



Faculty of Engineering & Technology – Computer Systems
Engineering Department

Second Semester 2023-2024

Computer Network ENCS3320

Project.2 - Network Layer Project

Prepared by:

Rasha Daoud - 1210382

Nadia Thaer – 1210021

Saja Yaser-1211278

Instructor: Abd Alkarim Awad

Section: 2

Date: 1st June 2024

Abstract

This report outlines the construction and validation of a network in Cisco Packet Tracer aimed at reinforcing theoretical knowledge through practical application. Guided by objectives to master network simulation, IP subnetting, device configuration, and routing protocol

establishment, the project involved setting up a topology with designated servers and end devices, configuring OSPF routing, and ensuring operational integrity through ping, traceroute, and server functionality tests.

Table of Contents

| | |
|---|-----------|
| Abstract | 2 |
| Part 1: Wireshark | 7 |
| 1.1 TCP packet | 7 |
| 1.2 DHCP packet | 8 |
| 1.3 ICMP packet | 10 |
| Part2: Packet Tracer | 12 |
| Part0: IP Subnetting and Assignment | 12 |
| Procedure of Subnetting..... | 13 |
| Part1 : Topology..... | 14 |
| Building the Topology | 14 |
| Routers Configurations | 15 |
| Servers Configurations | 23 |
| Part2: Configuring servers | 24 |

Table of Figures

| | |
|---|----|
| Figure 1:T cp connection | 7 |
| Figure 2:DHCP packet..... | 8 |
| Figure 3:ICMP packet..... | 10 |
| Figure 4:The Network Layout..... | 12 |
| Figure 5:Built Topology using Packet Tracer | 14 |
| Figure 6:R1 Ethernet0/0 Configurations..... | 15 |
| Figure 7:R1 Serial2/0 Configurations | 15 |
| Figure 8:R1 Serial3/0 Configurations | 16 |
| Figure 9:R2 Ethernet0/0 Configurations:..... | 16 |
| Figure 10:R2 Serial2/0 Configurations | 17 |
| Figure 11:R2 Serial3/0 Configurations | 17 |
| Figure 12:R3 Ethernet0/0 Configurations..... | 18 |
| Figure 13:R3 Serial2/0 Configurations | 18 |
| Figure 14:R3 Serial3/0 Configurations | 19 |
| Figure 15:R4 Ethernet0/0 Configurations..... | 19 |
| Figure 16:R4 Serial2/0 Configurations | 20 |
| Figure 17:R4 Serial3/0 Configurations | 20 |
| Figure 18:R5 Ethernet0/0 Configurations..... | 21 |
| Figure 19:R5 Ethernet1/0 Configurations..... | 21 |
| Figure 20:R5 Serial2/0 Configurations | 22 |
| Figure 21: R5 Serial3/0 Configurations | 22 |
| Figure 22: DNS Server Configurations..... | 23 |
| Figure 23:HTTP Server Configurations | 23 |
| Figure 24: Mail Server Configurations..... | 24 |
| Figure 25:PC2_1 Configuration | 24 |
| Figure 26: PC2_2 Configuration | 25 |
| Figure 27:PC2_3 Configuration | 25 |
| Figure 28:PC3_1 Configuration | 25 |
| Figure 29:PC3_2 Configuration | 25 |
| Figure 30:PC41_3 Configuration | 25 |
| Figure 31:PC41_2 Configuration | 25 |
| Figure 32:PC41_1Configuration | 25 |
| Figure 33:lab1Configuration | 25 |
| Figure 34:PC42_2Configuration | 25 |
| Figure 35:PC42_2Configuration | 25 |

List of tables

| | |
|----------------------------------|----|
| Table 1:Subnetting details | 13 |
|----------------------------------|----|

Part 1: Wireshark

Using Wireshark, capture few TCP, DHCP and ICMP packets. Show the packets and explain at least 4 fields of each packet.

1.1 TCP packet.

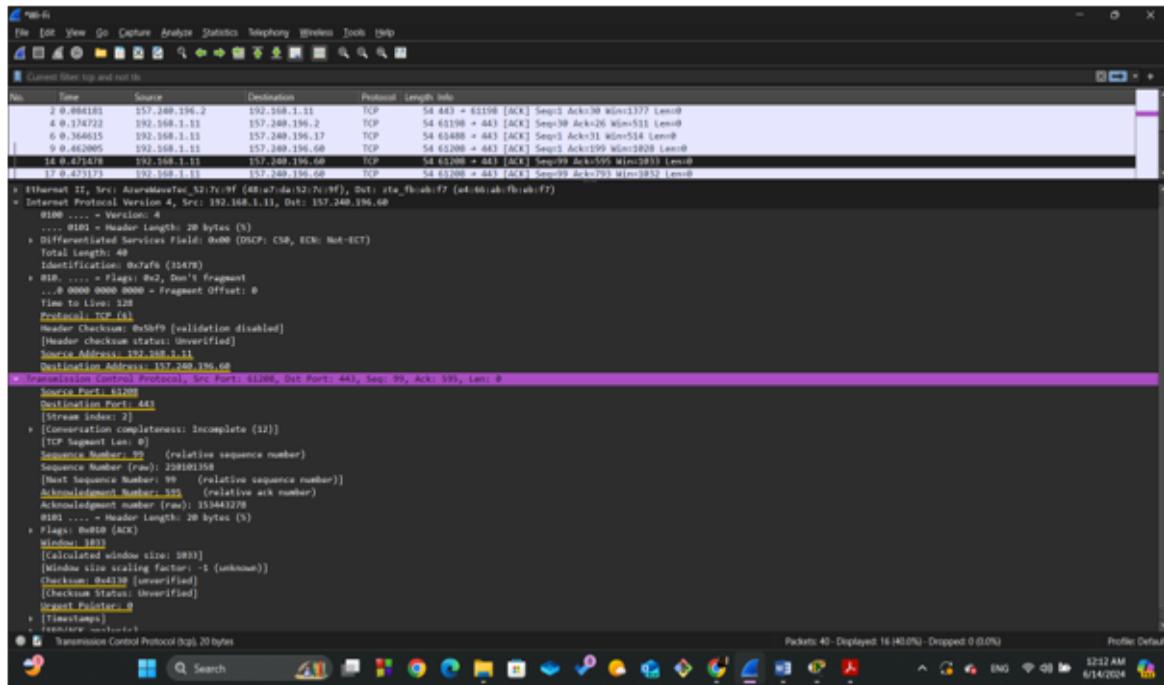


Figure 1: Tcp connection

1- Frame Details:

- **Frame Number:** 14
- **Frame Length:** 54 bytes (432 bits)
- **Capture Length:** 54 bytes (432 bits)

2- Ethernet II Header:

- **Source MAC Address:** AzureWaveTec_52:7c:9f (48:e7:da:52:7c:9f)
- **Destination MAC Address:** zte_fb:eb:f7 (e4:66:ab:fb:eb:f7)
- **Type:** IPv4 (0x0800)

3- Internet Protocol Version 4 (IPv4) Header:

- **Source IP Address:** 192.168.1.11
- **Destination IP Address:** 157.240.196.60
- **Time to Live (TTL):** 128

- **Protocol:** TCP (6)
 - **Total Length:** 40
 - **Identification:** 0x7af6 (31478)
 - **Flags:** Don't Fragment (0x2)

4- Transmission Control Protocol (TCP) Header:

- **Source Port:** 61208
 - **Destination Port:** 443 (typically HTTPS)
 - **Sequence Number:** 99 (relative sequence number)
 - **Acknowledgment Number:** 595 (relative ack number)
 - **Header Length:** 20 bytes
 - **Flags:** ACK (0x10)
 - **Flags Breakdown:**
 - **ACK:** Set (acknowledges received data)
 - **RST, FIN, SYN:** Not set
 - **Window Size:** 1033
 - **Checksum:** 0x4130 (unverified)
 - **Urgent Pointer:** 0
 - **TCP Segment Length:** 0

1.2 DHCP packet.

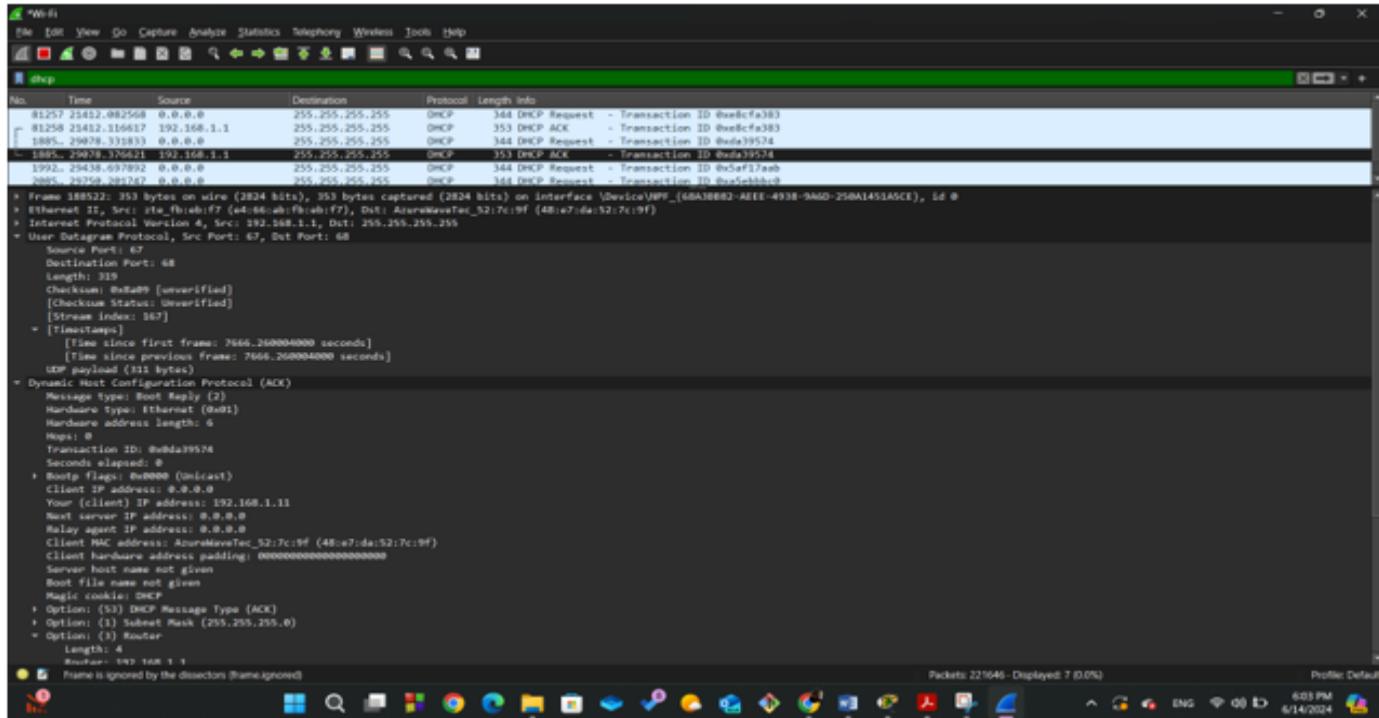


Figure 2:DHCP packet

1- Frame and Ethernet Details:

- **Frame Number:** 188522
- **Frame Length:** 353 bytes (2824 bits)
- **Capture Length:** 353 bytes (2824 bits)
- **Encapsulation type:** Ethernet
- **Source MAC Address:** zte_fb:eb(e4:66:ab:fb:eb)
- **Destination MAC Address:** AzureWaveTec_52:7c:9f (48:e7:da:52:7c:9f)

2- Internet Protocol (IP) Details:

- **Source IP Address:** 192.168.1.1
- **Destination IP Address:** 255.255.255.255
- **Protocol:** UDP (17)
- **Header Length:** 20 bytes

3- User Datagram Protocol (UDP) Details:

- **Source Port:** 67
- **Destination Port:** 68
- **Length:** 319 bytes

4- Dynamic Host Configuration Protocol (DHCP) Details:

- **Message Type:** Boot Reply (2)
- **Hardware Type:** Ethernet (0x01)
- **Hardware Address Length:** 6
- **Hops:** 0
- **Transaction ID:** 0x0da39574
- **Seconds Elapsed:** 0
- **Bootp Flags:** 0x0000 (Unicast)
- **Client IP Address:** 0.0.0.0
- **Your (client) IP Address:** 192.168.1.11
- **Next Server IP Address:** 0.0.0.0
- **Relay Agent IP Address:** 0.0.0.0
- **Client MAC Address:** AzureWaveTec_52:7c:9f (48:e7:da:52:7c:9f)

5- DHCP Options:

- **Option 53 (DHCP Message Type):** ACK (5)
- **Option 1 (Subnet Mask):** 255.255.255.0
- **Option 3 (Router):** 192.168.1.1
- **Option 6 (Domain Name Server):** 192.168.1.1
- **Option 54 (DHCP Server Identifier):** 192.168.1.1
- **Option 51 (IP Address Lease Time):** 1 day (86400 seconds)
- **Option 125 (V-I Vendor-specific Information):** Length: 35, Enterprise: Broadband Forum (3561)

- **Option 255 (End):** End of DHCP options

6- Significance of the DHCP ACK:

- **ACK Message:** The DHCP ACK message type indicates that the server has acknowledged and accepted the DHCP Request from the client.
- **Assigned IP Address:** The server has assigned the IP address 192.168.1.11 to the client.
- **Subnet Mask:** The subnet mask provided is 255.255.255.0, defining the network's address range.
- **Router (Default Gateway):** The default gateway is 192.168.1.1, typically the IP address of the router.
- **DNS Server:** The DNS server provided is also 192.168.1.1.
- **Lease Time:** The IP address lease time is 1 day (86400 seconds), indicating how long the IP address is valid before the client must request a renewal.

1.3 ICMP packet.

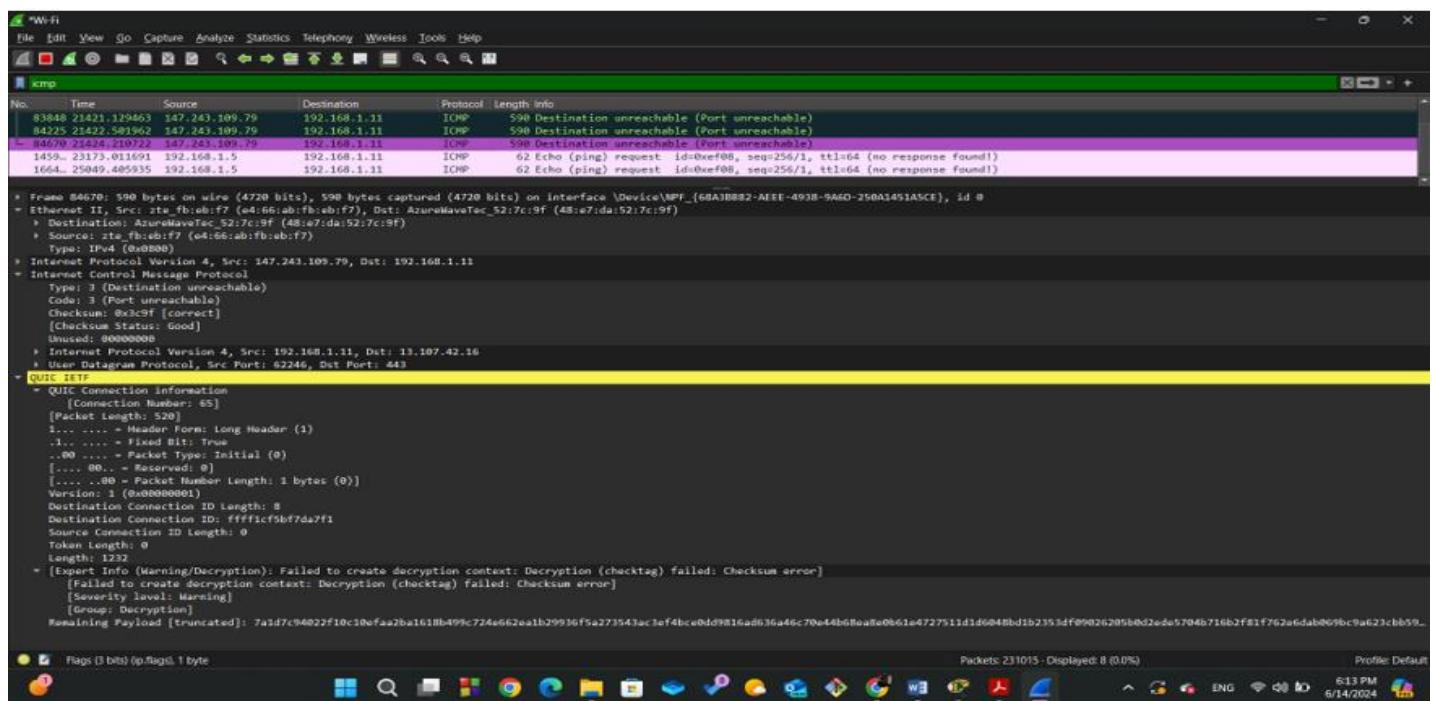


Figure 3: ICMP packet

1- Frame Details:

- **Frame Number:** 84670
- **Arrival Time:** Jun 14, 2024 15:36:36.994861 Jerusalem Daylight Time
- **Capture Length:** 590 bytes

2- Protocols in Frame:

- Ethernet
- IPv4
- ICMP
- IPv4 (embedded in ICMP payload)
- UDP (embedded in ICMP payload)
- QUIC (embedded in ICMP payload)

3- Ethernet II

- **Source:** zte_fb:eb(e4:66:ab:fb:eb)
- **Destination:** AzureWaveTec_52:7c:9f (48:e7:da:52:7c:9f)
- **Type:** IPv4 (0x0800)

4- Internet Protocol Version 4 (IPv4)

- **Source IP:** 147.243.109.79
- **Destination IP:** 192.168.1.11
- **Total Length:** 576
- **Identification:** 0x28c4 (10436)
- **Time to Live (TTL):** 117
- **Protocol:** ICMP (1)

5- Internet Control Message Protocol (ICMP)

- **Type:** 3 (Destination Unreachable)
- **Code:** 3 (Port Unreachable)
- **Checksum:** 0x3c9f [correct]

6- Embedded IPv4 Header (within ICMP payload)

- **Source IP:** 192.168.1.11
- **Destination IP:** 13.107.42.16
- **Total Length:** 1278
- **Identification:** 0x5887 (22663)
- **Time to Live (TTL):** 122
- **Protocol:** UDP (17)

7- User Datagram Protocol (UDP)

- **Source Port:** 62246
- **Destination Port:** 443
- **Length:** 1258

8- QUIC (Quick UDP Internet Connections)

- **Packet Type:** Initial (0)
- **Version:** 1 (0x00000001)
- **Destination Connection ID:** ffff1cf5bf7da7f1

Part2: Packet Tracer

Part0: IP Subnetting and Assignment

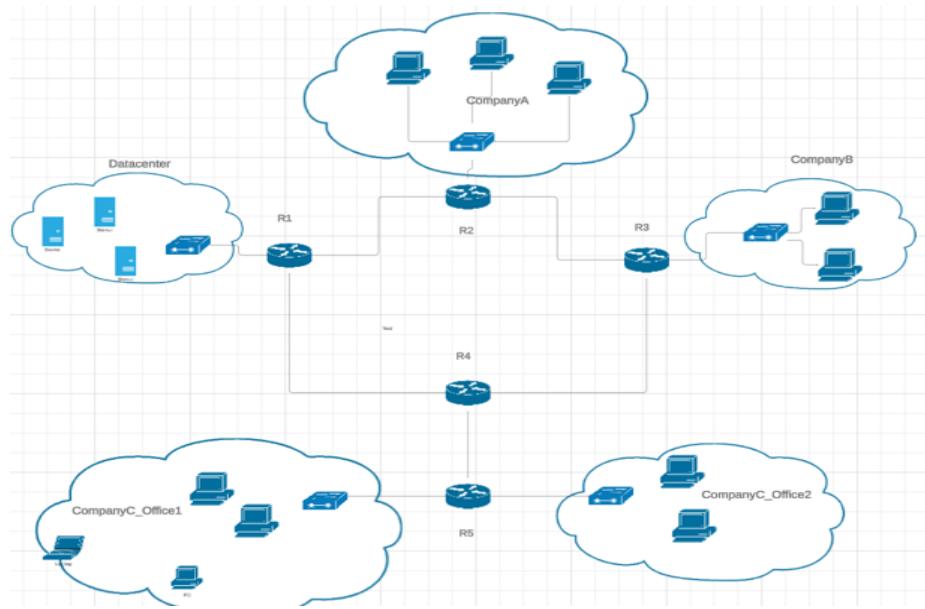


Figure 4: The Network Layout

As we see in the figure, we have a network consisting of 5 subnets. To determine the subnets, detach each interface from its host or router. Since the id is 0, then the IP address is 0

Procedure of Subnetting

To determine the best solution, we structured our approach around the number of devices connected within each network. For instance, networks with 26 devices are configured with a 5-bit allocation for the host address, which supports up to 32 devices. Likewise, networks hosting 12 devices utilize a 4-bit allocation, accommodating a maximum of 16 devices. Please refer to Table 1 for a detailed breakdown of this topology.

| <i>Subnet</i> | <i>Subnet Mask</i> | <i>Network</i> | <i>Broadcast</i> | <i>First IP</i> | <i>Last IP</i> | <i>Max IPs</i> |
|---------------------------|--------------------|-----------------|------------------|-----------------|----------------|----------------|
| <i>Data Center</i> | 255.255.255.192 | 103.82.4.0/26 | 103.82.4.63 | 103.82.4.1 | 103.82.4.62 | 62 |
| <i>Company A</i> | 255.255.255.224 | 103.82.4.64/27 | 103.82.4.95 | 103.82.4.65 | 103.82.4.94 | 30 |
| <i>Company B</i> | 255.255.255.224 | 103.82.4.96/27 | 103.82.4.127 | 103.82.4.97 | 103.82.4.126 | 30 |
| <i>Company C Office 1</i> | 255.255.255.240 | 103.82.4.128/28 | 103.82.4.143 | 103.82.4.129 | 103.82.4.142 | 14 |
| <i>Company C Office 2</i> | 255.255.255.224 | 103.82.4.144/27 | 103.82.4.159 | 103.82.4.145 | 103.82.4.158 | 14 |
| <i>R1-R2 Link</i> | 255.255.255.252 | 103.82.4.160/30 | 103.82.4.163 | 103.82.4.161 | 103.82.4.162 | 2 |
| <i>R2-R3 Link</i> | 255.255.255.252 | 103.82.4.164/30 | 103.82.4.167 | 103.82.4.165 | 103.82.4.166 | 2 |
| <i>R3-R4 Link</i> | 255.255.255.252 | 103.82.4.168/30 | 103.82.4.171 | 103.82.4.169 | 103.82.4.170 | 2 |
| <i>R4-R1 Link</i> | 255.255.255.252 | 103.82.4.172/30 | 103.82.4.175 | 103.82.4.173 | 103.82.4.174 | 2 |
| <i>R4-R5 Link</i> | 255.255.255.252 | 103.82.4.176/30 | 103.82.4.179 | 103.82.4.177 | 103.82.4.178 | 2 |

Table 1:Subnetting details

Part1 : Topology

Building the Topology

In this part, we use packet tracer to build the topology based on the IPs found in Part 0

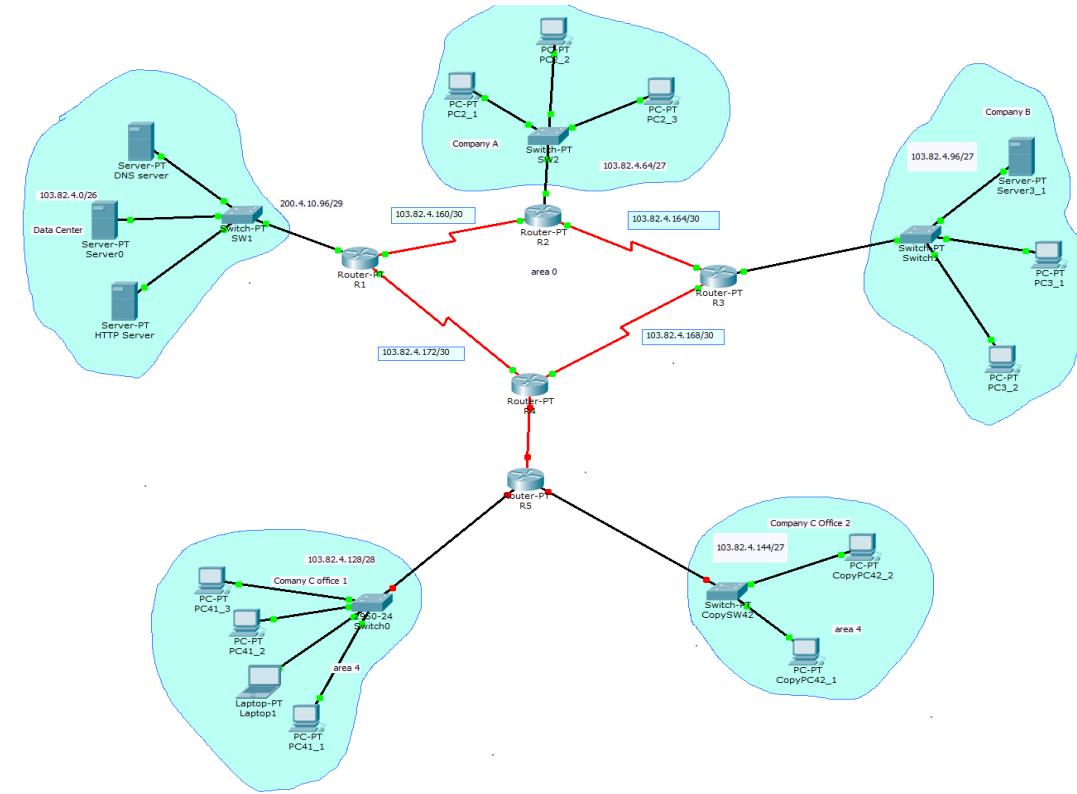


Figure 5:Built Topology using Packet Tracer

Routers Configurations

The configuration of the routers was carried out in accordance with the details presented in Table 1, which is depicted in Figure 5, taking into account one of the student IDs in our group which is "1210382".

For Router 1 (R1), the FastEthernet0/0 interface has been assigned the IP address 103.82.4.1 with a subnet mask of 255.255.255.192. Additionally, its Serial2/0 port has been configured with the IP address 103.82.4.161 and a subnet mask of 255.255.255.252. The Serial3/0 port on the same router has been assigned an IP address of 103.82.4.171 , using a subnet mask of 255.255.255.252. These configurations are illustrated in Figures 6, 7, and 8.

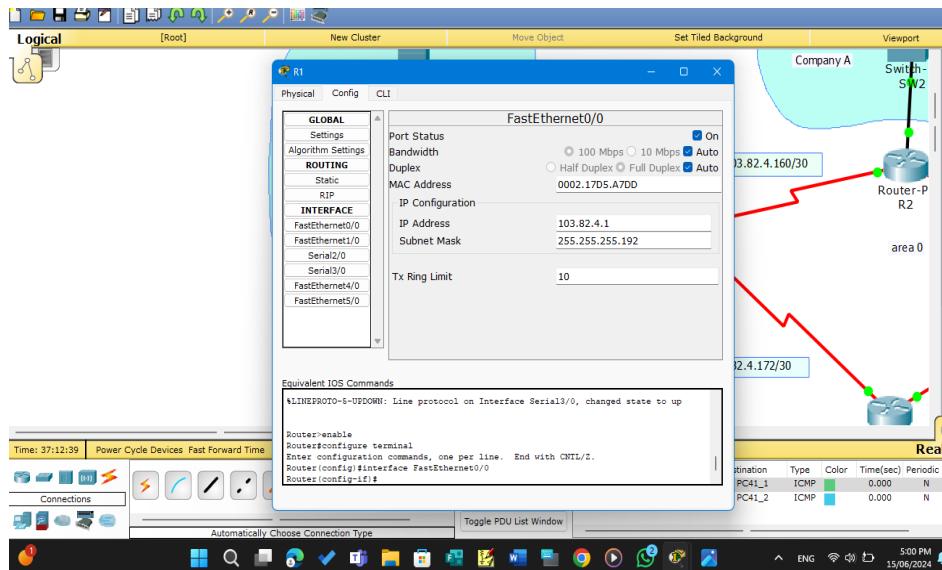


Figure 6: R1 Ethernet0/0 Configurations

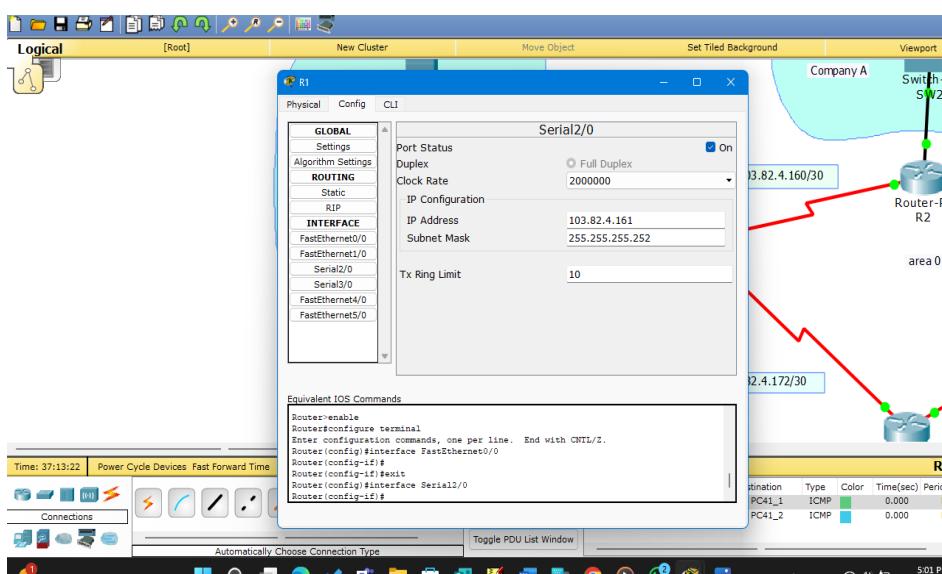


Figure 7: R1 Serial2/0 Configurations

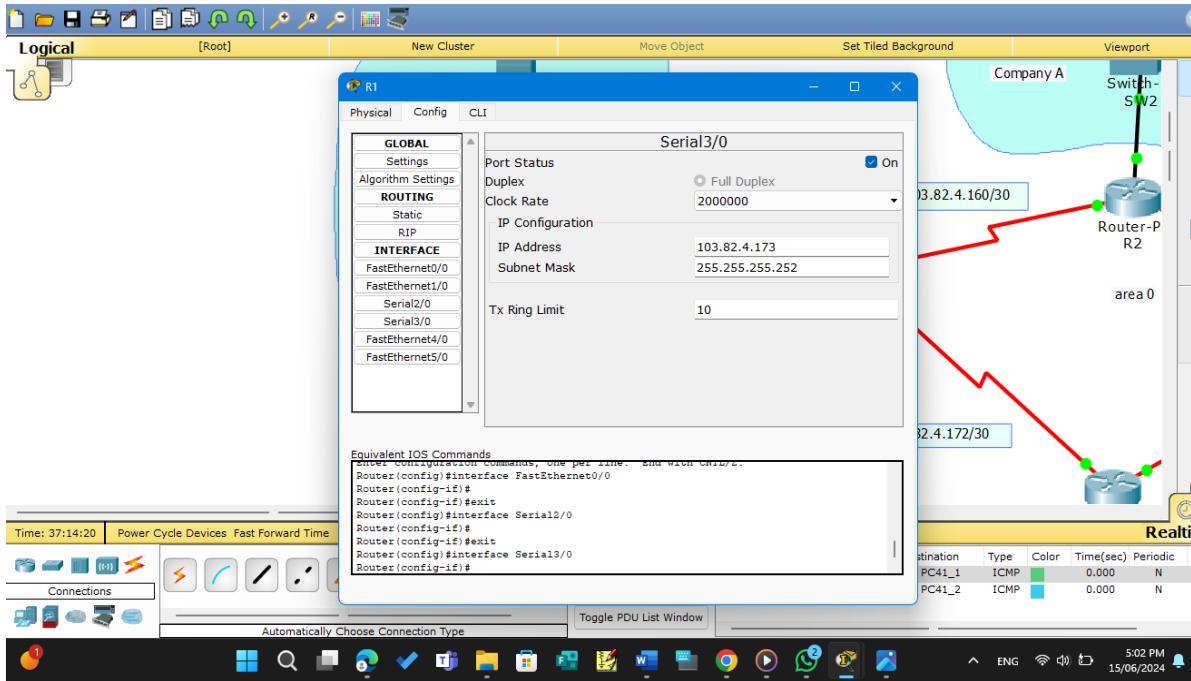


Figure 8: R1 Serial3/0 Configurations

For Router 2 (R2), the FastEthernet0/0 interface has been assigned the IP address 103.82.4.65 with a subnet mask of 255.255.255.224. Additionally, its Serial2/0 port has been configured with the IP address 103.82.4.165 and a subnet mask of 255.255.255.252. The Serial3/0 port on the same router has been assigned an IP address of 200.4.10.161, using a subnet mask of 255.255.255.252. These configurations are illustrated in Figures 9, 10, and 11

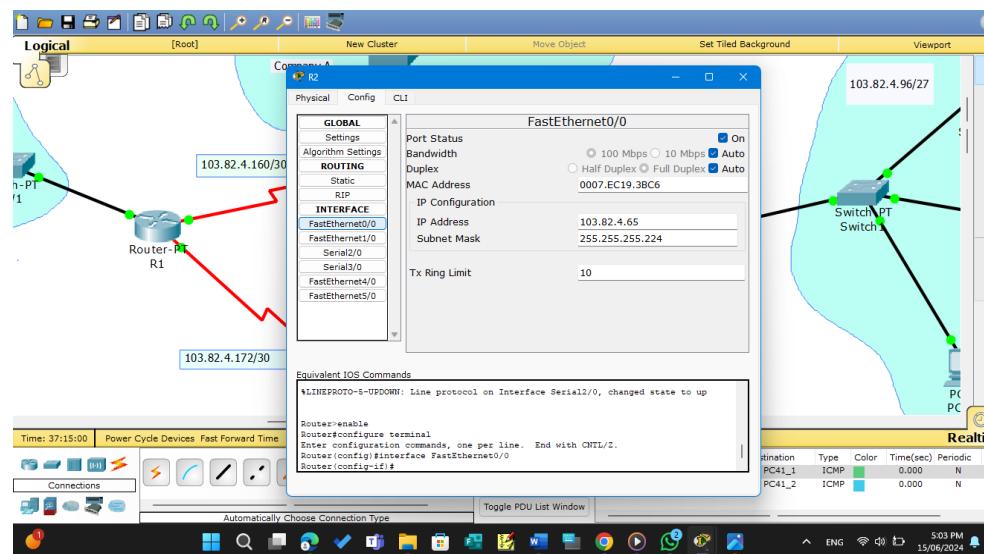


Figure 9: R2 Ethernet0/0 Configurations:

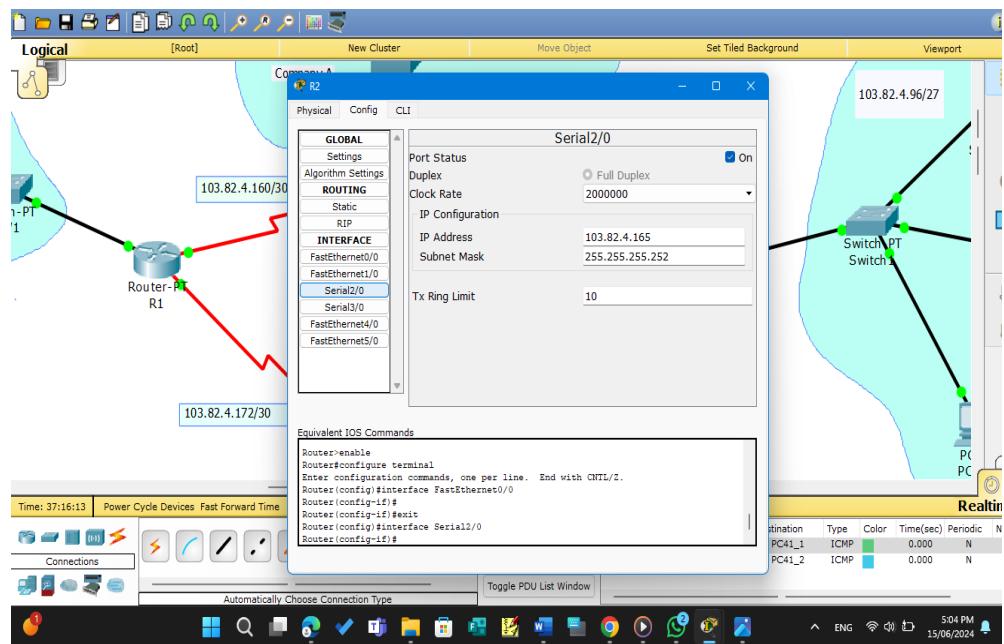


Figure 10:R2 Serial2/0 Configurations

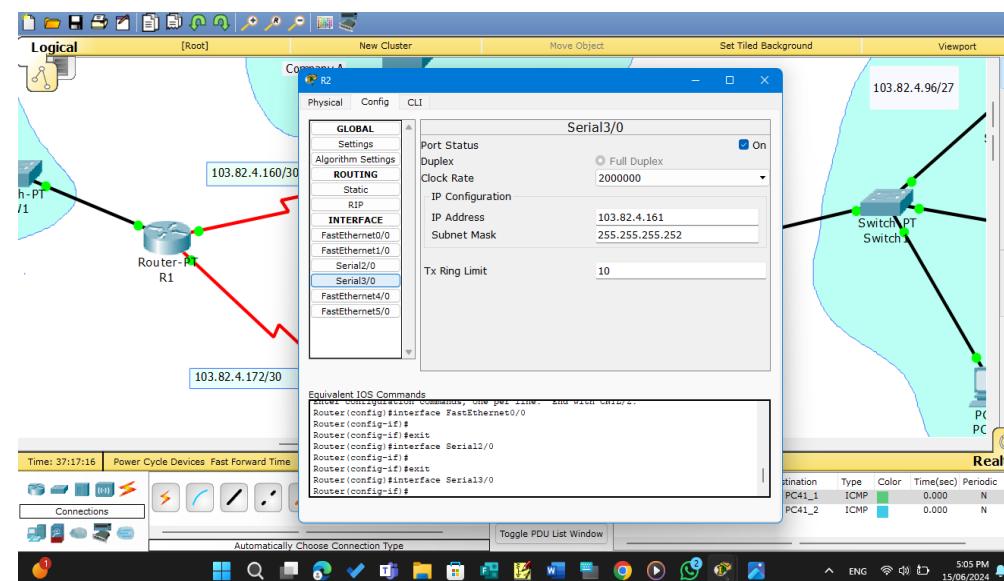


Figure 11:R2 Serial3/0 Configurations

For Router 3 (R3), the FastEthernet0/0 interface has been assigned the IP address 103.82.4.97 with a subnet mask of 255.255.255.224. Additionally, its Serial2/0 port has been configured with the IP address 103.82.4.169 and a subnet mask of 255.255.255.252. The Serial3/0 port on the same router has been assigned an IP address of 103.82.4.165, using a subnet mask of 255.255.255.252. These configurations are illustrated in Figures 12, 13, and 14.

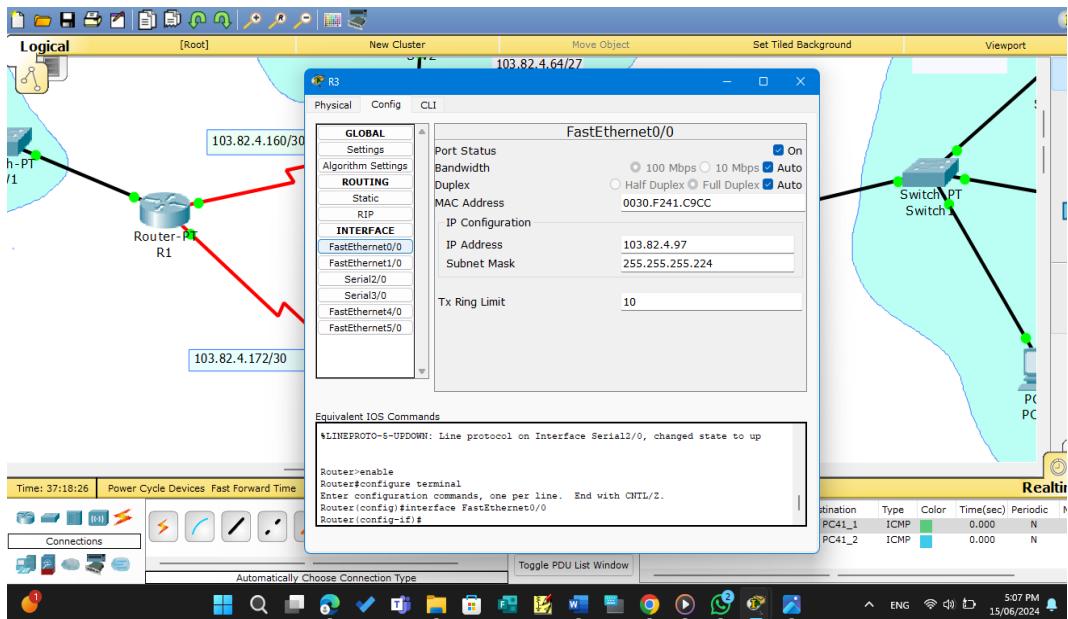


Figure 12:R3 Ethernet0/0 Configurations

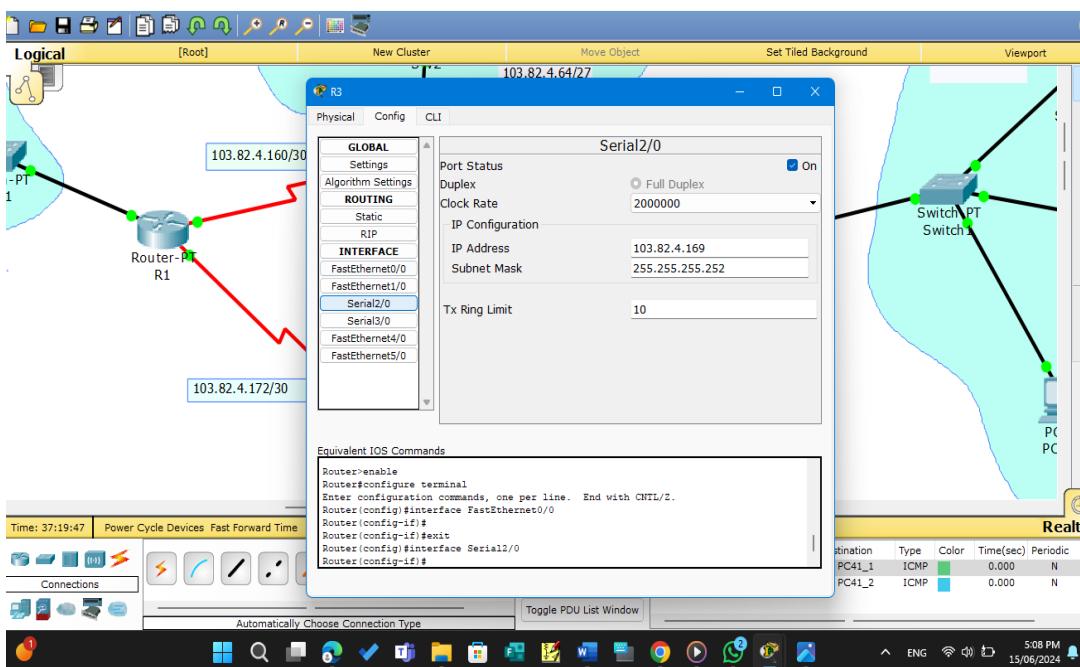


Figure 13:R3 Serial2/0 Configurations

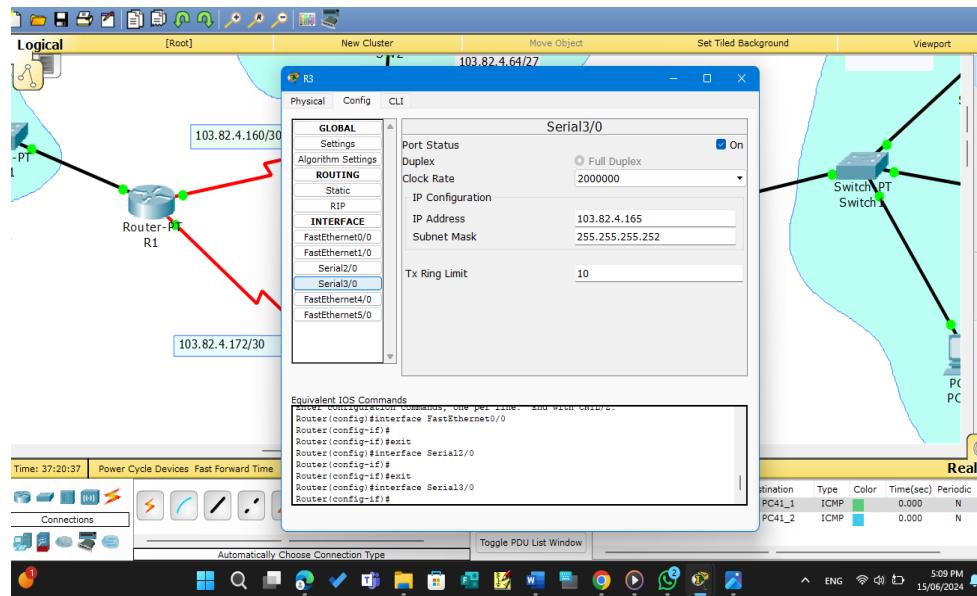


Figure 14: R3 Serial3/0 Configurations

For Router 4 (R4), the FastEthernet0/0 interface has been assigned the IP address 102.82.4.145 with a subnet mask of 255.255.255.224. The Serial2/0 port has been configured with the IP address 103.82.4.177 and a subnet mask of 255.255.255.252. The Serial3/0 port on the same router has been assigned an IP address of 103.82.4.173, using a subnet mask of 255.255.255.252. These configurations are illustrated in Figures 15, 16, 17.

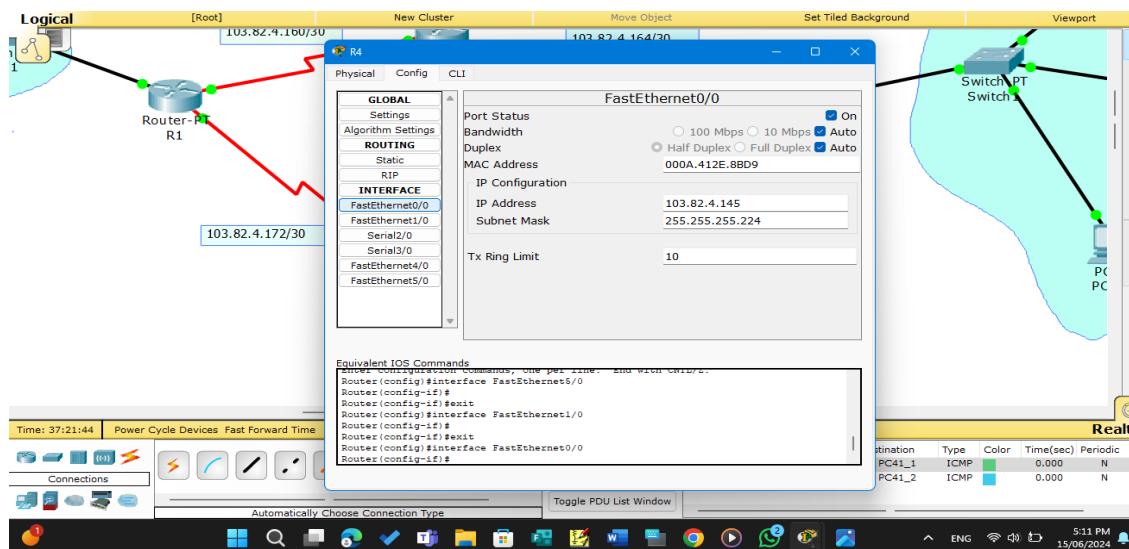


Figure 15: R4 Ethernet0/0 Configurations

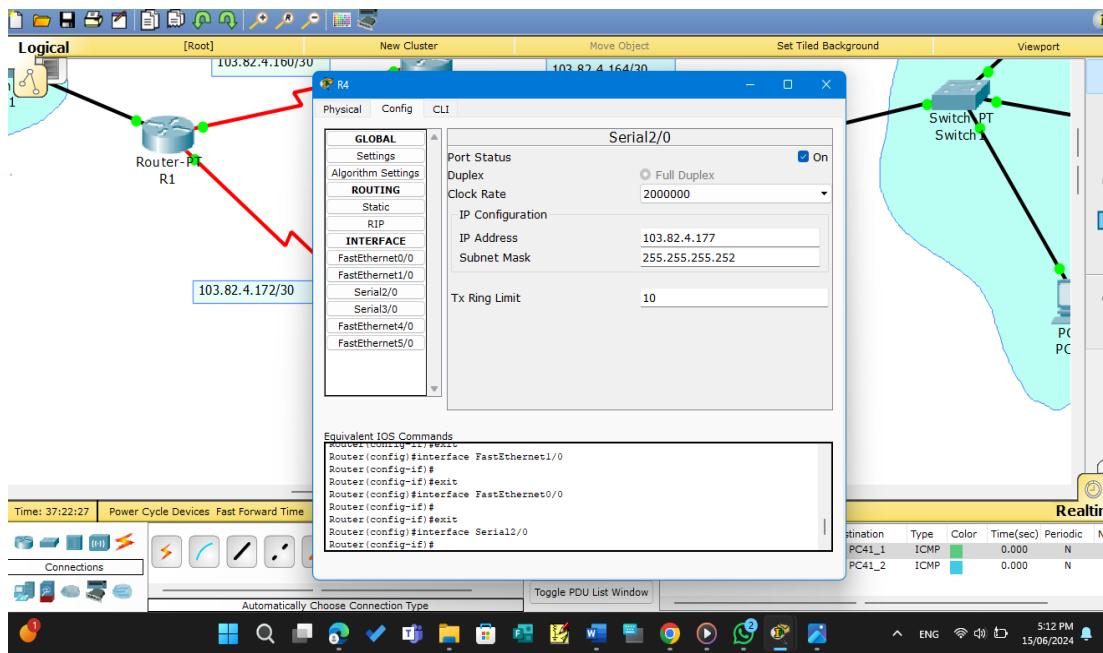


Figure 16: R4 Serial2/0 Configurations

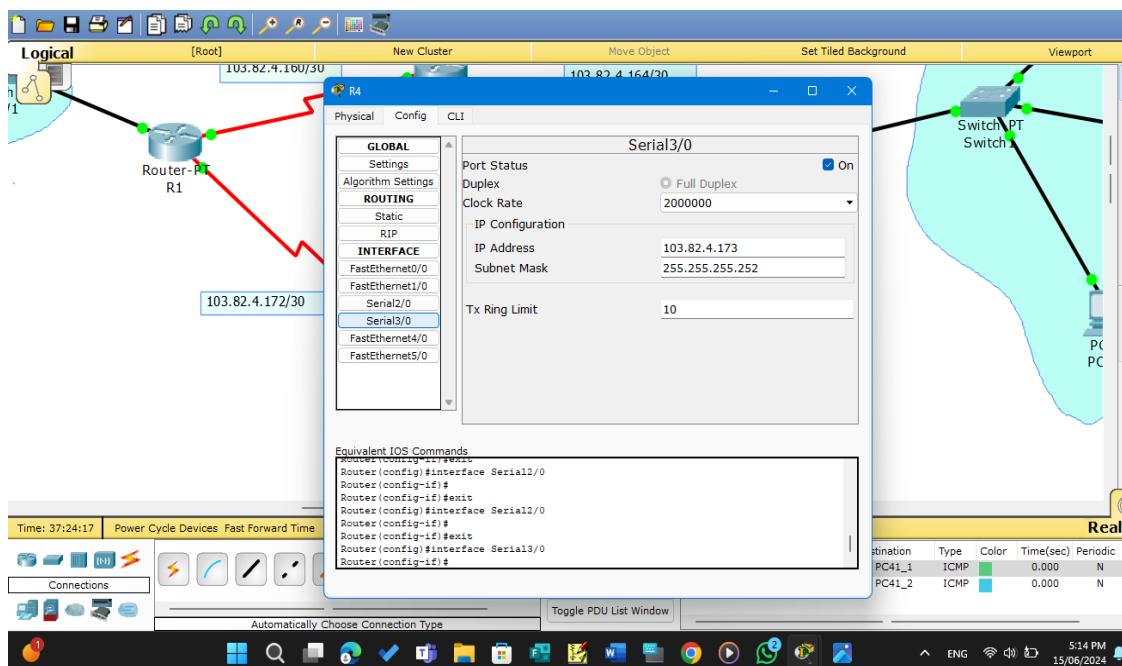


Figure 17: R4 Serial3/0 Configurations

For Router 5(R5), the FastEthernet0/0 interface has been assigned the IP address 103.82.4.129 with a subnet mask of 255.255.255.240. The FastEthernet1/0 interface has been assigned the IP address 103.82.4.146 with a subnet mask of 255.255.255.240. Additionally, its Serial2/0 port has been configured with the IP address 103.82.4.177 and a subnet mask of 255.255.255.252. The Serial3/0 port on the same router has been assigned an IP address of 200.4.10.110, using a subnet mask of 255.255.255.252. These configurations are illustrated in Figures 12, 11, 13, and 14.

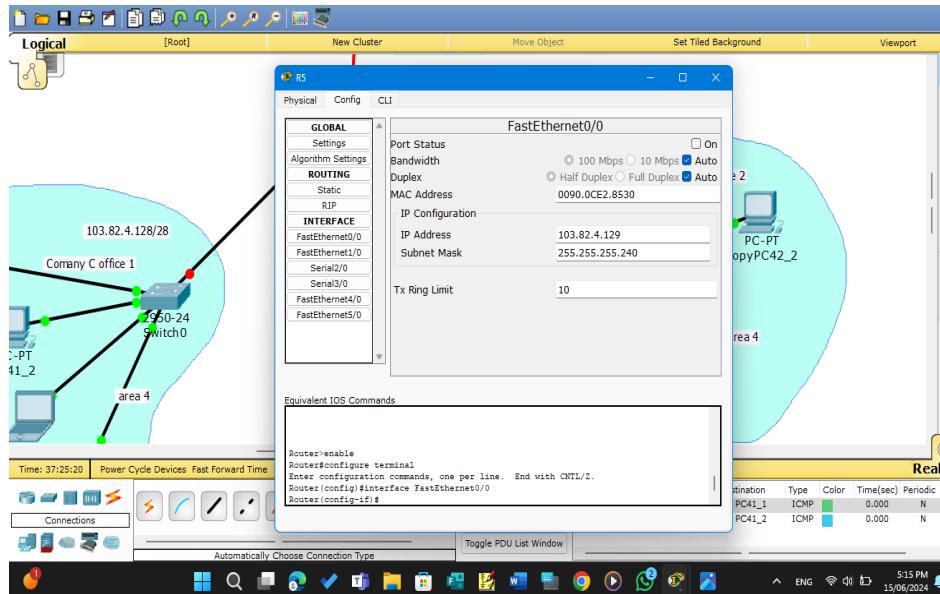


Figure 18:R5 Ethernet0/0 Configurations

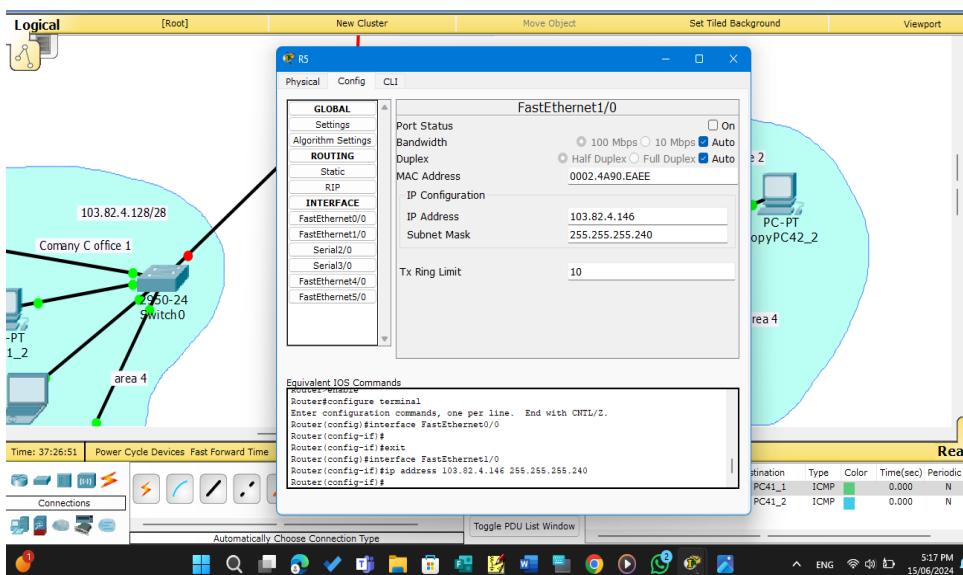


Figure 19:R5 Ethernet1/0 Configurations

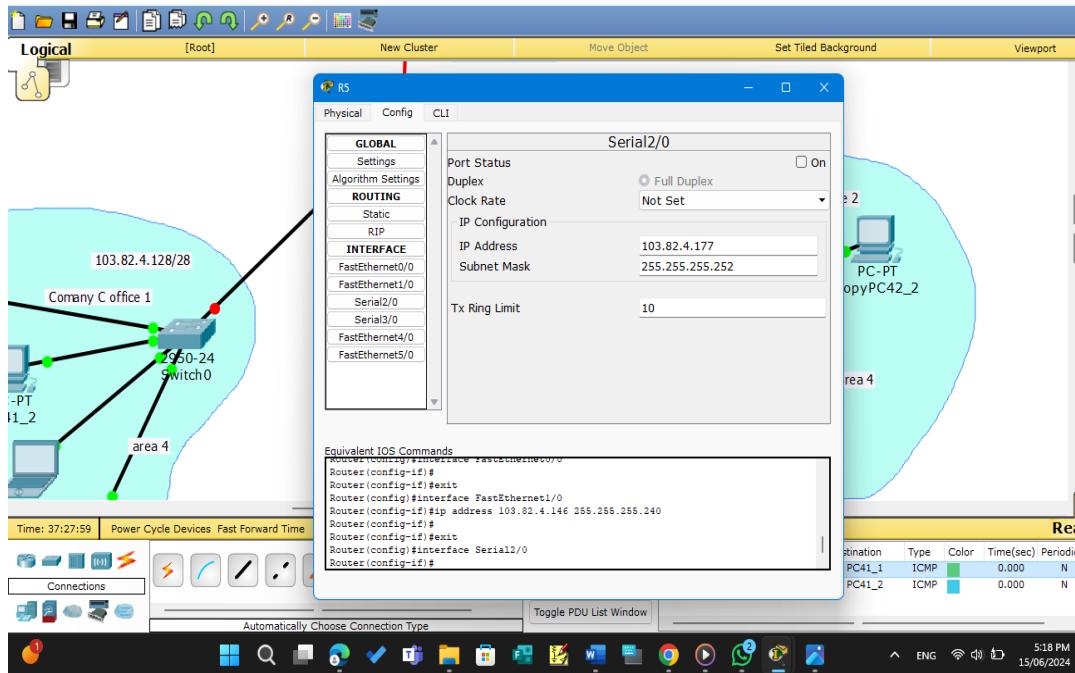


Figure 20: R5 Serial2/0 Configurations

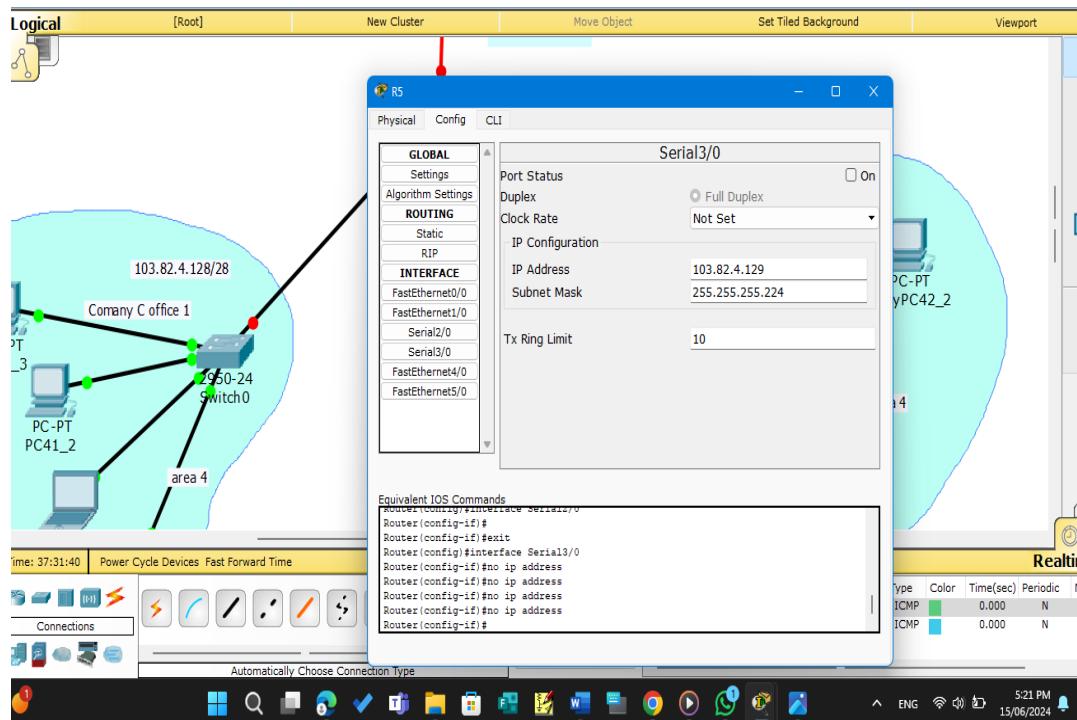


Figure 21: R5 Serial3/0 Configurations

Servers Configurations

For the DNS server, we configured the server's IP address, subnet mask, default gateway, and DNS server using the values shown in Figure 22.

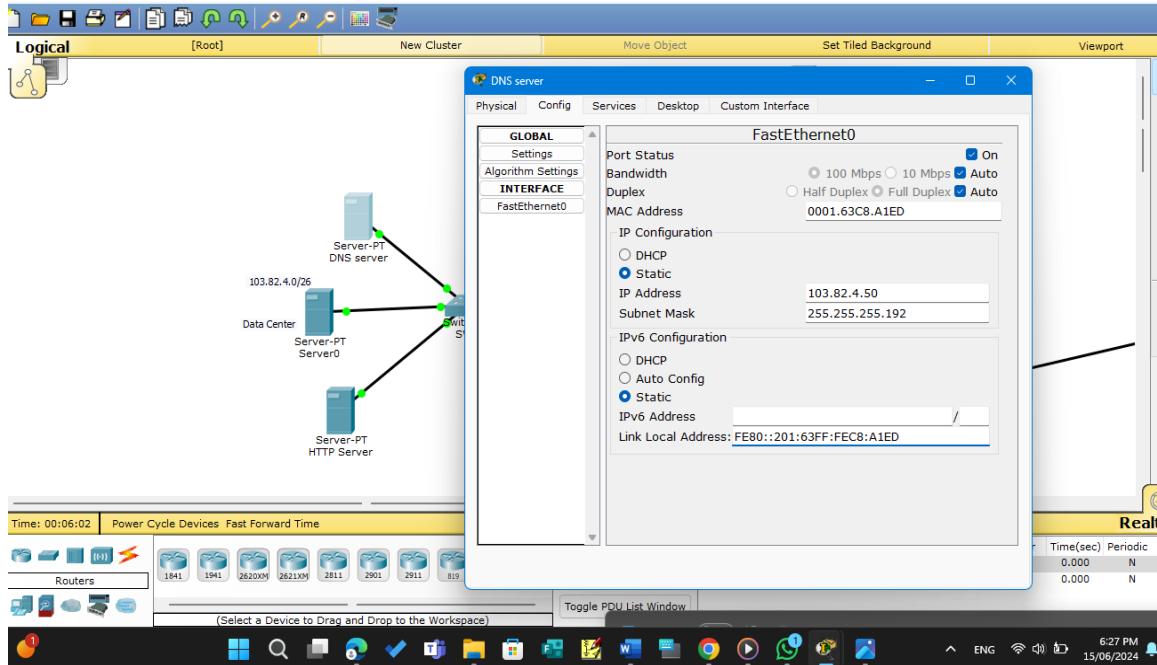


Figure 22: DNS Server Configurations

For the HTTP server, we configured the server's IP address, subnet mask, default gateway, and DNS server values with the parameters shown in Figure 23.

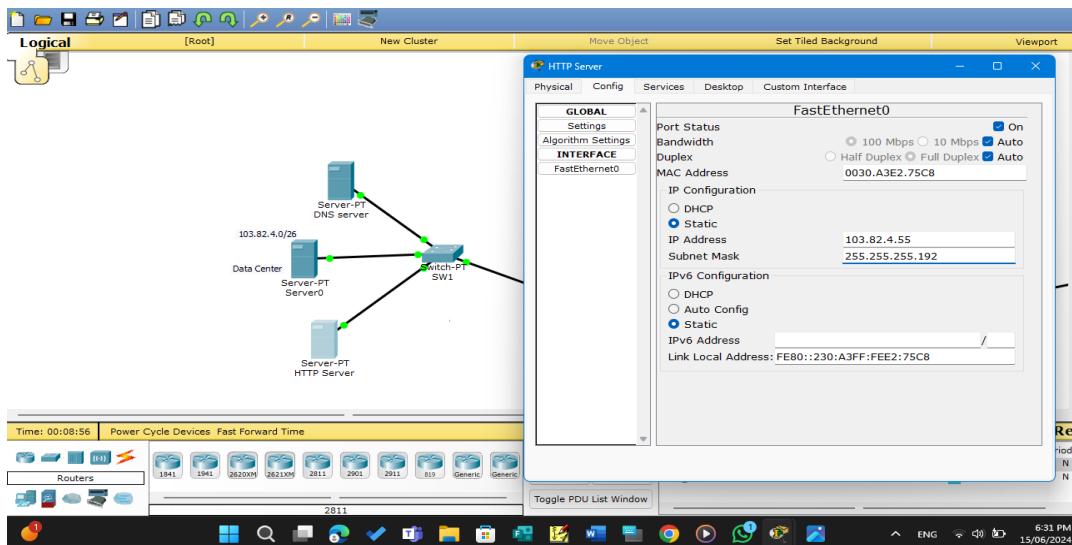


Figure 23:HTTP Server Configurations

the final server which serves as the mail server in Company B's area, we configured its IP address, subnet mask, default gateway, and DNS server values with the parameters shown in Figure24 .

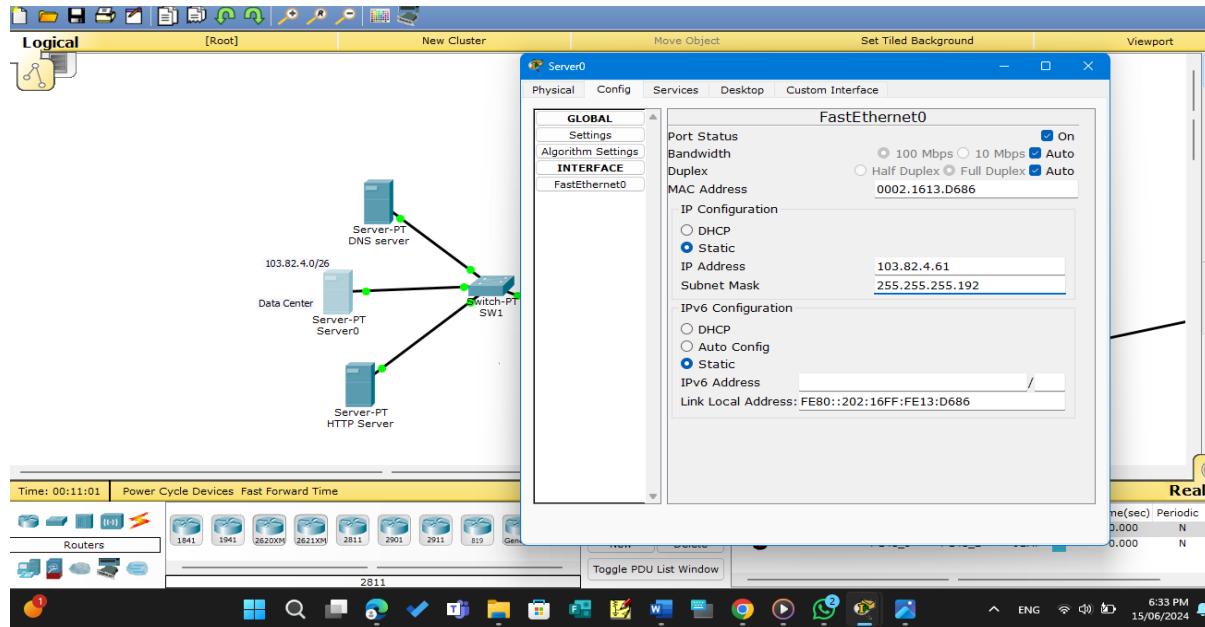


Figure 24: Mail Server Configurations

Finally, we set up the IP address, subnet mask, default gateway, and DNS server for each of our 10 PCs, located in different areas, which are all provided in Figures 25 through 35.

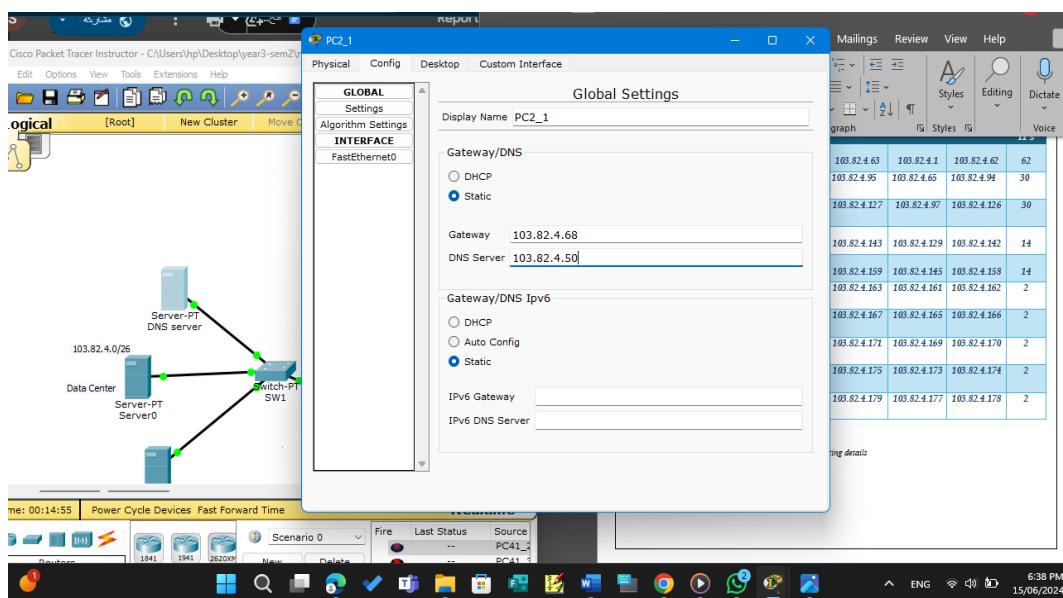


Figure 25:PC2_1 Configuration

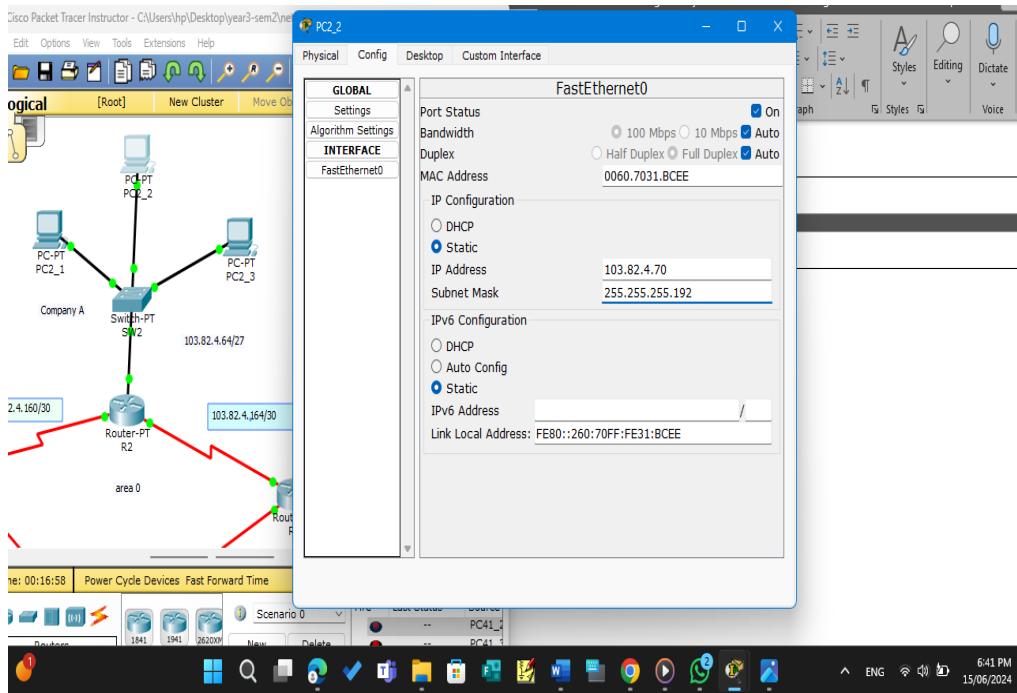


Figure 26: PC2_2 Configuration

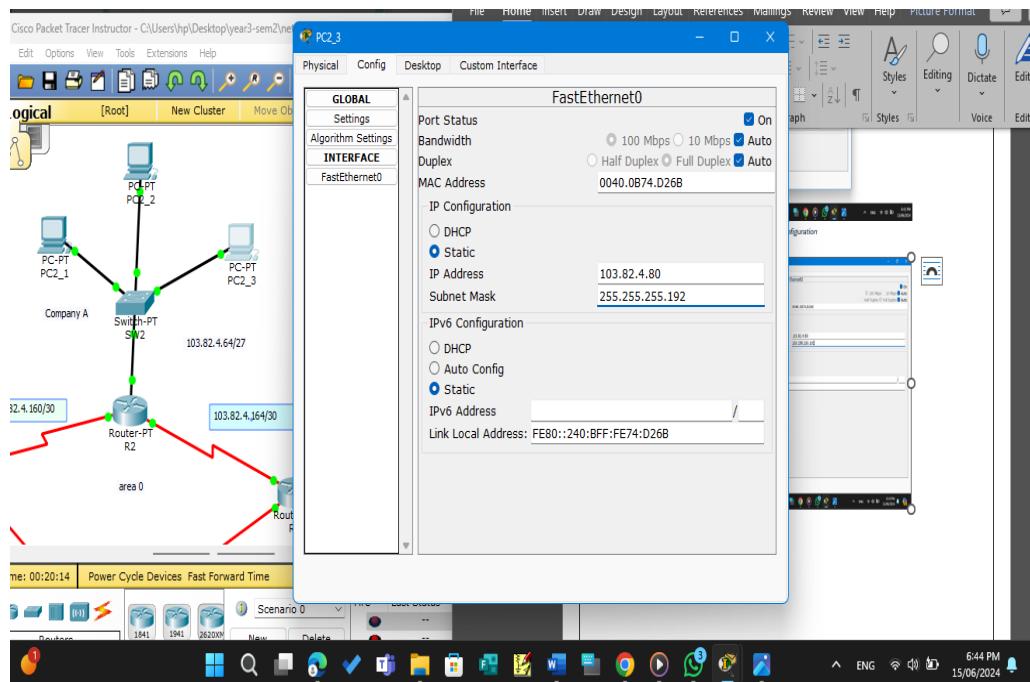


Figure 27: PC2_3 Configuration

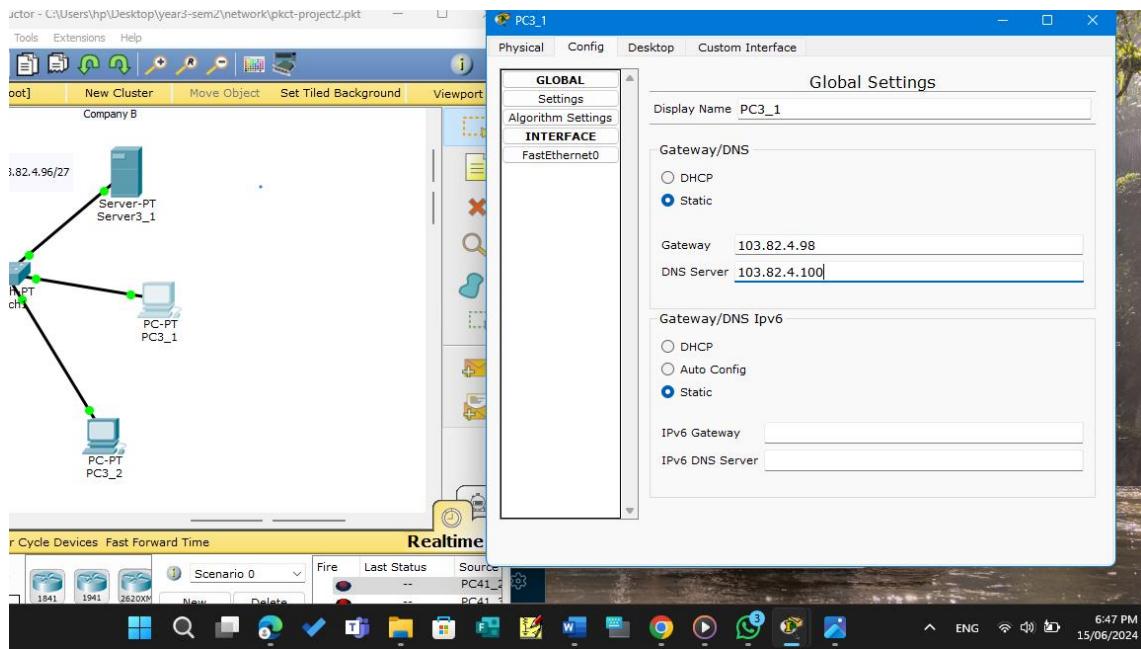


Figure 28:PC3_1 Configuration

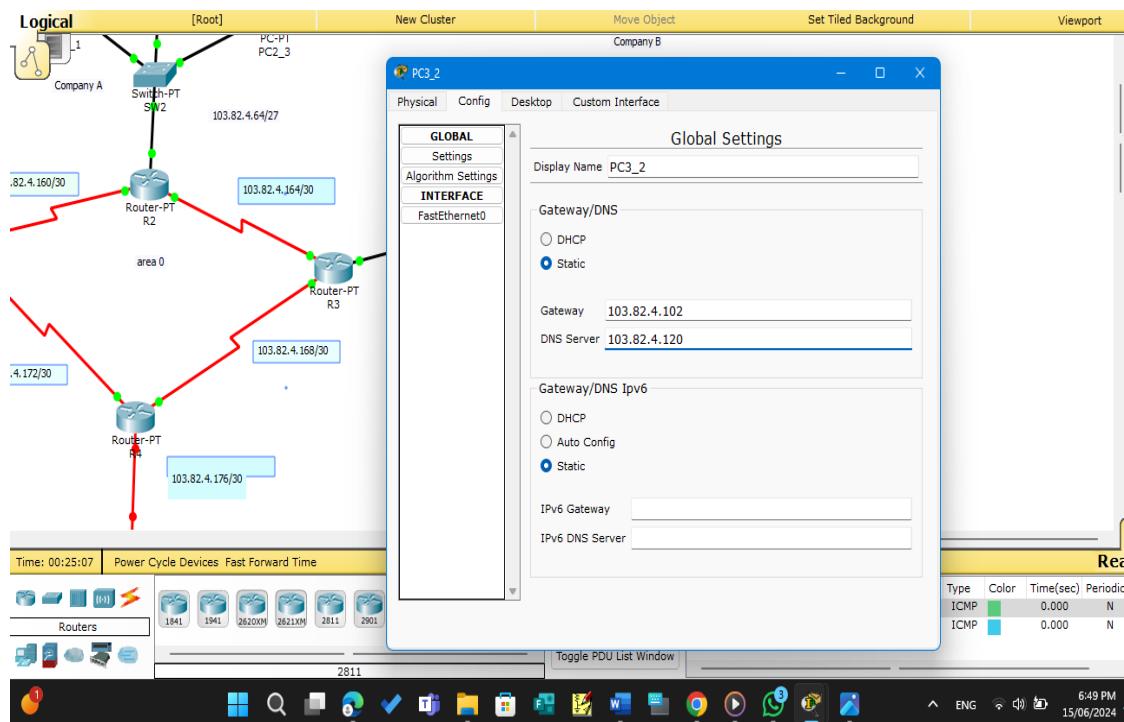


Figure 29:PC3_2 Configuration

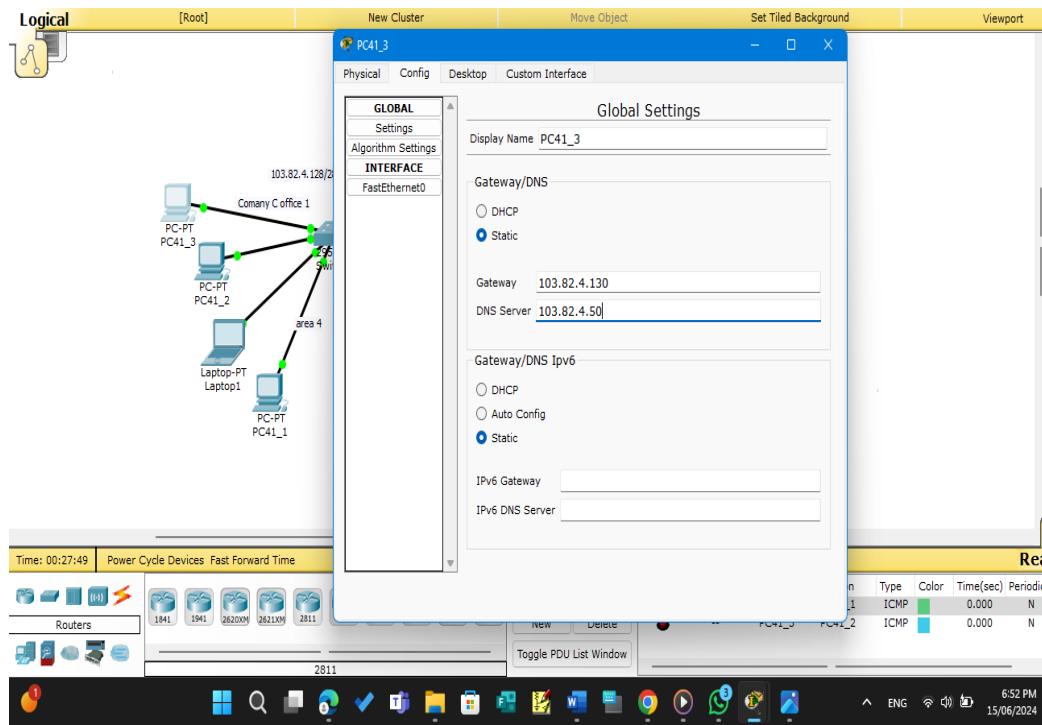


Figure 30:PC41_3 Configuration

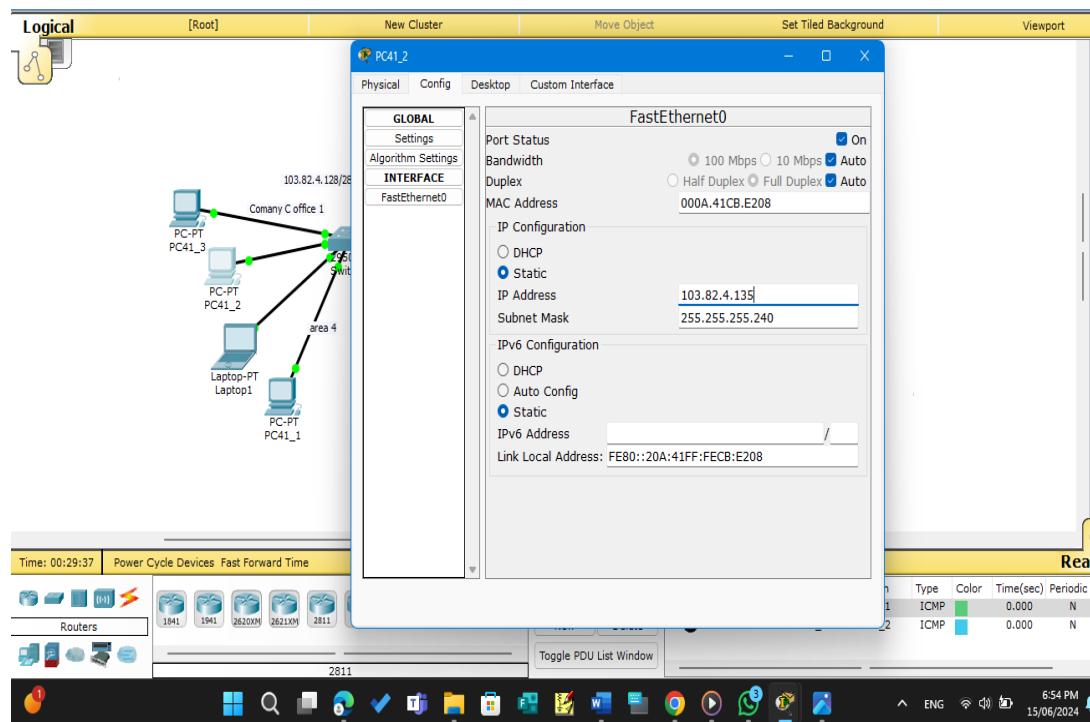


Figure 31:PC41_2 Configuration

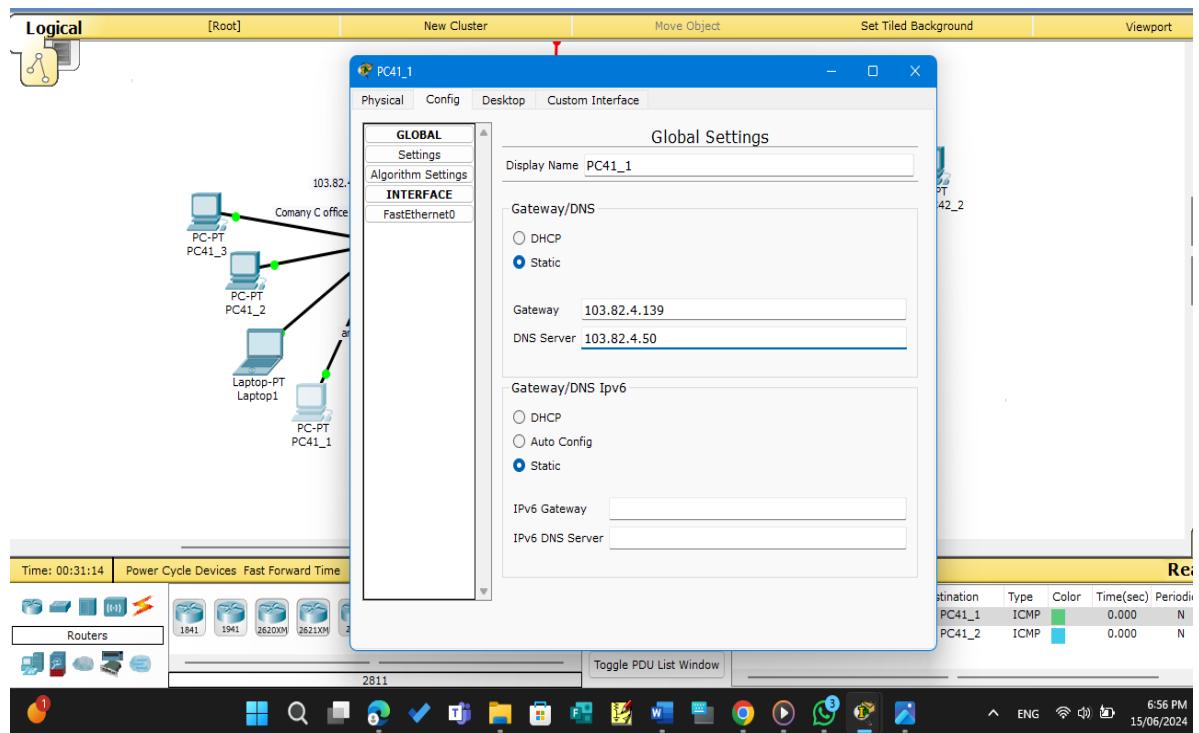


Figure 32:PC41_1 Configuration

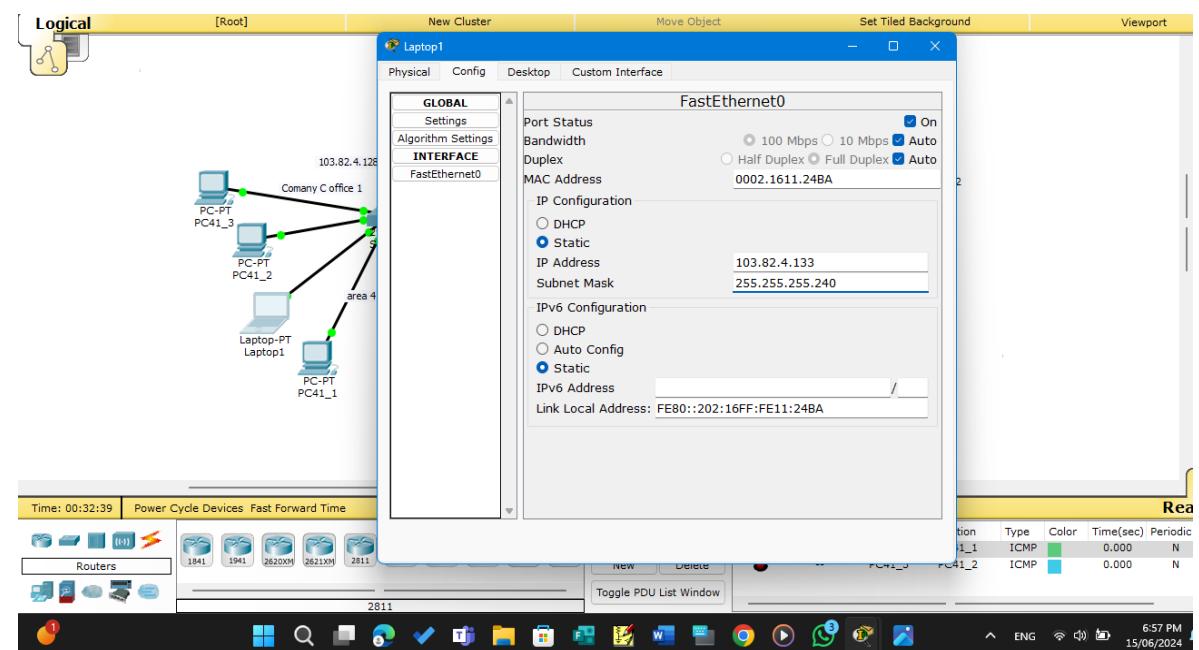


Figure 33:lab1 Configuration

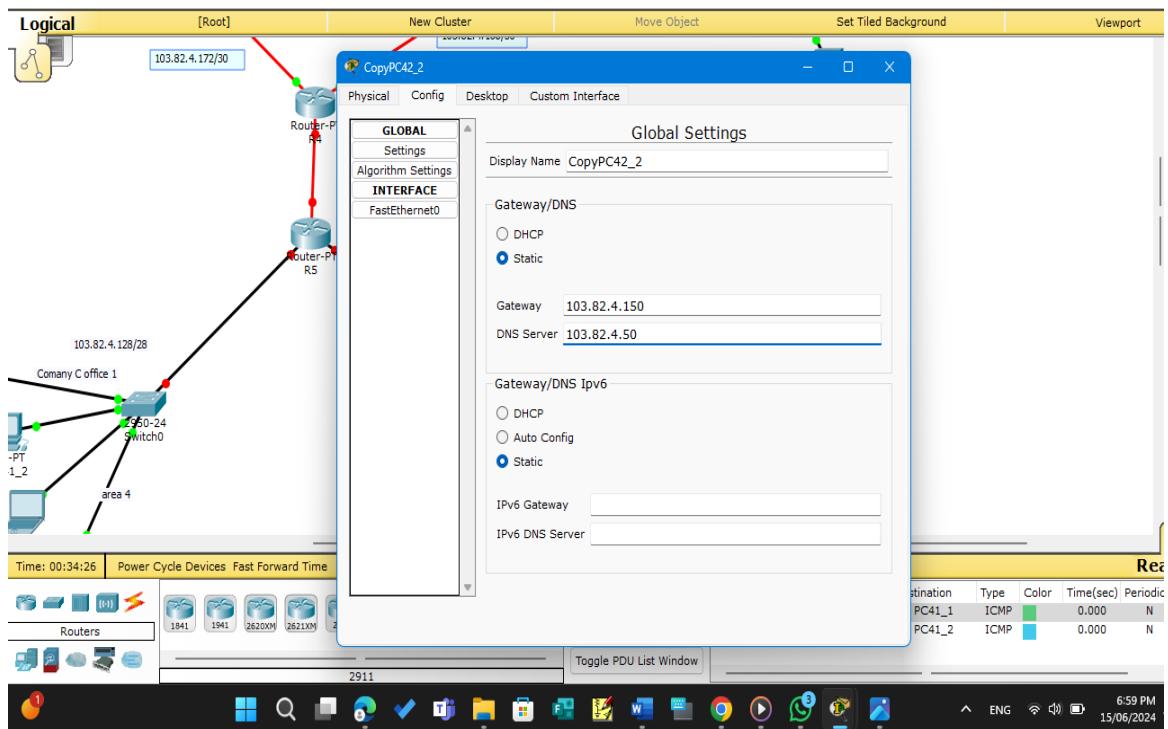


Figure 34:PC42_2 Configuration

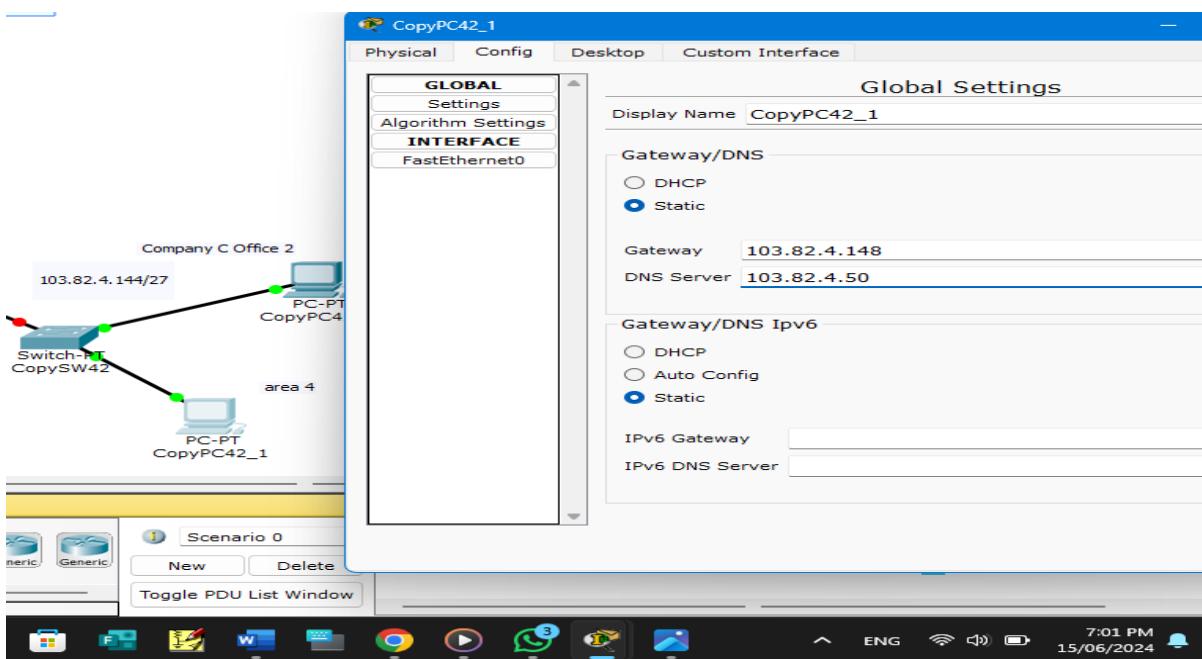


Figure 35:PC42_2 Configuration

Part2: Configuring servers

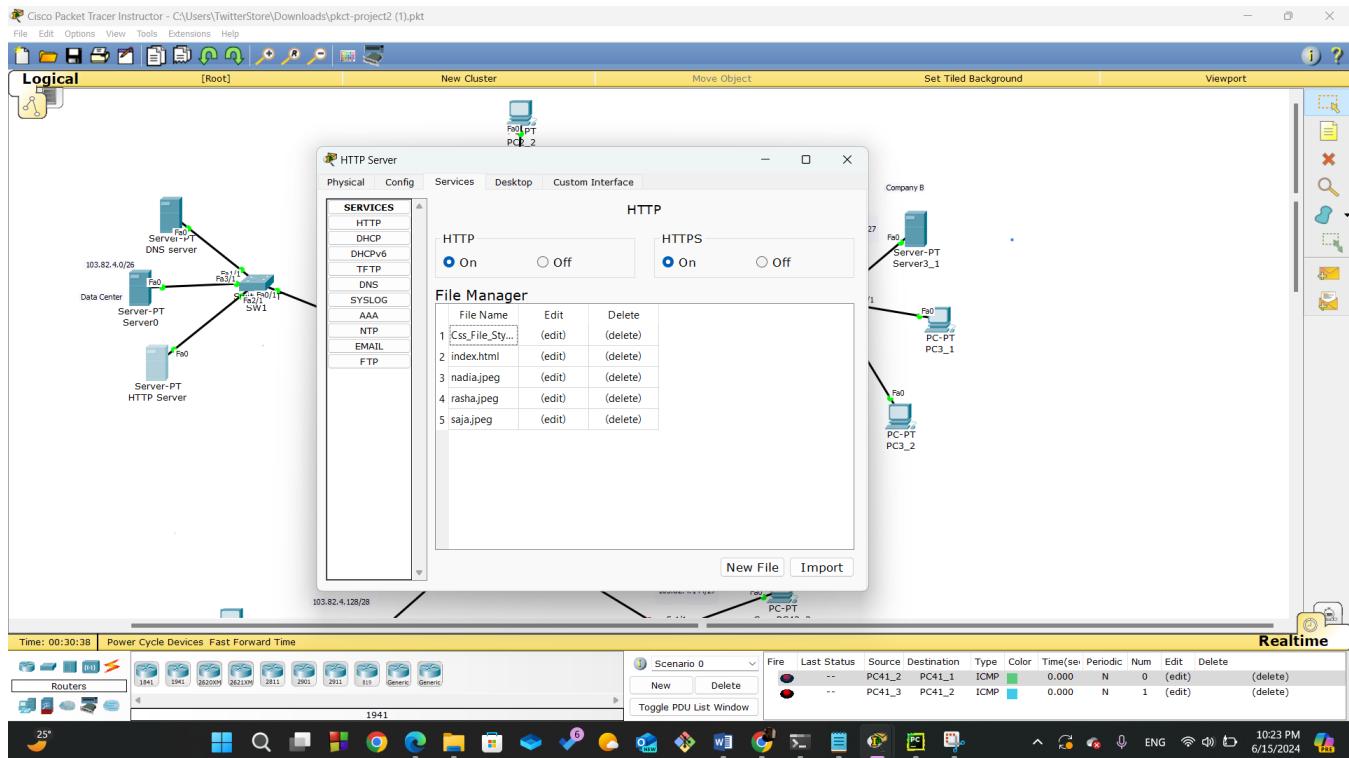


Figure 36: HTTP Server Configuration.

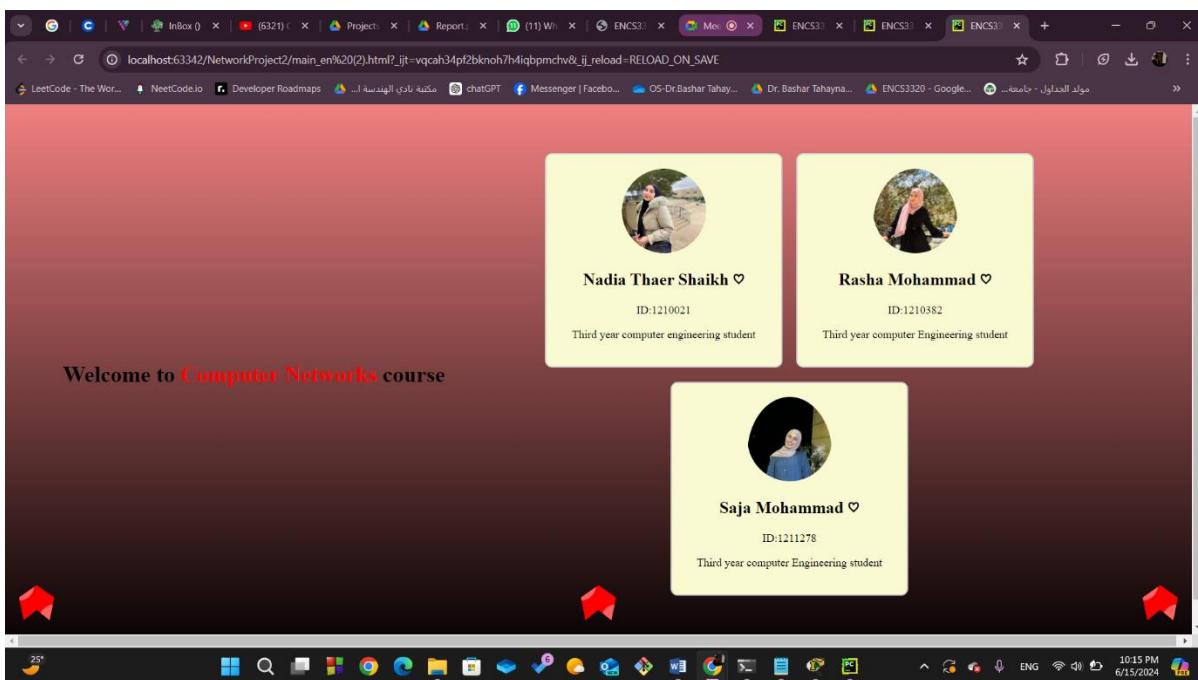


Figure 37: Designed HTML Webpage.

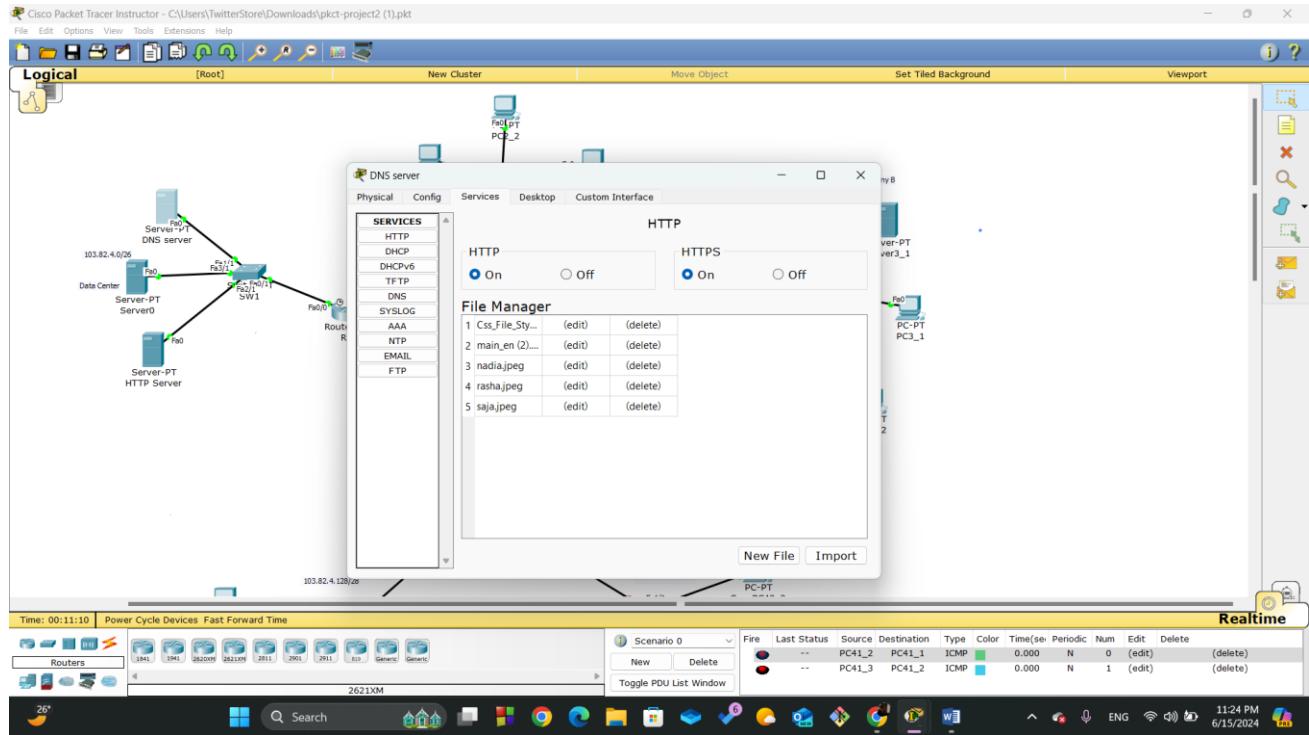


Figure 38: DNS Server Configuration.

Part3: Applying routing protocol

| <i>Figure</i> | <i>Router</i> | <i>Network</i> | <i>Area Connected to network</i> |
|-----------------|---------------|---|----------------------------------|
| Figure 1 | R1 | 103.82.4.67 103.82.4.71 103.82.4.91 | Area 0 |
| Figure2 | R2 | 103.82.4.98 103.82.4.101 103.82.4.122 | Area 1 |
| Figure3 | R3 | 103.82.4.162 103.82.4.158 103.82.4.7 | Area 2 |
| Figure4 | R4 | 103.82.4.124 103.82.4.96 103.82.4.90 | Area 3 |
| Figure5 | R5 | 103.82.4.128 103.82.4.23 103.82.4.66 | Area 4 |

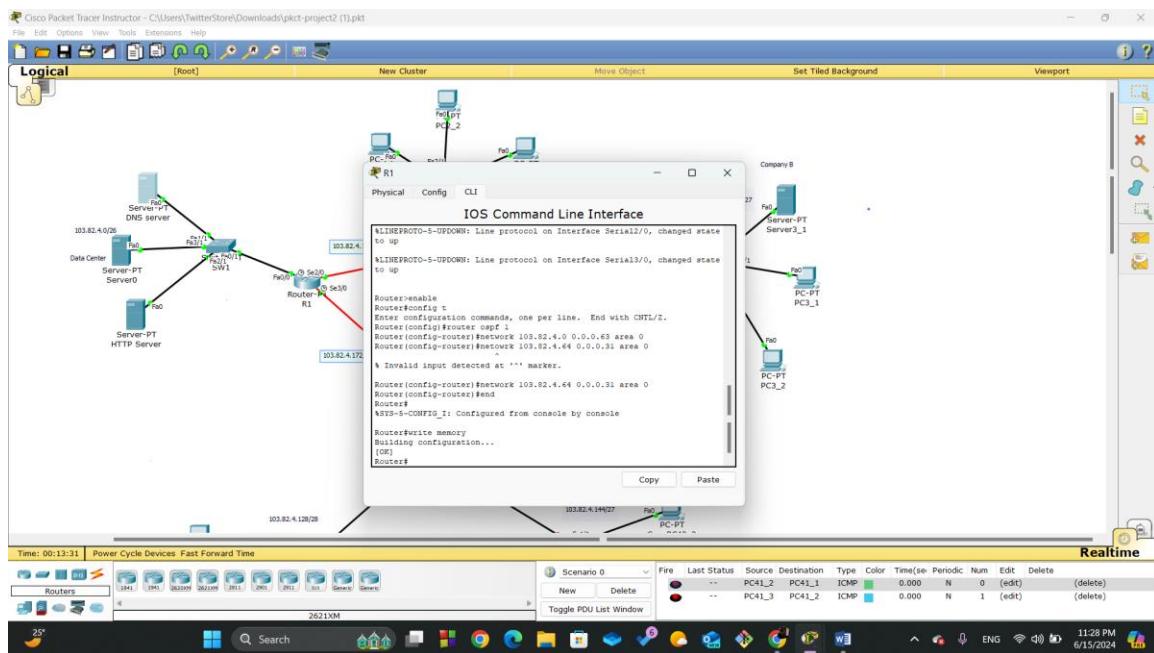


Figure 39: Applying OSPF in Router 1

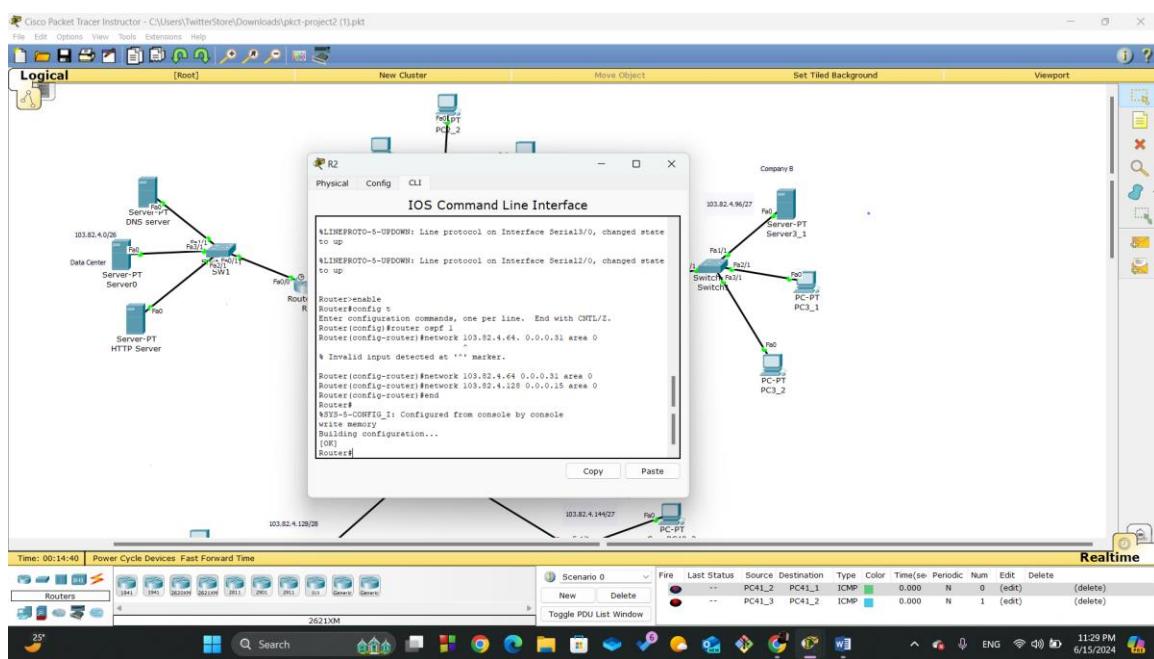


Figure 40: Applying OSPF in Router 2

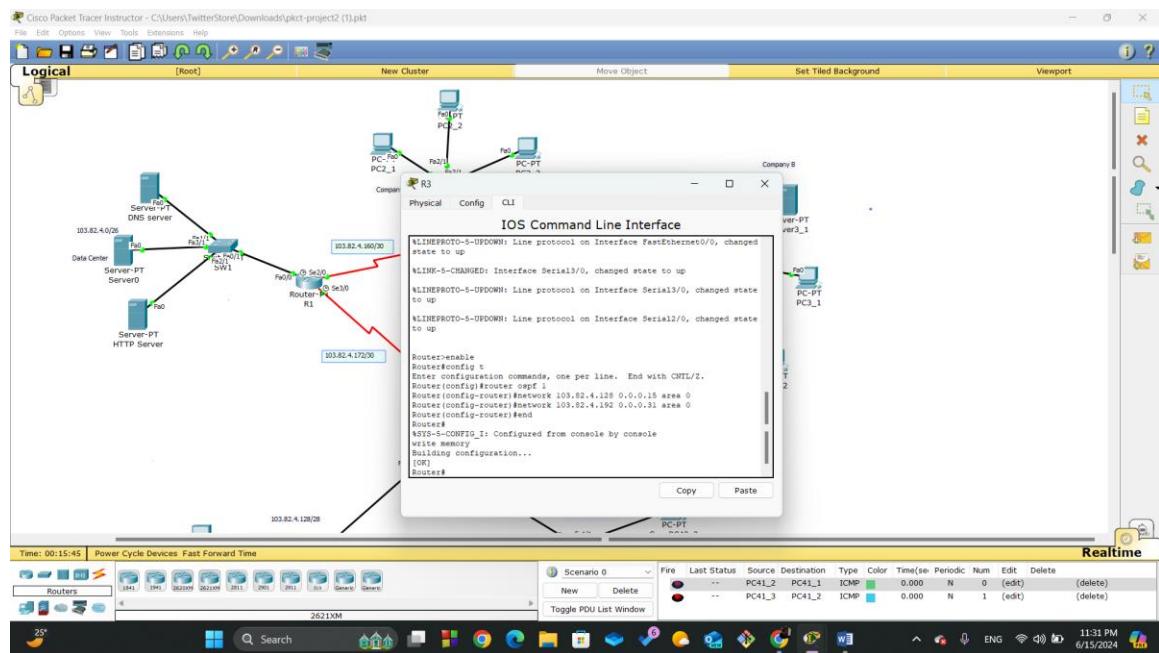


Figure 41: Applying OSPF in Router 3

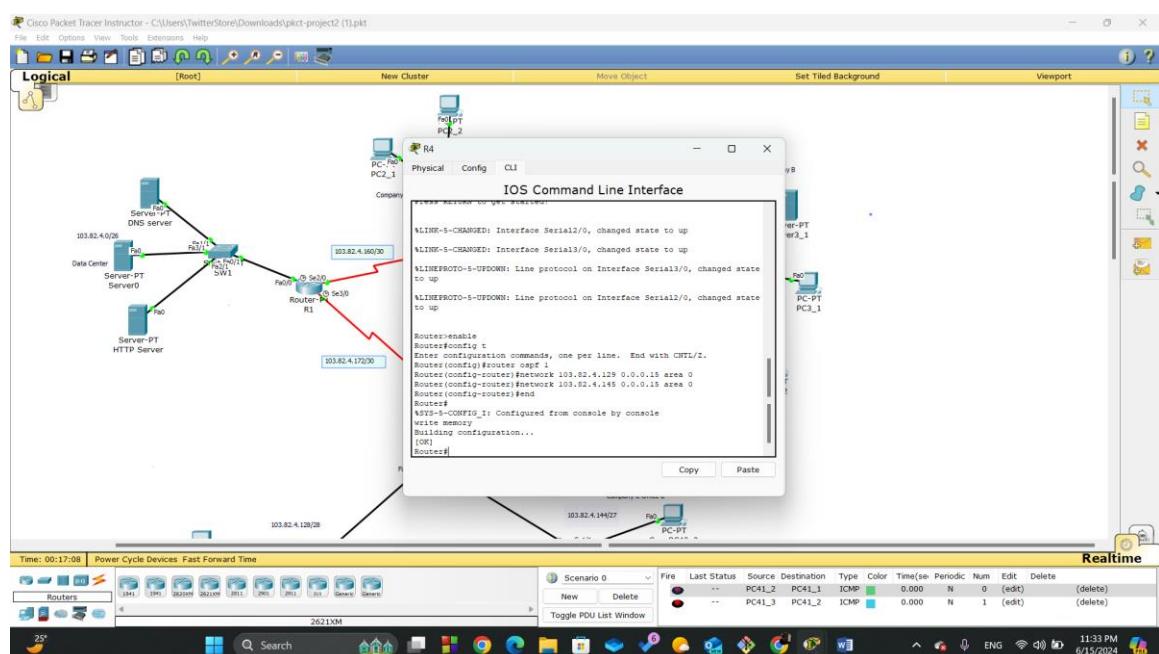


Figure 42: Applying OSPF in Router 4

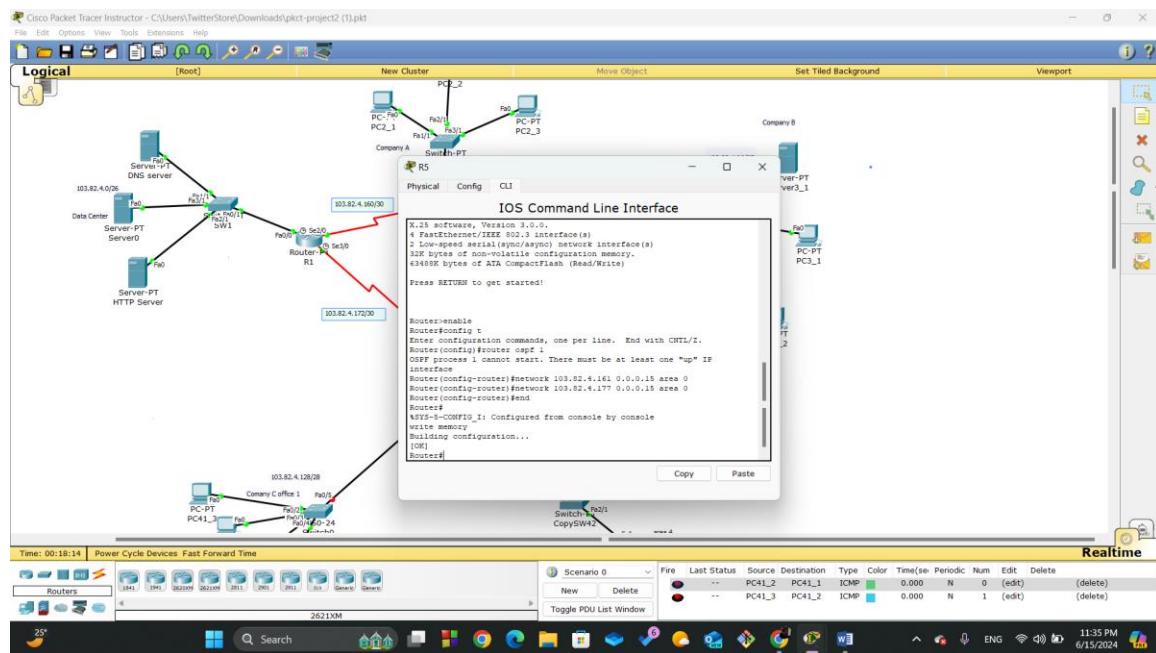
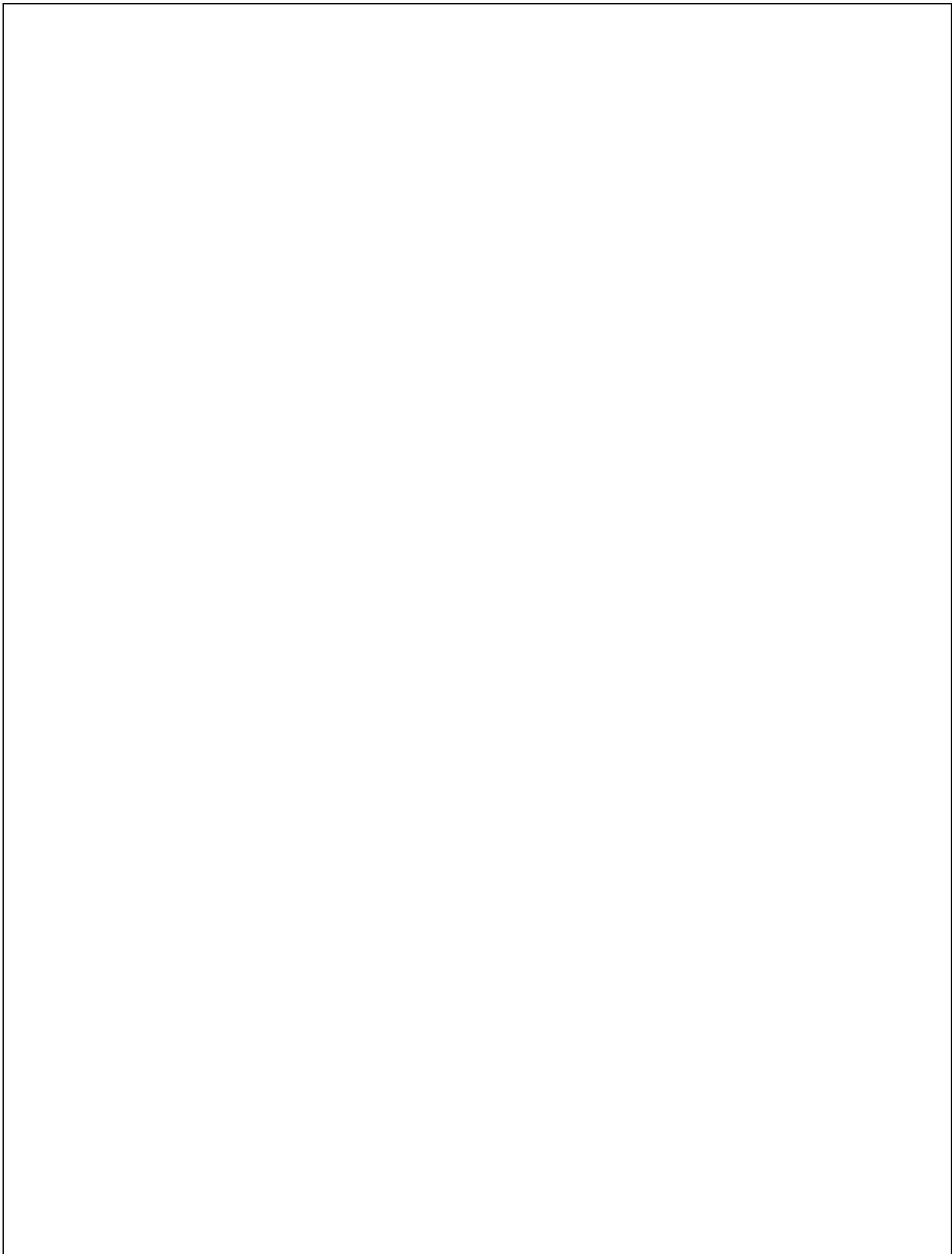
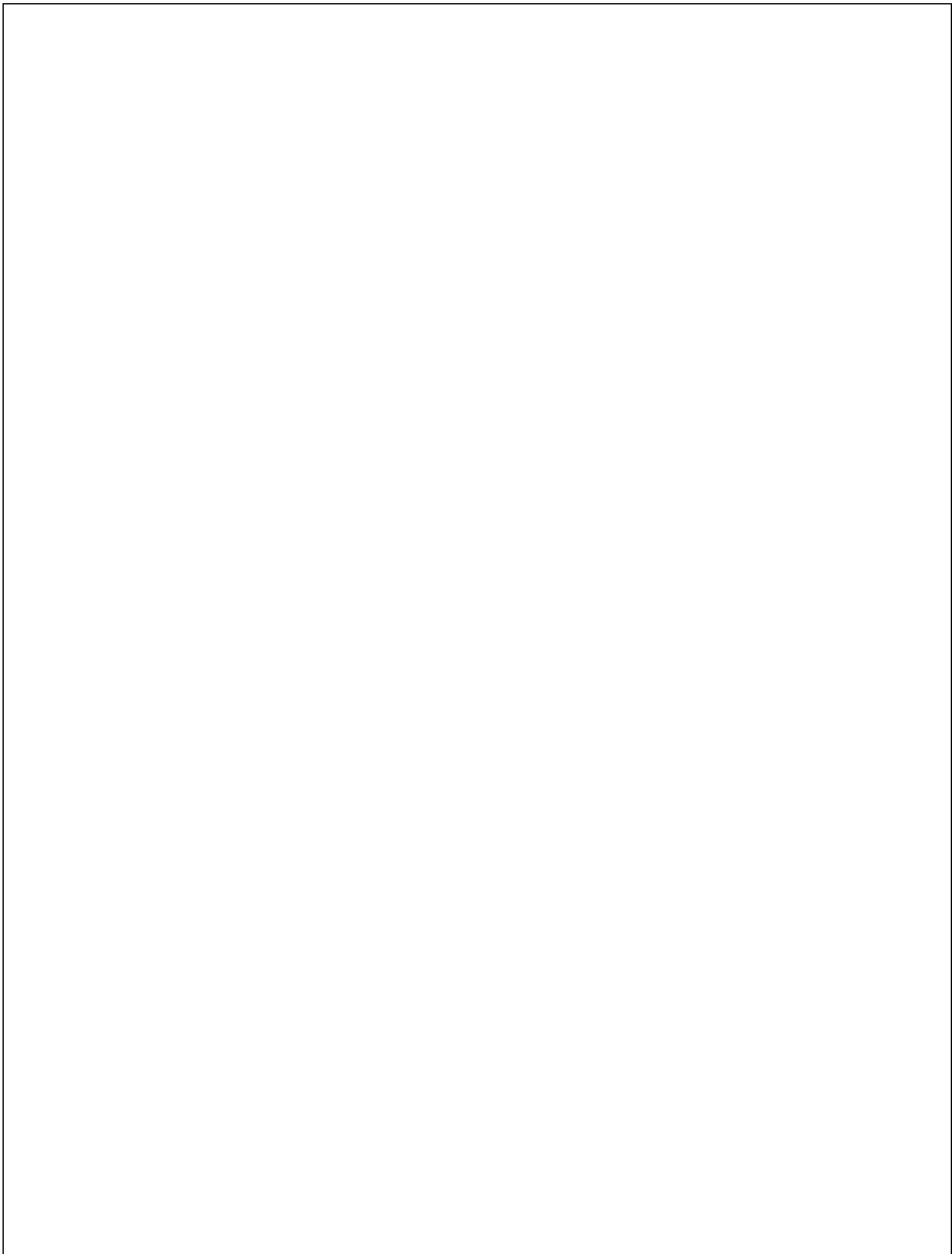
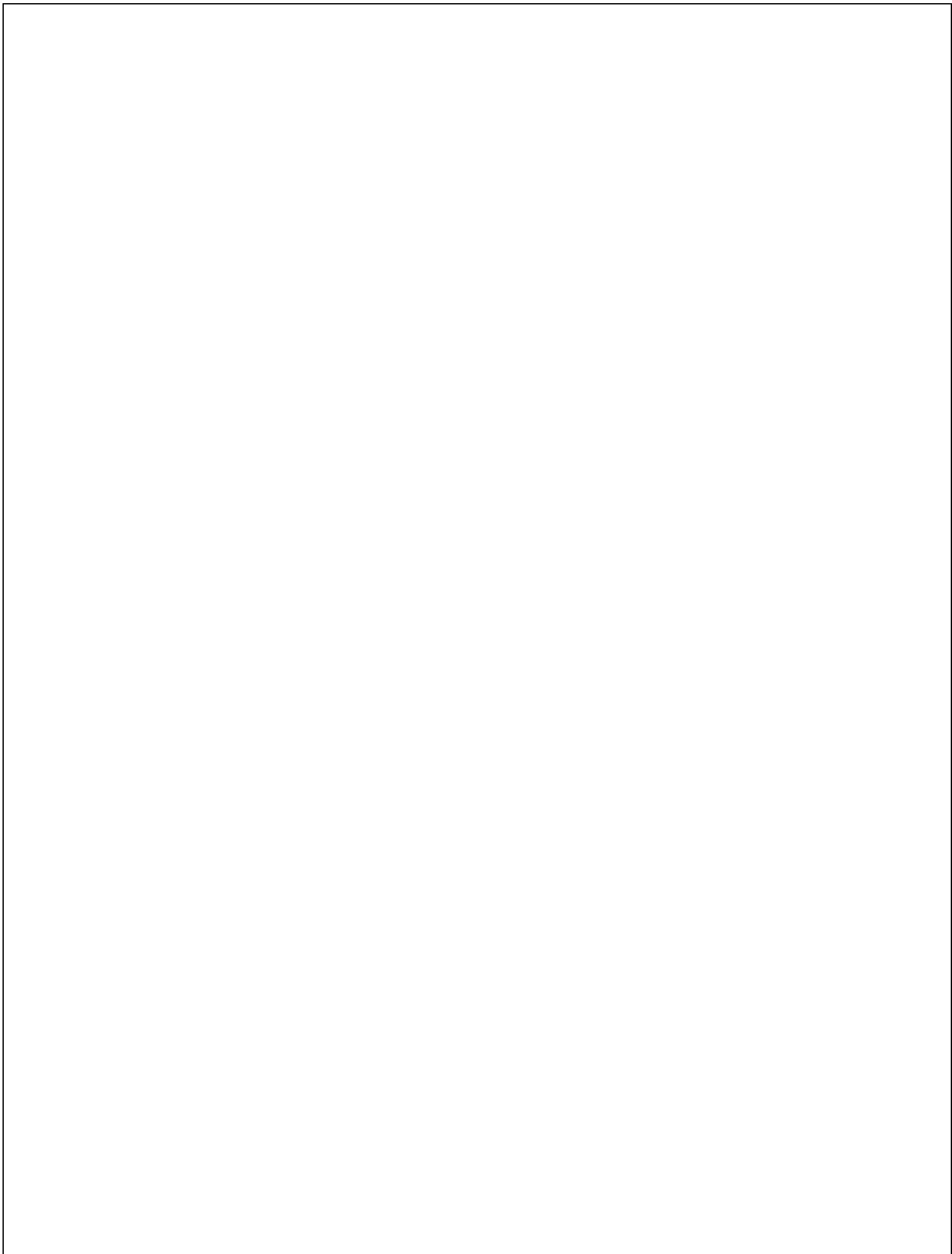


Figure 43: Applying OSPF in Router 5







Part 3: Applying routing protocol

In this phase, we implemented OSPF on each router to establish connections between them, with the specific details outlined in Table 3 and Figures 33 through 36.