Faculty of Engineering And Technology Electrical And Computer Engineering Department

Computer Networks ENCS3320

Project No.2_

Network Design

Group number : 14

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Section : 1

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Table of Contents

Table of figure:

Task0: IP subnetting & Assignment Part

Our IP address is 198.01.8.0/24. Based on what is required , Based on the shown drawing, we need 8 subnets (networks).

In short if your ID is1220198 then the IP is 198.01.8.0/22.

Network	Number of Hosts
NET2	60
NET1	20
NET3	30
NET4	10

NET2 > NET3>NET1 > NET 4

NET 2 = 60 HOST --- 2^6 -2 = 62 > 60 ---- 6 BIT
Block size = 2^6 = 64

NET 3 = 30 HOST --- 2^5 -2 = 30 => 30 ---- 5BIT Block size = 2^5 = 32

NET 1 = 20 HOST --- 2^5-2 = 30 > 20 ---- 5BIT Block size = 2^5 = 32

NET 4 = 10 HOST --- 2^4 -2 = 14 > 10 ---- 4 BIT Block size = 2^4= 16

Table of subnetting details :

Network Name	Subnet Mask	Network Address	First IP	Last IP	Broadcast	Number of Hosts
NET2 (Area 2) Subnet 1	/27	198.01.8.0	198.01.8.1	198.01.8.30	198.01.8.31	30
NET 2 (area2) Subnet2	/27	198.1.8.32	198.1.8.33	198.1.8.62	198.1.8.63	30
NET3 (Area 3)	/27	198.01.8.64	198.01.8.65	198.01.8.94	198.01.8.95	126
NET1 (Area 1)	/27	198.01.8.96	198.01.8.97	198.01.8.126	198.01.8.127	30
NET4 (Area 4) Subnet 1	/29	198.01.8.128	198.01.8.129	198.01.8.134	198.01.8.135	6
NET4 (area4) Subnet2	/29	198.1.8.136	198.1.8.137	198.1.8.142	198.1.8.143	6
R0-R1 Link 1	/30	198.01.8.144	198.01.8.145	198.01.8.146	198.01.8.147	2

R1-R2 Link 2	/30	198.01.8.148	198.01.8.149	198.01.8.150	198.01.8.151	2
R2-R3 Link 3	/30	198.01.8.152	198.01.8.153	198.01.8.154	198.01.8.155	2
R3-R0 Link 4	/30	198.01.8.156	198.01.8.157	198.01.8.158	198.01.8.159	2

IPv4

IPv4 (Internet Protocol version 4) is a widely used protocol for identifying devices on a network through an IP address. An IPv4 address is a 32-bit number typically expressed in decimal format as four octets separated by periods, such as 192.168.1.1[1].

An IPv4 address is divided into two parts:

1. **Network Part:** This identifies the specific network on which a device resides. The network portion is determined by the subnet mask, which specifies how many bits are used for the network address. For example, in a subnet mask of 255.255.255.0 (or /24 in CIDR notation), the first 24 bits of the IP address are used for the network part [1].
2. **Host Part**: This identifies the specific device within that network. The host portion of the address is the remaining part after the network portion. In the same example of a /24 network, the last 8 bits of the IP address are used for the host address, which allows for 256 addresses in the network, including network and broadcast addresses [1].

Task1: Building Topology Part

1. Build the topology given in Figure 1 using packet tracer based on the IP addressing you designed in Task0.

2. Configure the interfaces of all routers as instructed in Figure 1.

3. End devices (i.e. Laptops, PCs, and Servers) in the networks are getting their IPs in a static manner based on the assigned subnet IPs.

• Build the topology using packet tracer

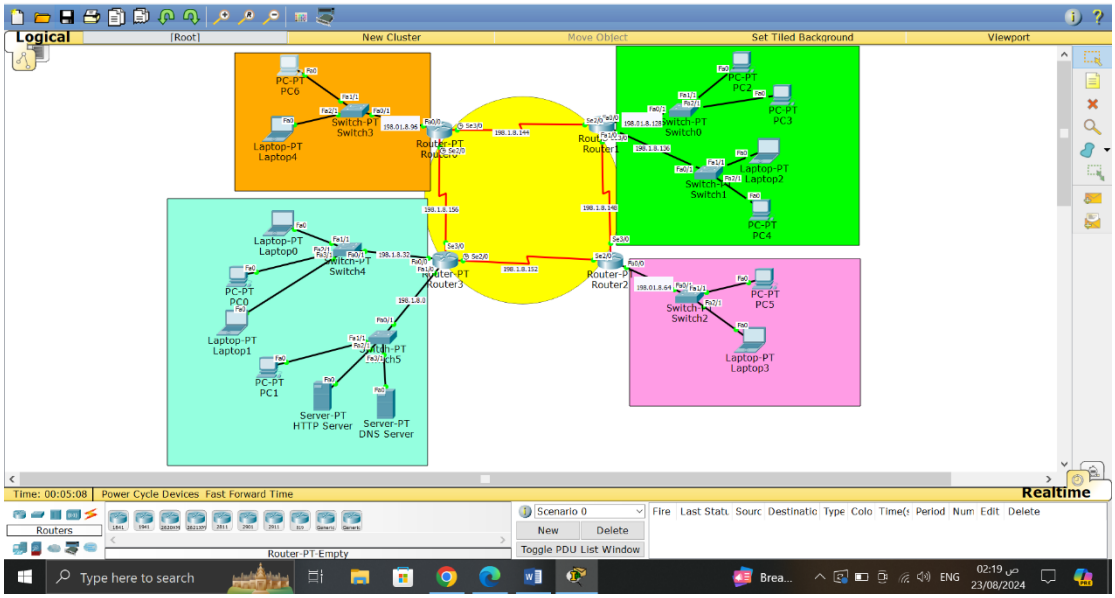

Figure 1:Network Topolog

Router 0 configuration

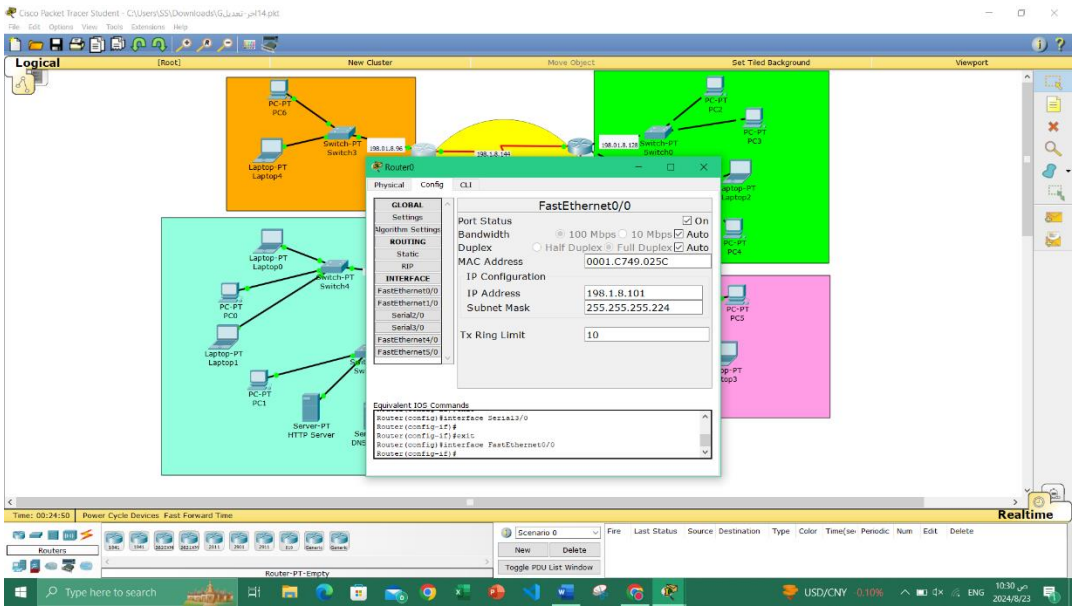

Figure 2router 0 (Fast Ethernet 0/0)

We use the subnet mask of network address (198.1.8.96 /27) [router 0 Fa 0/0] and an ip address from the rang of ip address of 198.1.8.96 network

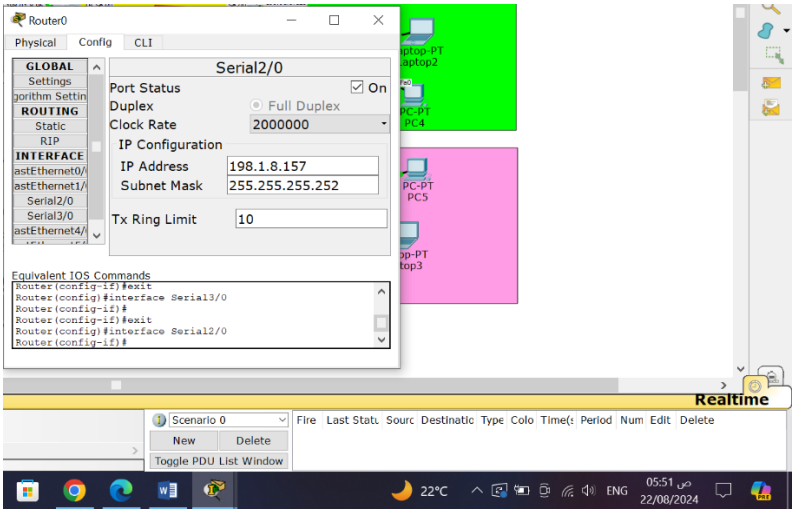

Figure 3: router 0 (Serial 2/0)

We use the subnet mask of network address (198.1.8.156 /30) [se 2/0] and an ip address from the rang of ip address of 198.1.8.156 network

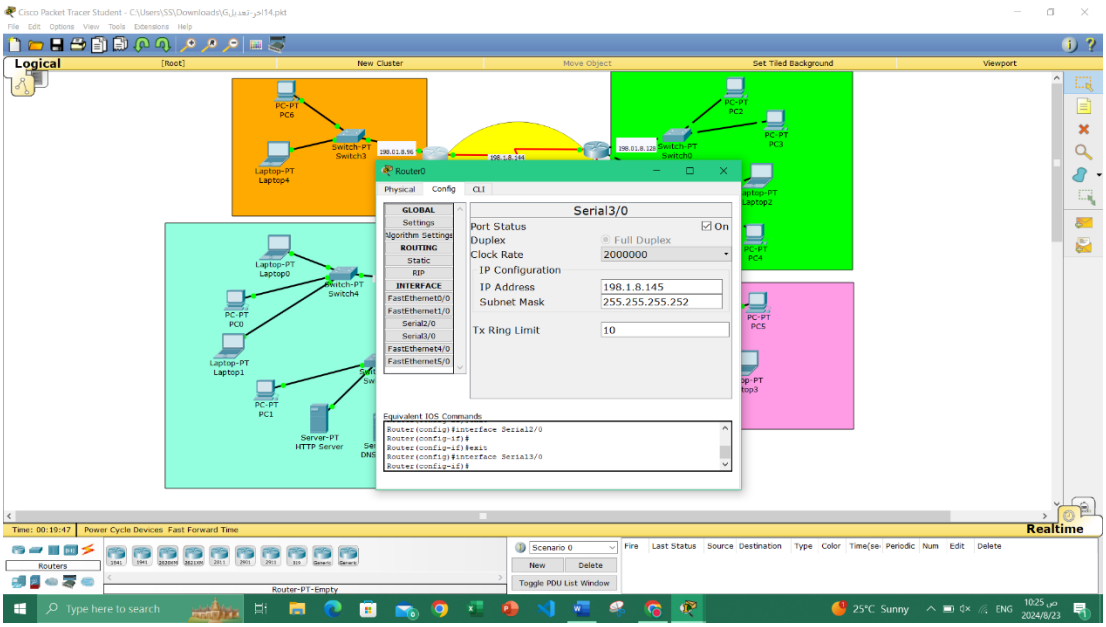

Figure 4:router 0 (Serial 3/0)

We use the subnet mask of network address (198.1.8.144 /30) [se 3/0] and an ip address from the rang of ip address of 198.1.8.144 network

Router 1 configuration

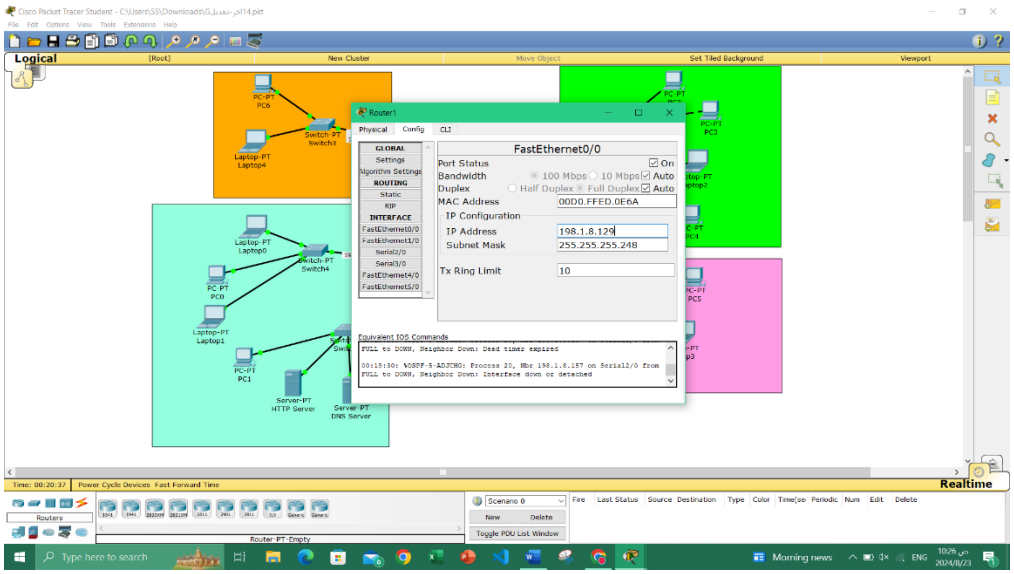

Figure 5: router 1 (Fast Ethernet 0/0)

We use the subnet mask of network address (198.1.8.128 /29) [router 1 Fa 0/0] and an ip address from the rang of ip address of 198.1.8.128 network

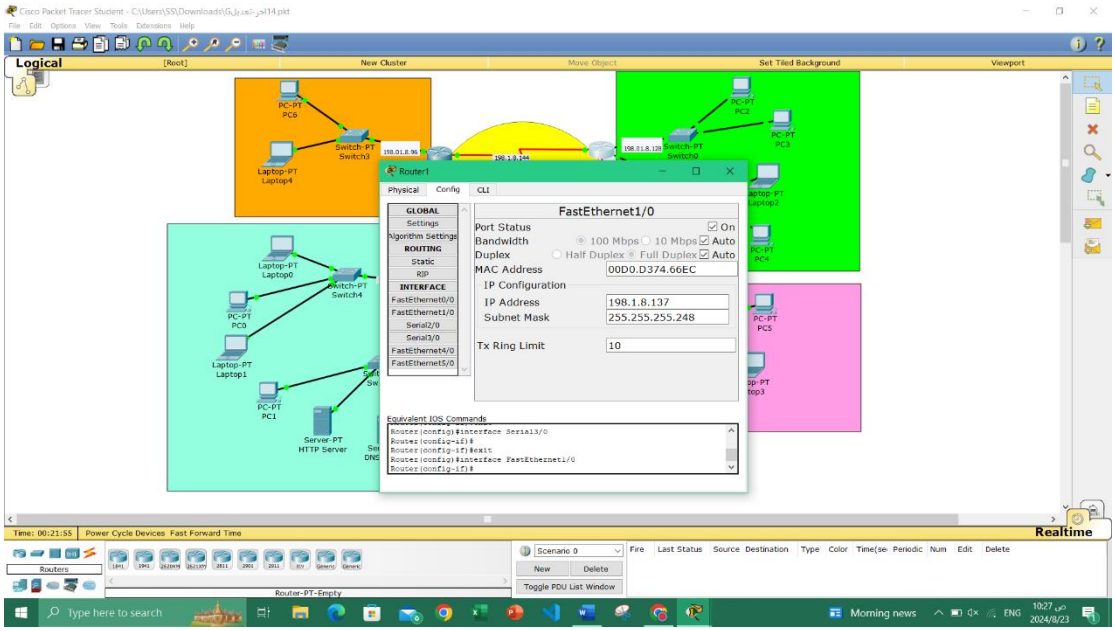

Figure 6 router 1 (Fast Ethernet 1/0)

We use the subnet mask of network address (198.1.8.136 /29) [router 1 Fa 1/0] and an ip address from the rang of ip address of 198.1.8.136 network

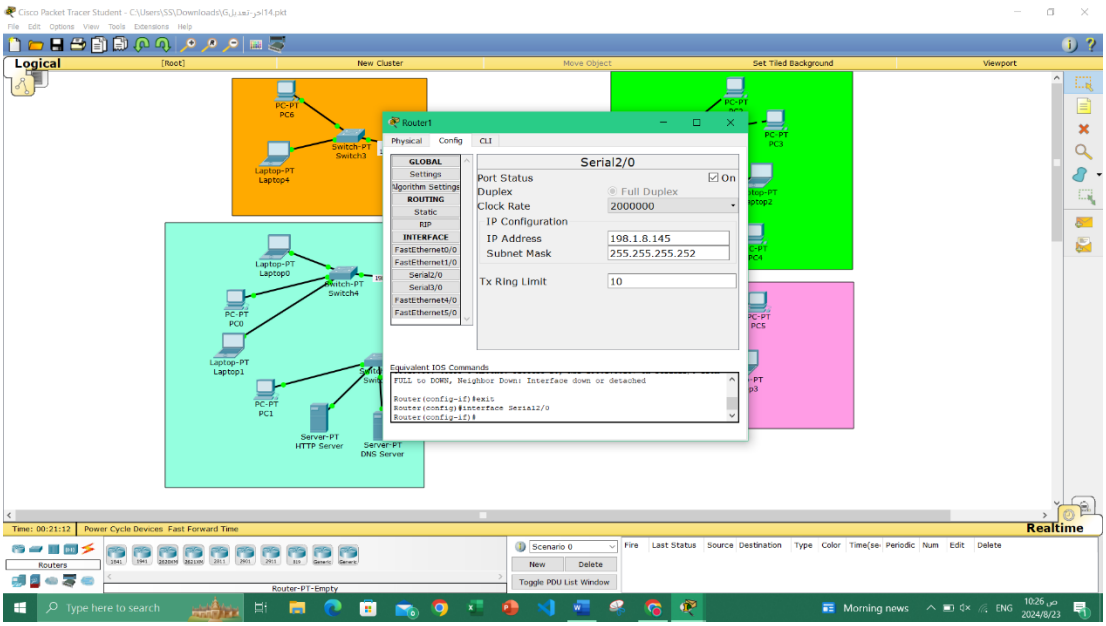

Figure 7: router 1 (Serial 2/0)

We use the subnet mask of network address (198.1.8.144 /30) [se 2/0] and an ip address from the rang of ip address of 198.1.8.144 network

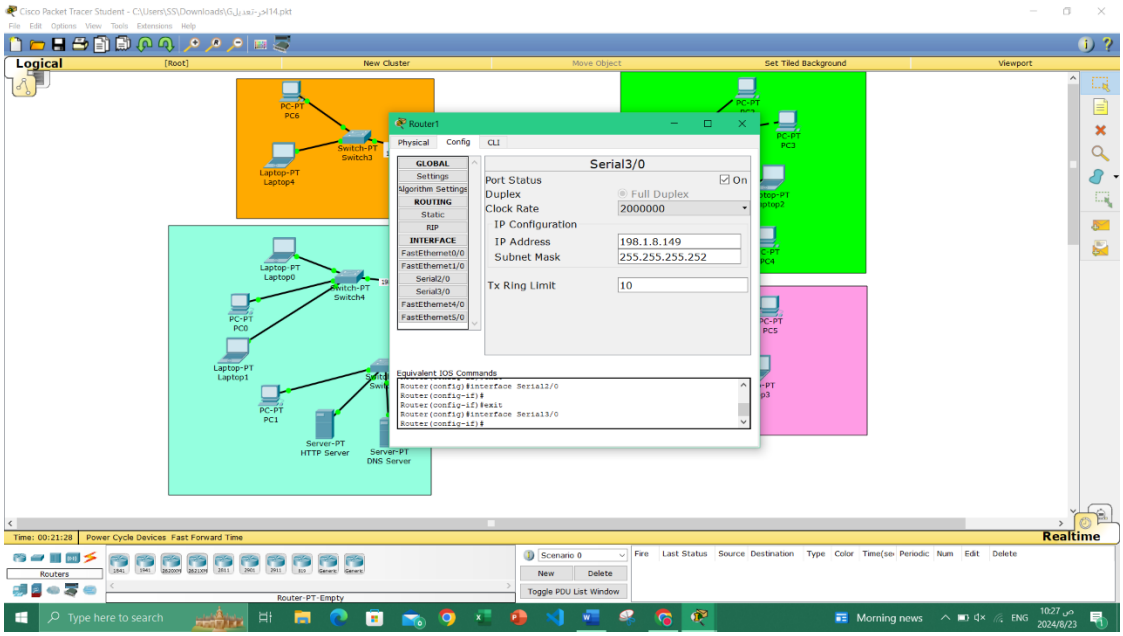

Figure 8: router 1(Serial 3/0)

We use the subnet mask of network address (198.1.8.148/30) [se 3/0] and an ip address from the rang of ip address of 198.1.8.148 network

Router 2 configuration

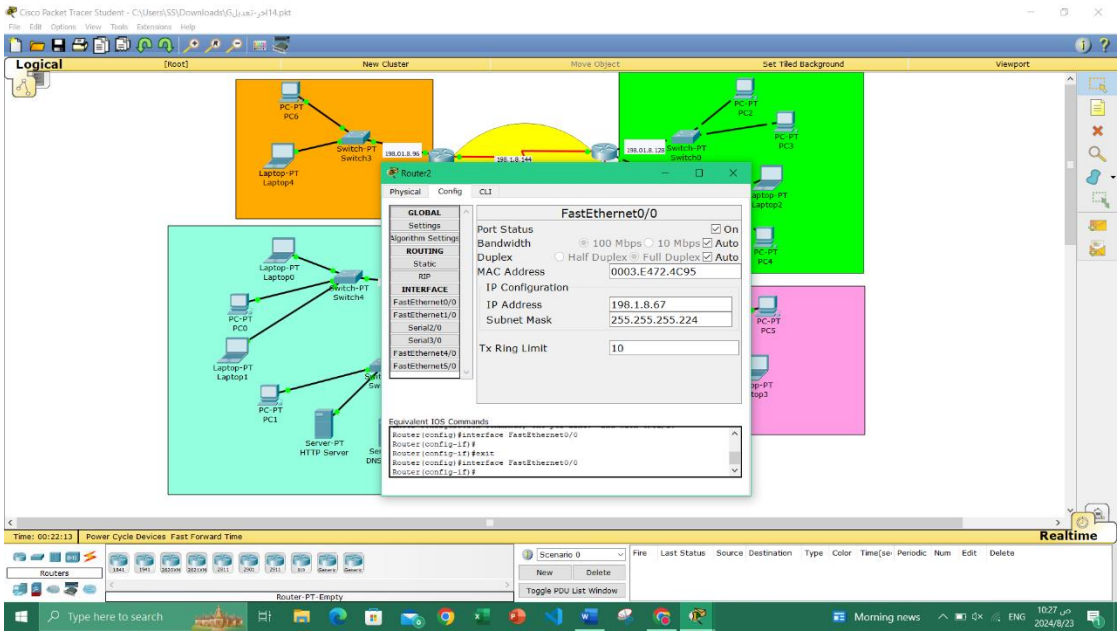

Figure 9: router 2 (Fast Ethernet 0/0)

We use the subnet mask of network address (198.1.8.64/27) [router 2 Fa 0/0] and an ip address from the rang of ip address of 198.1.8.64 network

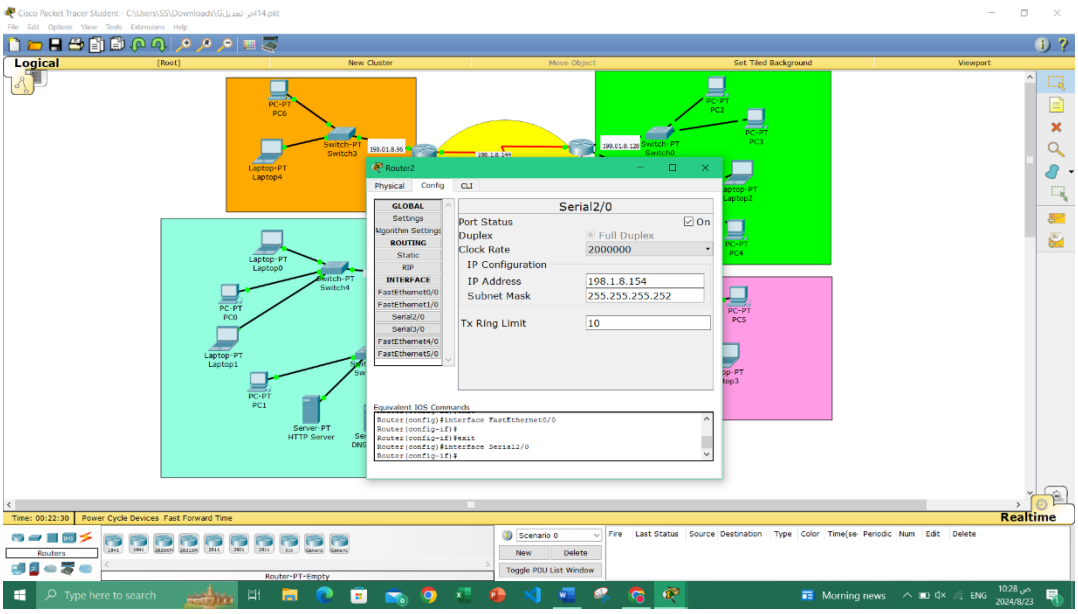

Figure 10: router 2(Serial 2/0)

We use the subnet mask of network address (198.1.8.152 /30) [se 2/0] and an ip address from the rang of ip address of 198.1.8.152 network

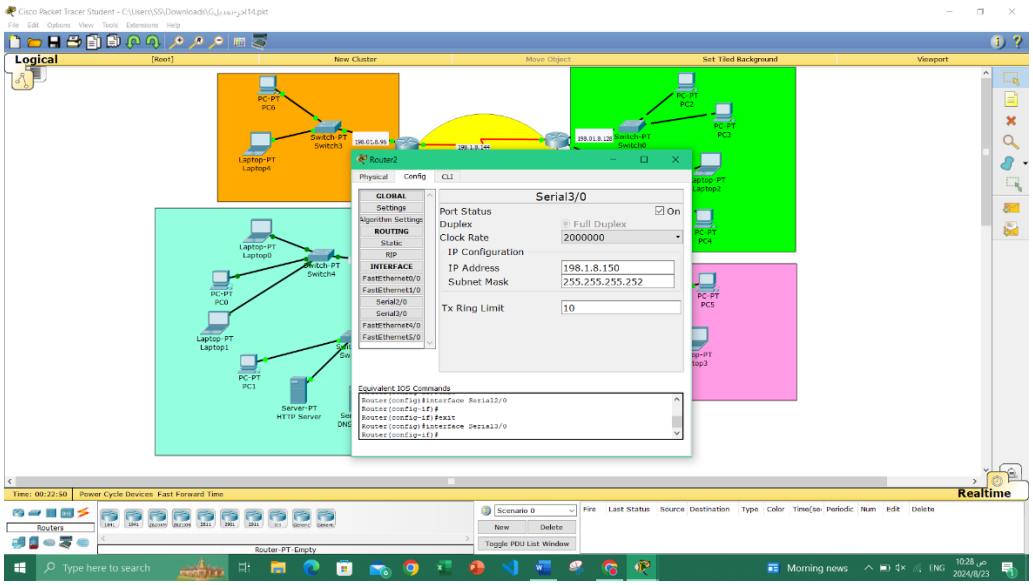

Figure 11:router 2(Serial 3/0)

We use the subnet mask of network address (198.1.8.148/30) [se 3/0] and an ip address from the rang of ip address of 198.1.8.148 network

Router 3 configuration

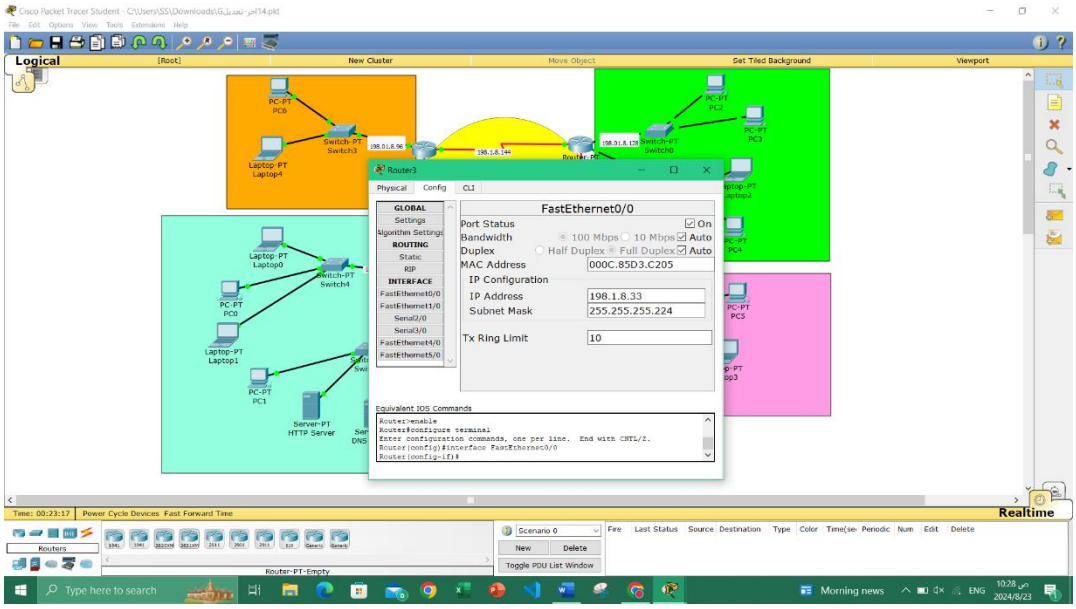

Figure 12:router3 Fast Ethernet 0/0)

We use the subnet mask of network address (198.1.8.32 /27) [router 3 Fa 0/0] and an ip address from the rang of ip address of 198.1.8.32 network

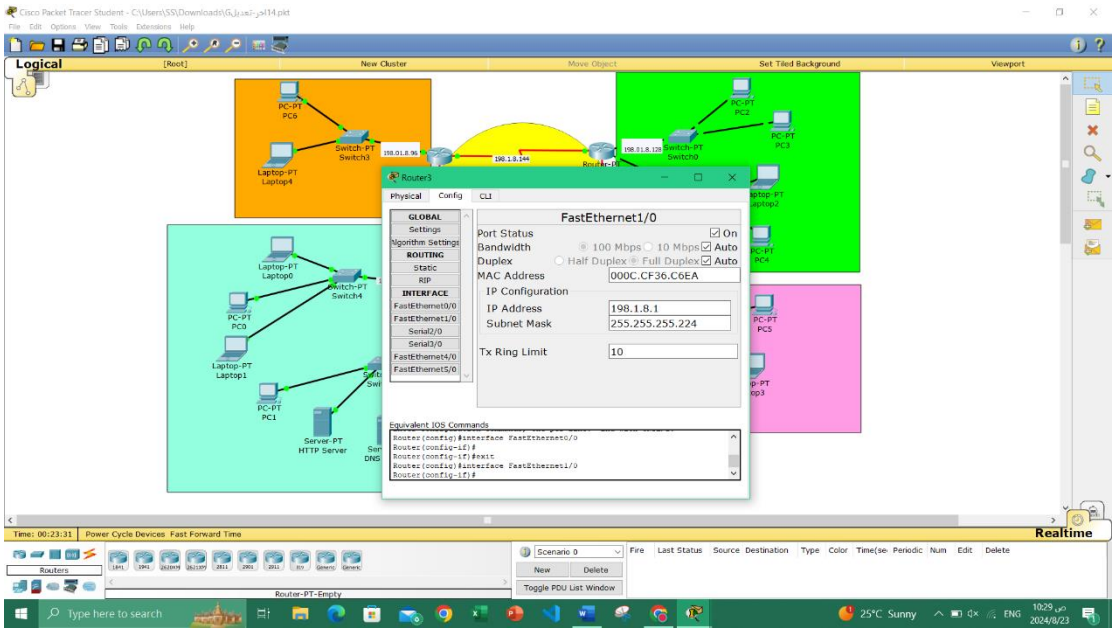

Figure 13 router 3 (Fast Ethernet 1/0)

We use the subnet mask of network address (198.1.8.0 /27) [router 3 Fa 1/0] and an ip address from the rang of ip address of 198.1.8.0 network

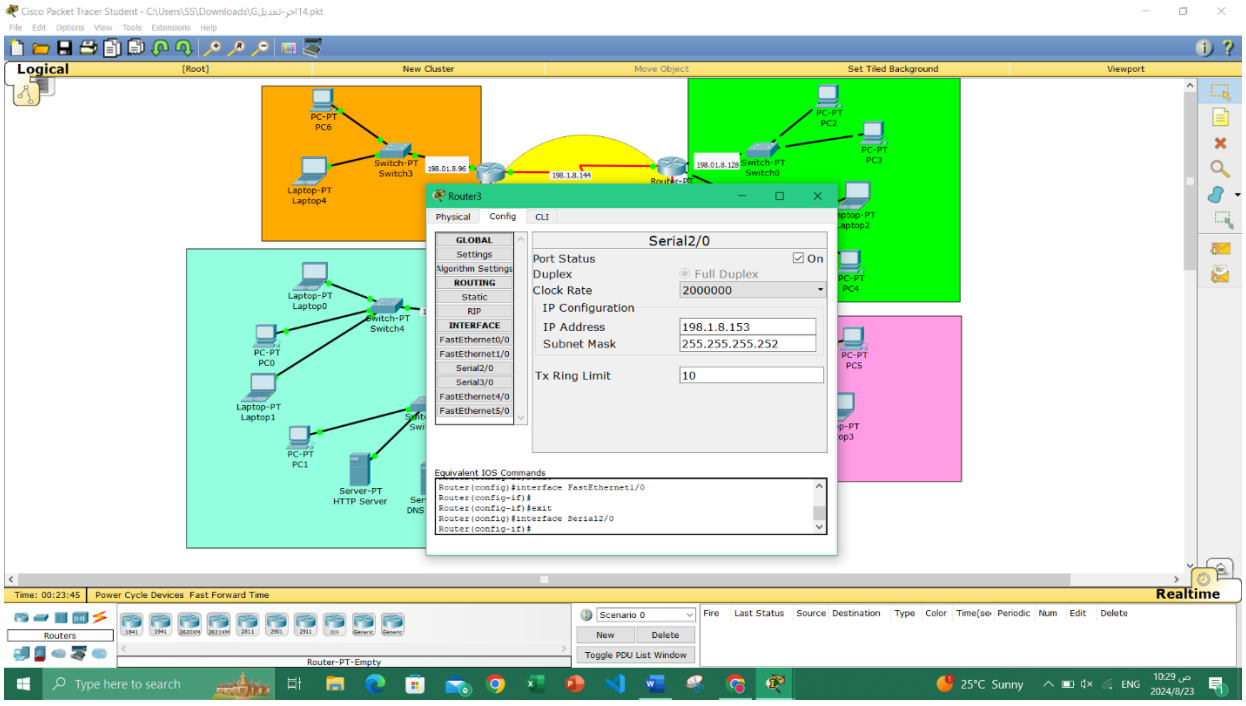

Figure 14:router 3(Serial 2/0)

We use the subnet mask of network address (198.1.8.152 /30) [se 2/0] and an ip address from the rang of ip address of 198.1.8.152 network

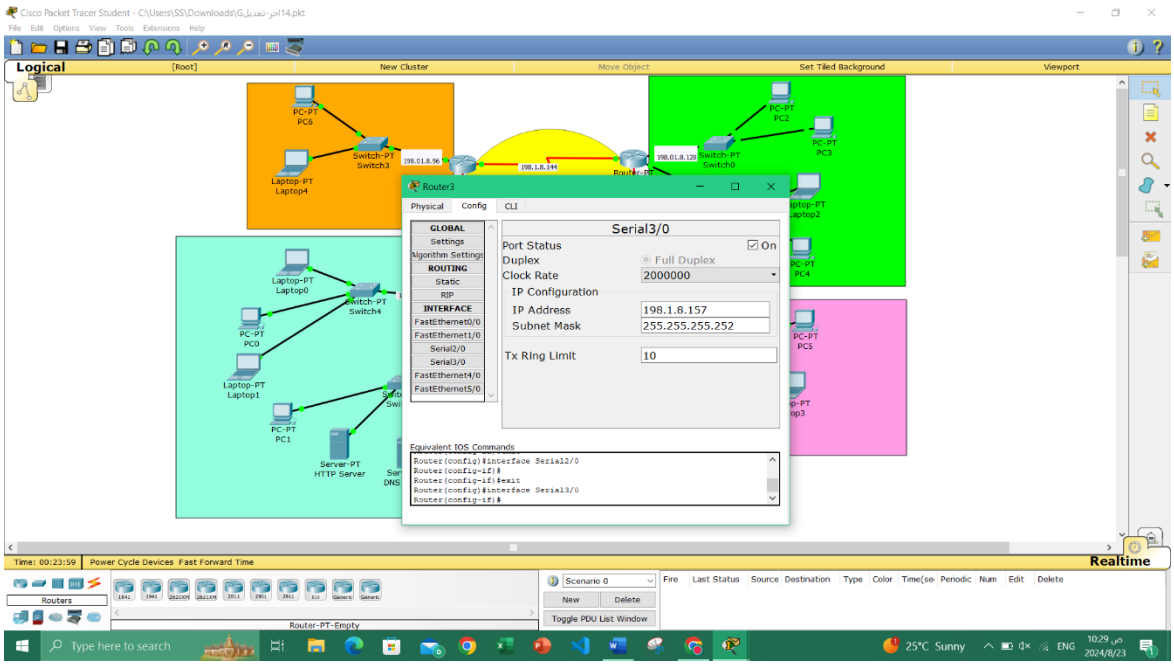

Figure 15:router 3(Serial 3/0)

We use the subnet mask of network address (198.1.8.156/30) [se 3/0] and an ip address from the rang of ip address of 198.1.8.148network

NET 1 (area1)

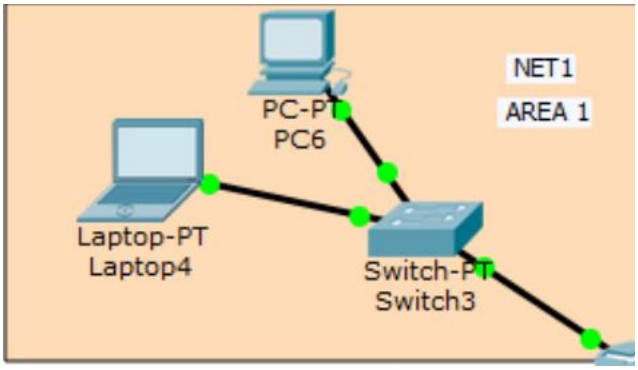

Figure 16:NET1 (area1)

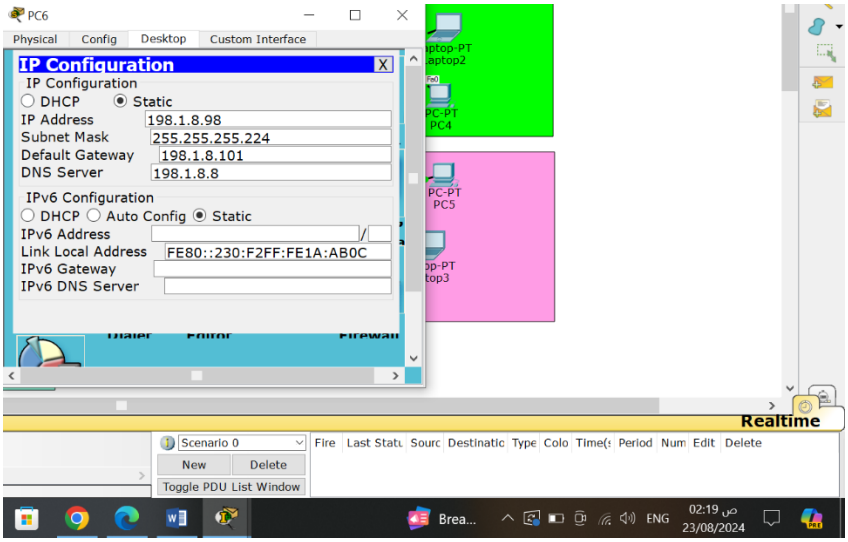

Figure 17:IP configuration of pc6

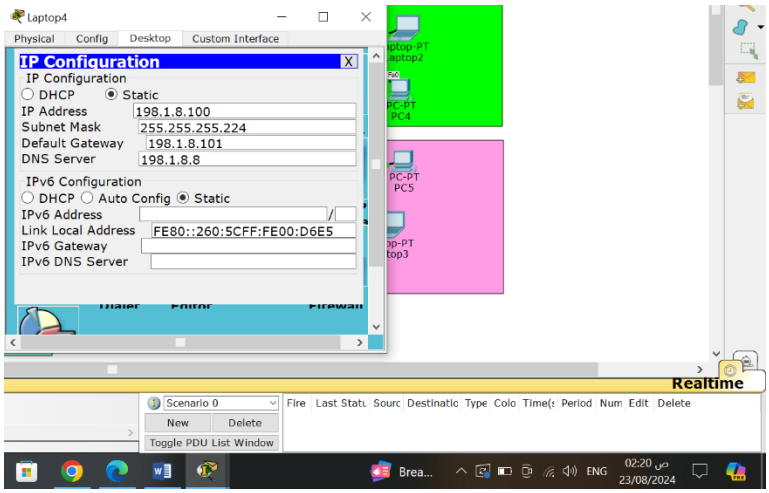

Figure 18:IP configuration of laptop4

NET1 : the network address (198.1.8.96 /27) →subnet mask :255.255.255.224 it has one pc and one laptop ,the ip address for the pc6 (198.1.8.98) and for laptop4 (198.1.8.100)

And the default gateway (198.1.8.101).

NET 2 (area2)

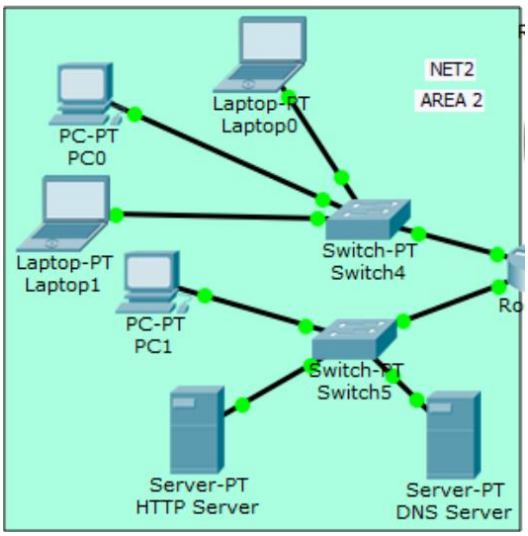

Figure 19:NET2 (area2)

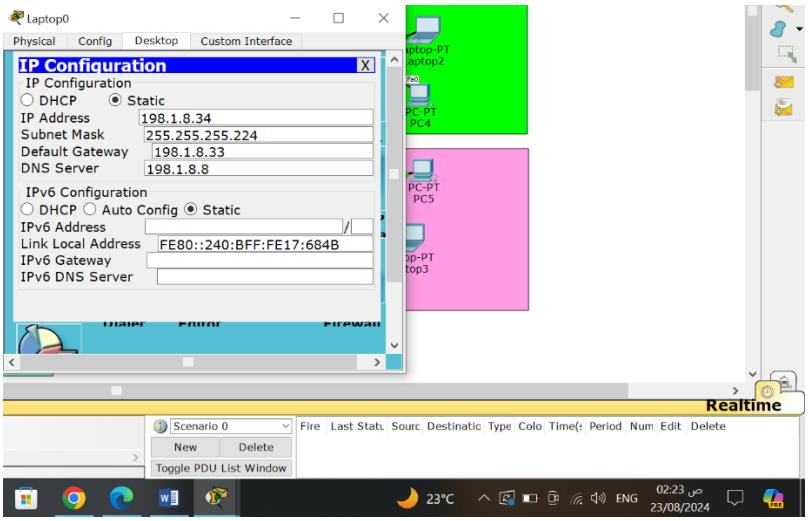

Figure 20:IP configuration of laptop0

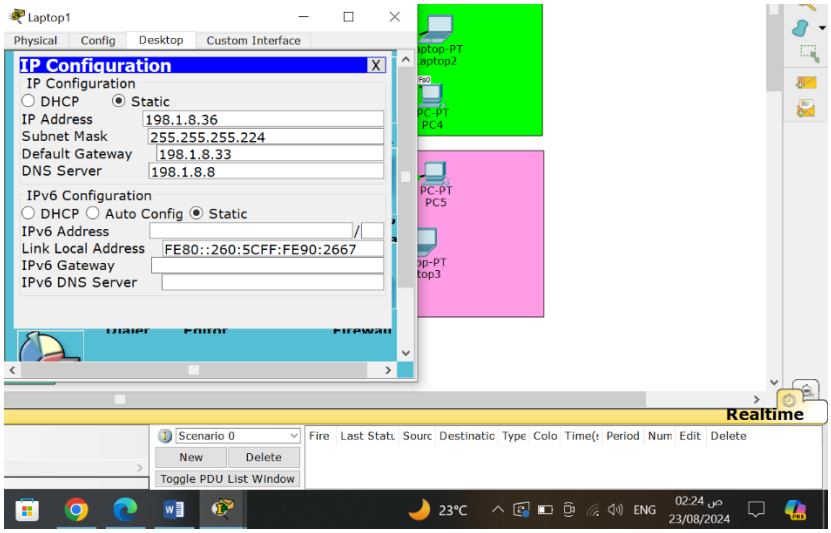

Figure 21:IP configuration of laptop1

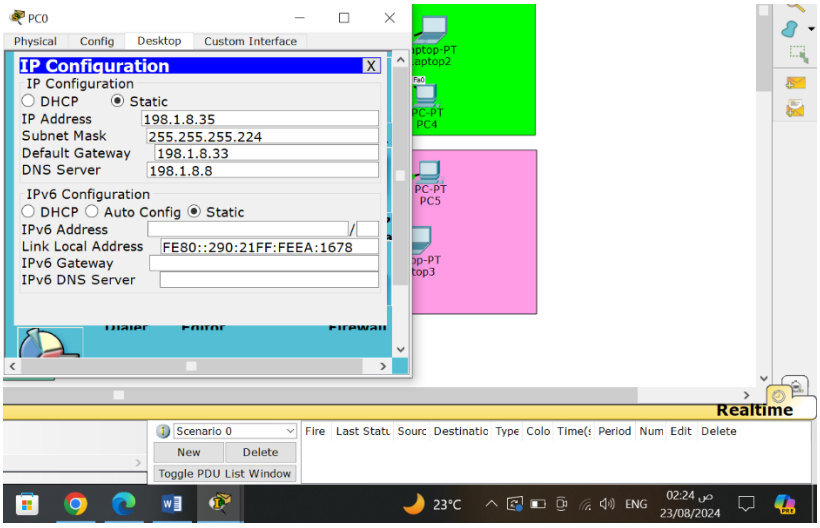

Figure 22:IP configuration of pc0

NET2 : it has two interfaces first (F0/0) ,the network addresses (198.1.8.32/27) →subnet mask :255.255.255.224 it has two laptops and one pc their ip addresses as th figures above

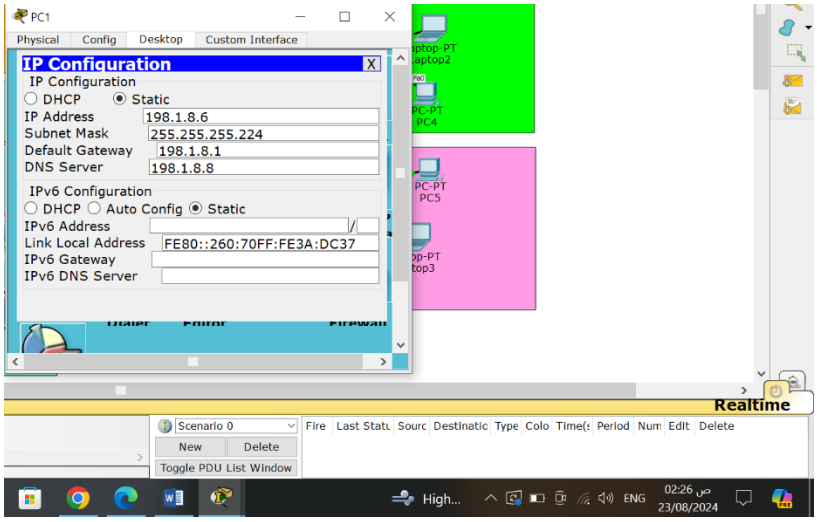

Figure 23:IP configuration of pc1

HTTP Server

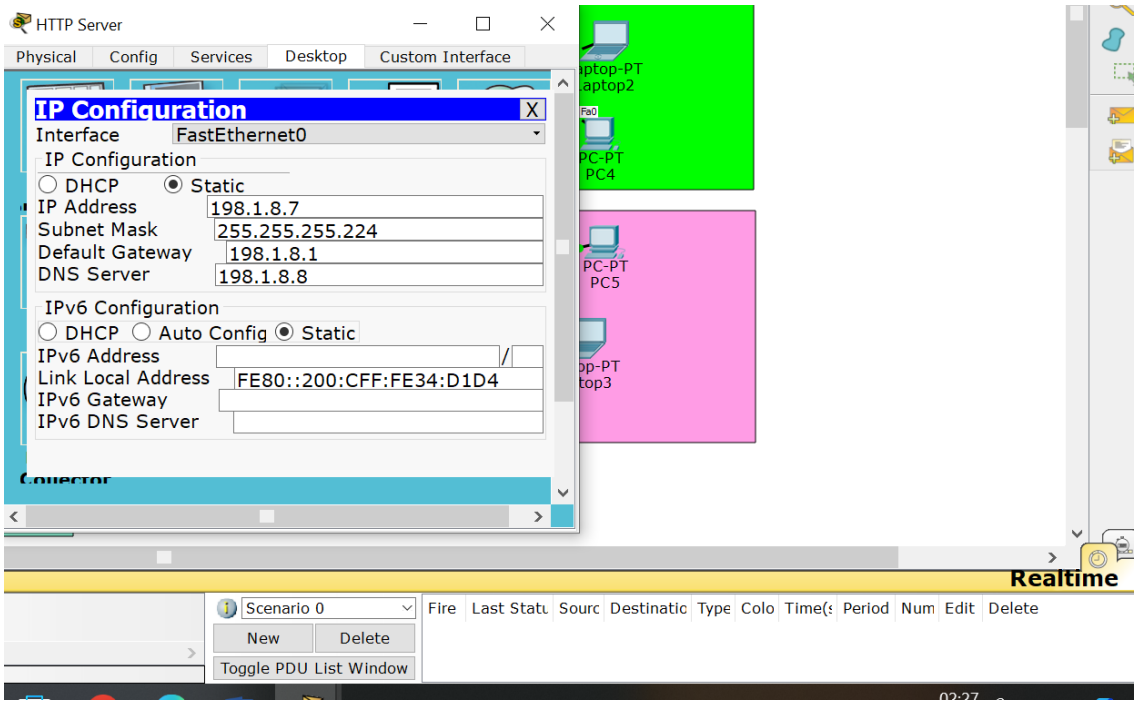

Figure 24:IP configuration of HTTP server

DNS Server

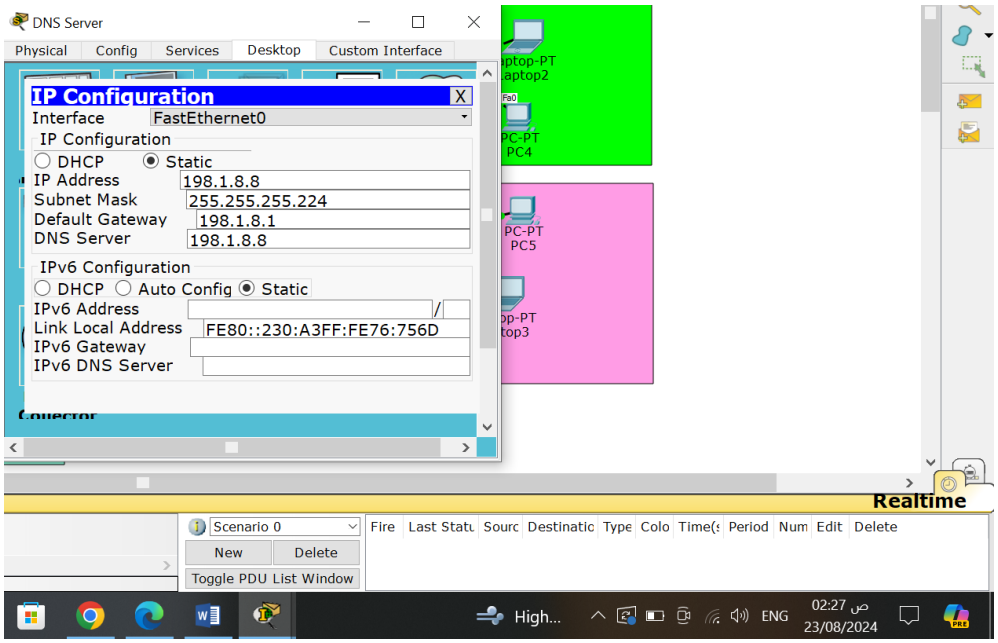

Figure 25:configuration of DNS server

NET2 : the network addresses (198.1.8.0 /27) →subnet mask :255.255.255.224 it has one DNS server , one http server , and one laptop ,the ip address for all devices as in the figure above .

NET 3 (area3)

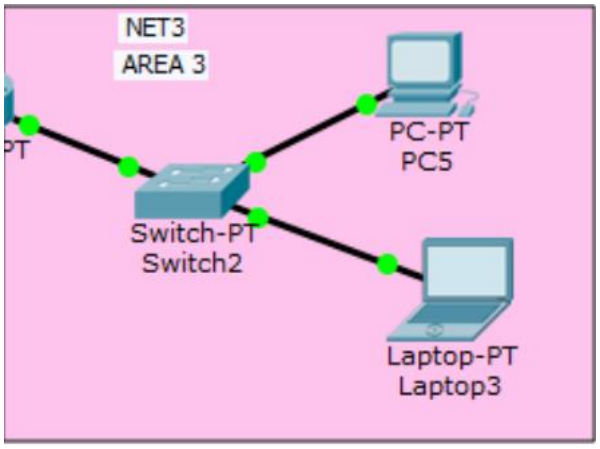

Figure 26:NET3 (area3)

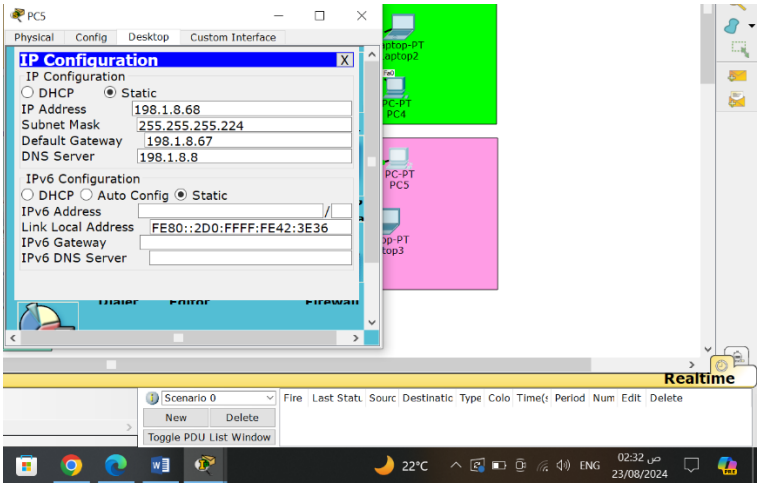

Figure 27:IP configuration of pc5

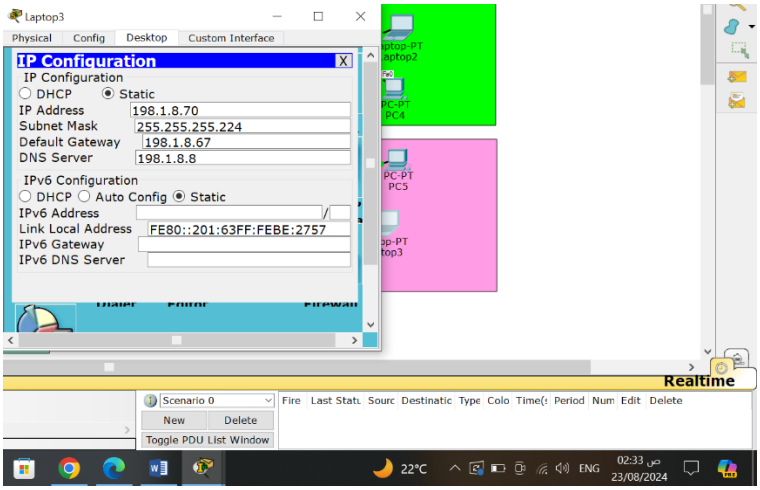

Figure 28:IP configuration of laptop3

NET 3: the network address (198.1.8.64 /27) →subnet mask :255.255.255.224 it has one pc and one laptop ,the ip address for pc5(198.1.8.66) and for laptop3 (198.1.8.70)

NET 4 (area4)

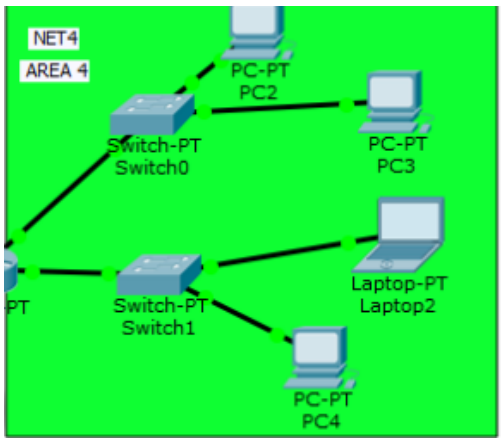

Figure 29:NET4 (area4)

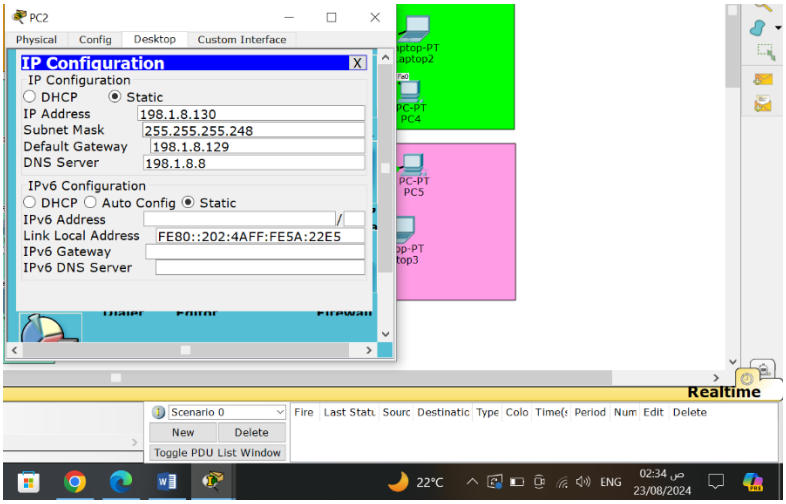

Figure 30:IP configuration of pc2

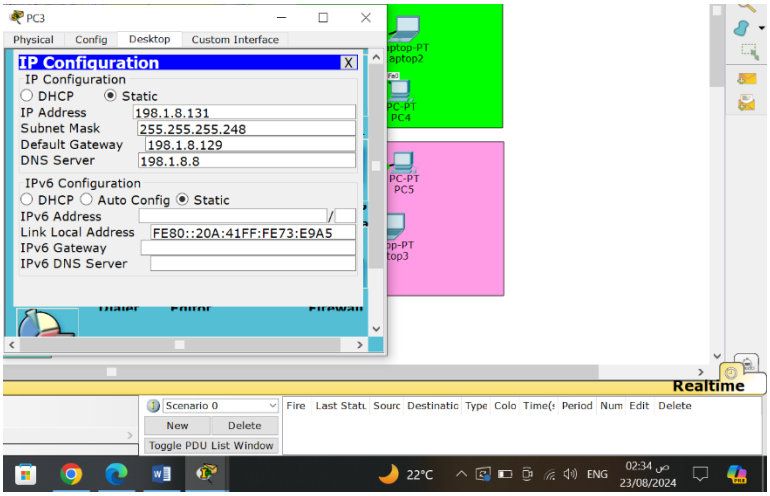

Figure 31:IP configuration of pc3

NET4 : has two interfaces first ,the network addresses (198.1.8.128 /29) →subnet mask :255.255.255.248 it has two pc, the ip addresses for all devices as in the figure above .

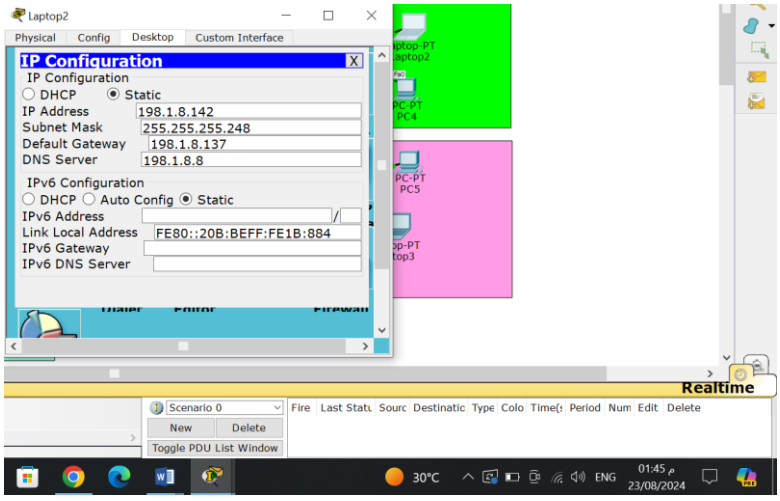

Figure 32:IP configuration of laptop2

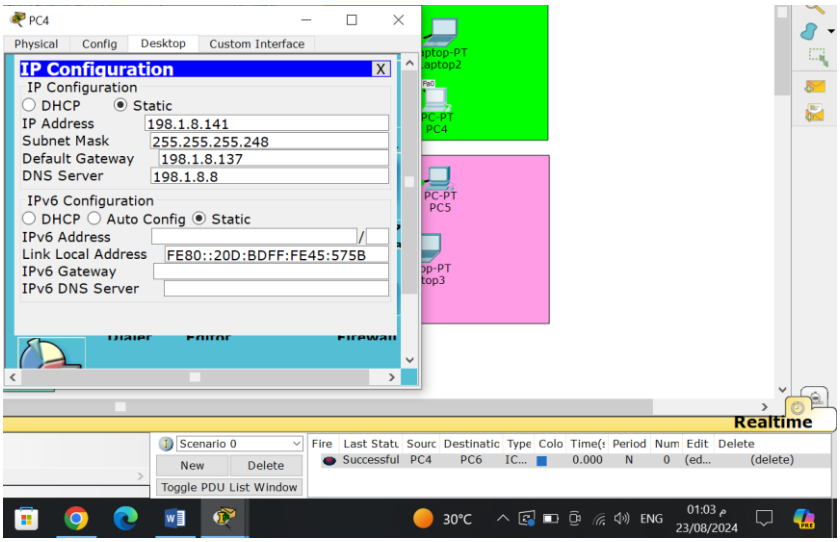

Figure 33:IP configuration of pc4

NET4 : the network addresses (198.1.8.136 /29) →subnet mask :255.255.255.248 it has one pc , one laptop, the ip addresses for all devices as in the figure above .

Task 2 : setting- up servers part

1. Two servers are used in this topology: HTTP/WEB server and DNS server in NET2.

2. Configure the DNS server and WEB server with domain name www.ENCS3320Summer.com

3. Create your website by modifying the index.html file in the HTTP server. Your website should contain:

- “ENCS3320-Summer Course Website” in the title.

- “Welcome to Computer Networks” (part of the phrase is in Blue).

- Group members’ names and IDs.

- Try to make the page look nice.

First, I started off by designing the website according to the instructions, using html language, so that it can be used in http configuration later on.

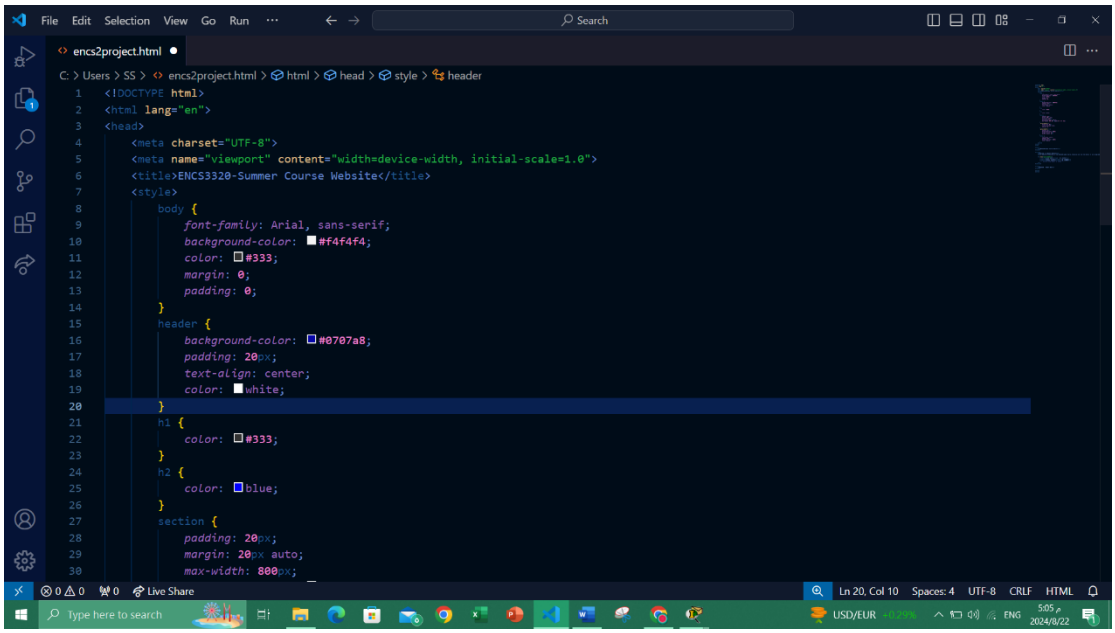

Figure 34 htm File, code snippet part1

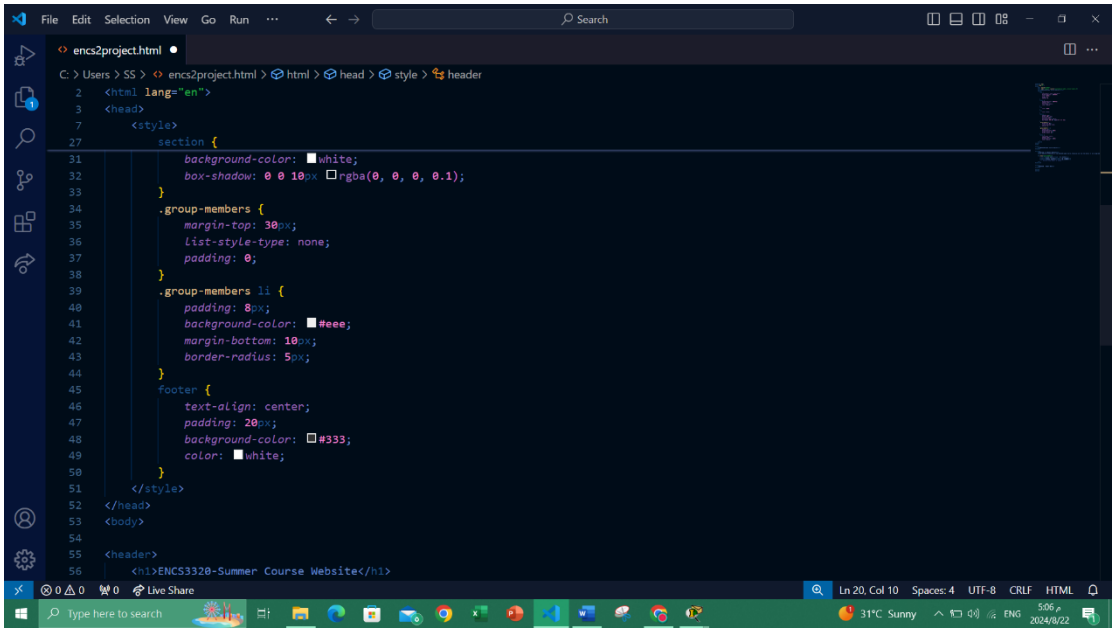

Figure 35 html file code snippet part2

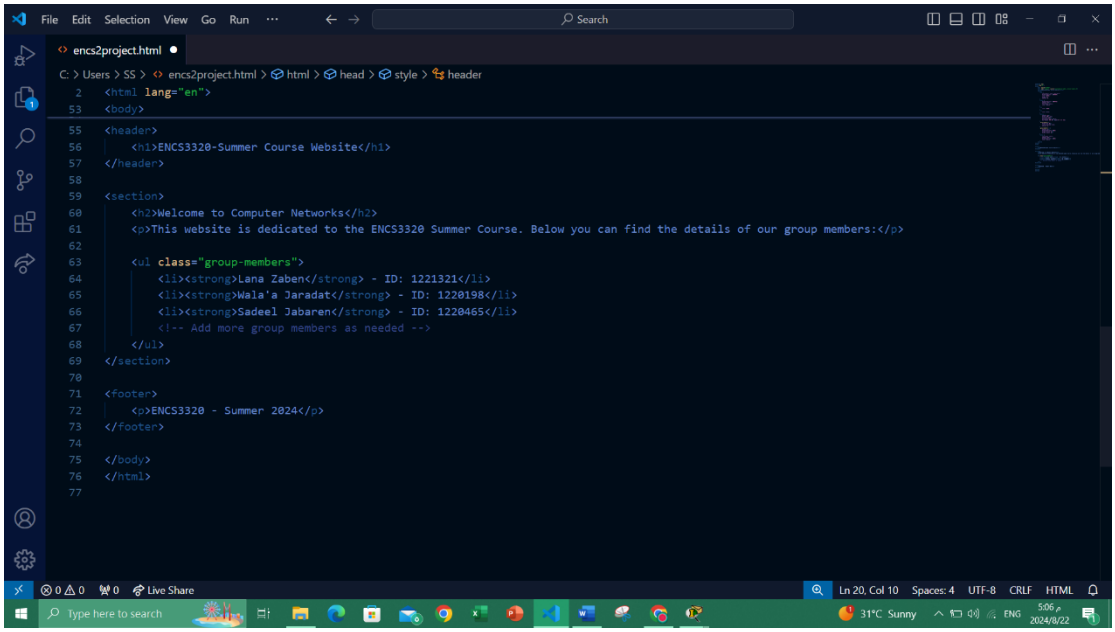

Figure 36 html file code snippet part3

In the packet tracer application, the servers were already named http, DNS servers, but I changed its service settings

For the HTTP server:

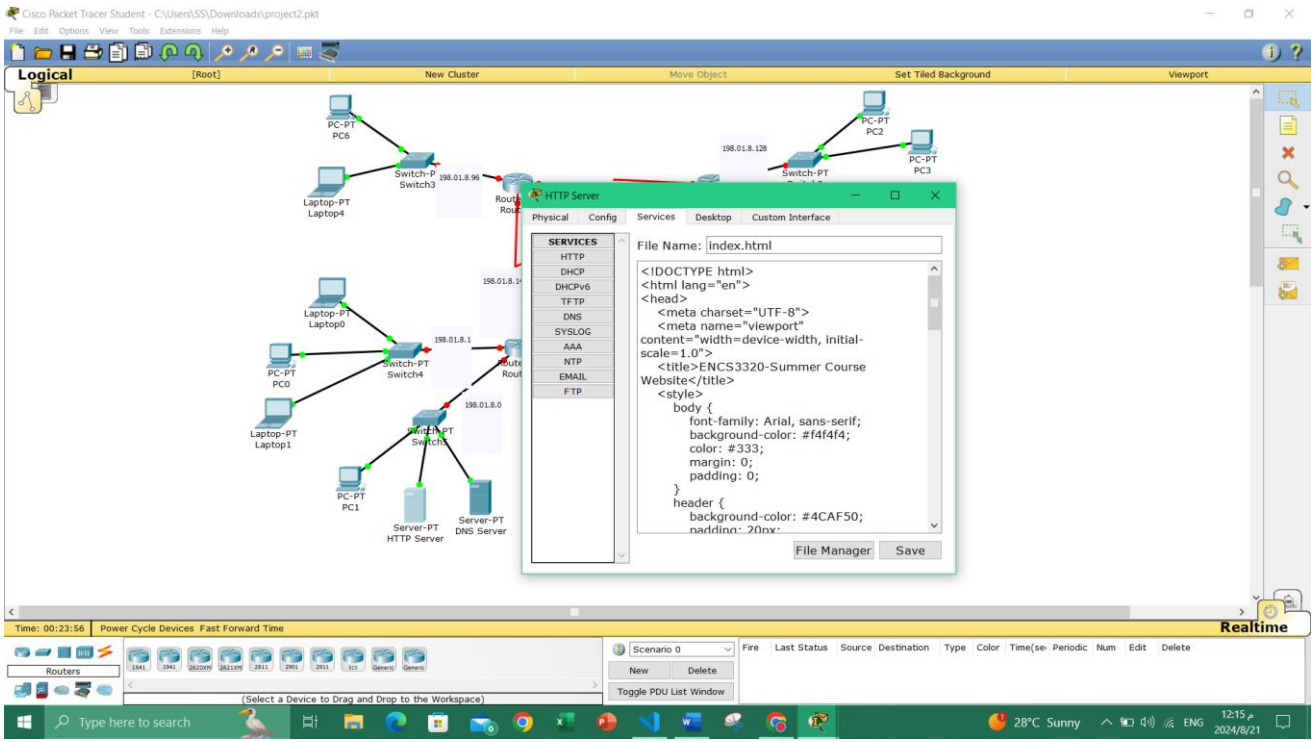

Figure 37 Index.html file modifying

I changed the index html file to the design code for the website I created.

Then the IP address for the HTTP server is automatically given to it by the router in the local area network , which is 198.1.8.7

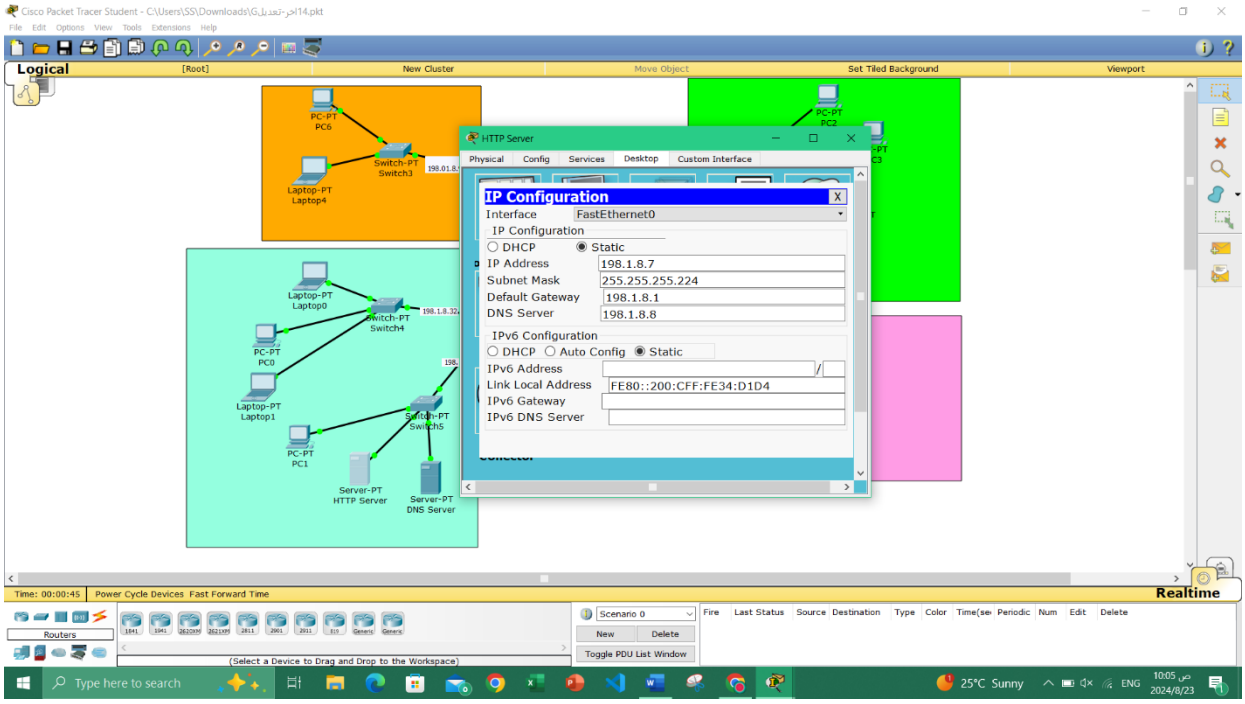

Figure 38 HTTP server IP addresses

For the DNS server:

The address of the DNS server is the URL for the website designed, which is specified in the instructions " www.ENCS3320Summer.com"

And Address bracket is the IP Address of the HTTP Server:

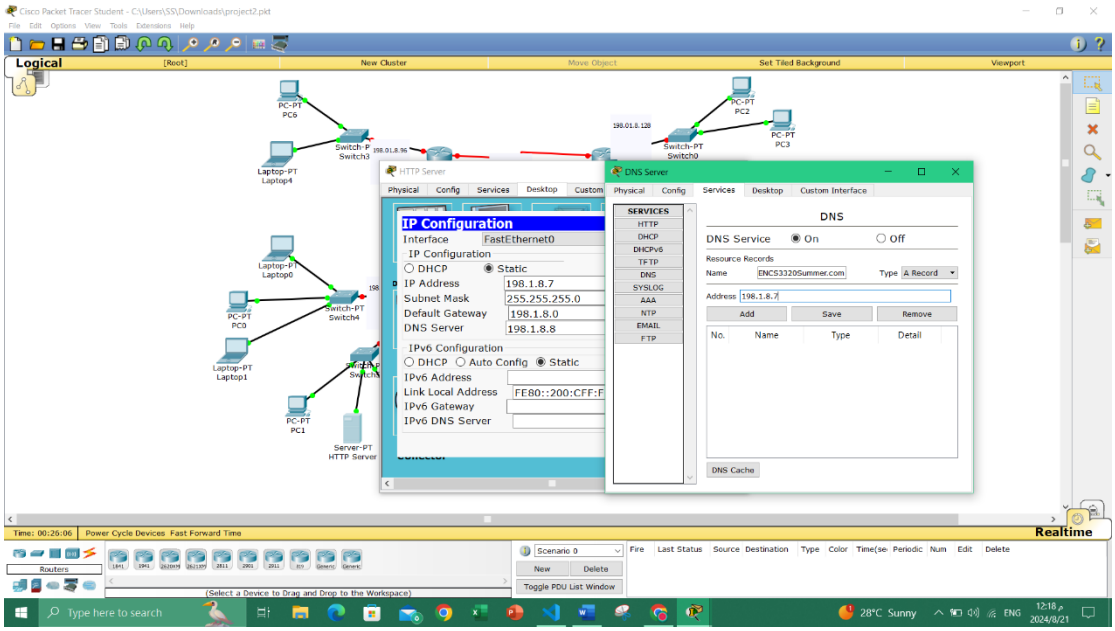

Figure 39 DNS configuration

And the result of filling the information , to show that it was successful:

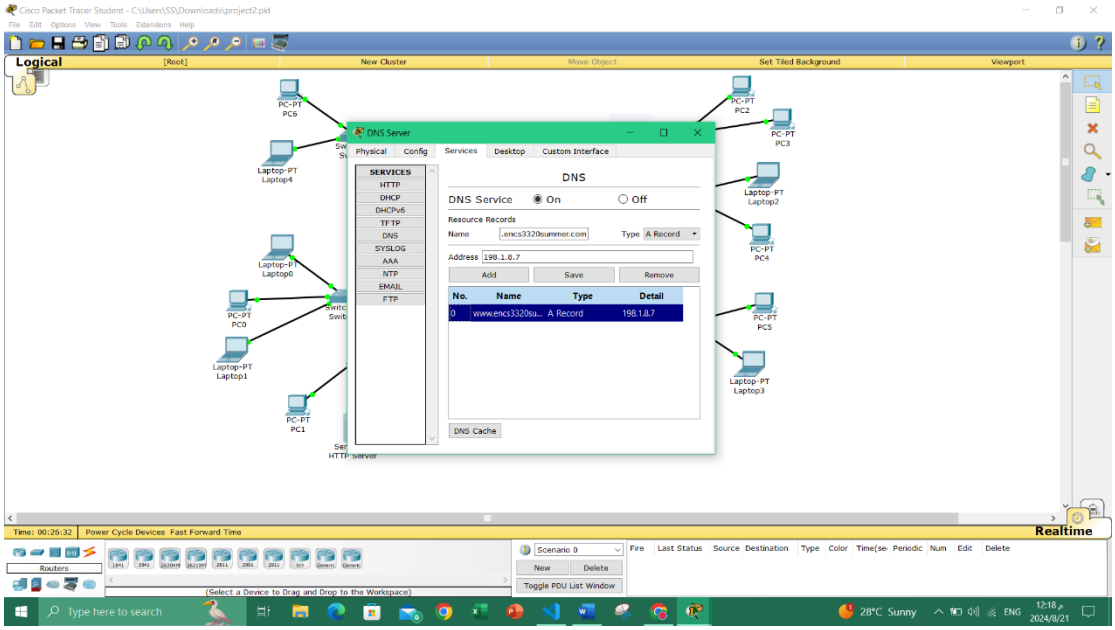

Figure 40 DNS configuration after the addition of the http server

The next step is configuring the PC in the same network to connect the HTTP server or the DNS server with it, so it can open the website through it:

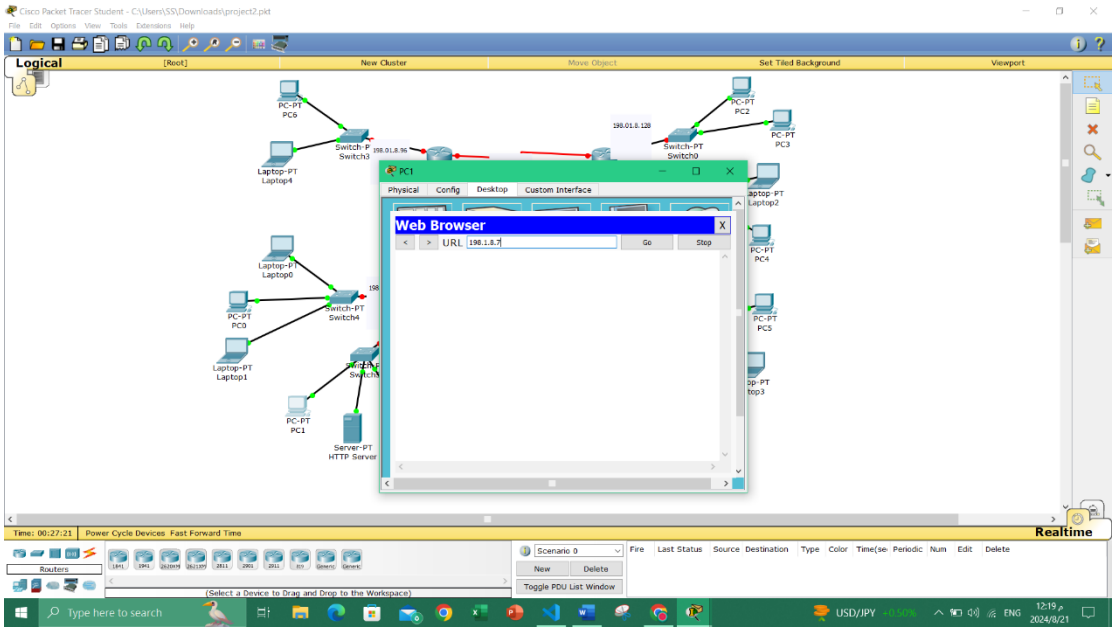

Figure 41 PC1 configuration to connect the website

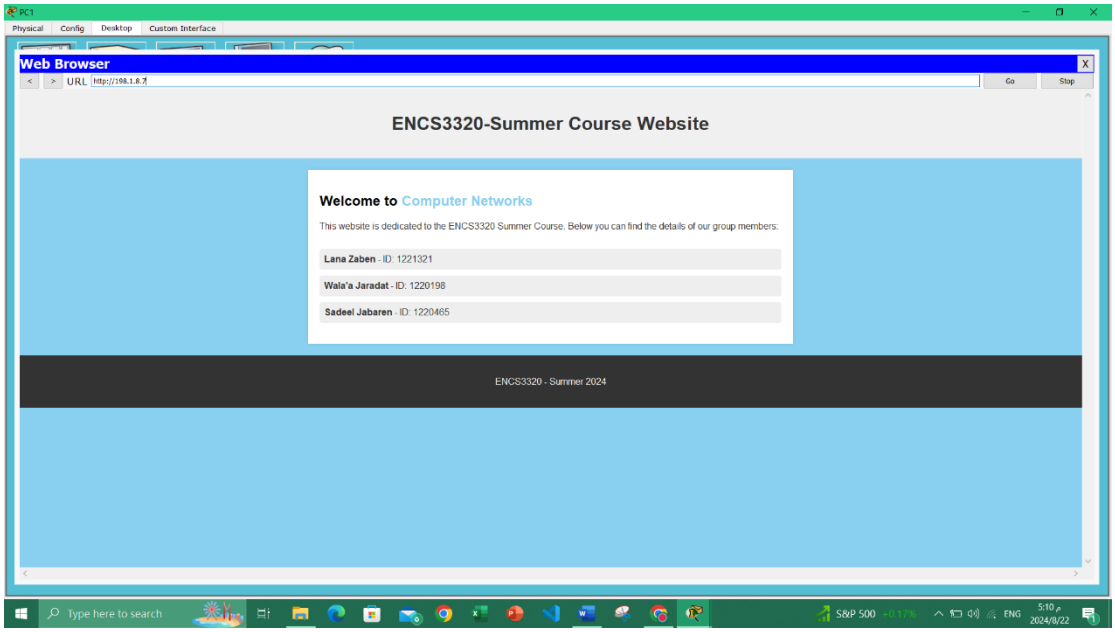

Figure 42 ENCS3320 WEBSITE

Task3: Routing Part:

You need to use open shortest path protocol (OSPF) on all routers given with process id is 20 and the areas as instructed in Figure 1.

OSPF (Open Shortest Path First) is a widely used link-state routing protocol that enables routers to dynamically discover and share information about the network topology with other routers in the same OSPF area. It uses the Dijkstra algorithm to calculate the shortest path between two routers and ensures efficient routing within a network.

In my topology, OSPF is configured with a process ID of 20. Each router will be configured to advertise its connected networks to other routers using OSPF. The routers will exchange OSPF hello packets, form adjacencies, and build a consistent view of the network topology within their area.

Router(config)# router ospf 20 → This command starts the OSPF process with ID 20.

Router(config-router)# network <NETWORK-ID> <WILDCARD-MASK> area <AREA-ID> → This command advertises a network to other OSPF routers. Replace <NETWORK-ID> with the actual network address, <WILDCARD-MASK> with the OSPF wildcard mask, and <AREA-ID> with the appropriate area ID (e.g., 0 for Area 0).

Router0:

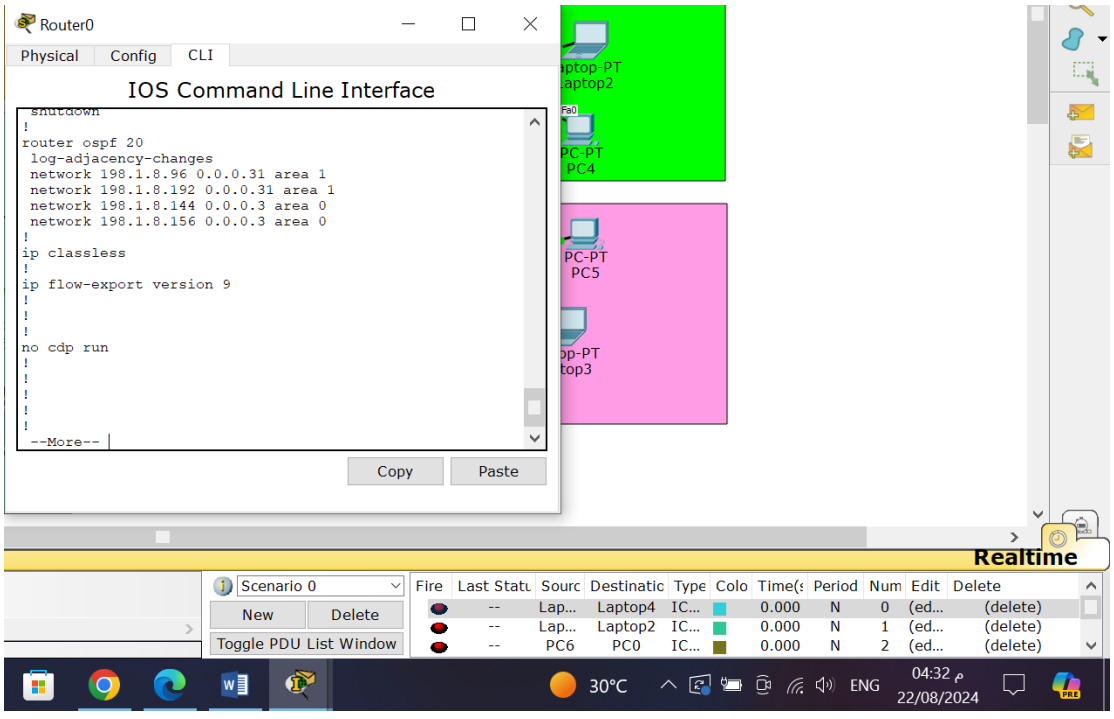

Figure 43:Router 0 configuration (1)

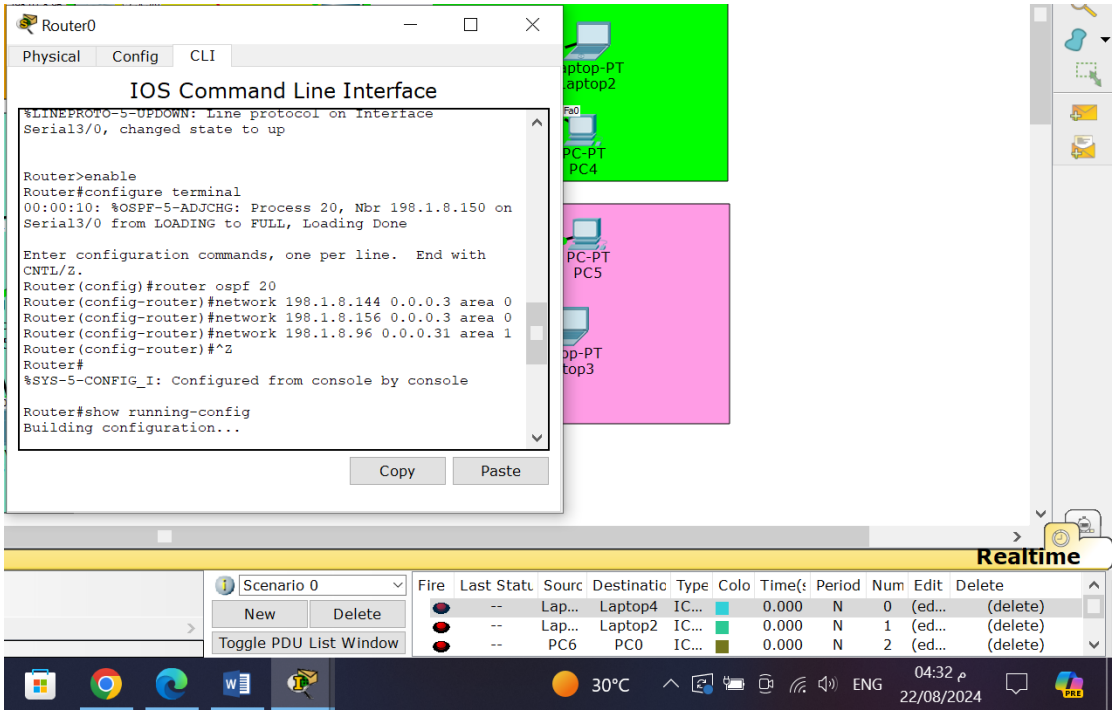

Figure 44:Router 0 configuration (2)

Router1:

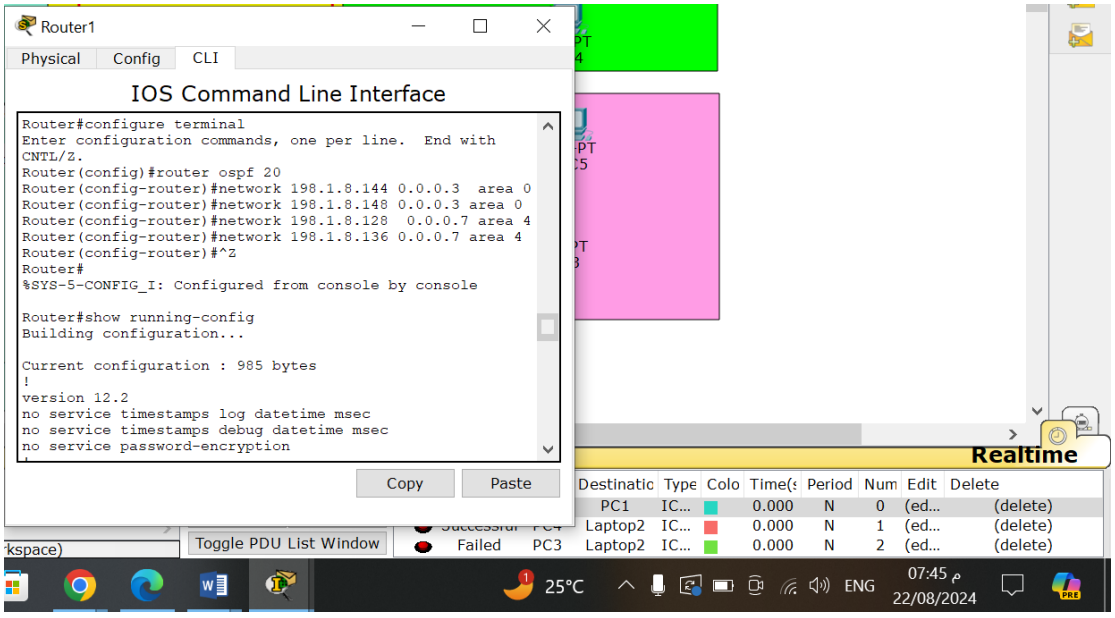

Figure 45:Router 1 configuration (1)

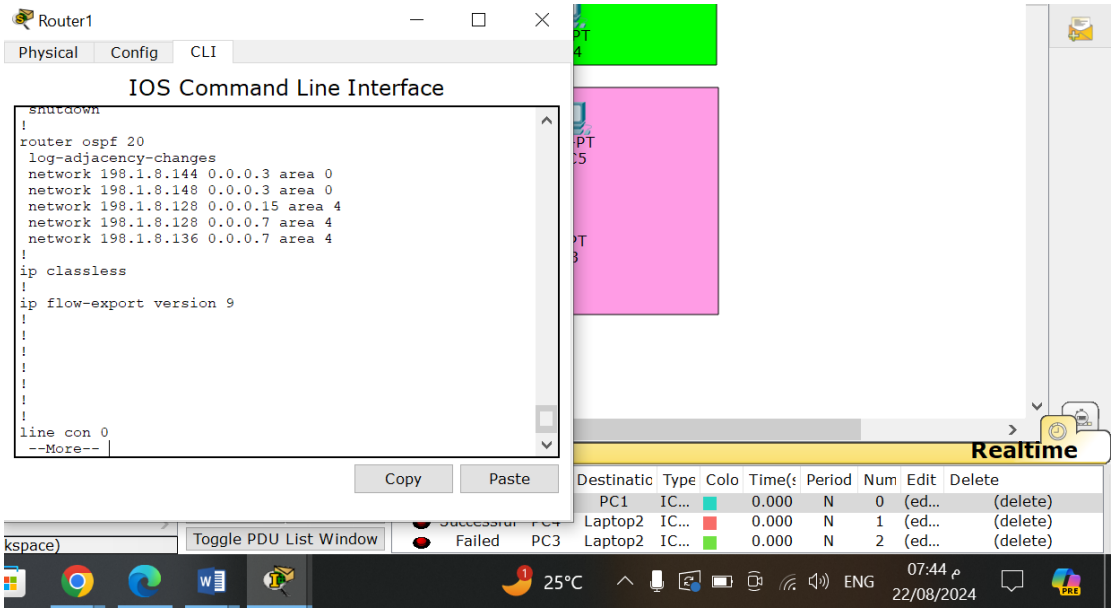

Figure 44:Router 1 configuration (2)

Router2:

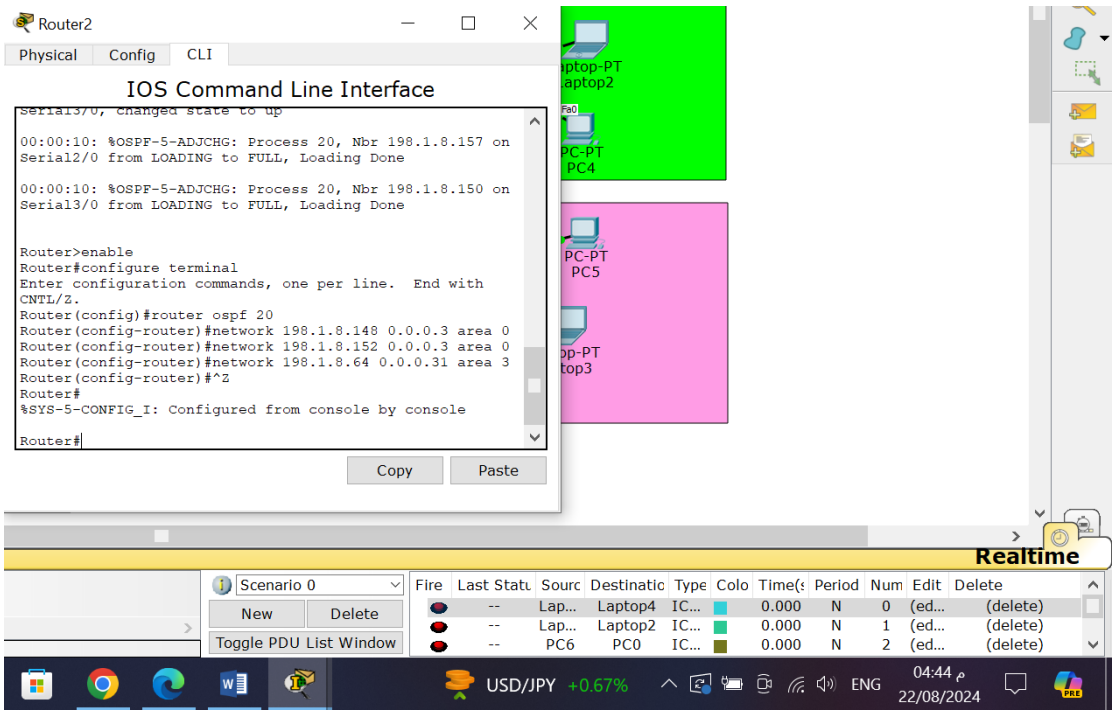

Figure 45:Router 2 configuration (1)

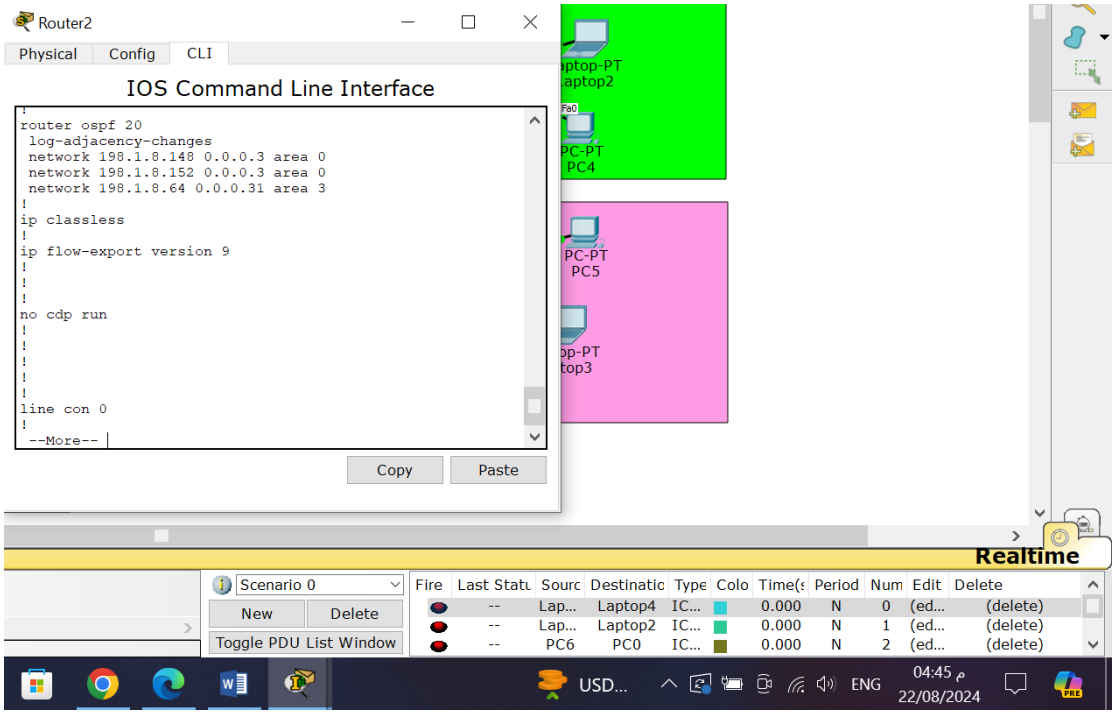

Figure 46:Router 2 configuration (2)

Router3:

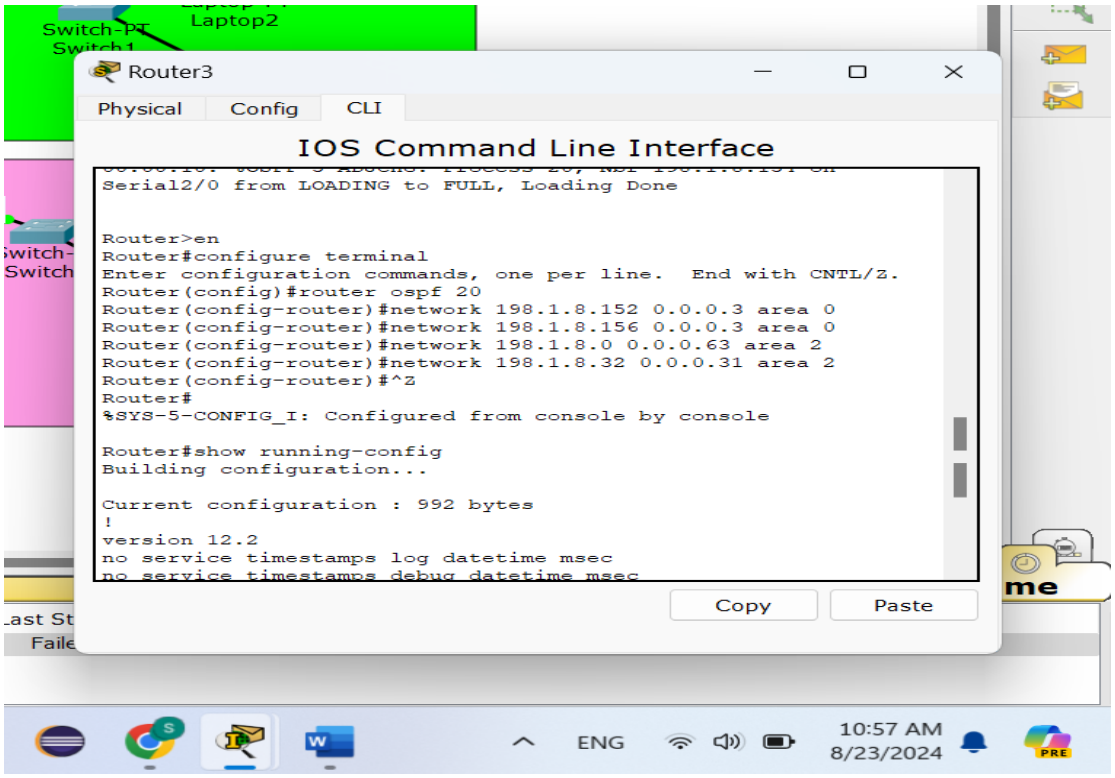

Figure 47:Router 3 configuration (1)

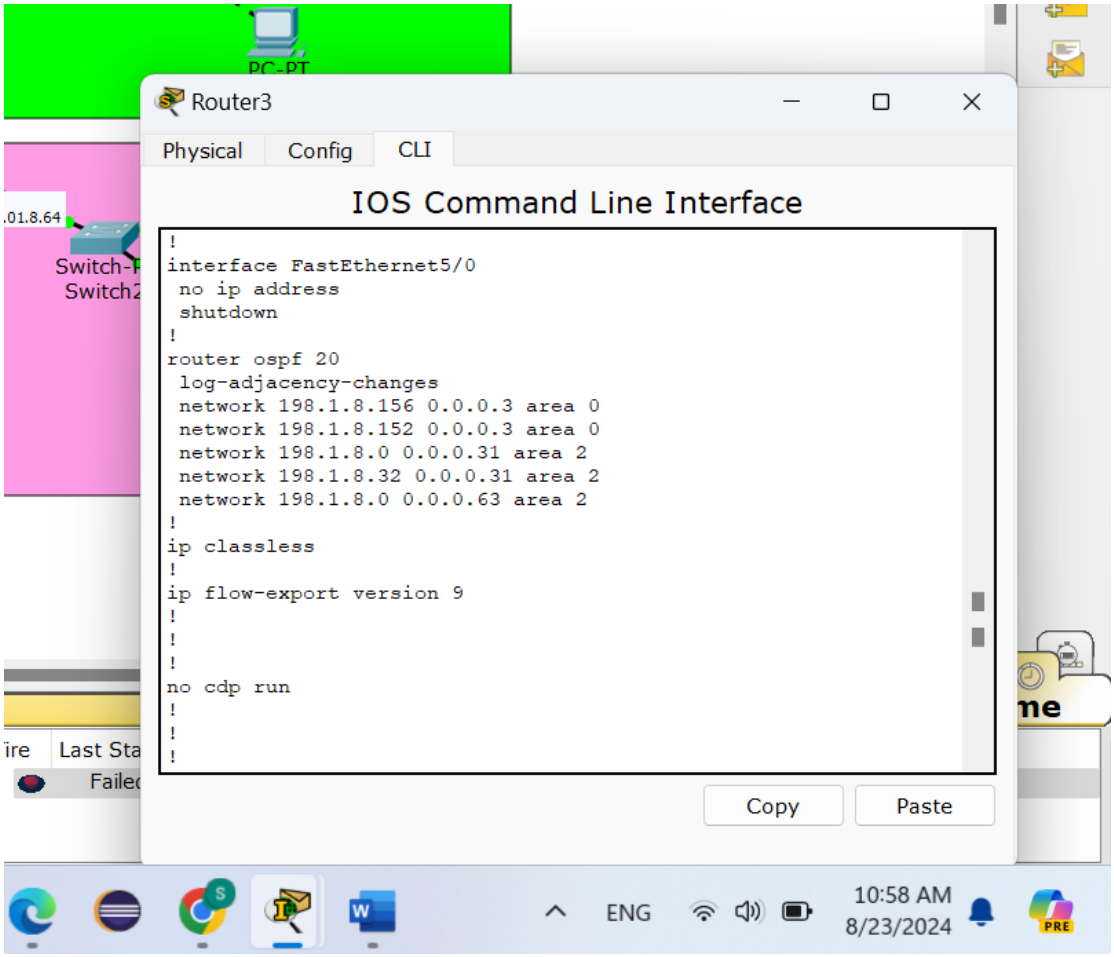

Figure 50 :Router 3 configuration (2)

Task4: Testing and Troubleshooting Part:

1. **Test the connectivity between all PCs. You need to make snapshots of the results for ping and tracert commands between all PCs.**

Test the connectivity between all PCs in the network using the ping command to ensure that all devices can reach each other.

And Trace the routes from each PC to every other PC in the network using the tracert command to ensure proper routing paths are being used.

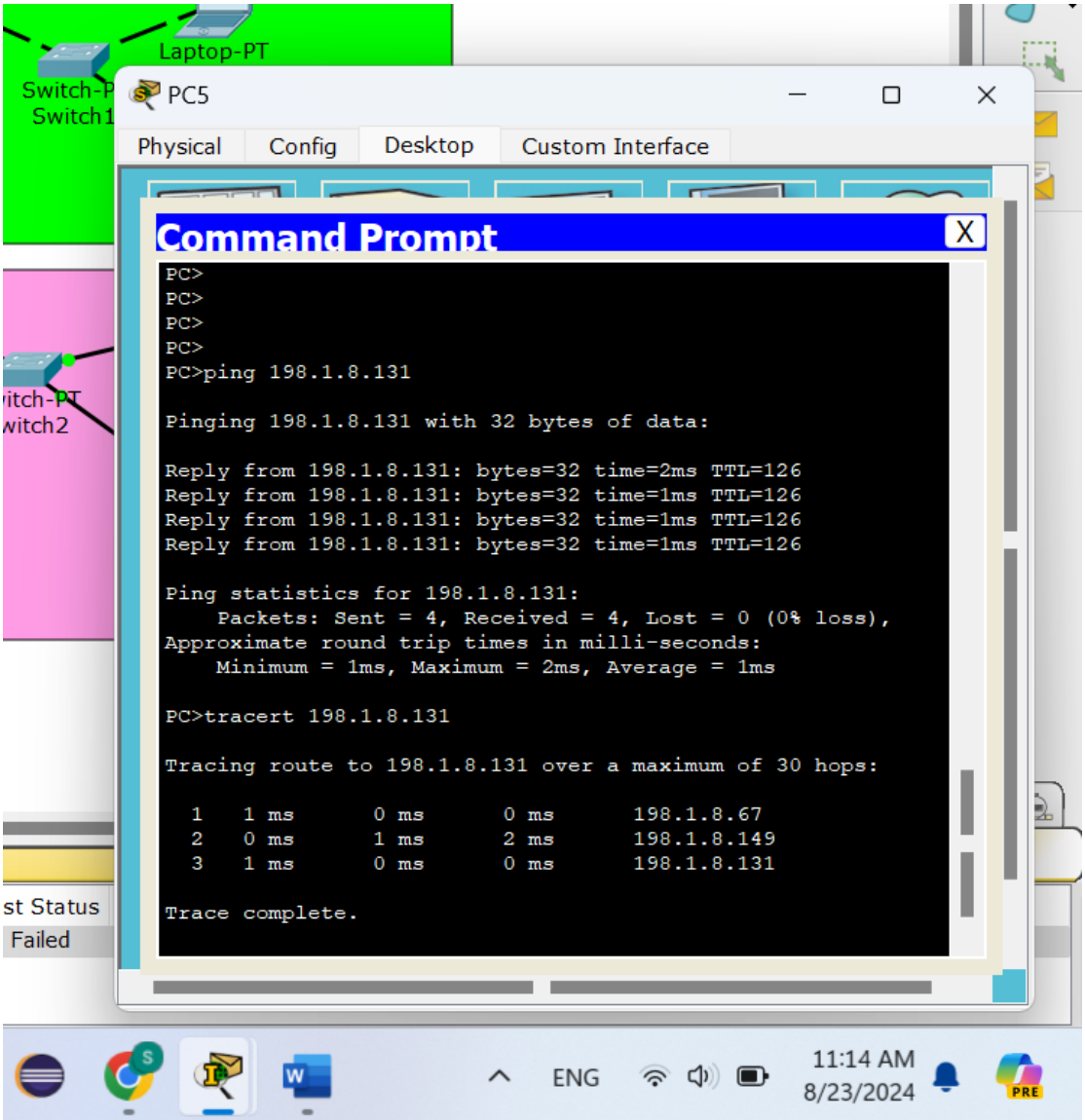

Figure 51:ping and trecert command between PC5 and PC3

The ping tests verify network communication between all PCs, as demonstrated in a screenshot from PC5 to PC3. The tracert tests verify device routing paths, as shown in a screenshot from PC5 to PC3, passing through routers R1, and R2. Both tests confirm successful communication between devices.

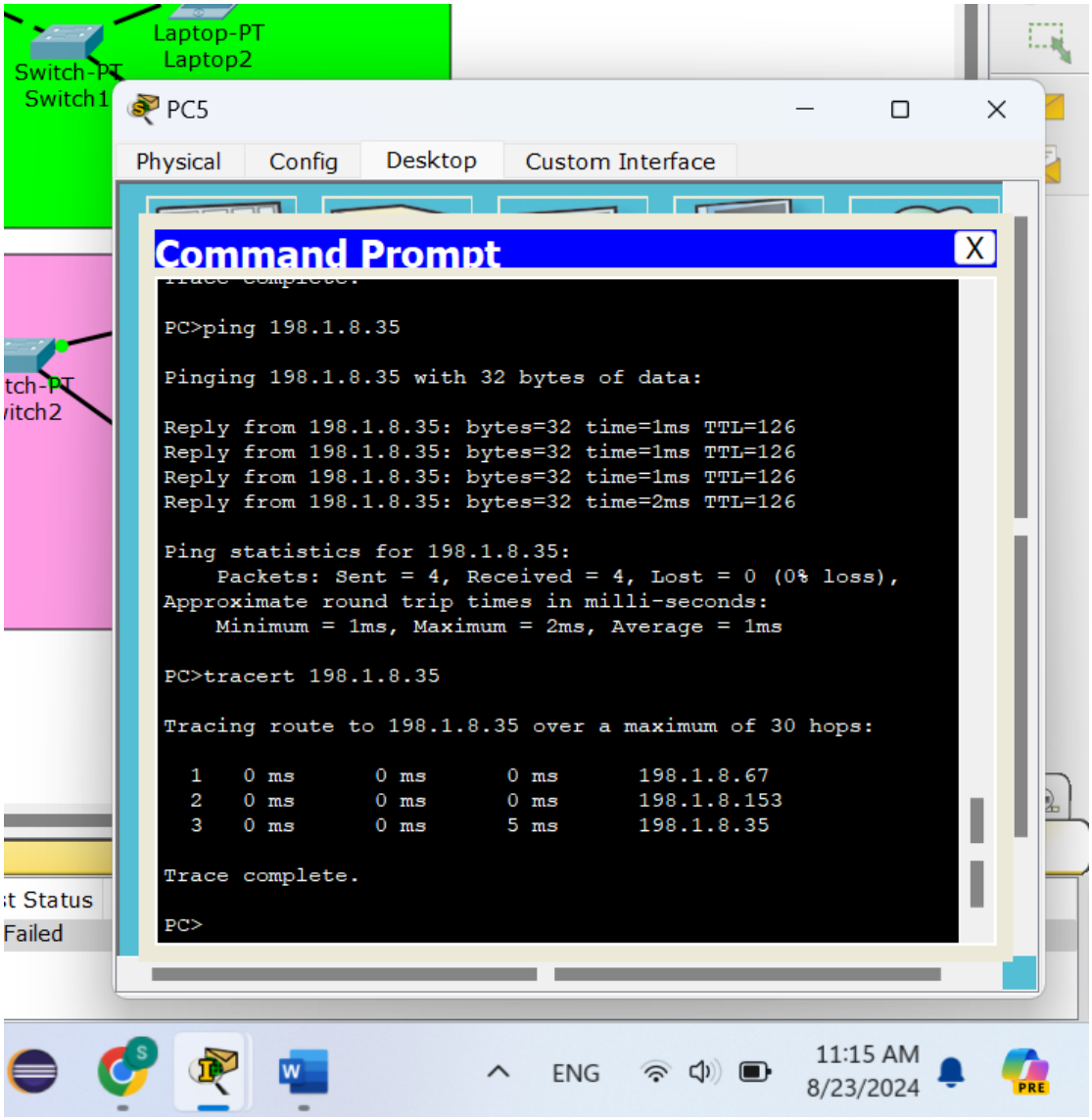

Figure 52: ping and trecert command between PC5 and PC0

The ping tests verify network communication between all PCs, as demonstrated in a screenshot from PC5 to PC0. The tracert tests verify device routing paths, as shown in a screenshot from PC5 to PC0, passing through routers R2, and R3. Both tests confirm successful communication between devices.

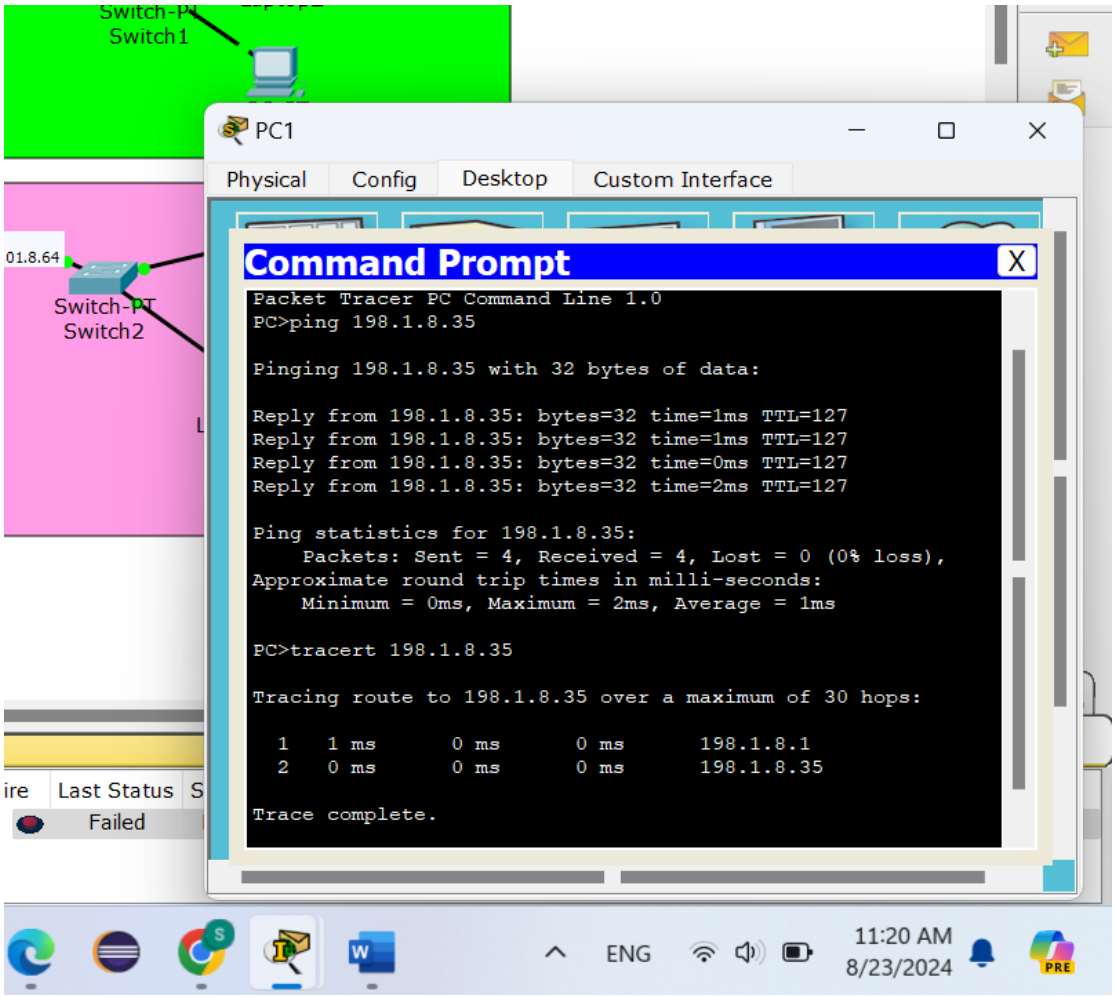

Figure 53: ping and trecert command between PC1 and PC0

The ping tests verify network communication between all PCs, as demonstrated in a screenshot from PC1 to PC0. The tracert tests verify device routing paths, as shown in a screenshot from PC1 to PC0, passing through routers R3. Both tests confirm successful communication between devices.

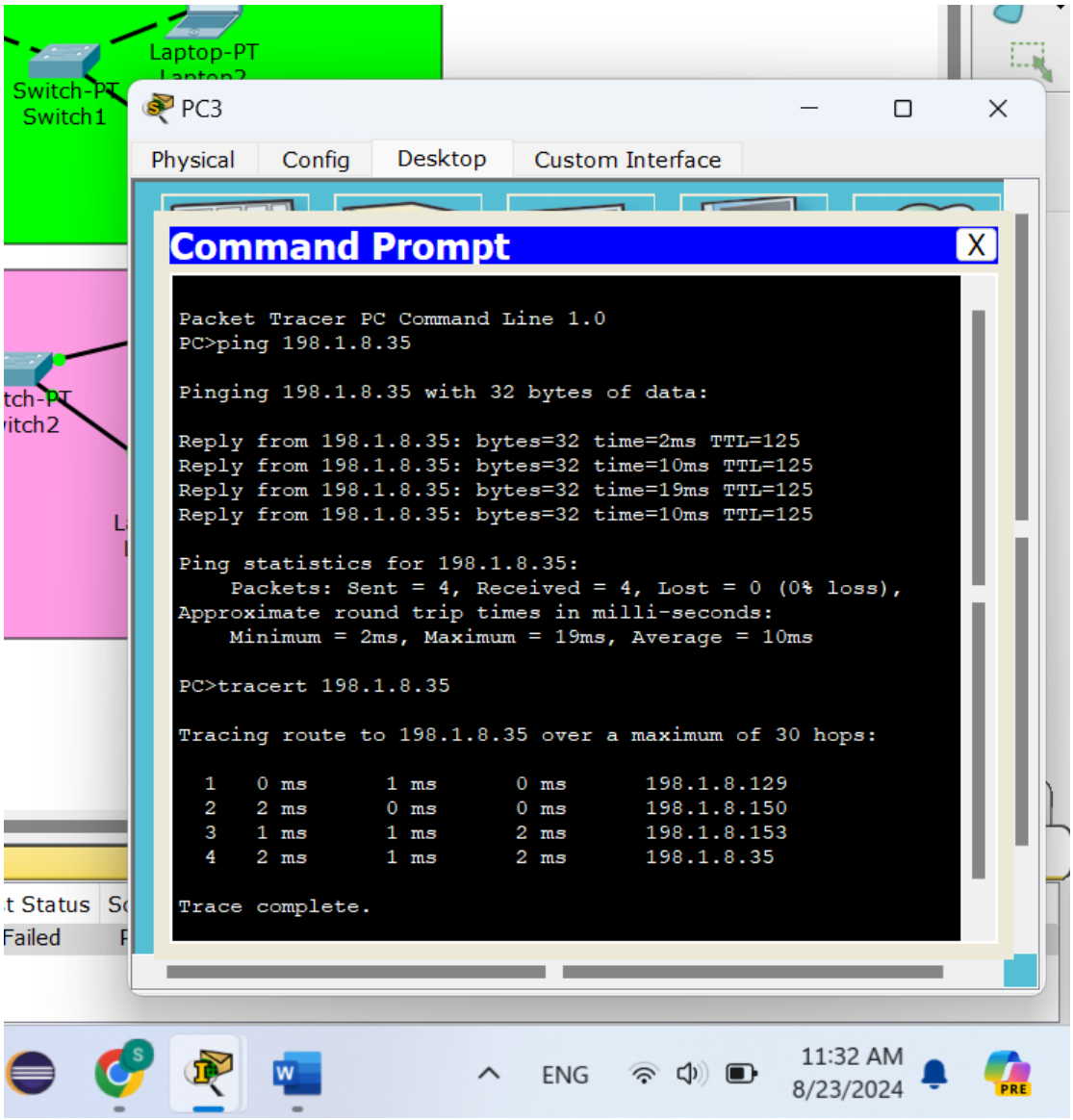

Figure 54: ping and trecert command between PC3 and PC0

The ping tests verify network communication between all PCs, as demonstrated in a screenshot from PC3 to PC0. The tracert tests verify device routing paths, as shown in a screenshot from PC3 to PC0, passing through routers R1, and R2 and R3. Both tests confirm successful communication between devices.

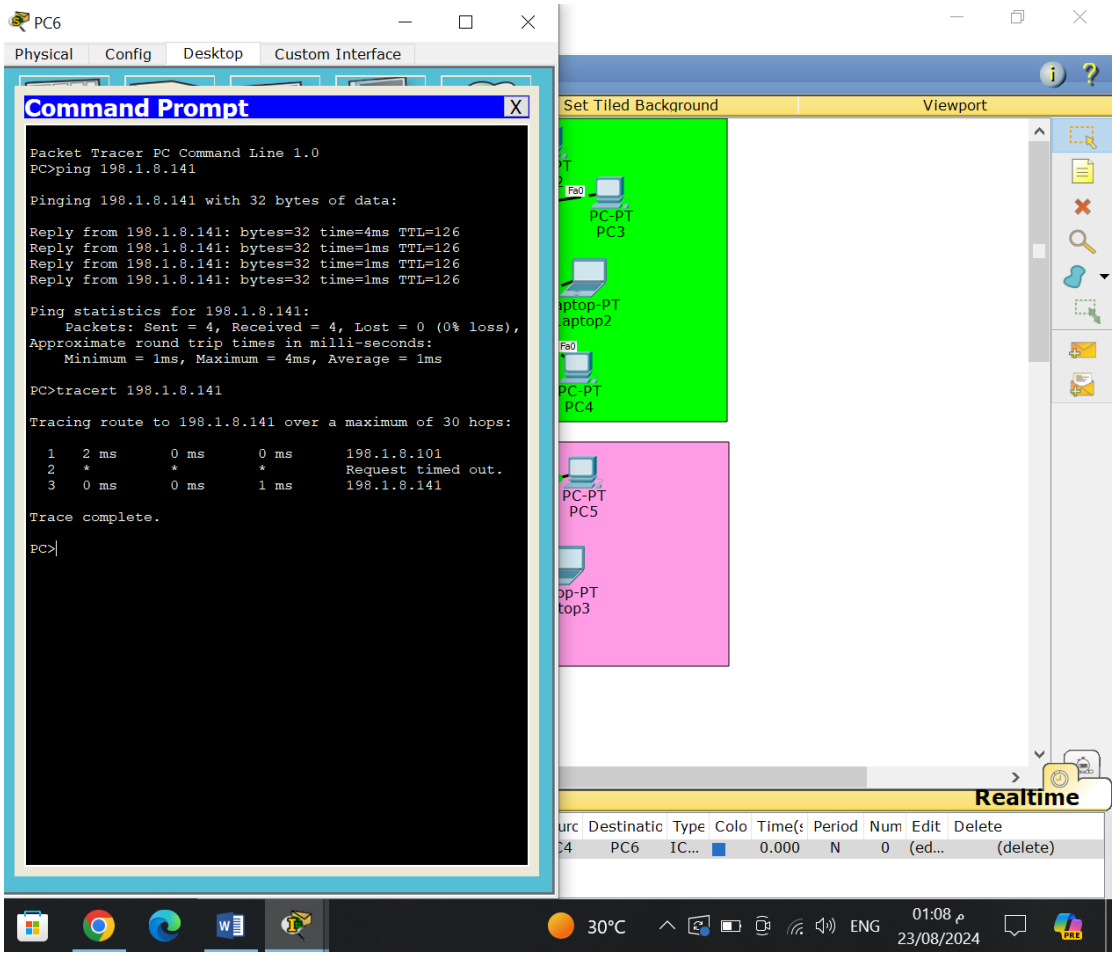

Figure 55: ping and trecert command between PC6 and PC4

The ping tests verify network communication between all PCs, as demonstrated in a screenshot from PC6 to PC4. The tracert tests verify device routing paths, as shown in a screenshot from PC6 to PC4, passing through routers R0, and R1. Both tests confirm successful communication between devices.

Routing Tables for All Routers:

The routing tables of all routers to ensure that the correct routes have been learned and advertised.

Router0:

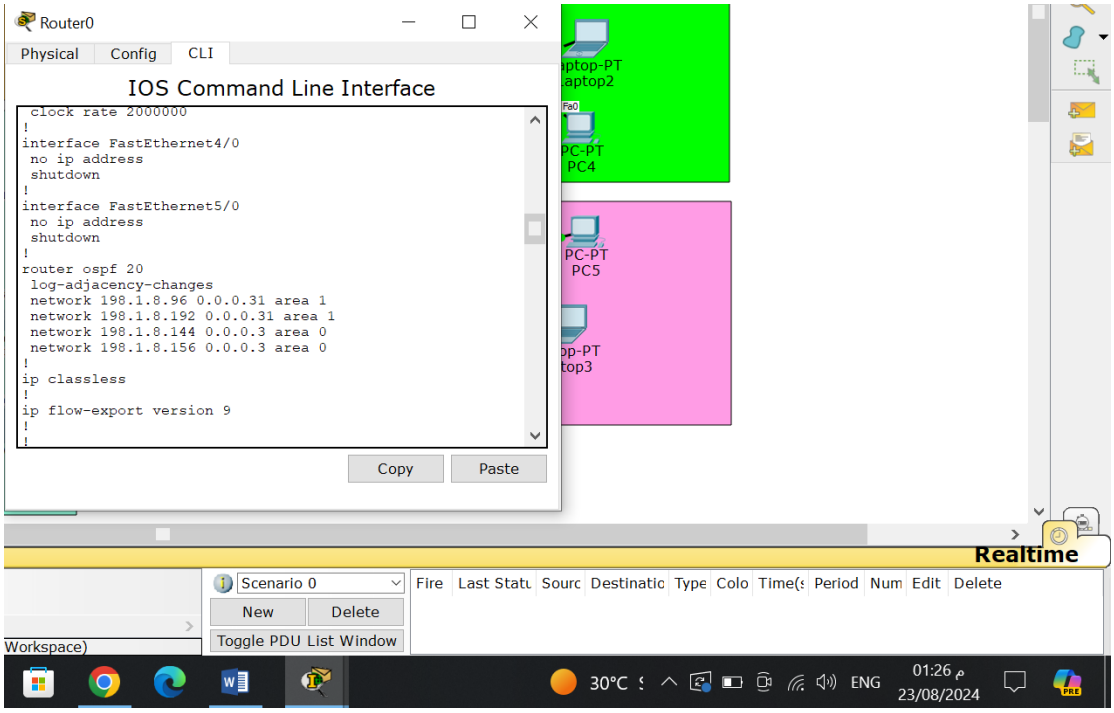

Figure 56: Router table of Router0

This screenshot shows the routing table of Router0, which includes the routes to all connected networks.

Router1:

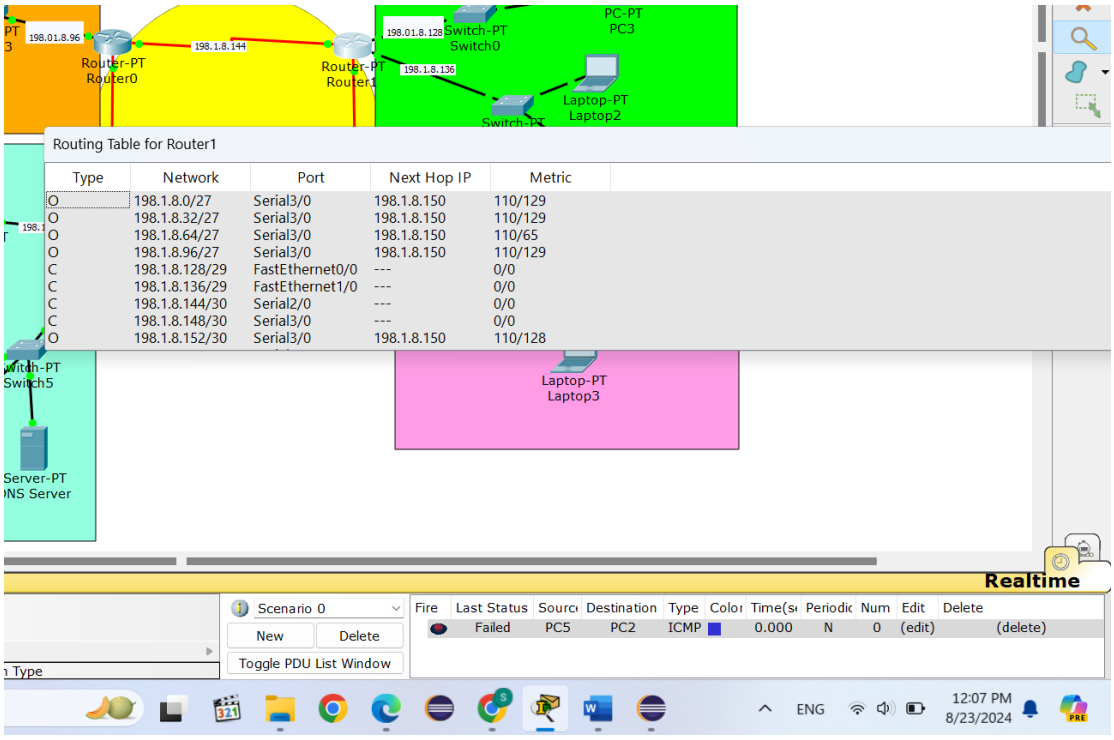

Figure 57: Router table of Router1

This screenshot shows the routing table of Router1, which includes the routes to all connected networks.

Router2:

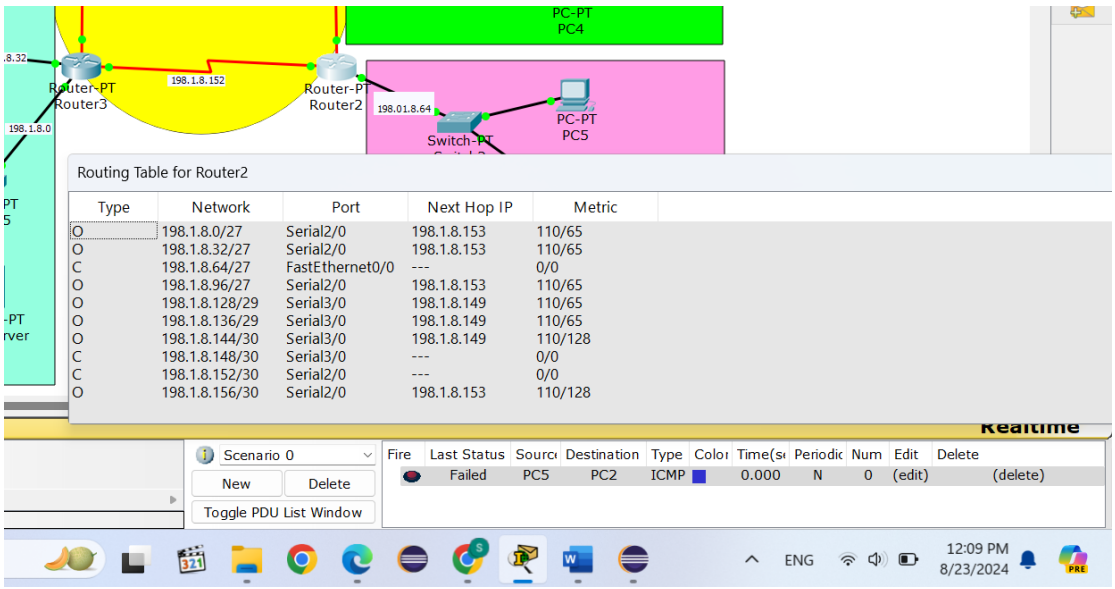

Figure 58: Router table of Router2

This screenshot shows the routing table of Router2, which includes the routes to all connected networks.

Router3:

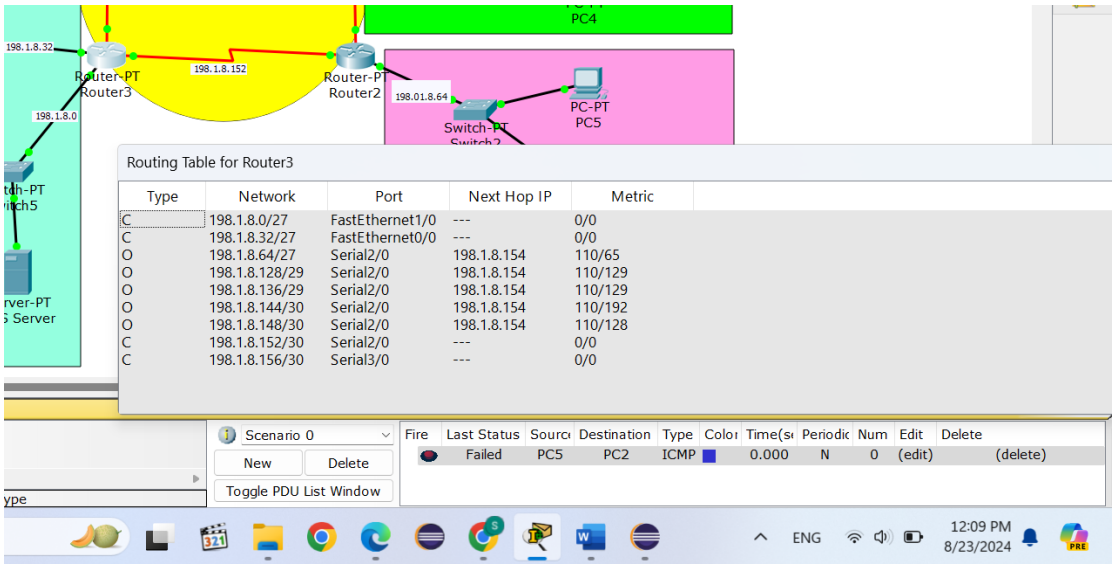

Figure 59: Router table of Router3

This screenshot shows the routing table of Router3, which includes the routes to all connected networks.

2. **Access www.ENCS3320Summer.com from all PCs, take snapshots for all cases.**

When we open the browser and write the address that the server indicates opens the page that we created

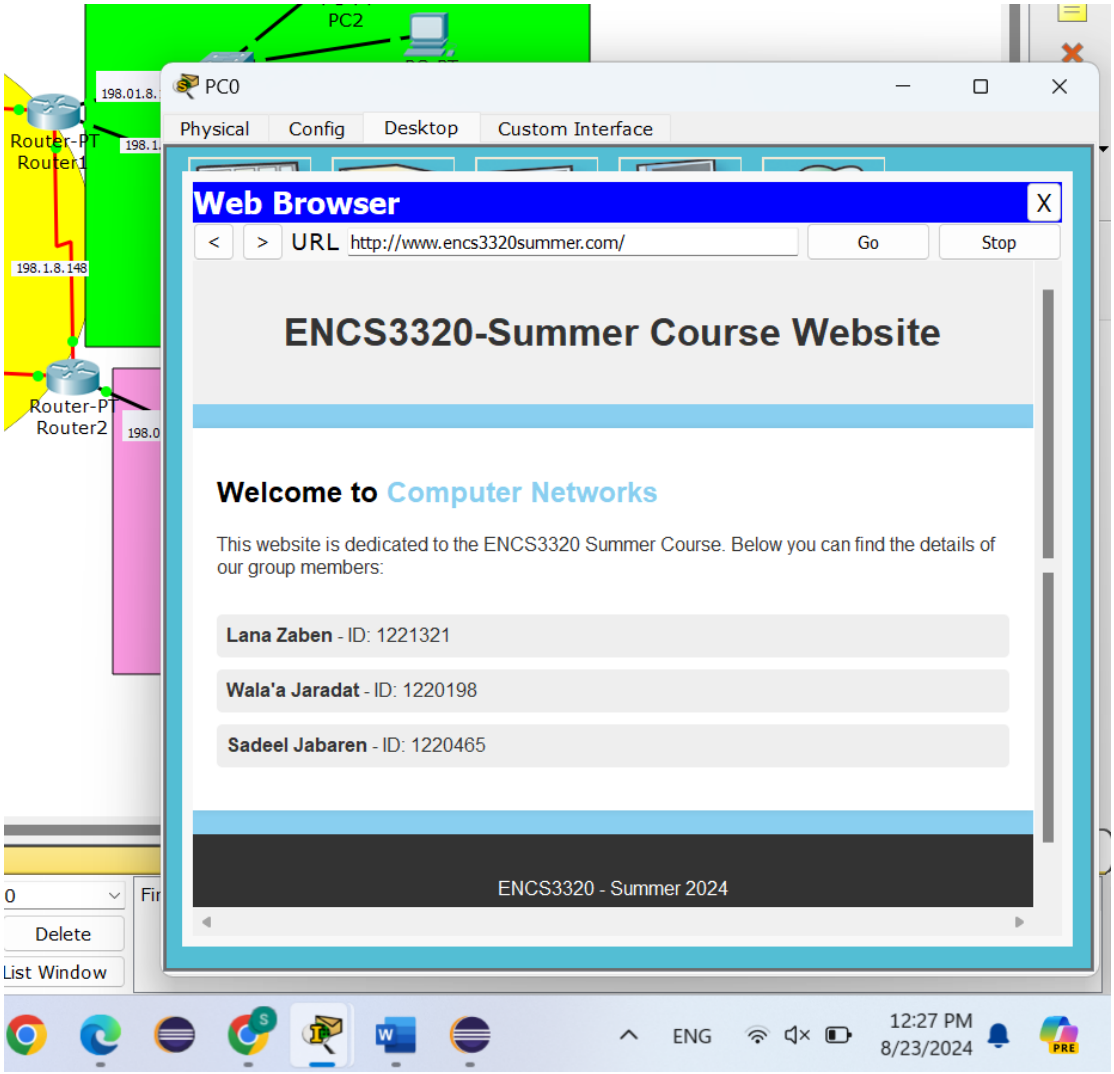

Figure 60: Web browser of PC0

This screenshot shows PC0 successfully accessing the web server at www.ENCS3320Summer.com, confirming the network's web service is functioning correctly.

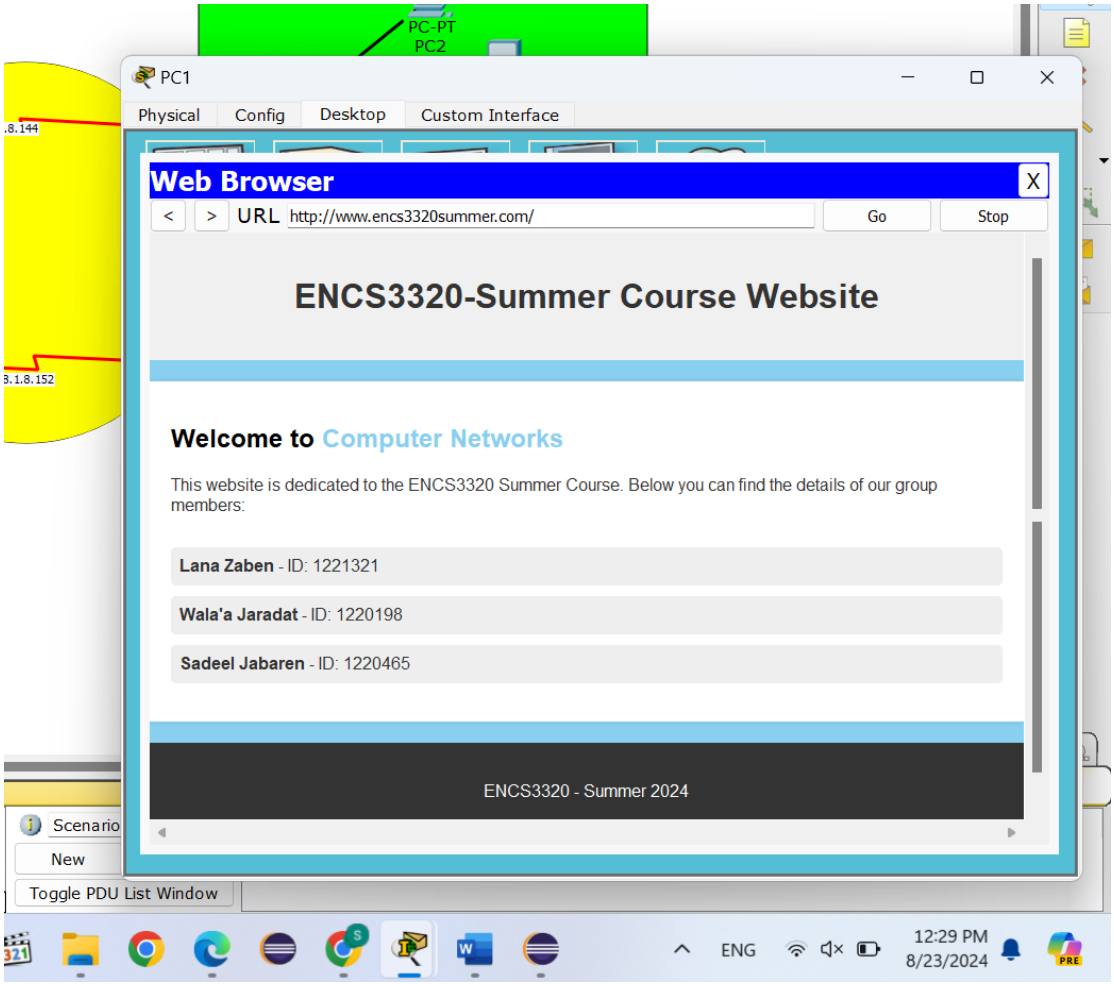

Figure 61: Web browser of PC1

This screenshot shows PC1 successfully accessing the web server at www.ENCS3320Summer.com, confirming the network's web service is functioning correctly.

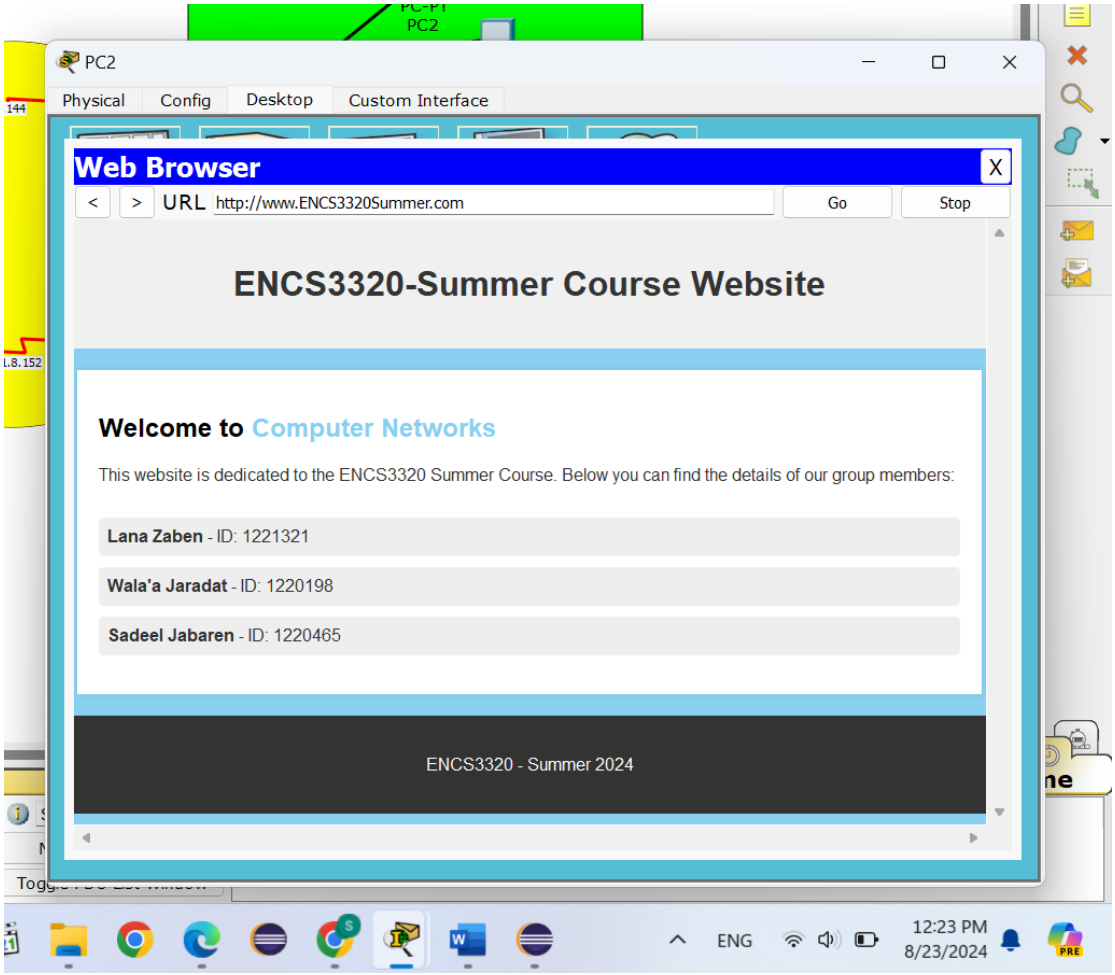

Figure 62: Web browser of PC2

This screenshot shows PC2 successfully accessing the web server at www.ENCS3320Summer.com, confirming the network's web service is functioning correctly.

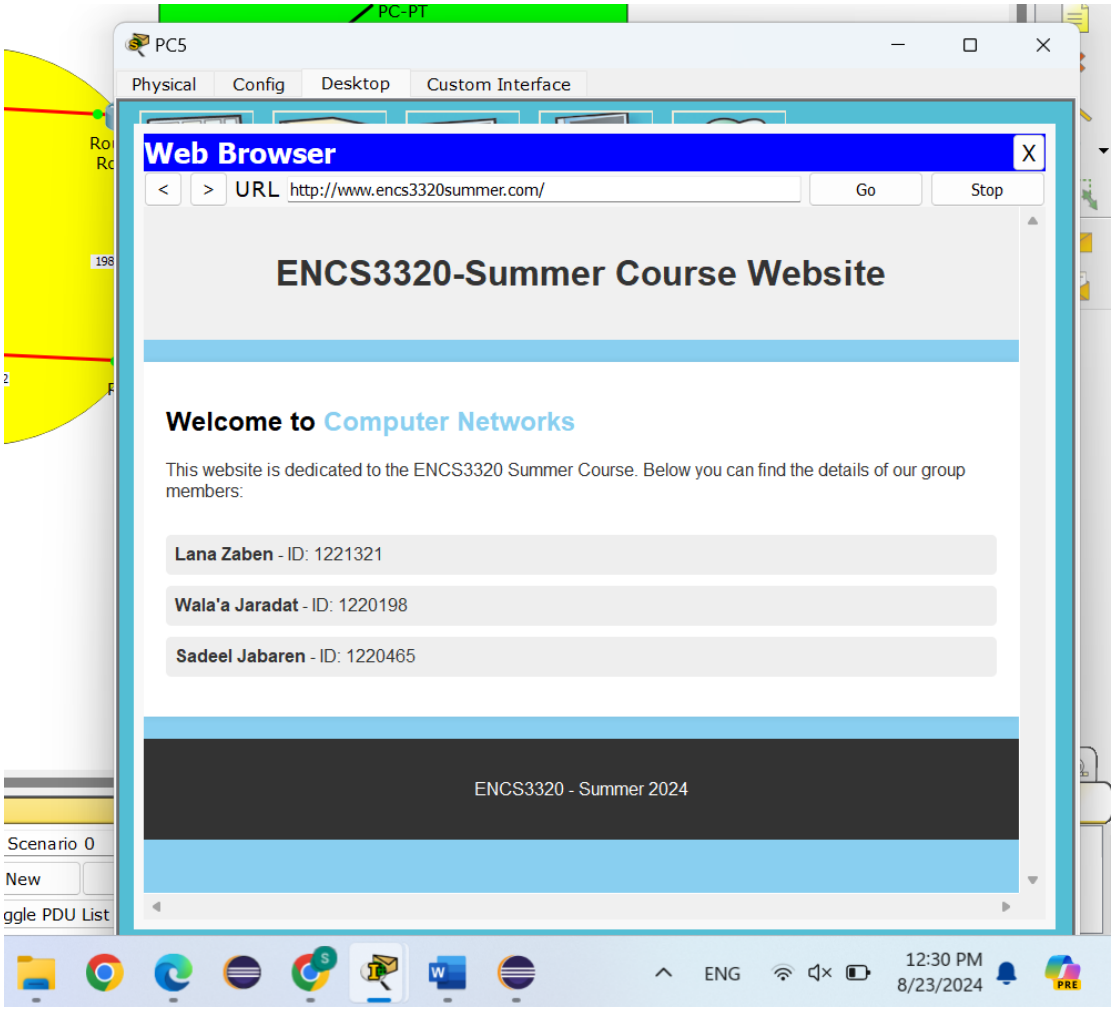

Figure 63: Web browser of PC5

This screenshot shows PC5 successfully accessing the web server at www.ENCS3320Summer.com, confirming the network's web service is functioning correctly.

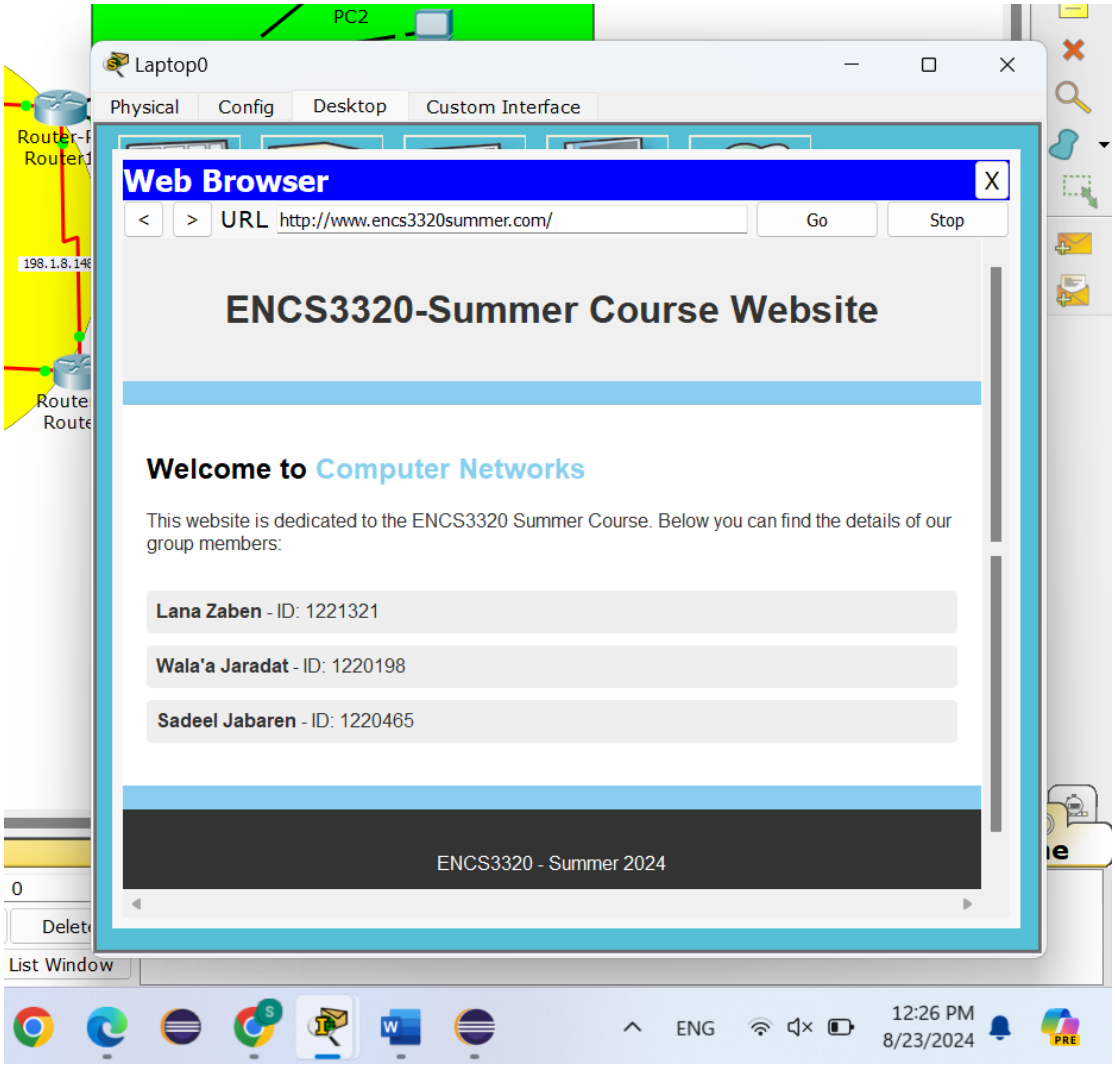

Figure 64: Web browser of Laptop0

This screenshot shows Laptop0 successfully accessing the web server at www.ENCS3320Summer.com, confirming the network's web service is functioning correctly.

Teamwork:

All of us worked together on design, implementation, simulation, testing, and reporting

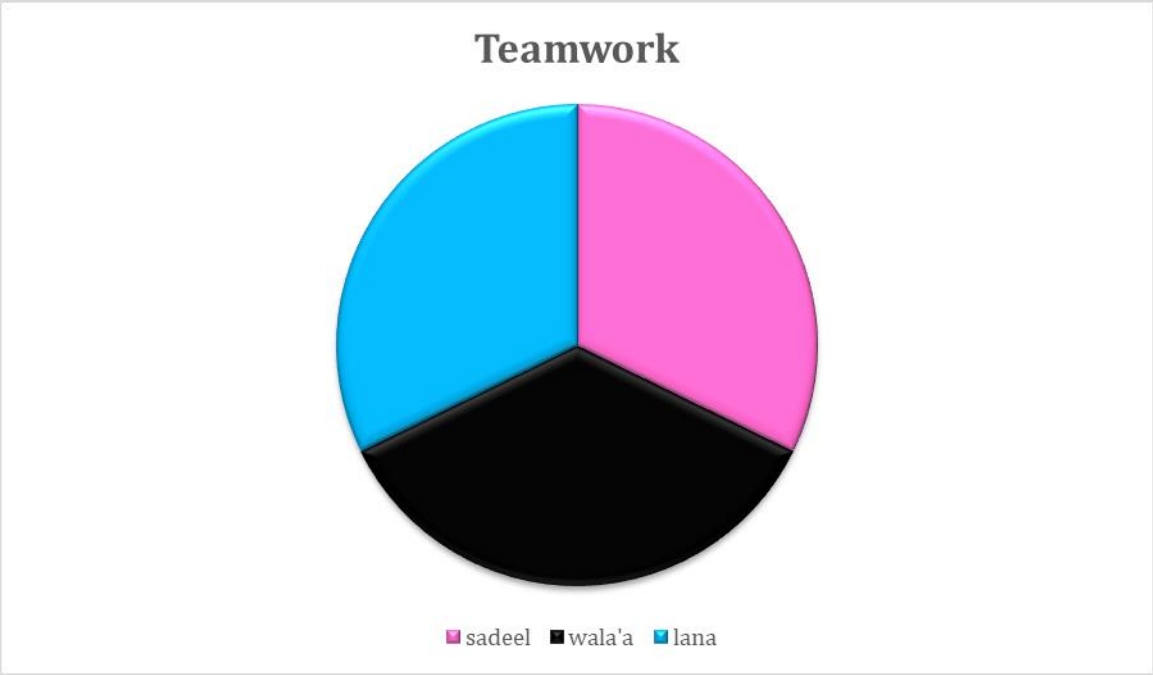

Figure 65: Team Work

References :

[1].https://www.cisco.com/c/dam/global/en_ca/solutions/strategy/docs/sbaBN_IPv4addrG.pdf