the guidelines outlined in the supplementary note on Canvas and tutorial session.

Answer:

(S = 1) IF (T > 115°C (1) AND W <= 120 (0)) OR (T <= 115°C (0) AND (P > 15 (1) OR W <= 120 (0)))

Condition 1) T = 1 AND W = 0
Condition 2) T = 0 AND (P = 1 OR W = 0)

Logic Gate Diagram:



Truth Table:

T	P	W	A	B	C	D	E	S
0	0	0	1	1	0	1	1	1
0	0	1	1	0	0	0	0	0
0	1	0	1	1	0	1	1	1
0	1	1	1	0	0	1	1	1
1	0	0	0	1	1	1	0	1
1	0	1	0	0	0	0	0	0
1	1	0	0	1	1	1	0	1
1	1	1	0	0	0	1	0	0

3. Value-added work

Additional marks are available if your answers satisfy the following criteria:

- **Question 1.** Are attempted. All intermediate logic gates are labelled, and their outputs added to the truth table. [5 marks]
- **Question 2.** Are attempted. All inputs and outputs in logic diagrams are fully labelled and explained. [5 marks]

Your answers do not necessarily need to be correct to satisfy the above criteria. No “part marks” will be awarded (you will be awarded either 0 or 5 marks per criterion).

Logbook activity 3: Introduction to Packet Tracer

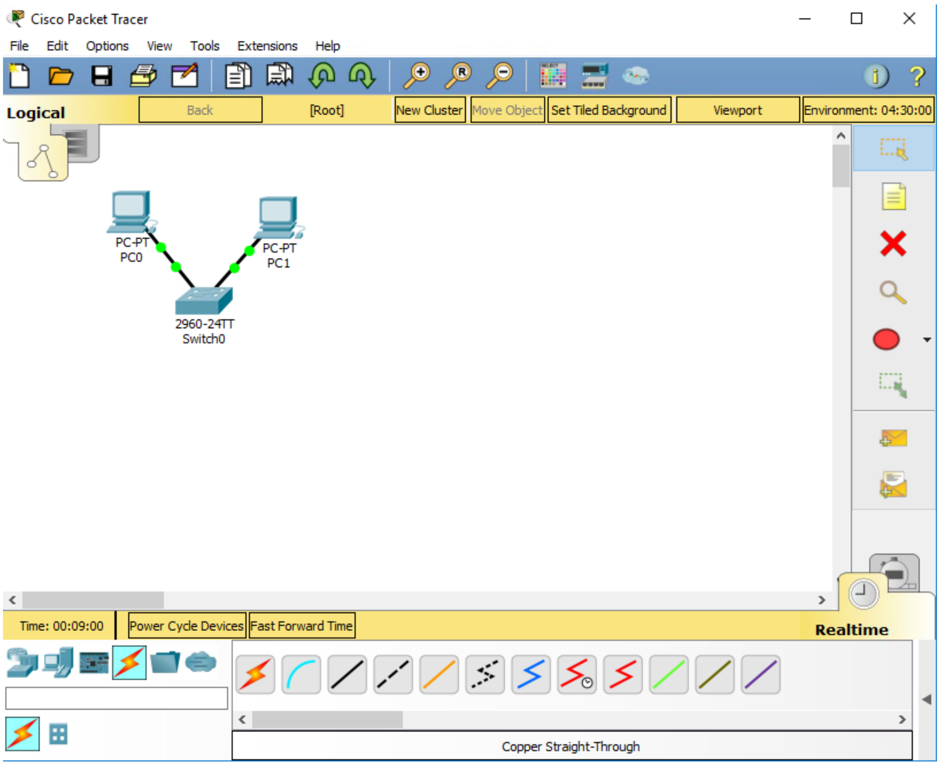
Instruction:

You must provide screenshots and accompanying explanations throughout your work to validate your efforts.

All routers in the topology must be labelled with your SID. For instance, Router0 should be renamed as Router0-X, where "X" is your SID. All screenshots and commands involving routers must clearly display your SID.

Failure to comply with the above requirements will result in a score of zero in this activity.

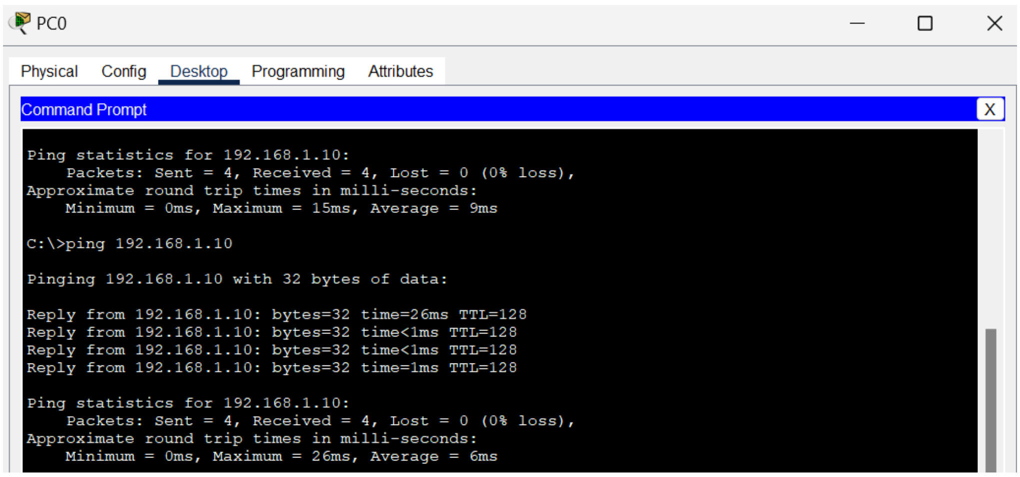
Task 1. Start a New Packet Tracer activity and connect two PCs and a switch as shown:



Task 1.1. Configure the two PCs Ethernet interfaces with the IP addresses shown and prove that they can communicate by sending ping between them.

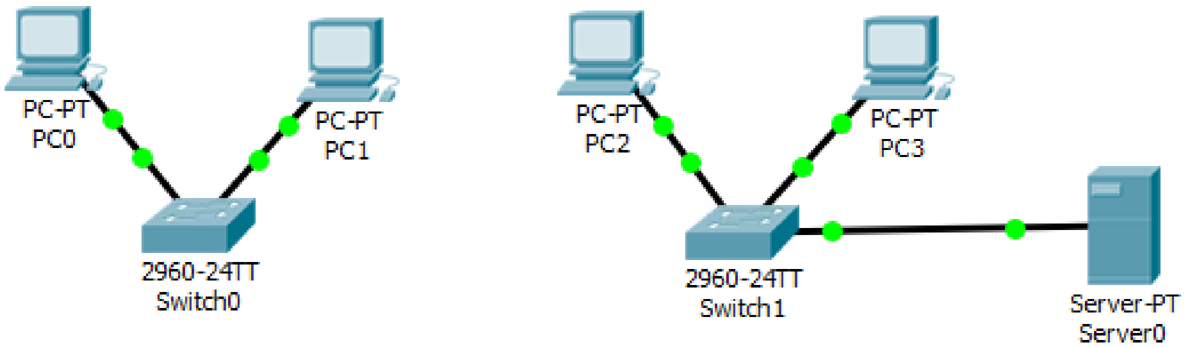
- `PC0` IP Address: `192.168.1.10`
- `PC0` Subnet Mask: `255.255.255.0`
- `PC1` IP Address: `192.168.1.11`
- `PC1` Subnet Mask: `255.255.255.0`
- Ping worked ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
●	Successful	PC0	PC1	ICMP	■	0.000	N	0	(edit)	



• MAC Address of **`PC0`**	`Physical Address. . . . . . . . . . . . . . . . : 0002.1629.98E9` 0002.1629.98E9
• MAC Address of **`PC1`**	`Physical Address. . . . . . . . . . . . . . . . : 0009.7CBC.71B5` 0009.7CBC.71B5

Task 2. Extend the topology as shown below



Task 2.1. Configure the Ethernet interface on **`Server0`** with

- IP Address: **`192.168.2.254`**
- Subnet mask: **`255.255.255.0`**

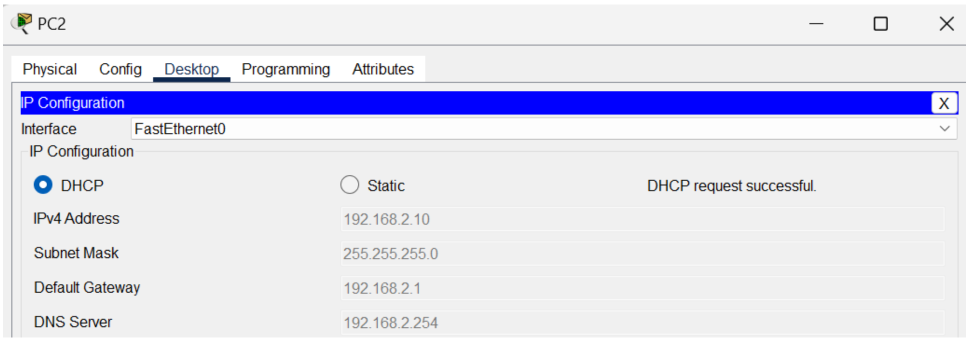
Task 2.2. On **`Server0`** configure the DHCP service with

- Default Gateway: **`192.168.2.1`**
- DNS Server: **`192.168.2.254`**
- Start IP Address: **`192.168.2.10`**
- Subnet Mask: **`255.255.255.0`**
- Maximum number of users: **`89`**
- Turn the Service On
- Save the configuration

Task 2.3. Configure **PC2** and **PC3** to use a DHCP IP configuration.

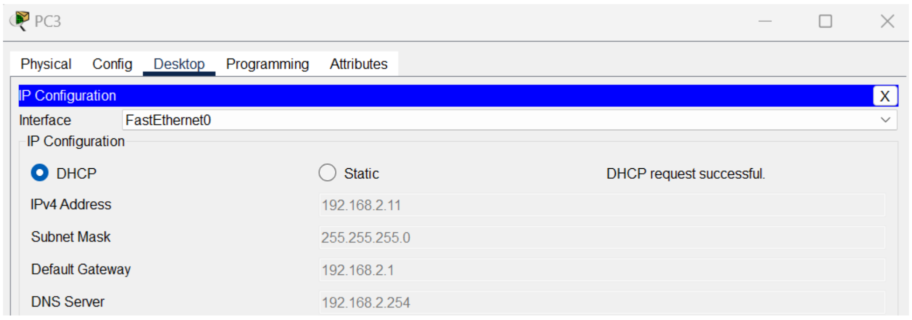
- What is **PC2**

i.	Default Gateway	192.168.2.1
ii.	DNS Server	192.168.2.254
iii.	IP Address	192.168.2.10
iv.	Subnet Mask	255.255.255.0



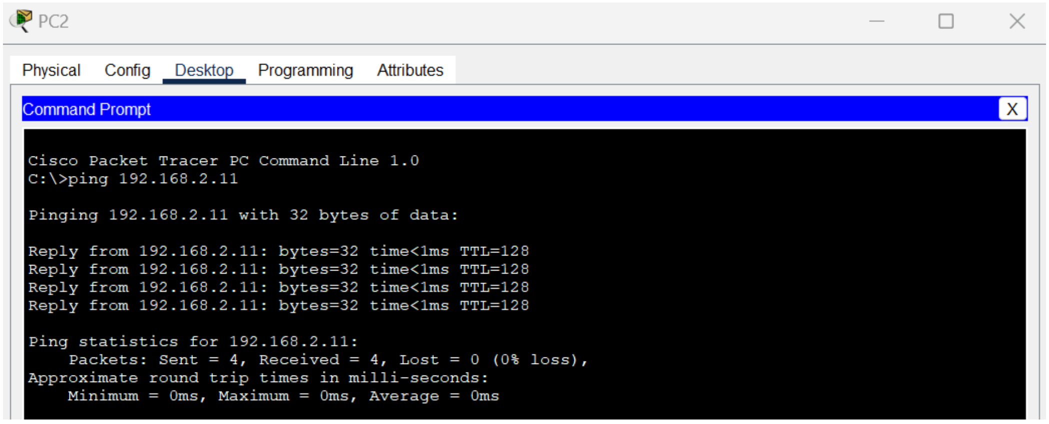
- What is **PC3**

i.	Default Gateway	192.168.2.1
ii.	DNS Server	192.168.2.254
iii.	IP Address	192.168.2.11
iv.	Subnet Mask	255.255.255.0

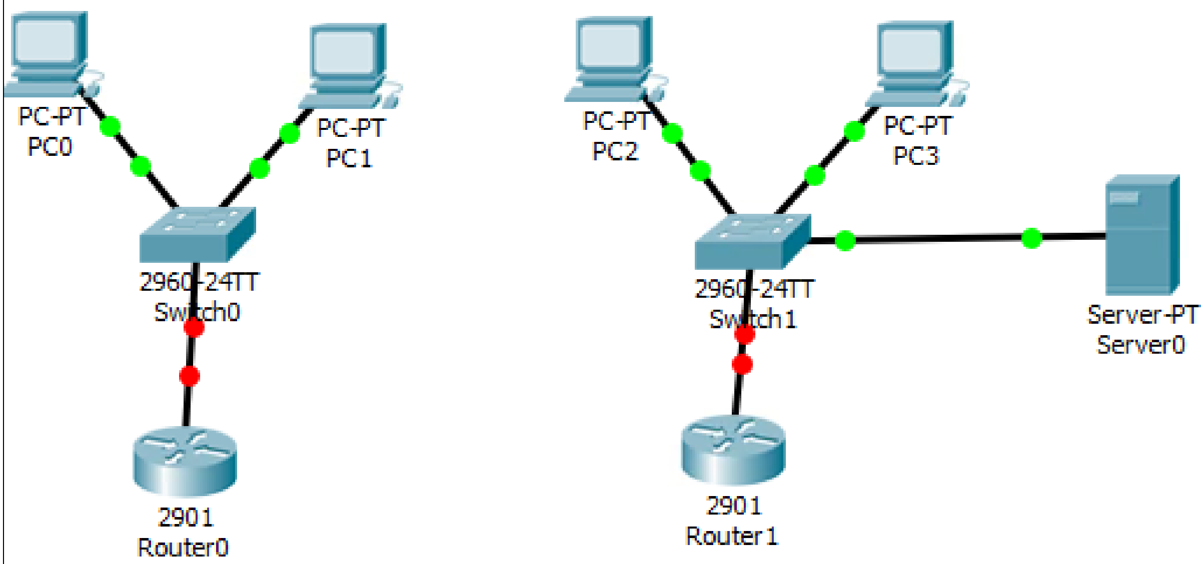


Task 2.4. Check that `PC2` can ping `PC3` ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC2	PC3	ICMP		0.000	N	0	(edit)	

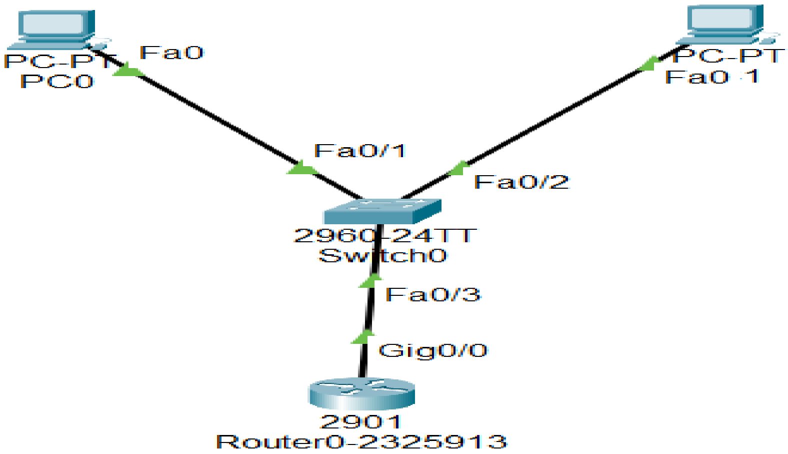


Task 3. Extend the topology as shown below. Note that the switches are connected to the routers using the Gigabit interfaces and that the lights on the interfaces remain at red.



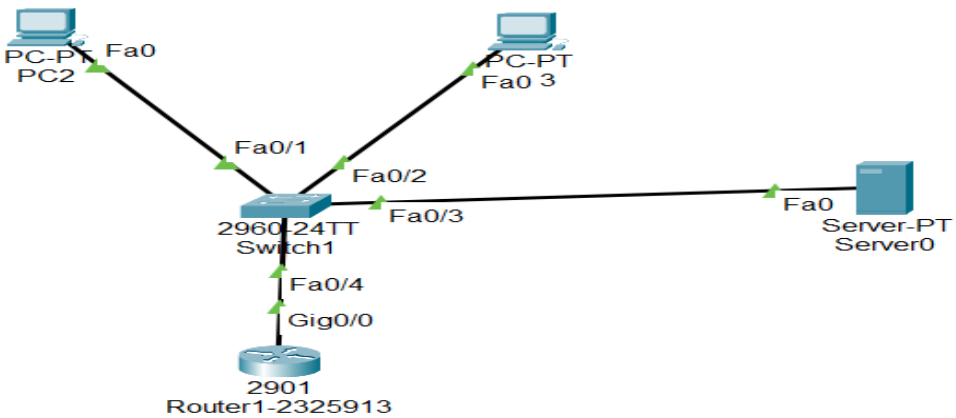
Task 3.1. Configure the Gigabit interface on **`Router0`** and notice that there is an IOS command window that indicates the commands being executed to perform the configuration. You will learn more about this during the module.

- IP Address: **`192.168.1.1`**
- Subnet Mask: **`255.255.255.0`**
- It is also necessary to change Port Status to: **`On`**
- The interface lights have now turned green: ☒



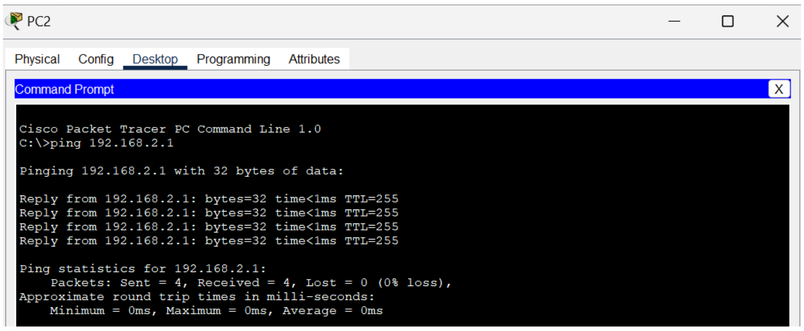
Task 3.2. Repeat (4.1) with **`Router1`** with

- IP Address: **`192.168.2.1`**
- Subnet Mask: **`255.255.255.0`**
- It is also necessary to change Port Status to: **`On`**
- The interface lights have now turned green: ☒

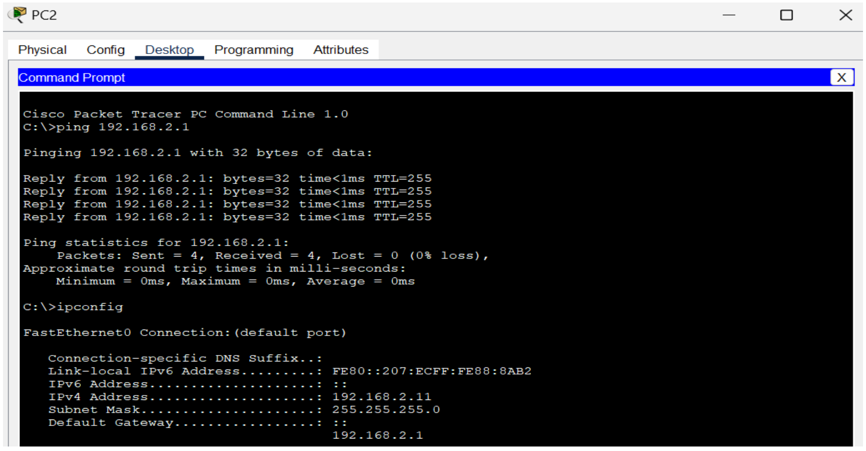


Task 3.3. `PC2` should be able to ping the router interface **`192.168.2.1`** ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC2	Router1-2...	ICMP		0.000	N	0	(edit)	



- If the ipconfig is executed at the command prompt, it should show the Default Gateway as **`192.168.2.1`** ☒



- This is because we set the DHCP server to inform the PC that this was the Default Gateway value (check 3.2 & 3.3)
- Research online and write on your words what is a Default Gateway?

The network device (generally a router) that acts as an access point for data transmission from a local network to other networks, most often the internet, is known as a default gateway. It serves as a bridge between external networks and local network devices, such as PCs, servers, and phones.

Task 3.4. Check that **`PC1`** can ping **`192.168.1.1`** ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC1	Router0-2...	ICMP		0.000	N	0	(edit)	

PC1

Physical Config Desktop Programming Attributes

Command Prompt X

```
Cisco Packet Tracer PC Command Line 1.0
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=18ms 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 = 18ms, Average = 4ms
```

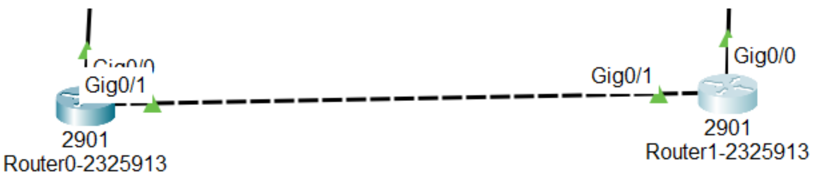
- And that **`ipconfig`** shows the Default Gateway as **`0.0.0.0`** ☒

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: FE80::209:7CFF:FEBC:71B5
   IPv6 Address....................: ::
   IPv4 Address....................: 192.168.1.11
   Subnet Mask.....................: 255.255.255.0
   Default Gateway.................: ::
                                     0.0.0.0
```

- This is because we did not manually set the Default Gateway.
- Configure the Default Gateway of **`PC1`** to **`192.168.1.1`**. Do not configure the Default Gateway of **`PC0`** at this point.

Task 4. Complete the topology by connecting the two routers together using a cross-over cable (a dotted one).

- Configure and enable the second Router0 Gigabit interface as
  - IP Address: **`192.168.3.1`**
  - Subnet Mask: **`255.255.255.252`**
- Configure and enable the second Router1 Gigabit interface as
  - IP Address: **`192.168.3.2`**
  - Subnet Mask: **`255.255.255.252`**
- The lights on the interface between the two routers is now Green ☒



Task 4.1. Select the CLI tab for **`Router1`**.

- Keep entering exit until the prompt changes to **`Router#`**
- Ping the other router ☒

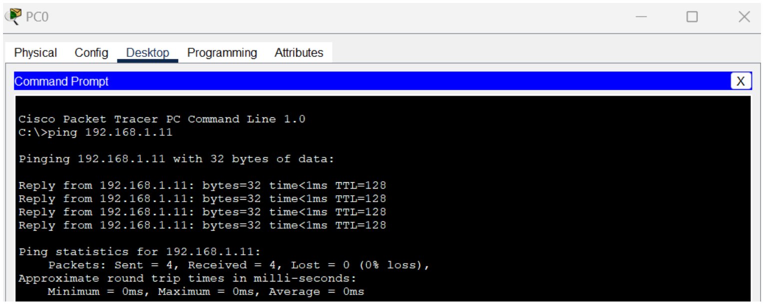
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	Route…	Router0-2…	ICMP		0.000	N	0	(edit)	

```
Router#ping 192.168.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.3.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

Task 4.2. Testing

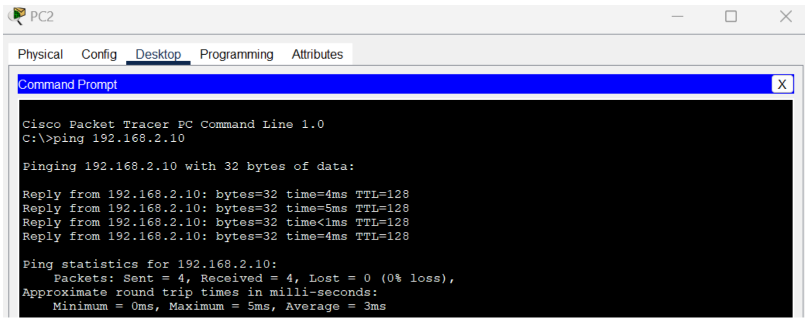
- **`PC0`** and **`PC1`** can communicate ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC1	ICMP		0.000	N	0	(edit)	



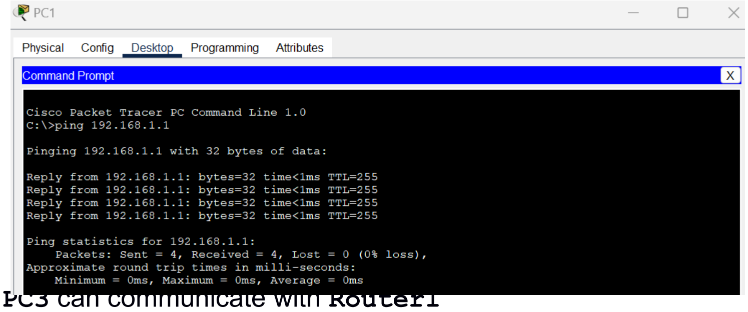
- **`PC2`** and **`PC3`** can communicate ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC2	PC3	ICMP		0.000	N	0	(edit)	



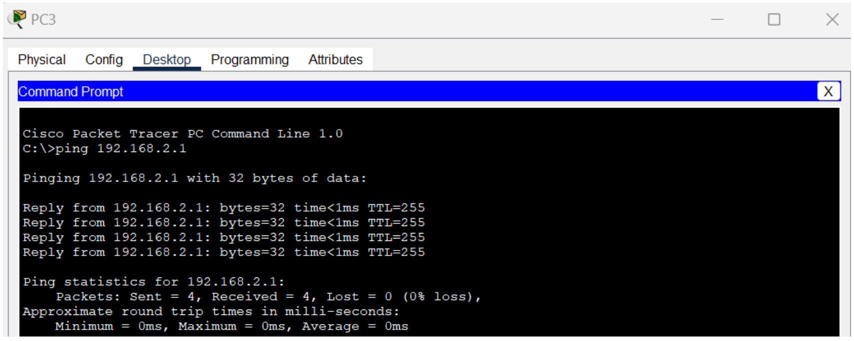
- **PC1** can communicate with **Router0** ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC1	Router0-2...	ICMP		0.000	N	0	(edit)	



- **PC3** can communicate with **Router1** ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC3	Router1-2...	ICMP		0.000	N	0	(edit)	



- **Router1** can communicate with **Router0** ☒

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	Route...	Router0-2...	ICMP		0.000	N	0	(edit)	

```
Router>enable
Router#ping 192.168.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.3.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

- **PC1** can communicate **PC3** ☐

```
C:\>ping 192.168.2.11

Pinging 192.168.2.11 with 32 bytes of data:

Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.
Request timed out.

Ping statistics for 192.168.2.11:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Task 4.3. -10 marks if you ticked the final box. You should get request timed out.

Task 4.4. At the **PC1** Command Prompt issue the command **netstat -r**. Copy the information about the active routed in the box below

Active Routes:
Network Destination Netmask Gateway Interface Metric
0.0.0.0 0.0.0.0 192.168.2.1 192.168.2.11 1
Default Gateway: 192.168.2.1
===

```
Active Routes:
Network Destination        Netmask          Gateway       Interface  Metric
          0.0.0.0          0.0.0.0      192.168.2.1    192.168.2.11       1
Default Gateway:      192.168.2.1
===========================================================================
```

This is the Routing Table in the PC and should tell you that for any network destination it does not know (**0.0.0.0**) then it will ship the packet to **192.168.1.1** (the Default Gateway) via the **192.168.1.11** (FastEthernet) interface.

Task 4.5. On **Router0**, if it shows 'Press **RETURN** to get started' then press **Return**, otherwise enter the command exit until you reach the **Router> prompt**.

- Enter the command **show ip route**.
- Enter the lines displayed after 'Gateway of last resort not set' in the box below

Gateway of last resort is not set

192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.1.0/24 is directly connected, GigabitEthernet0/0
L 192.168.1.1/32 is directly connected, GigabitEthernet0/0
192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.3.0/30 is directly connected, GigabitEthernet0/1
L 192.168.3.1/32 is directly connected, GigabitEthernet0/1

Now note the lines starting with 'L'. This means the router only knows about its own Local interfaces. In order for it to pass packets to the other router it must know about it. We are going to set this up manually.

Task 4.6. In the Config tab for **Router0** Click on the Static button under Routing. Enter the following information

- Network **192.168.2.0**
- Mask **255.255.255.0**
- Next Hop **192.168.3.2** (what route to take to get to the destination network)
- Click on **Add**
- Enter the **show ip route** command in **Router0** CLI tab. What is the difference in the Routing Table compared to the previous time?

There is a Static Route now which was not in the previous routing table.

Before: Only had directly connected routes

After: There is now a static route entry for 192.168.2.0/24, which allows Router0 to send packets to that network via the specified next hop.

```
Gateway of last resort is not set

     192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, GigabitEthernet0/0
L       192.168.1.1/32 is directly connected, GigabitEthernet0/0
S    192.168.2.0/24 [1/0] via 192.168.3.2
     192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.3.0/30 is directly connected, GigabitEthernet0/1
L       192.168.3.1/32 is directly connected, GigabitEthernet0/1
```

Task 4.7. Testing

- **PC0** and **PC1** can communicate ☒
- **PC2** and **PC3** can communicate ☒
- **PC1** can communicate with **Router0** ☒
- **PC3** can communicate with **Router1** ☒
- **Router1** can communicate with **Router0** ☒
- **PC1** can communicate **PC3** ☐

Task 4.8. -20 marks if you ticked the final box (you should have learnt from last time). You should get request timed out.

Task 4.9. Although **Router0** knows how to get to **192.168.2.0** network **Router1** does not know how to send the response back to **PC1**. Configure **Router1** with the info below.

- Network: **192.168.1.0**
- Mask: **255.255.255.0**
- Next Hop: **192.168.3.1** (what route to take to get to the destination network)
- Click on Add
- Enter the **show ip route** command in **Router1** CLI tab. What is the difference in the Routing Table compared to the previous time?

There is a Static Route now which was not in the previous routing table.

Before: Only had directly connected routes

After: There is now a static route entry for 192.168.1.0/24, which allows Router1 to send packets to that network via the specified next hop.

```
Gateway of last resort is not set

S    192.168.1.0/24 [1/0] via 192.168.3.1
     192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, GigabitEthernet0/0
L       192.168.2.1/32 is directly connected, GigabitEthernet0/0
     192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.3.0/30 is directly connected, GigabitEthernet0/1
L       192.168.3.2/32 is directly connected, GigabitEthernet0/1
```

Task 4.10. Testing

- **PC0** and **PC1** can communicate ☒
- **PC2** and **PC3** can communicate ☒
- **PC1** can communicate with **Router0** ☒

- `PC3` can communicate with `Router1` ☒
- `Router1` can communicate with `Router0` ☒
- `PC1` can communicate with `PC3` ☒
- `PC0` can communicate with `PC2` ☐

Task 4.11. Don't make me give you -30 marks!

- Why did the last test not work?
- What did you do to fix it?

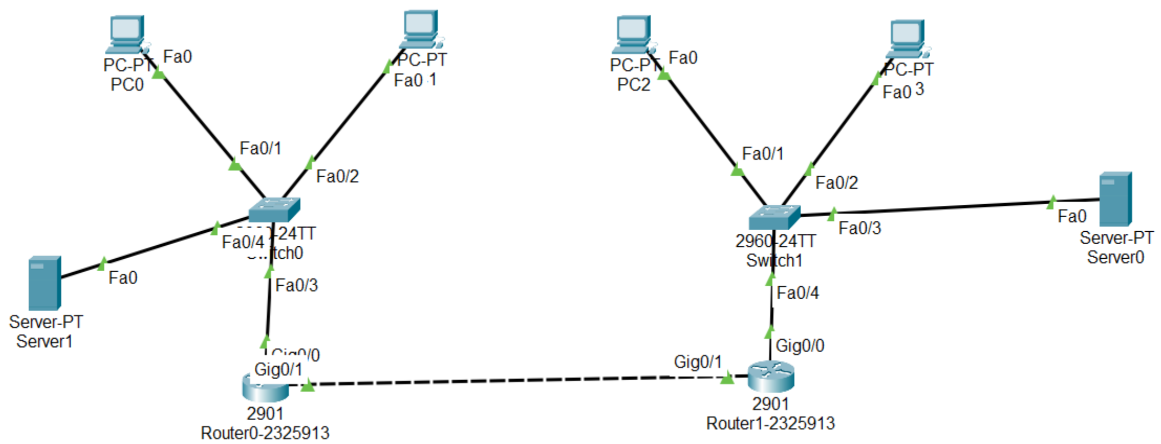
The default gateway of PC0 is not configured
Set the configuration on PC0 to be able to connect to PC2

Task 5. Now is time for showing off.

- Add `Server1` to `Switch0`.
- Configure its Ethernet interface so it has a similar IP address to `PC0` & `PC1`
- Enable the Web (HTTP) service
- Check that `PC3` can browse to the Web server
- What are the Quick Links on the server homepage?

Change the title on the server homepage to include your "SID", change the colour of the links, and provide a screenshot from Packet Tracer instead of text.

Task 6. Provide the final screenshot with appropriate labels



Logbook activity 4: IPv4 Network Address Calculations

Instruction: Throughout this lab, you are required to provide a clear explanation for each step in the designated explanation box. Use the algorithms discussed during class to calculate relevant network information accurately. Note, failure to include an explanation or providing an insufficient one will result in a mark of zero.

1. Determine whether IP addresses are on same network

a. You are configuring two PCs for your network. PC-A is given an IP address of 192.168.1.18, and PC-B is given an IP address of 192.168.1.27. Both PCs receive a subnet mask of 255.255.255.248. [25 marks]

What is the network address for PC-A?

Answer: 192.168.1.16

What is the network address for PC-B?

Answer: 192.168.1.24

Will these PCs be able to communicate directly with each other?

Answer: No

What is the highest address that can be given to PC-B that allows it to be on the same network as PC-A?

Answer: 192.168.1.22

EXPLANATION for a:

<u>PC-A network address calculation:</u>

Convert the Subnet Mask to binary:

255.255.255.248 = 11111111.11111111.11111111.11111000

Convert IP Address to binary:

192.168.1.18 = 11000000.10101000.00000001.00010010

Perform Logical ANDing:

11111111.11111111.11111111.11111000

11000000.10101000.00000001.00010010

11000000.10101000.00000001.00010000

Convert Logical ANDing to get network address:

11000000.10101000.00000001.00010000 = 192.168.1.16

PC-B network address calculation:

Convert the Subnet Mask to binary:

255.255.255.248 = 11111111.11111111.11111111.11111000

Convert IP Address to binary:

192.168.1.27 = 11000000.10101000.00000001.00011011

Perform Logical ANDing:

11111111.11111111.11111111.11111000

11000000.10101000.00000001.00011011

\---

11000000.10101000.00000001.00011000

Convert Logical ANDing to get network address:

11000000.10101000.00000001.00011000 = 192.168.1.24

PC-A and PC-B cannot communicate because they are on different subnets.

As PC-A has a range of usable addresses from 192.168.1.17 to 192.168.1.22 with 192.168.1.23 being the broadcast address.

On the other hand, PC-B has usable addresses from 192.168.1.25 to 192.168.1.29 with 192.168.1.30 being the broadcast address.

Since PC-A and PC-B are not in the same range, they cannot communicate directly.

Since PC-A has a range of usable addresses from 192.168.1.17 to 192.168.1.22, the highest usable address for PC-B to be in the same network as PC-A is 192.168.1.22.

b. You are configuring two PCs for your network. PC-A is given an IP address of 10.2.0.25, and PC-B is given an IP address of 10.3.0.50. Both PCs receive a subnet mask of 255.255.0.0. [25 marks]

What is the network address for PC-A?

Answer: 10.2.0.0

What is the network address for PC-B?

Answer: 10.3.0.0

Will these PCs be able to communicate directly with each other?

Answer: No, they cannot communicate directly

What is the lowest address that can be given to PC-B that allows it to be on the same network as PC-A?

Answer: 10.2.0.1

EXPLANATION for b:

PC-A network address calculation:

Convert the subnet mask to binary:

	255.255.0.0 = 11111111.11111111.00000000.00000000 Convert the IP address to binary: 10.2.0.25 = 00001010.00000010.00000000.00011001 Perform Logical ANDing: 11111111.11111111.00000000.00000000 00001010.00000010.00000000.00011001 -- 00001010.00000010.00000000.00000000 Convert Logical ANDing to get network address: 00001010.00000010.00000000.00000000 = 10.2.0.0 <u>PC-B network address calculation:</u> Convert the subnet mask to binary: 255.255.0.0 = 11111111.11111111.00000000.00000000 Convert the IP address to binary: 10.3.0.50 = 00001010.00000011.00000000.00110010 Perform Logical ANDing: 11111111.11111111.00000000.00000000 00001010.00000011.00000000.00110010 -- 00001010.00000011.00000000.00000000 Convert Logical ANDing to get network address: 00001010.00000011.00000000.00000000 = 10.3.0.0 PC-A and PC-B cannot communicate because they are on different networks. As PC-A is on the network 10.2.0.0 On the other hand, PC-B is on the network 10.3.0.0 Since PC-A and PC-B are not on the same network, they cannot communicate directly. The range of usable host addresses (given then subnet mask 255.255.255.0 and network address of PC-A being 10.2.0.0) is from 10.2.0.1 to 10.2.255.254, meaning the lowest usable address is 10.2.0.1

2. Identify the default gateway address.

a. Your company has a policy to use the first IP address in a network as the default gateway address. A host on the local-area network (LAN) has an IP address of 172.16.140.24 and a subnet mask of 255.255.192.0. [25 marks]

What is the network address for this network?

Answer: 172.16.128.0

What is the default gateway address for this host?

Answer: 172.16.128.1

EXPLANATION for a:

Convert the subnet mask to binary:

255.255.192.0 = 11111111.11111111.11000000.00000000

Convert the IP address to binary:

172.16.140.24 = 10101100.00010000.10001100.00011000

Perform Logical ANDing:

11111111.11111111.11000000.00000000

10101100.00010000.10001100.00011000

10101100.00010000.10000000.00000000

Convert Logical ANDing to get network address:

10101100.00010000.10000000.00000000 = 172.16.128.0

As the company's policies state, the first IP address in the network is to be used as the default gateway, which is 172.16.128.1 as 172.16.128.0 is the network address and cannot be assigned.

b. Your company has a policy to use the first IP address in a network as the default gateway address. You have been instructed to configure a new server with an IP address of 192.168.184.227 and a subnet mask of 255.255.255.248. [25 marks]

What is the network address for this network?

Answer: 192.168.184.224

What is the default gateway for this server?

Answer: 192.168.184.225

EXPLANATION for b:

Convert the subnet mask to binary:

255.255.255.248 = 11111111.11111111.11111111.11111000

Convert the IP address to binary:

192.168.184.227 = 11000000.10101000.10111000.11100011

Perform Logical ANDing:

11111111.11111111.11111111.11111000

11000000.10101000.10111000.11100011

11000000.10101000.10111000.11100000

Convert Logical ANDing to get network address:

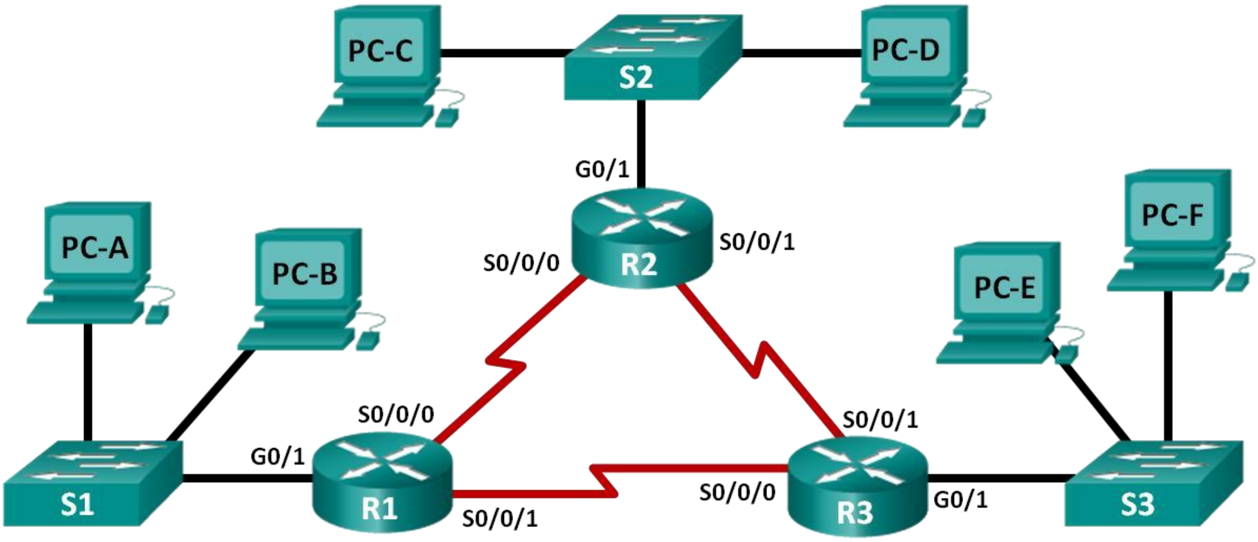
11000000.10101000.10111000.11100000 = 192.168.184.224

As the company's policies state, the first IP address in the network is to be used as the default gateway, which is 192.168.184.225 as 192.168.184.224 is the network address and cannot be assigned and has a range from 192.168.184.225 to 192.168.184.230, meaning the first IP address from the range is 192.168.184.225.

Logbook activity 5: Subnetting Network Topologies

1. Calculate subnet information

Use the 172.16.4.0/22 network address to provide addresses to the network devices in the following network topology. Also provide an IP address scheme that will accommodate these additional devices. For this topology, assign a subnet to each network.



Step 1: Determine the number of subnets in Network Topology C. [25 marks]

a. How many subnets are there?

   6

b. How many bits should you borrow to create the required number of subnets?

   3 bits

c. How many usable host addresses per subnet are in this addressing scheme?

   126 usable host addresses per subnet.

d. What is the new subnet mask in dotted decimal format?

   255.255.255.128

e. How many subnets are available for future use?

   2 subnets are available for future use.

EXPLANATION:

a) Looking at the topology, there are three routers (R1, R2, R3) connected to each other (R1-R2, R1, R3, R2-R3), meaning 3 subnets are required for them. Furthermore, these 3 routers are connected to 3 switches (S1, S2, S3), meaning each of these connections (R1-S1, R2-S2, R3-S3) also requires a subnet, totalling the number of subnets required to 6.

b) To find the number of bits to borrow, I used the formula 2^n where n is the number of bits borrowed. Using this formula, I found the lowest possible value of n that would make the equation equal more than 6.

$2^0 = 1$ (not enough)
$2^1 = 2$ (not enough)
$2^2 = 4$ (not enough)
$2^3 = 8$ (enough)

c) New mask = /22 + 3 = /25

Host bits: 32 – 25 = 7

Using the formula $2^h – 2$ where h is the number of host bits, we can determine that there is $2^7 – 2 = 126$

d) Starting with a subnet mask of 255.255.252.0, which is a 22-bit subnet mask, then adding 3 borrowed bits, makes it a 25-bit subnet mask, converting that to binary gives us 11111111.11111111.11111111.10000000, which in decimal is 255.255.255.128

e) Since we created 8 subnets in total, but only needed 6, there is 2 more subnets available for future use.

8 – 6 = 2

Step 2: Record the subnet information. [25 marks]

Fill in the following table with the subnet information:

Subnet Number	Subnet Address	First Usable Host Address	Last Usable Host Address	Broadcast Address
0	172.16.4.0	172.16.4.1	172.16.4.126	172.16.4.127
1	172.16.4.128	172.16.4.129	172.16.4.254	172.16.4.255
2	172.16.5.0	172.16.5.1	172.16.5.126	172.16.4.127
3	172.16.5.128	172.16.5.129	172.16.4.254	172.16.5.255
4	172.16.6.0	172.16.6.1	172.16.6.126	172.16.6.127
5	172.16.6.128	172.16.6.129	172.16.6.254	172.16.6.255
6	172.16.7.0	172.16.7.1	172.16.7.126	172.16.7.127
7	172.16.7.128	172.16.7.129	172.16.7.254	172.16.7.255
8	172.16.8.0	172.16.8.1	172.16.8.126	172.16.8.127

EXPLANATION:

Algorithm:

1. For each octet if Mask = 255:
   a. Copy host address octets to network address and broadcast address.

2. For each octet if Mask = 0:
   a. **Network address:** Write 0s in the network address octets.
   b. **Broadcast address:** Write 255s in the broadcast address octets.

3. If Mask is neither 0 nor 255
   a. Calculate the magic value, M = 256 – Mask Value.
   b. **Network address:** multiples of M less than or equal to host address octet and highest.
   c. **Broadcast address:** Use next magic multiple minus 1.

4. **First host address:** Copy network address to first host address and add 1 to 4th octet.

5. **Last host address:** Copy broadcast address to last host address and subtract 1 to 4th octet

I have used the following method to calculate subnet information.

Step 1: Using the subnet mask 255.255.255.128, we kept the first 3 octets the same for the network address and the broadcast address.

Network Address: 172.16.4.x

Broadcast Address: 172.16.4.x

Step 2: Calculating the magic value, M = 256 – 128 = 128

Using the address given 172.16.4.0, the 4th octet is 0, the multiple of 128 that is less than or equal to 0 is 0.

Network Address: 172.16.4.0

Steep 3: Using the next magic multiple, which is 128, minus one, is 127

Broadcast Address: 172.16.4.127

Step 4: First usable address was calculated by adding one to the 4th octet of the network address, giving us 172.16.4.1

Step 5: Last usable address can be calculating by subtracting one from the 4th octet of the broadcast address, giving us 172.16.4.126

I used this method for the rest of the table to calculate the rest of the subnet information.

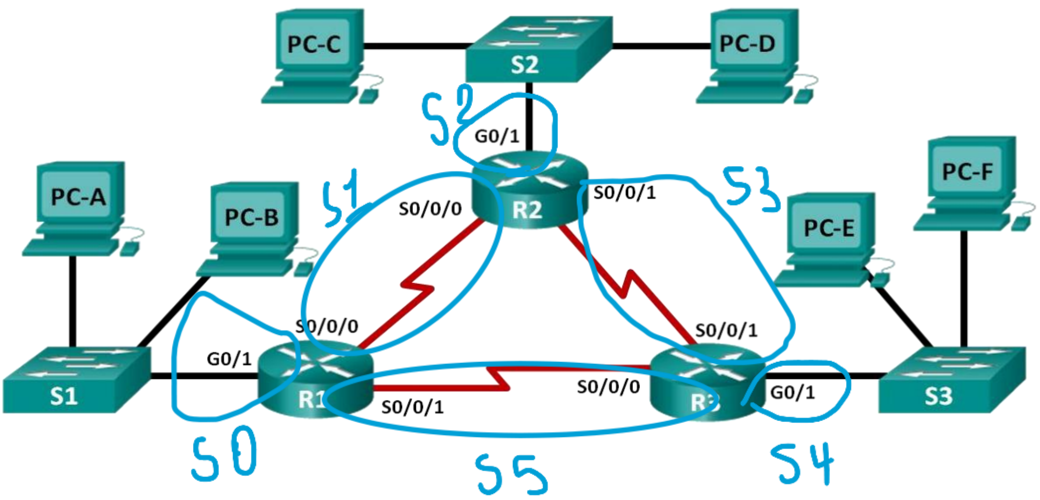
Step 3: Assign addresses to network devices in the subnets. [50 marks]

a. Fill in the following table with IP addresses and subnet masks for the router interfaces:

Device	Interface	Subnet Number	IP Address	Subnet Mask
R1	GigabitEthernet 0/1	0	172.16.4.1	255.255.255.128
	Serial 0/0/0	1	172.16.4.129	255.255.255.128
	Serial 0/0/1	5	172.16.6.129	255.255.255.128
R2	GigabitEthernet 0/1	2	172.16.5.1	255.255.255.128
	Serial 0/0/0	1	172.16.4.130	255.255.255.128
	Serial 0/0/1	3	172.16.5.129	255.255.255.128
R3	GigabitEthernet 0/1	4	172.16.6.1	255.255.255.128
	Serial 0/0/0	5	172.16.6.130	255.255.255.128
	Serial 0/0/1	3	172.16.5.130	255.255.255.128

EXPLANATION:

Step 1: Assign subnet numbers to topology



Step 2:
Assign first usable address of each subnet to the one it matched with from the table, and if it has been already used, use the following available address.

For example, for subnet number 1, it was used for R1, Serial 0/0/0 and given the first usable address of 172.16.4.129, it was then used again for R2, Serial 0/0/0 and given the following available address which was 172.16.4.130

b. Fill in the following table with the IP addresses and subnet masks for devices in the LAN as displayed in topology.

Device	Interface	IP Address	Subnet Mask	Default Gateway
PC-A	NIC	172.16.4.126	255.255.255.128	172.16.4.1
PC-B	NIC	172.16.4.125	255.255.255.128	172.16.4.1
S1	VLAN 1	172.16.4.124	255.255.255.128	172.16.4.1
PC-C	NIC	172.16.5.126	255.255.255.128	172.16.5.1
PC-D	NIC	172.16.5.125	255.255.255.128	172.16.5.1
S2	VLAN 1	172.16.5.124	255.255.255.128	172.16.5.1
PC-E	NIC	172.16.6.126	255.255.255.128	172.16.6.1
PC-F	NIC	172.16.6.125	255.255.255.128	172.16.6.1
S3	VLAN 1	172.16.6.124	255.255.255.128	172.16.6.1

EXPLANATION:

For end devices, we use a bottom-up approach with available IP addresses.

For PC-A, it is connected to subnet 0, which has a last usable address of 172.16.4.126.

For PC-B, it is connected to subnet 0, which has a last usable host address of 172.16.4.126, but since that has been used, we move down to the next available address from the top which is 172.16.4.125.

For S1, it is connected to subnet 0, which has a last usable host address of 172.16.4.126, but since that has been used, we move down to the next available address from the top which is 172.16.4.125 and since that has also been used, we move down to the next one which is 172.16.4.124.

Subnet mask is the same for all as all devices in LAN use the same subnet mask /25 (255.255.255.128).

The default gateway is the IP address of the GigabitEthernet 0/1 of the router they are connected to, for this case PC-A, PC-B and S1 are all connected to R1, which has a GigabitEthernet 0/1 IP address of 172.16.4.1

Same method was used for the rest of the table to figure out IP address, subnet mask and default gateway.

Logbook activity 6: VLSM Design and Implementation Practice

Objectives

Part 1: Examine the Network Requirements

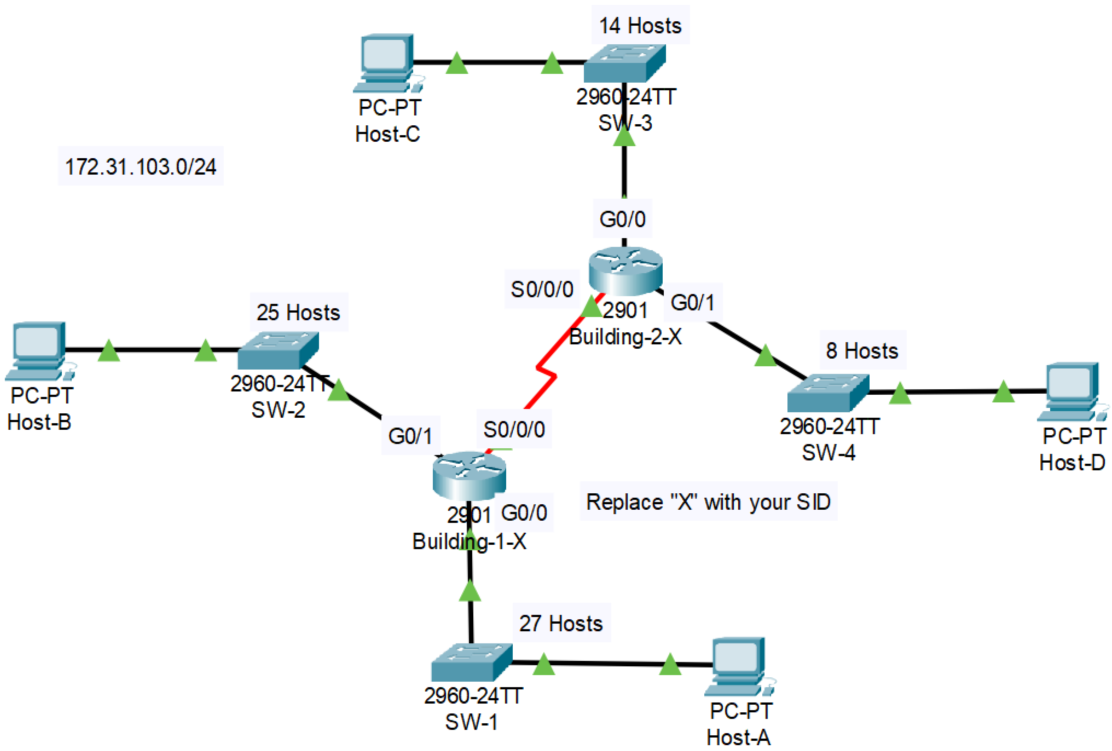
Part 2: Design the VLSM Addressing Scheme

Part 3: Assign IP Addresses to Devices and Verify Connectivity

Background

In this activity, you are given a /24 network address to use to design a VLSM addressing scheme. Based on a set of requirements, you will assign subnets and addressing, configure devices and verify connectivity.
Create the following network topology.

Network Topology:



Instruction: Connect your devices using the interface shown above. Make sure to replace "X" with your SID in the routers named Building-1-X and Building-2-X. The screenshots and commands must clearly display your SID. Ensure you provide a detailed response wherever there is an "Explanation" box. Failure to complete any of these tasks will result in a mark of zero.

Part 1. Examine the Network Requirements

Step 1. Determine the number of subnets needed.

You will subnet the network address 172.31.103.0/24. The network has the following requirements:

- SW-1 LAN will require 27 host IP addresses
- SW-2 LAN will require 25 host IP addresses
- SW-3 LAN will require 14 host IP addresses
- SW-4 LAN will require 8 host IP addresses

Question:

How many subnets are needed in the network topology?
5

Step 2. Determine the subnet mask information for each subnet.

Questions:

a. Which subnet mask will accommodate the number of IP addresses required for SW-1?

/27 or 255.255.255.224

How many usable host addresses will this subnet support?
$2^5 = 32, 32 - 2 = 30$

f) Which subnet mask will accommodate the number of IP addresses required for SW-2?
/27 or 255.255.255.224

How many usable host addresses will this subnet support?
$2^5 = 32, 32 - 2 = 30$

g) Which subnet mask will accommodate the number of IP addresses required for SW-3?

/28 or 255.255.255.240

How many usable host addresses will this subnet support?
$2^4 = 16, 16 - 2 = 14$

h) Which subnet mask will accommodate the number of IP addresses required for SW-4?

/28 or 255.255.255.240

How many usable host addresses will this subnet support?
$2^4 = 16, 16 - 2 = 14$

i) Which subnet mask will accommodate the number of IP addresses required for the connection between Building-1-X and Building-2-X?

/30 or 255.255.255.252

Part 2. Design the VLSM Addressing Scheme

Instruction: The addressing across the tables in this part must be consistent. Inconsistencies will result in a mark of zero.

Step 1. Divide the 172.31.103.0/24 network based on the number of hosts per subnet.

Now fill in the following summary table with the VLSM subnet information, list all possible subnets:

VLSM Summary Table:

Subnet Number	Subnet address/CIDR	Subnet Mask	First Usable Host Address	Broadcast Address	Usable Hosts	Status
0	172.31.103.0/27	255.255.255.224	172.31.103.1	172.31.103.31	30	Used
1	172.31.103.32/27	255.255.255.224	172.31.103.33	172.31.103.63	30	Used
2	172.31.103.64/28	255.255.255.240	172.31.103.65	172.31.103.79	14	Used
3	172.31.103.80/28	255.255.255.240	172.31.103.81	172.31.103.95	14	Used
4	172.31.103.96/30	255.255.255.252	172.31.103.97	172.31.103.99	2	Used
5	172.31.103.100/30	255.255.255.252	172.31.103.101	172.31.103.103	2	Unused
6	172.31.103.104/29	255.255.255.248	172.31.103.105	172.31.103.111	6	Unused
7	172.31.103.112/28	255.255.255.240	172.31.103.113	172.31.103.127	14	Unused
8	172.31.103.128/27	255.255.255.224	172.31.103.129/27	172.31.103.159/27	30	Unused
9	172.31.103.160/27	255.255.255.224	172.31.103.161/27	172.31.103.191/27	30	Unused
10	172.31.103.192/27	255.255.255.224	172.31.103.193/27	172.31.103.223/27	30	Unused
11	172.31.103.224/27	255.255.255.224	172.31.103.225/27	172.31.103.255/27	30	Unused

Explanation:

Step 1:

To go from a /24 subnet mask to a /27 subnet mask, we borrow 3 bits, so we create 2^3 subnets which equals 8 subnets and increment the 4th octet by the magic number of which is 32.

172.31.103.0/27
172.31.103.32/27
172.31.103.64/27
172.31.103.96/27
172.31.103.128/27
172.31.103.160/27
172.31.103.192/27
172.31.103.224/27

Step 2:

We use the first two (172.31.103.0/27) (172.31.103.32/27) and assign them to SW-1 and SW-2.

We also keep the third one (172.32.103.64/27) to use for further breakdown.

We move the rest to the unused section.

Used:

172.31.103.0/27
172.31.103.32/27

Breakdown:

172.31.103.64/27

Unused:

172.31.103.96/27
172.31.103.128/27
172.31.103.160/27
172.31.103.192/27
172.31.103.224/27

Step 3:

We use the breakdown subnet to create 2 /28 subnets, moving from /27 subnet mask to /28 subnet mask will create 2 subnets and increment the 4th octet by the magic value which is 16.

172.31.103.64/28
172.31.103.80/28

Step 4:

We use both (172.31.103.64/28) (172.31.103.80/28) and assign them to SW-3 and SW-4.

Step 5:

To get the last subnet needed which is a /30 mask, we take one out of the unused section and break it down to get a /30 mask.

Unused:

172.31.103.96/27
172.31.103.128/27
172.31.103.160/27
172.31.103.192/27
172.31.103.224/27

Breakdown:

172.31.103.96/27

Remaining unused:

172.31.103.128/27
172.31.103.160/27
172.31.103.192/27
172.31.103.224/27

Step 6:

We breakdown the chosen subnet into 2 subnets and increment by the magic value which is 16 as we are moving from a /27 mask to a /28 mask, then we use one for further breakdown and move the other one to the unused.

172.31.103.96/28
172.31.103.112/28

Breakdown:

172.31.103.96/28

Unused:

172.31.103.128/27
172.31.103.160/27
172.31.103.192/27
172.31.103.224/27
172.31.103.112/28

Step 7:

We breakdown the chosen subnet into 2 subnets and increment the 4th octet by the magic value which is 8 as we are moving from a /28 mask to a /29 mask, then we use one for further breakdown and move the other one to the unused.

172.31.103.96/29
172.31.103.104/29

Breakdown:

172.31.103.96/29

Unused:

172.31.103.128/27
172.31.103.160/27
172.31.103.192/27
172.31.103.224/27
172.31.103.112/28
172.31.103.104/29

Step 8:

We breakdown the chosen subnet into 2 subnets and increment the 4th octet by the magic value which is 4 as we are moving from a /29 mask to a /30 mask, then we use one for the subnet we need and move the other one to the unused.

172.31.103.96/30
172.31.103.100/30

Breakdown:

172.31.103.96/30

Unused:

172.31.103.128/27
172.31.103.160/27
172.31.103.192/27
172.31.103.224/27
172.31.103.112/28
172.31.103.104/29
172.31.103.100/30

Step 9:

Now that we have all the subnets we need, we work out the first usable address, the broadcast address and the number of usable hosts by the mask.

To work out the first usable address, we add 1 to the 4^{th} octet of the subnet.

To work out the broadcast address, we add the number usable hosts to the first usable address.

Step 2. Document the VLSM subnets.

Complete the **Subnet Table**, listing the subnet descriptions, number of hosts needed, then network address for the subnet, the first usable host address, and the broadcast address. Repeat until all addresses are listed.

a. Use the first subnet to accommodate the largest LAN.

b. Use the second subnet to accommodate the second largest LAN.

c. Use the third subnet to accommodate the third largest LAN.

d. Use the fourth subnet to accommodate the fourth largest LAN.

e. Use the fifth subnet to accommodate the connection between Building-1-X and Building-2-X.

VLSM Subnet Table:

Subnet Description	Number of Hosts Needed	Network Address/CIDR	First Usable Host Address	Broadcast Address
Host-A LAN	27	172.31.103.0/27	172.31.103.1	172.31.103.31
Host-B LAN	25	172.31.103.32/27	172.31.103.33	172.31.103.63
Host-C LAN	14	172.31.103.64/28	172.31.103.65	172.31.103.79
Host-D LAN	8	172.31.103.80/28	172.31.103.81	172.31.103.95
WAN Link	2	172.31.103.96/30	172.31.103.97	172.31.103.99

Explanation:

As we had created 12 subnets in total, but only 5 used, I only stated the used ones in the VLSM Subnet Table.

Step 3. Document the addressing scheme.

a. Assign the first usable IP addresses to Building-1-X for the two LAN links.

b. Assign the first usable IP addresses to Building-2-X for the two LAN links.

c. Assign the IP addresses to the WAN link.

d. Assign the second usable IP addresses to the switches.

e. Assign the last usable IP addresses to the hosts.

Addressing Table:

Device	Interface	IP Address	Subnet Mask	Default Gateway
Building-1-X	G0/0	172.31.103.1	255.255.255.224	N/A
	G0/1	172.31.103.33	255.255.255.224	N/A
	S0/0/0	172.31.103.97	255.255.255.252	N/A
Building-2-X	G0/0	172.31.103.65	255.255.255.240	N/A
	G0/1	172.31.103.81	255.255.255.240	N/A
	S0/0/0	172.31.103.98	255.255.255.252	N/A
SW-1	VLAN 1	172.31.103.2	255.255.255.224	172.31.103.1
SW-2	VLAN 1	172.31.103.34	255.255.255.224	172.31.103.33
SW-3	VLAN 1	172.31.103.66	255.255.255.240	172.31.103.65
SW-4	VLAN 1	172.31.103.82	255.255.255.240	172.31.103.81
Host-A	NIC	172.31.103.30	255.255.255.224	172.31.103.1
Host-B	NIC	172.31.103.62	255.255.255.224	172.31.103.33
Host-C	NIC	172.31.103.78	255.255.255.240	172.31.103.65
Host-D	NIC	172.31.103.94	255.255.255.240	172.31.103.81

Explanation:

I used the following table to complete the IP addresses for the Addressing Table:

Device	Interface	Subnet	Assign
R1	G0/0	0	First usable address
	G0/1	1	First usable address
	S0/0/0	4	First usable address
R2	G0/0	2	First usable address
	G0/1	3	First usable address
	S0/0/0	4	Last usable address
S1	VLAN 1	0	Second usable address
S2	VLAN 1	1	Second usable address
S3	VLAN 1	2	Second usable address
S4	VLAN 1	3	Second usable address
PC1	NIC	0	Last usable address
PC2	NIC	1	Last usable address
PC3	NIC	2	Last usable address
PC4	NIC	3	Last usable address

Subnet mask:

We look at the subnet mask of the subnet the IP address came from, and write it in dotted decimal form.

Default Gateway:

We look at the topology and look where each switch and PC are connecter to the router.

SW-1 and Host-A are connected to Building-1-X G0/0, meaning their default gateway will be the IP address of Building-1-X G/0/0.

SW-2 and Host-B are connected to Building-1-X G0/1, meaning their default gateway will be the IP address of Building-1-X G/0/1.

SW-3 and Host-C are connected to Building-2-X G0/0, meaning their default gateway will be the IP address of Building-2-X G/0/0.

SW-4 and Host-D are connected to Building-2-X G0/1, meaning their default gateway will be the IP address of Building-2-X G/0/1.

Part 3. Assign IP Addresses to Devices and Verify Connectivity

Choose Option 1, if you are using given topology. Choose Option 2, if you are creating your own topology. Use Command Line Interface to configure devices.

Example Configuration:

You have used GUI to configure router before. Now use CLI to configure router. Use below example.

Building-Router:

```
Router>en // User EXEC mode; View-only mode
Router#conf t // Privileged EXEC mode; The user can use this for any
                 // monitoring commands and execute configuration and
                 // management commands.
Router(config)#int g0/0 // global configuration mode
Router(config-if)#ip add <ip-address> <subnet-mask> // interface
                                                    // configuration
                                                    // mode
Router(config-if)#no shut // enable the interface
Router(config-if)#int g0/1
Router(config-if)#ip add <ip-address> <subnet-mask>
Router(config-if)#no shut
```

To access the switch remotely, an IP address and a subnet mask must be configured on the Switch Virtual Interface (SVI). To configure an SVI on a switch, use the interface vlan 1 global configuration command. Vlan 1 is not an actual physical interface but a virtual one. Next assign an IPv4 address using the **ip address <ip-**

address> <subnet-mask> interface configuration command. Finally, enable the virtual interface using the **no shutdown** interface configuration command.

After these commands are configured, the switch has all the IPv4 elements ready for communication over the network.

Note: Similar to a Windows hosts, switches configured with an IPv4 address will typically also need to have a default gateway assigned. This can be done using the **ip default-gateway <ip-address>** global configuration command. The ip-address parameter would be the IPv4 address of the local router on the network.
Use the below example to configure switches using CLI
LAN-Switch:

```
Switch>en
Switch#conf t
Switch(config)#int vlan 1
Switch(config-if)#ip add <ip-address> <subnet-mask>
Switch(config-if)#no shut
Switch(config-if)#ip def <default-gateway-address>
```

Implement the following steps to complete the addressing configuration.

Step 1: Configure Building-1-X router LAN and WAN interfaces.

Building-1-X configuration:

```
Press RETURN to get started!



Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int g0/0
Router(config-if)#ip add 172.31.103.1 255.255.255.224
Router(config-if)#no shutdown

Router(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

Router(config-if)#int g0/1
Router(config-if)#ip add 172.31.103.33 255.255.255.224
Router(config-if)#no shutdown

Router(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
Router(config-if)#int s0/0/0
Router(config-if)#ip add 172.31.103.97 255.255.255.252
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0/0, changed state to down
```

```
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     172.31.103.1    YES manual up                    up
GigabitEthernet0/1     172.31.103.33   YES manual up                    up
Serial0/0/0            172.31.103.97   YES manual down                  down
Serial0/0/1            unassigned      YES unset  administratively down down
Vlan1                  unassigned      YES unset  administratively down down
Router#
```

Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int g0/0
Router(config-if)#ip add 172.31.103.1 255.255.255.224
Router(config-if)#no shutdown

Router(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

Router(config-if)#int g0/1
Router(config-if)#ip add 172.31.103.33 255.255.255.224
Router(config-if)#no shutdown

Router(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
Router(config-if)#int s0/0/0
Router(config-if)#ip add 172.31.103.97 255.255.255.252
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0/0, changed state to down
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface IP-Address OK? Method Status Protocol
GigabitEthernet0/0 172.31.103.1 YES manual up up
GigabitEthernet0/1 172.31.103.33 YES manual up up
Serial0/0/0 172.31.103.97 YES manual down down
Serial0/0/1 unassigned YES unset administratively down down
Vlan1 unassigned YES unset administratively down down

Step 2: Configure Building-2-X router LAN and WAN interfaces.

Building-2-X configuration:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int g0/0
Router(config-if)#ip add 172.31.103.65 255.255.255.240
Router(config-if)#no shutdown

Router(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

Router(config-if)#int g0/1
Router(config-if)#ip add 172.31.103.81 255.255.255.240
Router(config-if)#no shutdown

Router(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

Router(config-if)#int s0/0/0
Router(config-if)#ip add 172.31.103.98 255.255.255.252
Router(config-if)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console
Building-1-2325913#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Building-1-2325913(config)#hostname Building-2-2325913
Building-2-2325913(config)#exit
Building-2-2325913#
%SYS-5-CONFIG_I: Configured from console by console
Building-2-2325913#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     172.31.103.65   YES manual up                    up
GigabitEthernet0/1     172.31.103.81   YES manual up                    up
Serial0/0/0            172.31.103.98   YES manual administratively down down
Serial0/0/1            unassigned      YES unset  administratively down down
Vlan1                  unassigned      YES unset  administratively down down
Building-2-2325913#
```

Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int g0/0
Router(config-if)#ip add 172.31.103.65 255.255.255.240
Router(config-if)#no shutdown

Router(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

Router(config-if)#int g0/1
Router(config-if)#ip add 172.31.103.81 255.255.255.240
Router(config-if)#no shutdown

Router(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

```
Router(config-if)#int s0/0/0
Router(config-if)#ip add 172.31.103.98 255.255.255.252
Router(config-if)#end
Building-1-2325913#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Building-1-2325913(config)#hostname Building-2-2325913
Building-2-2325913(config)#exit
Building-2-2325913#
%SYS-5-CONFIG_I: Configured from console by console

Building-2-2325913#show ip interface brief
Interface IP-Address OK? Method Status Protocol
GigabitEthernet0/0 172.31.103.65 YES manual up up
GigabitEthernet0/1 172.31.103.81 YES manual up up
Serial0/0/0 172.31.103.98 YES manual administratively down down
Serial0/0/1 unassigned YES unset administratively down down
Vlan1 unassigned YES unset administratively down down
Building-2-2325913#
```

Step 3: Configure SW-1, SW-2, and SW-3 switches including the default gateway.

SW-1 configuration:

```
S1>en
S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#int vlan 1
S1(config-if)#ip add 172.31.103.2 255.255.255.224
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)#ip def 172.31.103.1
S1(config)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console
```


```
S1>en
S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#int vlan 1
S1(config-if)#ip add 172.31.103.2 255.255.255.224
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)#ip def 172.31.103.1
S1(config)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console
```

SW-2 configuration:

```
S2>en
S2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S2(config)#int vlan 1
S2(config-if)#ip add 172.31.103.34 255.255.255.224
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)#ip def 172.31.103.33
S2(config)#end
S2#
%SYS-5-CONFIG_I: Configured from console by console
```


S2>en
S2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
S2(config)#int vlan 1
S2(config-if)#ip add 172.31.103.34 255.255.255.224
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)#ip def 172.31.103.33
S2(config)#end
S2#
%SYS-5-CONFIG_I: Configured from console by console

SW-3 configuration:

```
S3>en
S3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S3(config)#int vlan 1
S3(config-if)#ip add 172.31.103.66 255.255.255.240
S3(config-if)#no shutdown

S3(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

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

S3(config-if)#ip def 172.31.103.65
S3(config)#end
S3#
%SYS-5-CONFIG_I: Configured from console by console
```


S3>en
S3#conf t
Enter configuration commands, one per line. End with CNTL/Z.

```
S3(config)#int vlan 1
S3(config-if)#ip add 172.31.103.66 255.255.255.240
S3(config-if)#no shutdown

S3(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

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

S3(config-if)#ip def 172.31.103.65
S3(config)#end
S3#
%SYS-5-CONFIG_I: Configured from console by console
```

SW-4 configuration:

```
S4>en
S4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S4(config)#int vlan 1
S4(config-if)#ip add 172.31.103.82 255.255.255.240
S4(config-if)#no shutdown

S4(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

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

S4(config-if)#ip def 172.31.103.81
S4(config)#end
S4#
%SYS-5-CONFIG_I: Configured from console by console
```


S4>en
S4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
S4(config)#int vlan 1
S4(config-if)#ip add 172.31.103.82 255.255.255.240
S4(config-if)#no shutdown

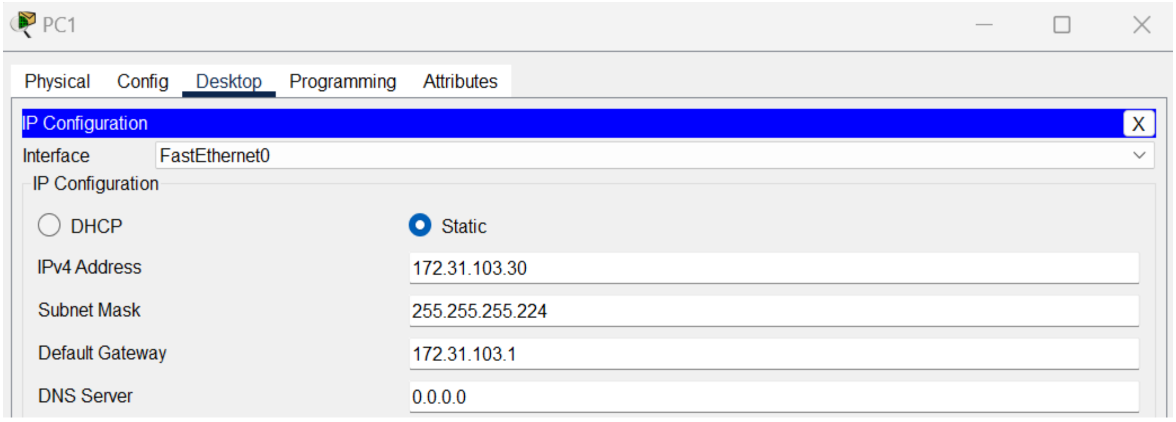
S4(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

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

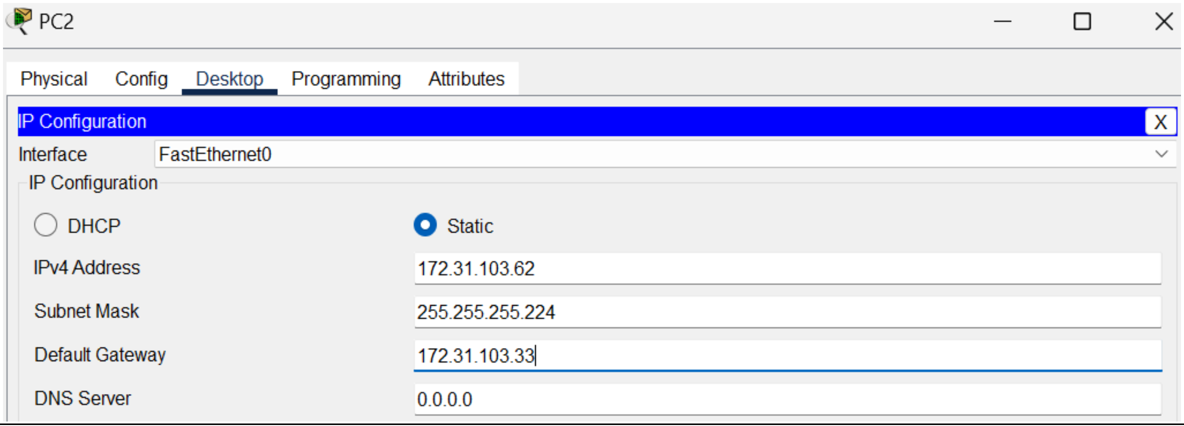
S4(config-if)#ip def 172.31.103.81
S4(config)#end
S4#
%SYS-5-CONFIG_I: Configured from console by console

Step 4: Configure Host-A, Host-B, Host-C, and Host-D, hosts including the default gateway.

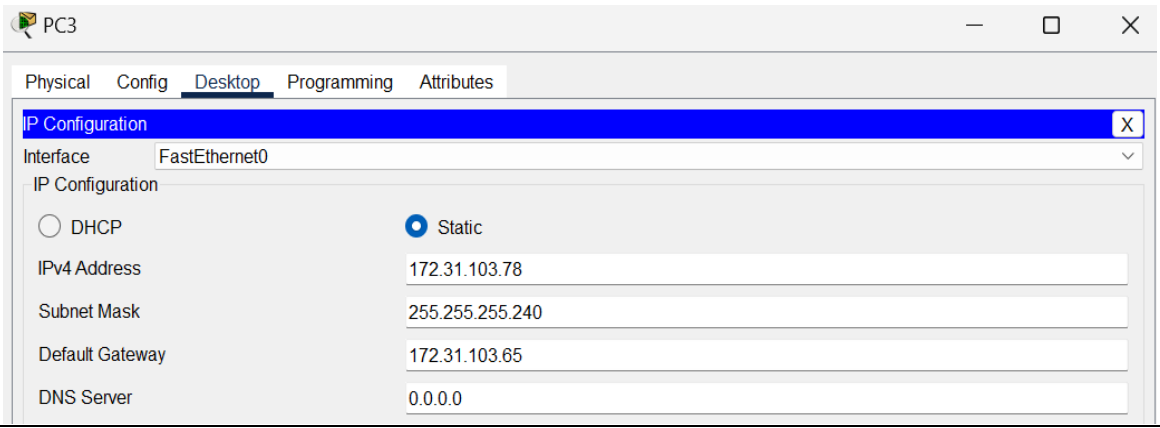
Host-A



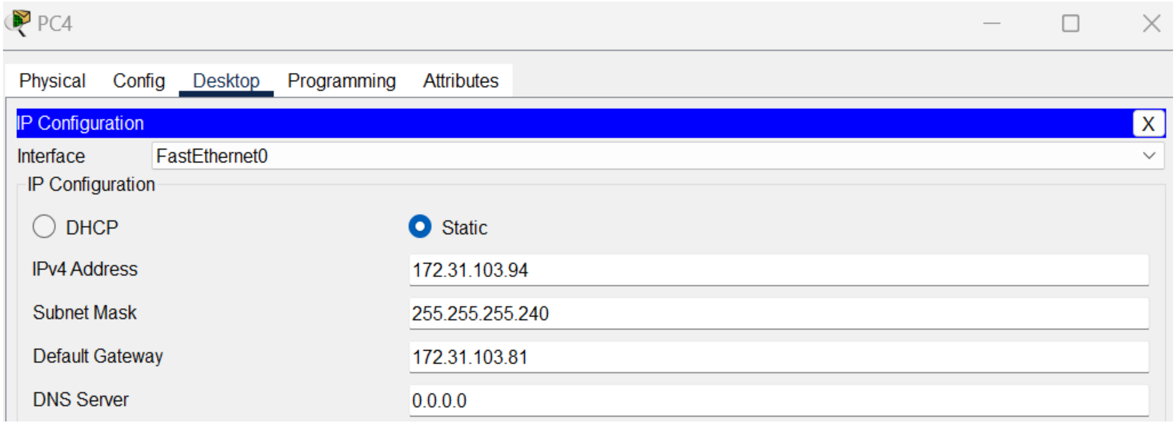
Host-B



Host-C



Host-D



Part 4: Verify connectivity.

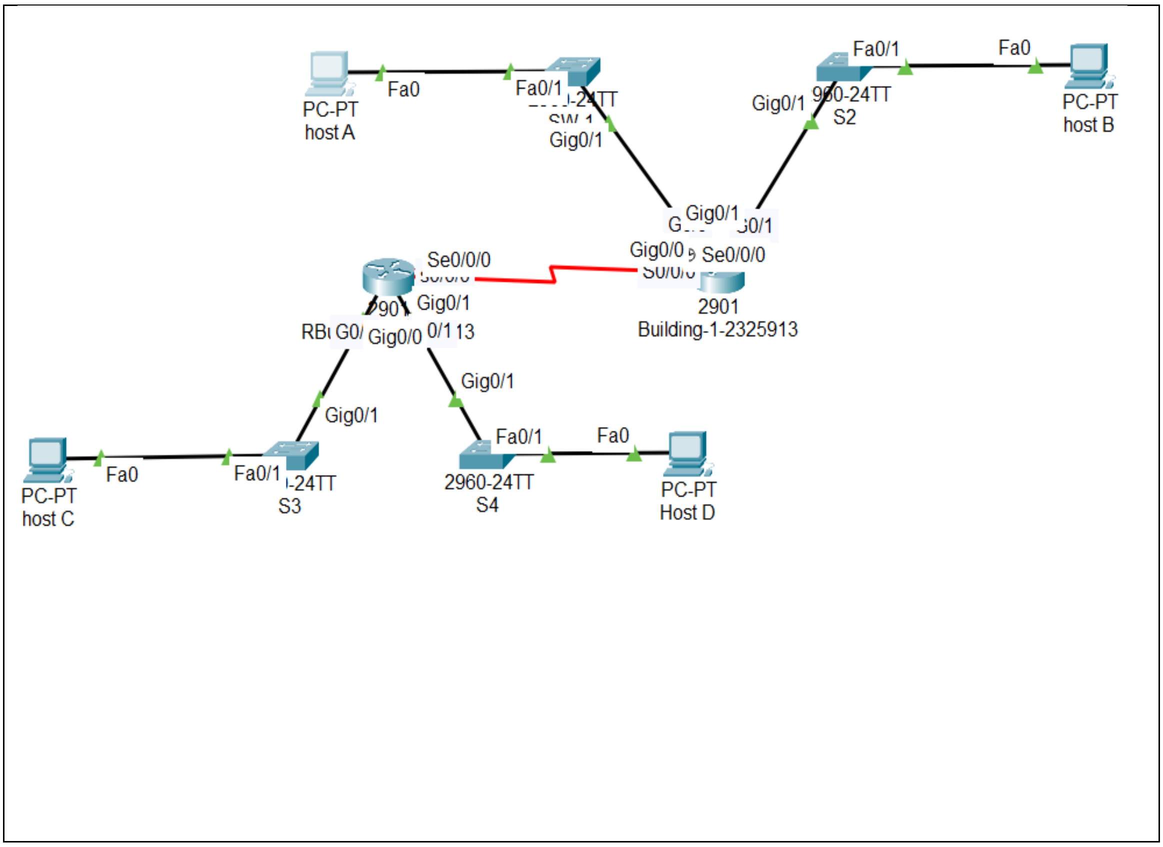
Verify connectivity from all hosts. Once all devices are correctly configured, you should be able to ping each IP address listed in the Addressing Table. Provide a screenshot to show your successful test. If the ping fails, explain the reason behind it and describe the steps you took to resolve the issue. Finally, include a screenshot of your complete network topology with all the labels clearly visible (referencing the tutorial session as a guide).

Explanation:

All pings were successful.

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	Building 2	Building 1	ICMP		0.000	N	0	(edit)	
	Successful	Building 2	host C	ICMP		0.000	N	1	(edit)	
	Successful	Building 2	Host D	ICMP		0.000	N	2	(edit)	
	Successful	Building 1	host B	ICMP		0.000	N	3	(edit)	
	Successful	Building 1	host A	ICMP		0.000	N	4	(edit)	

	Successful	Host D	host B	ICMP		0.000	N	0	(edit)	(delete)
	Successful	Host D	host A	ICMP		0.000	N	1	(edit)	(delete)
	Successful	host C	host A	ICMP		0.000	N	2	(edit)	(delete)
	Successful	host C	host B	ICMP		0.000	N	3	(edit)	(delete)


PC-PT
host A
Fa0
Fa0/1
Gig0/1
Fa0/1
Fa0
Gig0/1
S2
PC-PT
host B
Gig0/1
Gig0/0
Se0/0/0
2901
Building-1-2325913
Se0/0/0
Gig0/1
Gig0/0
Gig0/1
Gig0/1
Fa0/1
Fa0
2960-24TT
S4
PC-PT
Host D
PC-PT
host C
Fa0
Fa0/1
S3