Faculty of Engineering and Technology

Electrical and Computer Engineering Department

Computer Networks Laboratory ENCS4130

Report II

Experiment # 9: Internet Protocol Version 6 (IPv6) Configuration

---

Student Name: Yara Darabumukho

Student Number: 1211269

Instructor: Dr. Ismail Khater

Teaching Assistant: Eng. Burhan Dar Assi

Section No: 1

Date: 26/8/2024

Place: Masri503

Abstract

The aim of this experiment is to learn and understand the IPv6 routing protocol. Which is a way of routing as ipv4 that use in all previous experiments and apply both dynamic “RIP” and static routing protocols. This experiment applies using Cisco Packet Tracer.

Table of Contents

1. Introduction 1

1.1 Address Types 1

1.1.1 Unicast 1

1.1.2 Global unicast addresses 1

1.1.3 Link-local addresses 1

1.1.4 Multicast 1

1.1.5 Anycast 1

1.2 Reserved IPv6 addresses 1

1.3 Configuring Cisco Routers with IPv6 2

1.4 IPv6 Routing Protocols 2

1.4.1 Static Routing 2

1.4.2 RIPng 2

1.5 Cisco Discovery Protocol 2

2. Procedure and Discussion 3

2.1 Building the Topology 3

2.2 Configuring routing protocols 5

2.2.1 Static Routing 5

2.2.2 RIPng routing protocol 7

3. Results 8

3.1 Routing Tables 8

3.2 PC Testing 9

4. To Do 10

5. Conclusion 11

6. Feedback 12

7. References 13

Acronyms and Abbreviations

- RIP: Routing Information Protocol
- S.M: Subnet-MASK
- CLI: Command Line Interface
- IP: Internet Protocol

Table of Figures

Figure 2- 1: Topology. 3
Figure 2- 2: Router 0. 4
Figure 2- 3: PC2. 4
Figure 2- 4: Configuring routing protocols. 5
Figure 2- 5: Static routing on Router 0. 6
Figure 2- 6: Static routing on Router 1. 6
Figure 2- 7: Static routing on Router 2. 6
Figure 2- 8: RIP in router 2. 7
Figure 2- 9: RIP in router 1. 7

Figure 3- 1: Routing Table for R0. 8
Figure 3- 2: Routing Table for R1. 8
Figure 3- 3: Routing Table for R2. 8
Figure 3- 5: PC0 – PC3. 9
Figure 3- 6: PC2 – PC4. 9

Figure 4- 1: To Do Topology. 10

Table of Tables

Table 2- 1: IP Address. 3

1. Introduction

“An Internet Protocol version 6 address (IPv6 address) is a numeric label that is used to identify and locate a network interface of a computer or a network node participating in a computer network using IPv6. IP addresses are included in the packet header to indicate the source and the destination of each packet. The IP address of the destination is used to make decisions about routing IP packets to other networks. IPv6 is the successor to the first addressing infrastructure of the Internet, Internet Protocol version 4 (IPv4). In contrast to IPv4, which defined an IP address as a 32-bit value, IPv6 addresses have a size of 128 bits. Therefore, in comparison, IPv6 has a vastly enlarged address space.” [1]

1.1 Address Types

1.1.1 Unicast

“Packets addressed to a unicast address are delivered to a single interface.” [2]

1.1.2 Global unicast addresses

“These are like the public addresses in IPv4. Global addresses start at 2000::/3” [2]

1.1.3 Link-local addresses

“These are like the private addresses in IPv4 in that they’re not meant to be routed and they start with FE80::/10. Think of them as a handy tool that gives you the ability to throw a temporary LAN together for meetings or to create a small LAN that’s not going to be routed but still needs to share and access files and services locally.” [2]

1.1.4 Multicast

“Again, same as in IPv4, packets addressed to a multicast address are delivered to all interfaces tuned into the multicast address.” [2]

1.1.5 Anycast

“Like multicast addresses, an anycast address identifies multiple interfaces on multiple devices, but there is a big difference: The anycast packet is delivered to only one device—actually, to the closest one it finds defined in terms of routing distance.” [2]

1.2 Reserved IPv6 addresses

Some of the special addresses in IPv6:

- “0:0:0:0:0:0:0:1 Equals ::1. The equivalent of 127.0.0.1 in IPv4.
- 0:0:0:0:0:0:192.X.100.1 This is how an IPv4 address would be written in a mixed IPv6/IPv4 network environment.
- 2000::/3 The global unicast address range.
- FE80::/10 The link-local unicast range.” [2]

1.3 Configuring Cisco Routers with IPv6

Configure an IPv6 address on an interface done using the following interface configuration command:

“Router(config) #interface <TYPE> <SLOT>/<PORT>

Router(config-if) # ipv6 address <IPV6-PREFIX>/ < PREFIX-LENGTH>

- ⇨ The interface can have more than one IPv6 address.” [2]

1.4 IPv6 Routing Protocols

To enable IPv6 routing on a router, the following ipv6 unicast-routing global configuration command should use:

Router(config)#ipv6 unicast-routing

1.4.1 Static Routing

“Static routing referred to as non-adaptive routing, is a routing mechanism handled by the Internet Protocol (IP) and does not modify the routing table until manually modified by the network administrator. Since static routers do not exchange routing information with others, they must be configured and maintained independently. Static routing offers higher or greater security than dynamic routing because it does not require complicated routing algorithms.” [3]

Applying the static routing into ipv6 done using the following command:

“Router(config)# ipv6 route <IPV6-PREFIX> / <PREFIX-LENGTH> <IPV6-NEXT-HOP-ADDRESS>” [2]

1.4.2 RIPng

“Routing Information Protocol (RIP) is a distance vector protocol that uses hop count as its primary metric. RIP defines how routers should share information when moving traffic among an interconnected group of local area networks.” [4]

Applying RIP into ipv6 done using the following commands:

“Router(config) #interface <TYPE> <SLOT>/<PORT>

Router(config)#ipv6 rip <RIP-ID> enable” [2]

1.5 Cisco Discovery Protocol

“CDP is a protocol that runs over Layer 2 (the data link layer) on all Cisco routers, bridges, access servers, and switches. CDP allows network management applications to discover Cisco devices that are neighbors of already known devices, in particular, neighbors running lower-layer, transparent protocols.With CDP, network management applications can learn the device type and the SNMP agent address of neighboring devices. CDP enables applications to send SNMP queries to neighboring devices. CDP runs on all LAN and WAN media that support Subnetwork Access Protocol (SNAP). Each CDP-configured device sends periodic messages to a multicast address. Each device advertises at least one address at which it can receive SNMP messages. The advertisements also contain the time-to-live, or holdtime information, which indicates the length of time a receiving device should hold CDP information before discarding it.” [5]

2. Procedure and Discussion

2.1 Building the Topology

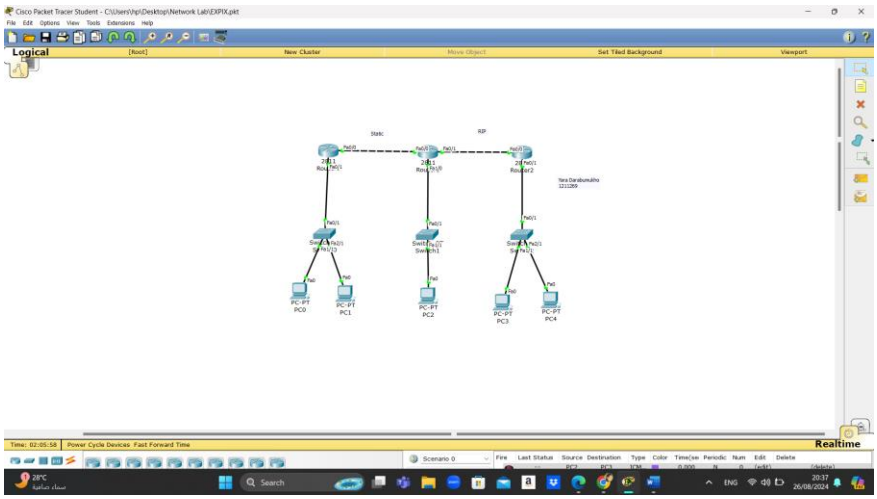

Figure 2- 1: Topology.

Network	Device	Interface	IP	S.M
2001:11AA:: /64	Router 0	Fa0/1	2001:11AA::1	/64
	PC 0	Fa0	2001:11AA::2	/64
	PC 1	Fa0	2001:11AA::3	/64
2001:22AA:: /64	Router 0	Fa0/0	2001:22AA::1	/64
	Router 1	Fa0/0	2001:22AA::2	/64
2001:33AA:: /64	Router 1	Fa0/1	2001:33AA::1	/64
	Router 2	Fa0/0	2001:33AA::2	/64
2001:44AA:: /64	Router 1	Fa0/1	2001:44AA::1	/64
	PC 2	Fa0	2001:44AA::2	/64
2001:55AA:: /64	Router 0	Fa0/1	2001:55AA::1	/64
	PC 3	Fa0	2001:55AA::2	/64
	PC 4	Fa0	2001:55AA::3	/64

Table 2- 1: IP Address.

- Adding the serial numbers and the FastEthernet numbers done by open the CLI for each router then enter each interface, add the IP address, and activate the interface. As such:

  Router(config) # interface fa0/0

  Router(config-if) # ipv6 address 2001:22AA::1/64 “This command for Router 0

  Router(config-if) # no shutdown”

- The FastEthernet for the PCs add using IP configurations in the desktop tab for each one.

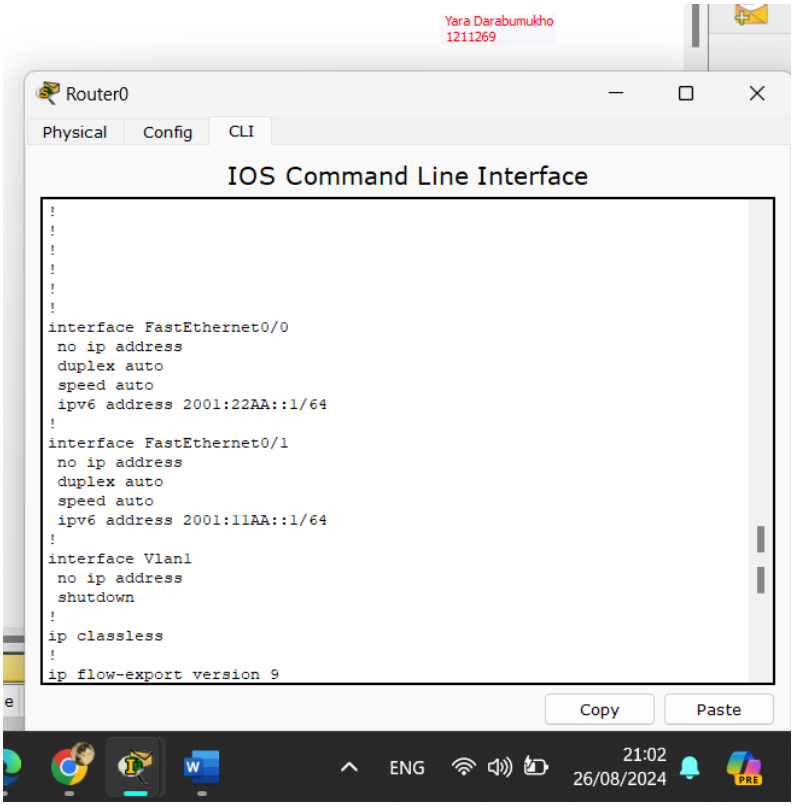

Figure 2- 2: Router 0.

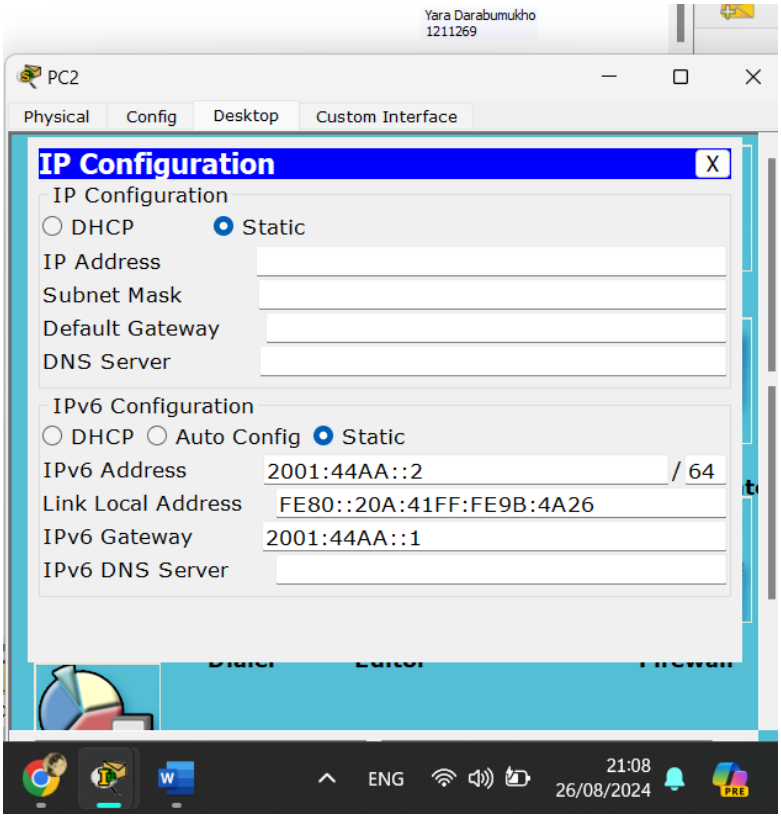

Figure 2- 3: PC2.

This is PC 2 IP for example and Router 0 address.

2.2 Configuring routing protocols

To enable the routing in the ipv6 network the following command must be run in the network's routers:

- ⇨ Router(config) #ipv6 unicast-routing

The routing protocols enabled for all routers in the same way as the following figure for Router 1.

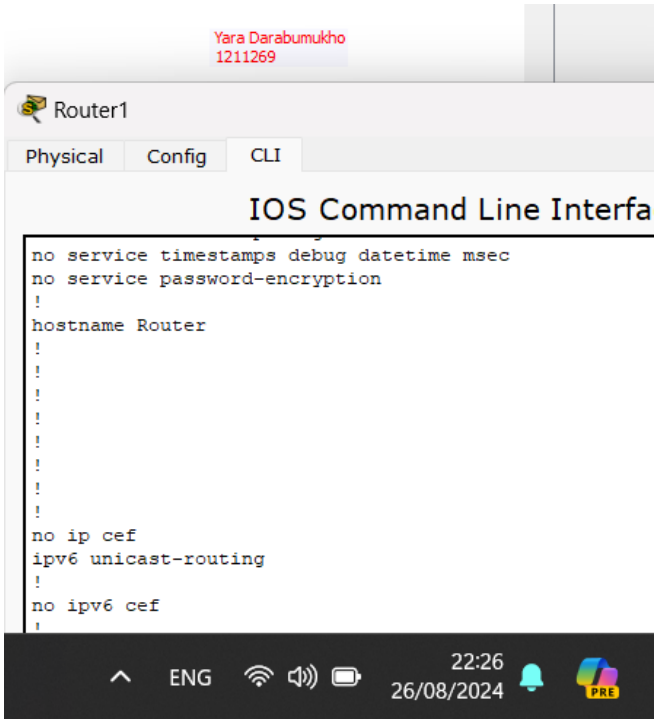

Figure 2- 4: Configuring routing protocols.

2.2.1 Static Routing

After building the topology the network ready to apply any routing protocol. In this experiment the routing protocol will be a static routing in the first part and a RIP in the second one. Let's start with the static routing. Which done by connection the router with the unreachable end devices in the other networks that don't have any direct connection with the router.

These commands will set the static routing for router 0:

- ⇨ Router(config) #ipv6 route 2001:33AA::/64 2001:22AA::2
- ⇨ Router(config) #ipv6 route 2001:55AA::/64 2001:22AA::2
- ⇨ Router(config) #ipv6 route 2001:44AA::/64 2001:22AA::2

Same instruction uses for Router 1, and 2 but with the right IPs of course as shown in the next figures.

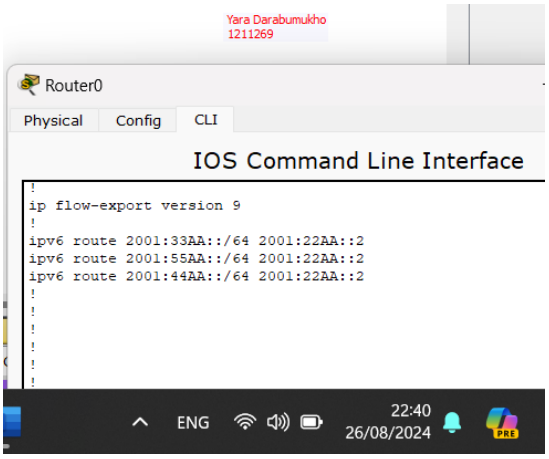

Figure 2- 5: Static routing on Router 0.

Figure 2- 6: Static routing on Router 1.

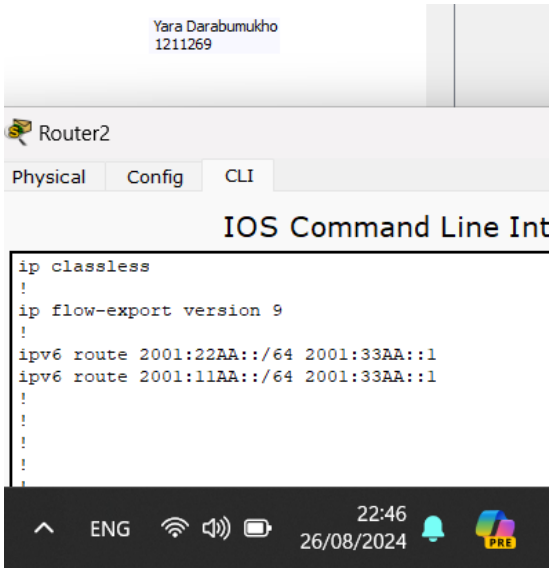

Figure 2- 7: Static routing on Router 2.

2.2.2 RIPng routing protocol

After finishing the static routing, the RIP routing for the second part of the topology. Which done by enabling the RIP routing protocol for all routers interfaces “Router 1 and 2”.

These commands will set the RIP routing for router 2:

- ⇨ Router(config) #interface Fa0/0
- ⇨ Router(config-if) #ipv6 rip 1 enable
- ⇨ Router(config-if) #exit
- ⇨ Router(config) #interface Fa0/1
- ⇨ Router(config-if) #ipv6 rip 1 enable

Same instruction uses for Router 0 for interfaces Fa0/1 and Fa1/0. “because they were a part of the RIP section”

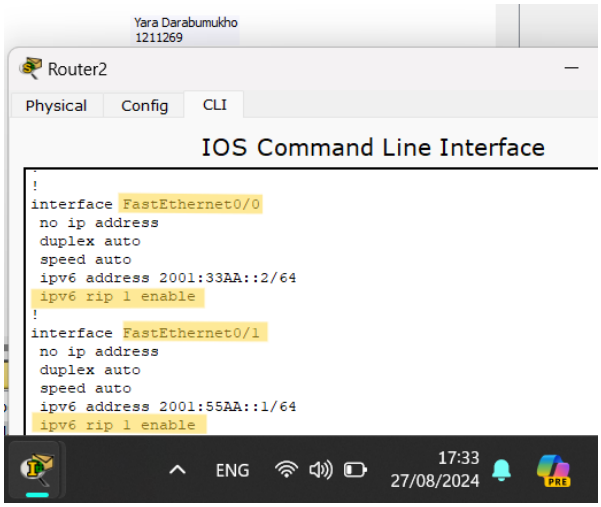

Figure 2- 8: RIP in router 2.

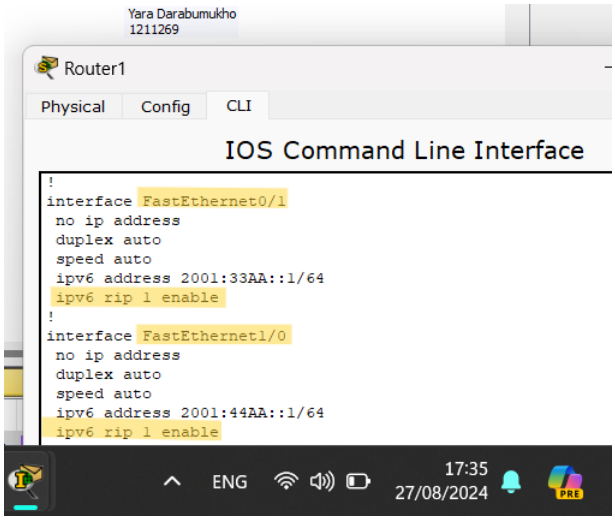

Figure 2- 9: RIP in router 1.

3. Results

The results for each section above added next to the description. This part contains the routing table for each Router and PC testing using “Ping” command.

3.1 Routing Tables

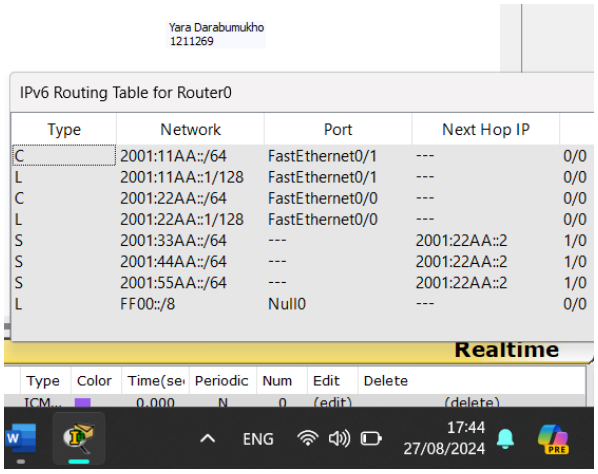

Figure 3- 1: Routing Table for R0.

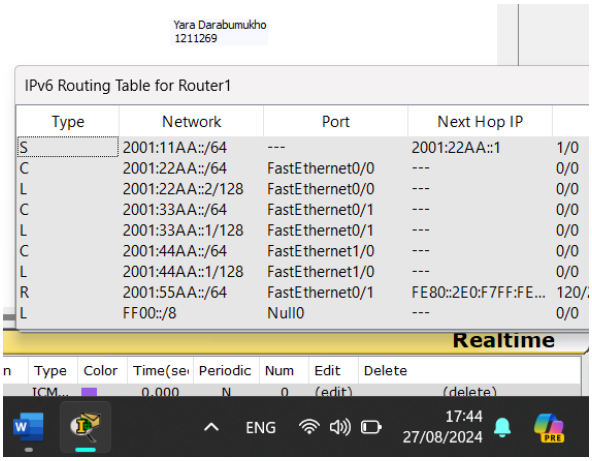

Figure 3- 2: Routing Table for R1.

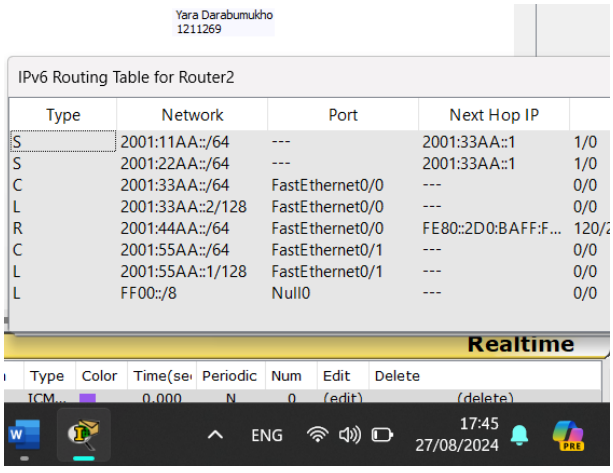

Figure 3- 3: Routing Table for R2.

As shown in the figures above each router has routing table include all IPs and neighbour networks IP.

3.2 PC Testing

This section is to test the topology and sending the packets through the network.

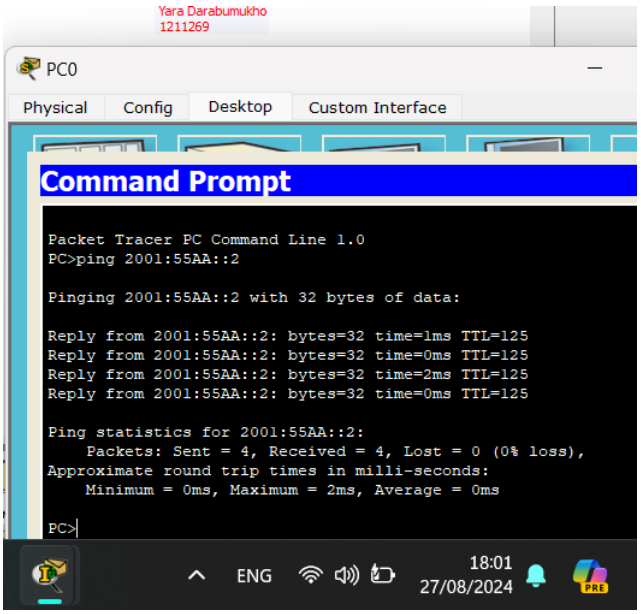

Figure 3- 4: PC0 – PC3.

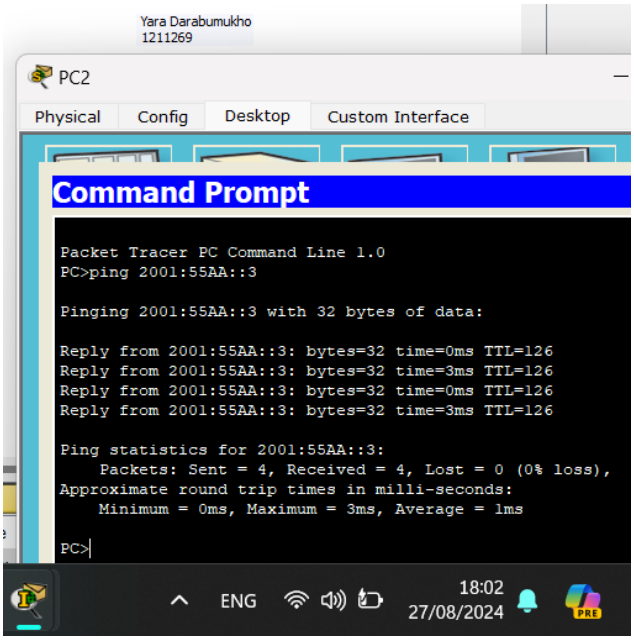

Figure 3- 5: PC2 – PC4.

So, as shown in the figures above the process done successfully for all testing.

- ⇨ The first packet sent from PC0 to PC3
- ⇨ The third packet sent from PC2 to PC4

These two cases cover the transmissions between both sections “static and dynamic routing”.

4. To Do

Applying the RIP only for this experiment topology.

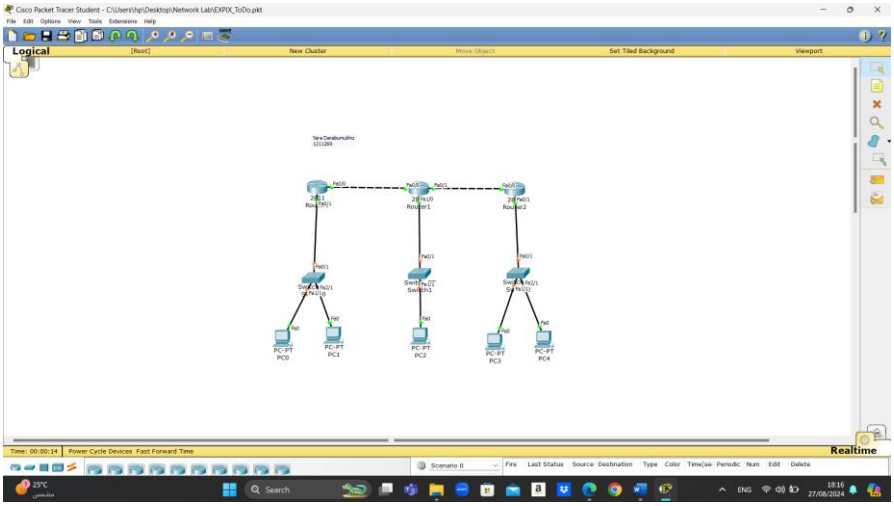

Figure 4- 1: To Do Topology.

It submits previously via ritaj as a packet tracker file.

- ⇨ The RIP protocol enables for all routers interfaces, same as the part of the RIP in the experiment but for all routers nor just for that section.

5. Conclusion

In this experiment we build a topology and set the ipv6 address for each router and PC in each area.

Learned about the ipv6 as an internet protocol instead of the ipv4 which used in all previous experiments and applying both static and dynamic routing protocols in the same network. We understand these topics and steps then apply them into the topology and verify that its work successfully. The main aim of this experiment is to use the ipv6.

The to do apply same internet protocol and the same topology but with applying only the dynamic routing “RIP” as a routing protocol.

6. Feedback

It was an exciting experiment; the experiment requires less time than the lab time but this better actually to understand all details.

7. References

[1]: https://en.wikipedia.org/wiki/IPv6_address

[Accessed in 26/8/2024 at 18:57]

[2]: ENCS4130Manual_2023_2024.pdf

[Accessed in 26/8/2024 at 19:05]

[3]: https://www.ruijienetworks.com/support/faq/what-is-static-routing

[Accessed in 26/8/2024 at 20:10]

[4]: https://www.techtarget.com/searchnetworking/definition/Routing-Information-Protocol

[Accessed in 26/8/2024 at 20:15]

[5]: https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst4500/12-2/25ew/configuration/guide/conf/cdp.pdf

[Accessed in 26/8/2024 at 20:30]