Faculty of Engineering & Technology

Electrical & Computer Engineering Department

Computer networking

Project 2 (Network Design)

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Section: 2

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Abstract:

In this network project, we aimed to master the use of Packet Tracer for network design and configuration. The objectives included practicing IP subnetting and address assignment, configuring end devices such as PCs and servers, and implementing routing protocols like OSPF on routers. The topology, as detailed in Figure 1, was constructed with specific device requirements across multiple subnets, including NET1 with 1 PC, 1 Laptop, and 1 Switch; NET2 with 2 Servers, 2 Switches, 2 PCs, and 2 Laptops; NET3 with 1 PC, 1 Laptop, and 1 Switch; NET4 with 3 PCs, 1 Laptop, and 2 Switches; and a CORE network with 4 Routers. This simulation exercise provided practical experience in designing, configuring, and troubleshooting a network, ensuring that all devices were properly set up and could communicate effectively within and between subnetworks.

Overview: firstly, the subnet Networks mean divides the large network into small Networks.

Some Calculation: IP Address: 110.19.8.0/22 to Find Ip Network it's the and Bitwise Between Ip Address and His Subnet Mask 255.255.252.0 (11111111.11111111.11111100.00000000) And the Ip address 110.19.8.0 so it's a Ip network Usable Ip 2^10 –2 =1022 , then Usable IP addresses 110.19.8.1 to 110.19.11.254 and the Broadcast is 110.19.11.255 .

IN PROJECT:

We need to calculate the number of subnets on the given Ip 110.19.8.0 this Ip under Class A I mean to how much networks can I divides this Ip (how much of Ip can results from this Ip) 110.19.8.0/22 this is an Ip rang the subnet mask is 255.255.252.0 that mean s first 22 bits to network potion another 10 bits for host portion ,the number 1024 means each networks can have at most 1024 Devices such as(PC and Servers and looptops and so on), absolutely each device with unique Ip, number of subnet = 2^n where n the borrowed bit from original Ip so in our project 2^10=1024 subnet, each subnet can have at most 1024 devices, with 10 bits for the host portion, we can have 2^10 = 2024 unique IP addresses per subnet.

Contents

Table of figure

Table of tables

Theory

and introduction

1.1. Packet tracer

Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks. The software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface. Packet Tracer makes use of a drag and drop user interface, allowing users to add and remove simulated network devices as they see fit. Previously students enrolled in a CCNA Academy program could freely download and use the tool free of charge for educational use[1].

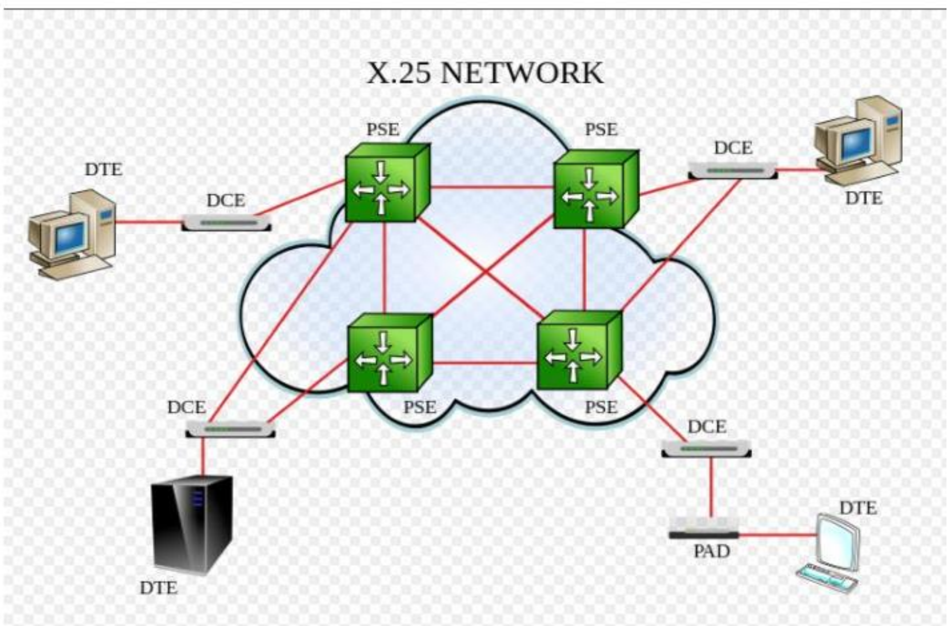

Figure 1:packet tracer algorithm[2]

In addition to simulating certain aspects of computer networks, Packet Tracer can also be used for collaboration. As of Packet Tracer 5.0, Packet Tracer supports a multi-user system that enables multiple users to connect multiple topologies together over a computer network. Packet Tracer also allows instructors to create activities that students have to complete. Packet Tracer is often used in educational settings as a learning aid. Cisco Systems claims that Packet Tracer is useful for network experimentation[3].

1.2 IP Subnetting And Assignment

A subnetwork or subnet is a logical subdivision of an IP network. The practice of dividing a network into two or more networks is called subnetting. Computers that belong to the same subnet are addressed with an identical group of its most significant bits of their IP addresses. This results in the logical division of an IP address into two fields: the network number or routing prefix, and the rest field or host identifier. The rest field is an identifier for a specific host or network interface[4].

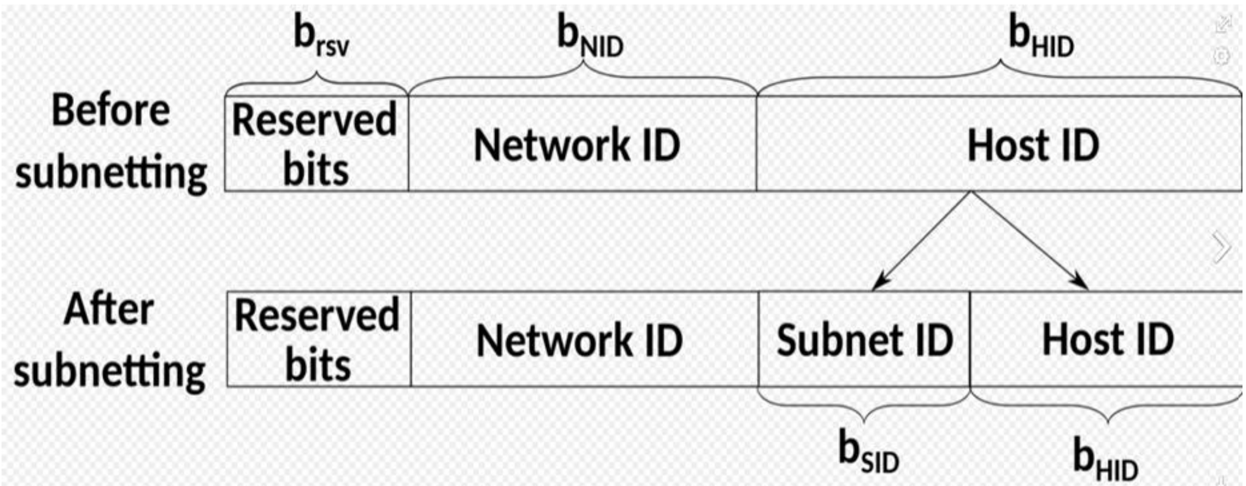

Figure 2:IP subnetting[5]

The routing prefix may be expressed as the first address of a network, written in Classless Inter Domain Routing (CIDR) notation, followed by a slash character (/), and ending with the bit-length of the prefix. For example, 198.51.100.0/24 is the prefix of the Internet Protocol version 4 network starting at the given address, having 24 bits allocated for the network prefix, and the remaining 8 bits reserved for host addressing. Addresses in the range 198.51.100.0 to 198.51.100.255 belong to this network, with 198.51.100.255 as the subnet broadcast address. The IPv6 address specification 2001:db8::/32 is a large address block with 296 addresses, having a 32-bit routing prefix[6].

1.3 End Devices

In networking jargon, a computer, phone, or internet of things device connected to a computer network is sometimes referred to as an end system or end station, because it sits at the edge of the network. The end user directly interacts with an end system that provides information or services. End systems that are connected to the Internet are also referred to as internet hosts; this is because they host (run) internet applications such as a web browser or an email retrieval program. The Internet's end systems include some computers with which the end user does not directly interact. These include mail servers, web servers, or database servers. With the emergence of the internet of things, household items (such as toasters and refrigerators) as well as portable, handheld computers and digital cameras are all being connected to the internet as end systems[7].

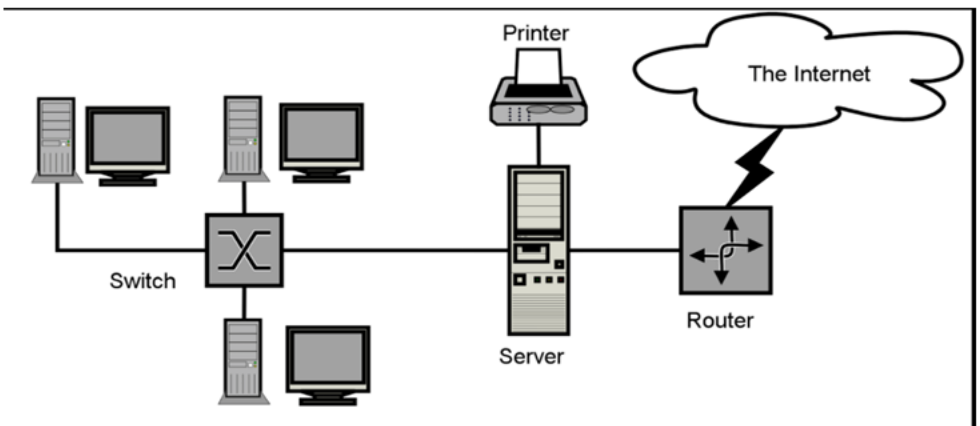

Figure 3:End devices[8]

End systems are generally connected to each other using switching devices known as routers rather than using a single communication link. The path that transmitted information taken from the sending end system, through a series of communications links and routers, to the receiving end system is known as a route or path through the network. The sending and receiving route can be different, and can be reallocated during transmission due to changes in the Normally the cheapest or fastest route is chosen. For the end user the actual routing should be completely transparent [9].

1.4 Routing Algorithms

Routing has evolved to meet the requirements of advances in network technology. Routing is no longer just about switching data packets between autonomous systems and the internet. We now have cloud infrastructure with computing resources and hardware hosted by third-party cloud providers. These cloud resources are connected virtually to create a virtual network of resources that businesses can use to host and run applications. Many organizations now have hybrid networks that consist of both on-premises networks with internal hardware and cloud networks. Routers must route traffic between these internal networks, the internet, and the cloud[10].

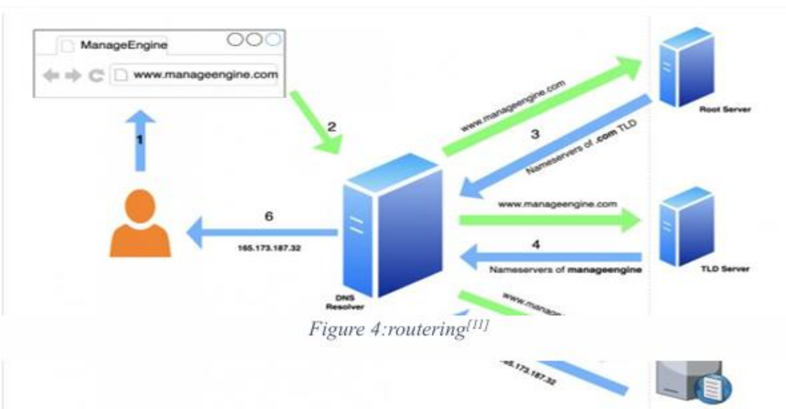

Figure 4:routering[11]

DNS routing, DNS, or the Domain Name System, translates human-readable domain names (for example, www.amazon.com) to machine-readable IP addresses (for example, 192.0.2.44). The data that maps this name information to machine information is stored separately on DNS servers. Before sending data to any website, routers must communicate with the DNS server to identify the exact machine address for the data packets. DNS server communication can become a bottleneck, especially when many users want to visit a website at the same time. DNS routing refers to the various routing strategies and algorithms that manage communication with the DNS server. Various strategies, such as latency-based routing and geographic location–based routing, help manage the DNS server communication load[12].

2. Requirements

Task #0

I have Four Router with Circular Connection

R0-->R1

R1-->R2

R2->R3

R3-->R0

So ,each one Have Unique Subnet in total 4 subnet in This Part

We have This Ip Address 110.19.8.0/22 According to Alaa Moqade Id 1211910Number

The CIDR (Classless Inter-Domain Routing)

Its Under Class A ,/22 bits for networks and Remining Bit To the Host 22-32=10 bit for host address ,So 2^10=1024

the number of usable hosts in the subnet 110.19.8.0/22is 1024–2=1022

subtract 2 from this count because the first and last addresses in the range are reserved for the network address and the broadcast address

If i want two divide it to 2 parts we barrow one additional bit from host

- Starting with the subnet **110.19.8.0/22**

Table 1Subnetting details

	Subnet Mask	Network IP	Broadcast IP	First IP	last IP	#Hosts
R0-R1 Link	255.255.255.252/30	110.19.8.144	110.19.8.147	110.19.8.145	110.19.8.146	2
NET1	255.255.255.224 /27	110.19.8.64	110.19.8.95	110.19.8.65	110.19.8.94	30
R1-R2 Link	255.255.255.252/30	110.19.8.148	110.19.8.151	110.19.8.149	110.19.8.150	2
NET2	255.255.255.192/26	110.19.8.0	110.19.8.63	110.19.8.1	110.19.8.62	62
NET3	255.255.255.224 /27	110.19.8.96	110.19.8.127	110.19.8.97	110.19.8.126	30
NET4	255.255.255.240 /28	110.19.8.128	110.19.8.143	110.19.8.129	110.19.8.142	14
R2-R3 Link	255.255.255.252/30	110.19.8.152	110.19.8.155	110.19.8.153	110.19.8.154	2
R3-R0 Link	255.255.255.252/30	110.19.8.156	110.19.8.159	110.19.8.157	110.19.8.158	2

Table 2Areas IPs

AREA	AREA IP	AREA COLOR OF TOPOLOGY
ROUTER	IP BETWEEN RANG 110.19.8.144 TO 110.19.8.156	Yellow
NET1	110.19.8.64/27	Page
NET2	110.19.8.0/26	pharos
NET3	110.19.8.96/27	Pinky
NET4	110.19.8.128/28	Green

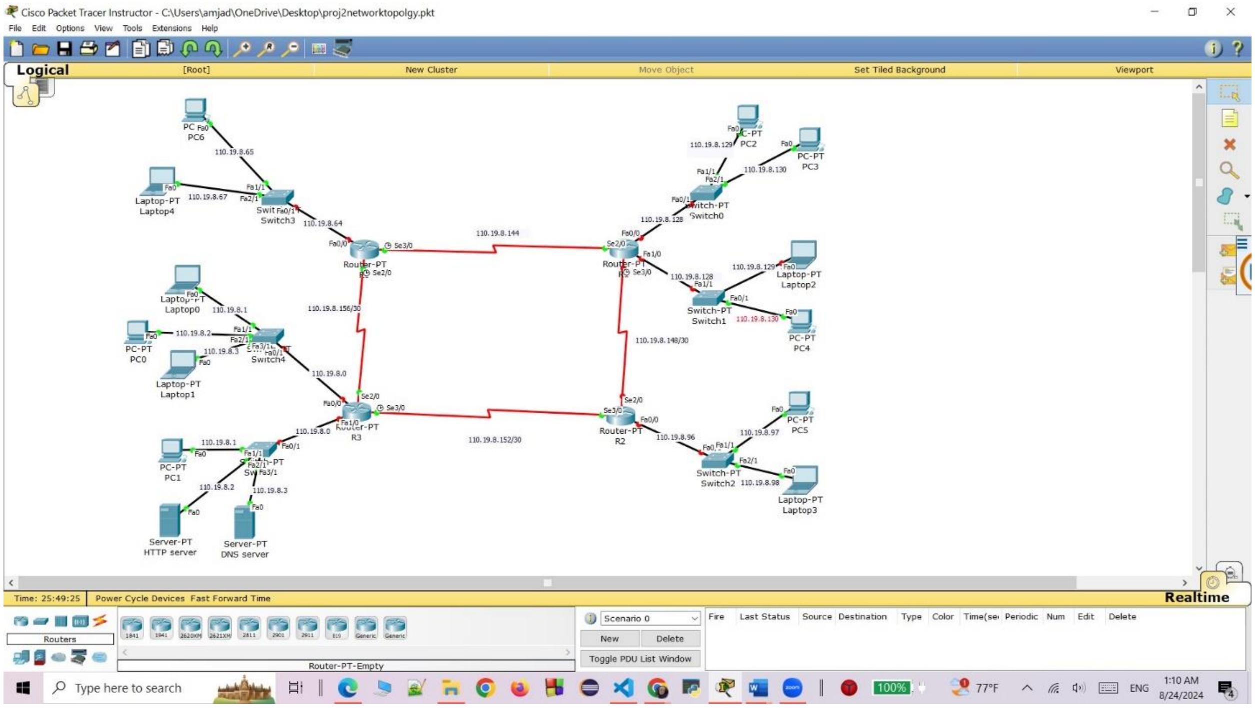

Figure 5topology

Routers Configurations R0

The configuration of the routers was carried out in accordance with the details presented in Table 1, which is depicted in Figure topology 5, taking into account one of the student IDs in our group which is "1211910".

For Router 0 (R0), the FastEthernet0/NET1 interface has been assigned the IP address 110.19.8.64/27 with a subnet mask of 255.255.255.224. Additionally, its Serial 2 /0 port has been configured with the IP address 110.19.8.145 and a subnet mask of 255.255.255.252/30.

The Serial 3/0 port on the same router has been assigned an IP address of 110.19.8.157, using a subnet mask of 255.255.255.252/30. These configurations are illustrated in Figures bellow

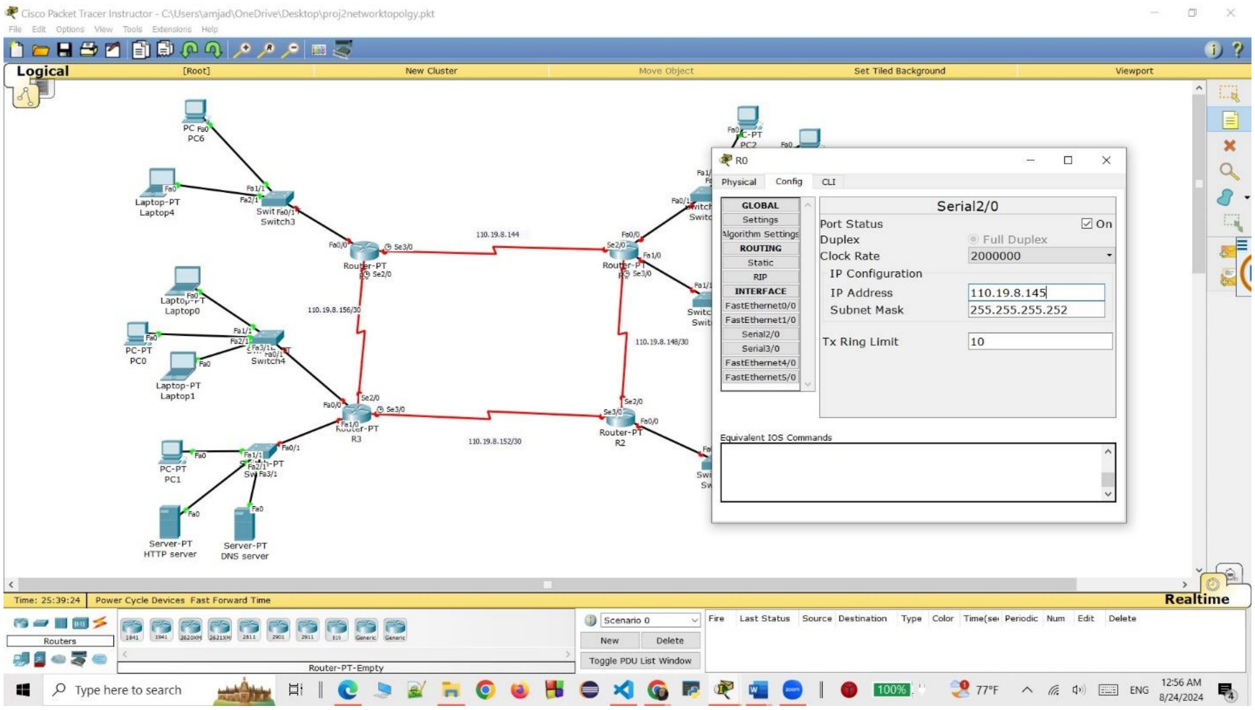

Figure 6configR0

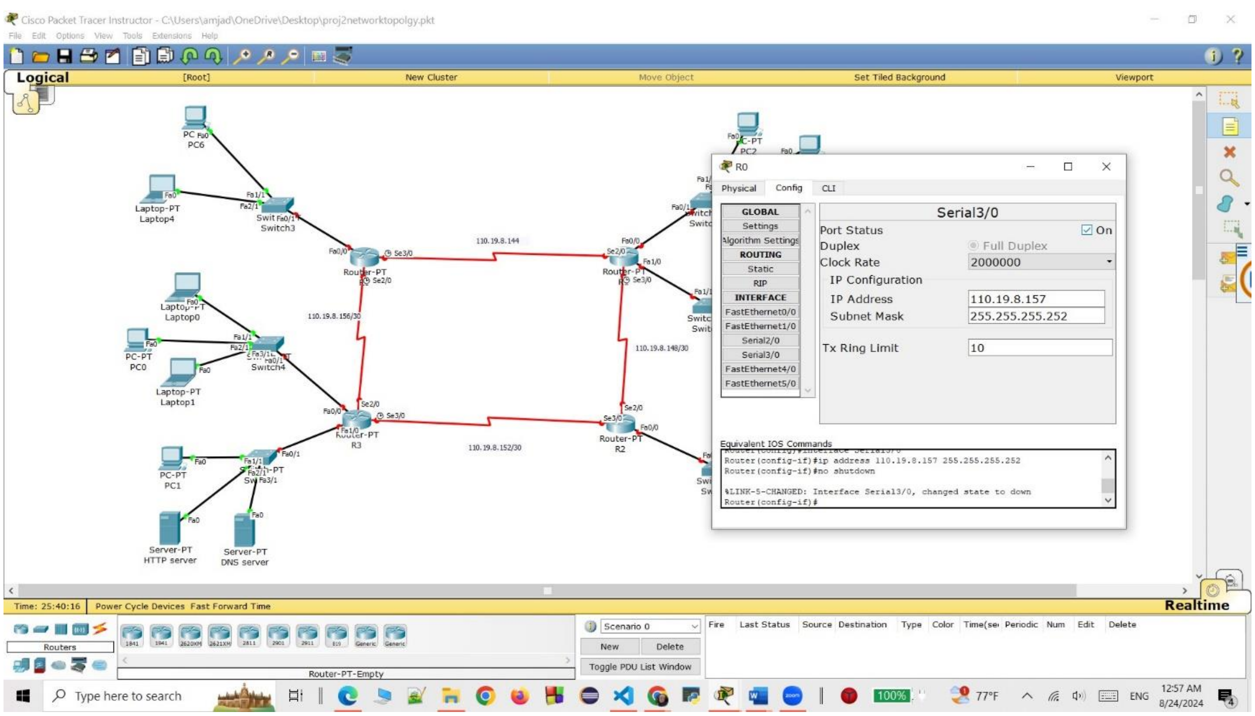

Figure 7CONFIG R0 SCRREN 2

Routers Configurations of R1

The configuration of the routers was carried out in accordance with the details presented in Table 1, which is depicted in Figure topology 5, taking into account one of the student IDs in our group which is "1211910".

For Router 1 (R1), the FastEthernet0/NET4 interface has been assigned the IP address 110.19.8.128/28 with a subnet mask of 255.255.255.240/28 . Additionally, its Serial 2/0 port has been configured with the IP address 110.19.8.146 and a subnet mask of 255.255.255.252/30

The Serial 3/0port on the same router has been assigned an IP address of 110.19.8.149, using a subnet mask of 255.255.255.252/30. These configurations are illustrated in Figures bellow

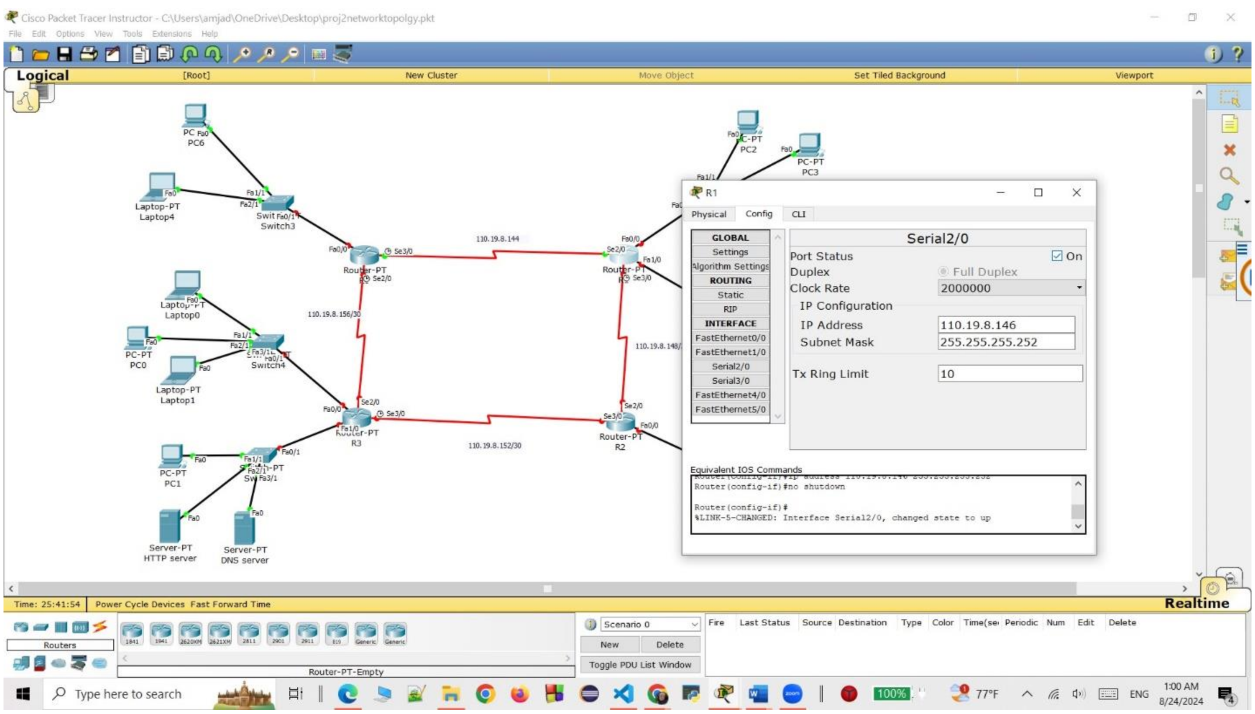

Figure 8: CONFIG R1

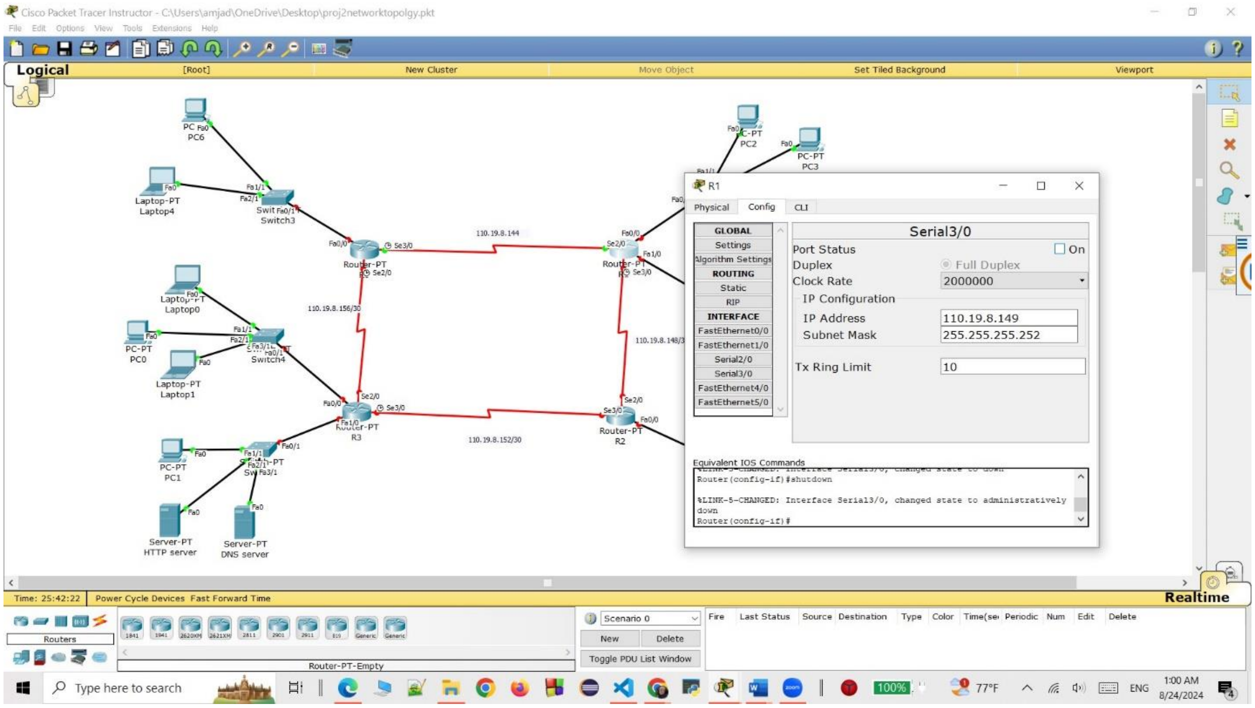

Figure 9: SCREEN 2 OF CONFIG R1

Routers Configurations of R2

The configuration of the routers was carried out in accordance with the details presented in Table 1, which is depicted in Figure topology 5, taking into account one of the student IDs in our group which is "1211910".

For Router 2 (R2), the FastEthernet0/NET3 interface has been assigned the IP address 110.19.8.96/27 with a subnet mask of 255.255.255.240/ 28 . Additionally, its Serial 2/0 port has been configured with the IP address 110.19.8.150 and a subnet mask of 255.255.255.252/30

The Serial 3/0 port on the same router has been assigned an IP address of 110.19.8.153, using a subnet mask of 255.255.255.252/30. These configurations are illustrated in Figures bellow

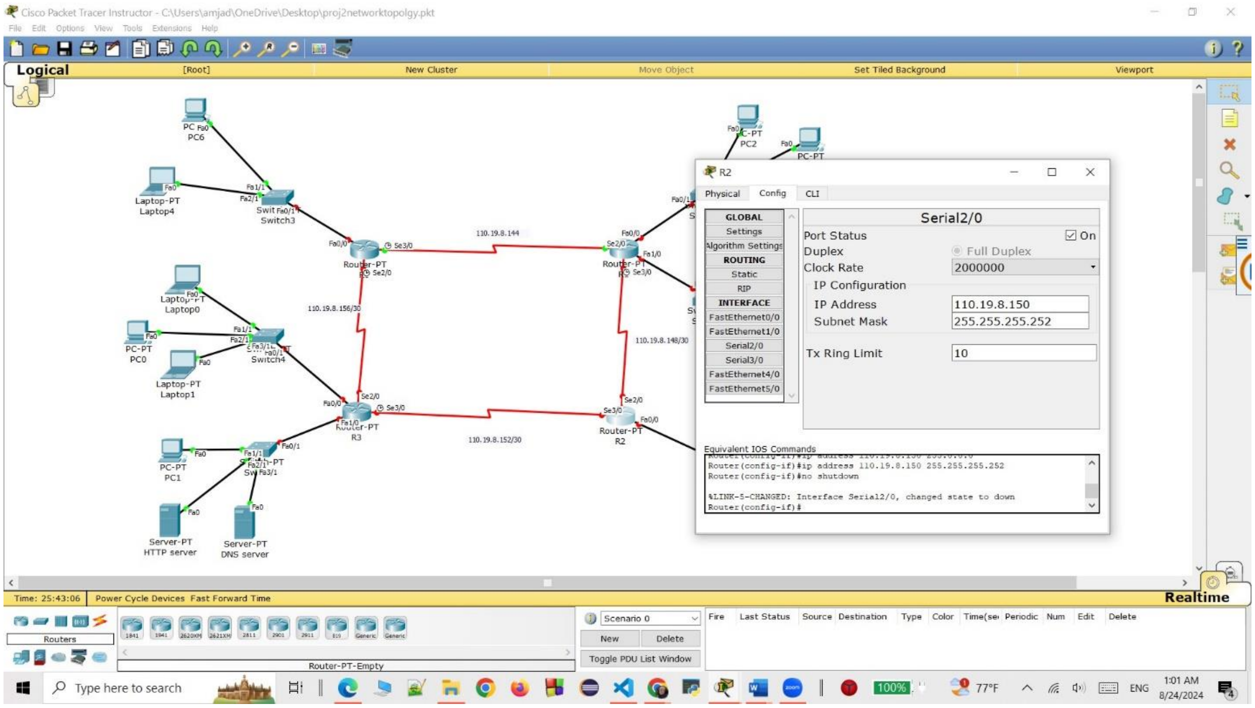

Figure 10CONFIG R2

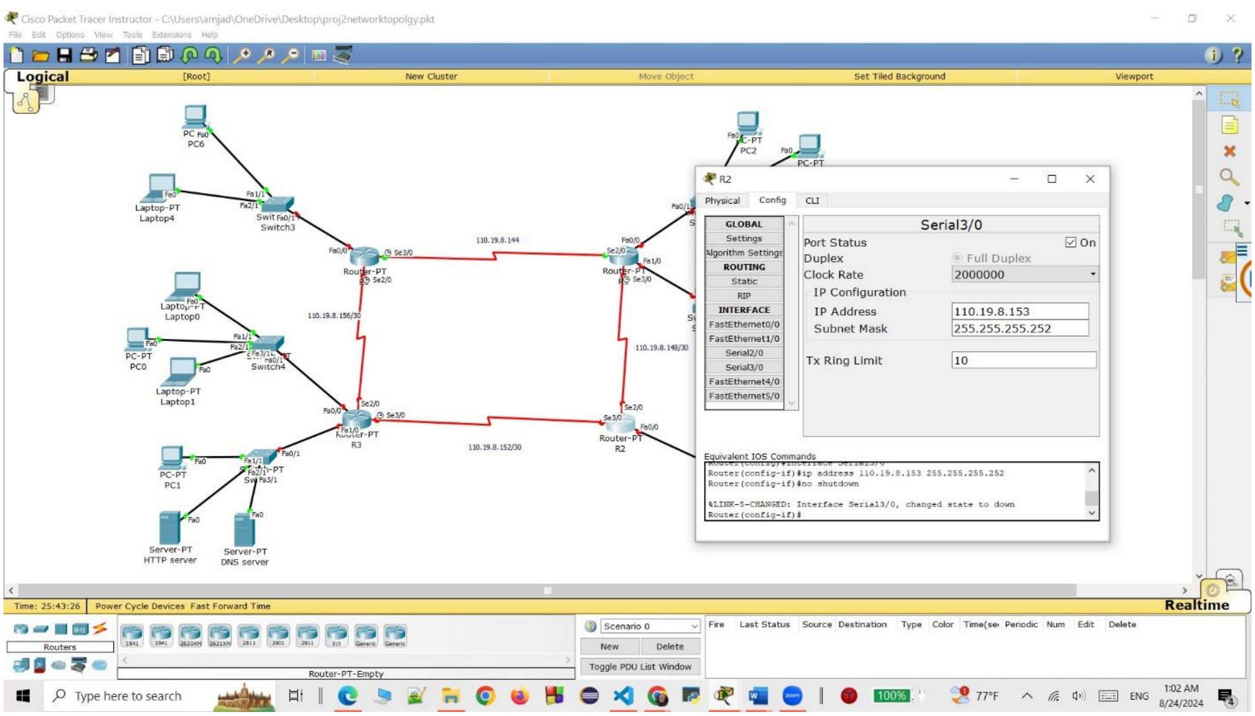

Figure 11: SCREEN 2 OF COINFIG R2

Routers Configurations of R3

The configuration of the routers was carried out in accordance with the details presented in Table 1, which is depicted in Figure topology 5, taking into account one of the student IDs in our group which is "1211910".

For Router 3 (R3), the FastEthernet0/0 interface has been assigned the IP address 110.19.8.0/26 with a subnet mask of 255.255.255.192/26 . Additionally, its Serial 2/0 port has been configured with the IP address 110.19.8.154 and a subnet mask of 255.255.255.252/30

The Serial 3/0 port on the same router has been assigned an IP address of 110.19.8.158, using a subnet mask of 255.255.255.252/30. These configurations are illustrated in Figures bellow

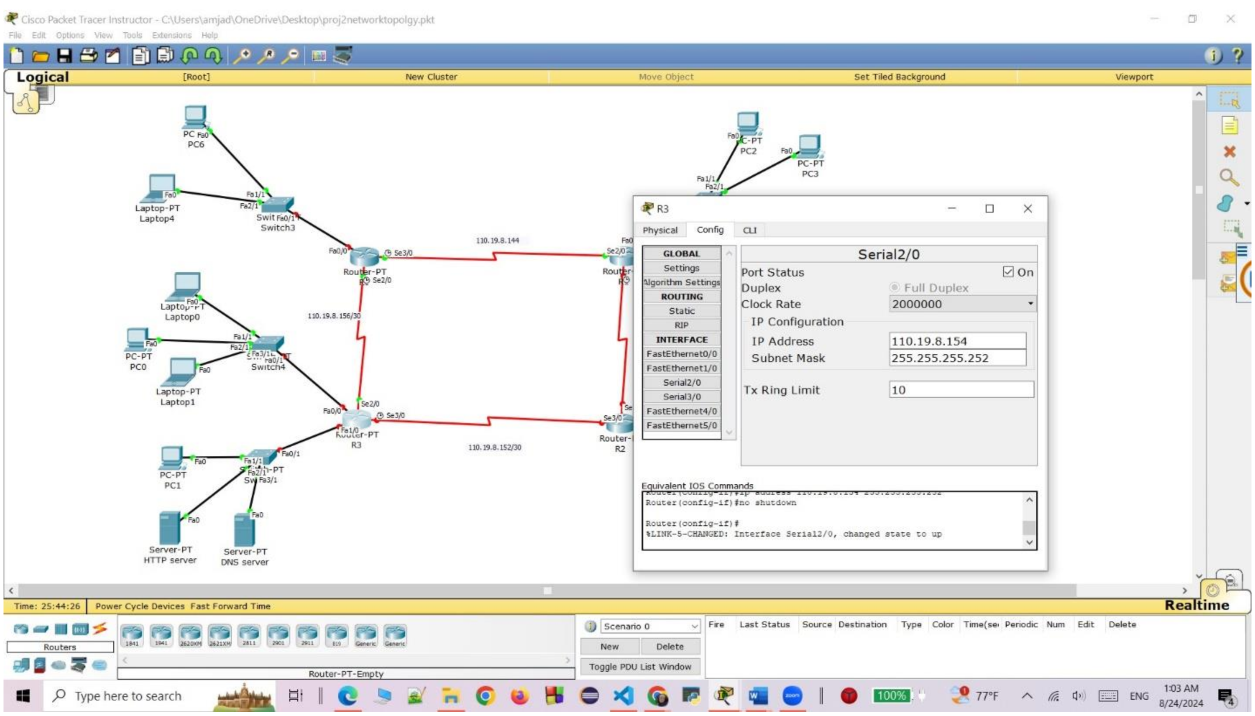

Figure 12: CONFIG OF R3

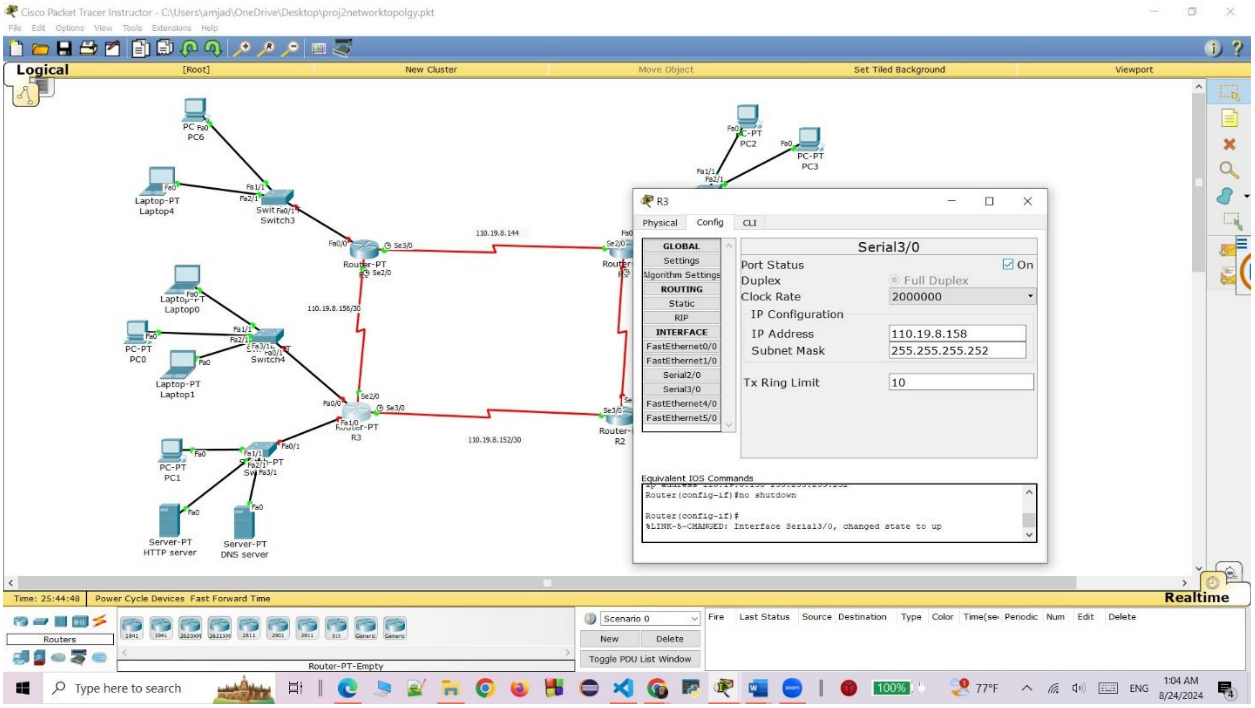

Figure 13: CONFIG OF R3 SCREEN 2

Finally, we set up the IP address, subnet mask, default gateway, and DNS server for each of our 7 PCs, located in different areas, which are all provided in Figures below.

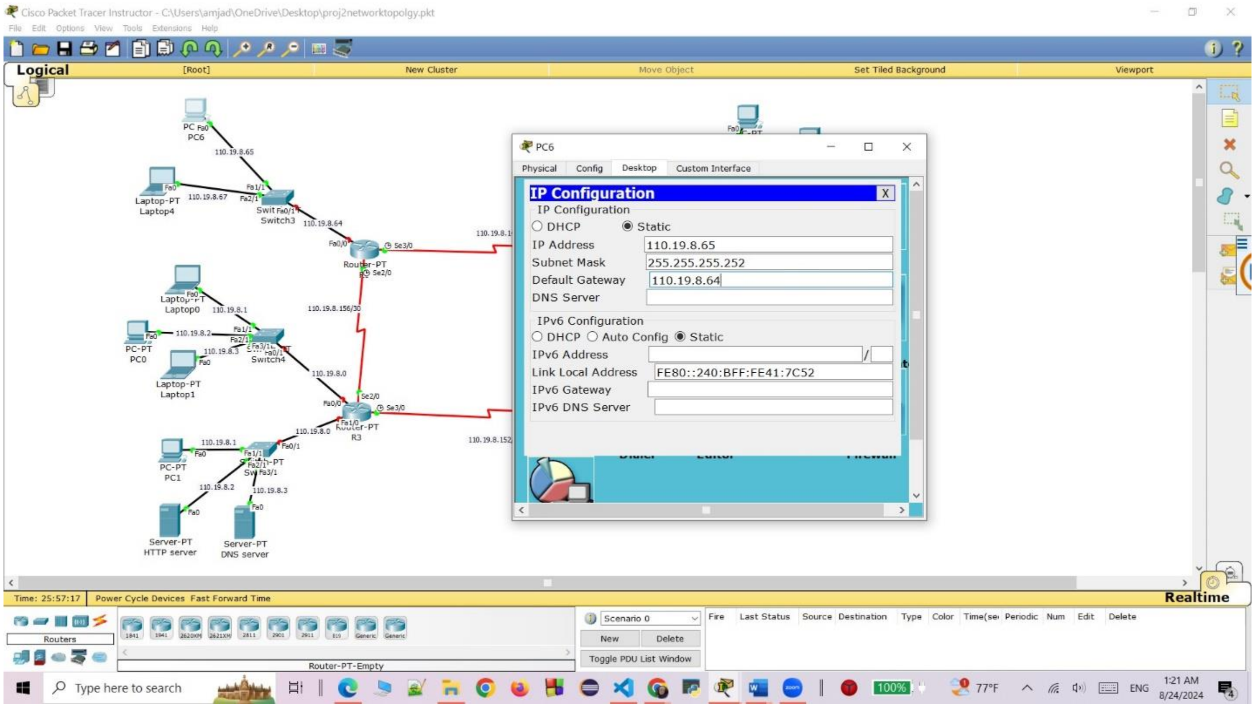

Figure 14: IP CONFIGRATION OF PC6

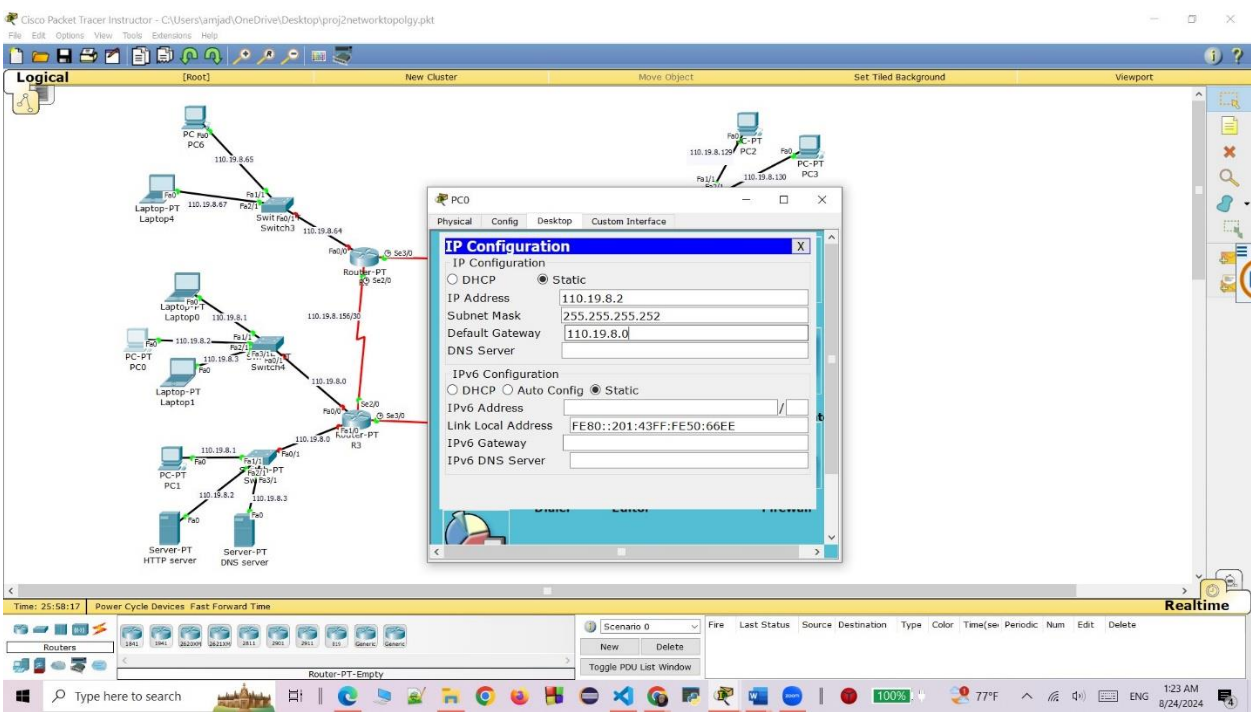

Figure 15IP CONFIGRATION OF PC0

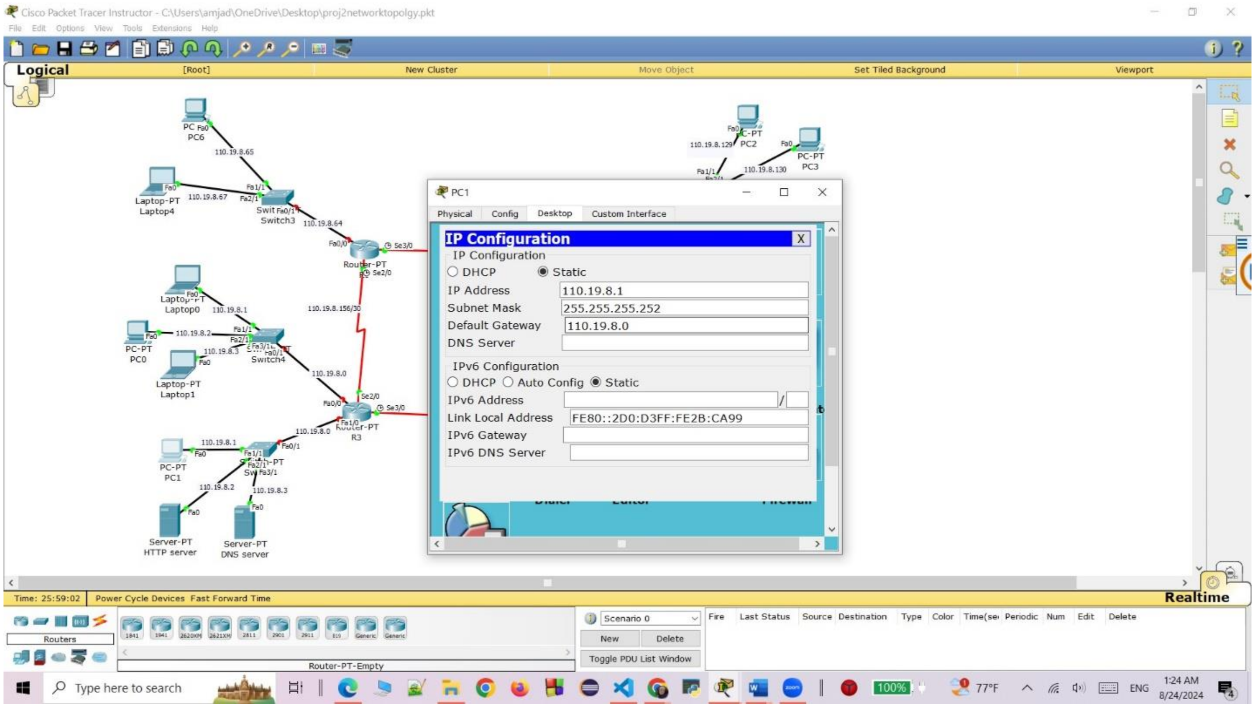

Figure 16IP CONFIGRATION OF PC1

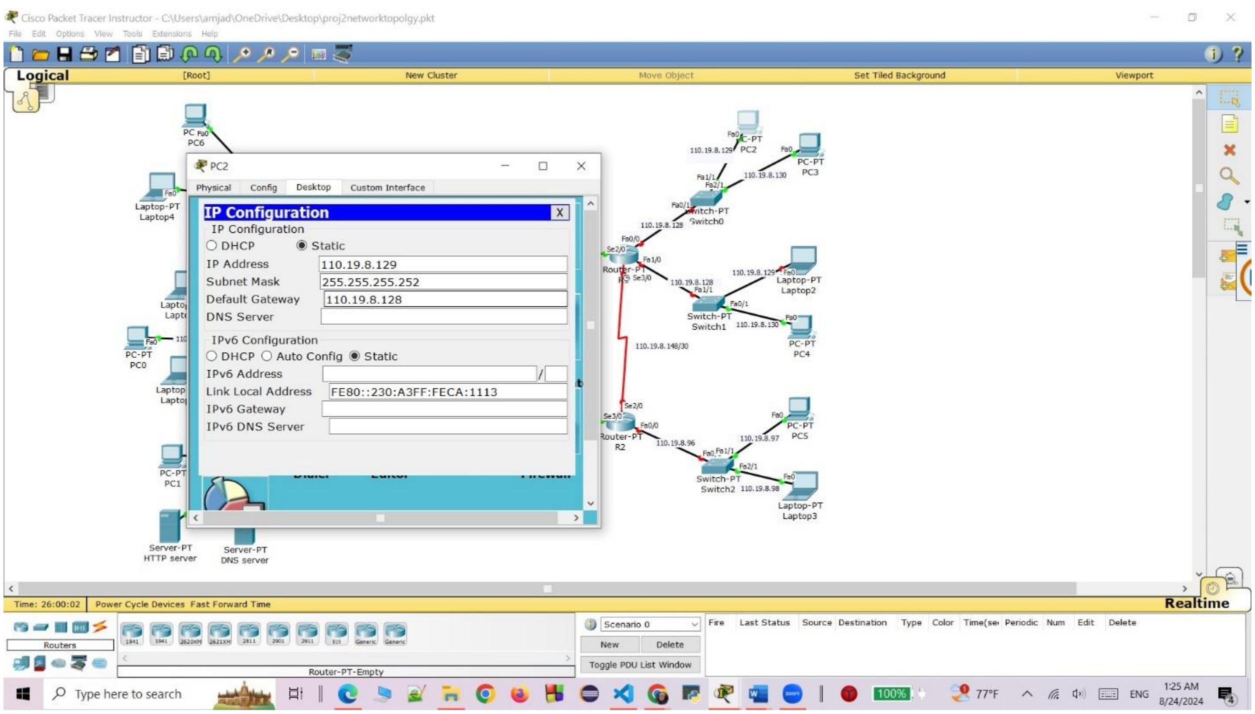

Figure 17IP CONFIGRATION OF PC2

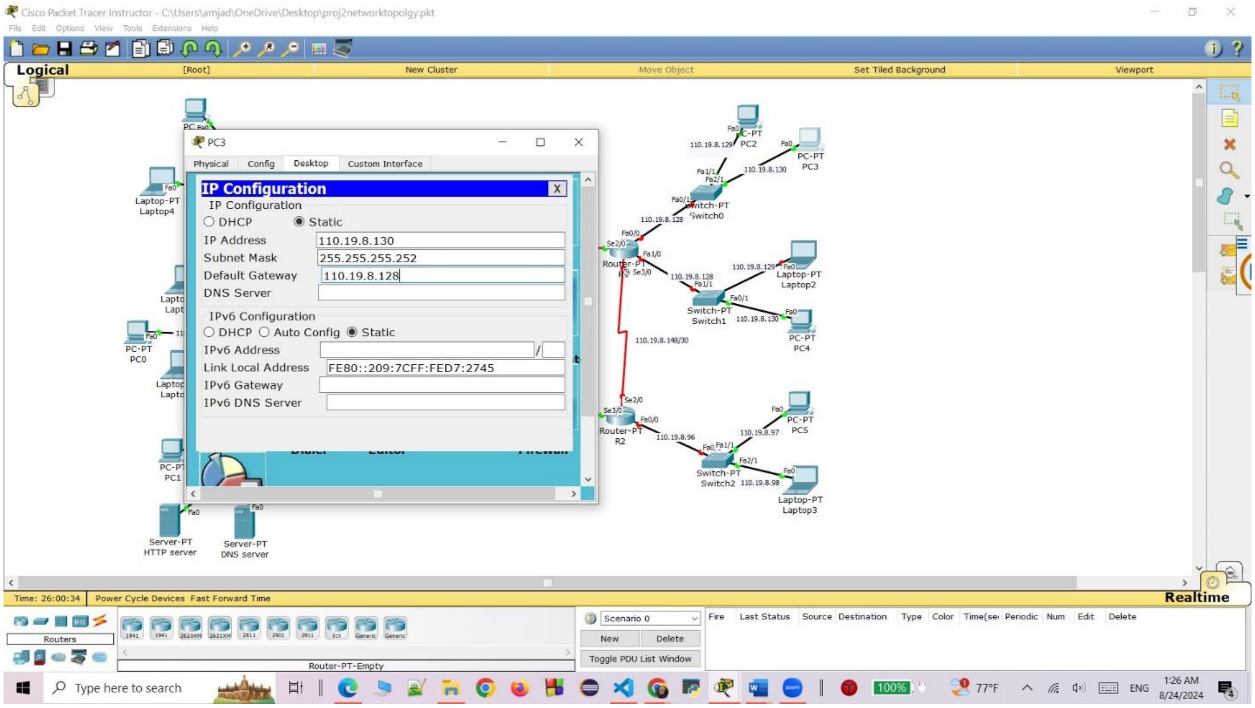

Figure 18IP CONFIGRATION OF PC3

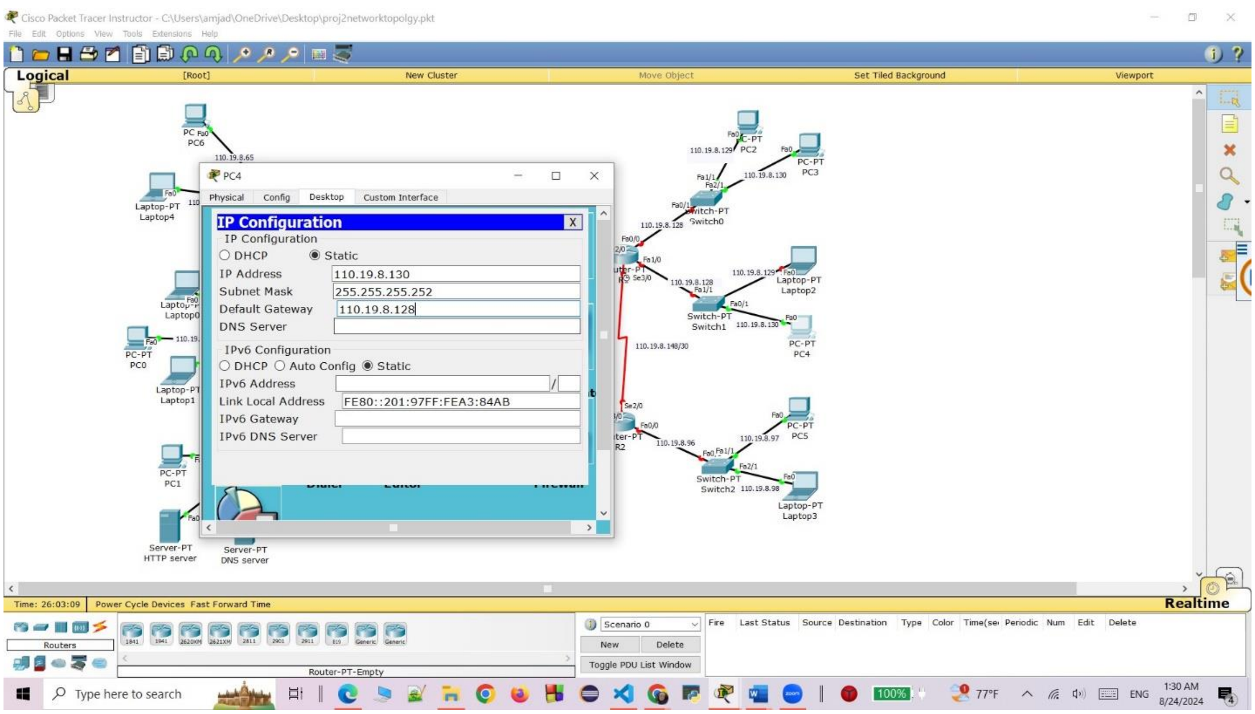

Figure 19IP CONFIGRATION OF PC4

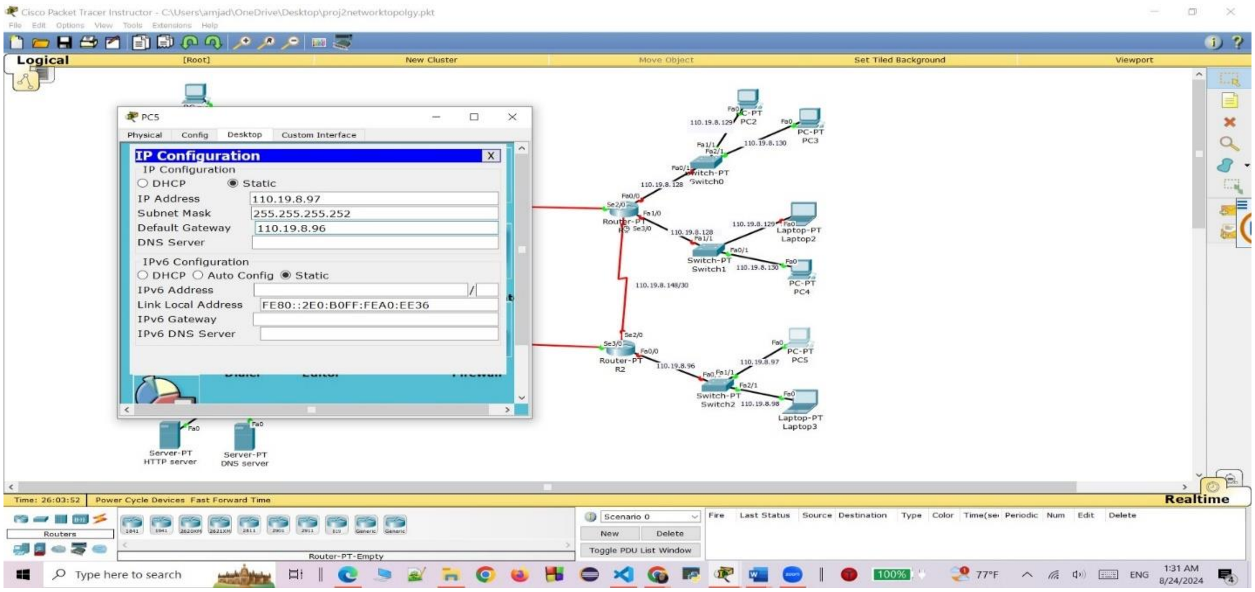

Figure 20IP CONFIGRATION OF PC5

Servers Configurations

In the HTTP server, we activated both HTTP and HTTPS services, and uploaded the necessary files, including HTML document as shown below

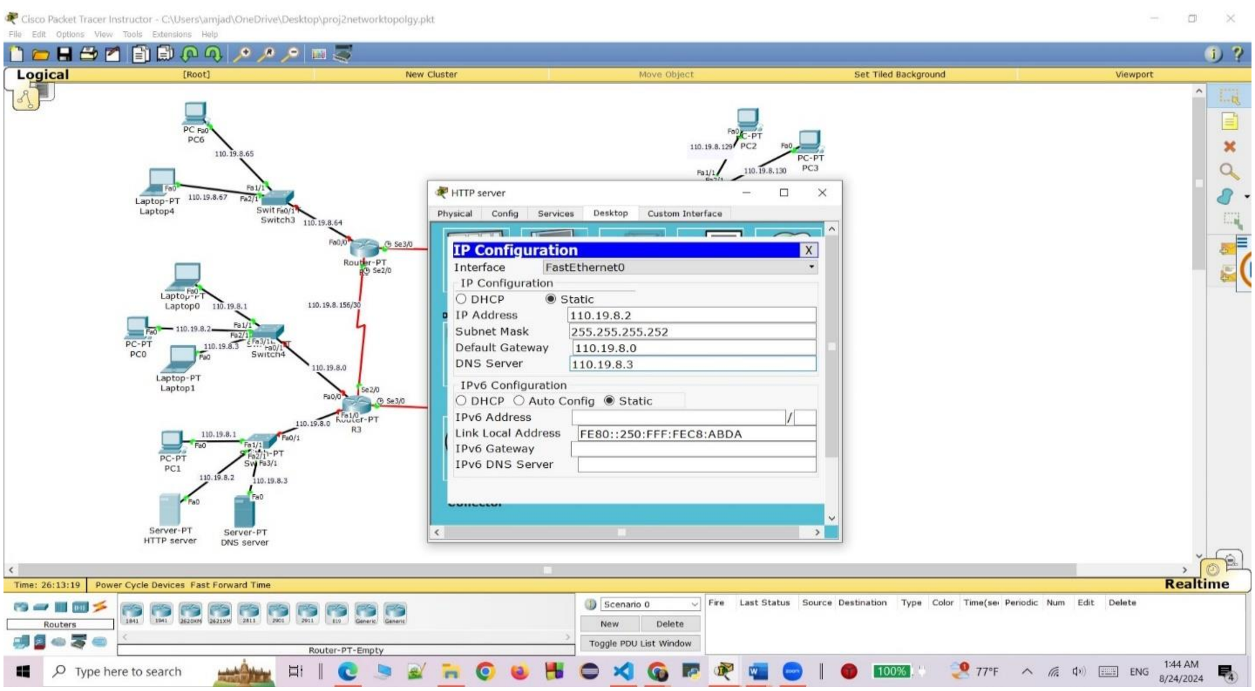

Figure 21IP CONFIGRATION OF HTTP SERVER

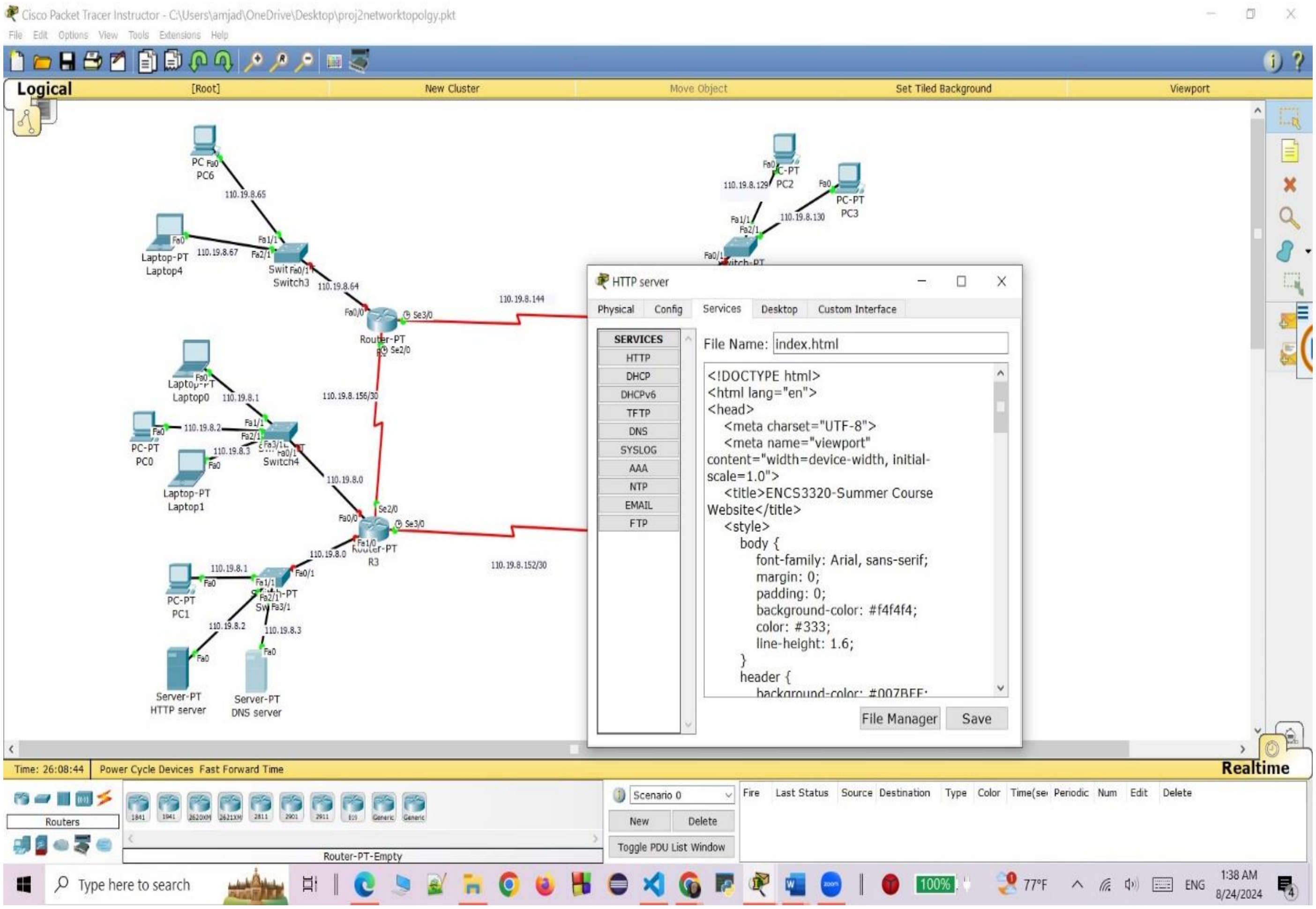

Figure 22:ON HTTP SSERVER

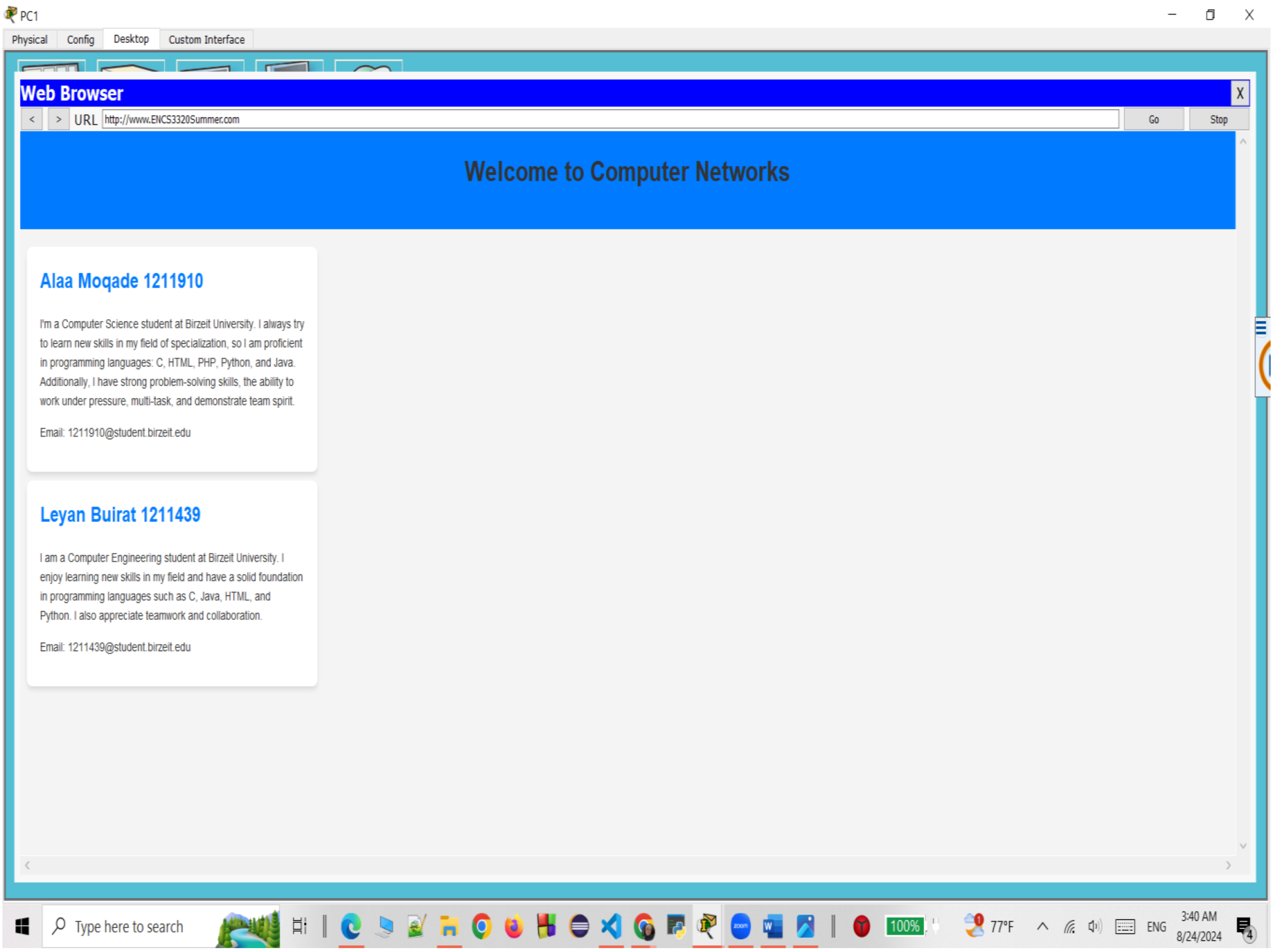

Figure 23Designed HTML Webpage

For the DNS server, identified as server1we configured the server's IP address, subnet mask, default gateway, and DNS server using the values shown in Figure below

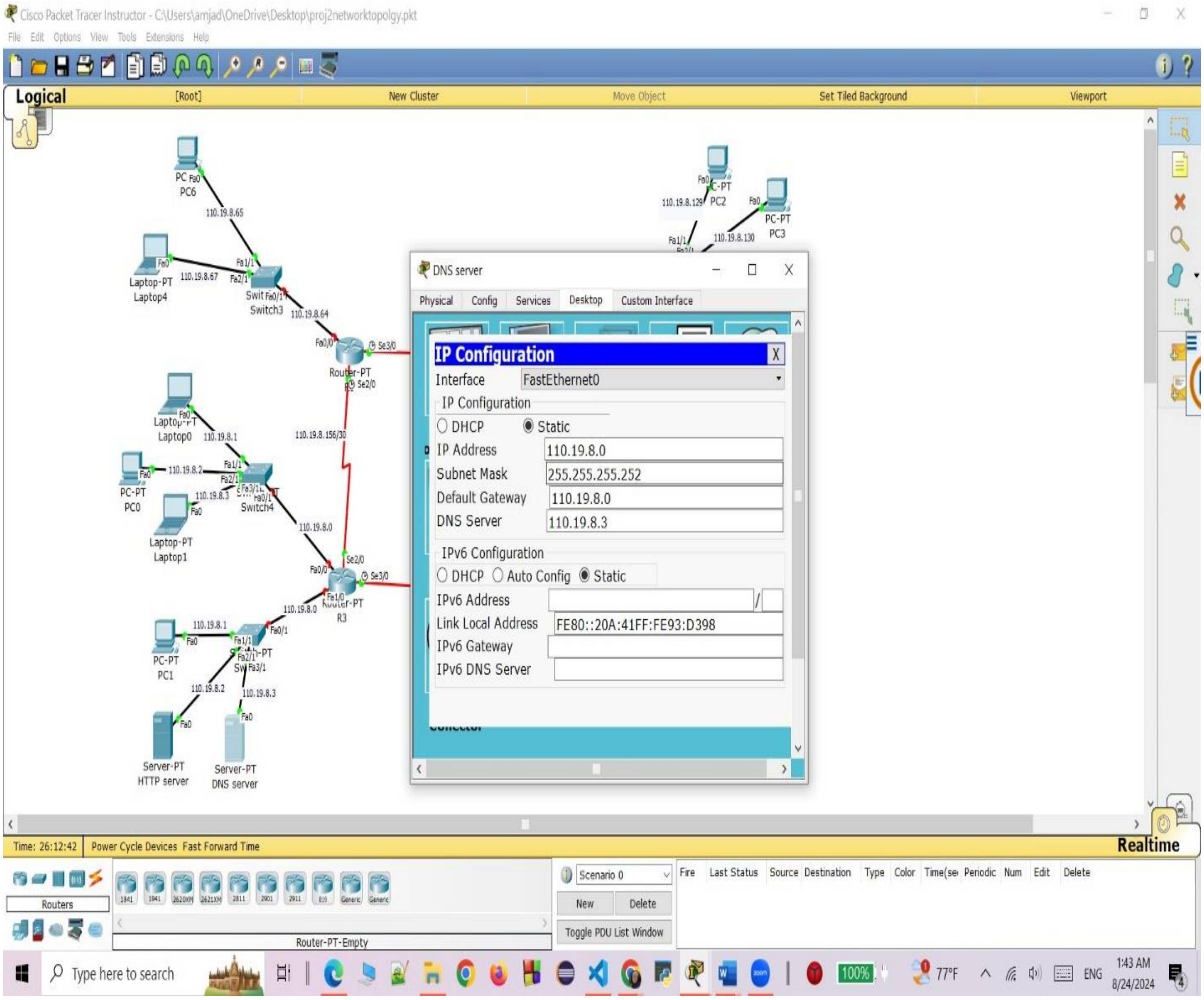

Figure 24IP CONFIGRATION OF DNS SERVER

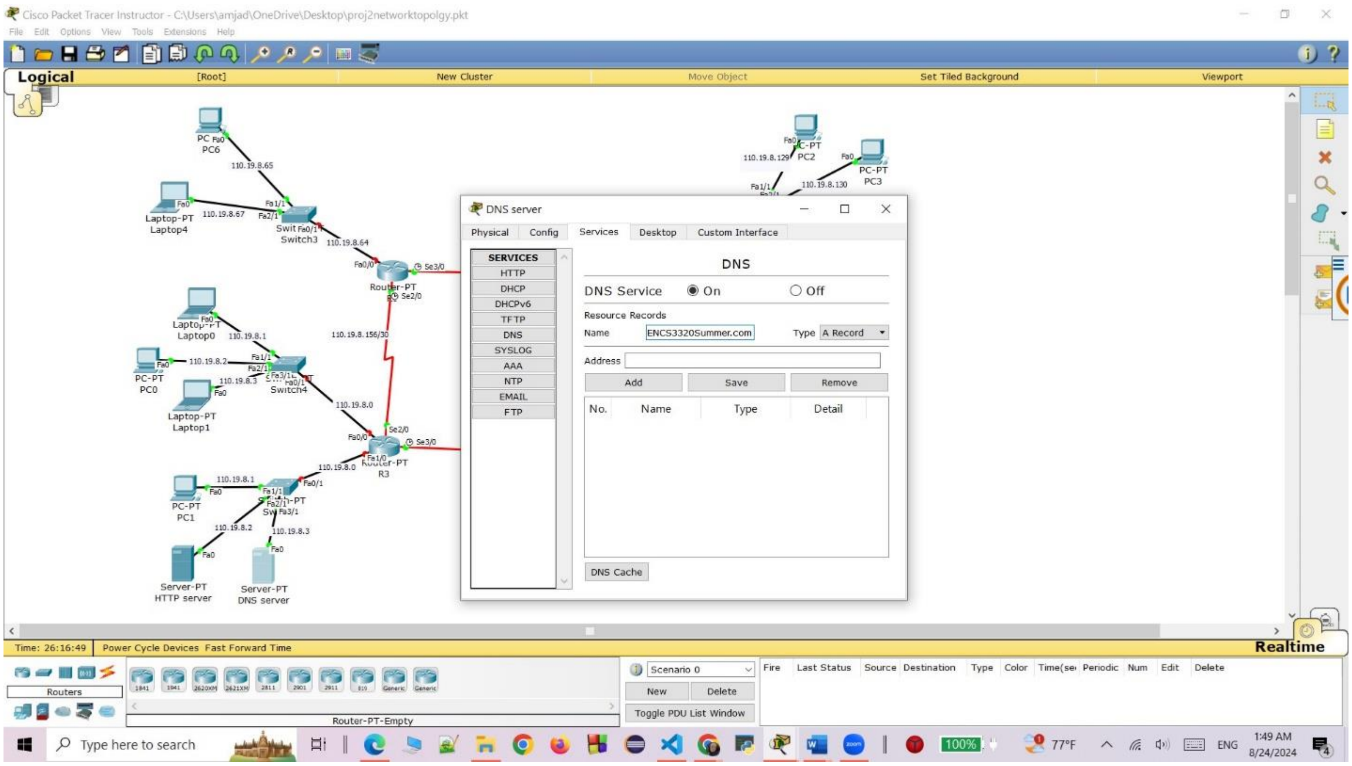

Figure 25: ON OF DNC SERVER

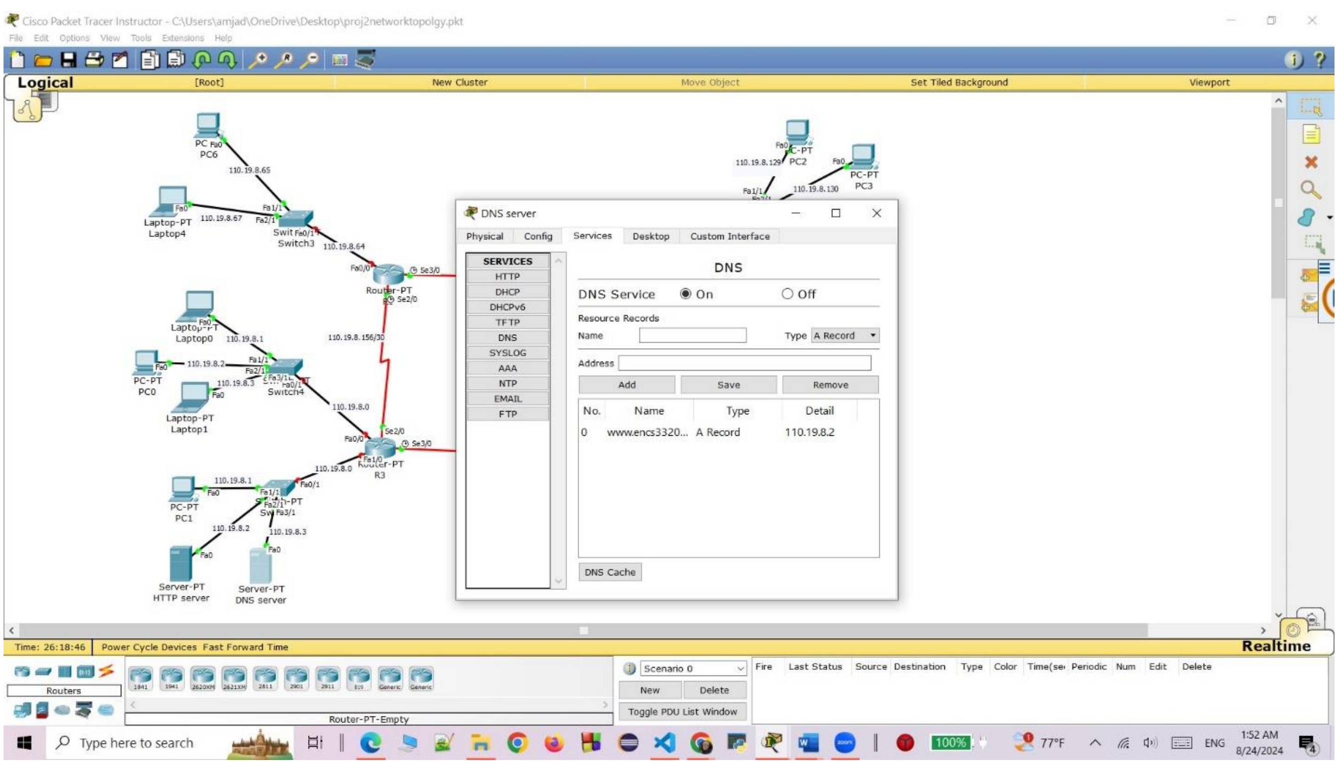

Figure 26: SERVER DNS

Task 3

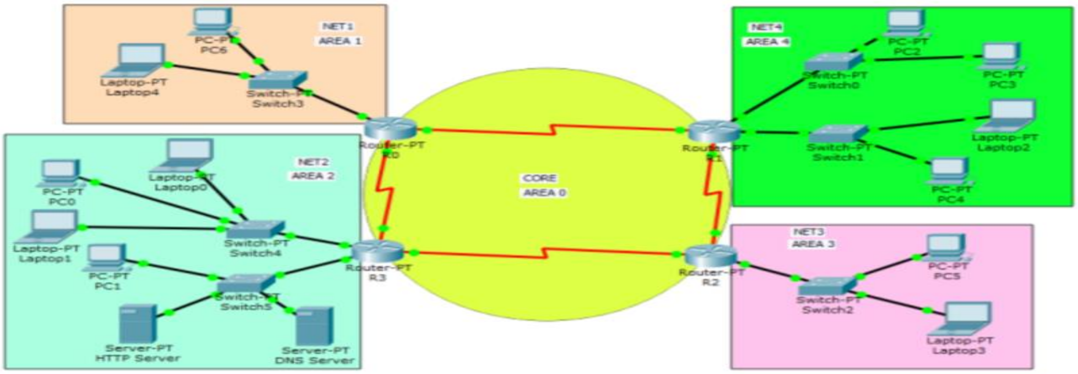

Figure 27: TOPOLOGY

When building using packet tracing

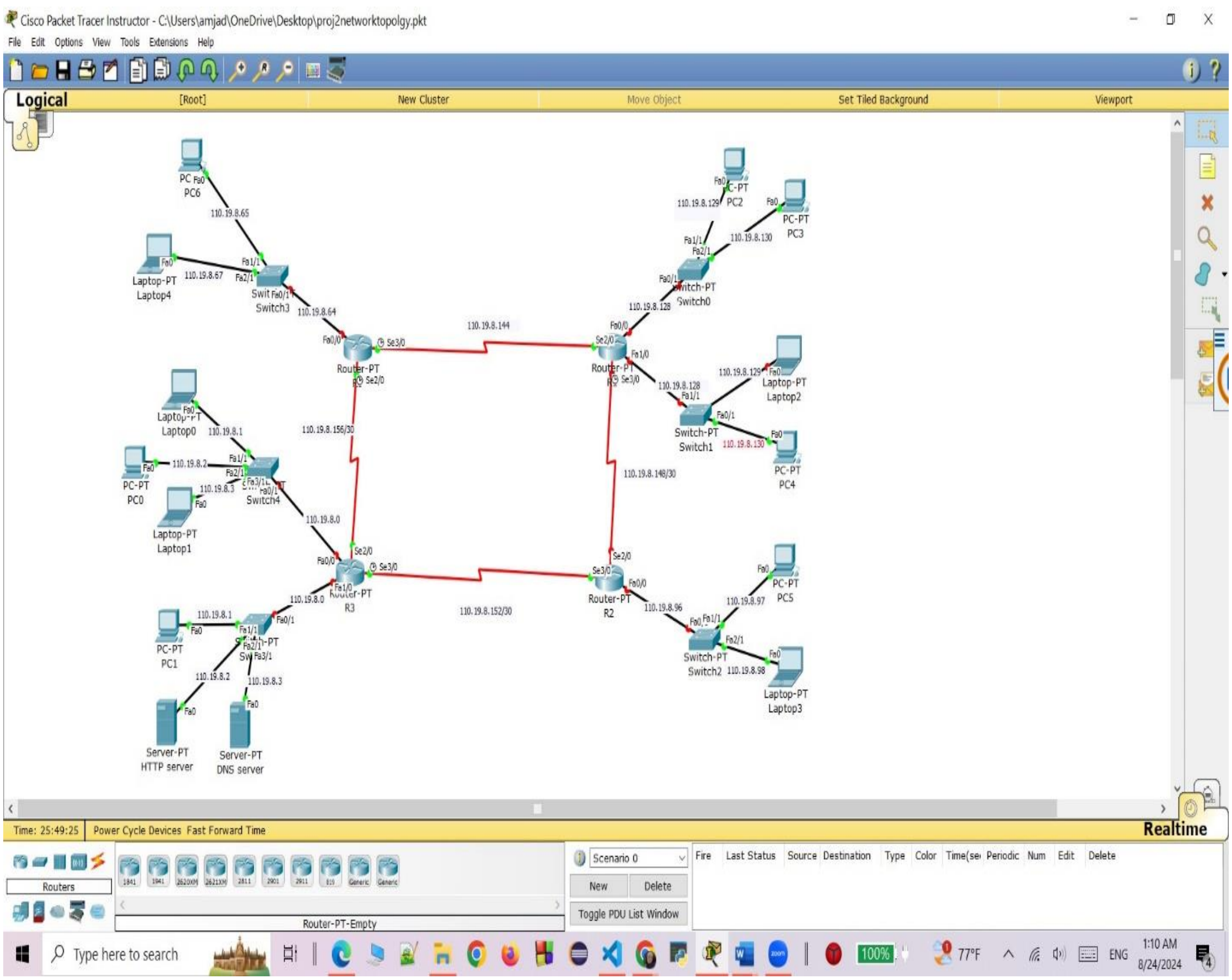

Figure 28TOPOLOGY bulding

Configuration for Each Router

In this phase, we implemented OSPF on each router to establish connections between them, with the specific details outlined in Table

Table 3Routing Details

Router	network	area
R0	110.19.8.64 110.19.8.144 110.19.8.156	Area0
R1	110.19.8.128 110.19.8.144 110.19.8.148	Area0
R2	110.19.8.96 110.19.8.148 110.19.8.152	Area0
R3	110.19.8.0 110.19.8.152 110.19.8.156	Area0

Configure OSPF on each router with process ID 1.

Use the appropriate network statements to include all interfaces and assign them to area 0.

Access R0 CLI

Router# configure terminal

Configure OSPF R0:

Router(config)# router ospf 1

Router network area R0 110.19.8.144 110.19.8.156 Area0

R1 110.19.8.144 Area0 R2 110.19.8.152 Area0

R3 110.19.8.152 110.19.8.156 Area0

Check OSPF Neighbors:

Router# show ip ospf neighbor

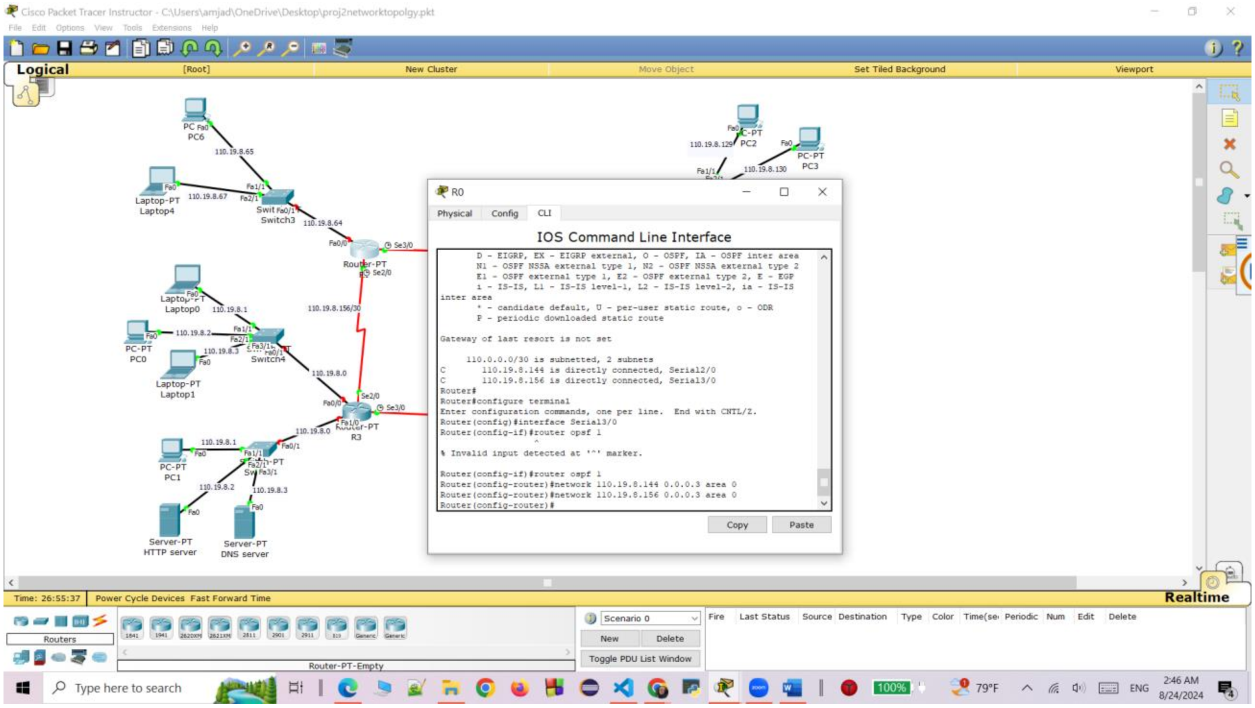

Figure 29Configure OSPF RO

Configure OSPF Router R1

1. **Access R1 CLI**:

Router# configure terminal

Router(config)# router ospf 1

Router(config-router)# network 110.19.8.144 0.0.0.3 area 0

Check OSPF Neighbors:

Router# show ip ospf neighbor Check OSPF Neighbors:

Router# show ip ospf neighbor

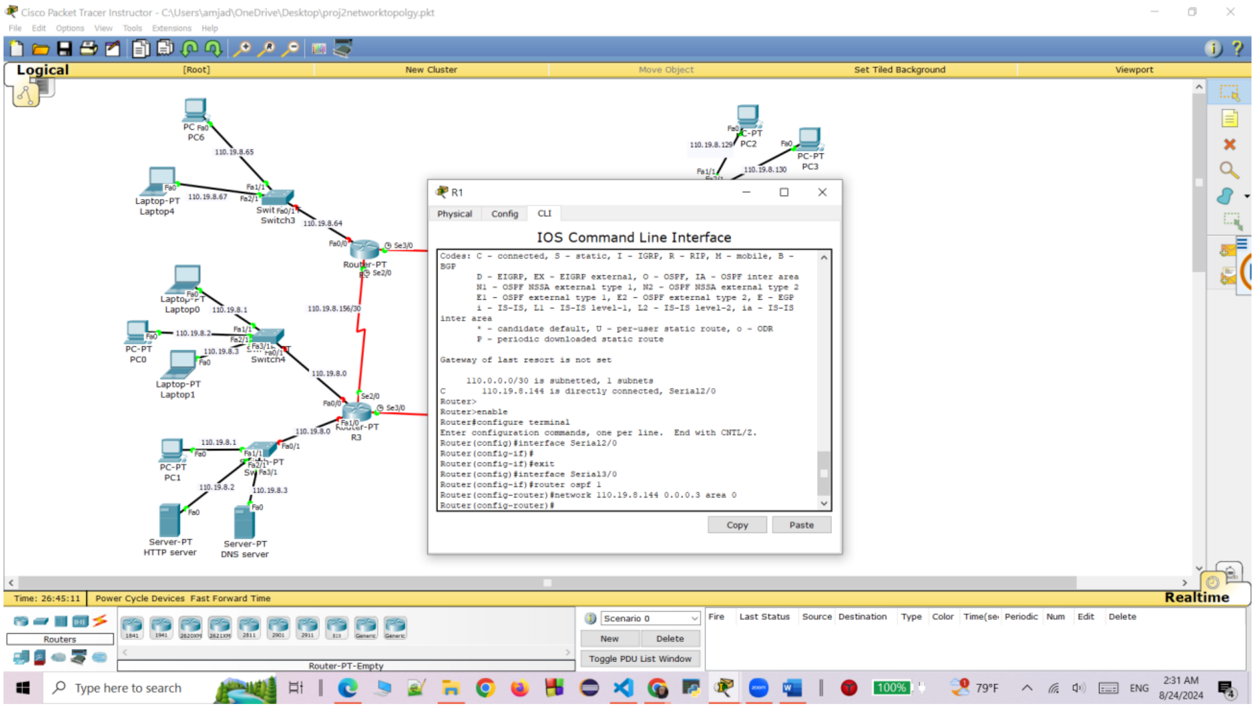

Figure 30Configure OSPF Router R1

Configure OSPF **Router R2**

1. **Access R2 CLI**:

Router# configure terminal

2: **Configure OSPF**:

Router(config)# router ospf 1

Router(config-router)# Router(config-router)# network 110.19.8.152 0.0.0.3 area 0

Check OSPF Neighbors:

Router# show ip ospf neighbor

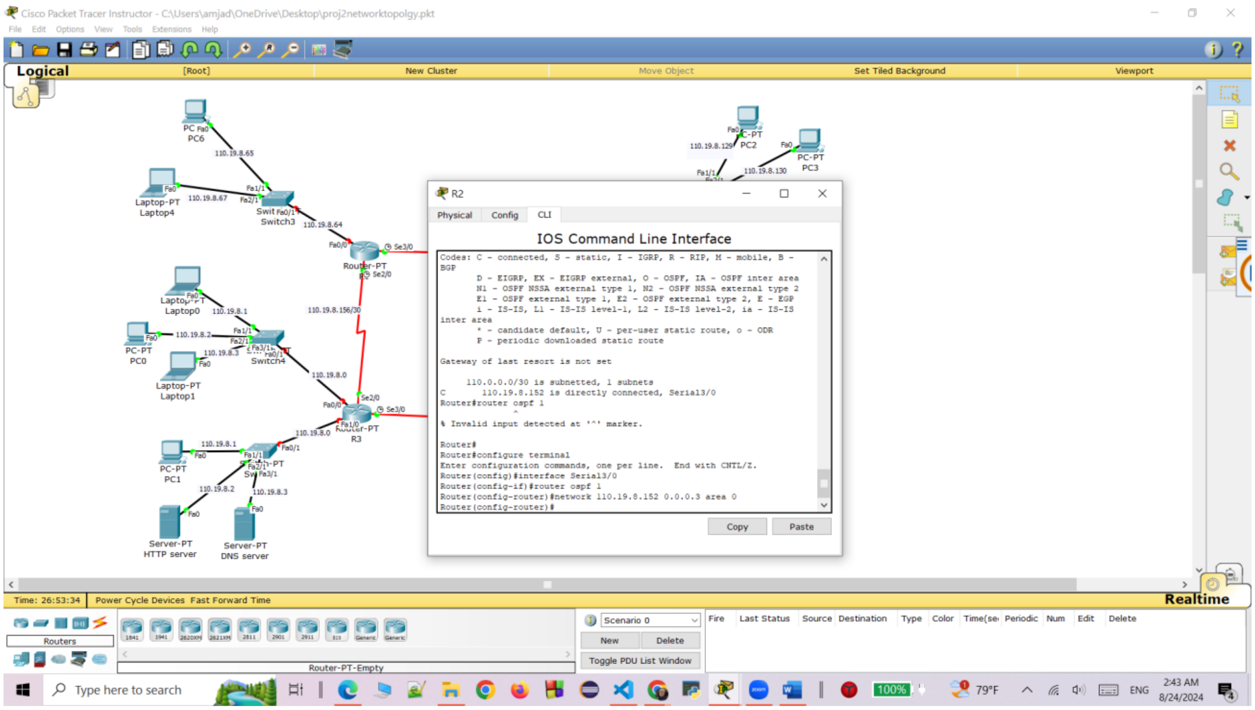

Figure 31Configure OSPF Router R2

Configure Router R3

1. **Access R3 CLI**:

Router# configure terminal

Configure OSPF:

Router(config)# router ospf 1

Router(config-router)# network 110.19.8.152 0.0.0.3 area 0

Router(config-router)# network 110.19.8.156 0.0.0.3 area 0

Check OSPF Neighbors:

Router# show ip ospf neighbor

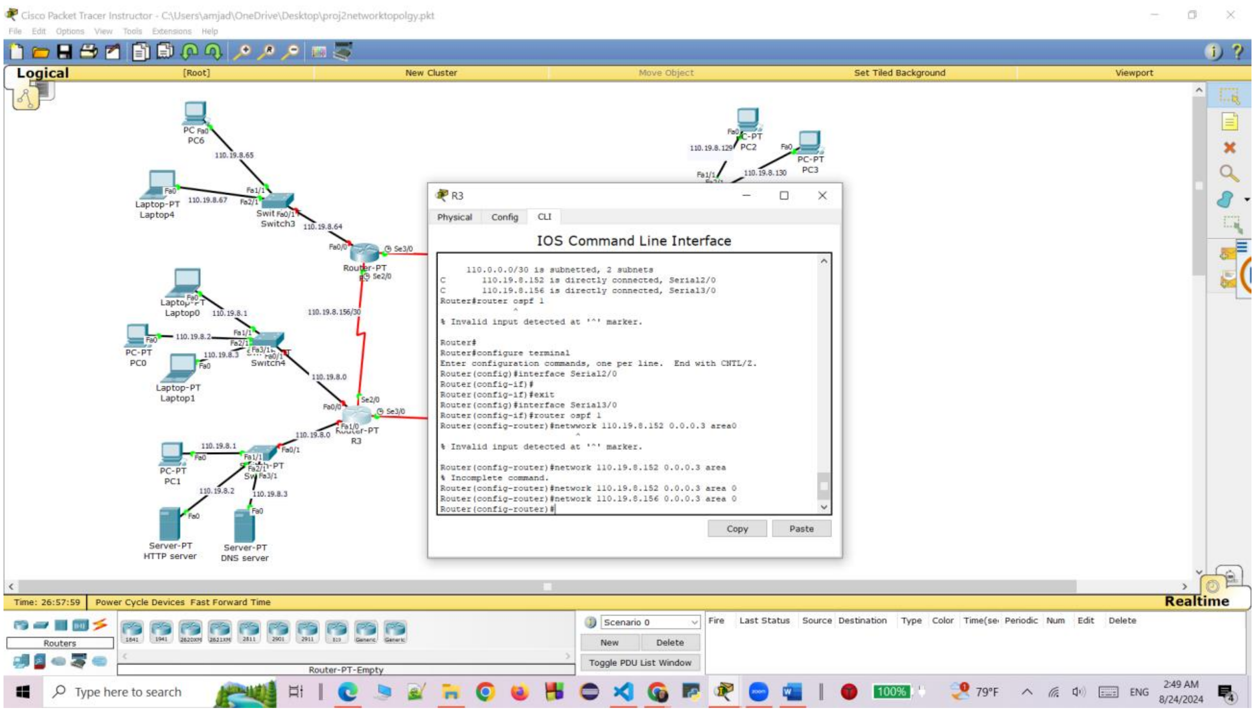

Figure 32Configure Router R3

Task4

Ping Test Between PCs:

Repeat this for all pairs of PCs as shown bellow is example of ping PC2

ping [IP Address of PC2]

Performing Tracert Tests

1. **Run Tracert Command**:

In the Command Prompt, use the tracert command to trace the path between PCs.

Testing connectivity between all PCs

In this part, we employed CMD commands such as "ping" and "tracert" to examine the connectivity between computers. These commands help assess the accessibility of devices within the network. Traceroute, in particular, allows us to trace the path taken by a packet as it journeys towards its destination.

From the below picture we try to ping to all pcs from PC 0 to PC 6 by sending packets and we can see that all packets arrive without and lost packet or requested out. As shown below of all PC .

Net2 (PC0 & PC1)

Ping of PC 0

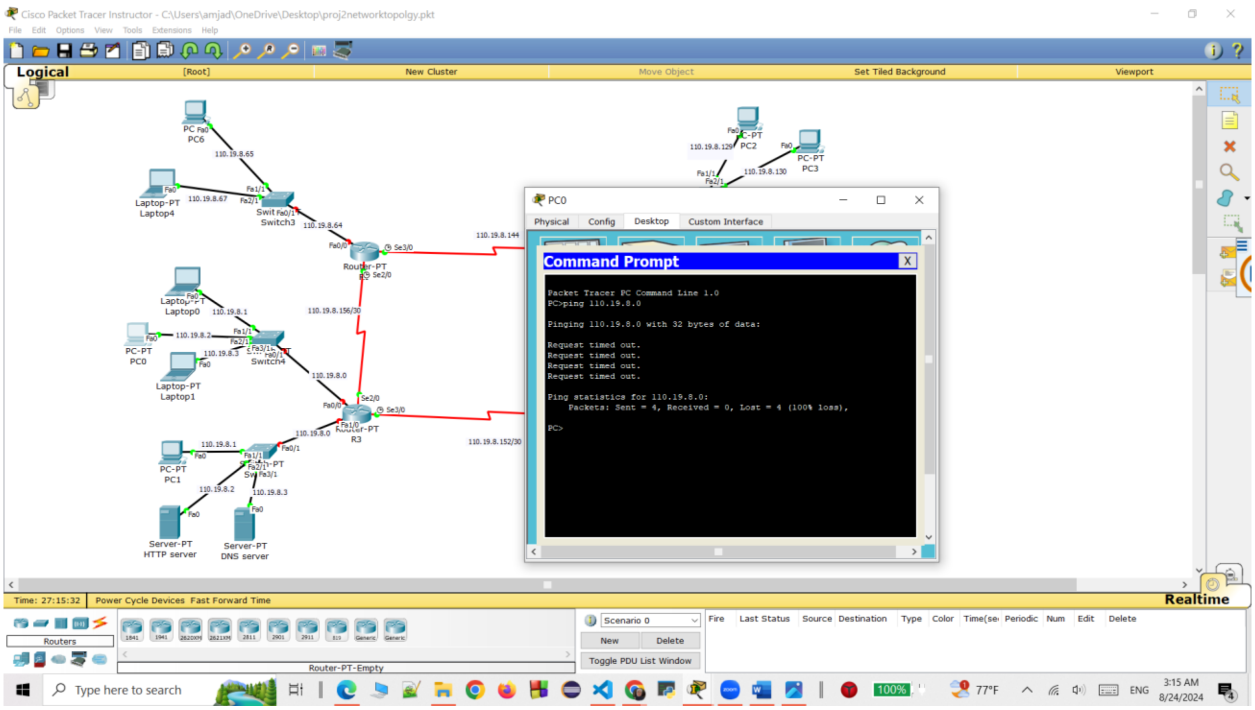

Figure 33 Ping of PC 0

Tract of PC0

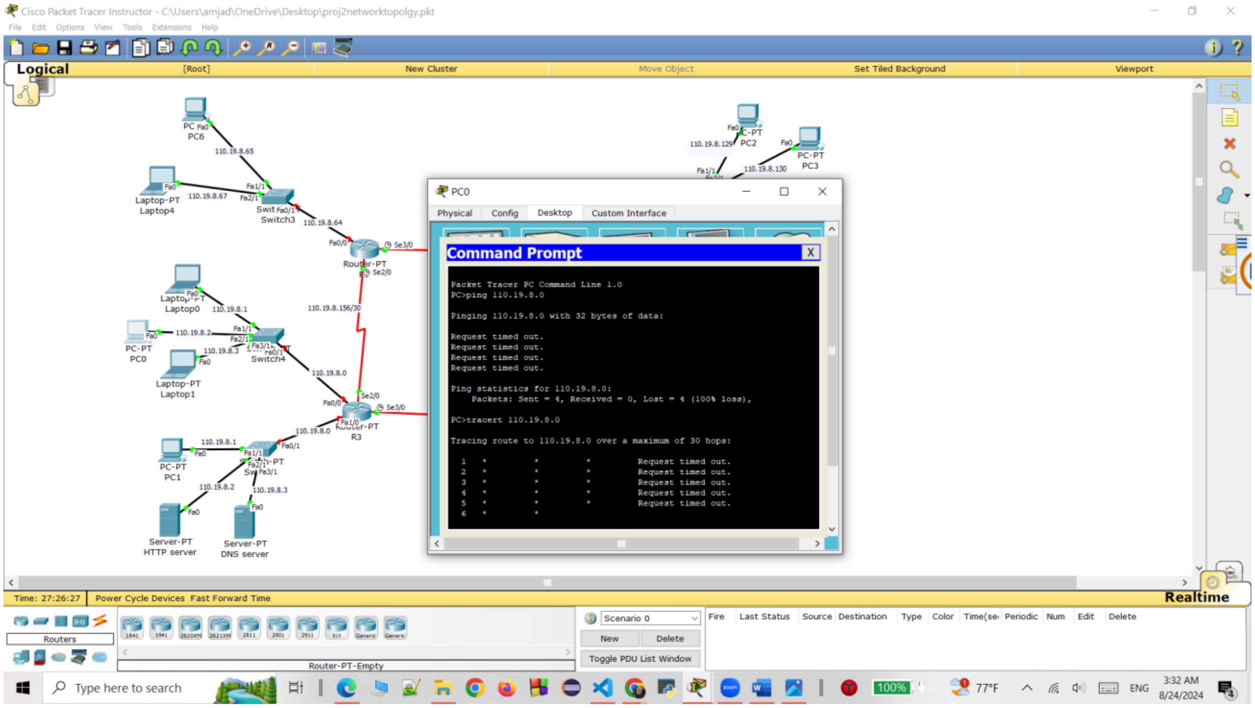

Figure 34Tract of PC0

Ping of PC 1

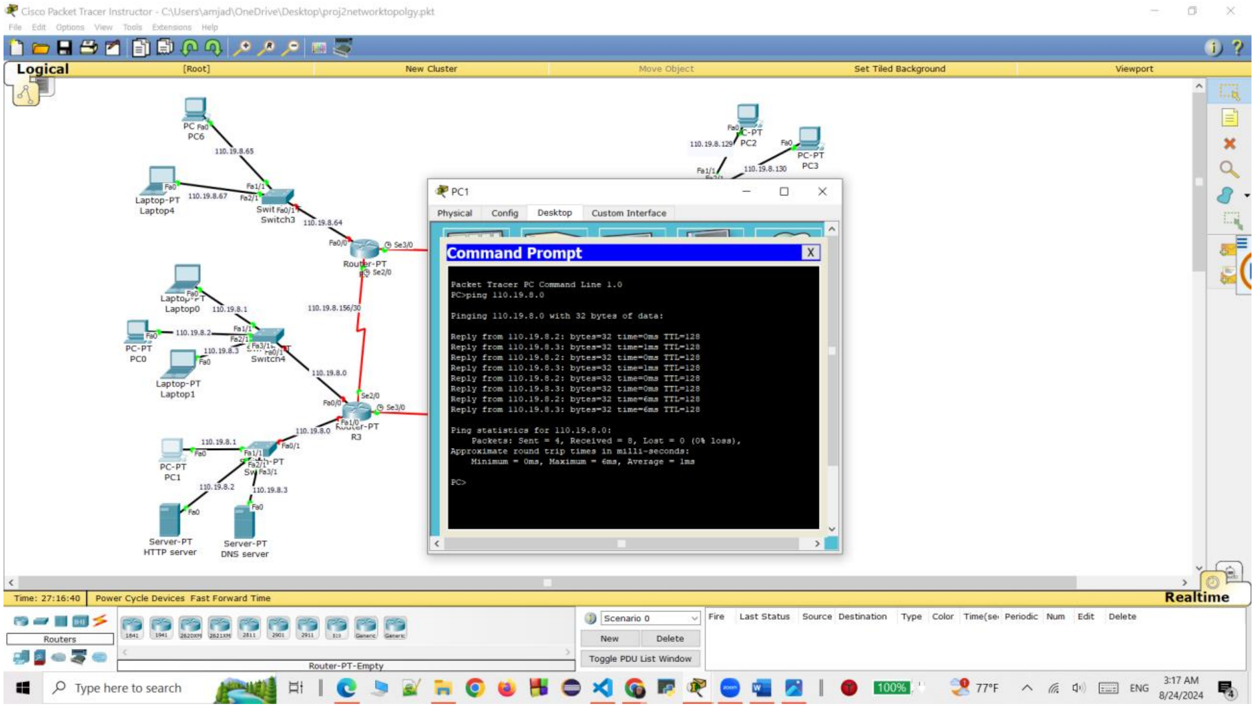

Figure 35Ping of PC 1

Tract of PC2

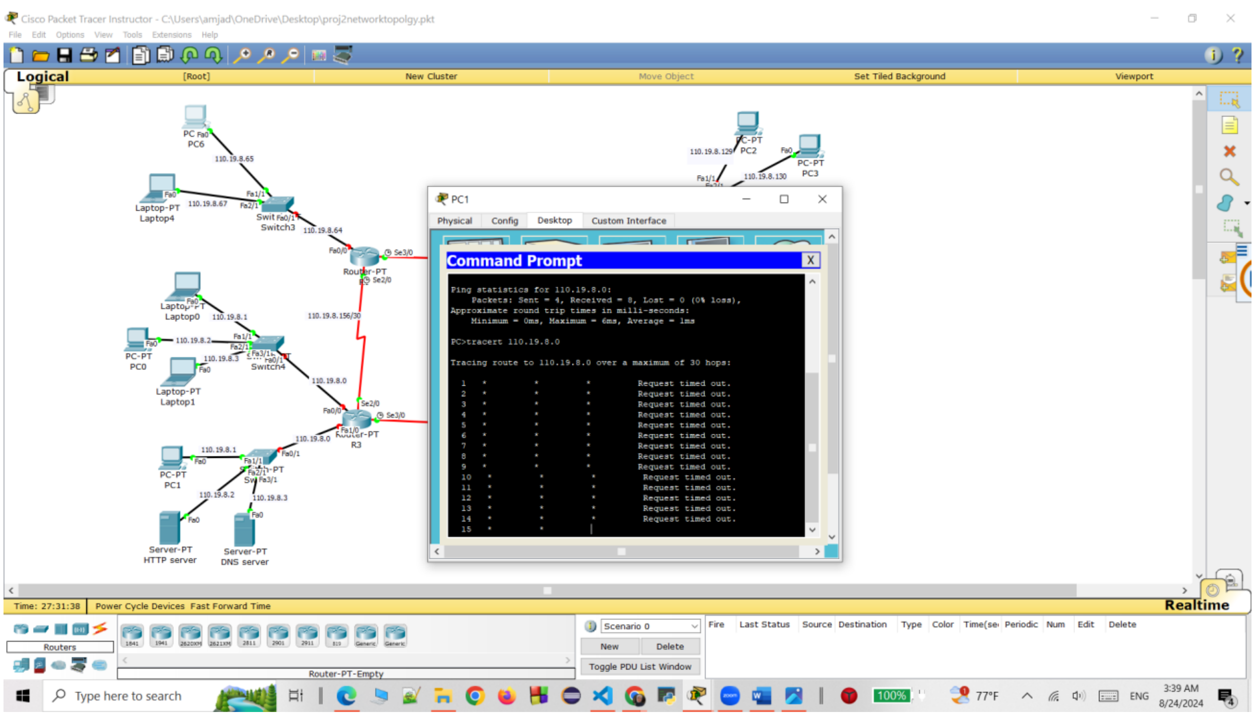

Figure 36Tract of PC2

Net4_Area4(PC2 , PC3 & PC4)

Ping of PC 2

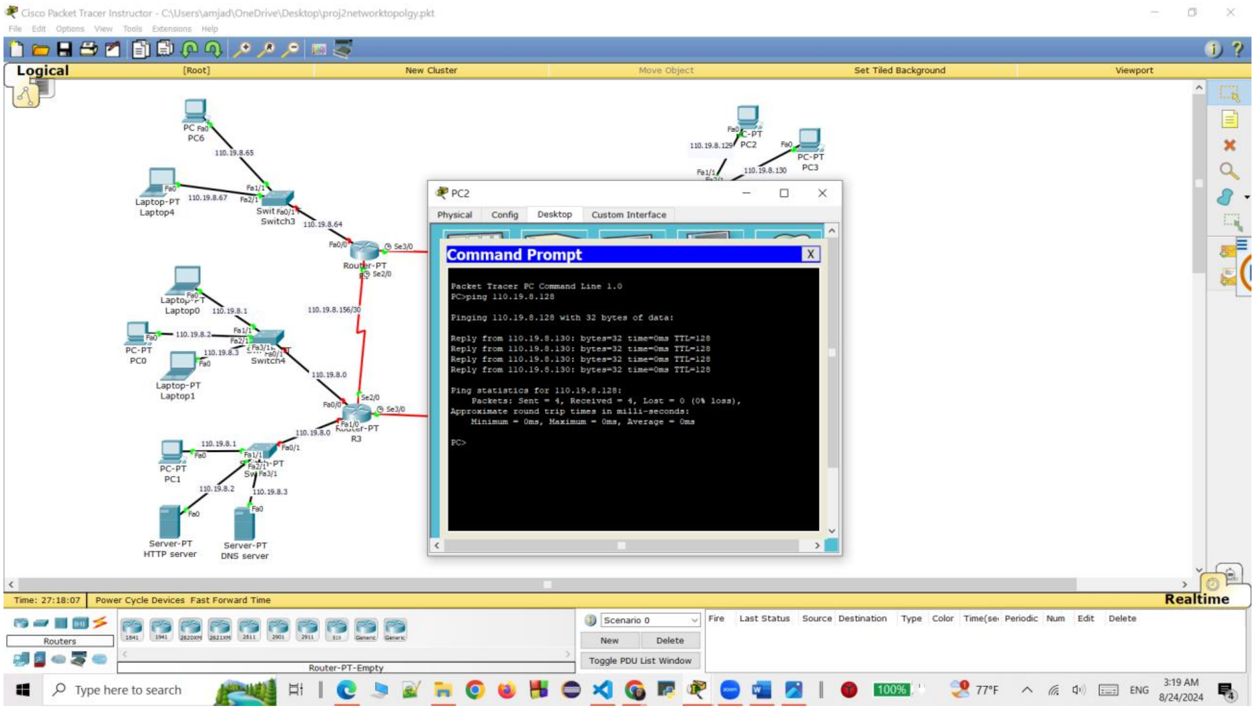

Figure 37Ping of PC 2

Tract of PC2

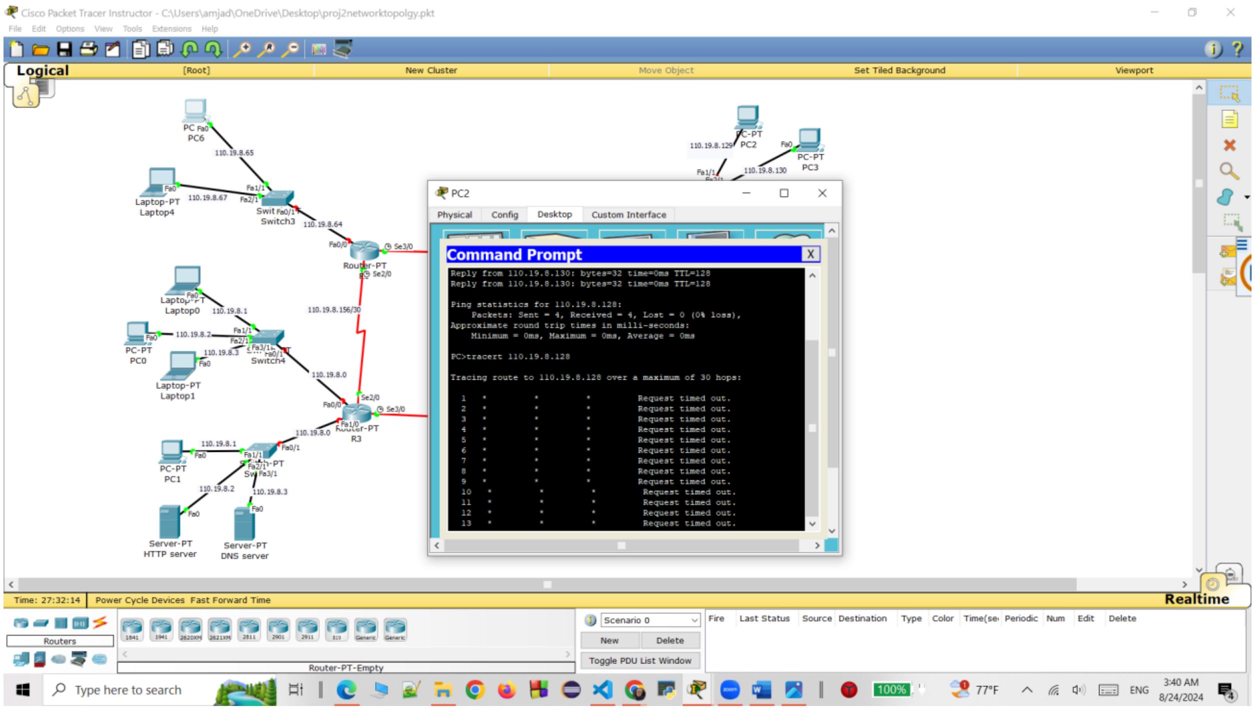

Figure 38Tract of PC2

Ping of PC 3

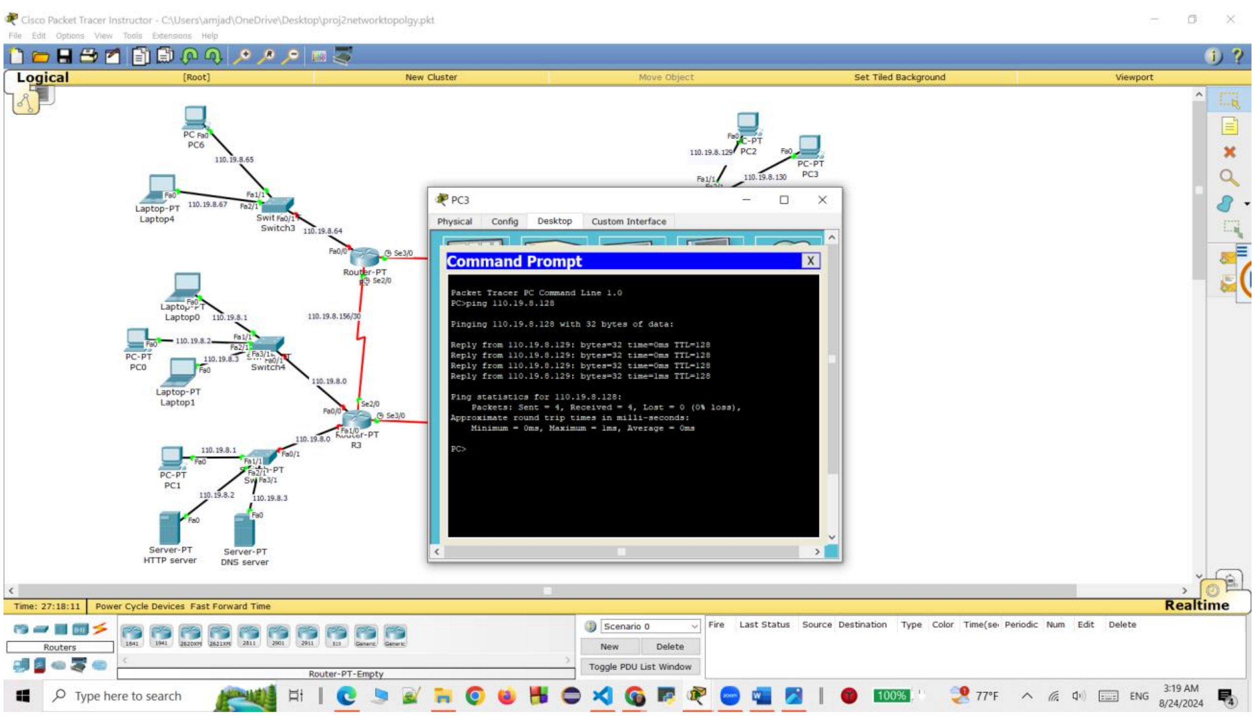

Figure 39Ping of PC 3

Tract of PC3

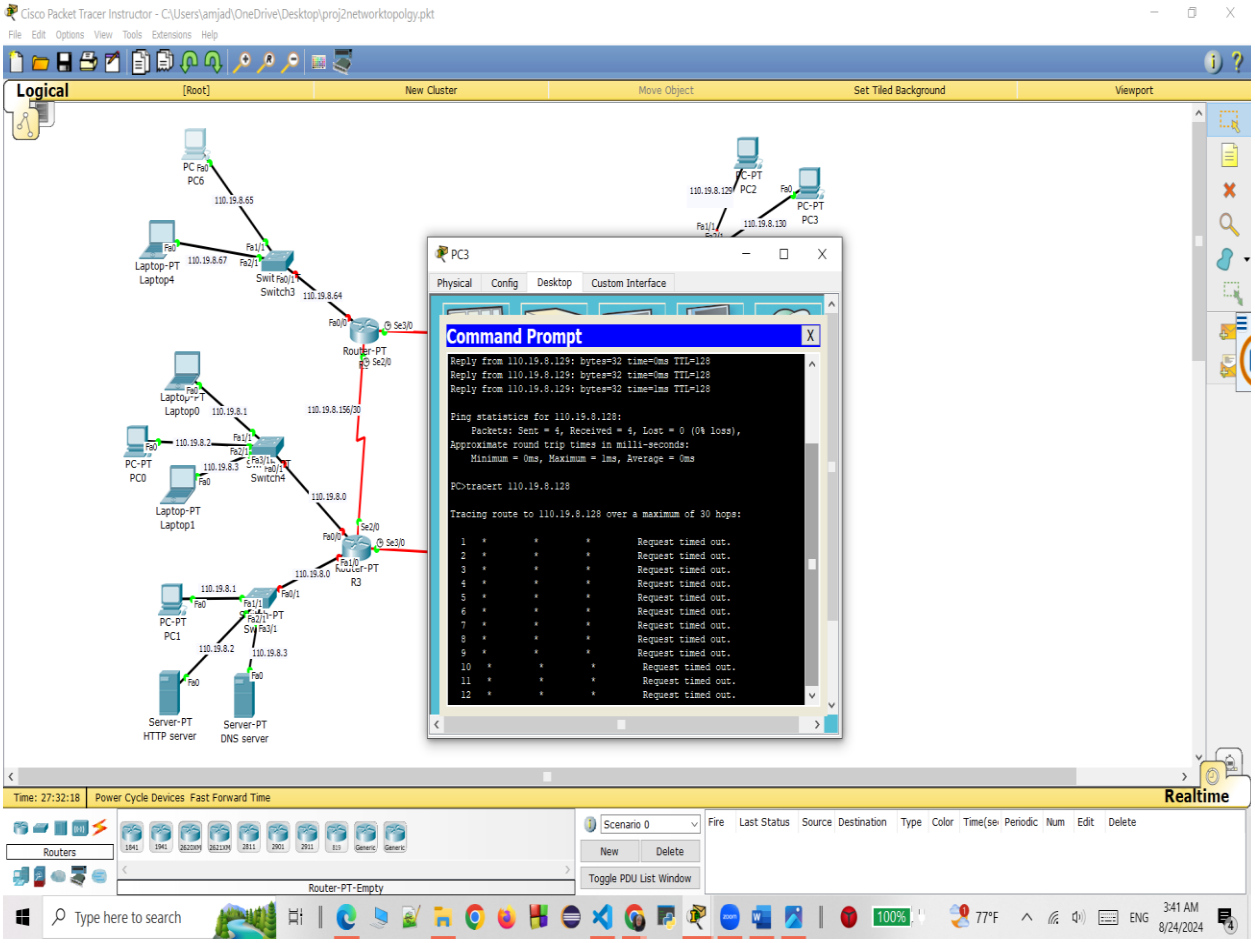

Figure 40Tract of PC3

Ping of PC 4

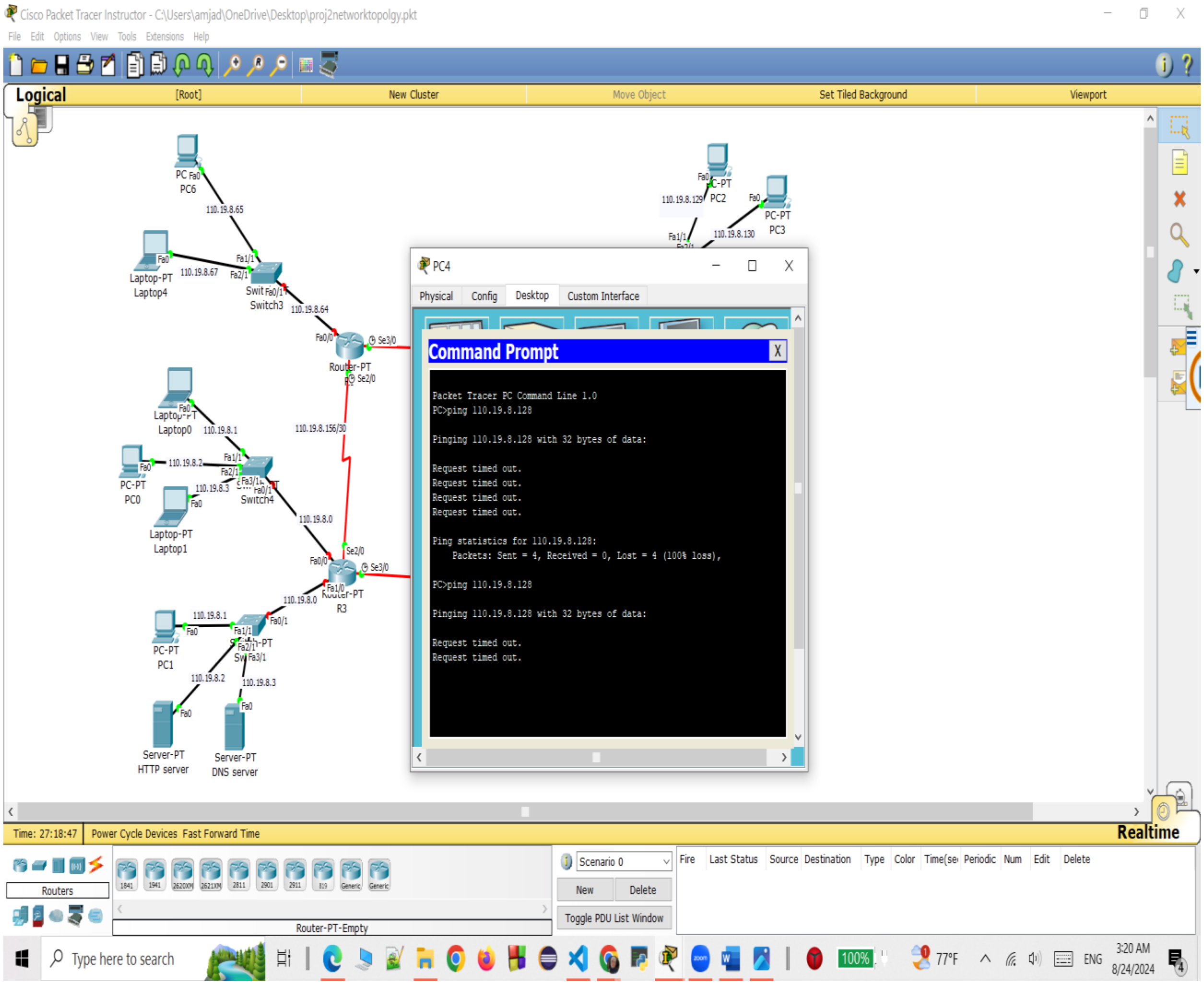

Figure 41Ping of PC 4

Tract of PC4

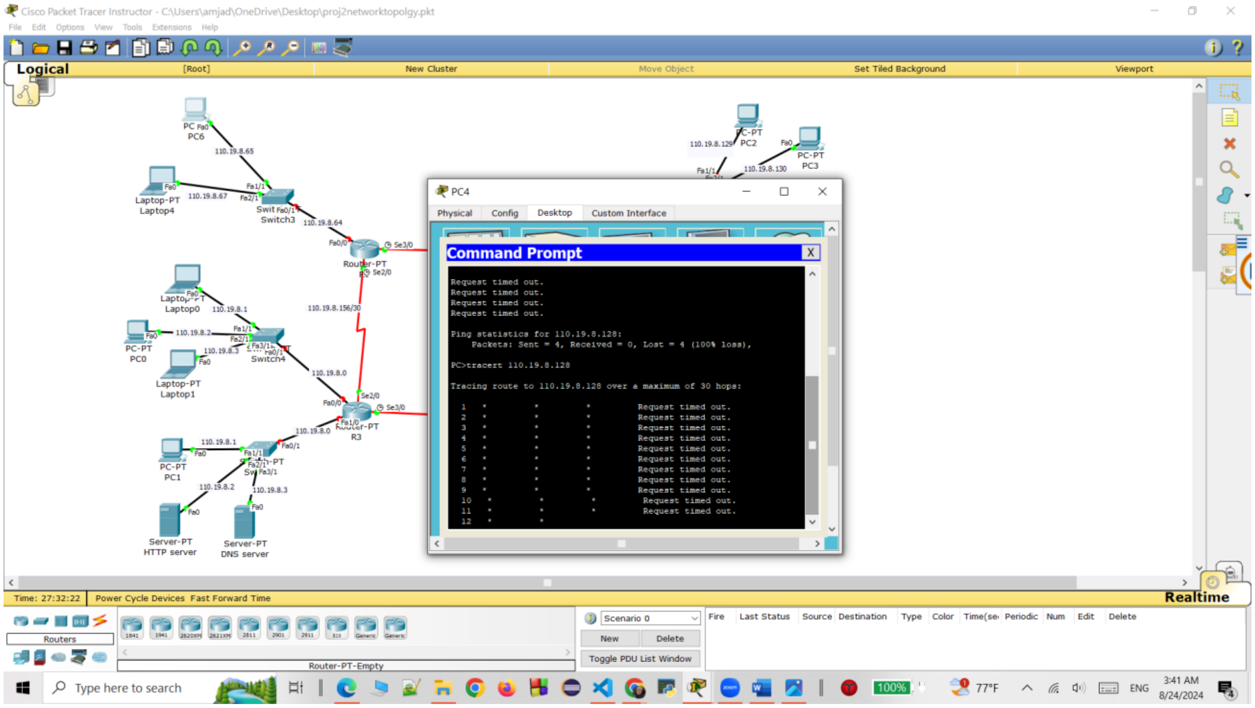

Figure 42Tract of PC4

Net3_Area3 (PC5)

Ping of PC 5

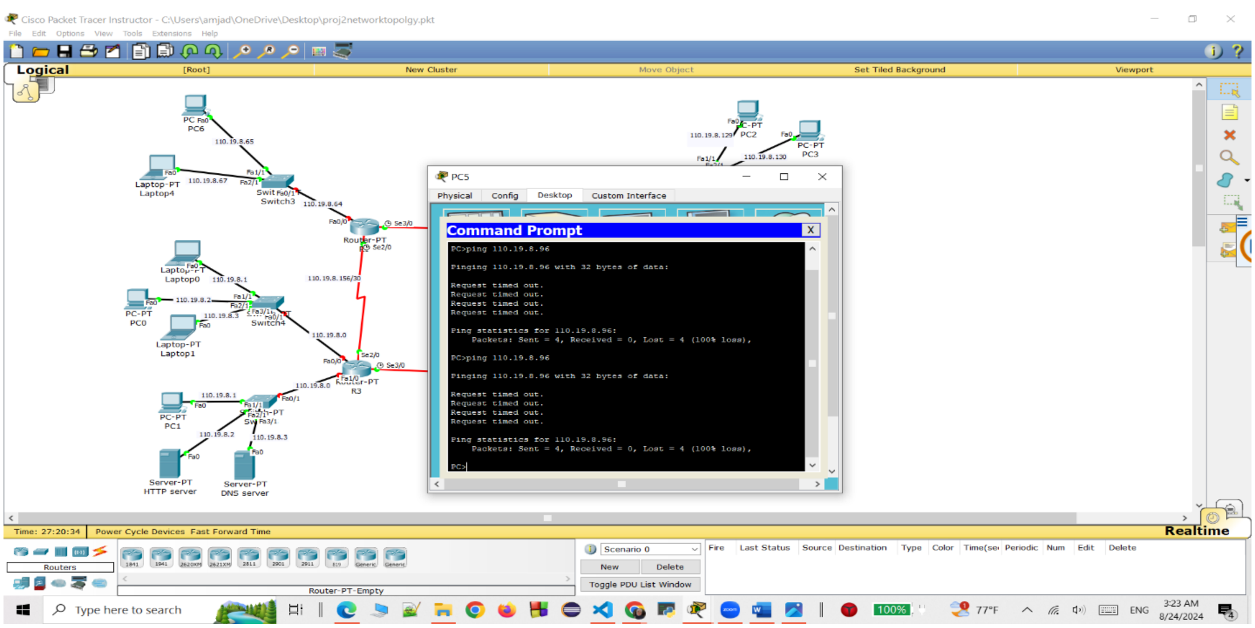

Figure 43Ping of PC 5

Tract of PC5

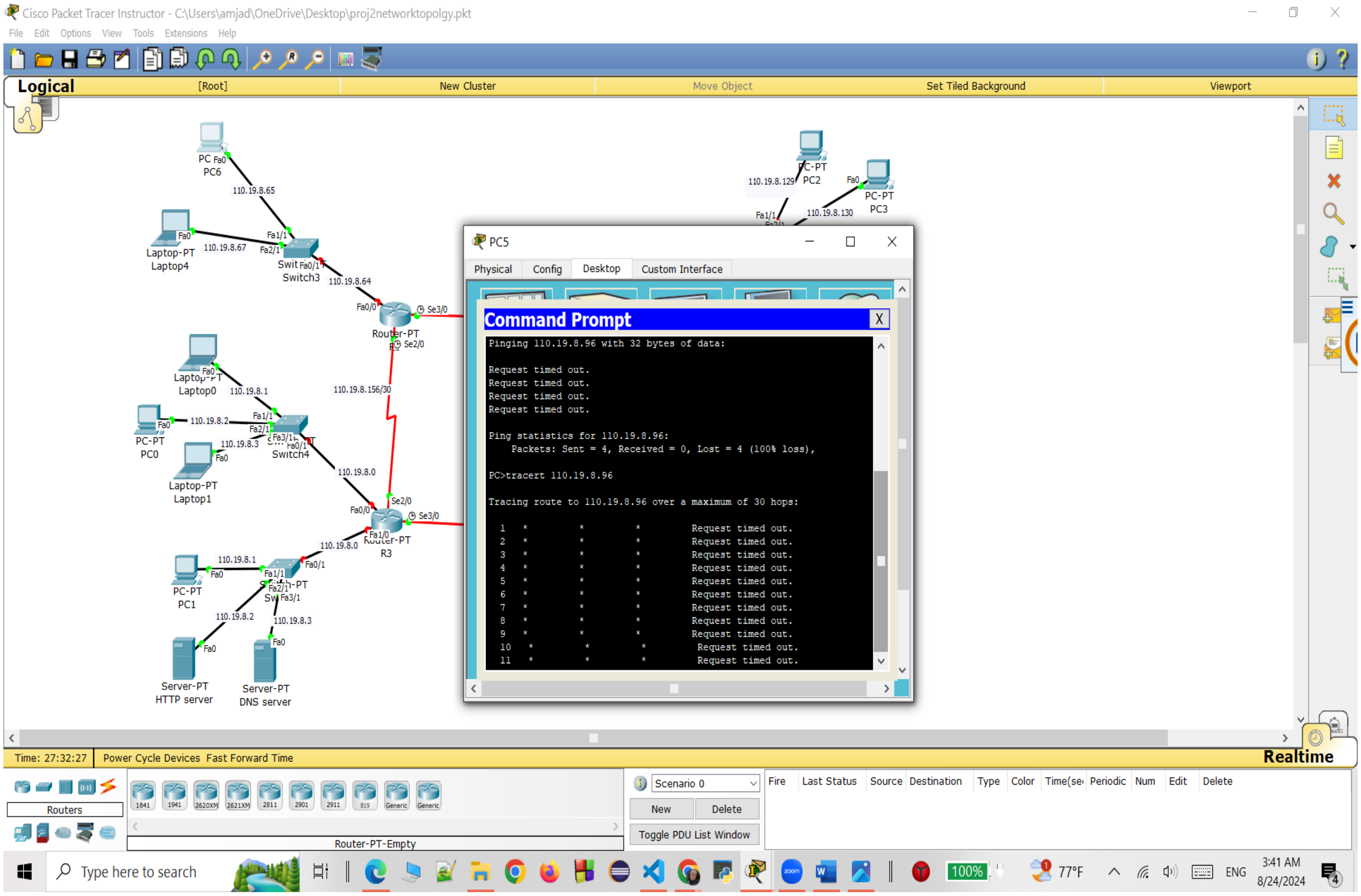

Figure 44Tract of PC5

Net1_Area1(PC 6)

Ping of PC6

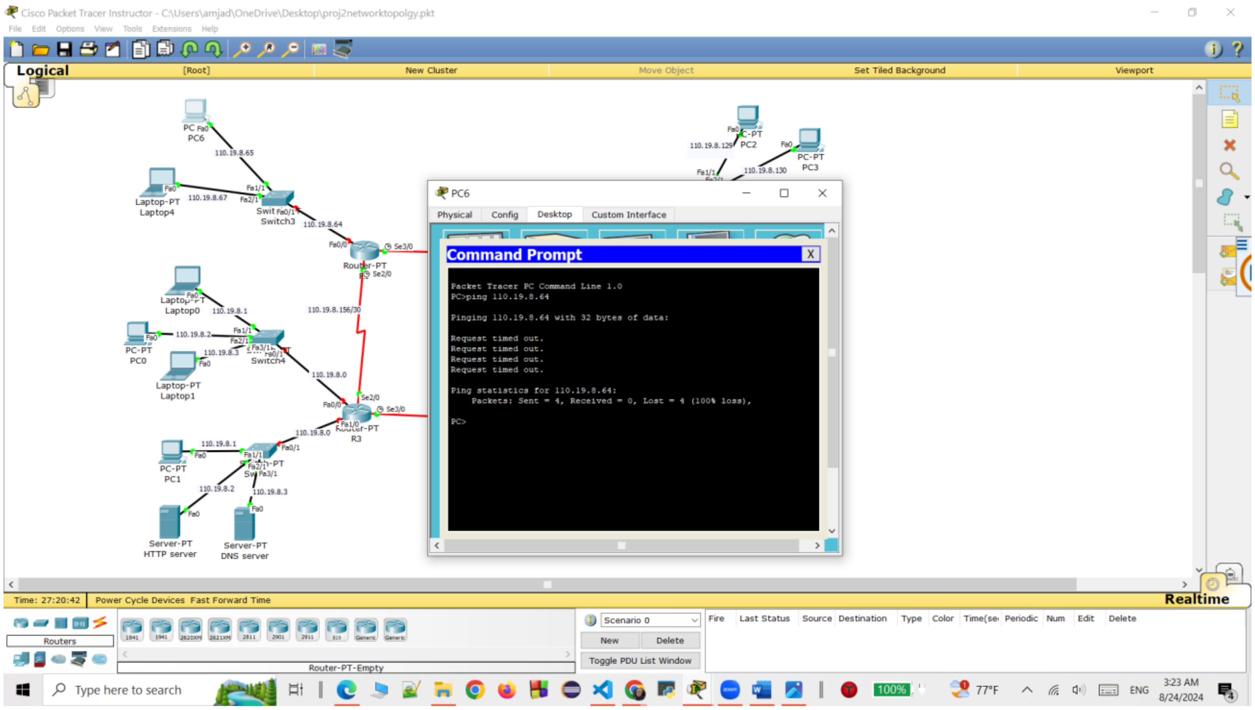

Figure 45Ping of PC6

Tract of PC6

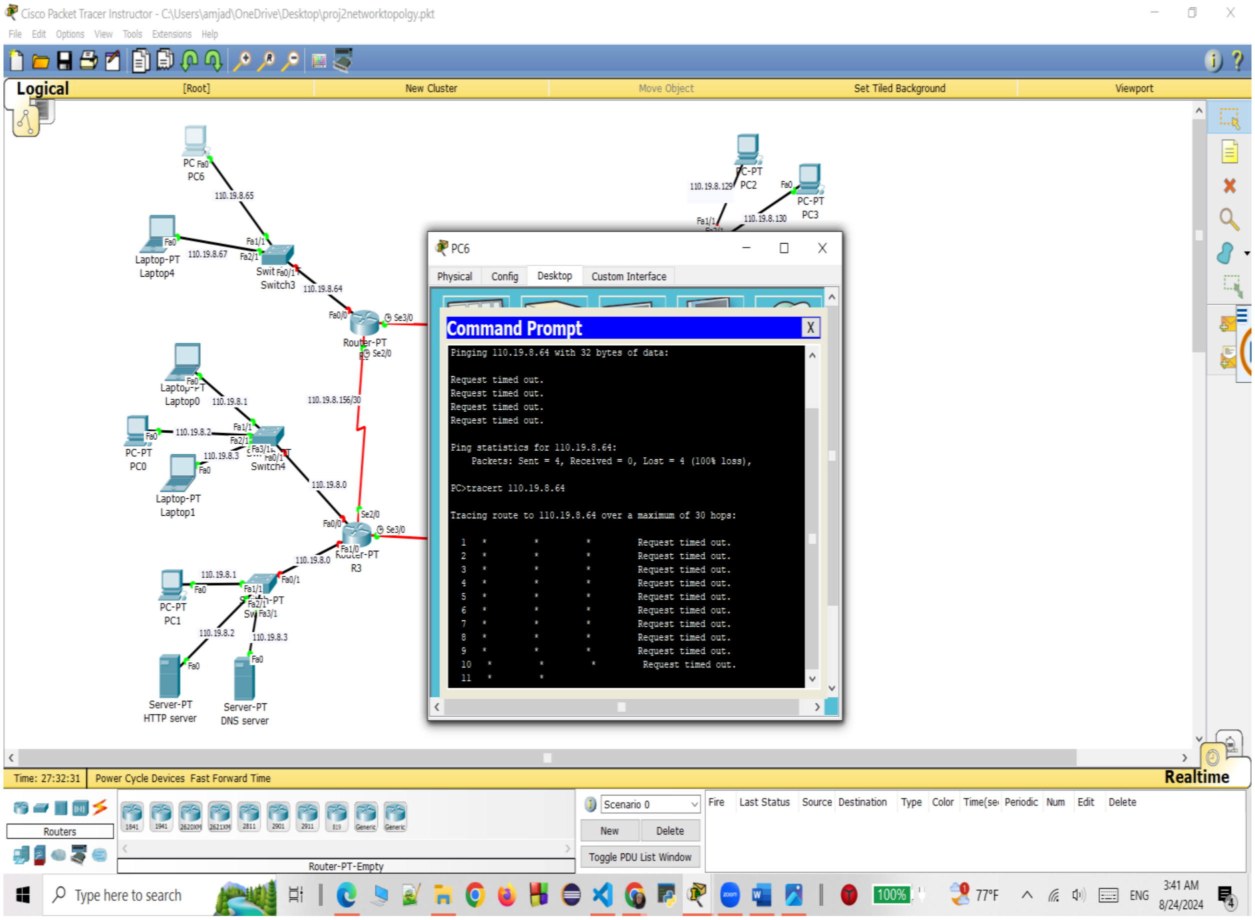

Figure 46Tract of PC6

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