Lab Number: 10 **Date: 2025/08/17**

Title: Implementation of Dynamic Interior/ Exterior Routing (RIP, OSPF, BGP)

Theory:

a. Dynamic Interior Routing/ Exterior Routing

Dynamic Interior Routing involves the automatic handling and updating of routes within a single Autonomous System (AS). It allows within the same network or organization to share information and determine the optimal path to a destination. Several interior routing protocols are commonly used to achieve this, including RIP (Routing Information Protocol), OSPF (Open Shortest Path First) and EIGRP (Enhanced Interior Gateway Routing Protocol).

Dynamic Exterior Routing focuses on managing routing between different Autonomous Systems (ASes), enabling routers to share information across the boundaries of various networks or organizations. This type of routing is essential for communication on the Internet, where exterior routing protocols are used to connect different ASes. The primary protocol for this purpose is BGP (Border Gateway Protocol), which is the standard exterior routing protocol. BGP maintains routing information between ASes, ensuring efficient data transfer across networks on a global scale.

b. RIP, OSPF, BGP

RIP: Routing Information Protocol (RIP) is a distance-vector routing protocol that selects the best route based on hop count. It has a maximum hop count limit of 15, making it most suitable for smaller networks. Although it is easy to set up, RIP has slow convergence and lacks the scalability needed for larger or more complex networks.

OSPF: Open Shortest Path First (OSPF) is a link-state routing protocol that uses the Dijkstra algorithm to determine the shortest path. OSPF is well-suited for large networks as it supports hierarchical structuring by splitting the network into areas. It offers faster convergence, advanced features like route summarization, and supports variable-length subnet masks, though it is more challenging to configure than RIP.

BGP: Border Gateway Protocol (BGP) is a path-vector routing protocol primarily used for routing between different autonomous systems, such as ISPs (Internet Service Providers) and large organizations. BGP focuses on policy-based routing, making it crucial for managing traffic across the internet. It is highly scalable but requires more careful and complex configuration due to its slower convergence compared to internal protocols like OSPF.

c. **Network Diagram**

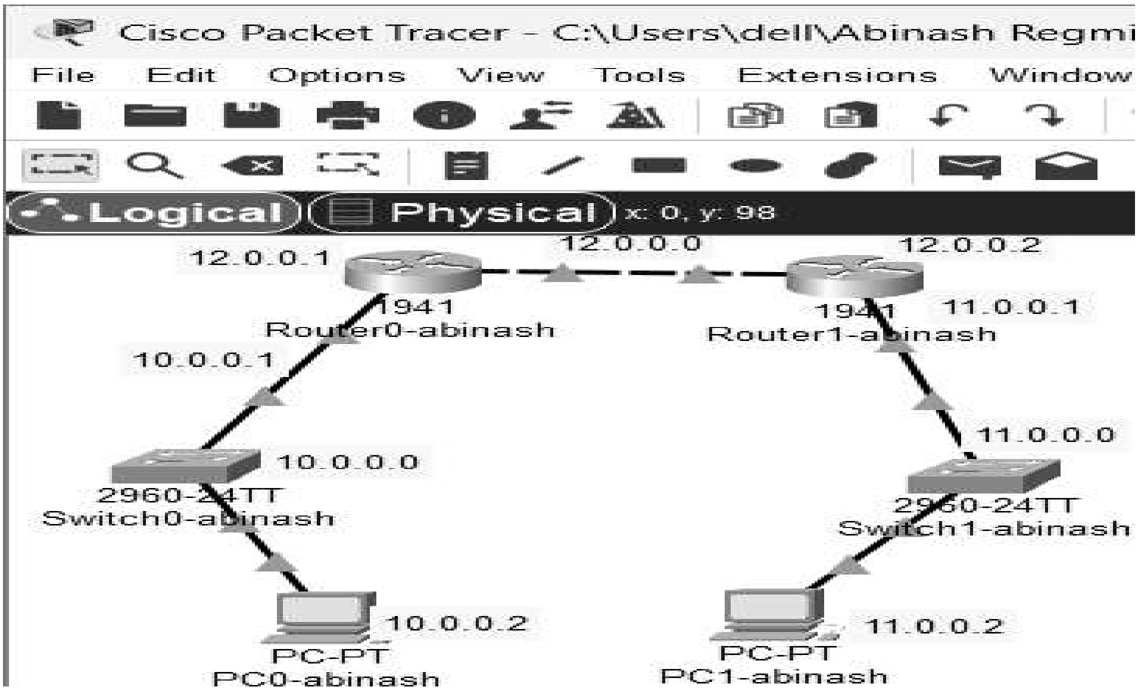

Fig: Network Diagram

Implementation Sequence

Here is the implementation sequence for Implementation of Dynamic Interior/ Exterior Routing (RIP, OSPF, BGP).

a) **Configuring Network**

Configure the network for PCs and Routers

Step 1: Open Packet Tracer and setup the devices.

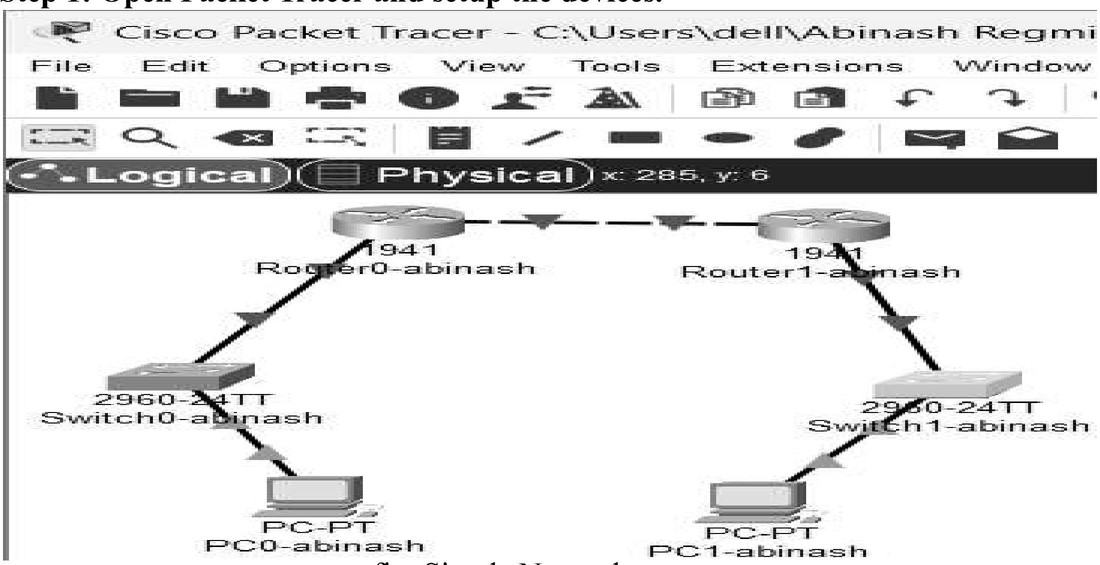

fig: Simple Network setup

Step 2: Assign IP addresses to each PC.

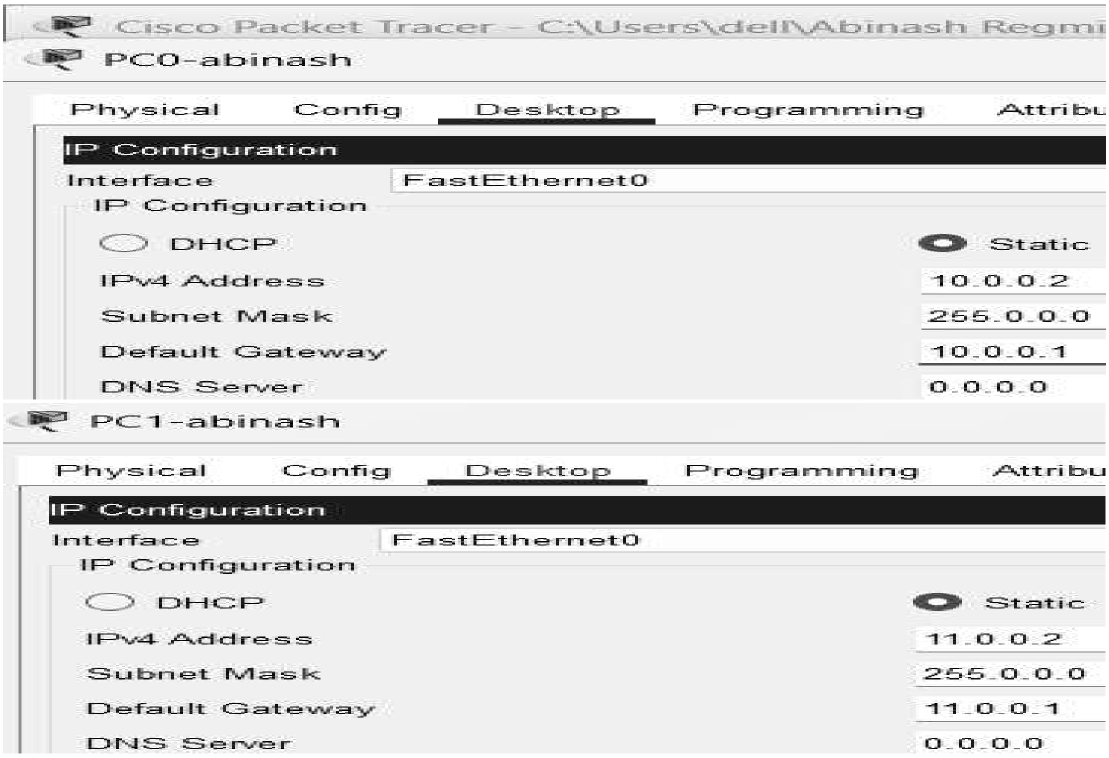

Fig: IP configuration

Step 3: Assign IP addresses to router interfaces.

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface GigabitEthernet 0/1
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface GigabitEthernet 0/0
Router(config-if)#ip address 12.0.0.1 255.0.0.0
Router(config-if)#no shutdown

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

Fig: Gigabit Ethernet configuration on router0

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface GigabitEthernet 0/0
Router(config-if)#ip address 12.0.0.2 255.0.0.0
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)#interface GigabitEthernet 0/1
Router(config-if)#ip address 11.0.0.1 255.0.0.0
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
```

Fig: Gigabit Ethernet configuration on router1

Implementation & explain the need for Dynamic Routing

Implementation of Dynamic Routing: Dynamic routing protocols, such as RIP, OSPF, and BGP, are used to enable routers to automatically exchange and update routing information based on changes in the network. The implementation process involves:

- **Network Configuration:** Set up our network by configuring routers and PCs, and assign IP addresses to each device.

- **Dynamic Routing Setup:** Enable the chosen dynamic routing protocol (RIP, OSPF, or BGP) on each router. This allows routers to automatically share and update routing information.

- **Testing:** Use tools like ping to verify that the network configuration is correct and that connectivity is established across the routers.

Need for Dynamic Routing: Dynamic routing is crucial for modern networks due to the following reasons:

- **Automatic Route Updates:** As network conditions change-such as when links fail or new devices are added-dynamic routing protocols automatically update the routing tables. This keeps the network connected without requiring manual adjustments.

- **Scalability:** In large or rapidly changing networks, manually configuring static routes can be impractical. Dynamic routing protocols handle the growth of the network efficiently, making it easier to scale.

- **Efficient Path Selectin:** Dynamic protocols continuously evaluate network conditions and choose the best path for data. This helps in optimizing performance and reducing delays.

- **Redundancy and Fault Tolerance:** These protocols improve network reliability by quickly adapting to failures and rerouting traffic through alternative paths, minimizing downtime.

- **Improve Load Balancing:** Dynamic routing protocols can distribute network traffic evenly across multiple paths. This load balancing ensures that no single path is overloaded, enhancing overall network efficiency overall network efficiency and performance.

b) Dynamic Routing Configuration

i. Using RIP Command

Network Diagram

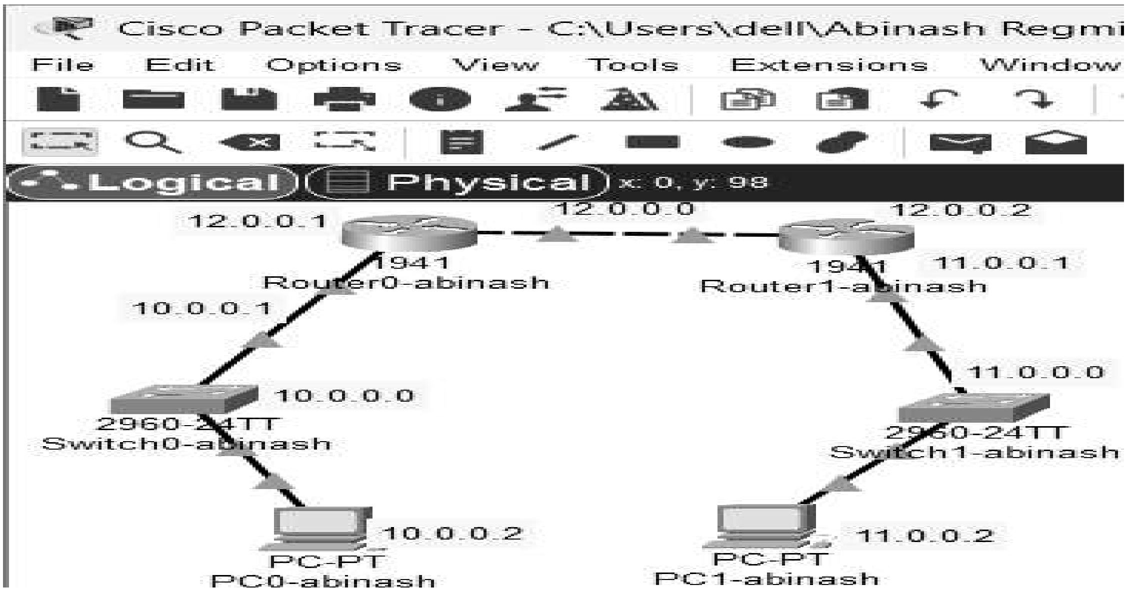

fig: Network Diagram

Code for Dynamic Routing Configuration using RIP command

For Router 0

Router>enable

Router#configure terminal

Router(config)#router rip

Router(config-router)#version 2

Router(config-router)#network 10.0.0.0

Router(config-router)#network 12.0.0.0

Router(config-router)#exit

For Router 1

Router>enable

Router#configure terminal

Router(config)#router rip

Router(config-router)#version 2

Router(config-router)#network 12.0.0.0

Router(config-router)#network 11.0.0.0

Router(config-router)#exit

Steps for Dynamic Routing Configuration using RIP Command

Step 1: Access the Router CLI

- Open Packet Tracer
- Click on the router we want to configure to access its CLI (Command Line Interface).

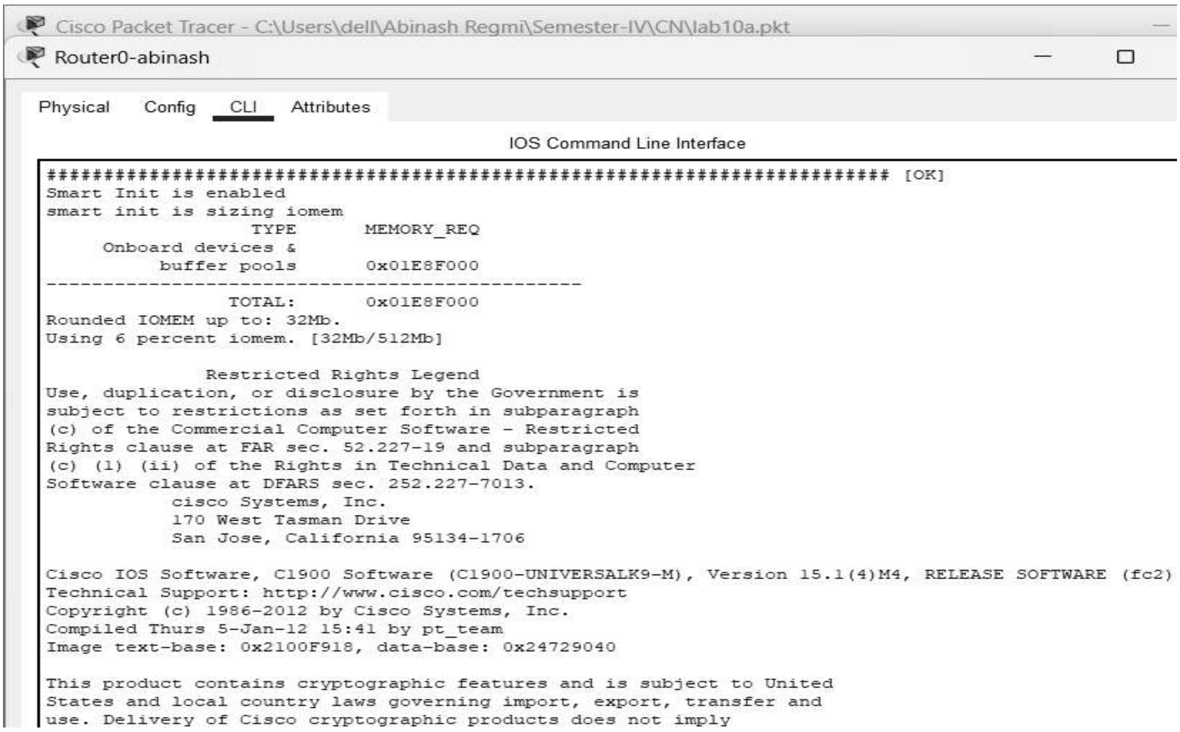

fig: Accessing Router CLI via Console Cable

Step 2: Enter Global Configuration Mode

- Enable RIP Routing Protocol
- Specify the RIP Version
- Configure the RIP Networks
- Exit RIP Configuration Mode

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 10.0.0.0
Router(config-router)#network 12.0.0.0
```

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 12.0.0.0
Router(config-router)#network 11.0.0.0
Router(config-router)#
```

Fig: Router configuration of router0 and router1 using RIP command

-Abinash Regmi

Testing

To test whether the network is working, we can ping other devices on the network from each PC. If the ping is successful, we should see replies from the other device.

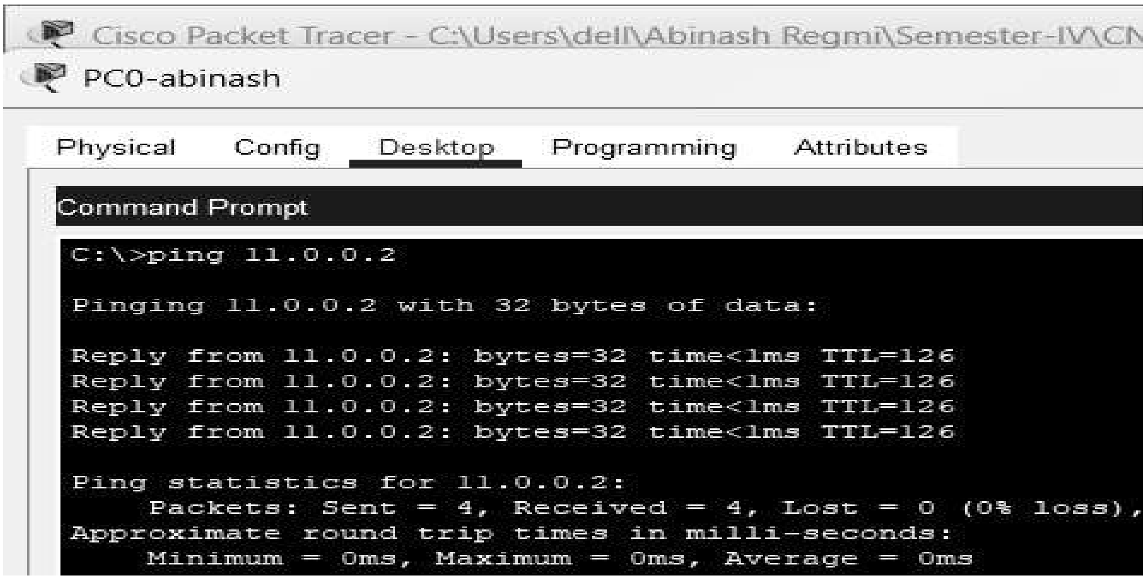

Fig: Connectivity test from PC0-abinash to PC1-abinash

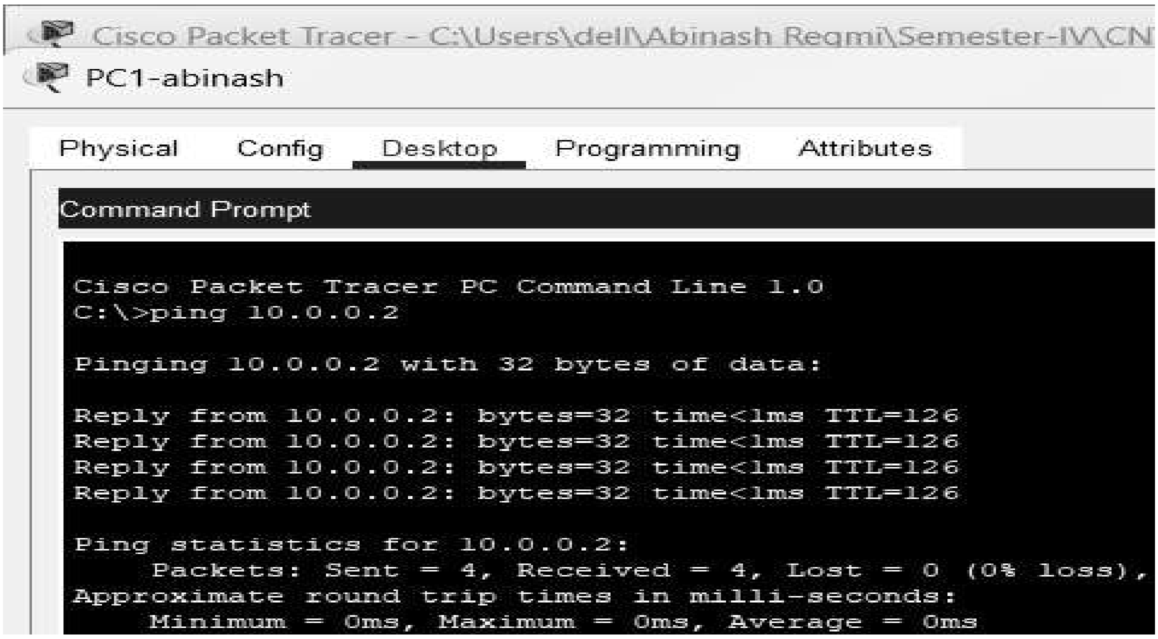

Fig: Connectivity test between PC1-abinash to PC0-abinash

Above figure shows the results of a ping test between two PCs on a network. The ping test was successful, indicating that there is connectivity between the two devices. The output of the ping test shows the number of packets sent, received, and lost, as well as the approximate round trip time for each packet.

Using OSPF Command

Network Diagram

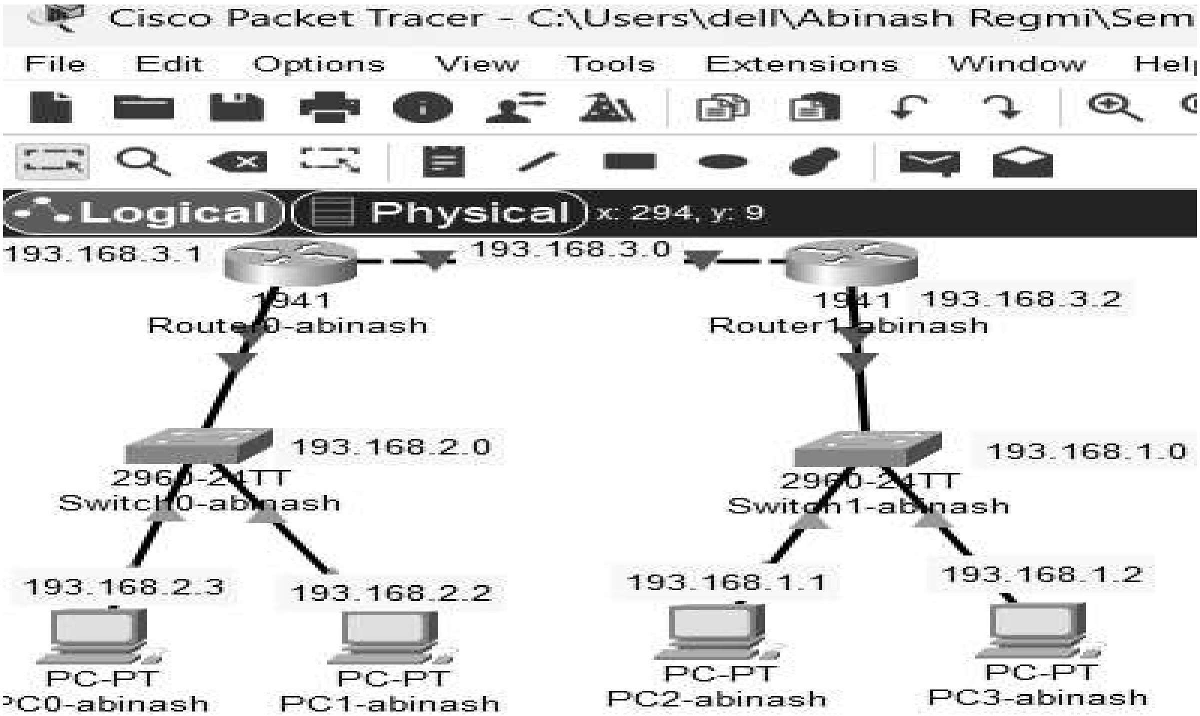

Fig: Network Diagram

Code for Dynamic Routing Configuration Using OSPF Command

For Router0

Router>enable

Router#config t

Router(config)#router ospf 1

Router(config-router)#network 193.168.1.0 0.0.0.255 area 0

Router(config-router)#network 193.168.3.0 0.0.0.255 area 0

Router(config-router)#exit

For Router1

Router>enable

Router#config t

Router(config)#router ospf 2

Router(config-router)#network 193.168.2.0 0.0.0.255 area 0

Router(config-router)#network 193.168.3.0 0.0.0.255 area 0

Router(config-router)#exit

Steps for Dynamic Routing Configuration using OSPF command

Step 1: Access the Router CLI

- ❖ Open Packet Tracer.
- ❖ Click on the router we want to configure to access its CLI (Command Line Interface).

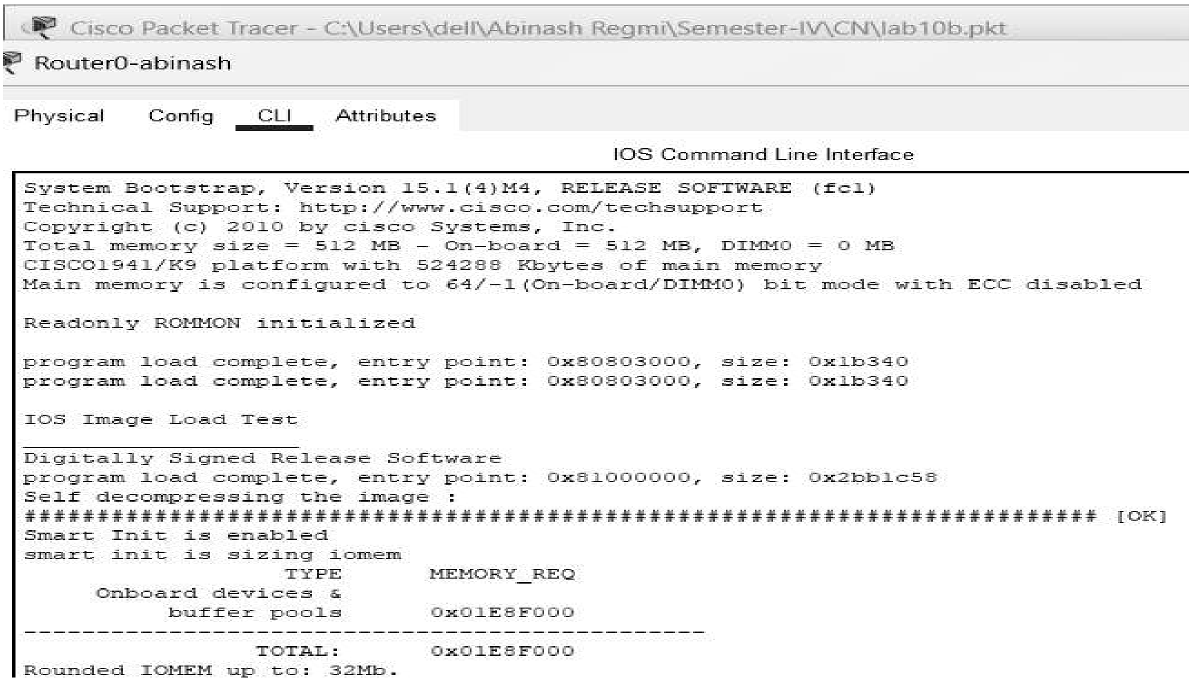

Fig: Accessing Router Command-Line Interface via Console Cable

Step 2: Enter Global Configuration Mode

- ➢ Enable OSPF Routing Protocol
- ➢ Start the OSPF process and assign it a process ID
- ➢ Assign a router ID
- ➢ Specify the networks connected to Router 1, and define the areas.
- ➢ Exit OSPF configuration.

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 193.168.1.0 0.0.0.255 area 0
Router(config-router)#network 193.168.3.0 0.0.0.255 area 0
Router(config-router)#exit
```

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 2
Router(config-router)#network 193.168.2.0 0.0.0.255 area 0
Router(config-router)#network 193.168.3.0 0.0.0.255 area 0
Router(config-router)#exit
```

Fig: Router configuration for router0 and router1 using OSPF command

Testing

To test whether the network is working, we can ping other devices on the network from each PC. If the ping is successful, we should see replies from the other device.

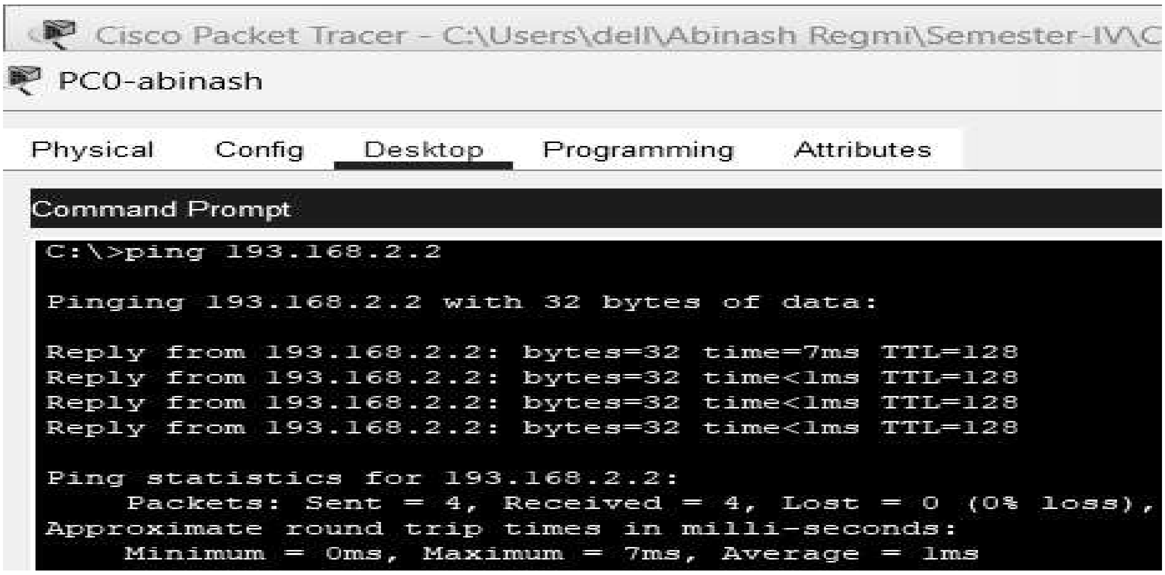

Fig: Connectivity test from PC0-abinash to PC1-abinash

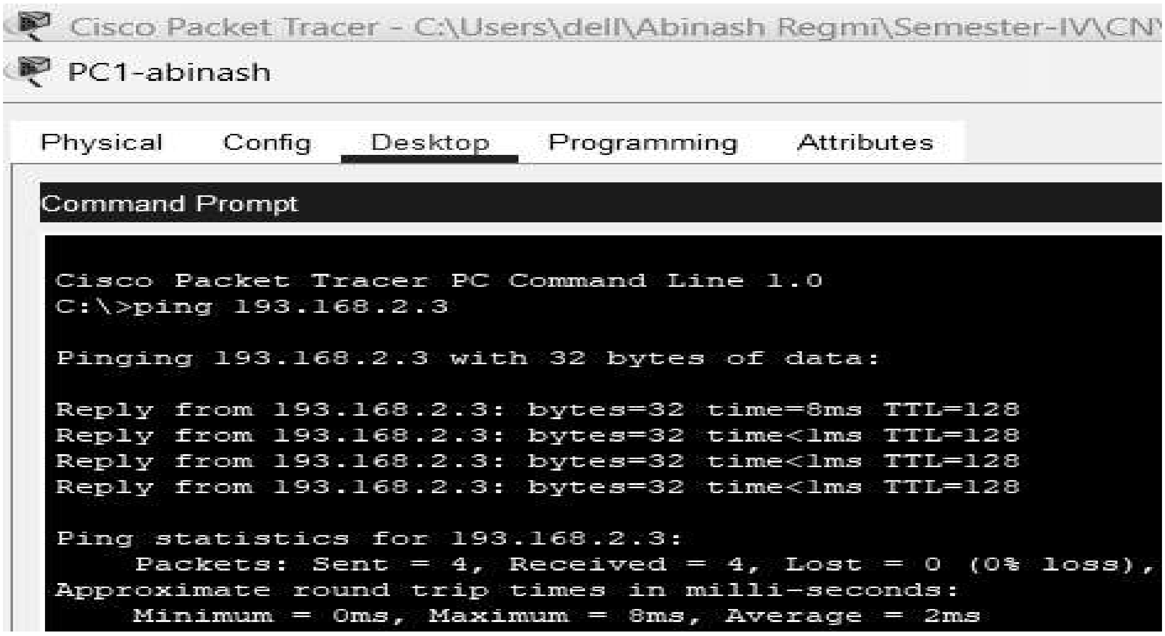

Fig: Connectivity test from PC1-abinash to PC0-abinash

Above figure shows the results of a ping test between two PCs on a network. The ping test was successful, indicating that there is connectivity between the two devices. The ping output of the ping test shows the number of packets sent, received, and lost, as well as the approximate round trip time for each packet.

Addressing Table:

The addressing table of the OSPF configuration is as follows:

Device	Interface	IPv4 Address	Subnet	Router no.
PC0	NIC	193.168.2.3	255.255.255.0	0
PC1	NIC	193.168.2.2	255.255.255.0	0
PC2	NIC	193.168.1.1	255.255.255.0	1
PC3	NIC	193.168.1.2	255.255.255.0	1

Using BGP Command

Network Diagram

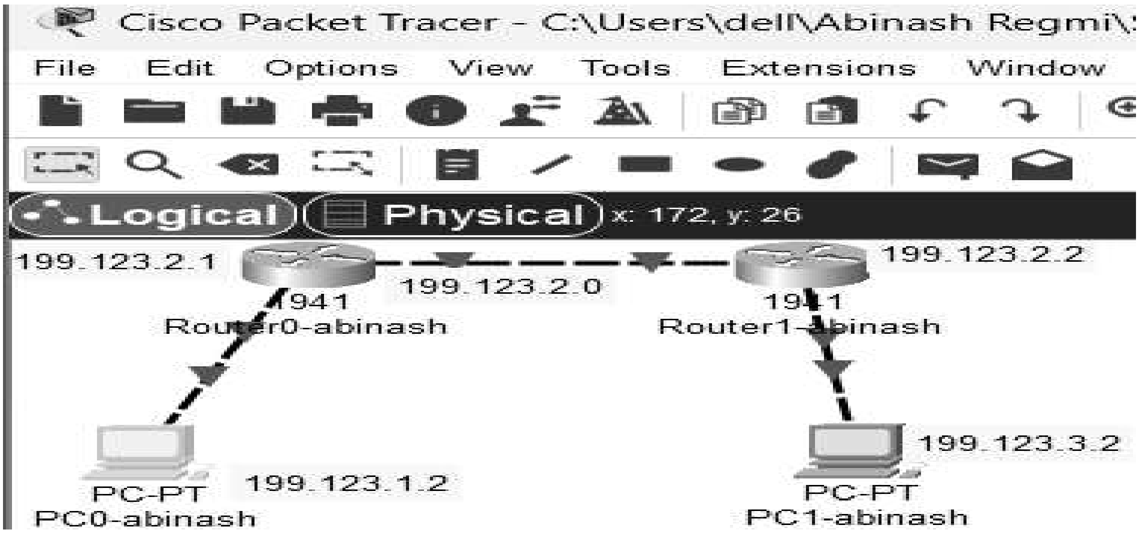

Fig: Network Diagram

Code for Dynamic Routing Configuration Using BGP Command

For Router 0

Router0> enable

Router0# configure terminal

Router(config)# router bgp 420

Router(config-router)# network 199.123.1.0

Router(config-router)# network 199.123.2.0

Router(config-router)# neighbor 199.123.2.2 remote-as 520

Router(config-router)# neighbor 199.123.3.2 remote-as 520

Router(config-router)# exit

For Router1

Router0> enable

Router0# configure terminal

Router(config)# router bgp 420

Router(config-router)# network 199.123.1.0

Router(config-router)# network 199.123.2.0

Router(config-router)# neighbor 199.123.2.1 remote-as 520

Router(config-router)# neighbor 199.123.1.2 remote-as 520

Router(config-router)# exit

Steps For Dynamic Routing Configuration Using BGP Command

Step 1: Access the Router CLI

- ✓ Open Packet Tracer
- ✓ Click on the router we want to configure to access its CLI (Command Line Interface).

Fig: Accessing Router CLI via Console Cable

Step 2: Enter Global Configuration Mode

- Enable BGP Routing Protocol
- Start the BGP process and specify the AS number
- Configure Neighbor

- Advertise Networks
- Exit BGP configuration

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router bgp 420
Router(config-router)#network 199.123.1.0
Router(config-router)#network 199.123.2.0
Router(config-router)#neighbor 199.123.2.2 remote-as 520
Router(config-router)#neighbor 199.123.3.2 remote-as 520
Router(config-router)#exit
```

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router bgp 420
Router(config-router)#network 199.123.1.0
Router(config-router)#network 199.123.2.0
Router(config-router)#neighbor 199.123.2.2 remote-as 520
Router(config-router)#neighbor 199.123.3.2 remote-as 520
Router(config-router)#exit
```

Fig: Router configuration for router0 and router1 using BGP command

Testing

To test whether the network is working, we can ping other devices on the network from each PC. If the ping is successful, we should see replies from the other device.

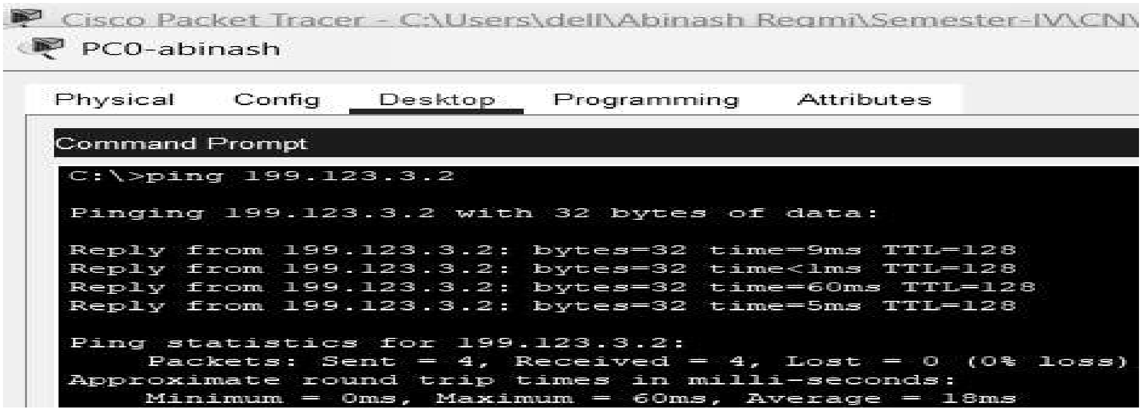

Fig: Connectivity test from PC0-abinash to PC1-abinash

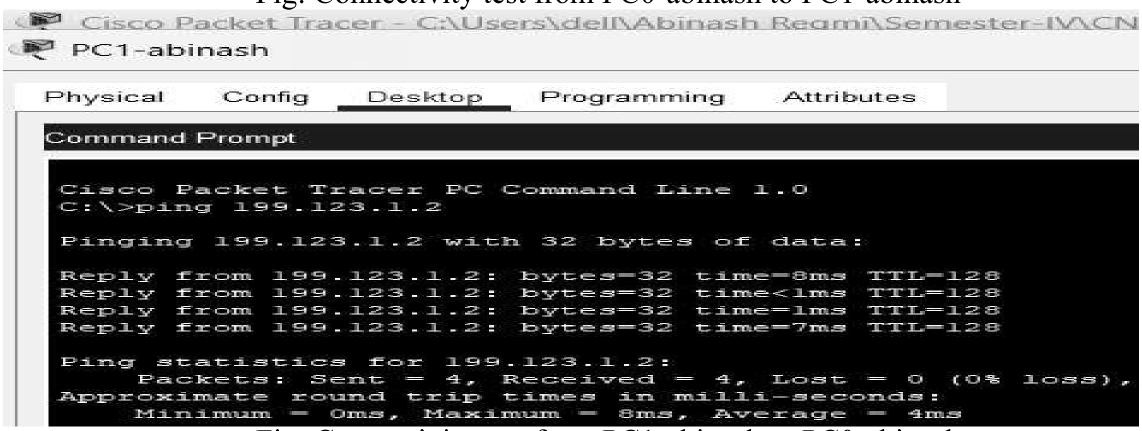

Fig: Connectivity test from PC1-abinash to PC0-abinash

Above figure shows the results of a ping test between two PCs on a network. The ping test was successful, indicating that there is connectivity between the two devices. The output of the ping test shows the number of packets sent, received, and lost, as well as the approximate round trip time for each packet.

Addressing Table:

The addressing table of the BGP Configuration is as follows:

Device	Interface	IPv4 Address	Subnet	Router No	Link
PC0	NIC	199.123.1.2	255.255.255.0	0	Access
PC1	NIC	199.123.3.2	255.255.255.0	1	Access

Conclusion

In this lab, we implemented dynamic routing protocols RIP, OSPF and BGP to automate route updates and maintain efficient network connectivity. RIP's simplicity makes it suitable for smaller networks, while OSPF's faster convergence and scalability handle larger, more complex networks effectively. BGP plays a crucial role in exterior routing, managing inter-AS communication and supporting global internet traffic. Through successful ping tests, we verified proper network configuration and confirmed the seamless operation of these protocols.