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Final Project

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Robotics and Telecommunications Engineering.

Computation, Electronics and Mecatronics Department

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Abstract

This project delves into the implementation of static routing in a simulated network environment. The network topology consists of interconnected devices such as routers, switches, and bridges, configured to ensure seamless packet delivery across different subnets. Manual static routing configurations are utilized to establish connectivity, and network performance is tested using ping and traceroute commands. This document explores the outcomes of these tests, analyzing the reasons for successful or unsuccessful communications, and demonstrates how static routing protocols enable effective data forwarding between distinct networks. Key findings highlight the intricacies of manual routing table setup and its impact on network functionality.

Introduction

The growing complexity of network infrastructures in various industries requires robust and precise configurations to ensure connectivity. Static routing, though simple in implementation, plays a fundamental role in network operations by explicitly defining the paths for data transmission between devices. This project explores a network topology designed for static routing, providing a hands-on approach to understanding how routing tables influence IP forwarding.

The simulation replicates a multi-network scenario using Packet Tracer, a versatile tool for designing and testing network configurations. Through this process, the relationship between network prefixes and IP forwarding is examined, emphasizing the critical role of manual configurations in network reliability and performance.

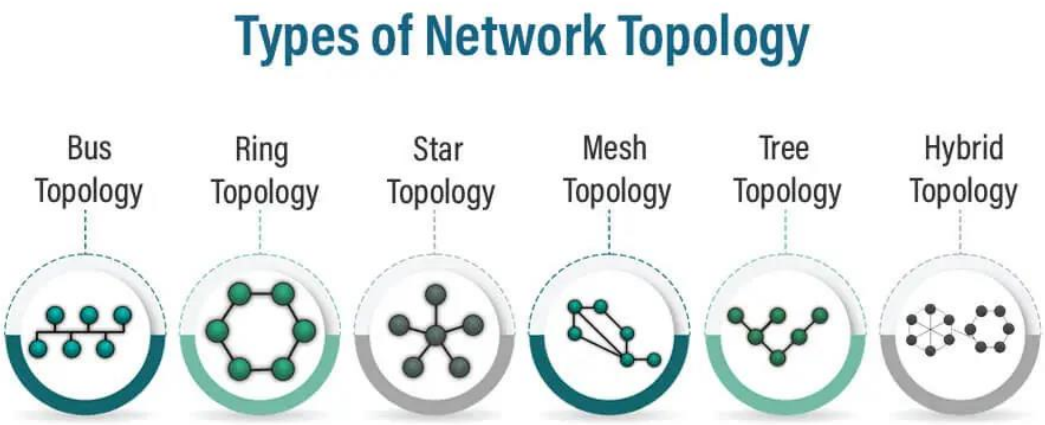

Figure 1 educba types-of-network-topology (August 3, 2023)

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Figure 2: CISCO switch (CISCO, n.d.)

A network switch connects devices within a local area network (LAN) and facilitates communication between them by forwarding data to the appropriate device. It operates at Layer 2 of the OSI model, focusing on the transmission of data frames within the same network. Switches are a core component of modern networking, commonly used to manage connections in environments like homes, businesses, and data centers.

Figure 3 Cisco SPA122 Router (n.d)

Routers perform a different function by linking separate networks and managing the flow of data between them. Operating at Layer 3 of the OSI model, routers determine the best path for data to travel across networks, including connecting local networks to the internet. In many households, routers often include built-in wireless features, enabling both wired and wireless connections.

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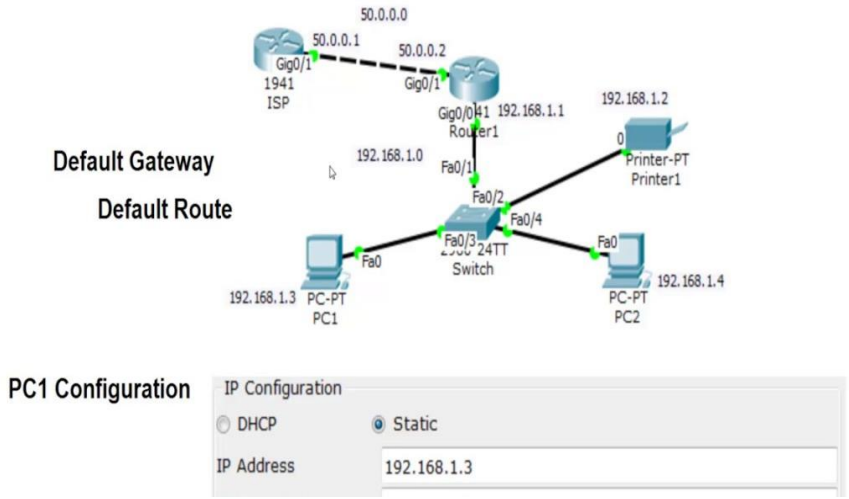

Figure 4 Cisco Router Basics - Default Gateway (2017)

The default gateway is the designated IP address used to direct traffic from a local network to other networks, such as the internet. When a device within the network needs to communicate with one outside its own subnet, it sends the data to the default gateway, which forwards it to its final destination.

Methodology:

We will start by configuring the interfaces on Router 1.
This is how the 10.0.1.0/24 and 10.0.4.0/24 interfaces were configured for the gigabit0/0 port on Router 1:

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface gigabit0/0
Router(config-if)#ip address 10.0.1.1 255.255.255.0
Router(config-if)#ip address 10.0.4.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#end
```

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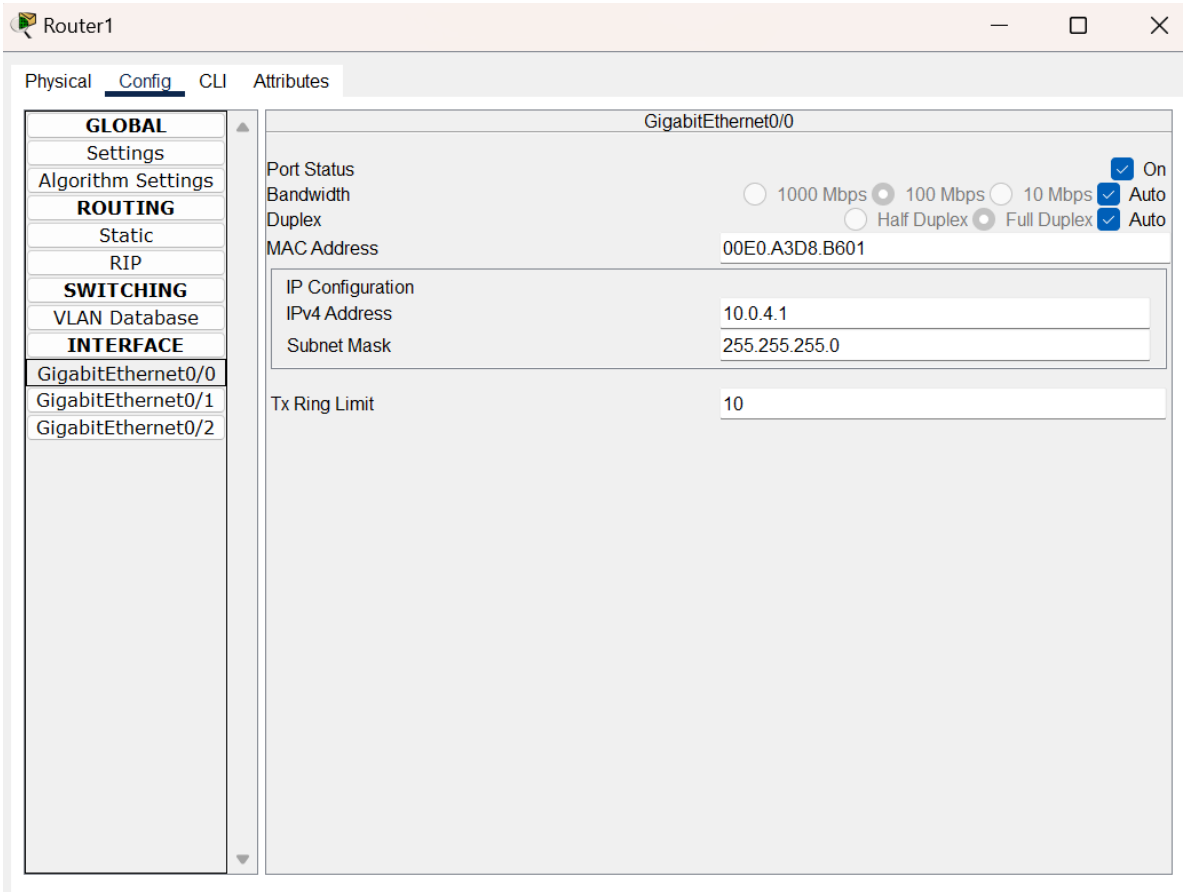

Figure 5 (Router1)

This is how the 10.0.3.0/24 interface was configured for the gigabit0/1 port on Router 1:

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface gigabit0/1
Router(config-if)#ip address 10.0.3.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Router(config-if)#exit
Router(config)#end
```

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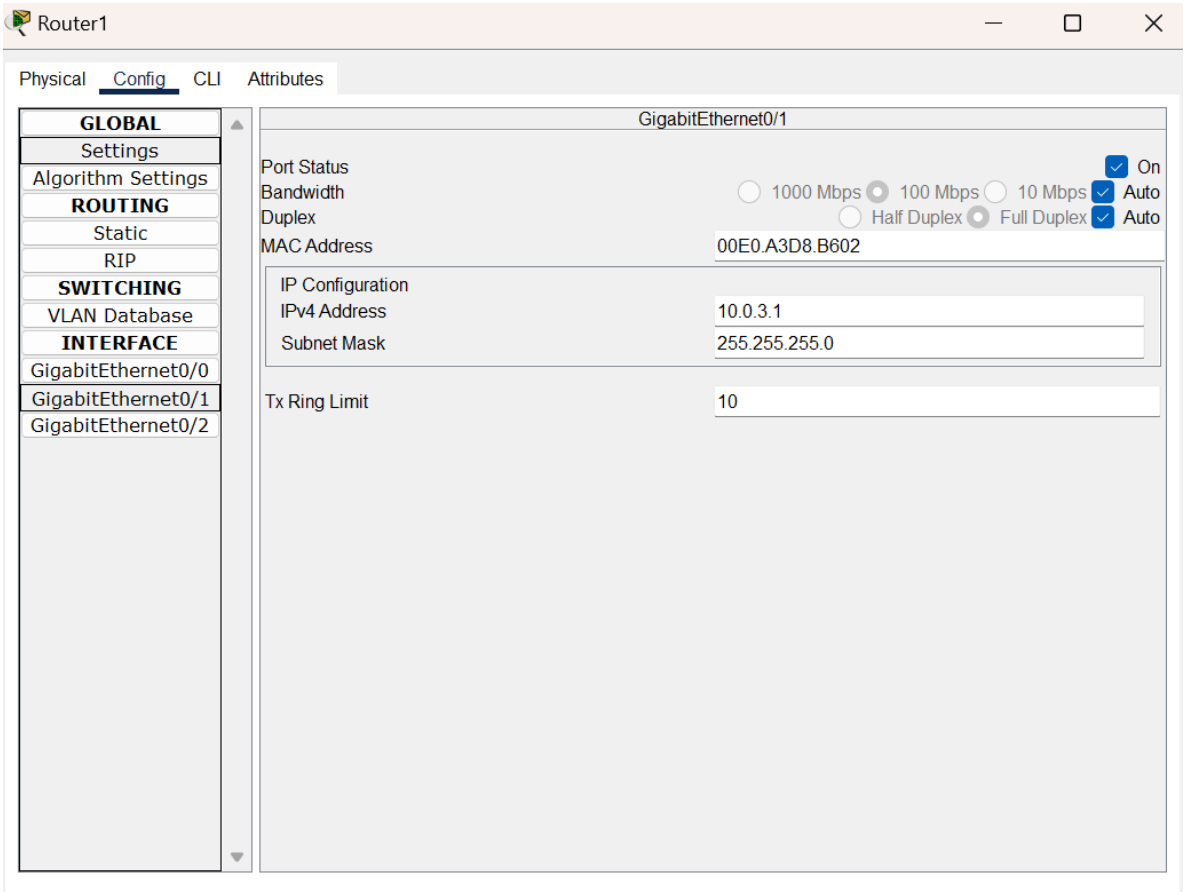

Figure 6 (Router0)

For Router 0,
the following procedure was performed to configure the 10.0.3.0/24 and 10.0.4.0/24 interfaces on Router 0:
For the gigabit0/0 port:

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface gigabit0/0
Router(config-if)#ip address 10.0.4.2/24 255.255.255.0
                             ^
% Invalid input detected at '^' marker.

Router(config-if)#ip address 10.0.4.2 255.255.255.0
Router(config-if)#no shutdown
```

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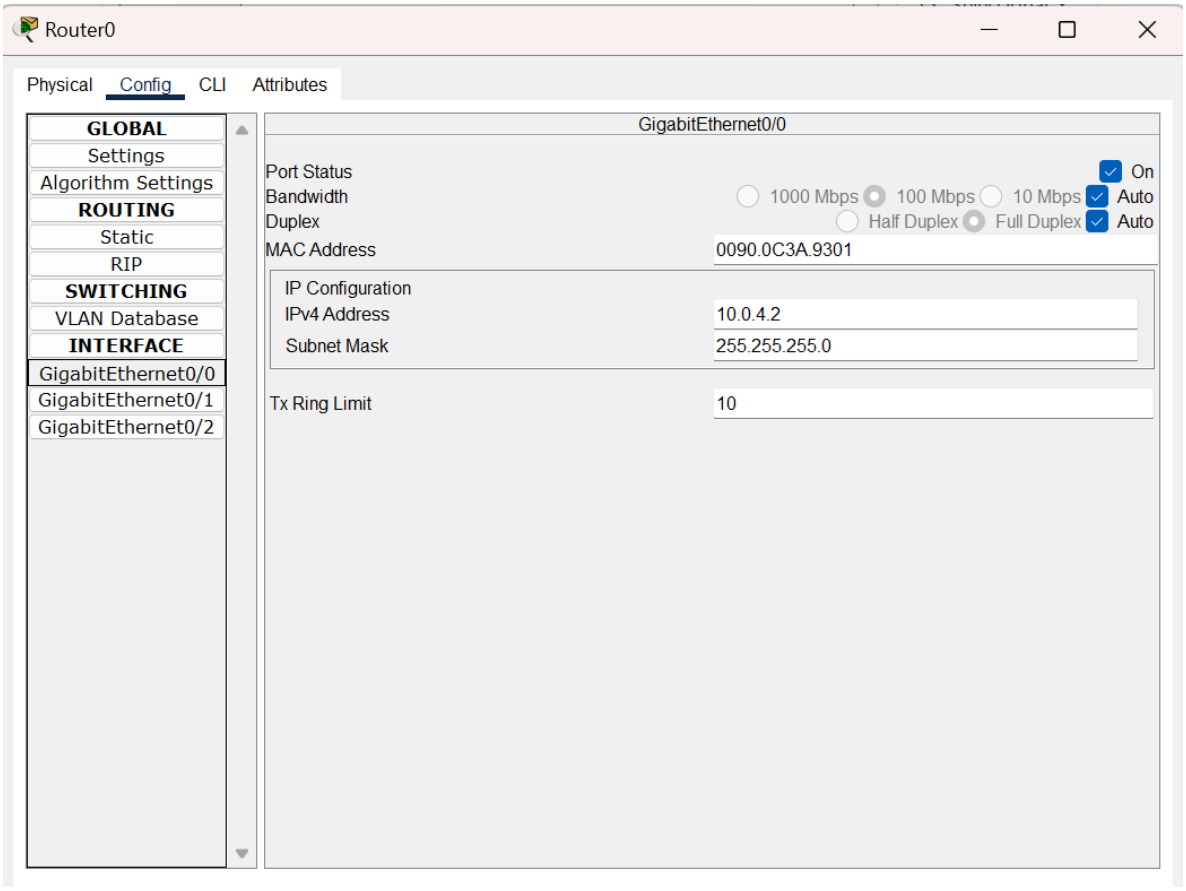

Figure 7 (gigabit0)

For the gigabit0/1 of router 0:

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface gigabit0/1
Router(config-if)#ip address 10.0.3.2
% Incomplete command.
Router(config-if)#ip address 10.0.3.2 255.255.255.0
Router(config-if)#no shutdown
```

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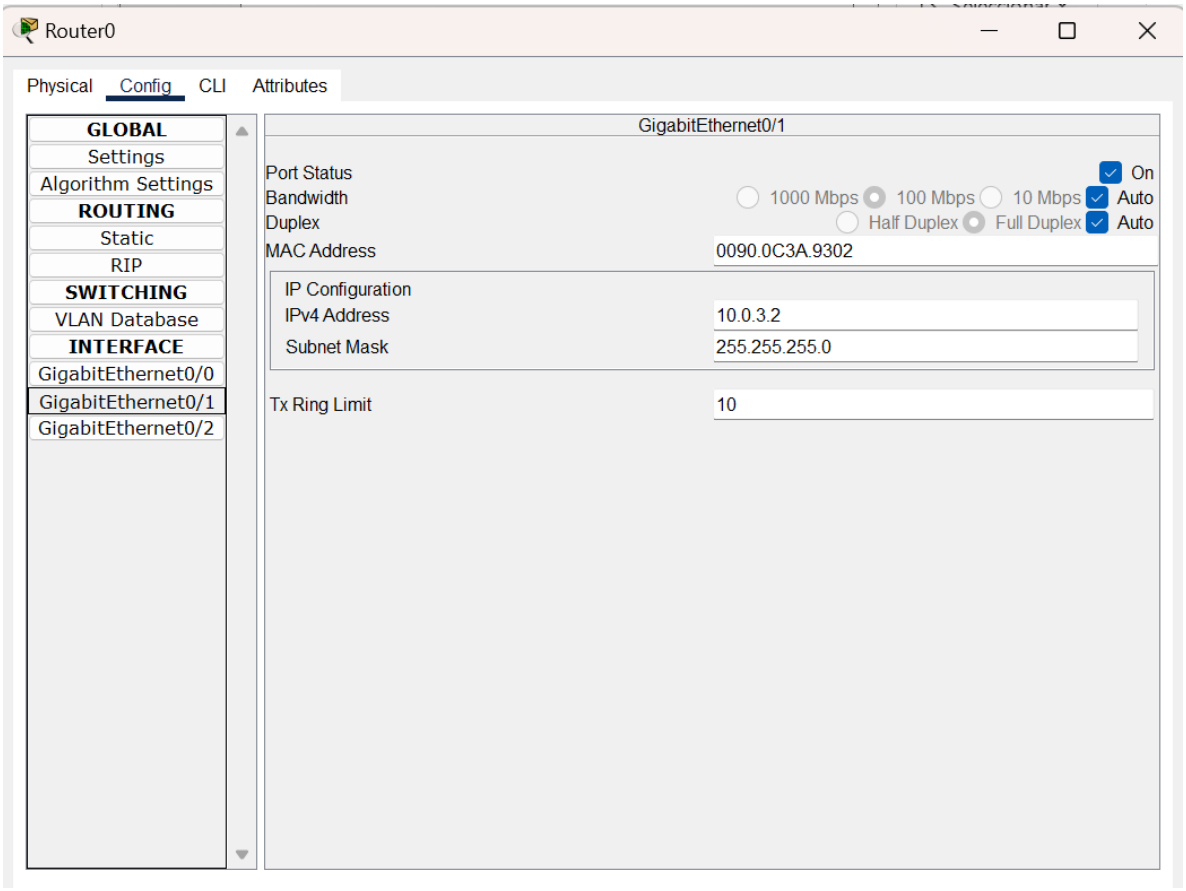
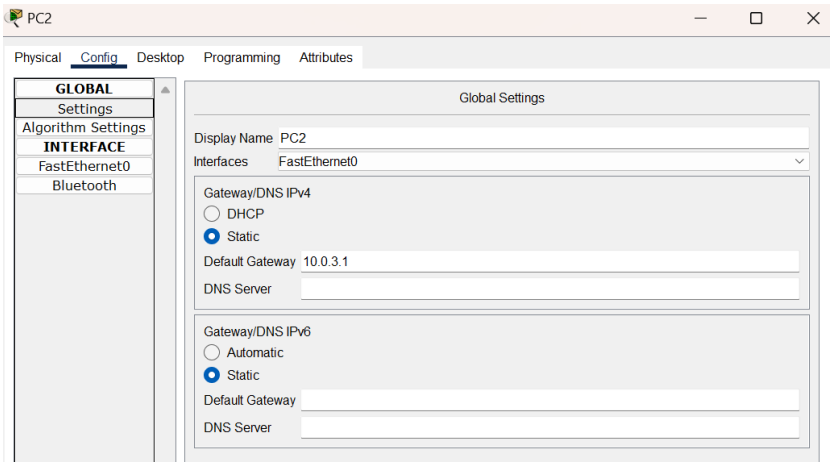


We configured the PCs as follows:
PC 2:



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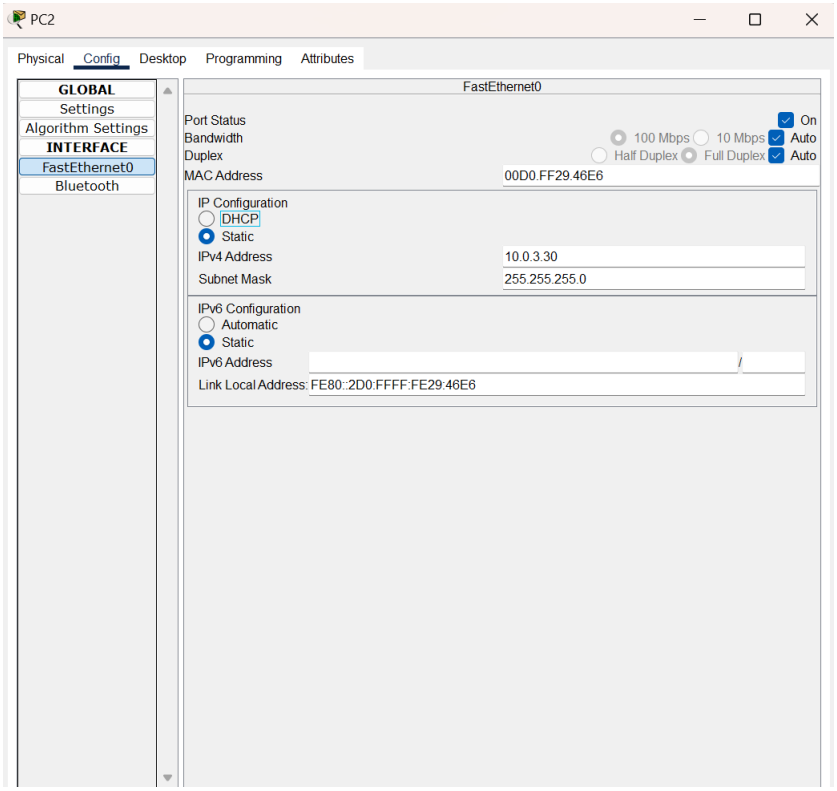
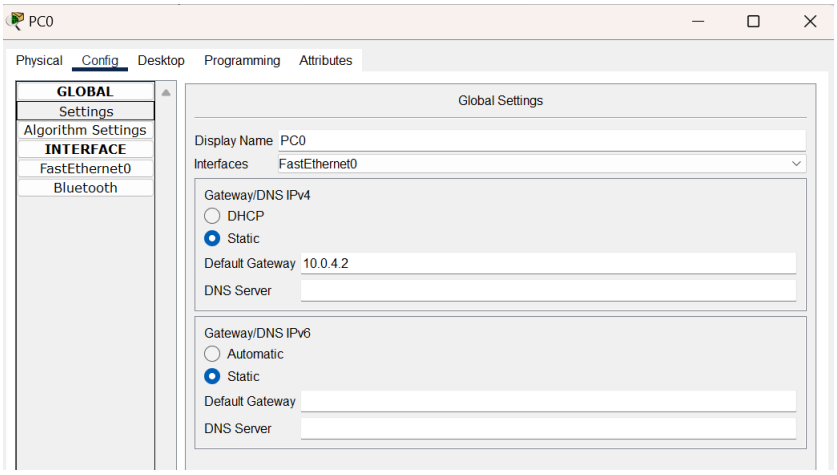


PC0:



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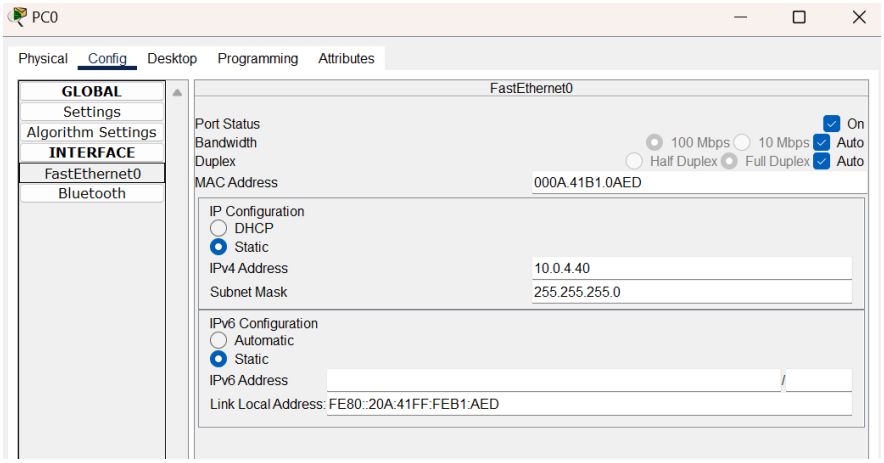
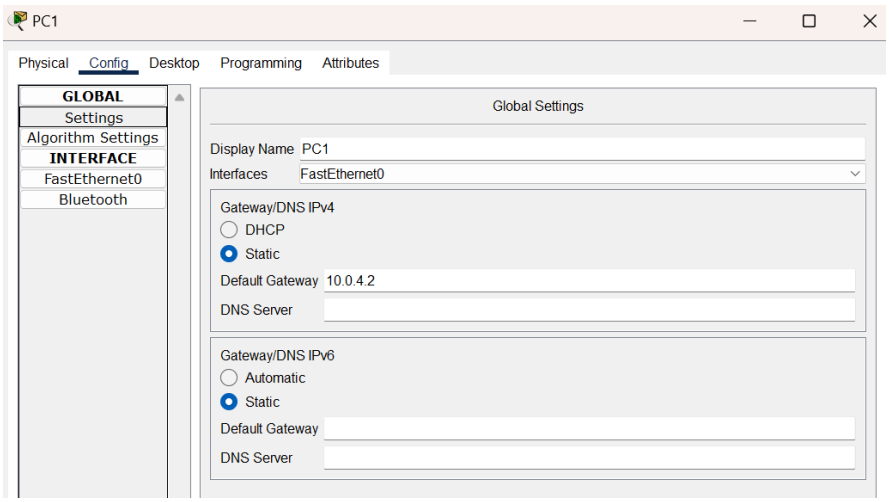
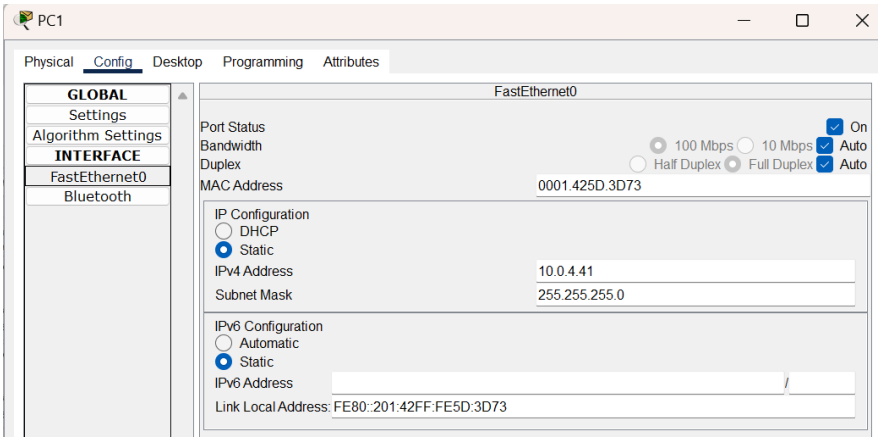


PC1:





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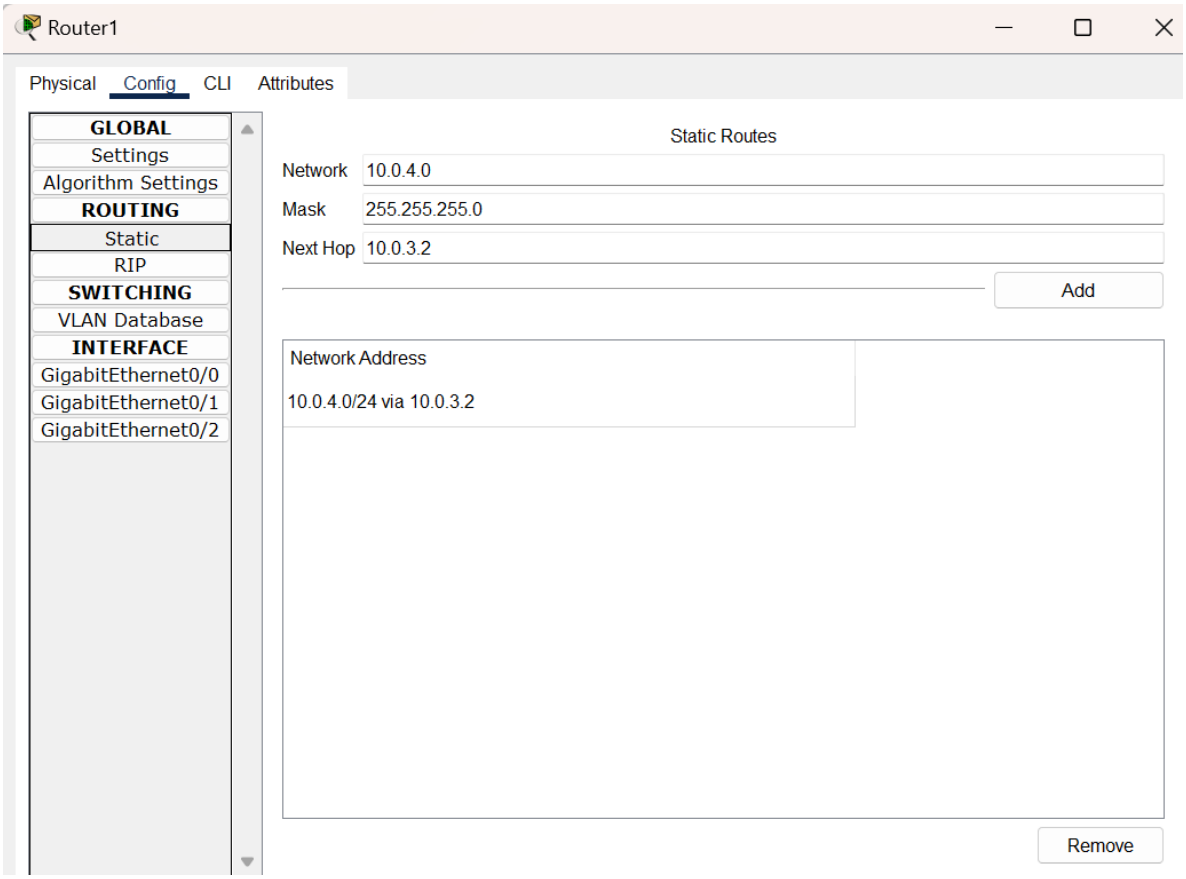
To enable routing functionality, we configured the routers as follows:

We configured Router 1 (the one in the middle) as follows:



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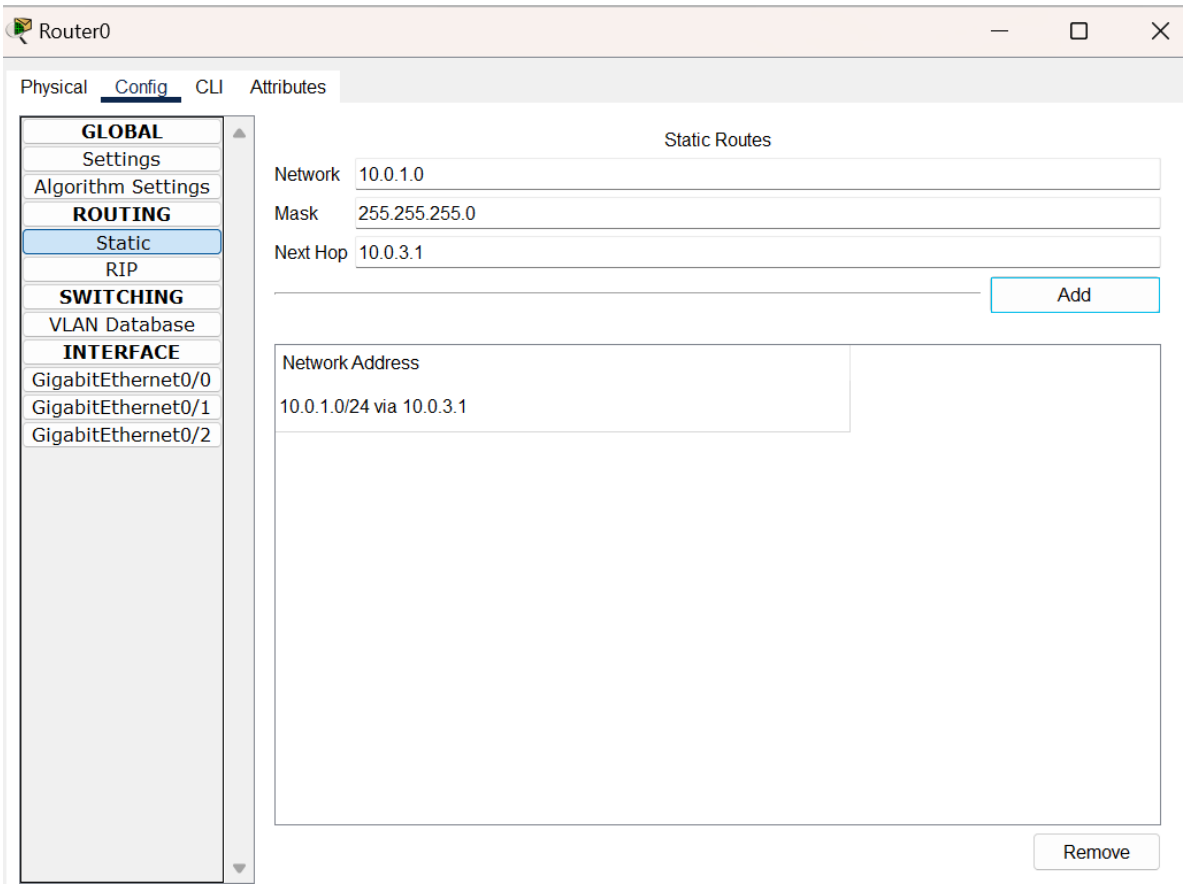
We configured Router 0 (the one on the left) as follows:



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Ping

PC0:

```
C:\>ping 10.0.1.10

Pinging 10.0.1.10 with 32 bytes of data:

Reply from 10.0.1.10: bytes=32 time=1ms TTL=126
Reply from 10.0.1.10: bytes=32 time=2ms TTL=126
Reply from 10.0.1.10: bytes=32 time<1ms TTL=126
Reply from 10.0.1.10: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.1.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms

C:\>ping 10.0.3.30

Pinging 10.0.3.30 with 32 bytes of data:

Reply from 10.0.3.30: bytes=32 time<1ms TTL=126
Reply from 10.0.3.30: bytes=32 time=9ms TTL=126
Reply from 10.0.3.30: bytes=32 time<1ms TTL=126
Reply from 10.0.3.30: bytes=32 time<1ms TTL=126

Ping statistics for 10.0.3.30:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 9ms, Average = 2ms

C:\>ping 10.0.4.41

Pinging 10.0.4.41 with 32 bytes of data:

Reply from 10.0.4.41: bytes=32 time=1ms TTL=128
Reply from 10.0.4.41: bytes=32 time=23ms TTL=128
Reply from 10.0.4.41: bytes=32 time=1ms TTL=128
Reply from 10.0.4.41: bytes=32 time=10ms TTL=128

Ping statistics for 10.0.4.41:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 23ms, Average = 8ms
```

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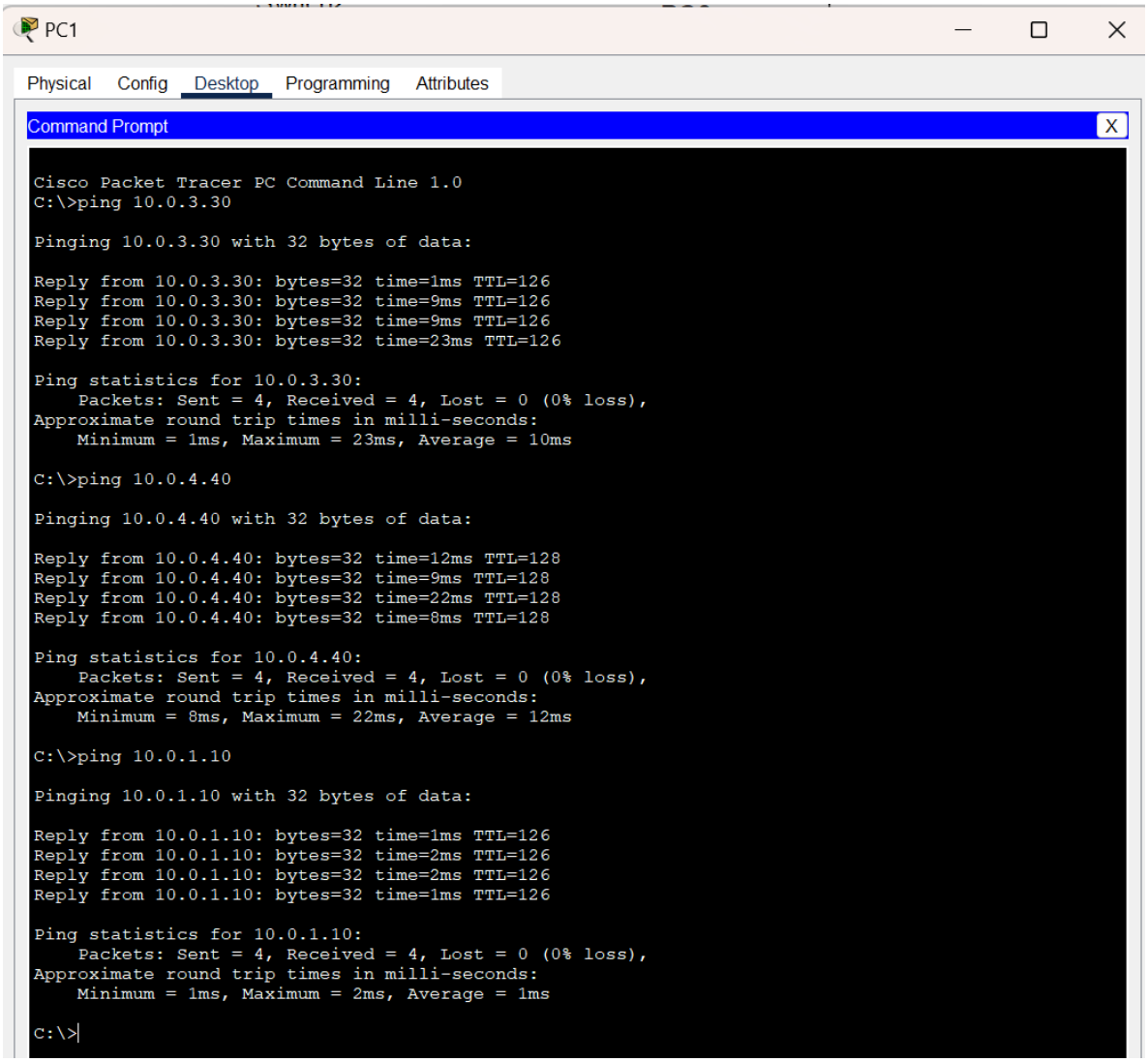
PC1:



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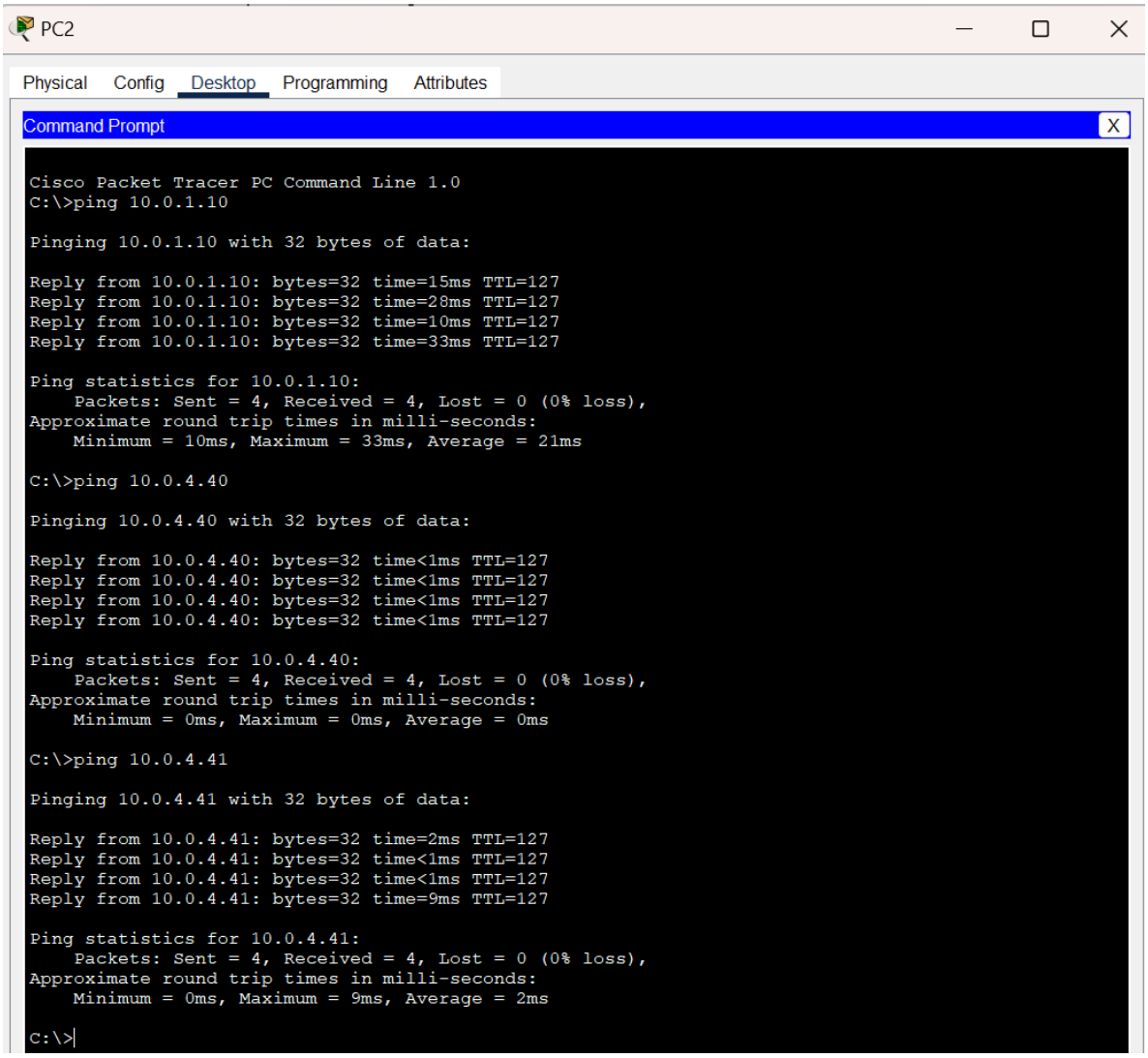
PC2:



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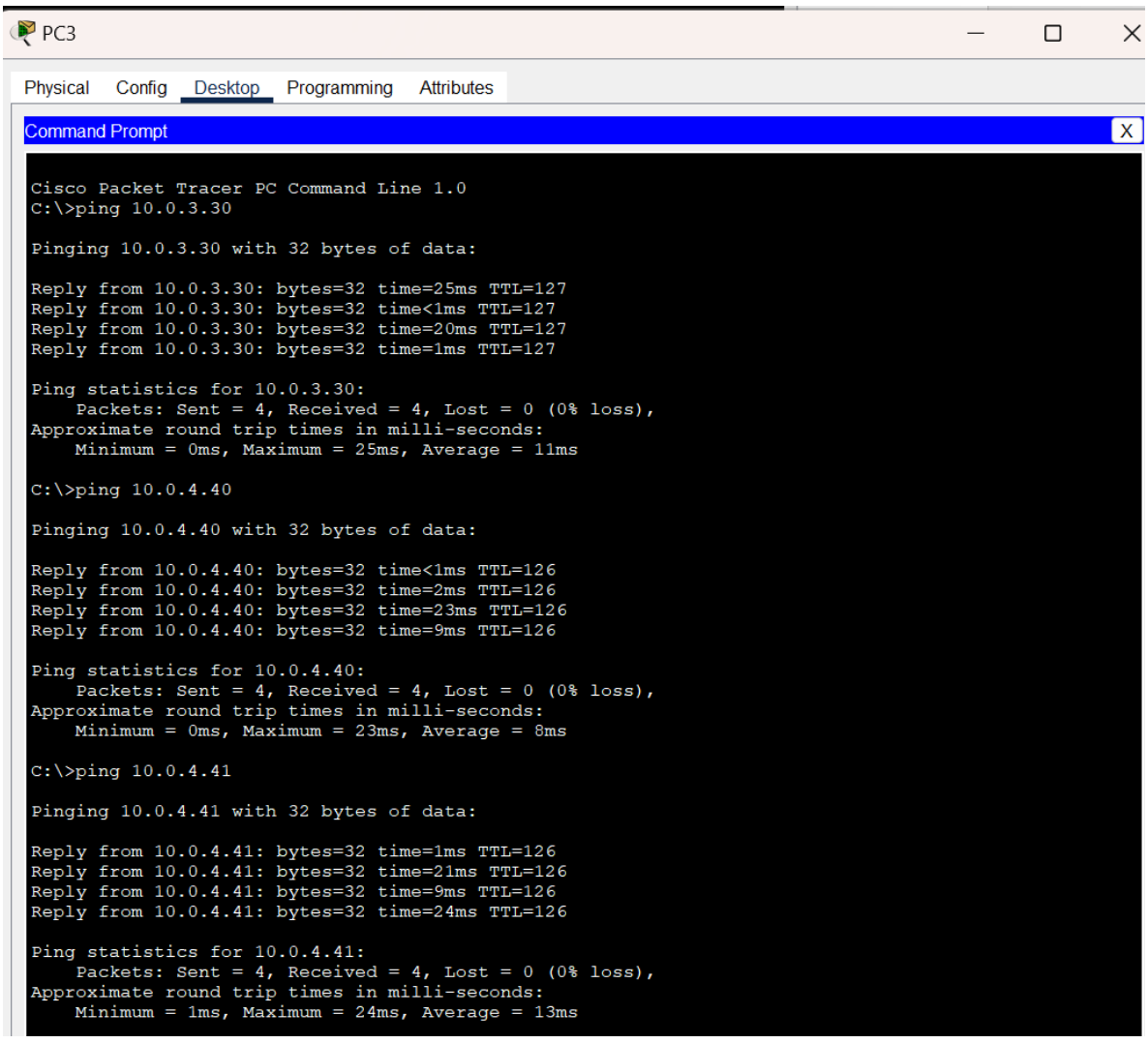
PC3:



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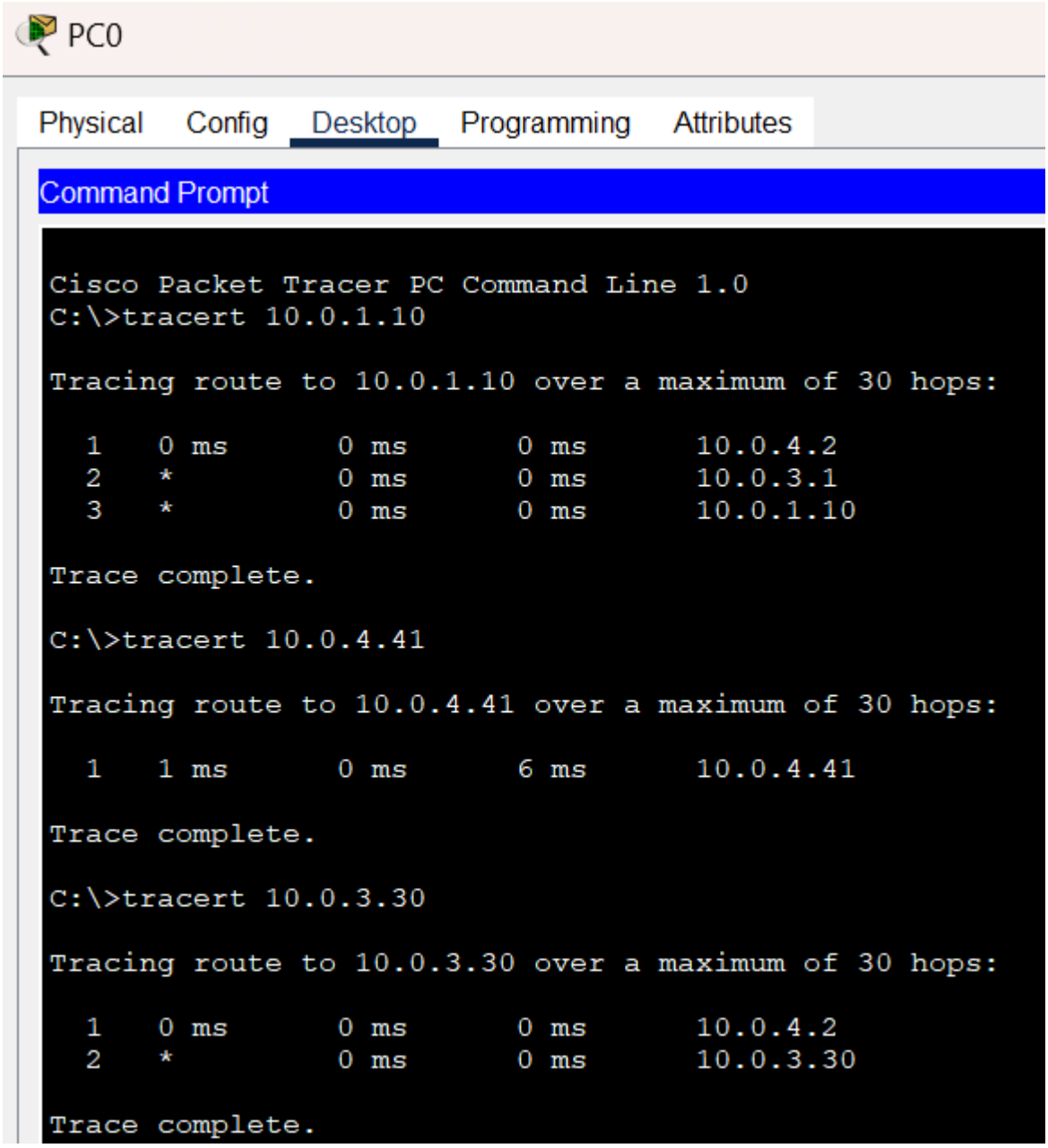
TRACERT

PC0:



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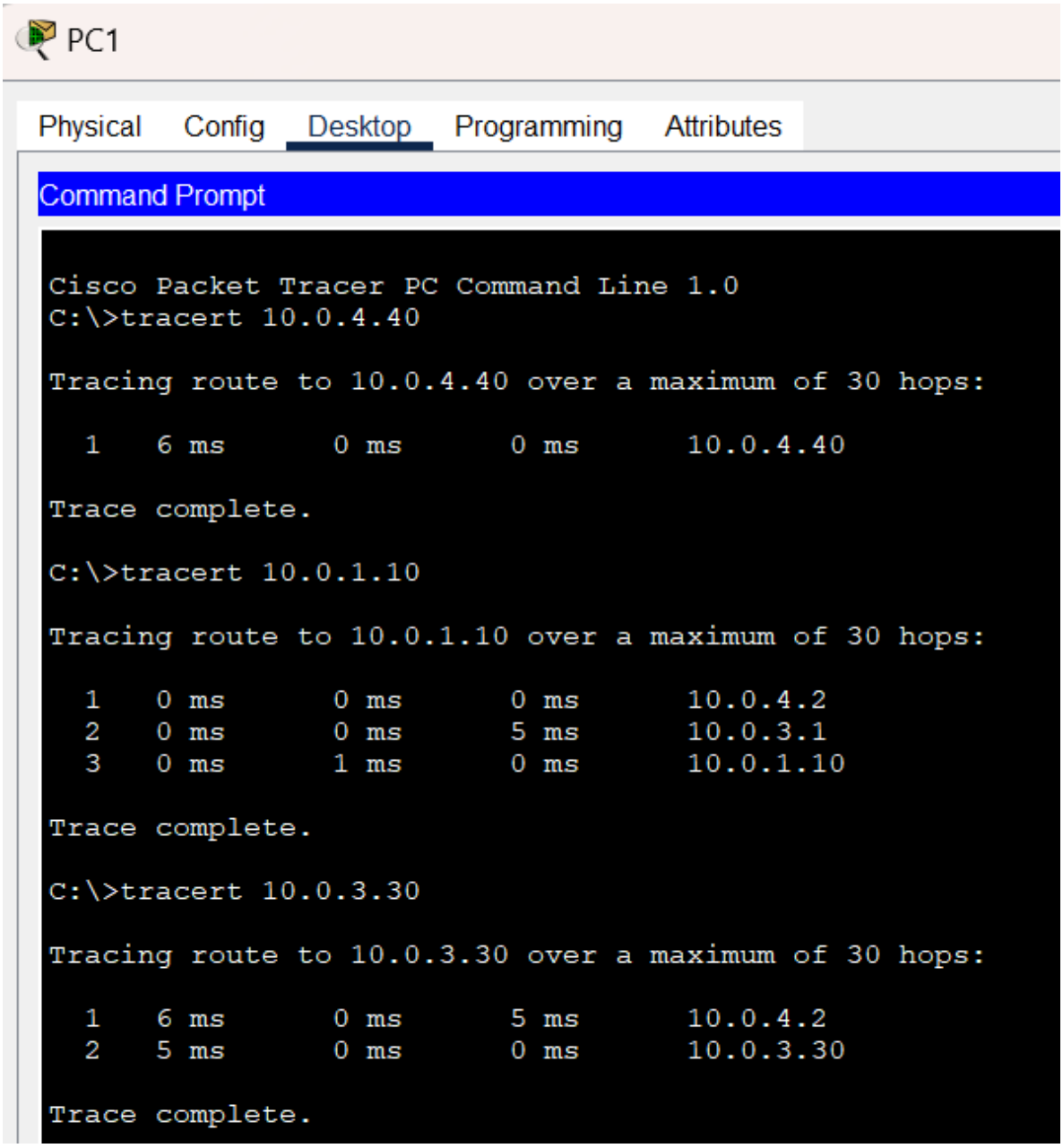
PC1:



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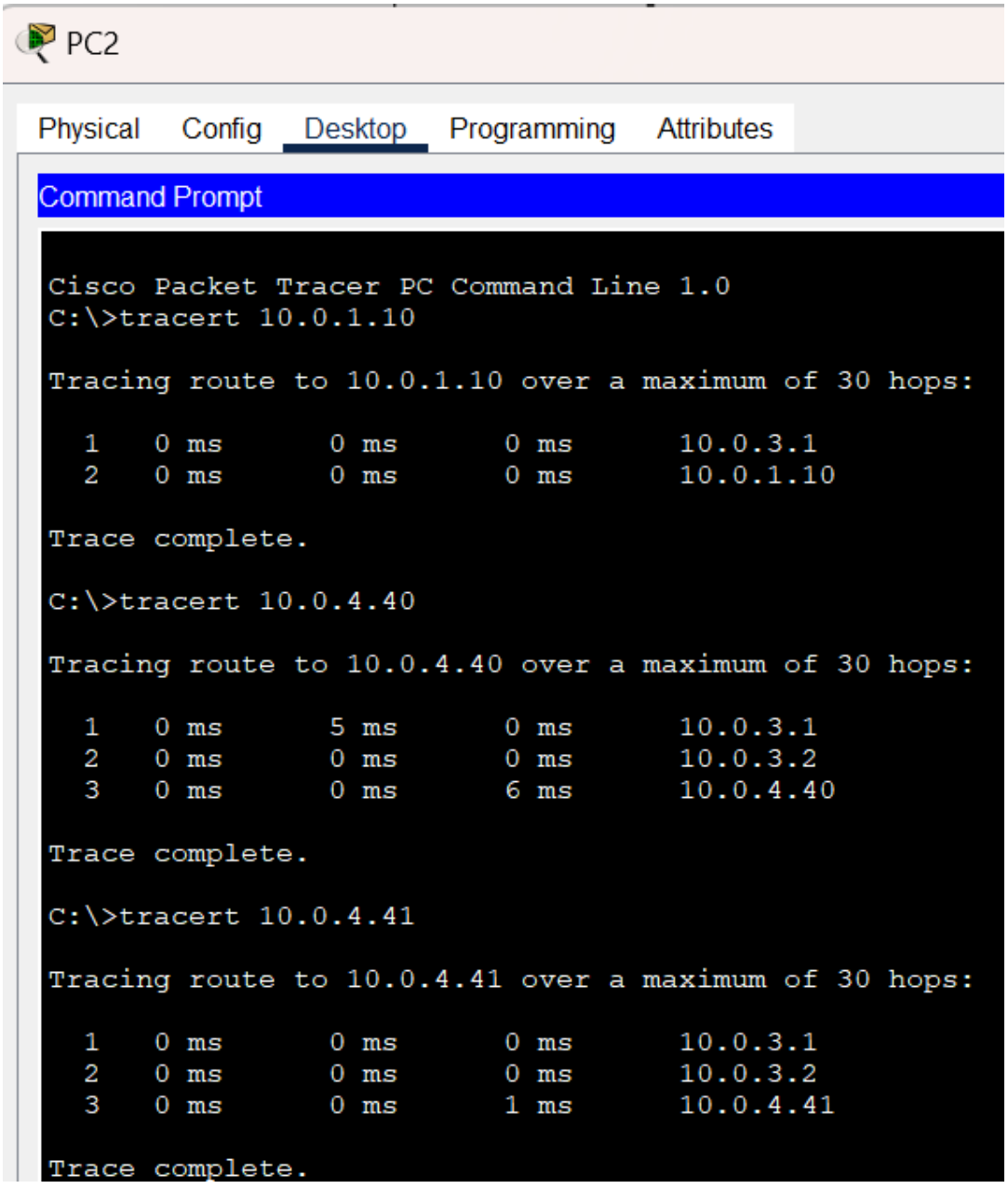
PC2:



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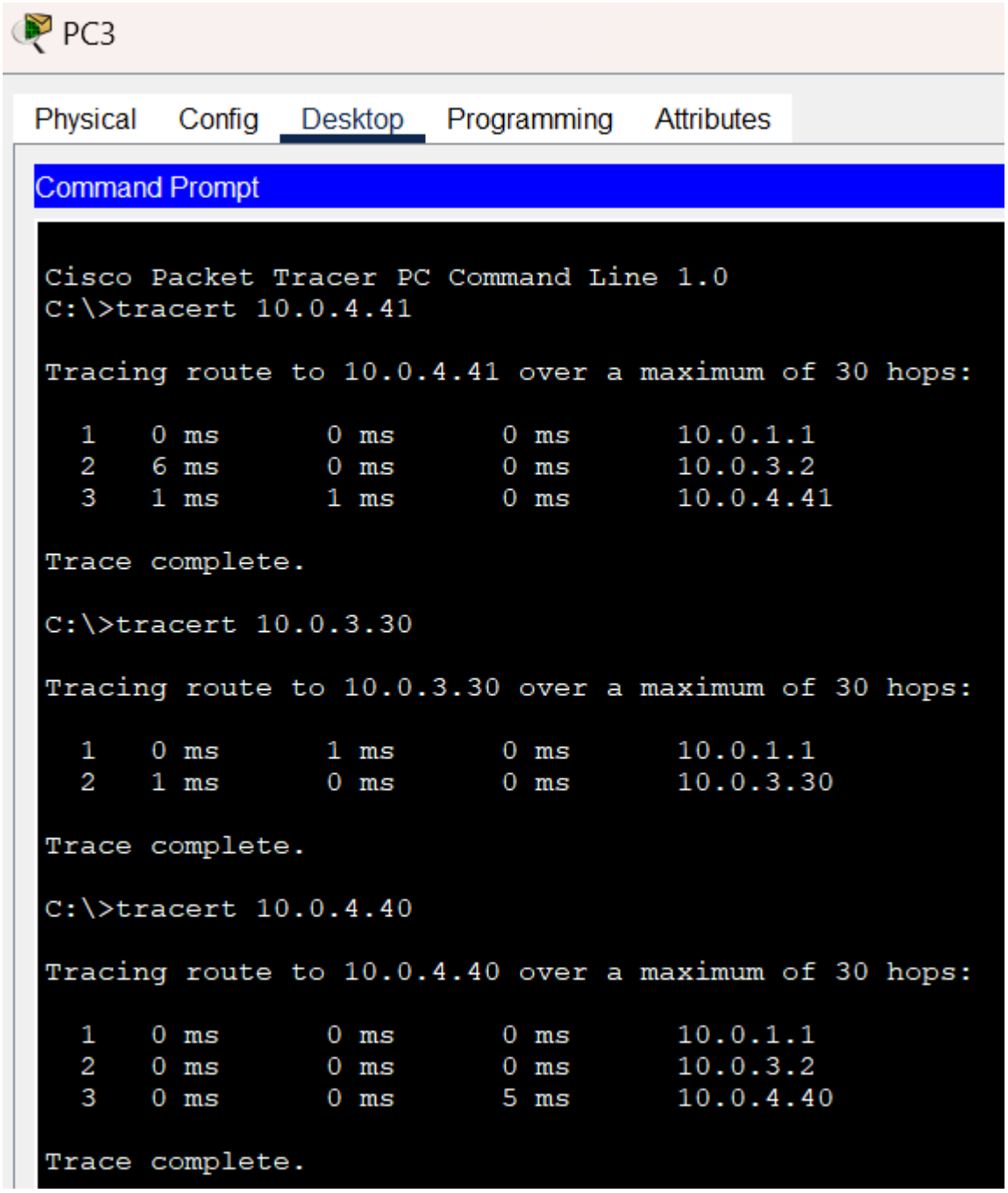
PC3:



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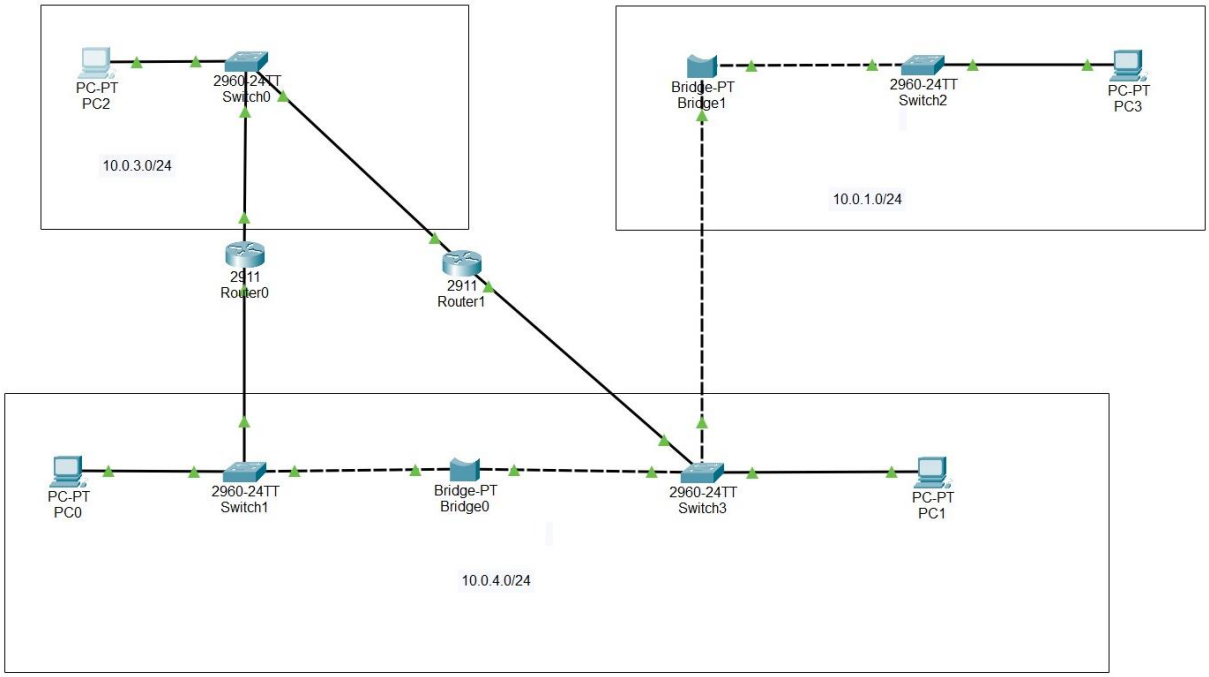

Results and Discussion

This network diagram showcases a segmented topology where we have implemented a structured communication system using routers, switches, bridges, and PCs. Here's how we configured and designed the network:

1. PC2 Network (Top Left):
    - We connected PC2 to Switch0, assigning it to the 10.0.3.0/24 network.
    - Switch0 routes traffic through Router0, facilitating communication with other network segments.
2. Router0 (Middle Left):
    - We configured Router0 to connect the 10.0.3.0/24 network (via Switch0) and the 10.0.4.0/24 network.
    - Router0 serves as a gateway between PC2 and the central Router1.

3. Central Router1:
    - We set up Router1 as the core connection point, linking three main networks:
        - 10.0.3.0/24 (connecting via Router0).
        - 10.0.4.0/24 (linking through Bridge0 and Switch3).
        - 10.0.1.0/24 (connected via Switch2 and PC3).
4. PC0 Network (Bottom Left):
    - We included PC0 in the 10.0.4.0/24 network by connecting it through Switch1 and Bridge0.
    - This setup ensures that PC0 can communicate across the entire topology via Router1.
5. PC3 Network (Top Right):
    - We added PC3 to the 10.0.1.0/24 network, linking it to Switch2.
    - Router1 manages PC3's communication with other network segments.
6. PC1 Network (Bottom Right):
    - We placed PC1 in the 10.0.4.0/24 network, connecting it through Switch3 and Bridge0 to Router1.

Overall Functionality:

We designed this topology to ensure seamless communication between networks while maintaining a clear segmentation for efficient routing. The combination of routers and switches allows for scalability, and we leveraged bridges to enhance network connectivity. This approach ensures that every device can reach its intended destination while minimizing broadcast traffic and maintaining network organization.

Conclusions:

This project effectively demonstrates the role of static routing in network design. By manually configuring routing tables, devices were able to communicate across subnets with minimal latency. The use of Packet Tracer provided a practical understanding of network topology, IP addressing, and routing protocols. The project highlights the importance of meticulous planning and configuration in ensuring network reliability.

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Bibliography

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2. TP-Link, "Configuring Default Gateways," TP-Link Technical Support, 2024.
3. Fortinet, "Internet Control Message Protocol (ICMP)," Fortinet Cybersecurity Glossary, 2024.
4. Liebeherr, J., & El Zarki, M., *Mastering Networks: An Internet Lab Manual,* Pearson Addison-Wesley, 2004.

Video Link:

https://www.youtube.com/watch?v=KjA2eNrty-M