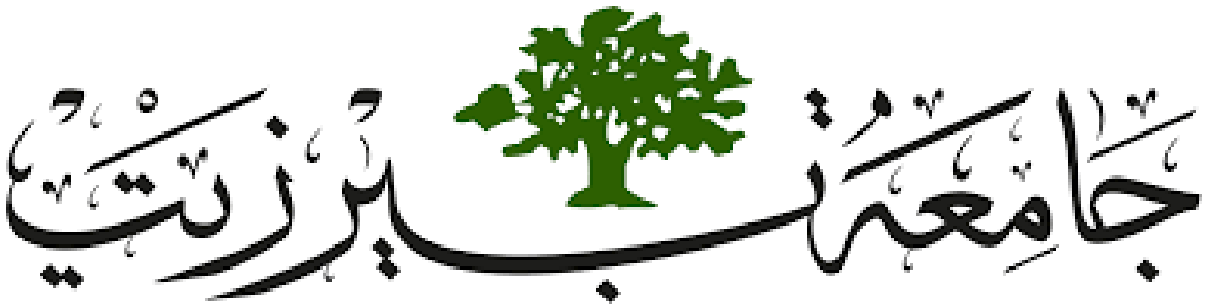

BIRZEIT UNIVERSITY

Faculty of Engineering & Technology
Department of Electrical & Computer Engineering
ENCS4130-Computer network laboratory
Report #1
Experiment 4 : Dynamic Routing 2 (Link State Routing Protocols)
Open Shortest Path First (OSPF)

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Section: 7

Date: 14/10/2024

Place: Masri503

Abstract:

This experiment aimed at learning and applying IP routing configurations on Cisco routers, with a specific focus on dynamic routing using the Open Shortest Path First protocol which is an example of the internal dynamic routing protocol that belong to the link state protocol. The experiment's objectives include configuring IP routing, verifying routing tables, and examining the behavior of Open Shortest Path First as a dynamic routing protocol in a network environment using Cisco Packet Tracer. Key steps involved setting up routers, establishing Open Shortest Path First areas, and ensuring proper communication between network devices. The experiment also evaluates the efficiency of Open Shortest Path First in dynamically adapting to changes within the network topology, ensuring optimal and shortest routing paths. The results provide valuable insights into the practical application of Open Shortest Path First, demonstrating how to configure, implement, and verify dynamic routing protocols on Cisco devices.

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Acronyms and Abbreviations:

→ OSPF : Open Shortest Path First

→ IGP : Interior Gateway Protocol

→ RIP: Routing Information Protocol

→ CLI : Command line interface

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1. Theory

Interior Gateway Protocol (IGP) is a dynamic routing protocol used by routers in a single autonomous system to convey information about IP routes. This flexibility in the case of routing data dissemination is provided by interior gateway protocol, a road which is connected by different routers in a TCP/IP network. Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Intermediate System to Intermediate System (IS-IS), and Enhanced Interior Gateway Routing Protocol (EIGRP) are some of the common examples of IGPs [1].

1.1 Open Shortest Path First (OSPF)

Open Shortest Path First (OSPF) is a link-state routing protocol meant for the routing of Internet Protocol (IP) networks using the Shortest Path First (SPF) algorithm. It is an IGP, allowing multiple routers within one area to work off of the same link-state database, essentially a description of the network topology within that area. This database is built from link-state advertisements (LSAs) sent and received by routers, containing information with relation to neighboring routers and their associated path costs. Once received, each router computes its own shortest-path spanning tree via an SPF algorithm, with itself the root of that tree.

OSPF has its great assets. Unlike distance-vector protocols such as RIP, OSPF suits itself to large, heterogeneous topologies with considerable scalability and can respond fast if it has had to re-provision any routes on failure. Moreover, OSPF provides partitioning of the Autonomous System (AS) into several areas-a feature that lowers the amount of routing update traffic and thus reduces the size of the link-state database. Another virtue is that OSPF permits implementation of equal-cost multipath routing; one or more paths exhibiting equal cost can, thus, be used simultaneously with different next-hop routers by forwarding traffic along that multilink path [2].

1.1.1. OSPF Configuration

To configure OSPF on a Cisco router, its need to start by entering the router's global configuration mode and enabling OSPF using the router ospf command, followed by a process ID (a locally significant number). After that, define the network areas by specifying which networks should participate in OSPF and associate them with an area using the network command. This requires identifying the network address, wildcard mask, and OSPF area ID [6] .

Once OSPF is configured, you can check the status using these commands **:**

```
show ip route,
show ip ospf neighbor
show ip protocols
```

1.2 Route Summarization

Route summarization is also known as route aggregation or supernetting and it summarize several networks or subnets into a single summary route. Advantages include fewer entries in the routing table, thus lowering the memory usage ,reduced usage of bandwidth because fewer routes have to be advertised and optimization of the CPU, given that fewer packets are processed and the sizes of routing tables are made smaller. Furthermore, it enhances the performance of the network by stabilizing the routing table and avoiding flapping due to a newly adopted route. Certain disadvantages should also be noted, one such disadvantage is the router forwarding packets meant for a subnet that is inactive, resulting in, at times, unnecessary traffic being sent to routers advertising the summary route, continuing until an entry point to the given summary route is closed. Besides, the choice of a route when there is a summary route may not always be an optimal one for some routers, as a router will by preference always match the longest prefix; such selection may lead to a lesser efficient one. Denoting all covered networks with the same metric might also not reflect the actual optimal path of each one of the individual networks [3].

1.3 Routing Hierarchy

Hierarchical routing involves organizing routers in a layered structure, which can be exemplified by a corporate intranet. Typically, corporate intranets have a high-speed backbone network, with routers connected to this backbone, each serving a specific workgroup. Each workgroup operates within a unique local area network (LAN). This setup is efficient because, despite having numerous workgroups, the maximum hop count between any two hosts in the network remains low, typically 2. Even if the LANs are .further subdivided, the hop count might only increase to 4 in such cases

When compared to other configurations, such as connecting every router directly to each other or having each router connect to just two others, hierarchical routing proves to be more advantageous. It simplifies the network topology, enhances routing efficiency, and reduces network congestion by limiting the number of routing advertisements. In a hierarchical system, only the core routers connected to the backbone are aware of all the network routes, while routers within a LAN only manage local routes. For any unknown destinations, traffic is forwarded to the default route **[4]**.

1.4 OSPF Neighbor Relationships

The OSPF neighbor relationship involves two routers forming a connection by exchanging Hello packets to verify network parameters. Once compatibility is confirmed, the routers transition through various states such as "Init" and "2-Way" before establishing full adjacency. In full adjacency, routers share complete routing information. Not all neighbors become fully adjacent; some remain in the 2-Way state. Core routers in designated roles, like Designated Routers (DR) and Backup Designated Routers (BDR), typically form full adjacencies to optimize network efficiency. This hierarchical structure helps reduce network congestion and complexity [5].

1.5 Router ID

In OSPF, each router is assigned a unique Router ID (RID) to distinguish itself within the network. This RID must be unique across the OSPF domain, as duplicate RIDs can lead to network reachability issues. If two routers share the same RID, they will not establish a neighbor relationship. However, duplicated RIDs may still exist between routers that are not directly connected. OSPF selects the RID using a specific order of criteria: first, a manually configured RID is used if set. If not, the highest IP address on any loopback interface is chosen. In the absence of a loopback interface, OSPF uses the highest IP address from a non-loopback interface [7].

1.6 loopback interface

A loopback interface is a virtual interface on a switch that remains up and reachable as long as at least one physical IP interface on the device is operational. This makes it highly reliable for tasks like debugging, as its IP address can always be pinged when other interfaces are up. The loopback interface can also be used to establish Telnet, SNMP, SSH, and HTTP (WebAgent) sessions. It has further relevance in routing protocols where the loopback IP can be configured as the router ID, especially in OSPF, and guaranteeing that the router ID is stable and not impacted by physical interface failures [8].

2. Procedure And Data Analysis

2.1 Building the Topology

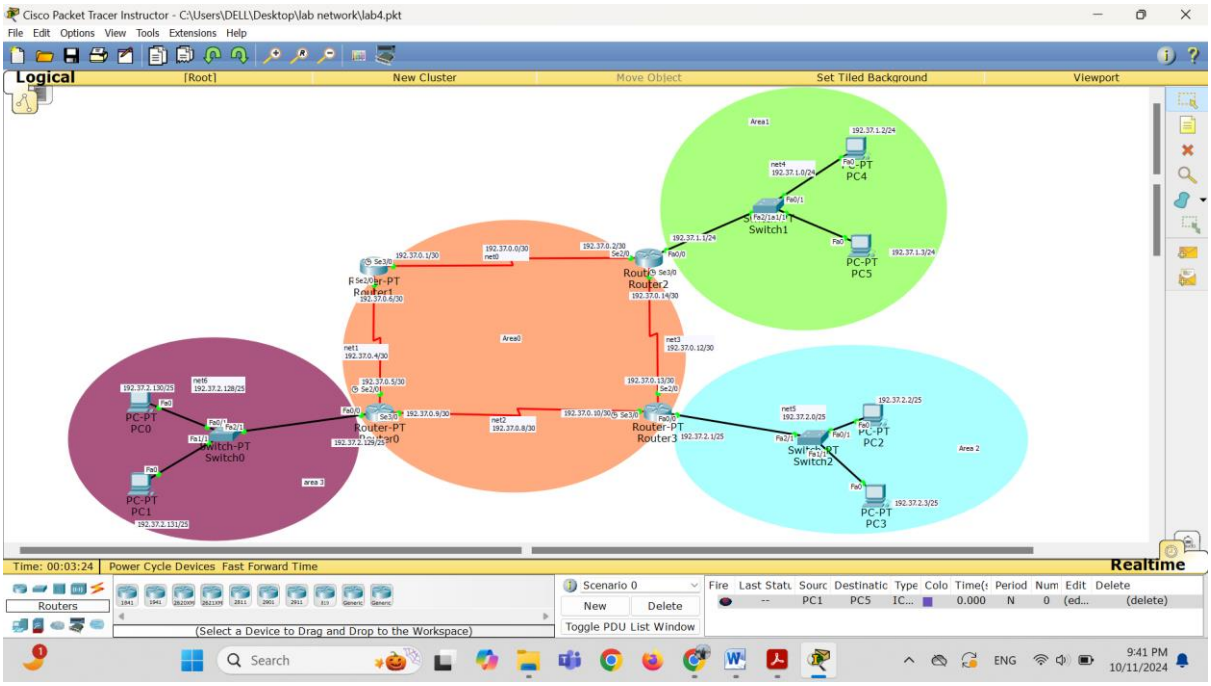

Figure 2- 1:Topology

For the topology in figure 2-1 , I used four routers from type Router-Pt , 3 switches from type Switch-Pt , 6 Pc from type PC-Pt and For the connections between the PCs, switches and routers use Automatically use connection type.

This is the IP address for the topology requirements:

Table 2-1:IP address in the topology

Area /Summarization	Network	Devices	Interface	IP	Subnet mask	Wildcard mask
Area 0	Network 0 192.37.0.0/30	Router1	Se 3/0	192.37.0.1/30	255.255.255.252	0.0.0.3
		Router2	Se 2/0	192.37.0.2/30	255.255.255.252	0.0.0.3
	Network 1 192.37.0.4/30	Router0	Se 2/0	192.37.0.5/30	255.255.255.252	0.0.0.3
		Router1	Se 2/0	192.37.0.6/30	255.255.255.252	0.0.0.3
	Network 2 192.37.0.8/30	Router0	Se 3/0	192.37.0.9/30	255.255.255.252	0.0.0.3
		Router3	Se 3/0	192.37.0.10/30	255.255.255.252	0.0.0.3
	Network 3 192.37.0.12/30	Router3	Se 2/0	192.37.0.13/30	255.255.255.252	0.0.0.3
		Router0	Se 2/0	192.37.0.14/30	255.255.255.25	0.0.0.3

					2	
Area 1	Network 4 192.37.1.0/24	Router0	Fa 0/0	192.37.1.1/24	255.255.255.0	0.0.0.255
		PC4	Fa 0	192.37.1.2/24	255.255.255.0	0.0.0.255
		PC5	Fa 0	192.37.1.3/24	255.255.255.0	0.0.0.255
Area 2	Network 5 192.37.2.0/25	Router2	Fa 0/0	192.37.2.1/25	255.255.255.128	0.0.0.127
		PC2	Fa 0	192.37.2.2/25	255.255.255.128	0.0.0.127
		PC3	Fa 0	192.37.2.3/25	255.255.255.128	0.0.0.127
Area 3	Network 6 192.37.2.128/25	Router0	Fa 0/0	192.37.2.129/25	255.255.255.128	0.0.0.127
		PC0	Fa 0	192.37.2.130/25	255.255.255.128	0.0.0.127
		PC1	Fa 0	192.37.2.131/25	255.255.255.128	0.0.0.127
Summarization 172.16.0.0/22	172.16.0.0/24	Router2	Loopback0	172.16.0.1/24	255.255.255.0	0.0.0.255
	172.16.1.0/24	Router2	Loopback1	172.16.1.1/24	255.255.255.0	0.0.0.255
	172.16.2.0/24	Router2	Loopback2	172.16.2.1/24	255.255.255.0	0.0.0.255
	172.16.3.0/24	Router2	Loopback3	172.16.3.1/24	255.255.255.0	0.0.0.255
Summarization 172.16.4.0/23	172.16.4.0/24	Router2	Loopback4	172.16.4.1/24	255.255.255.0	0.0.0.255
	172.16.5.0/24	Router2	Loopback5	172.16.5.1/24	255.255.255.0	0.0.0.255

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 (this step I made it in lab so this how I did it):

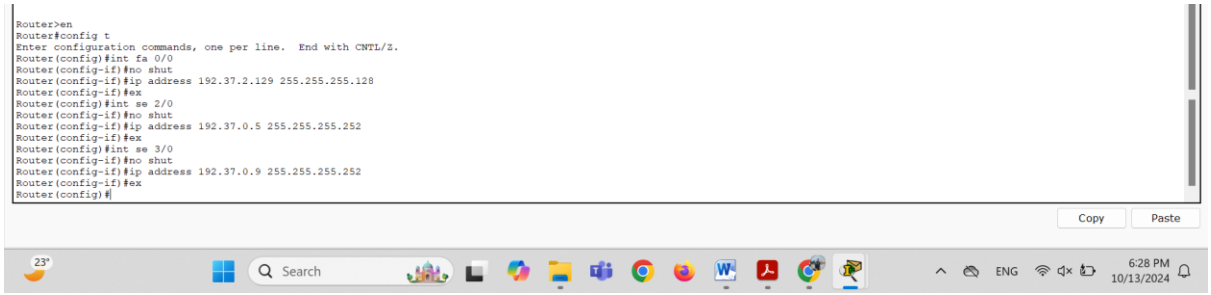

Figure 2- 2:Adding serial numbers and FastEthernet for router0

And this step done for each router with their correct IPs and subnetmasks

Then using command show running-config in privilege mode to show the interfaces connection for each router :

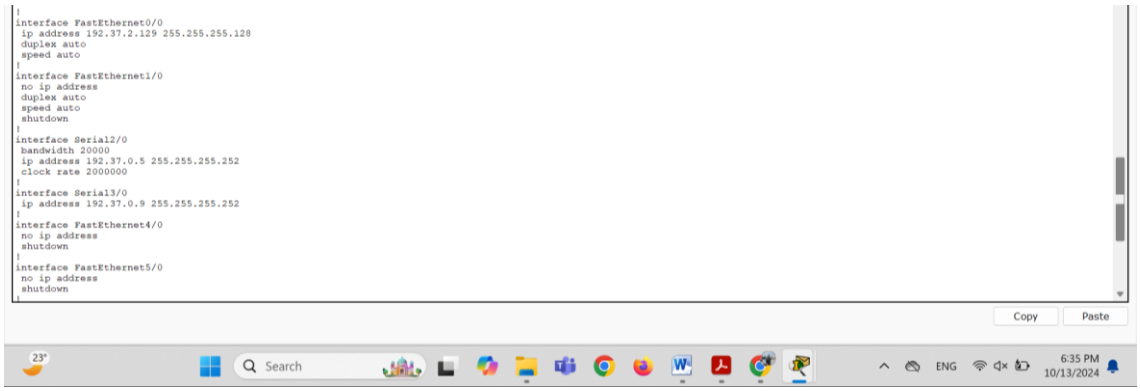

Figure 2- 3:Running configrution for router0

Figure 2- 4:Running configrution for router1

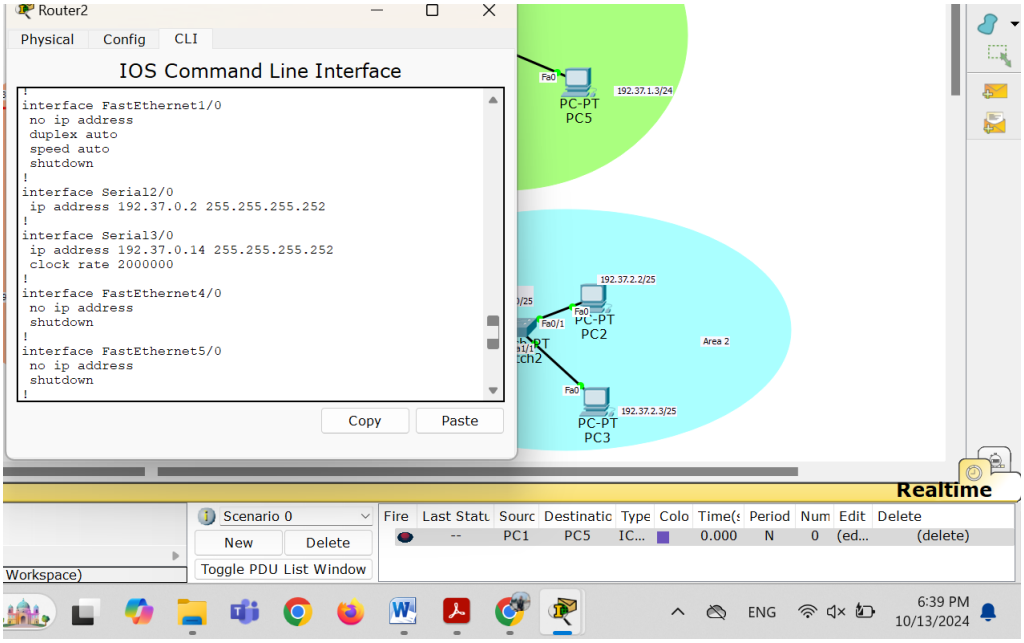

Figure 2- 5:Running configrution for router2

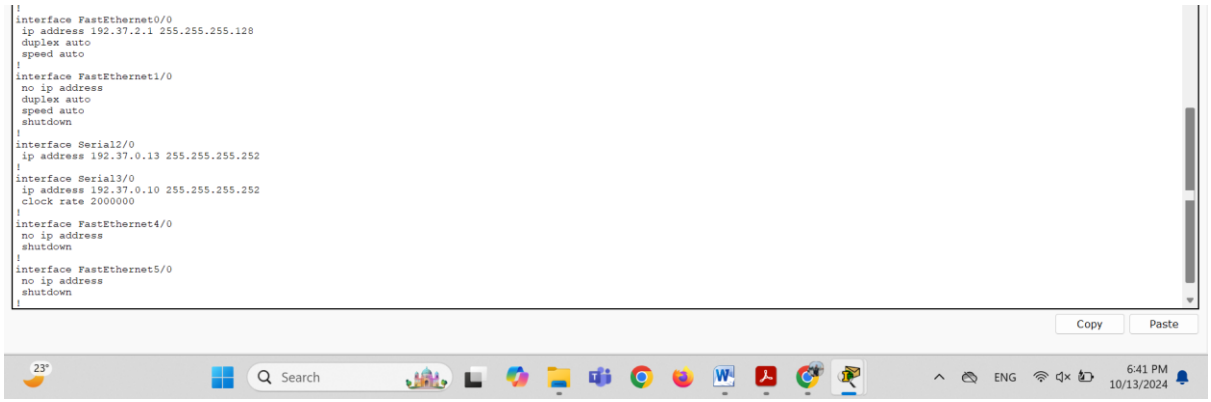

Figure 2- 6:Running configrution for router3

Then for PCs, the FastEathernet is done by the ip configuration from the desktop in the PC

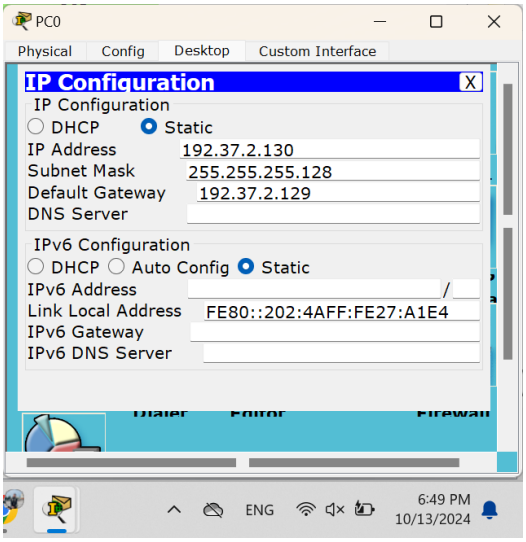

Figure 2- 7:IP Configruition for PC0

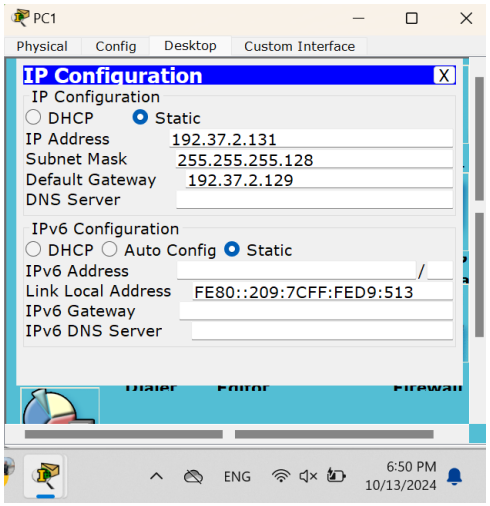

Figure 2- 8:IP Configuration for PC1

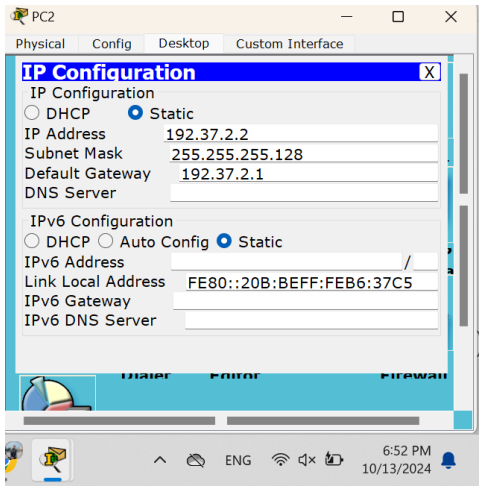

Figure 2- 9:IP Configuration for PC2

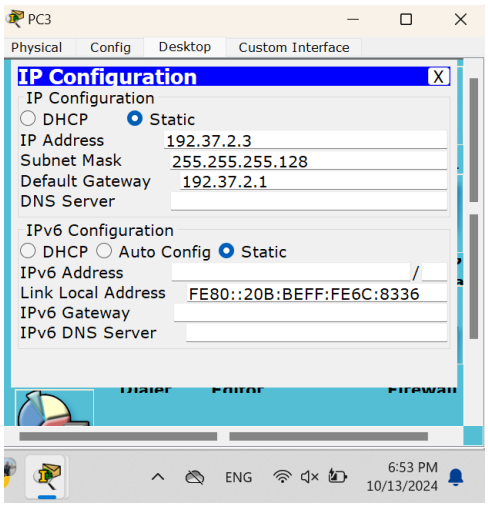

Figure 2- 10:IP Configuration for PC3

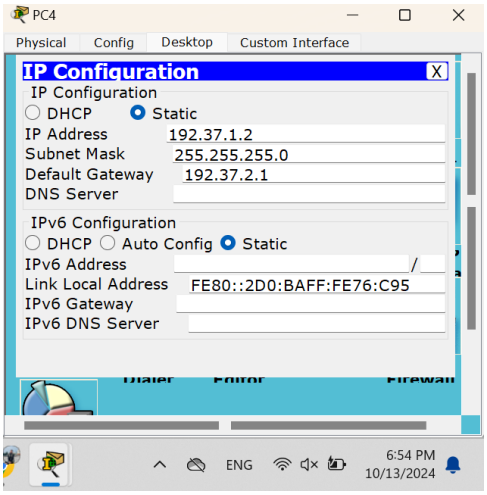

Figure 2- 11:IP Configuration for PC4

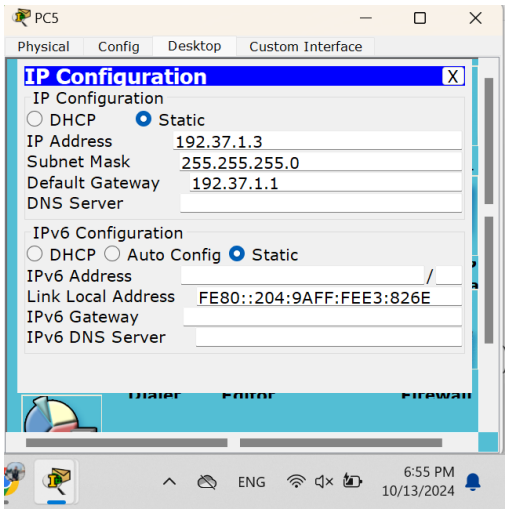

Figure 2- 12:IP Configuration for PC5

Then I configure the loopback IPs, but first need to create a loopback interface and then add the IP address to the loopback

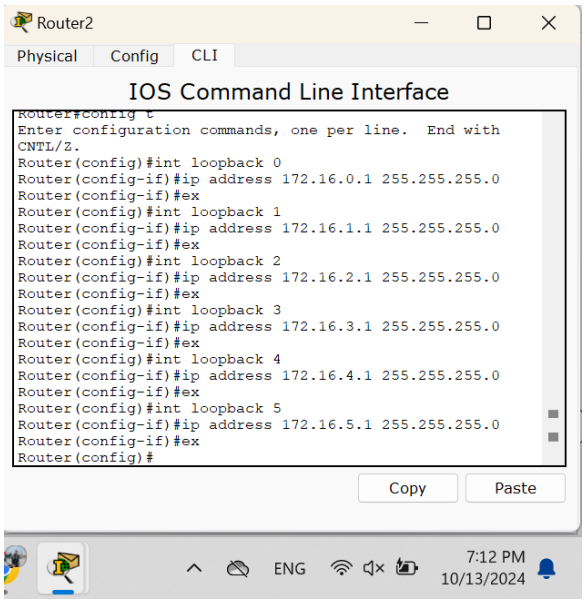

Figure 2- 13:configuration the loopback in router2

2.2 Configuring OSPF Routing

Once the topology is built, the network is ready for the implementation of any routing protocol. In this experiment, OSPF is the chosen routing protocol. It is applied by configuring the network IDs along with their wildcard masks.

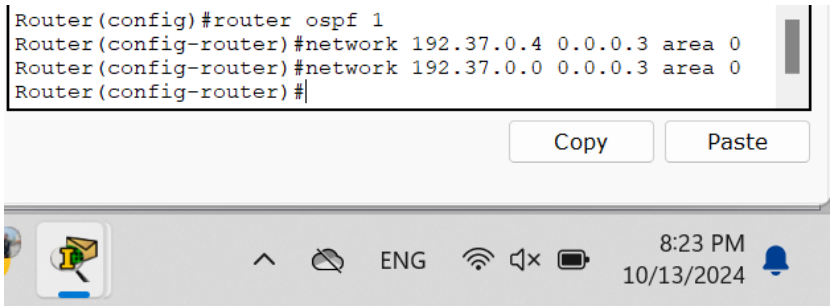

Figure 2- 14:OSPF configurating for router1

Figure 2-14 show the OSPF configuration for router1 , and I did that for all routers

Then use command show ip route in privilege mode to see the configuration of OSPF in each router.

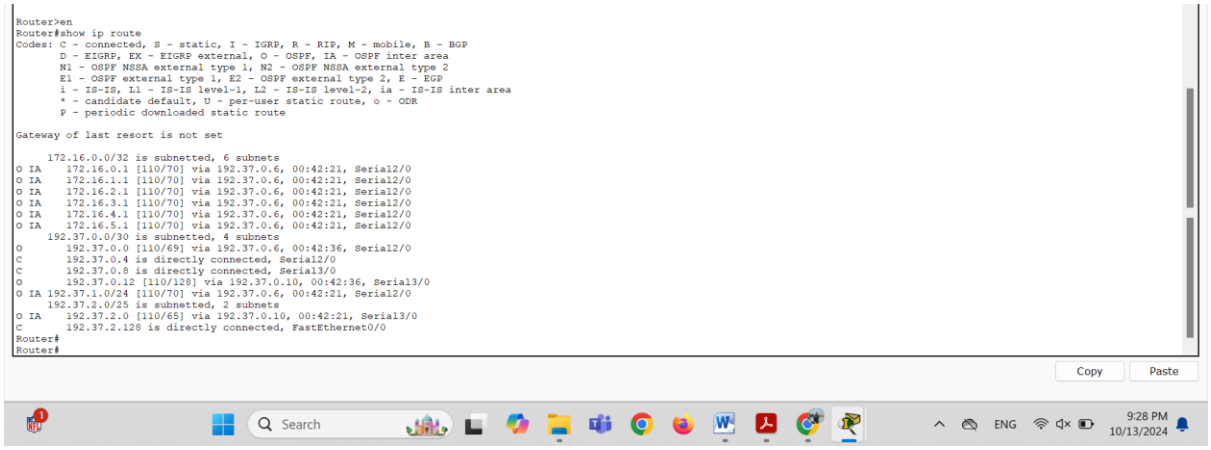

Figure 2- 15:Routing table for router0

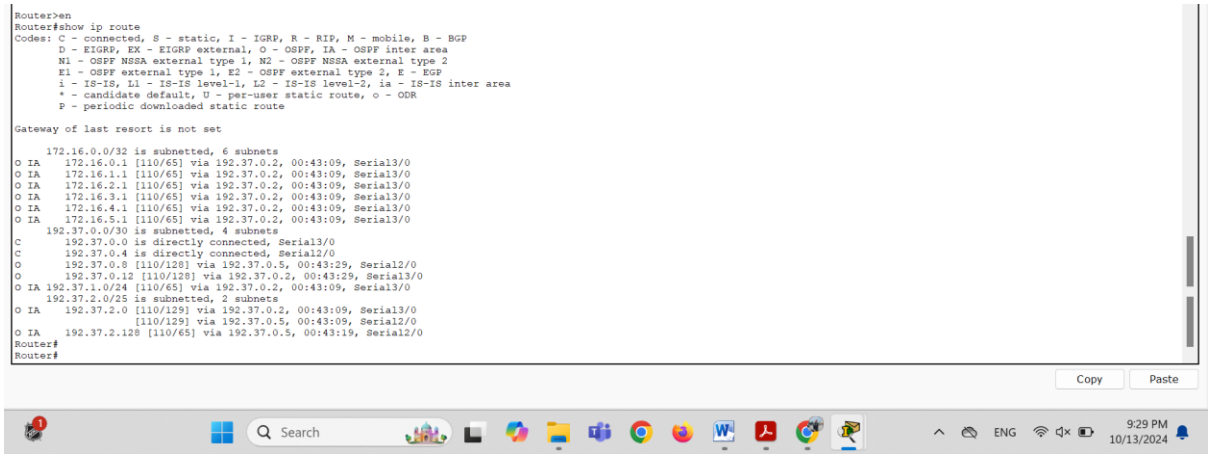

Figure 2- 16:Routing table for router1

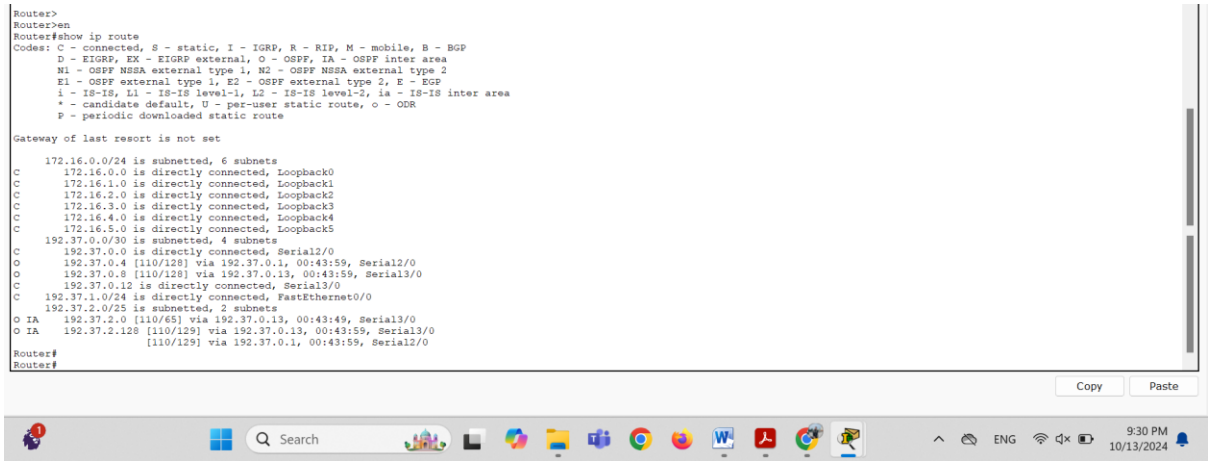

Figure 2- 17:Routing table for router2

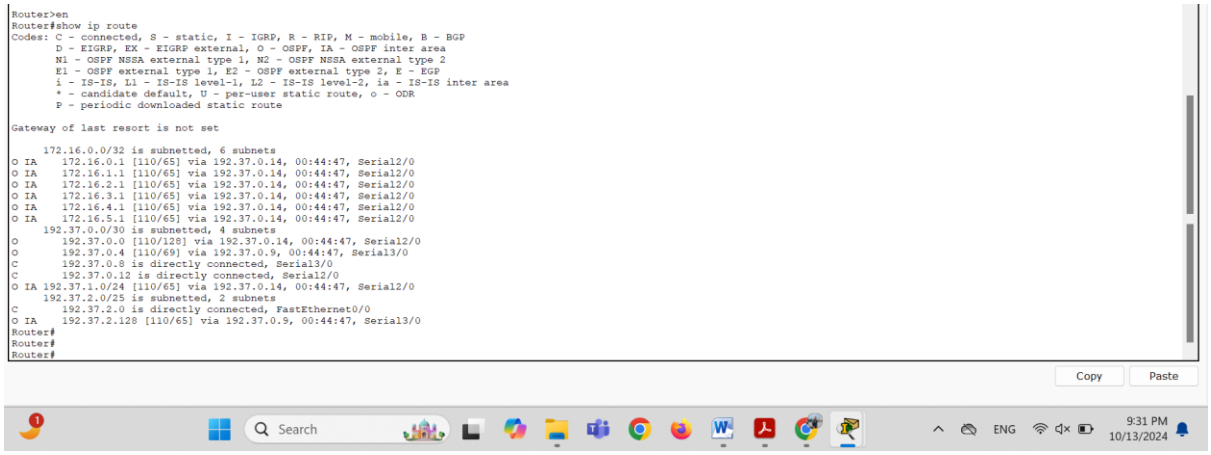

Figure 2- 18:Routing table for router3

2.3 Changing the Cost

This section requires modifying the cost between two routers by adjusting the bandwidth on the serial interface. To change the cost between Router 1 and Router 2:

$$\text{Cost} = \frac{refrance\ bandwidth}{interface\ bandwidth}$$

$$5 = \frac{100Mbps}{interface\ bandwidth} \rightarrow \text{interface bandwidth= 20Mbps}$$

If we make this its reduce the cost for going from PC0 to PC4 through Routers R0 →R1→R2.

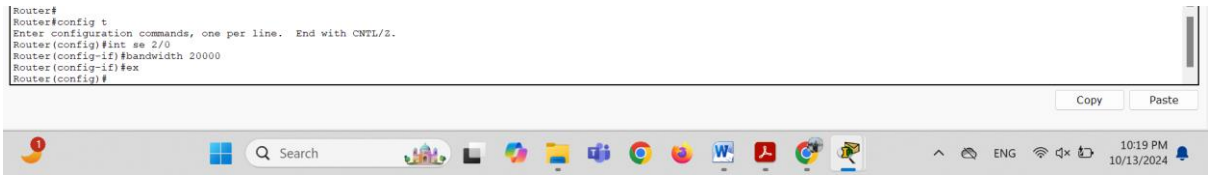

Figure 2- 19:Changing the cost

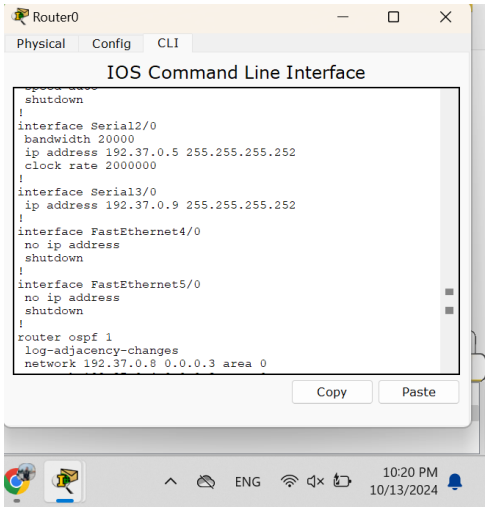

Figure 2- 20:show the change of bandwidth in se 2/0 router0

Figure 2-20 is done by command show running-config in privilege mode.

To verify that the cost change , we can use the command traceroute any Pc in area 1 in privilege mode:

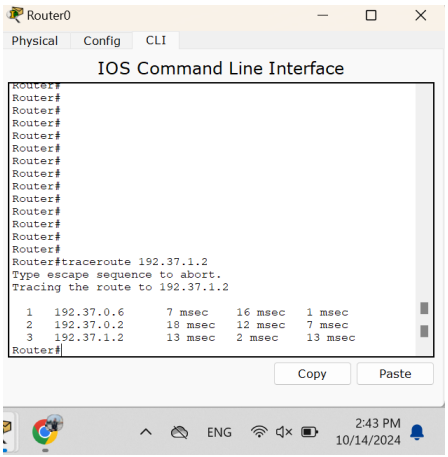

Figure 2- 21:The way from area 3 to area 1 by traceroute command

And also we can see the cost directly be using the command show ip ospf interface in privilege mode

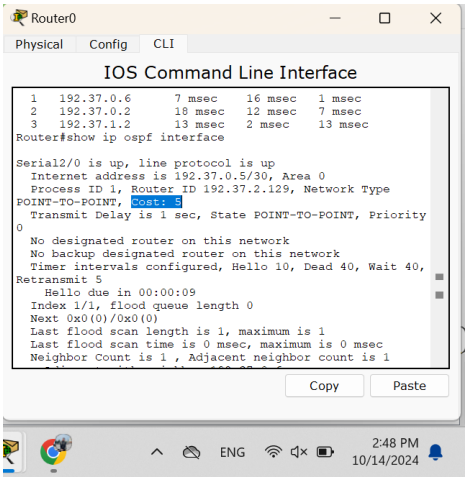

Figure 2- 22:The cost of se 2/0 router0

2.4 Summarization

To add the loopback networks to the OSPF on router 2 we can do it in several way

First one by one:

```
Router(config)#router ospf 1
Router(config-router)#network 172.16.0.0 0.0.0.255 area 1
Router(config-router)#network 172.16.1.0 0.0.0.255 area 1
Router(config-router)#network 172.16.2.0 0.0.0.255 area 1
Router(config-router)#network 172.16.3.0 0.0.0.255 area 1
Router(config-router)#network 172.16.4.0 0.0.0.255 area 1
Router(config-router)#network 172.16.5.0 0.0.0.255 area 1
```

Figure 2-23:add loopback networks to the OSPF One by One [9]

But we can combine the first networks with one large network that include them all which is 172.16.0.0/22

```
Router(config)#router ospf 1
Router(config-router)#network 172.16.0.0 0.0.3.255 area 1
Router(config-router)#network 172.16.4.0 0.0.0.255 area 1
Router(config-router)#network 172.16.5.0 0.0.0.255 area 1
```

Figure 2- 24:Add loopback networks to the OSPF by replace the first four betworks with one ID [9]

Also we can combined the last two networks to 172.16.4.0/23 :

```
Router(config)#router ospf 1
Router(config-router)#network 172.16.0.0 0.0.3.255 area 1
Router(config-router)#network 172.16.4.0 0.0.1.255 area 1
```

Figure 2- 25:Summrization for all loopbacks

And any one of them is correct but the last one is very useful to reduce the CPU execution and not dealing with 6 networks but with only two.

And we can verify the OSPF for loopback by ping it from any PC in different area like this:

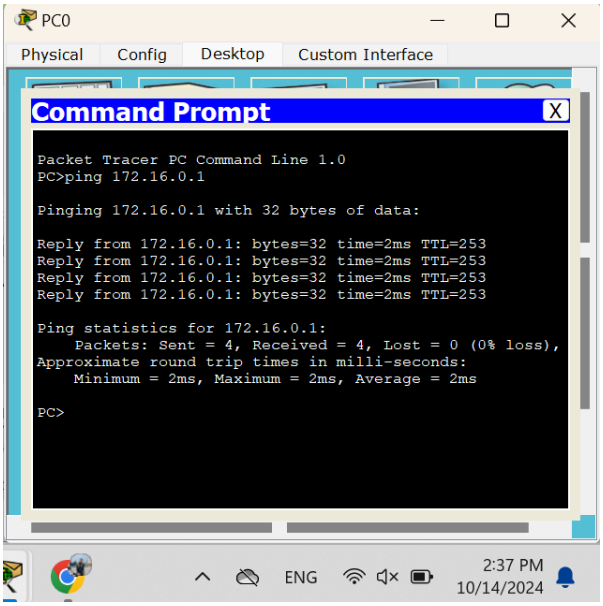

Figure 2- 26:Ping the loopback from PC0

2.5 important Questions

2.5.1 First Question

Why do we need for loopback interfaces?

In any network configuration, loopback interfaces play an important role in the identification and testing of devices as well as in internal communications. They allow for a constant IP address for specific devices like routers regardless of the operational state of the physical interfaces which is very important for routing protocols such OSPF and BGP. Also, loopback interfaces have an application in the testing of networks, for instance, allowing services running on the computer to be tested locally (e.g. `ping 127.0.0.1`) and allowing a web server or database service to connect locally without risk of connecting to the public network. They remain available and work where virtual networks are provided even if the actual physical hardware is non-existent or has broken down which makes them important even in service restoration [8] .

2.5.2 Second Question

What is the router-id for OSPF? And why do we need it?

In OSPF, each router is assigned a unique Router ID (RID) to distinguish itself within the network. This RID must be unique across the OSPF domain, as duplicate RIDs can lead to network reachability issues. If two routers share the same RID, they will not establish a neighbor relationship. However, duplicated RIDs may still exist between routers that are not directly connected. OSPF selects the RID using a specific order of criteria: first, a manually configured RID is used if set. If not, the highest IP address on any loopback interface is chosen. In the absence of a loopback interface, OSPF uses the highest IP address from a non-loopback interface [7].

2.5.3 Third Question

Hardcode the router-id for R1, R2, and R3 as 1.1.1.1, 2.2.2.2, and 3.3.3.3 respectively. And Verify that.

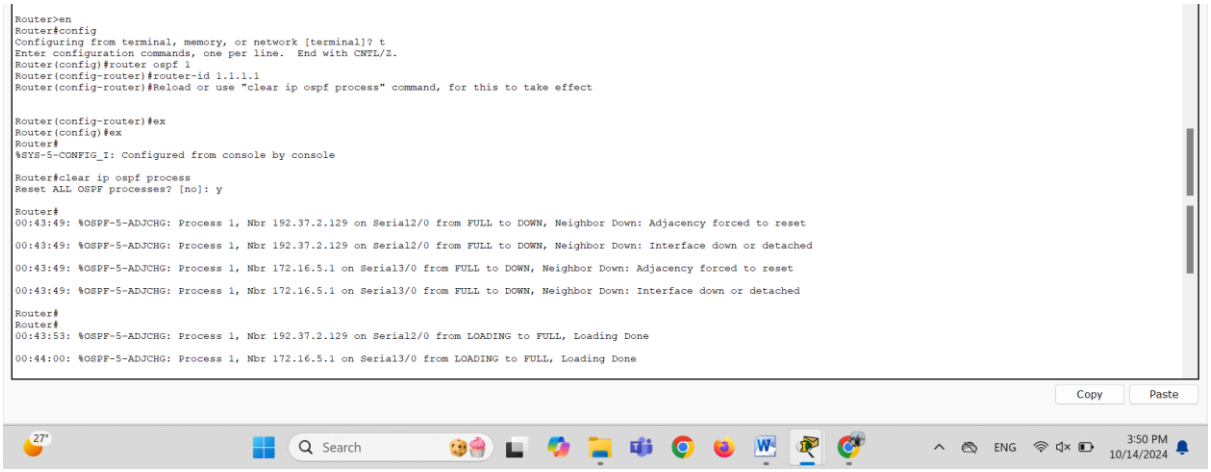

Figure 2- 27:Set router-id for router1

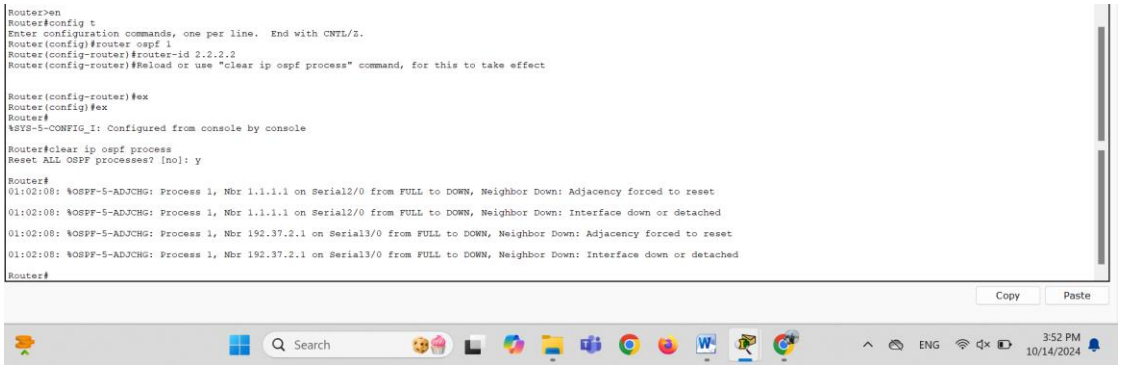

Figure 2- 28:Set router-id for router2

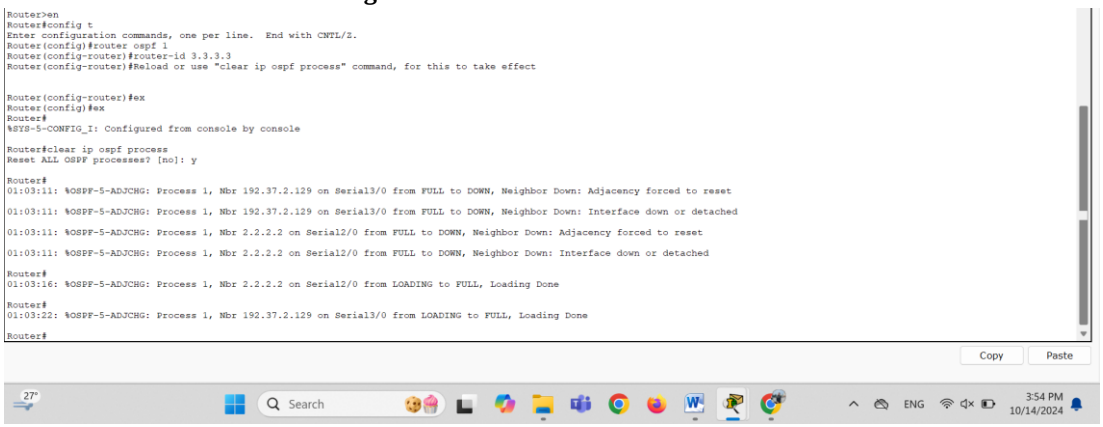

Figure 2- 29:Set router-id for router2

Then use the command show ip protocols in privilege mode to see the router-id for each router:

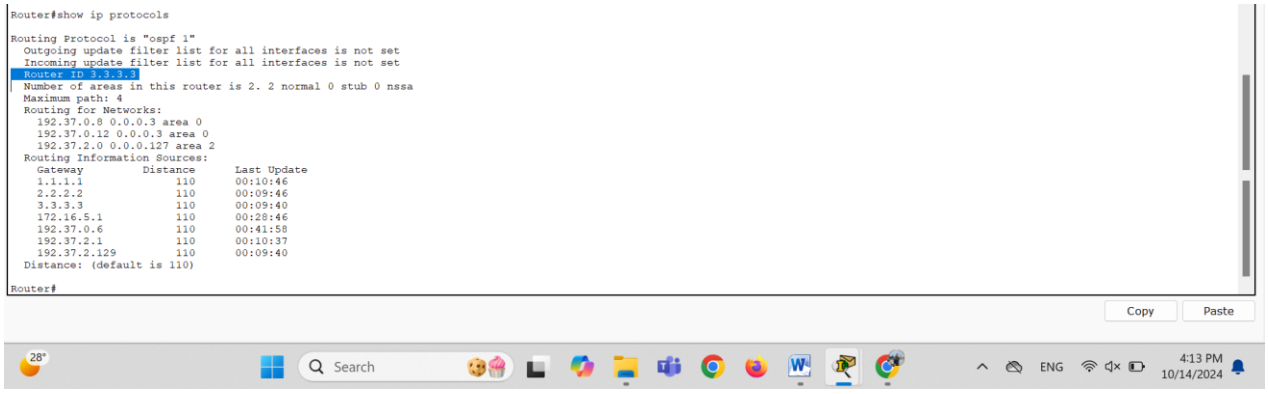

Figure 2- 30:router-id for router 3

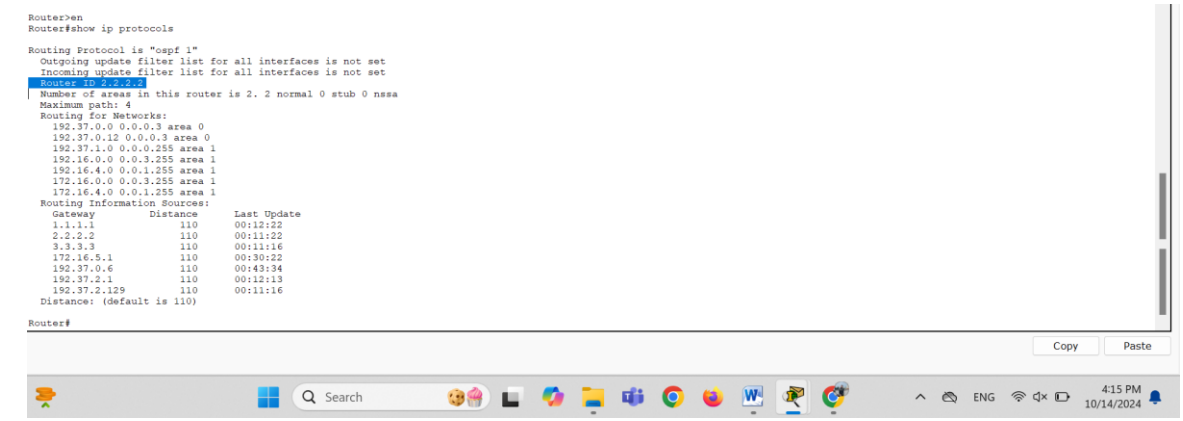

Figure 2- 31:router-id for router 2

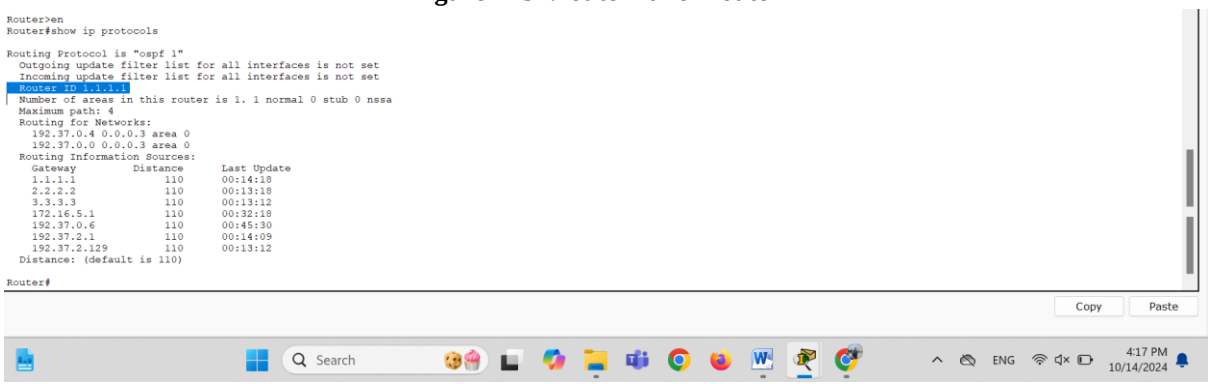

Figure 2- 32:router-id for router 1

3. Results

The results for each section mentioned earlier are placed next to their corresponding descriptions. This section includes the routing table for each router and PC, along with the testing results using the "Ping" command.

3.1 Routing Tables

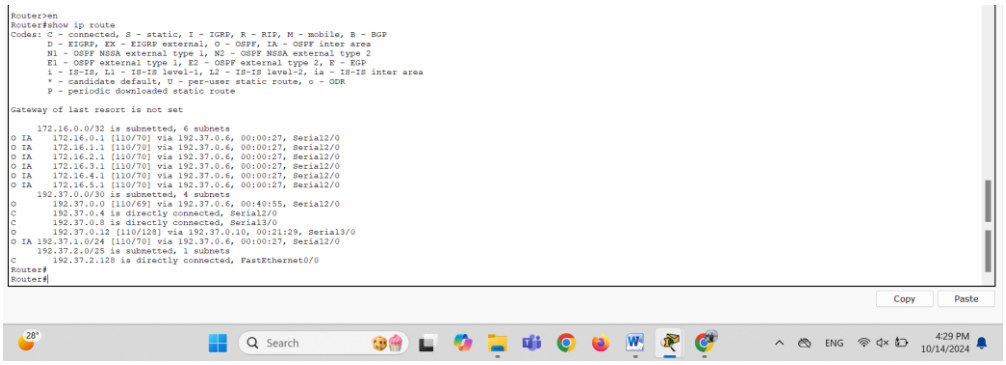

Figure 3- 1:routing table for R0

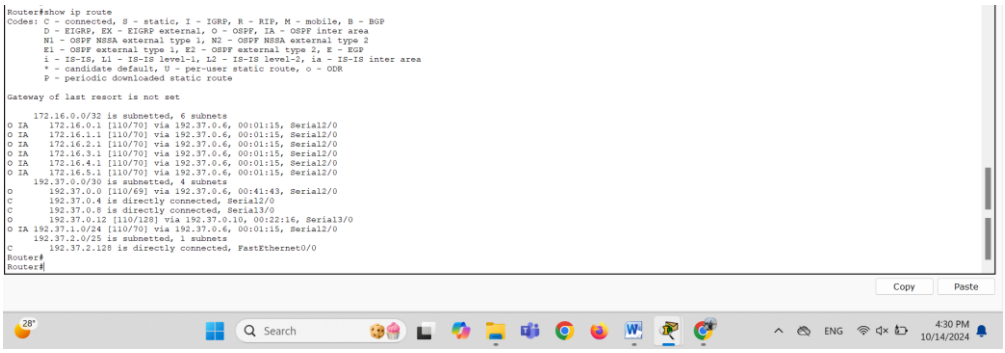

Figure 3- 2:routing table for R1

Figure 3- 3:routing table for R2

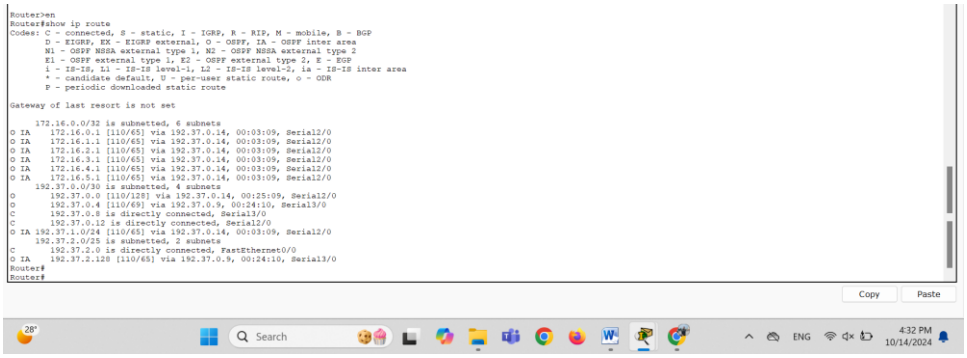

Figure 3- 4:routing table for R3

3.2 PC Testing:

This section is to test sending packet between the areas in the topology:

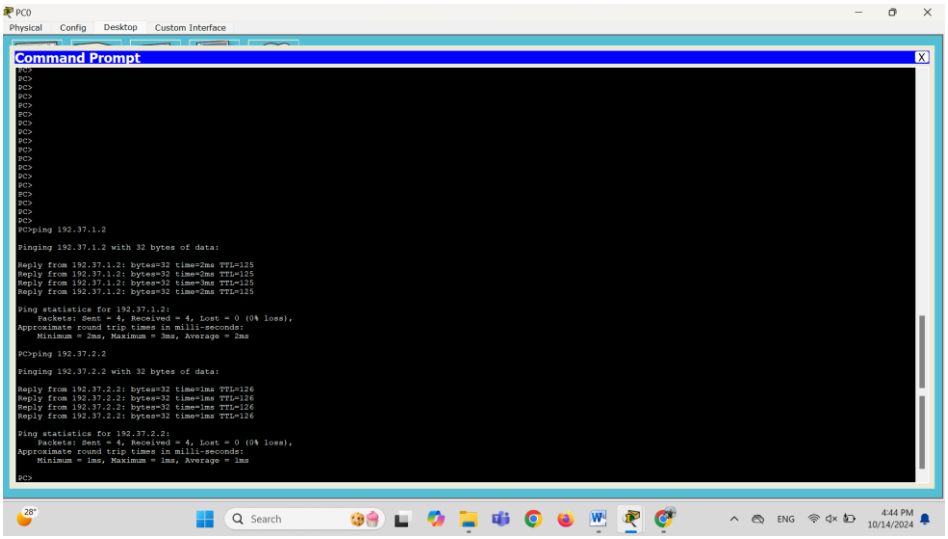

Figure 3-5:Ping from PC0 to PC4 and PC2

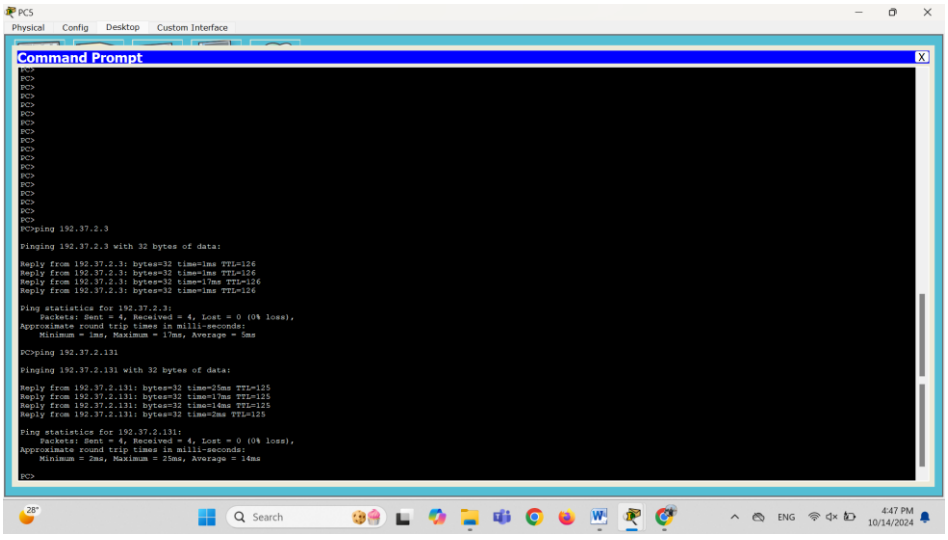

Figure 3- 6:Ping from PC5 to PC3 and PC1

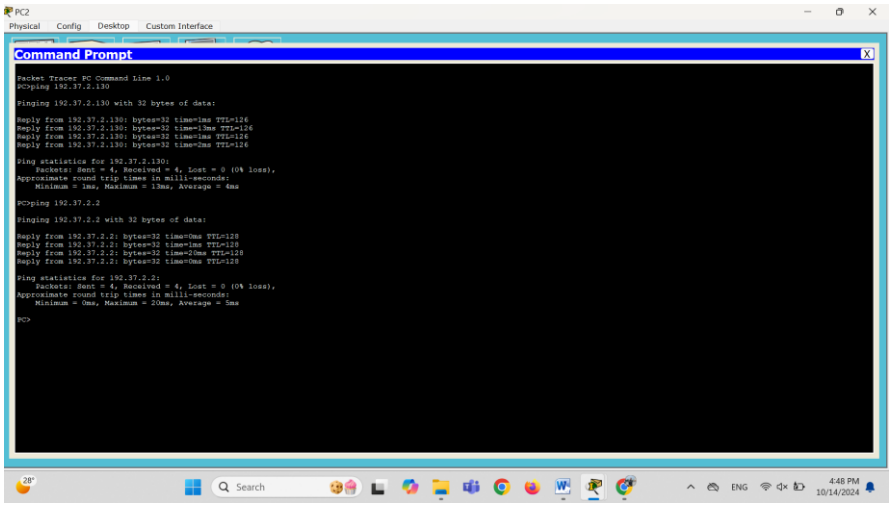

Figure 3- 7:Ping from PC2 to PC0 and PC2

3.3 loopback Testing:

To verify that OSPF for loopbacks set correctly we can ping it from any PC in different areas:

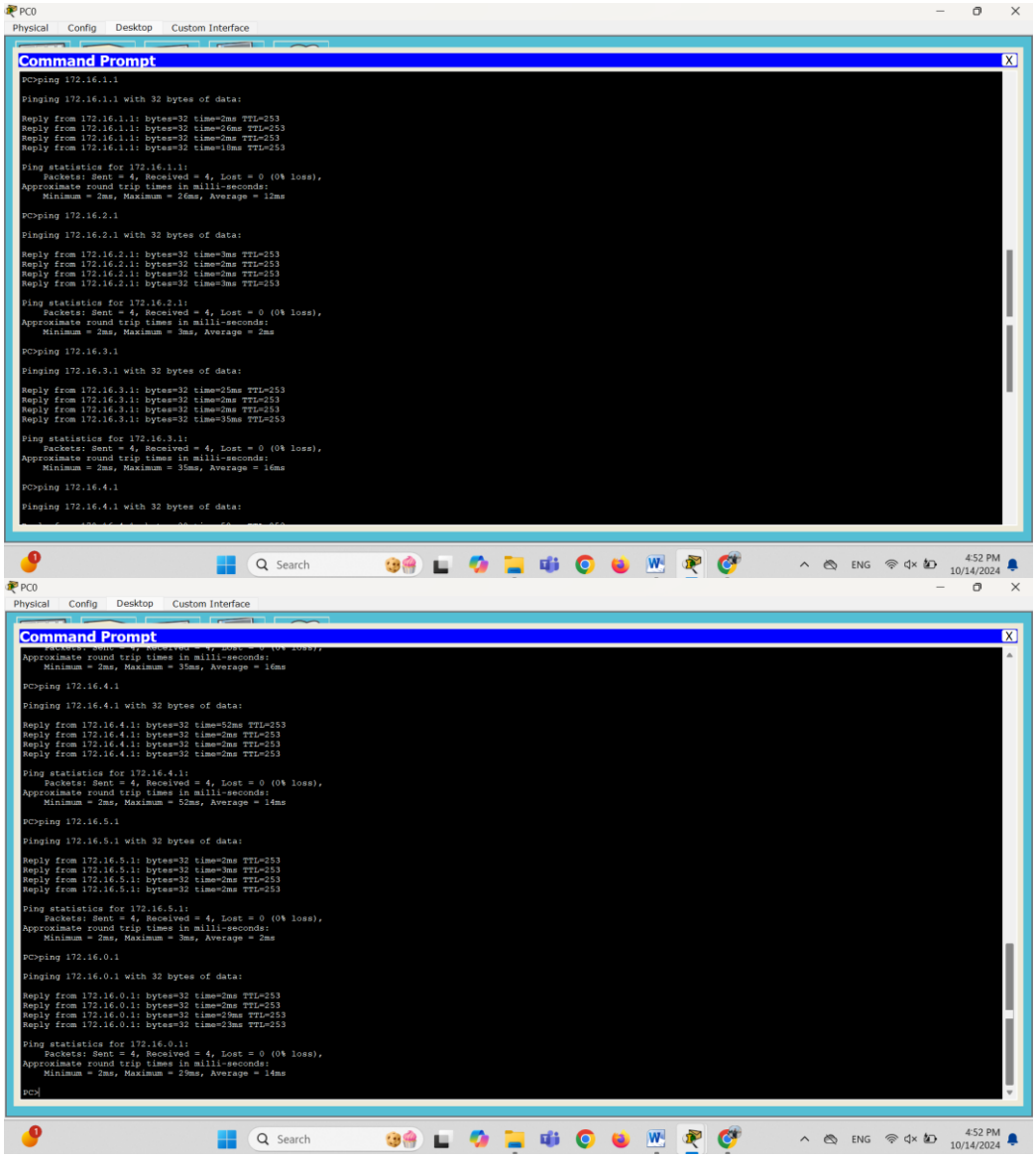

Figure 3- 8:Ping from PC0 to all loopbacks

3.3 Cost and road (from area3 to area1)Testing:

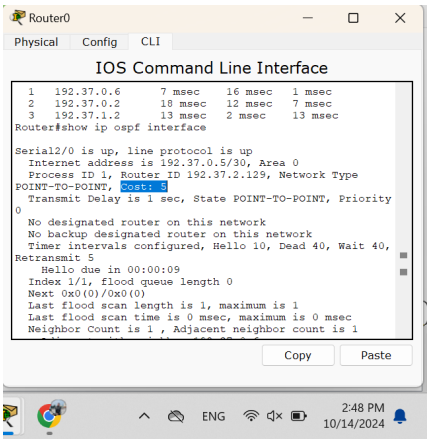

Figure 3- 9:The cost of se 2/0 in router0 after change the bandwidth

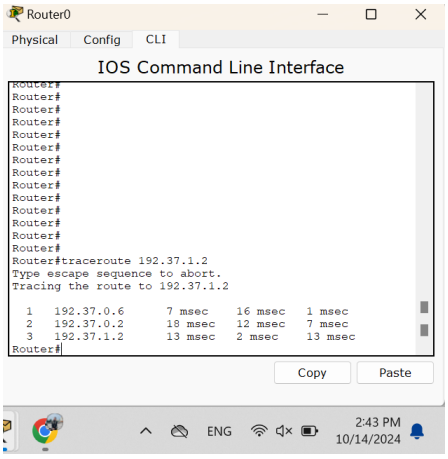

Figure 3- 10:The road from area3 to area1

4. Problem

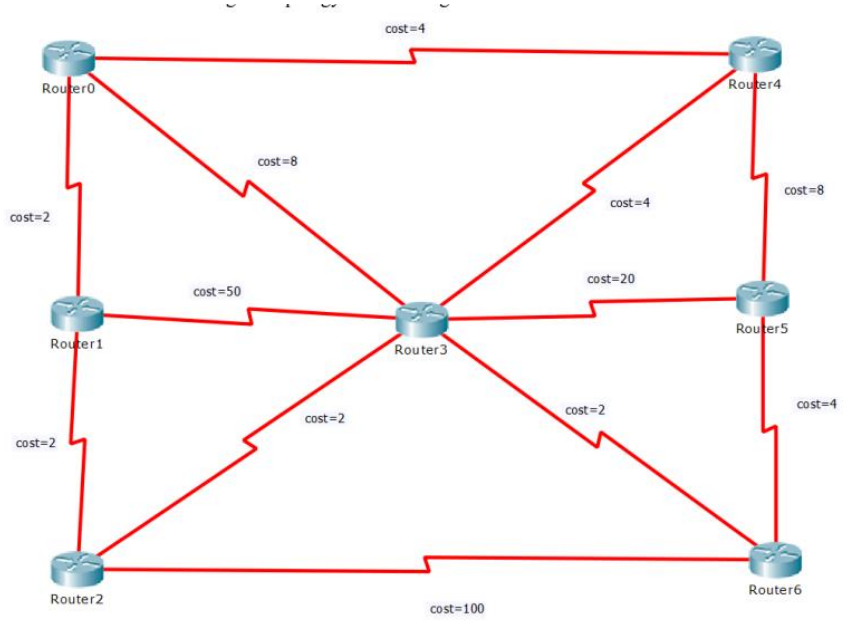

Figure 4-1:Problem Topology

4.1 Part One

4.1.1 Question:

1. find the shortest path from router 0 to router 6 using Dijkstra's algorithm
2. what is the cost of the shortest path from router 0 to router 6?

4.1.2 Solution:

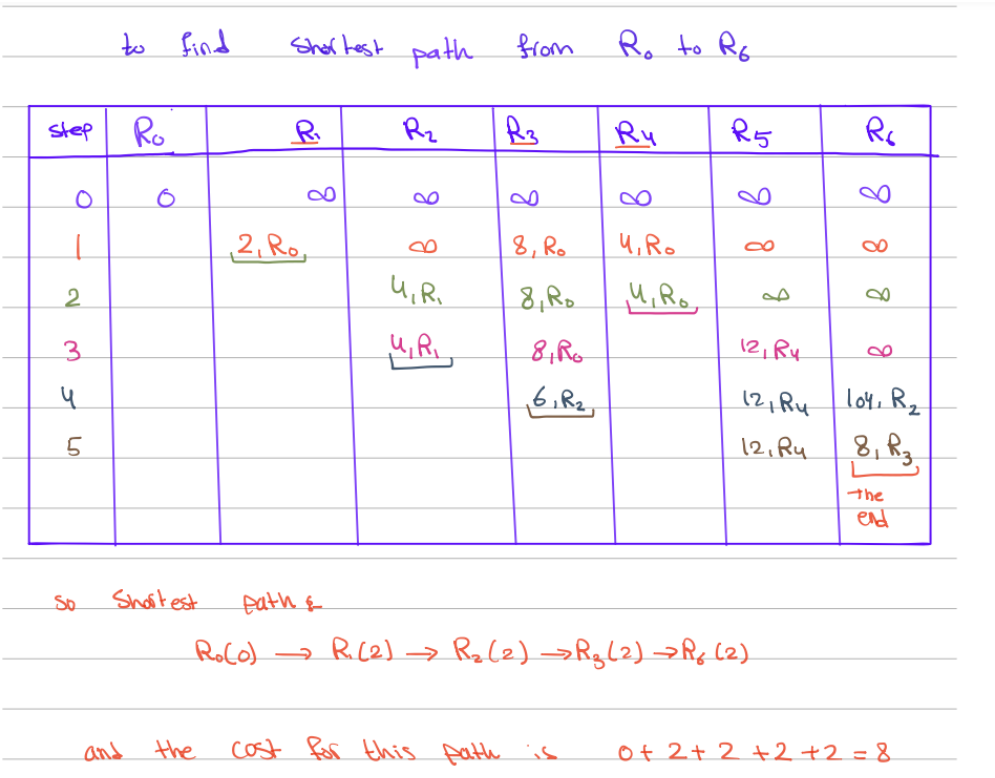

Figure 4-2:Part one solution (by hand)

4.2 Part Two

Build and configure the above topology using Packet Tracer software based on the following requirements.

4.2.1 requirement 1:

For addressing the above network use the class C address 192.A.B.0 and use it to create networks (subnets) of 2 hosts each. A, and B represent the last four digits of your university ID. For example: if your university ID 1140302 then (A = 03 = 3) and (B = 02 = 2)

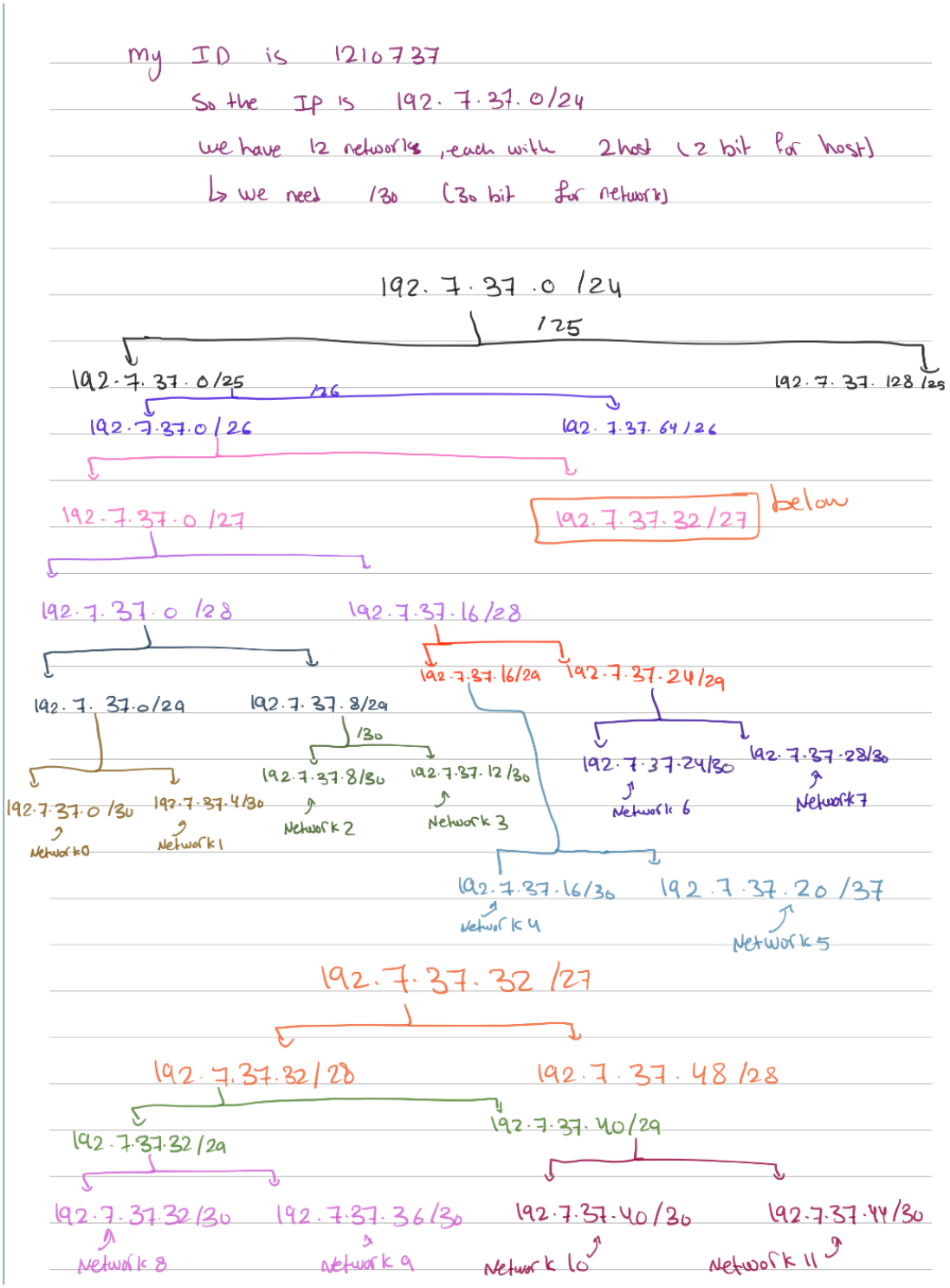

Table 4-1:Networks IPs

Network	Device	Interface	IP	Subnet mask	Wildcard mask
Network 0 192.7.37.0/30	Router 2	Se 2/0	192.7.37.1/30	255.255.255.252	0.0.0.3
	Router 1	Se 3/0	192.7.37.2/30	255.255.255.252	0.0.0.3
Network 1 192.7.37.4/30	Router 1	Se 2/0	192.7.37.5/30	255.255.255.252	0.0.0.3
	Router 0	Se 2/0	192.7.37.6/30	255.255.255.252	0.0.0.3
Network 2 192.7.37.8/30	Router 0	Se 3/0	192.7.37.9/30	255.255.255.252	0.0.0.3
	Router 4	Se 2/0	192.7.37.10/30	255.255.255.252	0.0.0.3
Network 3 192.7.37.12/30	Router 4	Fa 0/0	192.7.37.14/30	255.255.255.252	0.0.0.3
	Router 5	Fa 1/0	192.7.37.13/30	255.255.255.252	0.0.0.3
Network 4 192.7.37.16/30	Router 5	Se 2/0	192.7.37.18/30	255.255.255.252	0.0.0.3
	Router 6	Se 2/0	192.7.37.17/30	255.255.255.252	0.0.0.3
Network 5 192.7.37.20/30	Router 6	Fa 0/0	192.7.37.22/30	255.255.255.252	0.0.0.3
	Router 2	Fa 0/0	192.7.37.21/30	255.255.255.252	0.0.0.3
Network 6 192.7.37.24/30	Router 2	Se 3/0	192.7.37.25/30	255.255.255.252	0.0.0.3
	Router 3	Se 2/0	192.7.37.26/30	255.255.255.252	0.0.0.3
Network 7 192.7.37.28/30	Router 1	Fa 4/0	192.7.37.29/30	255.255.255.252	0.0.0.3
	Router 3	Fa 4/0	192.7.37.30/30	255.255.255.252	0.0.0.3
Network 8 192.7.37.32/30	Router 3	Fa 1/0	192.7.37.33/30	255.255.255.252	0.0.0.3
	Router 0	Fa 0/0	192.7.37.34/30	255.255.255.252	0.0.0.3
Network 9 192.7.37.36/30	Router 3	Se 3/0	192.7.37.37/30	255.255.255.252	0.0.0.3
	Router 4	Se 3/0	192.7.37.38/30	255.255.255.252	0.0.0.3
Network 10 192.7.37.40/30	Router 3	Fa 0/0	192.7.37.41/30	255.255.255.252	0.0.0.3
	Router 5	Fa 0/0	192.7.37.42/30	255.255.255.252	0.0.0.3
Network 11 192.7.37.44/30	Router 6	Fa 4/0	192.7.37.45/30	255.255.255.252	0.0.0.3
	Router 3	Fa 5/0	192.7.37.46/30	255.255.255.252	0.0.0.3

And below example of how to set the IPs for interfaces

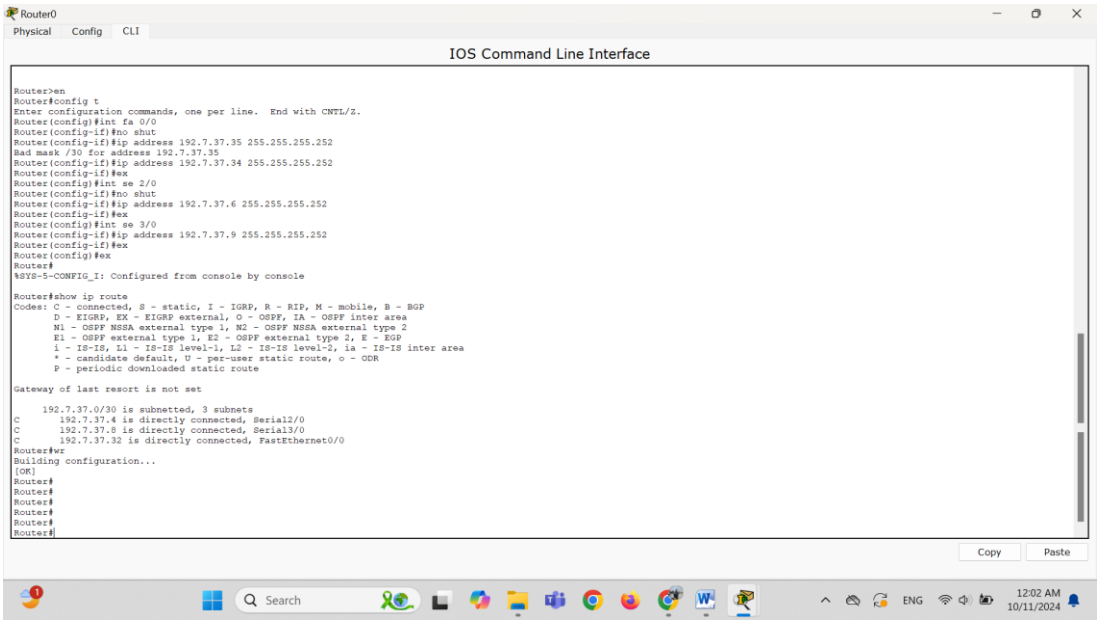

Figure 4-3:Setteing IPs for interfaces in router0

4.2.2 requirement 2:

Enable OSPF routing. Assume all routers are in area 0 (backbone)

The figure below show how to do it for router 6 , and the same step with different IPs done for all routers

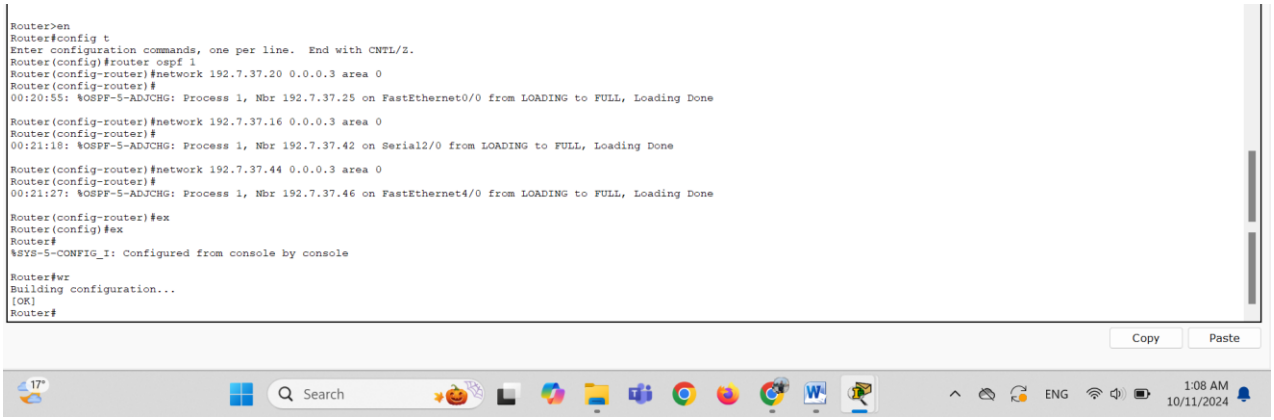

Figure 4-4:Enable OSPF for router6

4.2.3 requirement 3:

Configure Router 6 with a loopback IP address 7.7.7.7/24. Advertise this network into OSPF process.

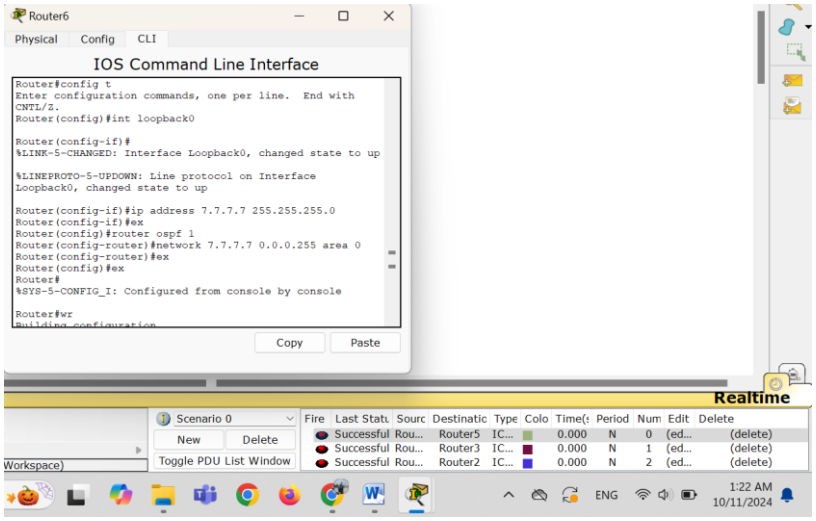

Figure 4-5:add the loopback0 7.7.7.7/24 to router6 and enable OSPF for it

Figure 4- 6:Routing table after OSPF for router0

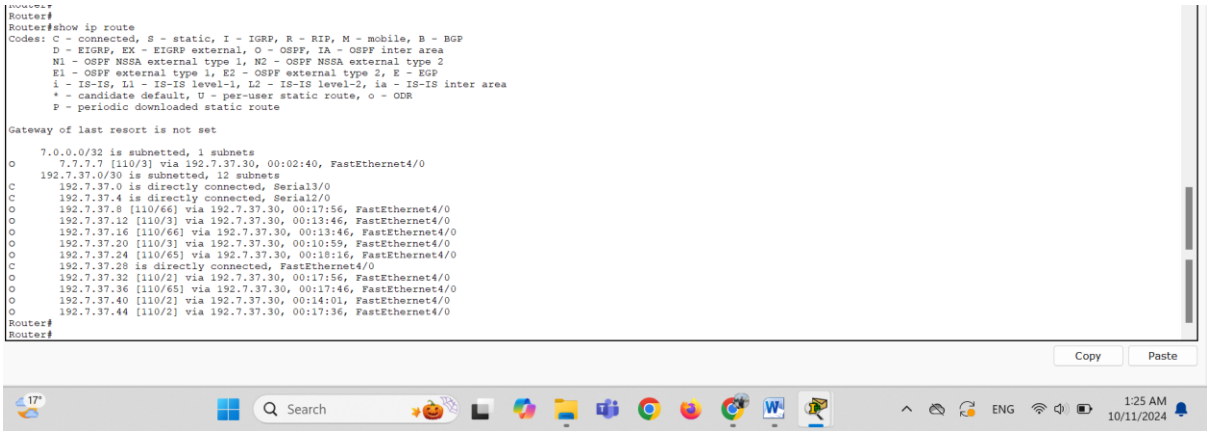

Figure 4- 7:Routing table after OSPF for router1

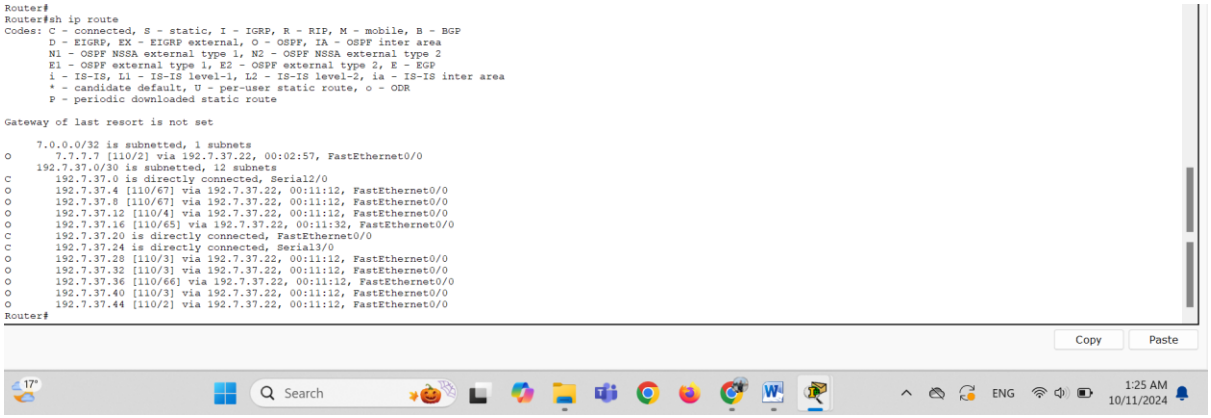

Figure 4- 8:Routing table after OSPF for router2

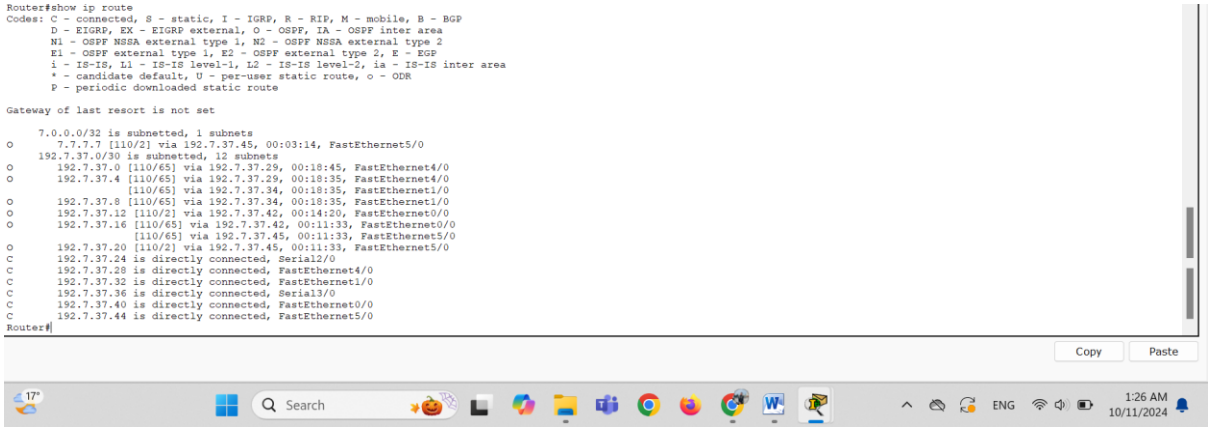

Figure 4- 9:Routing table after OSPF for router3

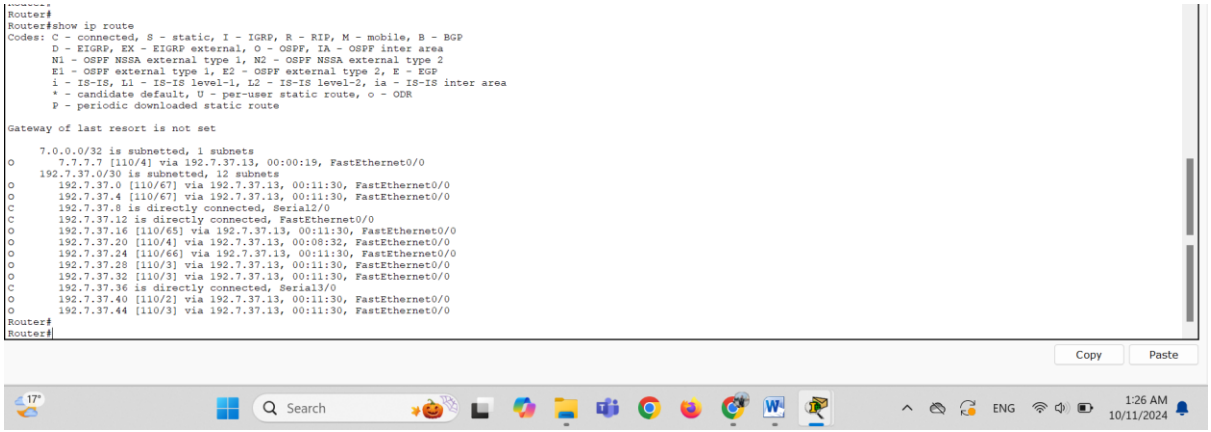

Figure 4- 10:Routing table after OSPF for router4

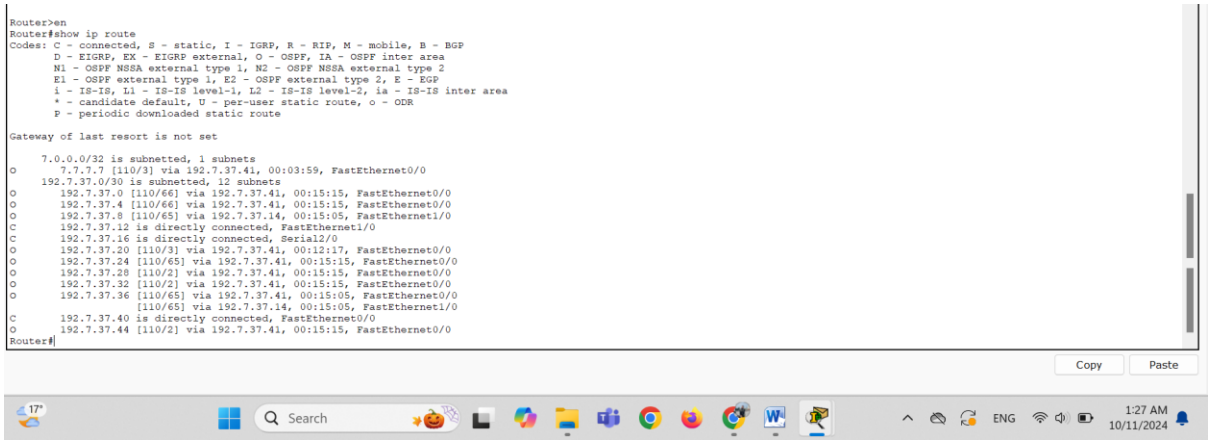

Figure 4- 11:Routing table after OSPF for router5

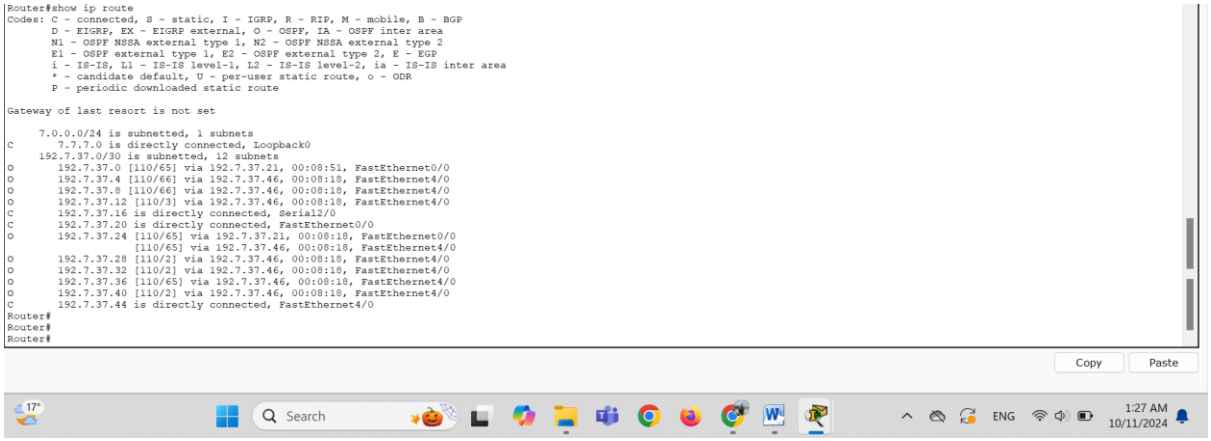

Figure 4- 12:Routing table after OSPF for router6

4.2.4 requirement 4:

Don't forget to configure bandwidth values between links. These values should reflect the costs that are shown in the network diagram

To find interface bandwidth we should use this row → cost $= \frac{refrence\ bandwidth = 100Mbps}{interface\ bandwidth}$

Table 4-2:Cost and Bandwidth

Cost	Bandwidth
2	50000 MBPS
4	25000 MBPS
8	12500 MBPS
20	5000 MBPS
50	2000 MBPS
100	1000 MBPS

And the figure below show how to do it for router0 , in same step but with different bandwidth are done for all routers:

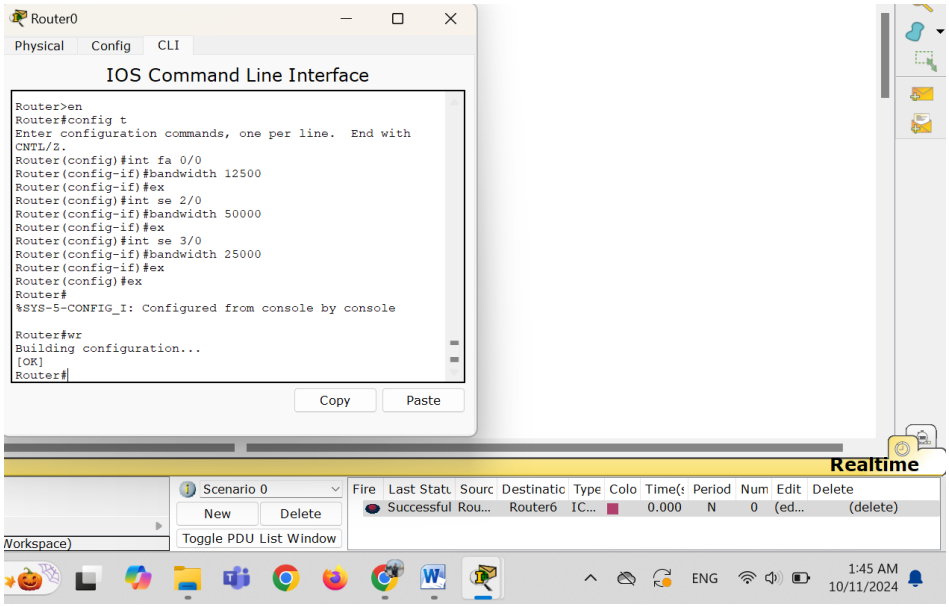

Figure 4-13:set Bandwidth for interfaces in router0

4.2.5 requirement 5:

If a packet is sent from Router 0 to Router 7 (i.e. loopback 7.7.7.7). What routers it passes through until it reaches its destination? Use the traceroute command to test that.

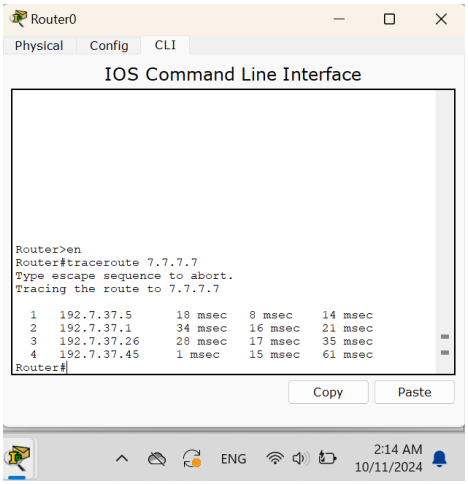

Figure 4-14:traceroute (send packet from router0 to router 6)

The path is exactly the one that I found in part 1 which is :
R0→R1→R2→R3→R6

4.2.6 requirement 6:

Run the show IP route command on Router 0. From the output result. What is the cost (metric) to get from Router 0 to Router 6? Explain that.

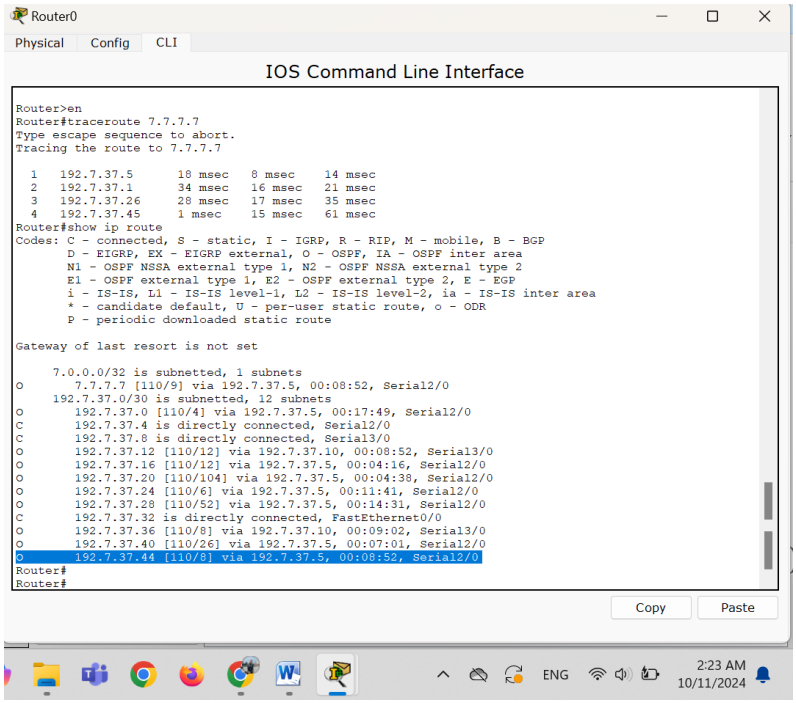

Figure 4- 15:the cost (metric) to get from router0 to router6 from rouuting table for router0

The cost (metric) in OSPF is B in [A/B]

The cost to get from router0 to router6 is 8 which found from 192.7.37.44 [110/8] where 110 is AD for OSPF and 8 is the cost which equal to the one that I found in part1.

4.2.7 requirement 7:

What is the router-id for Router 0, and Router 6? Verify your answers

To find the router-id we use command show ip protocols in privilege mode.

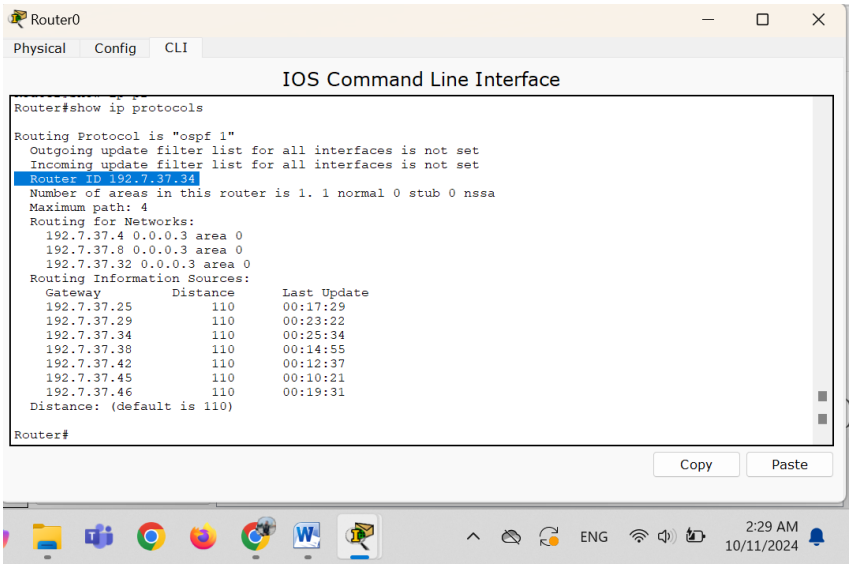

Figure 4- 16:Find router-id for router0

Router-id for router0 → 192.7.37.34 which is the highest IP for the physical interface in router0

-for Router6 which it have loopback so the router-id must be the highest IP in loopbacks

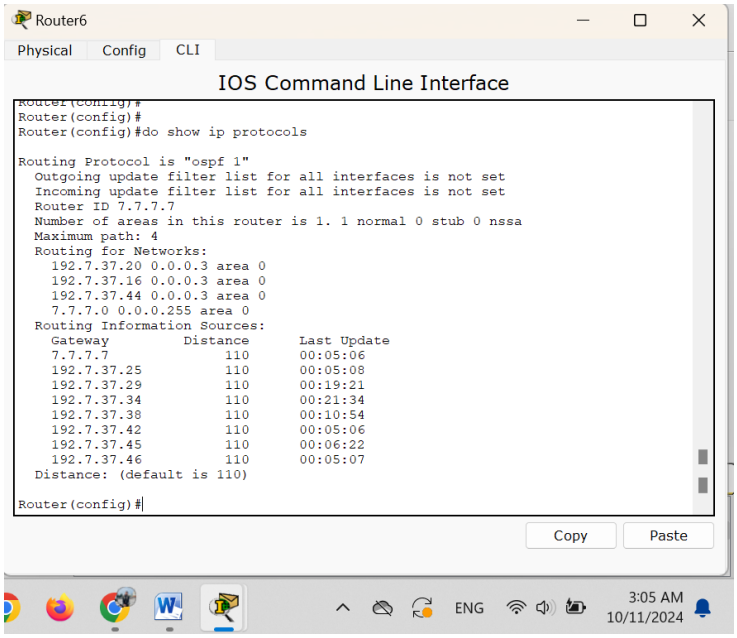

Figure 4- 17:Find router-id for router6

Router-id for router6 → 7.7.7.7

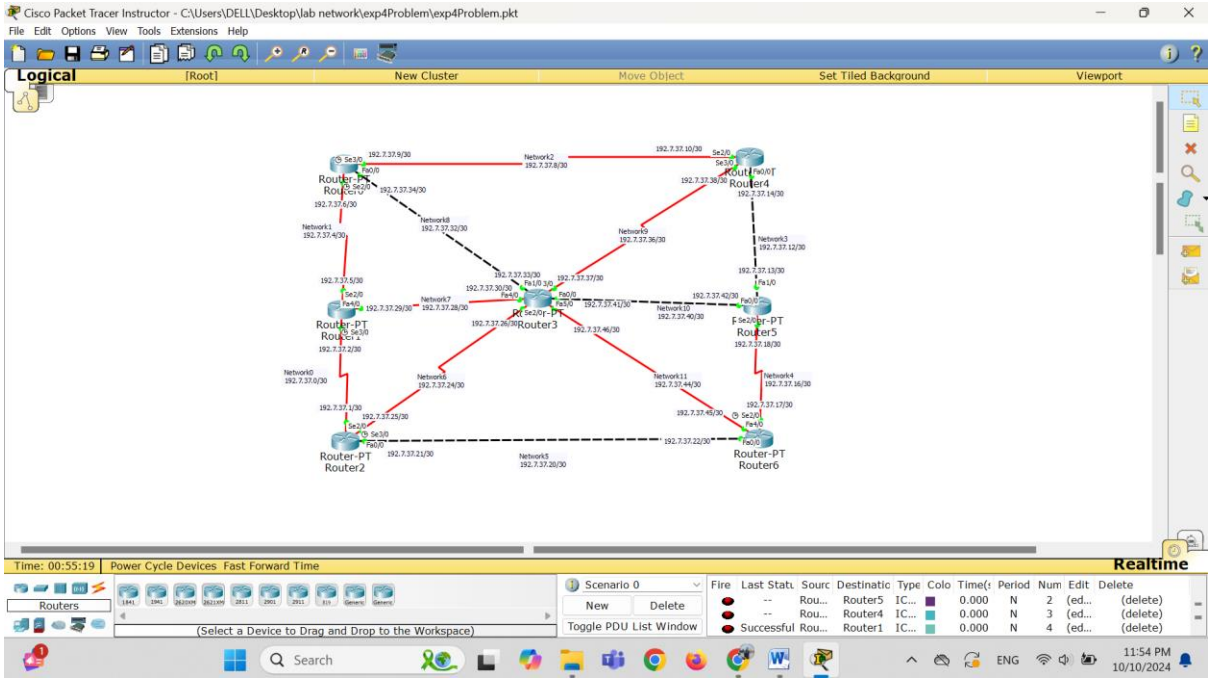

Figure 4- 18:Final topology

5. Conclusion

In this experiment, I successfully built a network topology and applied essential networking concepts such as loopback interfaces, route summarization, and OSPF configuration. By working with the OSPF routing protocol, I gained a comprehensive understanding of its significance in dynamic routing within an autonomous system. Additionally, I explored router IDs and their impact on network communication, as well as the practical importance of adjusting cost metrics for optimal routing. Through hands-on tasks like configuring OSPF and calculating routing paths with Dijkstra's algorithm, this experiment reinforced key theoretical principles and demonstrated their application in real-world networking scenarios. The integration of these concepts not only optimized network efficiency but also enhanced our understanding of large-scale network management.

6. Feedback

This experiment was helpful in learning how the OSPF routing protocol works and how to set it up. Using Cisco Packet Tracer made it easier to understand the concepts by actually building and testing the network. The steps were clear, and the time given for the experiment was just right to complete everything without feeling rushed. Overall, it was a good learning experience and helped to understand dynamic routing better.

7. References

[1]https://www.benocs.com/glossary/igp/#:~:text=An%20Interior%20Gateway%20Protocol%20(IGP,exchange%20information%20about%20IP%20routes. [Accessed in 11/10/2024 at 16:06]

[2] https://www.ibm.com/docs/en/i/7.4?topic=routing-open-shortest-path-first [Accessed in 11/10/2024 at 16:29]

[3] https://networklessons.com/rip/introduction-route-summarization [Accessed in 11/10/2024 at 16:57]

[4] https://en.wikipedia.org/wiki/Hierarchical_routing [Accessed in 11/10/2024 at 18:03]

[5] https://www.cisco.com/c/en/us/support/docs/ip/open-shortest-path-first-ospf/13685-13.html [Accessed in 11/10/2024 at 18:11]

[6] https://study-ccna.com/ospf-configuration/ [Accessed in 11/10/2024 at 18:25]

[7] https://networklessons.com/ospf/ospf-router-id [Accessed in 11/10/2024 at 18:46]

[8] https://support.hpe.com/techhub/eginfolib/networking/docs/switches/common/15-18/5998-8158_bog/content/ch06s03.html [Accessed in 11/10/2024 at 20:37]

[9] Lab Manual