TRIBHUVAN UNIVERSITY

Faculty of Management

Shanker Dev Campus

BUSINESS DATA COMMUNICATION AND NETWORKING

A LAB REPORT

Submitted To

Department of BIM
Shanker Dev Campus
Putalisadak, Kathmandu

In partial fulfillment of the requirements for the Fourth Semester of the Bachelor of Information Management Degree

Submitted By

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(TU Exam Roll No: 16323 / 23)

Under Supervision: **Mr. Ishwor Shrestha**

September 2025

Supervisor's Signature:

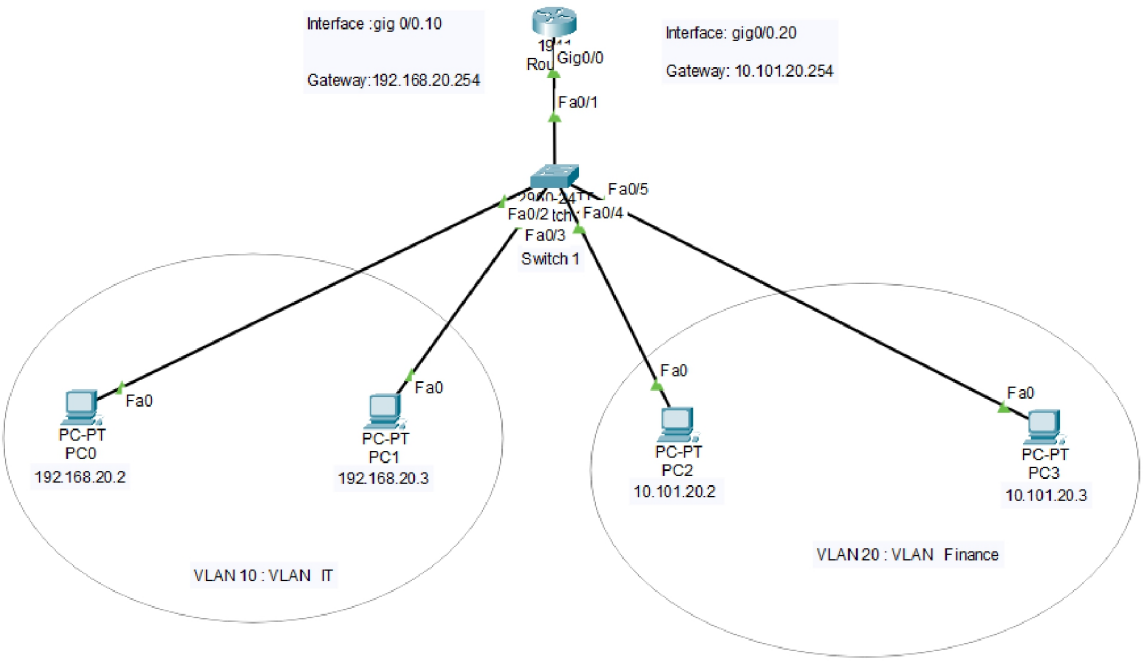
1. Write a color code table of T568B RJ45 connection.

Pin Number	Color Code	Signal	Description
1	White/Orange	Transmit + (Tx +)	Transmits data
2	Orange	Transmit - (Tx -)	Transmits data
3	White/Green	Receive + (Rx +)	Receives data
4	Blue	Unused/PoE	Used for Power over Ethernet (PoE)
5	White/Blue	Unused/PoE	Used for Power over Ethernet (PoE)
6	Green	Receive - (Rx -)	Receives data
7	White/Brown	Unused/PoE	Used for Power over Ethernet (PoE)
8	Brown	Unused/PoE	Used for Power over Ethernet (PoE)

2. Suppose you are a network administrator of Shankerdev Campus. You need to create two VLAN Named IT and Finance that are connected to a single switch which is then connected to a single router for inter-vlan routing. Connect two computers in each VLAN and make sure computers in different VLAN can communicate with each other. The IP address in all the computers should be assigned dynamically using DHCP protocol. The network subnets are:

Device Name	IP Address	Subnet	Gateway
PC 0 (switch 1)	192.168.20.2	/24	192.168.20.254
PC 1 (switch 1)	192.168.20.3	/24	192.168.20.254
PC 2 (switch 2)	10.101.20.2	/24	10.101.20.254
PC 3 (switch 2)	10.101.20.3	/24	10.101.20.254

Output:



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a) Detailed information of how I did:

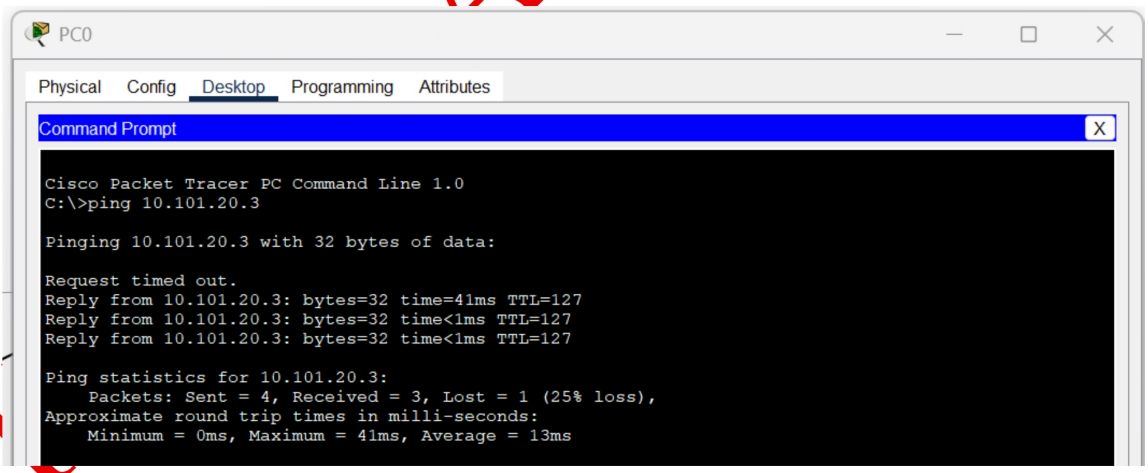
In this task, I used four computers, a switch, and a router. The switch is directly connected to all four computers, and each PC is assigned a unique IP address configured dynamically using the DHCP protocol.

In the switch configuration, two VLANs were created: **VLAN 10** and **VLAN 20**. VLAN 10 was named **IT VLAN**, and VLAN 20 was named **Finance VLAN**. The IT VLAN was assigned to interfaces **Fa0/2** and **Fa0/3**, while the Finance VLAN was assigned to interfaces **Fa0/4** and **Fa0/5**. The switch is also directly connected to the router through interface **Fa0/1**.

Using the command prompt on **PC0**, I attempted to ping **PC3**. The ping was unsuccessful because both computers belong to different VLANs, and communication between different VLANs is not possible without **inter-VLAN routing**.

To enable inter-VLAN routing, the router was configured accordingly. The physical interface **Gig0/0** of the router was virtually divided into two sub-interfaces: **Gig0/0.10** and **Gig0/0.20**. Each sub-interface was assigned an appropriate encapsulation type along with a gateway IP address and subnet mask.

After completing the router configuration, the ping between **PC0** and **PC3** became successful as shown in the picture below:



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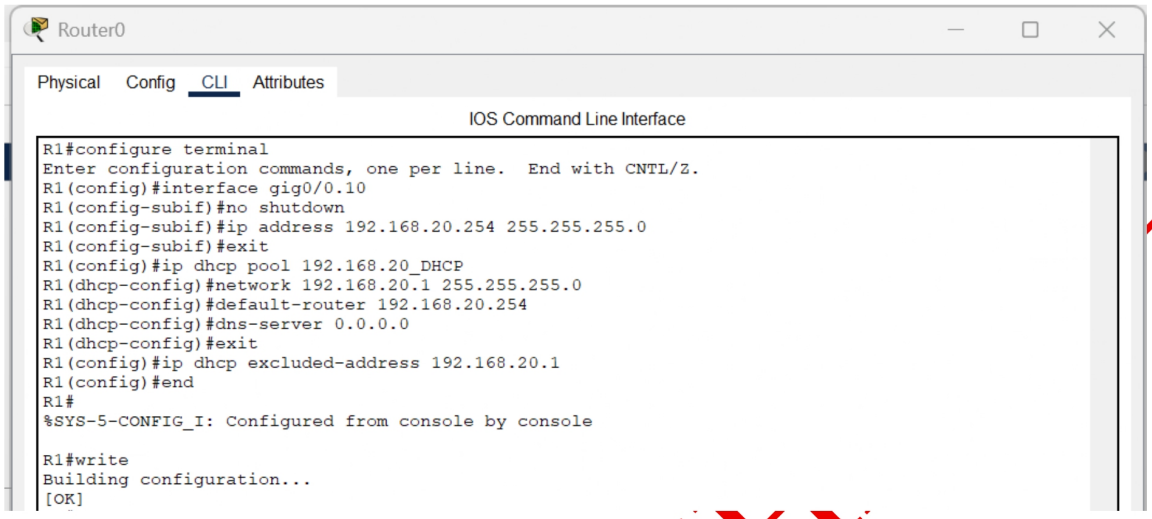
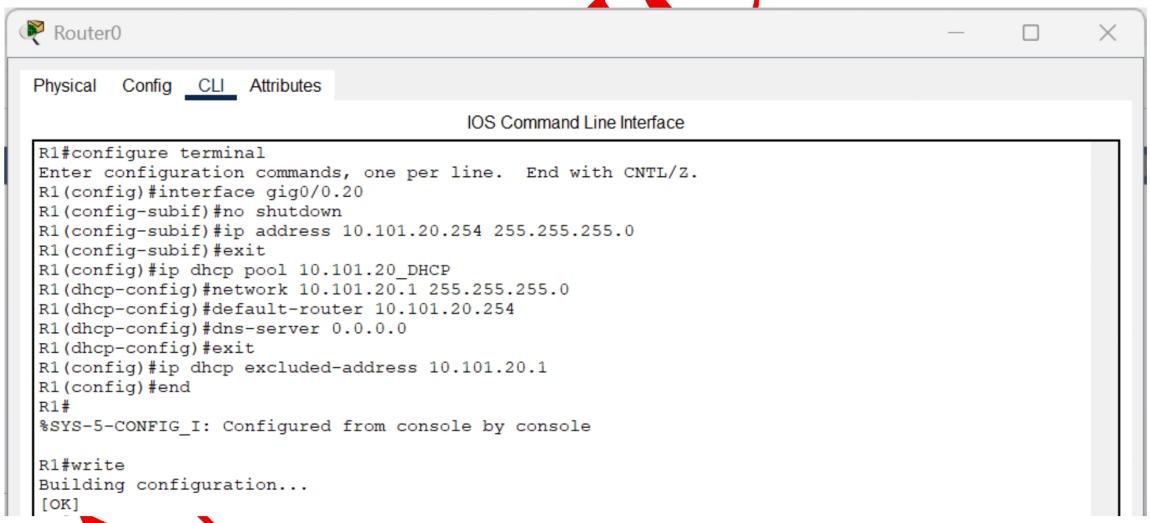
b) Screenshot of Desktop IP configuration:





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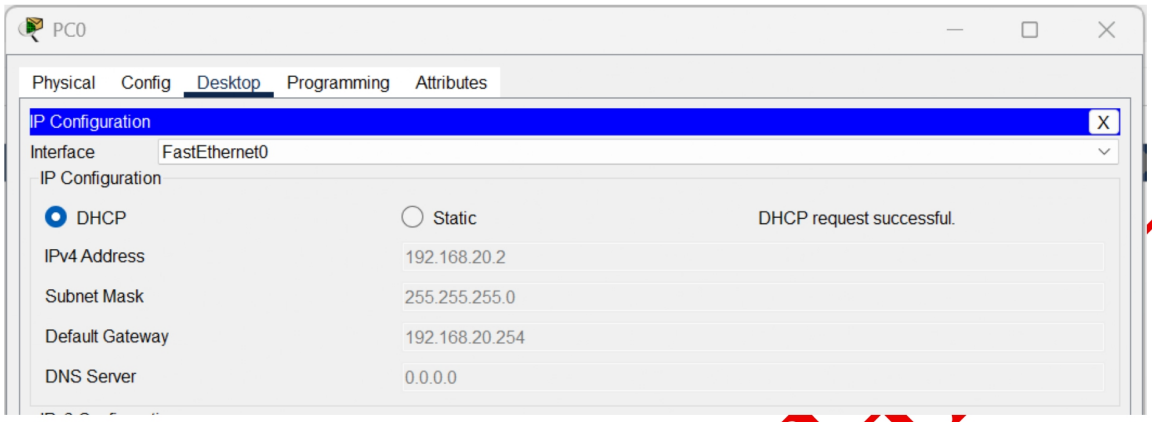
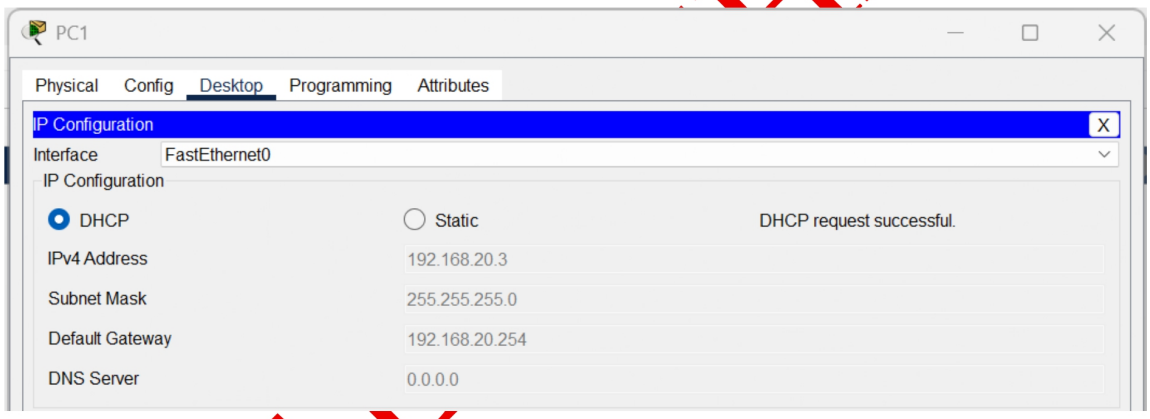
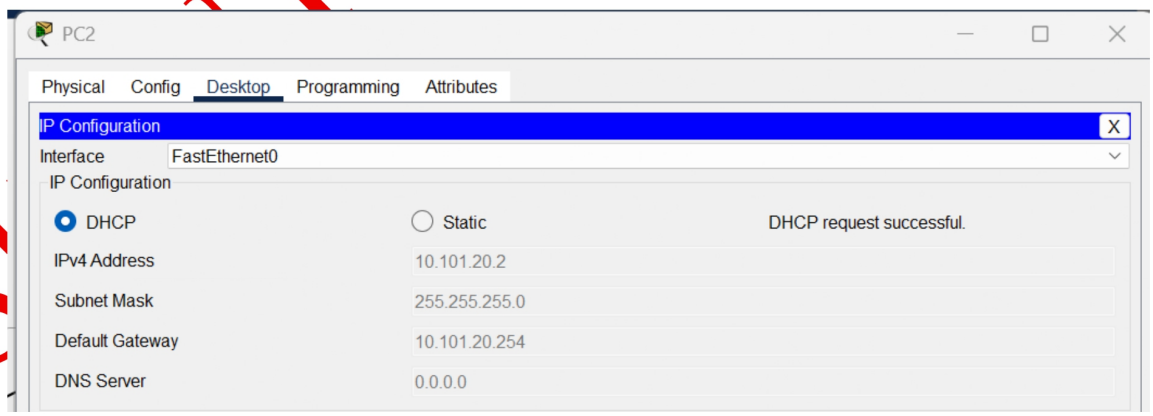
1) PC 0:



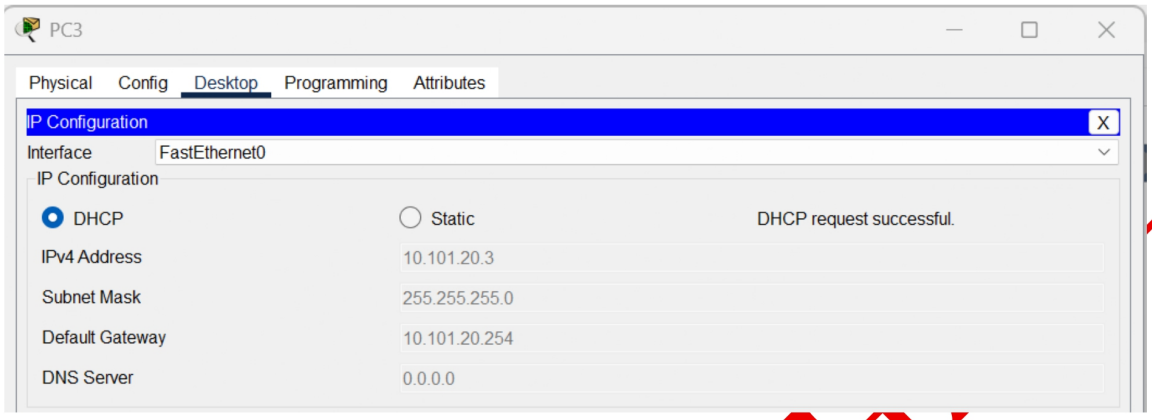
2) PC 1:



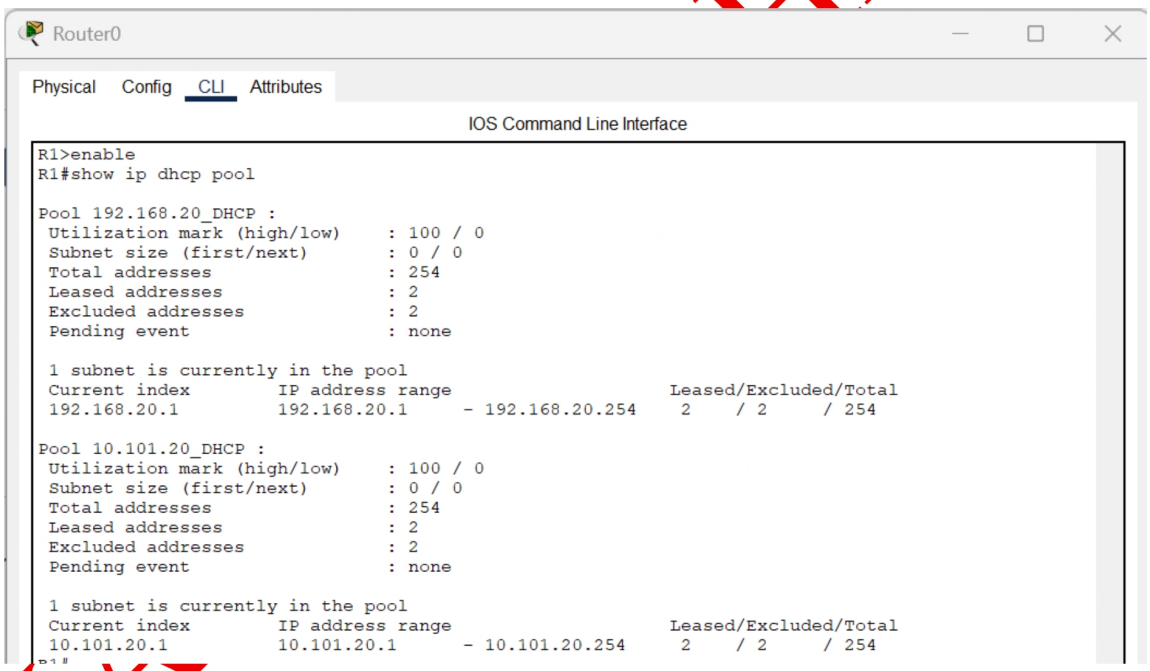
3) PC 2:



4) PC 3:



c) Screenshot of DHCP pool information:



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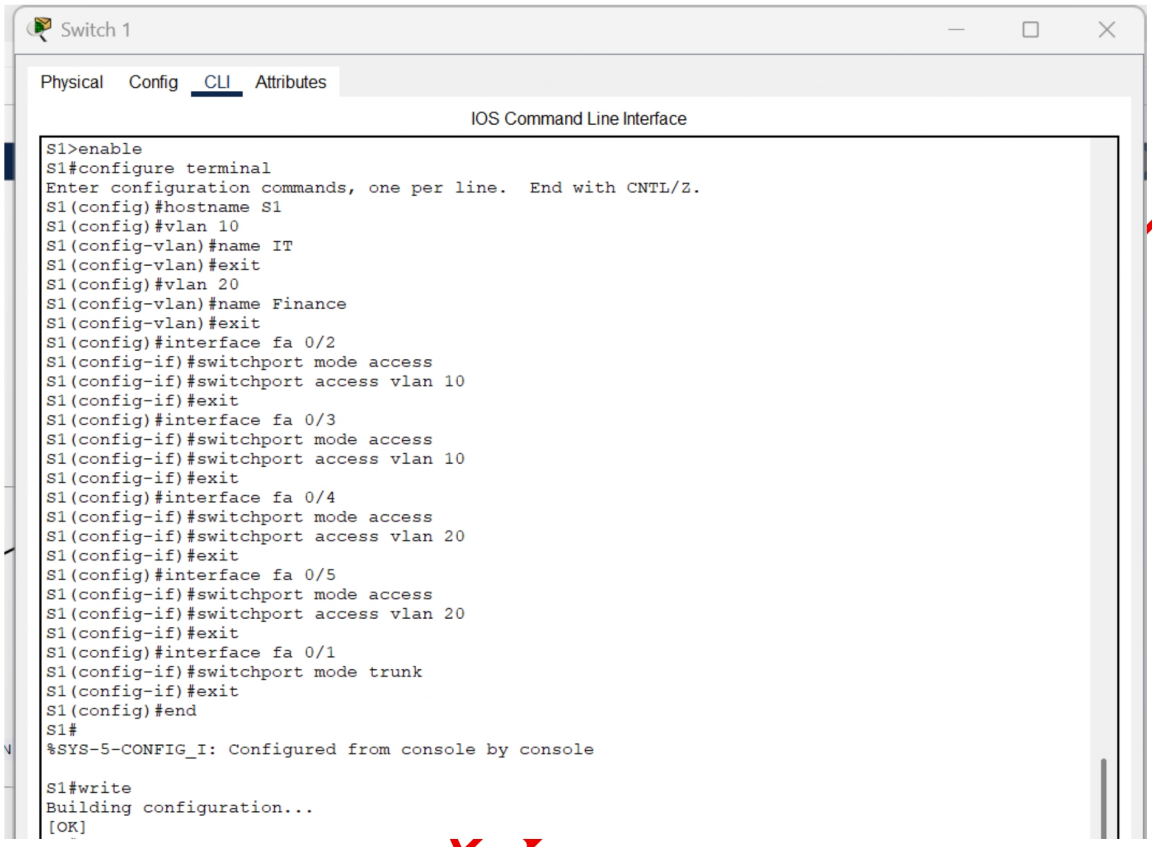
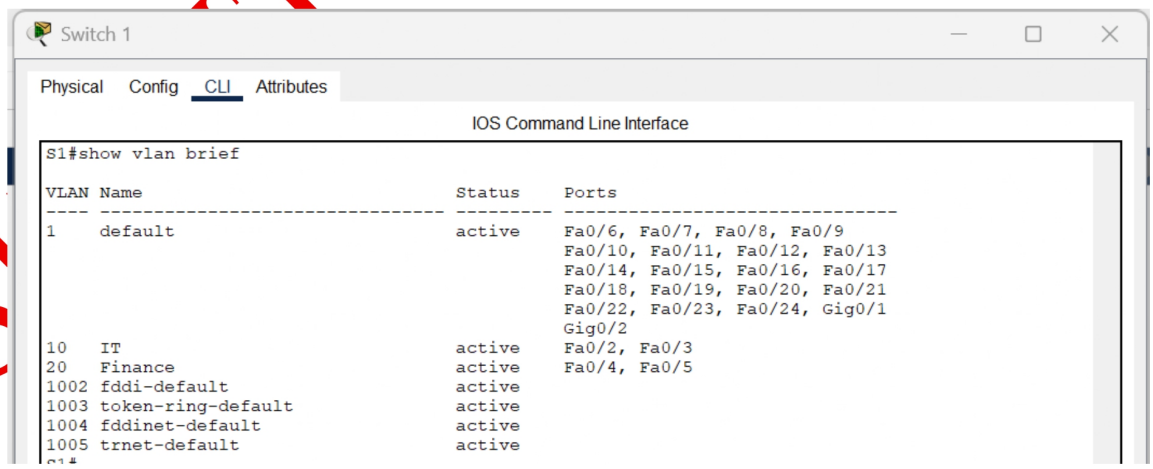
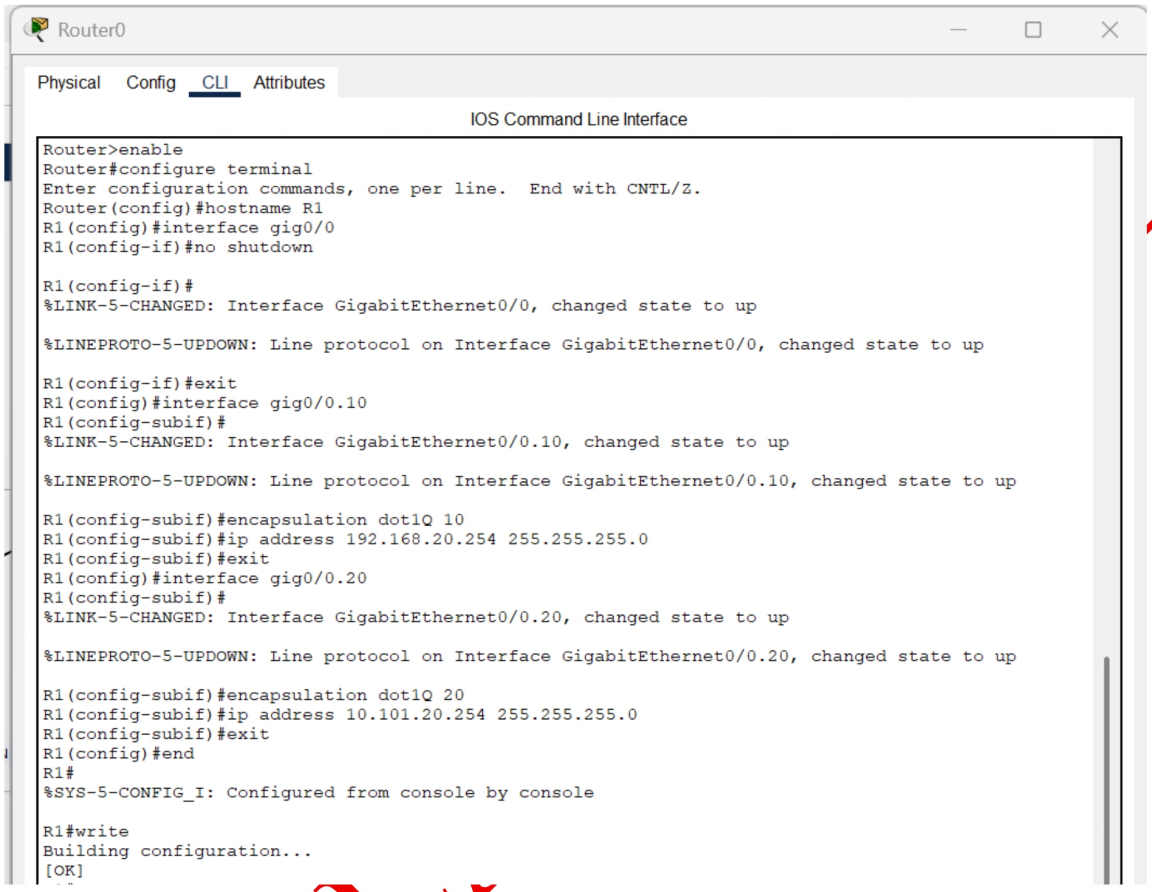
d) Screenshot of VLAN Configuration:

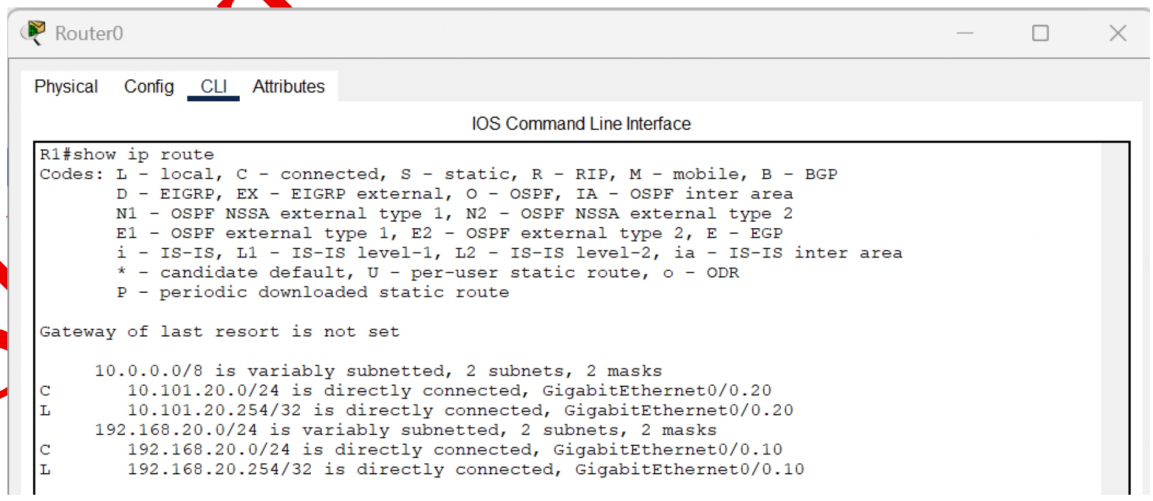


To verify the above switch configuration, the **IT VLAN** should be assigned to interfaces **Fa0/2** and **Fa0/3**, while the **Finance VLAN** should be assigned to interfaces **Fa0/4** and **Fa0/5**, as clearly shown in the figure below.

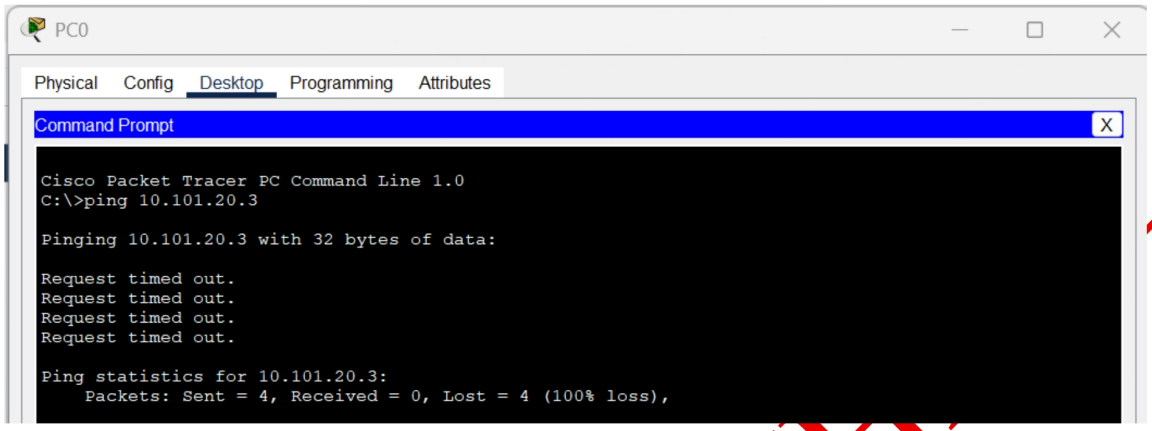


e) Screenshot of Router IP Configuration:

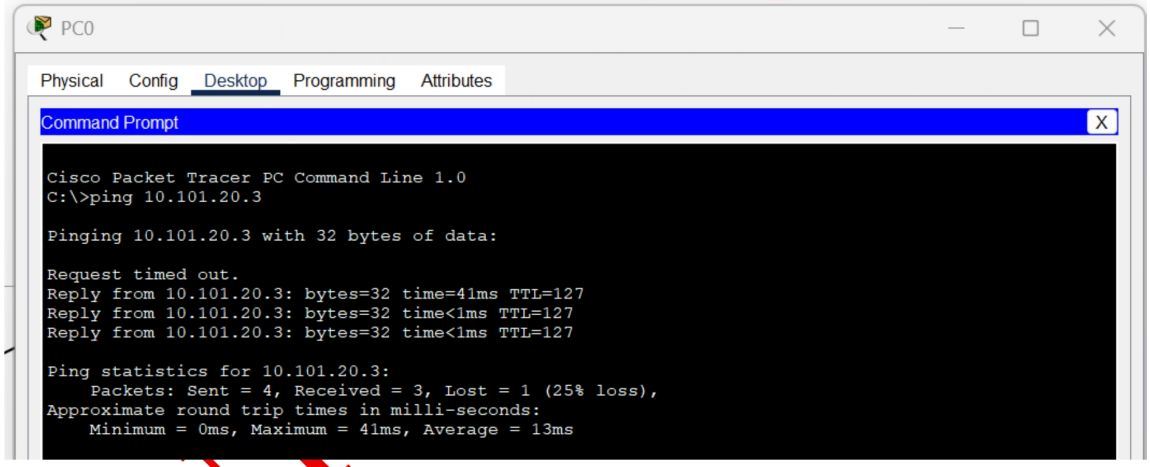




f) Ping failure before configuration and success after configuration between PC0 and PC3:



After the **Inter-VLAN Routing** is configured correctly, devices in different VLANs can communicate with each other, as shown in the figure below:



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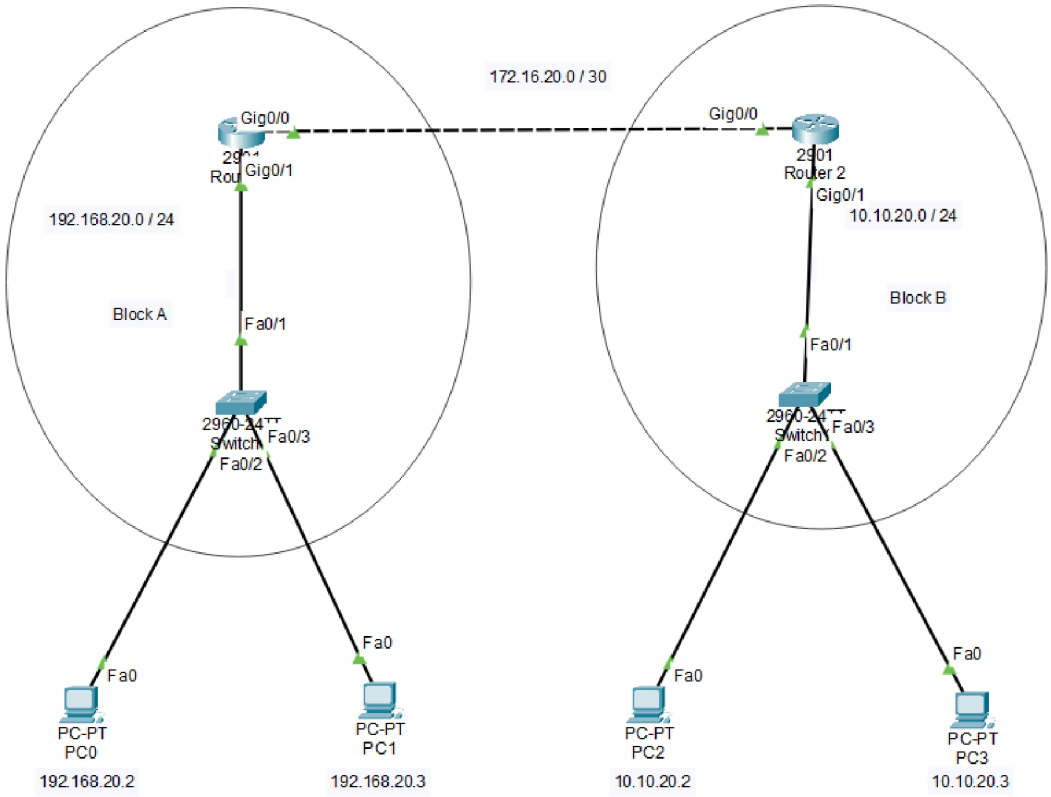
3. You are a network administrator of ShankerDev Campus. You are responsible for designing a simple network by connecting two routers in Block A and Block B where each router is connected to one switch in which two desktops are connected respectively. Configure a static route to connect Block A desktop and Block B desktop. The network information should be:

Device Name	IP Address	Subnet	Gateway
PC 0 (switch 1)	192.168.20.2	/24	192.168.20.254
PC 1 (switch 1)	192.168.20.3	/24	192.168.20.254
PC 2 (switch 2)	10.10.20.2	/24	10.10.20.254
PC 3 (switch 2)	10.10.20.3	/24	10.10.20.254

Output:



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a) Detail information of how I did:

In this task, I connected two separate network blocks (Block A and Block B) at **ShankerDev Campus** by designing a simple network topology. Each block contains a router connected to a switch, with two desktop PCs connected to each switch. Appropriate IP addresses were assigned to each desktop, switch, and router interface to ensure that they belong to different subnets.

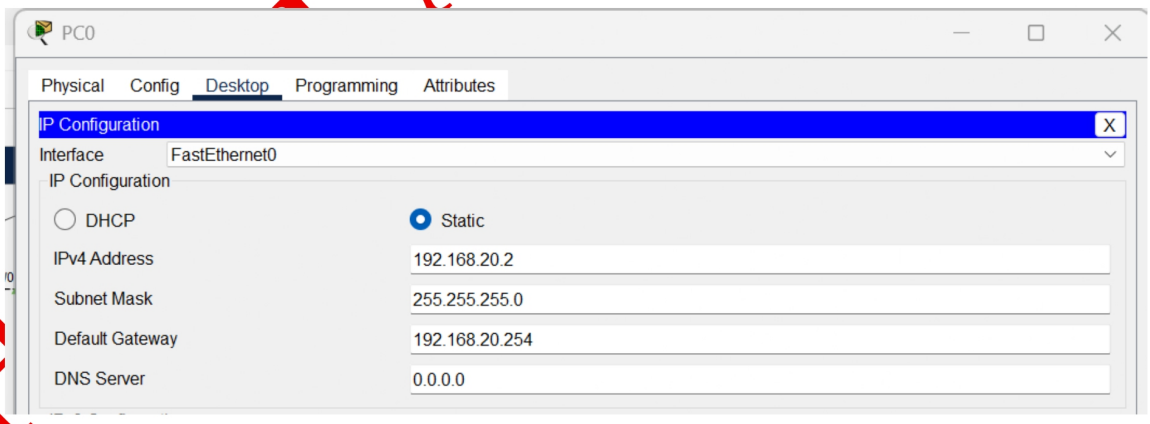
In **Block A**, desktops **PC0** and **PC1** were assigned IP addresses within the **192.168.20.0/24** subnet, while in **Block B**, desktops **PC2** and **PC3** used the **10.10.20.0/24** subnet. The routers were connected via their serial interfaces using a **point-to-point link** with the subnet **172.16.20.0/30**.

Static routing was configured on both routers to enable communication between the two LANs. On **Router A**, a static route was added to reach the **10.10.20.0/24** network via the next-hop IP address of **Router B**. Similarly, on **Router B**, a static route was configured to reach the **192.168.20.0/24** network via **Router A's** serial interface IP.

Before configuring routing, a ping test from **PC0 (Block A)** to **PC3 (Block B)** failed, indicating that there was no route between the networks. After static routing was properly configured, the ping was successful, confirming that the routing tables were correctly updated and the two networks were fully connected.

b) Screenshot of Desktop IP configuration:

1) PC 0:



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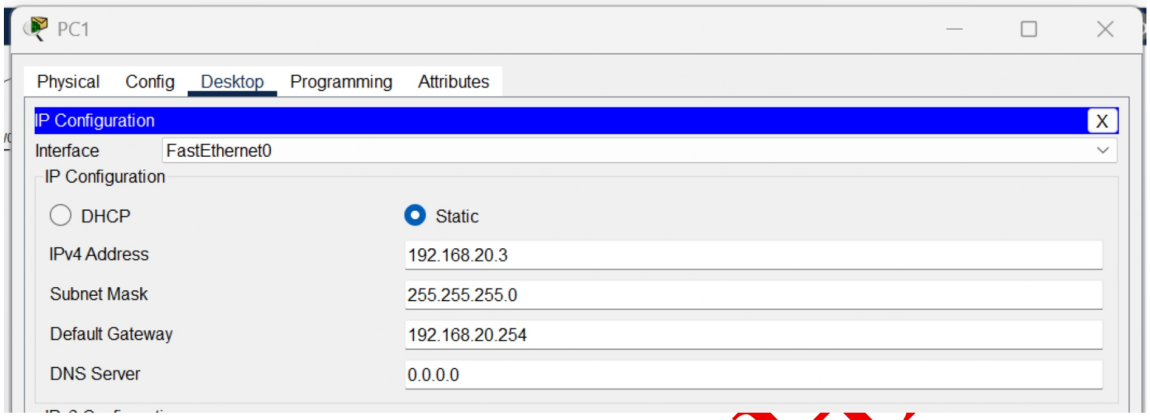
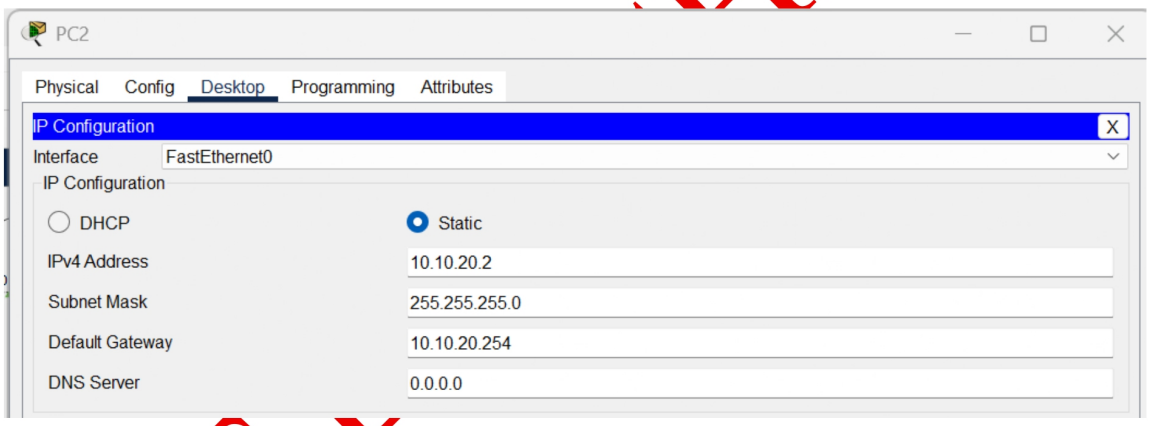
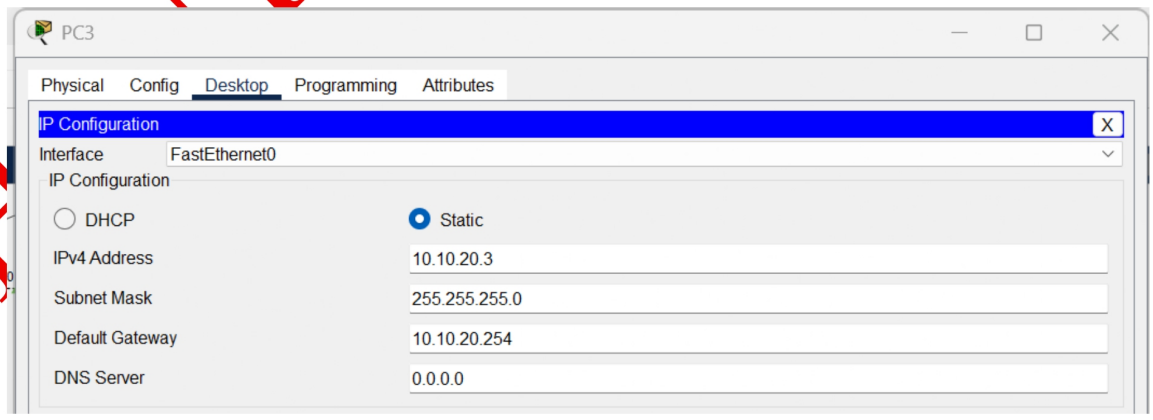
2) PC 1:



3) PC 2:



4) PC 3:



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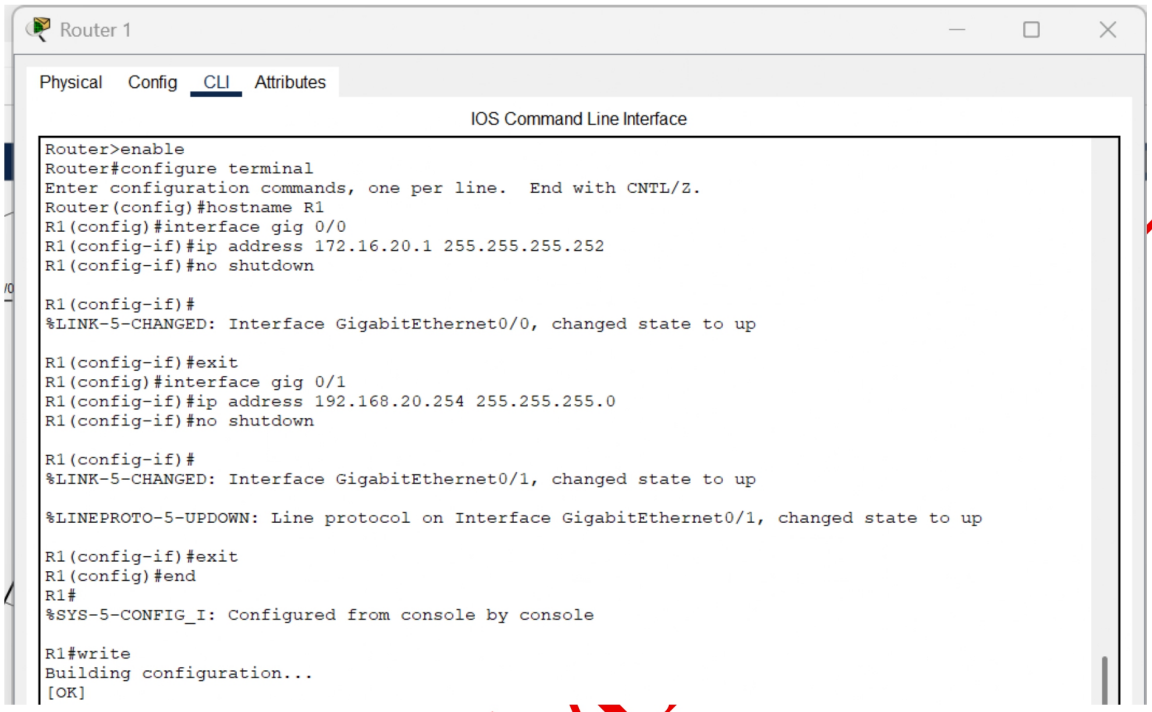
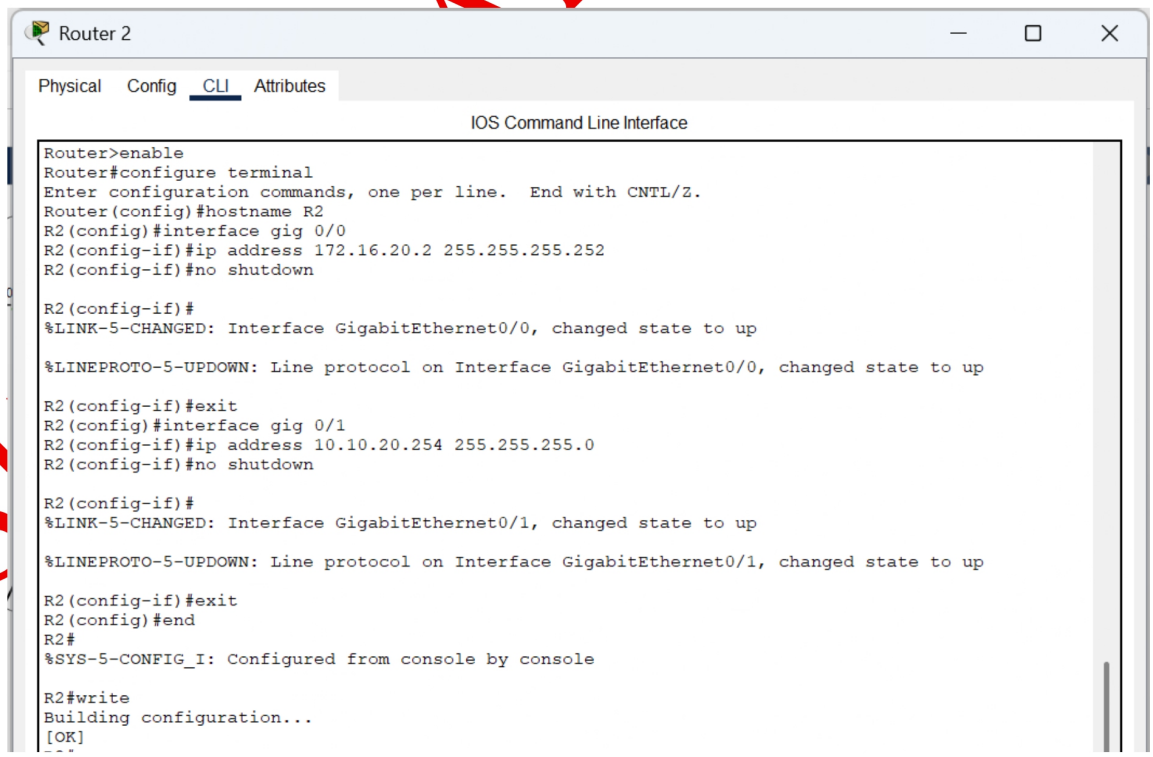
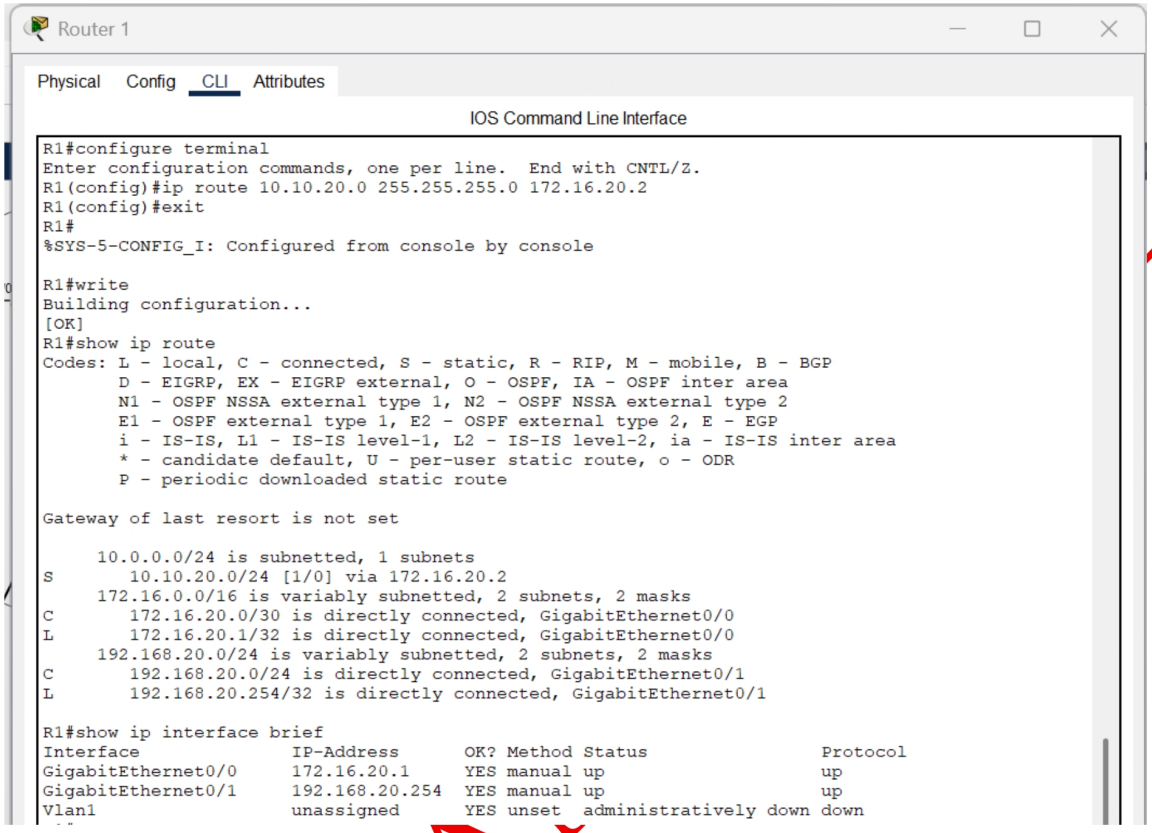
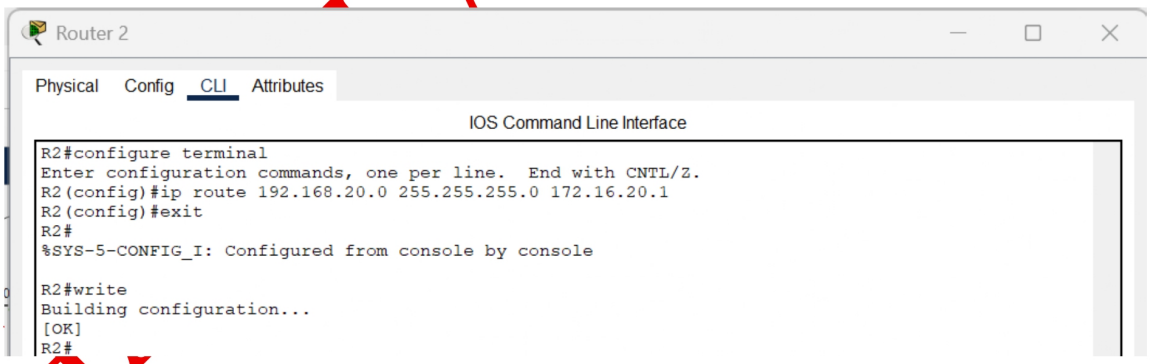
c) Screenshot of Router IP Configuration:





d) Screenshot of static routing:





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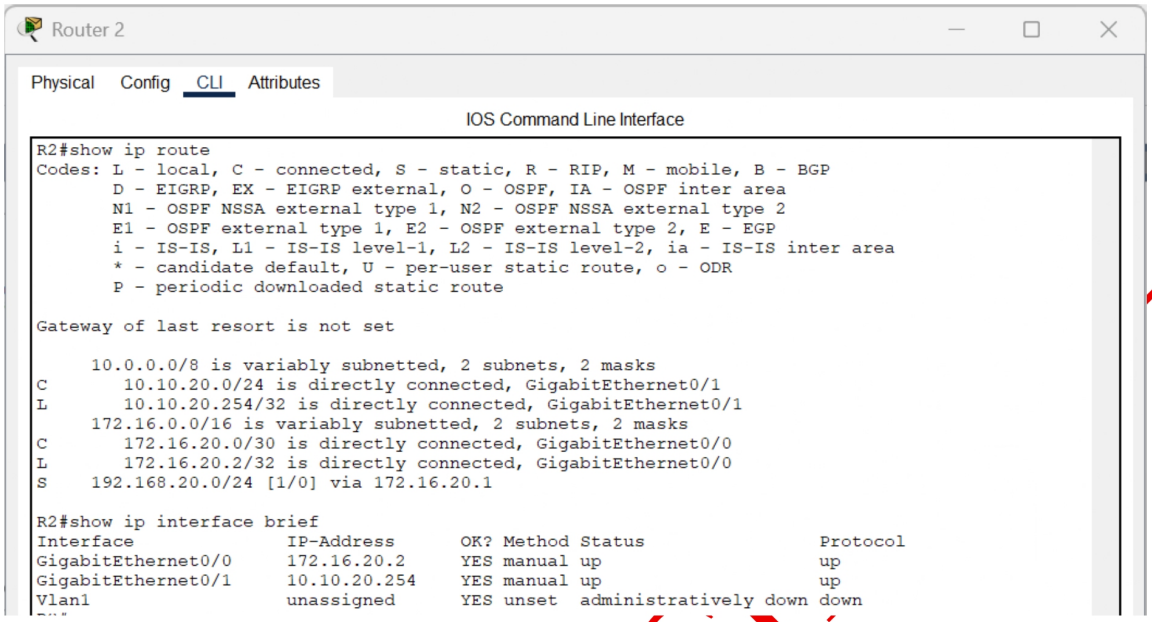
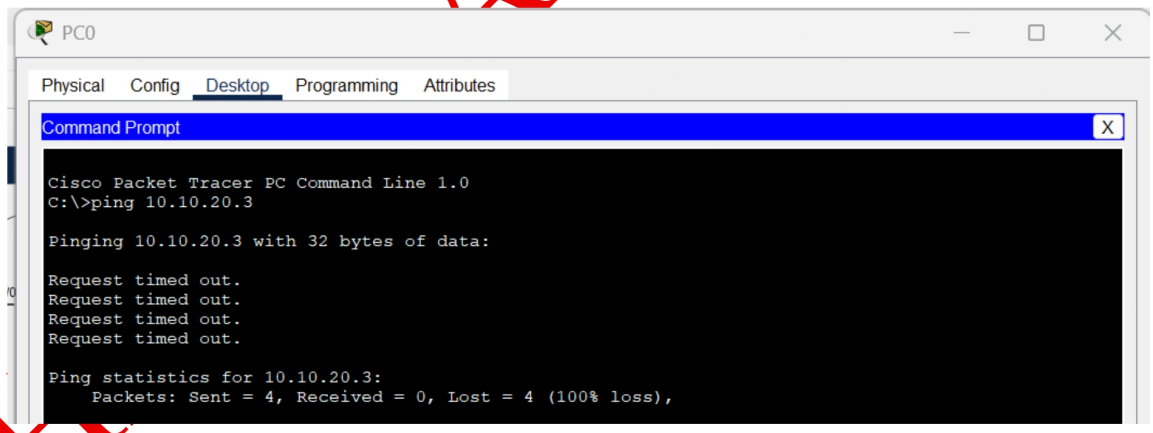


e) Ping failure before configuration and success after configuration between PC0 and PC3: Before configuring static routing, I tested the connectivity between **PC0** in **Block A** and **PC3** in **Block B**. However, the ping from PC0 to PC3 failed, displaying a *"Request timed out"* message. This occurred because the routers in each block were unaware of each other's networks, and no route existed to forward packets between them.



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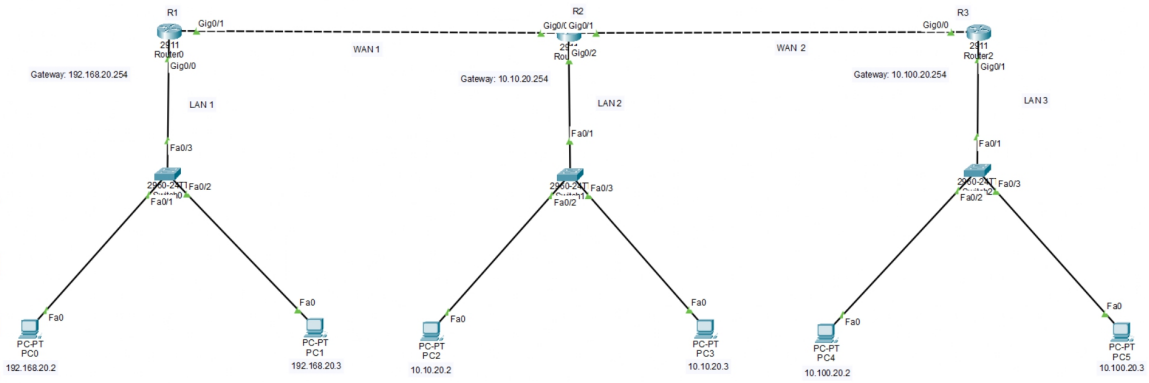
After configuring static routing, I repeated the ping test from **PC0** to **PC3**. This time, the ping was successful, confirming that static routing had enabled proper communication between the two networks, as shown in the figure below.

```
C:\>ping 10.10.20.3

Pinging 10.10.20.3 with 32 bytes of data:

Reply from 10.10.20.3: bytes=32 time<1ms TTL=126
Reply from 10.10.20.3: bytes=32 time<1ms TTL=126
Reply from 10.10.20.3: bytes=32 time<1ms TTL=126
Reply from 10.10.20.3: bytes=32 time=1ms TTL=126

Ping statistics for 10.10.20.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

4. Consider you are a network engineer and need to design a network design where three routers (Router 2911), namely R1, R2 and R3 are interconnected with each other directly and within each router one switch is connected and within that switch, two personal computers are connected. Configure OSPF dynamic routing to connect each network. The IP information is:

Device Name	IP Address	Subnet	Gateway
PC 0 (Switch 1)	192.168.20.2	/24	192.168.20.254
PC 1 (Switch 1)	192.168.20.3	/24	192.168.20.254
PC 2 (Switch 2)	10.10.20.2	/24	10.10.20.254
PC 3 (Switch 2)	10.10.20.3	/24	10.10.20.254
PC 4 (Switch 3)	10.100.20.2	/24	10.100.20.254
PC 5 (Switch 3)	10.100.20.3	/24	10.100.20.254

Output:



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a) Detail information about how I did:

In this task, I designed a network topology consisting of three Cisco 2911 routers: **R1**, **R2**, and **R3**, each directly connected to one another. Each router was also connected to a switch, and each switch had two PCs connected to it. Appropriate IP addresses and subnet masks were assigned to all PCs based on the provided information. The default gateways on the PCs were configured to match their respective router interfaces: **192.168.20.254** for **PC0** and **PC1** (R1), **10.10.20.254** for **PC2** and **PC3** (R2), and **10.100.20.254** for **PC4** and **PC5** (R3).

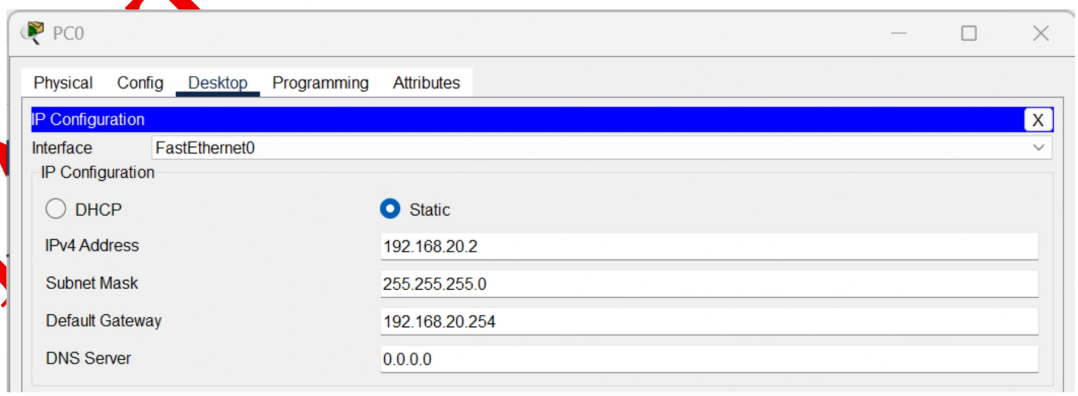
Initially, when I attempted to ping between PCs on different networks such as from **PC0** to **PC3** and from **PC0** to **PC5** -the ping requests failed, indicating that routing had not yet been configured.

To enable communication across all networks, I configured **OSPF (Open Shortest Path First)** dynamic routing on all three routers. A unique router ID was assigned to each router, and **OSPF process ID 1** was used. Network statements were added for all connected subnets, and OSPF was activated on the interfaces connected to other routers and LANs.

After enabling OSPF, I verified the routing tables on each router and confirmed that all routes were successfully learned dynamically through OSPF. Following the routing setup, I reattempted the ping tests between PCs across different networks. This time, all pings were successful from **PC0** to **PC3**, **PC0** to **PC5**, and vice versa - confirming that **OSPF dynamic routing** was functioning correctly.

b) Screenshot of Desktop IP Configuration:

1) PC 0:



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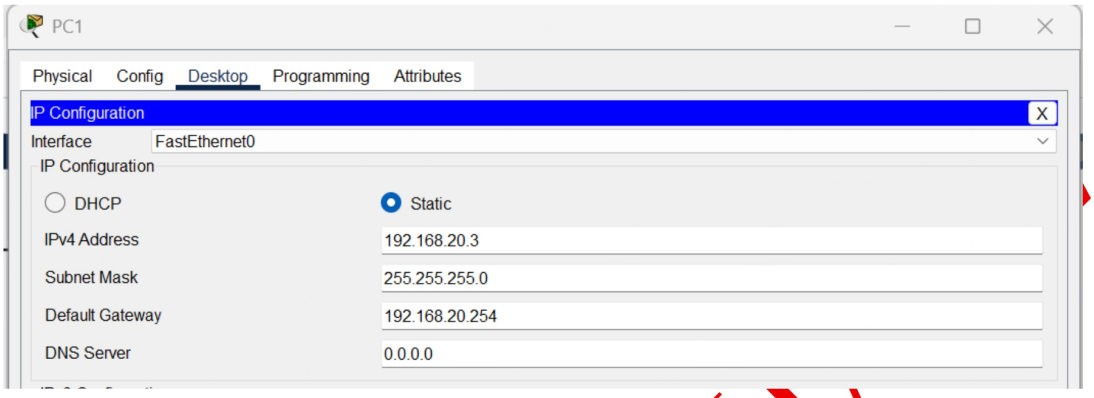
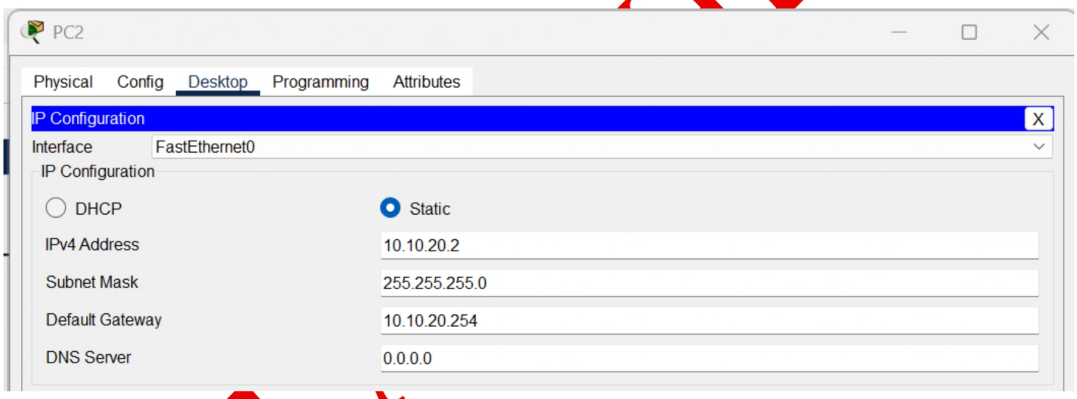
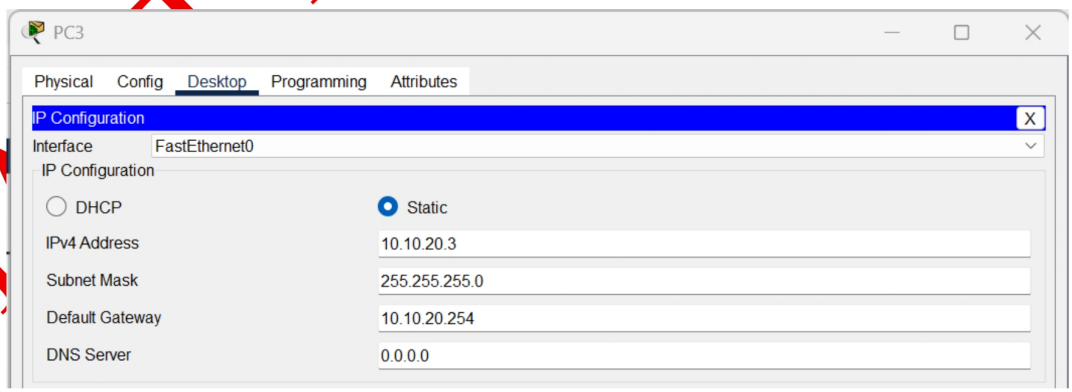
2) PC 1:



3) PC 2:



4) PC 3:



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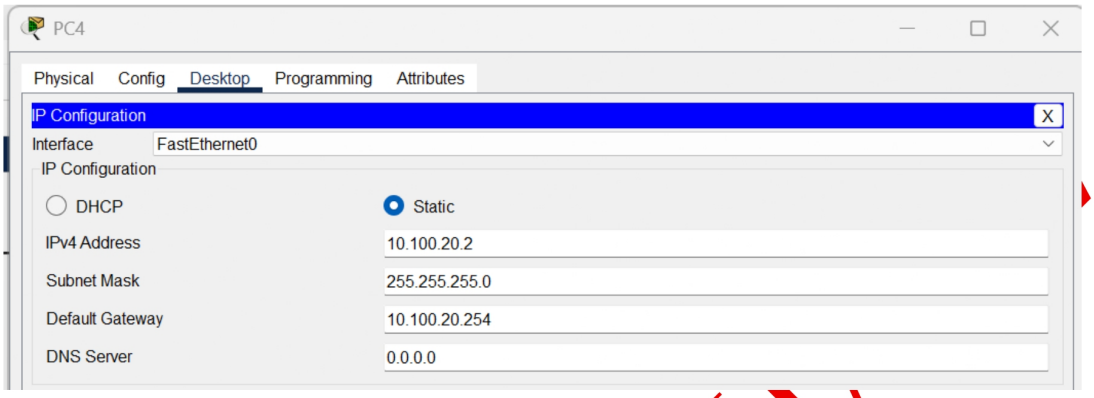
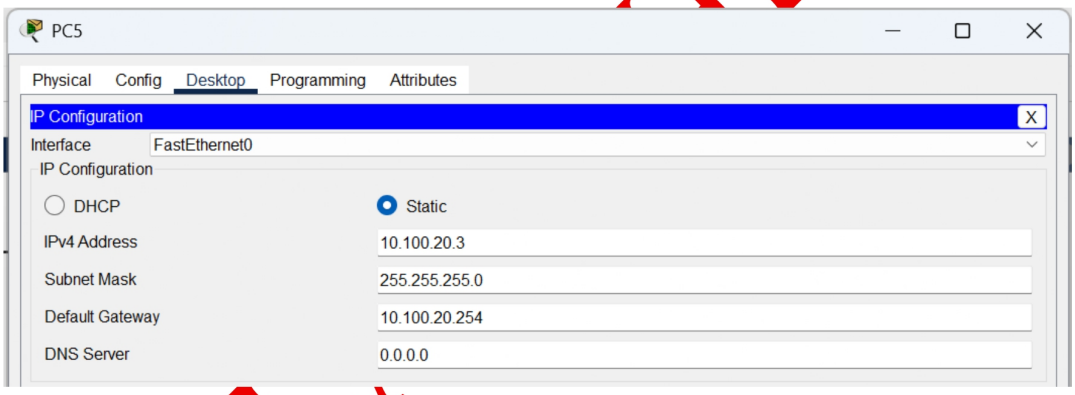
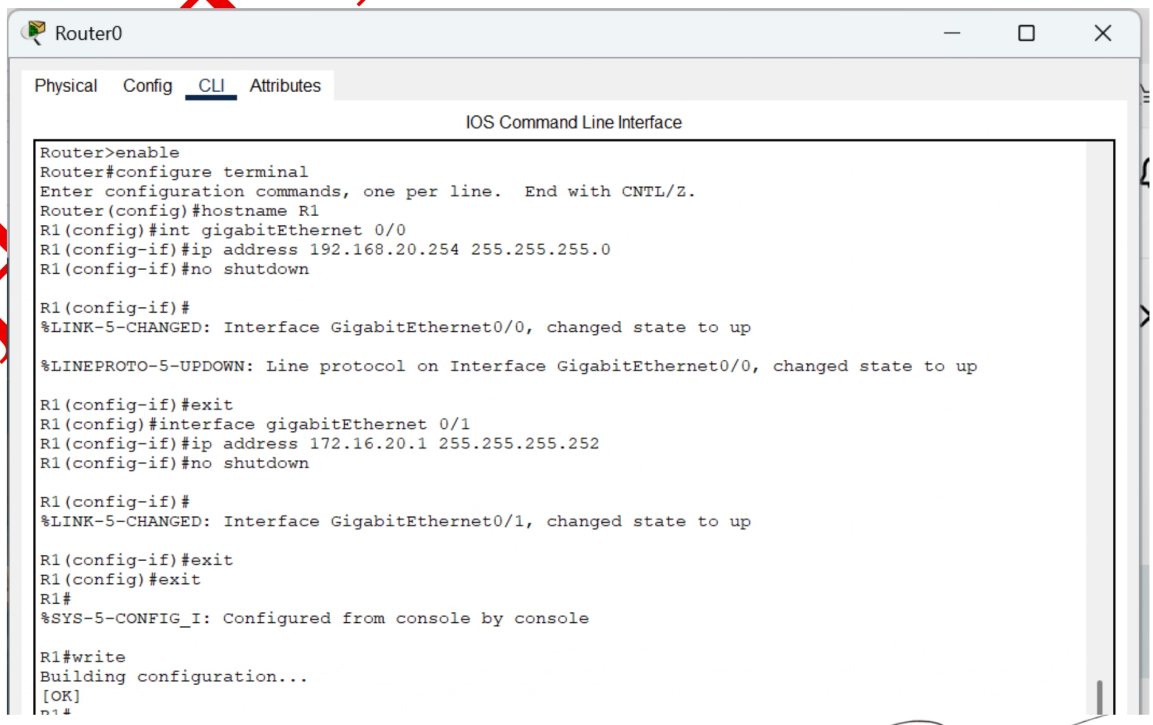
5) PC 4:



6) PC 5:



c) Screenshot of Router IP Configuration:



Router1

Physical Config CLI Attributes

IOS Command Line Interface

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#interface gigabitEthernet 0/2
R2(config-if)#ip address 10.10.20.254 255.255.255.0
R2(config-if)#no shutdown

R2(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

R2(config-if)#exit
R2(config)#interface gigabitEthernet 0/1
R2(config-if)#no shutdown

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

R2(config-if)#ip address 172.16.30.1 255.255.255.252
R2(config-if)#exit
R2(config)#interface gigabitEthernet 0/0
R2(config-if)#ip address 172.16.20.2 255.255.255.252
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)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#write
Building configuration...
[OK]
```

Router2

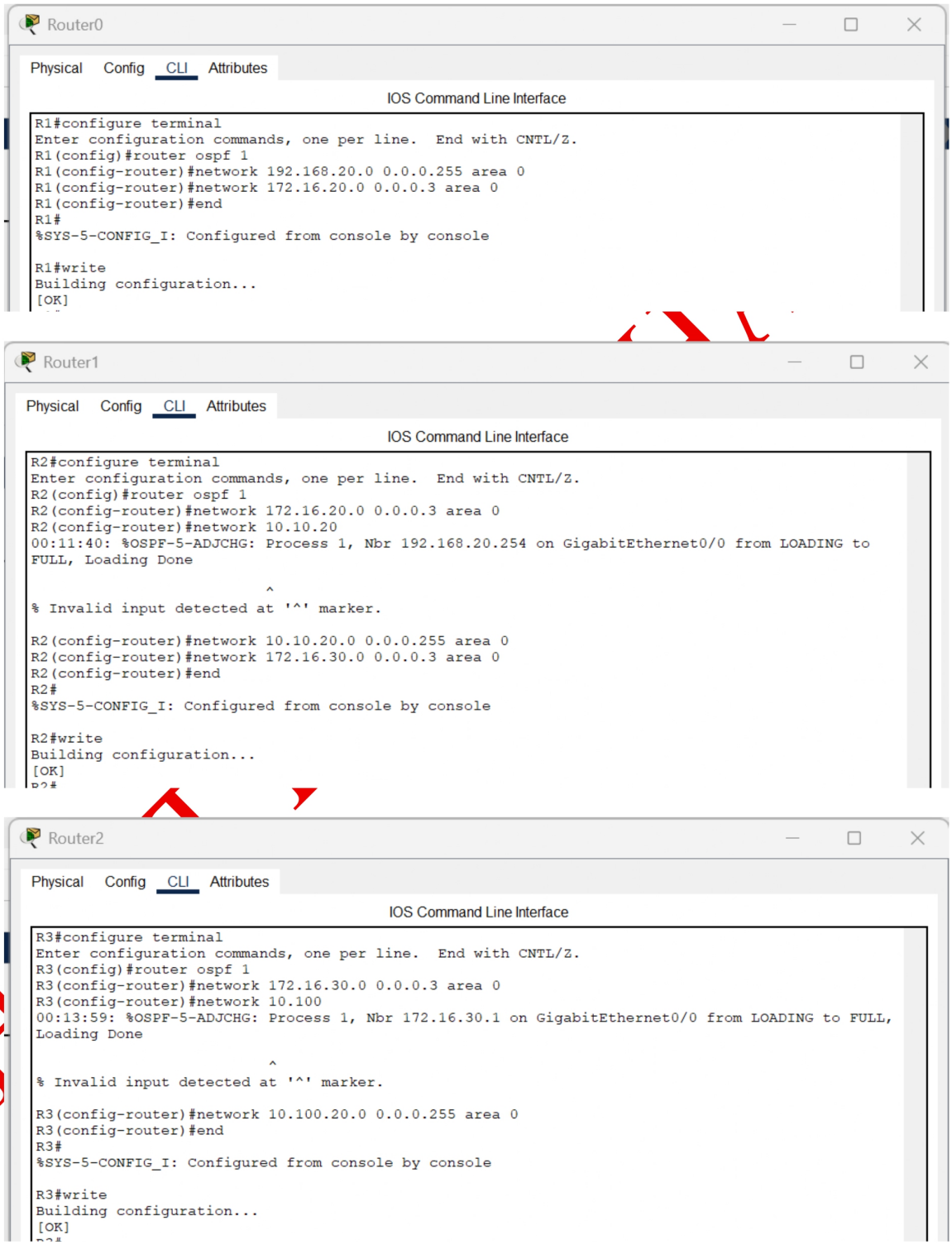
Physical Config CLI Attributes

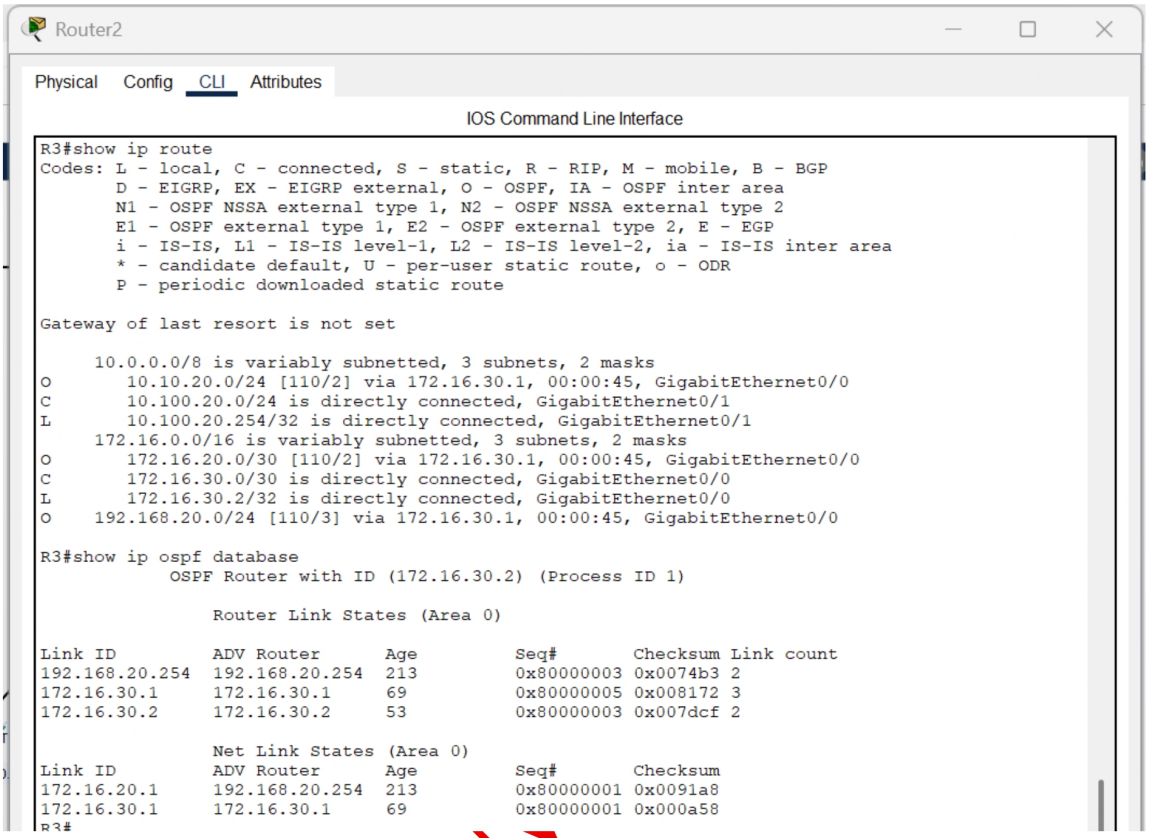
IOS Command Line Interface

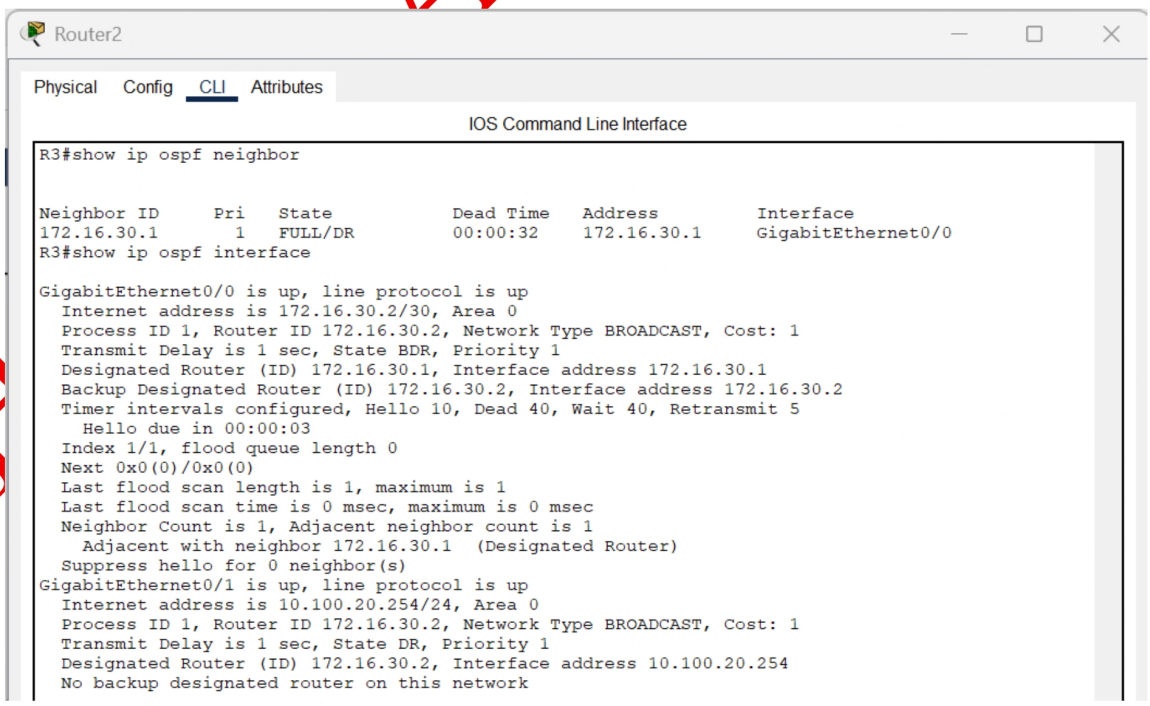
```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R3
R3(config)#interface gigabitEthernet 0/1
R3(config-if)#no shutdown

R3(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

R3(config-if)#ip address 10.100.20.254 255.255.255.0
R3(config-if)#exit
R3(config)#interface gigabitEthernet 0/0
R3(config-if)#no shutdown

R3(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

R3(config-if)#ip address 172.16.30.2 255.255.255.252
R3(config-if)#exit
R3(config)#end
R3#
%SYS-5-CONFIG_I: Configured from console by console

R3#write
Building configuration...
[OK]
```

NISH

d) Screenshot of OSPF routing of each router:



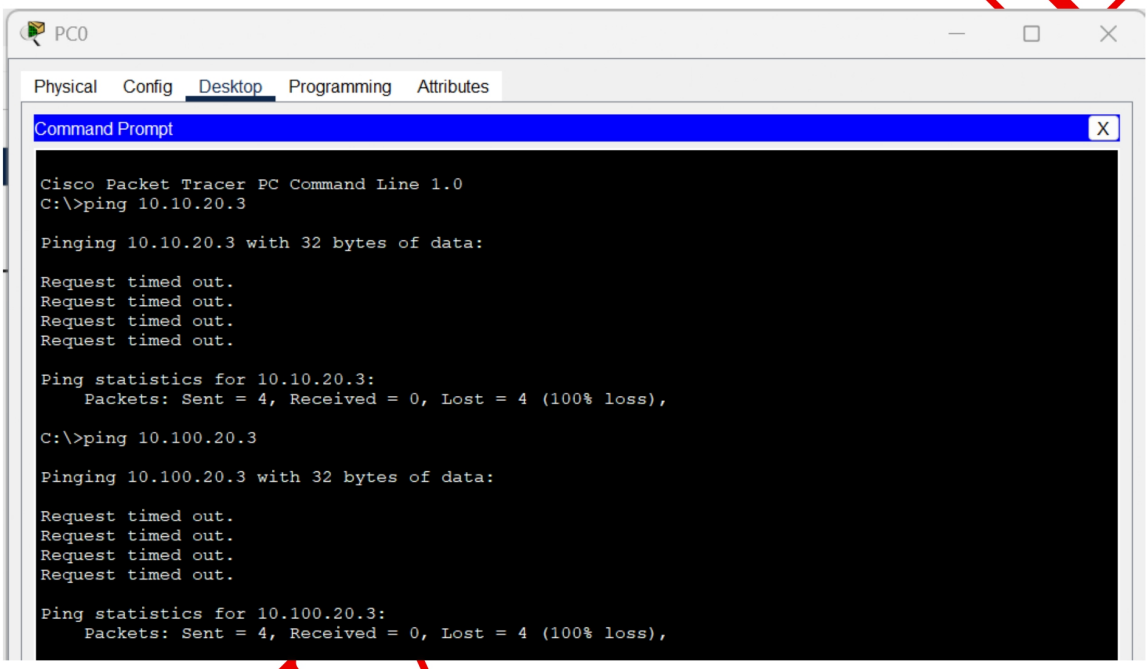

Router2
Physical
Config
CLI
Attributes
IOS Command Line Interface
R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external 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
10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O 10.10.20.0/24 [110/2] via 172.16.30.1, 00:00:45, GigabitEthernet0/0
C 10.100.20.0/24 is directly connected, GigabitEthernet0/1
L 10.100.20.254/32 is directly connected, GigabitEthernet0/1
172.16.0.0/16 is variably subnetted, 3 subnets, 2 masks
O 172.16.20.0/30 [110/2] via 172.16.30.1, 00:00:45, GigabitEthernet0/0
C 172.16.30.0/30 is directly connected, GigabitEthernet0/0
L 172.16.30.2/32 is directly connected, GigabitEthernet0/0
O 192.168.20.0/24 [110/3] via 172.16.30.1, 00:00:45, GigabitEthernet0/0
R3#show ip ospf database
OSPF Router with ID (172.16.30.2) (Process ID 1)
Router Link States (Area 0)
Link ID ADV Router Age Seq# Checksum Link count
192.168.20.254 192.168.20.254 213 0x80000003 0x0074b3 2
172.16.30.1 172.16.30.1 69 0x80000005 0x008172 3
172.16.30.2 172.16.30.2 53 0x80000003 0x007dcf 2
Net Link States (Area 0)
Link ID ADV Router Age Seq# Checksum
172.16.20.1 192.168.20.254 213 0x80000001 0x0091a8
172.16.30.1 172.16.30.1 69 0x80000001 0x000a58
R3#

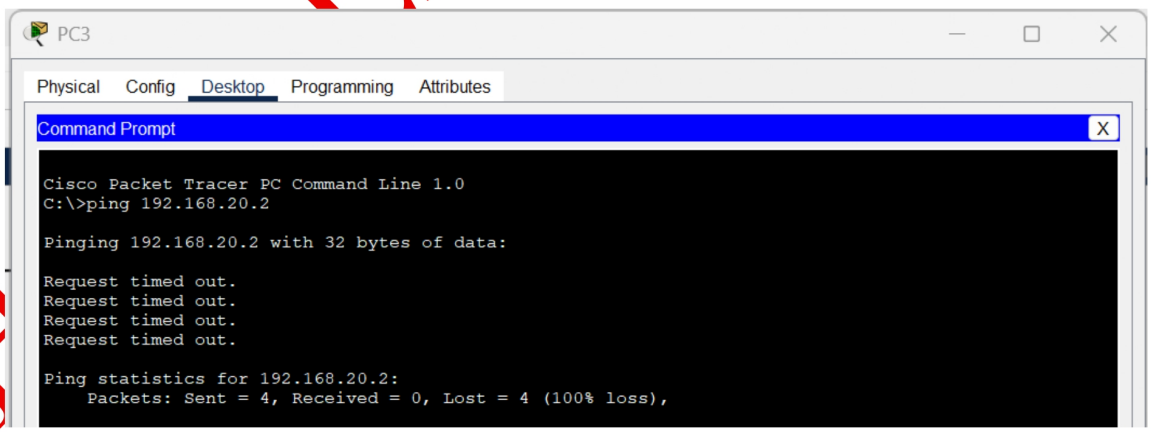

Router2
Physical
Config
CLI
Attributes
IOS Command Line Interface
R3#show ip ospf neighbor
Neighbor ID Pri State Dead Time Address Interface
172.16.30.1 1 FULL/DR 00:00:32 172.16.30.1 GigabitEthernet0/0
R3#show ip ospf interface
GigabitEthernet0/0 is up, line protocol is up
Internet address is 172.16.30.2/30, Area 0
Process ID 1, Router ID 172.16.30.2, Network Type BROADCAST, Cost: 1
Transmit Delay is 1 sec, State BDR, Priority 1
Designated Router (ID) 172.16.30.1, Interface address 172.16.30.1
Backup Designated Router (ID) 172.16.30.2, Interface address 172.16.30.2
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:03
Index 1/1, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 1
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 172.16.30.1 (Designated Router)
Suppress hello for 0 neighbor(s)
GigabitEthernet0/1 is up, line protocol is up
Internet address is 10.100.20.254/24, Area 0
Process ID 1, Router ID 172.16.30.2, Network Type BROADCAST, Cost: 1
Transmit Delay is 1 sec, State DR, Priority 1
Designated Router (ID) 172.16.30.2, Interface address 10.100.20.254
No backup designated router on this network

NISH

e) Ping failure before configuration and success after configuration between PC0 and PC3, PC0 and PC5 and vice - versa.

When pinging between PCs across different networks such as from **PC0 to PC3**, **PC0 to PC5**, **PC3 to PC0**, and **PC5 to PC0** the ping requests failed, indicating that **OSPF dynamic routing** had not yet been configured, as shown in the figure below.





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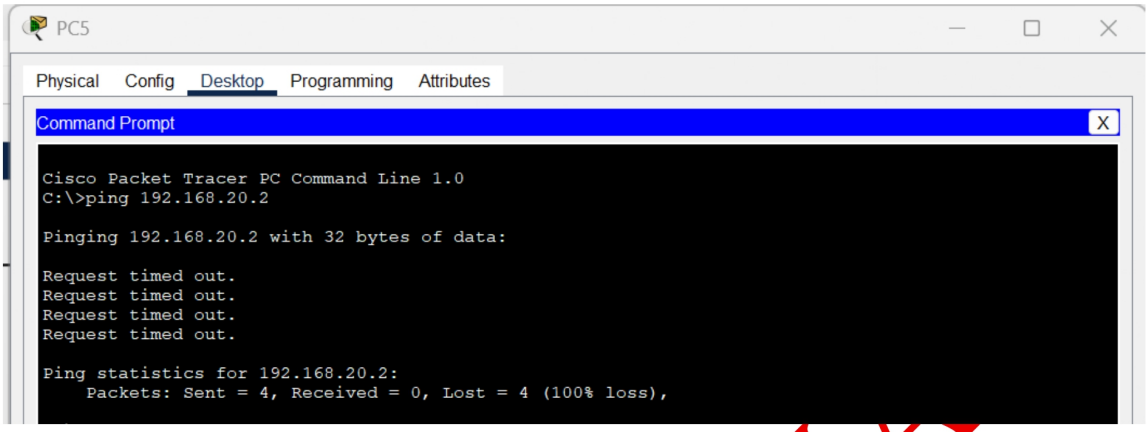
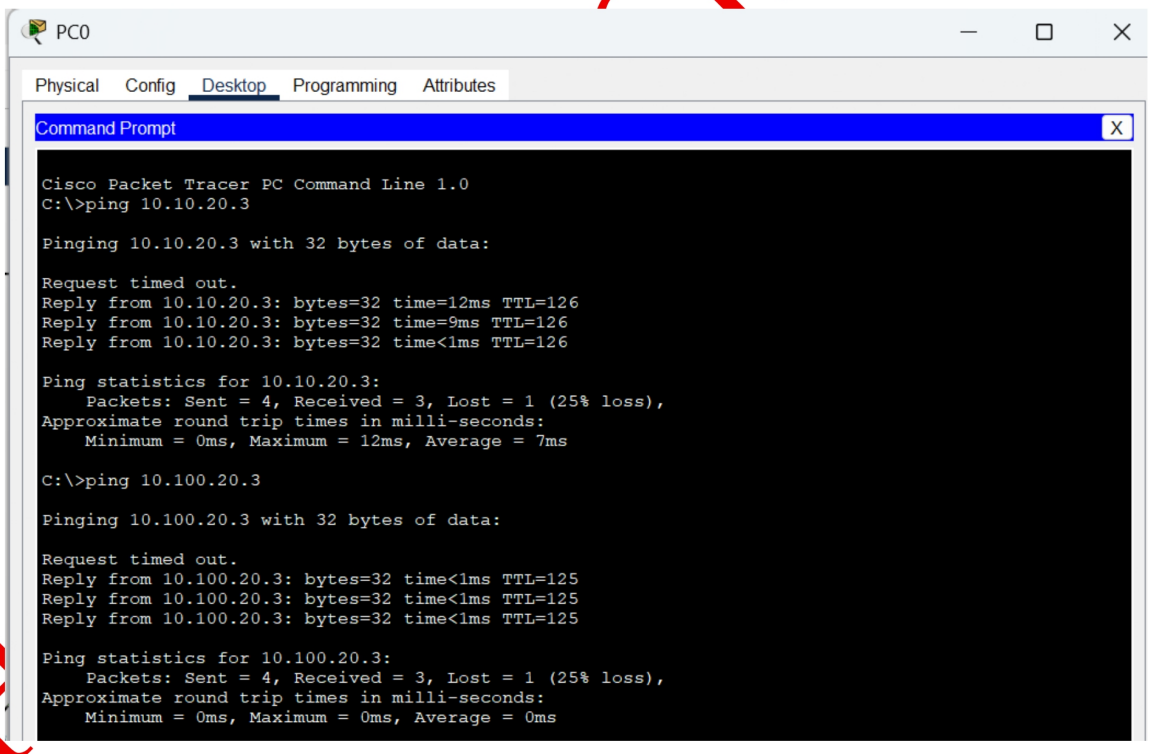


After configuring **OSPF dynamic routing** on all three routers, pinging between PCs across different networks such as from **PC0 to PC3**, **PC0 to PC5**, **PC3 to PC0**, and **PC5 to PC0** became successful, as shown in the figure below.



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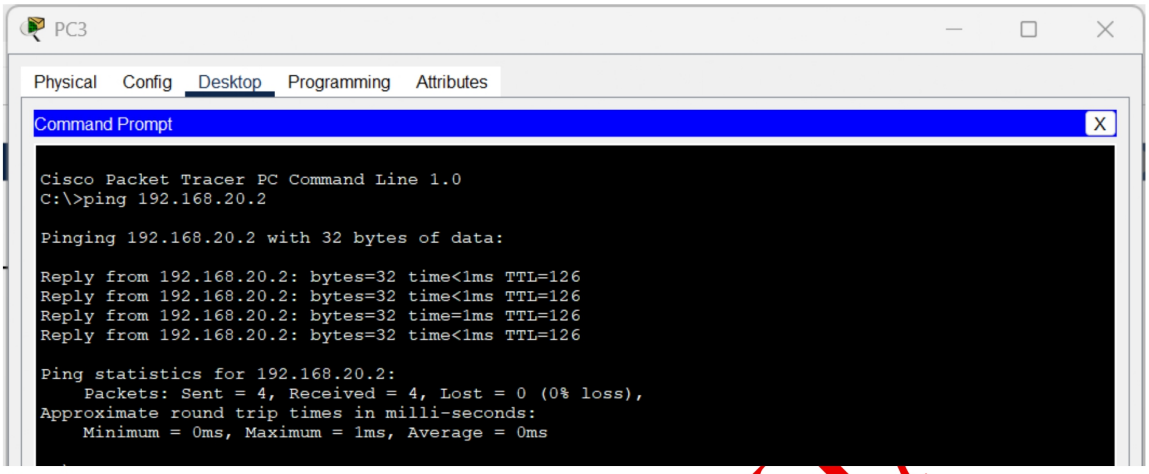
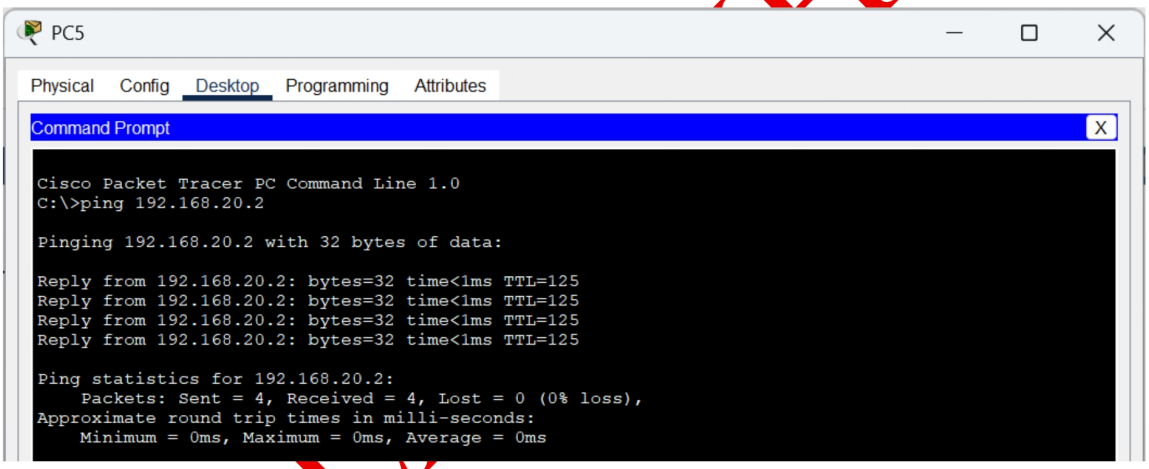

PC3
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.20.2
Pinging 192.168.20.2 with 32 bytes of data:
Reply from 192.168.20.2: bytes=32 time<1ms TTL=126
Reply from 192.168.20.2: bytes=32 time<1ms TTL=126
Reply from 192.168.20.2: bytes=32 time=1ms TTL=126
Reply from 192.168.20.2: bytes=32 time<1ms TTL=126
Ping statistics for 192.168.20.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms


PC5
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.20.2
Pinging 192.168.20.2 with 32 bytes of data:
Reply from 192.168.20.2: bytes=32 time<1ms TTL=125
Reply from 192.168.20.2: bytes=32 time<1ms TTL=125
Reply from 192.168.20.2: bytes=32 time<1ms TTL=125
Reply from 192.168.20.2: bytes=32 time<1ms TTL=125
Ping statistics for 192.168.20.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms

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