



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

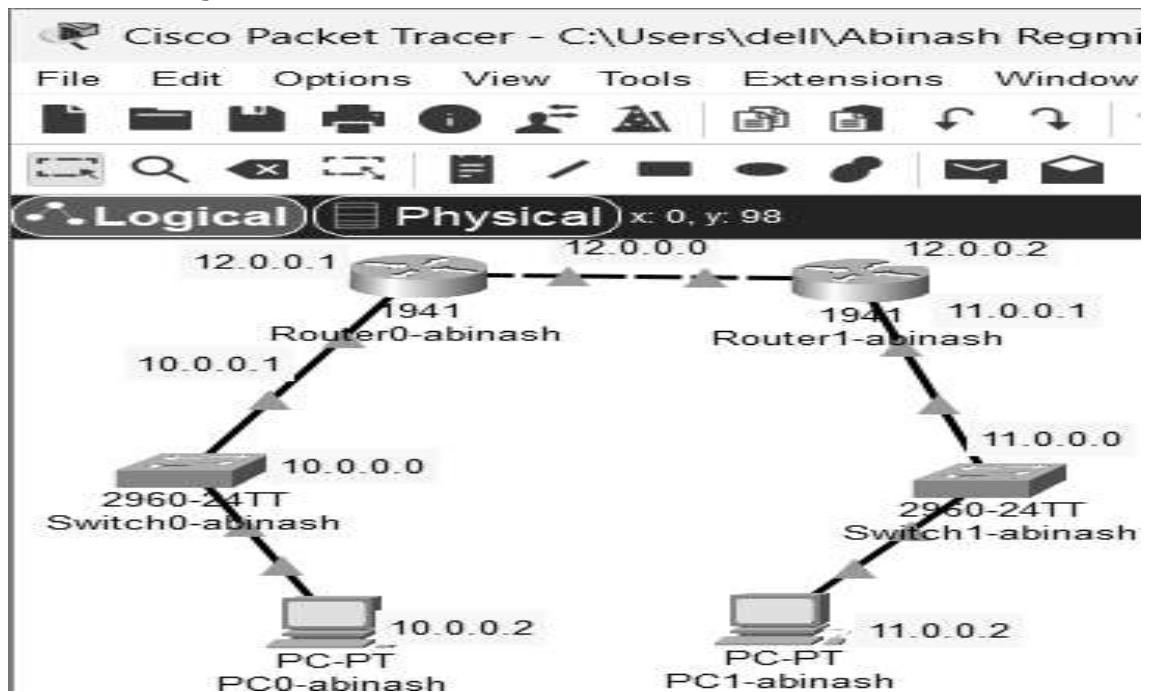


Fig: Network Diagram

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.

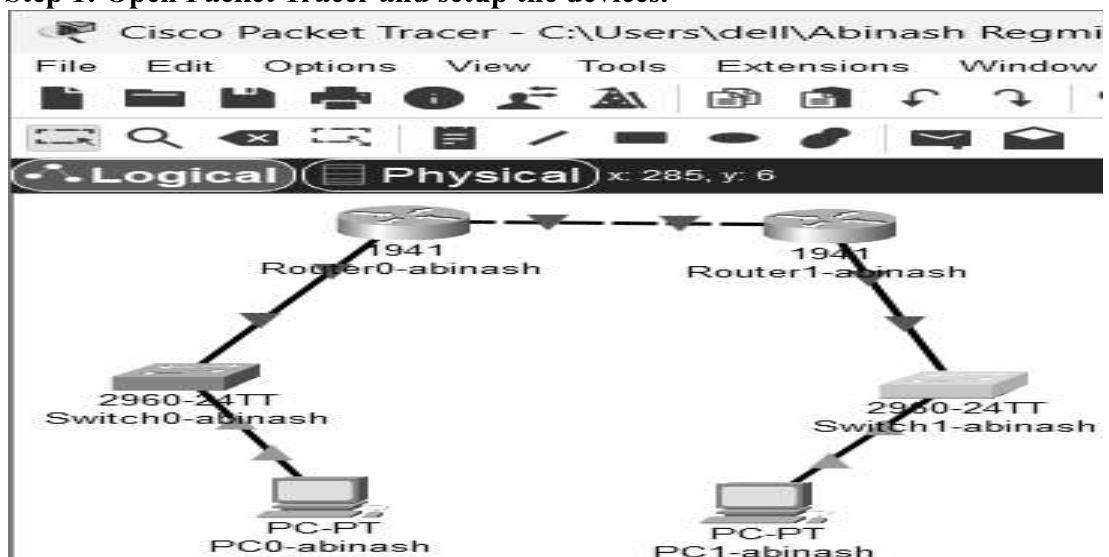


fig: Simple Network setup

Step 2: Assign IP addresses to each PC.

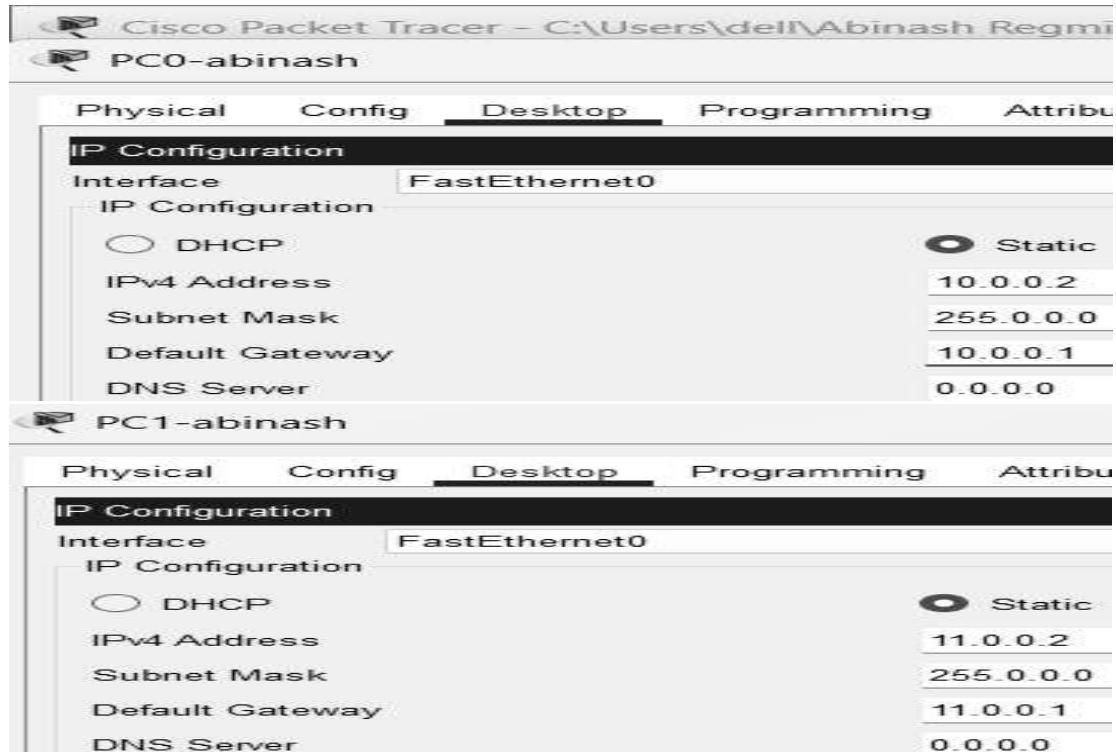


Fig: IP configuration

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 Selection:** 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

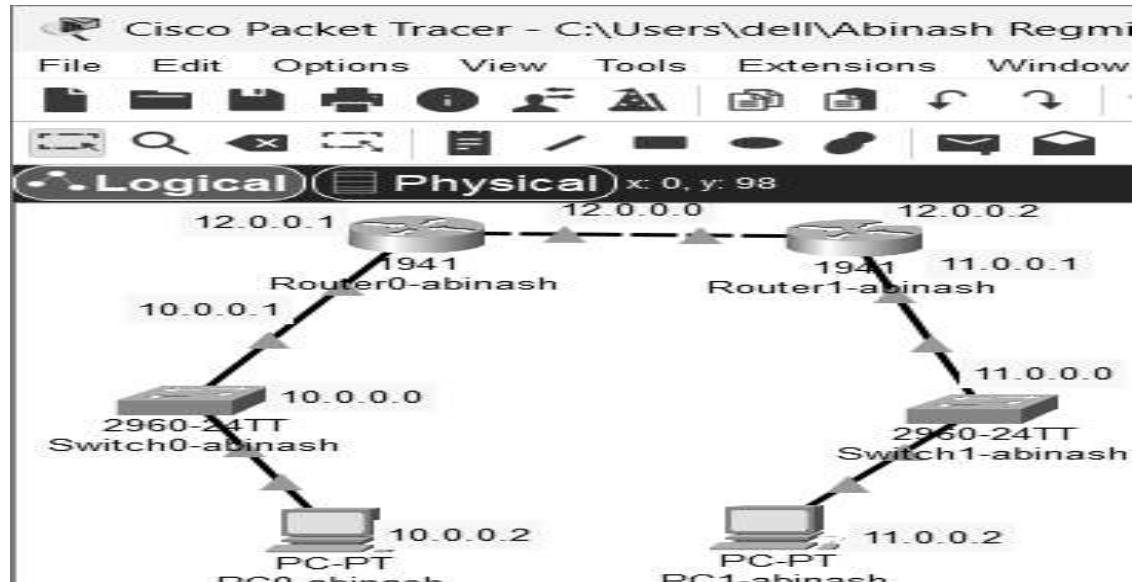


fig: Network Diagram

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).

```
Cisco Packet Tracer - C:\Users\dell\Abinash Regmi\Semester-IV\CN\lab10a.pkt
Router0-abinash

Physical Config CLI Attributes

IOS Command Line Interface

#####
Smart Init is enabled [OK]
smart init is sizing iomem
    TYPE      MEMORY_REQ
    Onboard devices & buffer pools      0x01E8F000
-----
    TOTAL:      0x01E8F000
Rounded IOMEM up to: 32Mb.
Using 6 percent iomem. [32Mb/512Mb]

Restricted Rights Legend
Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subparagraph (c) of the Commercial Computer Software - Restricted Rights clause at FAR sec. 52.227-19 and subparagraph (c) (1) (iii) of the Rights in Technical Data and Computer Software clause at DFARS sec. 252.227-7013.
cisco Systems, Inc.
170 West Tasman Drive
San Jose, California 95134-1706

Cisco IOS Software, C1900 Software (C1900-UNIVERSALK9-M), Version 15.1(4)M4, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Thurs 5-Jan-12 15:41 by pt_team
Image text-base: 0x2100F918, data-base: 0x24729040

This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply
```

fig: Accessing Router CLI via Console Cable

Step 2: Enter Global Configuration Mode

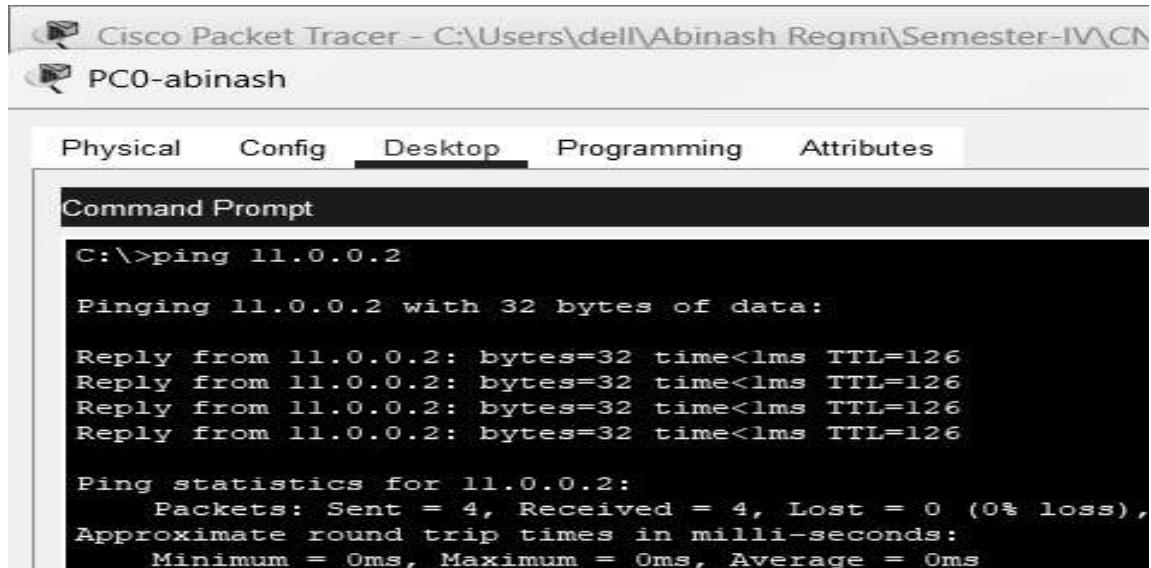
- Enable RIP Routing Protocol
- Specify the RIP Version
- Configure the RIP Networks
- Exit RIP Configuration Mode

```
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(config-router)#
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)#
Router>
```

Fig: Router configuration of router0 and router1 using RIP 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.



The screenshot shows the Cisco Packet Tracer interface. The title bar reads "Cisco Packet Tracer - C:\Users\dell\Abinash Regmi\Semester-IV\CN". Below the title bar, there are five tabs: Physical, Config, Desktop, Programming, and Attributes. The "Desktop" tab is currently selected. In the main window, there is a "Command Prompt" window titled "PC0-abinash". The command entered is "C:\>ping 11.0.0.2". The output of the ping test is displayed, showing four successful replies from the target IP address. The ping statistics show 0% loss and minimum, maximum, and average round trip times of 0ms.

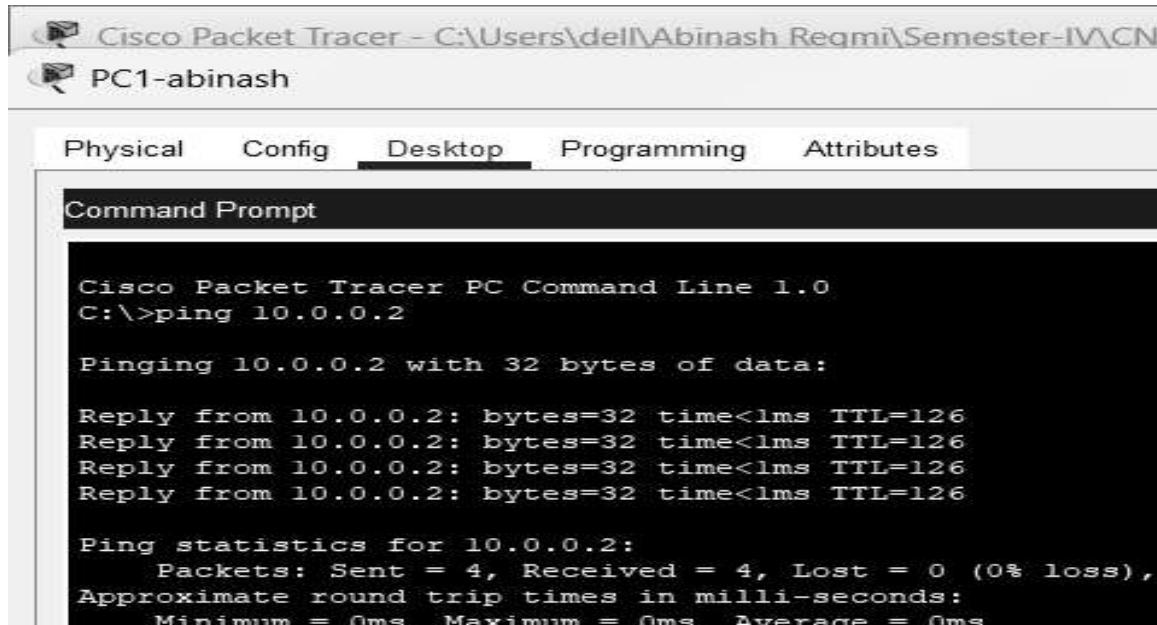
```
C:\>ping 11.0.0.2

Pinging 11.0.0.2 with 32 bytes of data:

Reply from 11.0.0.2: bytes=32 time<1ms TTL=126

Ping statistics for 11.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

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



The screenshot shows the Cisco Packet Tracer interface. The title bar reads "Cisco Packet Tracer - C:\Users\dell\Abinash Regmi\Semester-IV\CN". Below the title bar, there are five tabs: Physical, Config, Desktop, Programming, and Attributes. The "Desktop" tab is currently selected. In the main window, there is a "Command Prompt" window titled "PC1-abinash". The command entered is "C:\>ping 10.0.0.2". The output of the ping test is displayed, showing four successful replies from the target IP address. The ping statistics show 0% loss and minimum, maximum, and average round trip times of 0ms.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.0.0.2

Pinging 10.0.0.2 with 32 bytes of data:

Reply from 10.0.0.2: bytes=32 time<1ms TTL=126

Ping statistics for 10.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

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

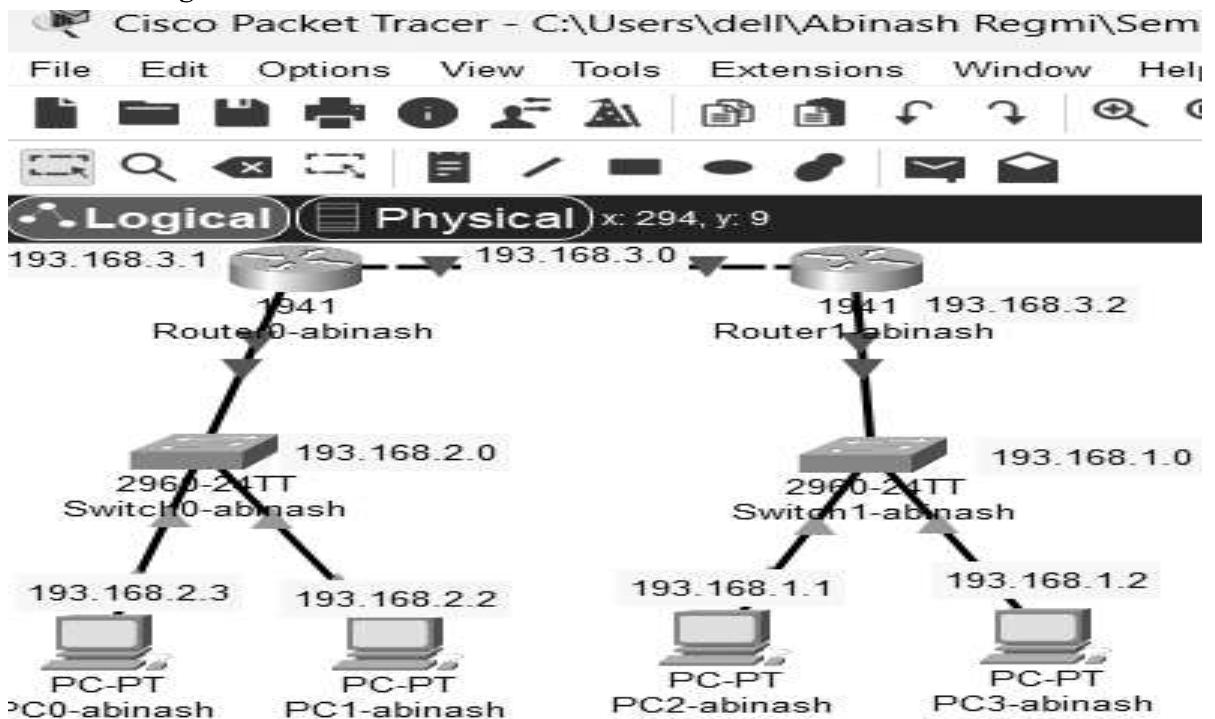


Fig: Network Diagram

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).

```
Cisco Packet Tracer - C:\Users\dell\Abinash Regmi\Semester-IV\CN\lab10b.pkt
Router0-abinash

Physical Config CLI Attributes

IOS Command Line Interface

System Bootstrap, Version 15.1(4)M4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2010 by cisco Systems, Inc.
Total memory size = 512 MB - On-board = 512 MB, DIMMO = 0 MB
CISCO1941/K9 platform with 524288 Kbytes of main memory
Main memory is configured to 64/-1(On-board/DIMMO) bit mode with ECC disabled

 Readonly ROMMON initialized

 program load complete, entry point: 0x80803000, size: 0xb340
 program load complete, entry point: 0x80803000, size: 0xb340

 IOS Image Load Test

 Digitally Signed Release Software
 program load complete, entry point: 0x81000000, size: 0x2bb1c58
 Self decompressing the image :
 ###### [OK]
 Smart Init is enabled
 smart init is sizing iomem
      TYPE      MEMORY_REQ
 Onboard devices &          0x01E8F000
 buffer pools
 -----
 TOTAL: 0x01E8F000
 Rounded IOMEM up to: 32Mb.
```

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.

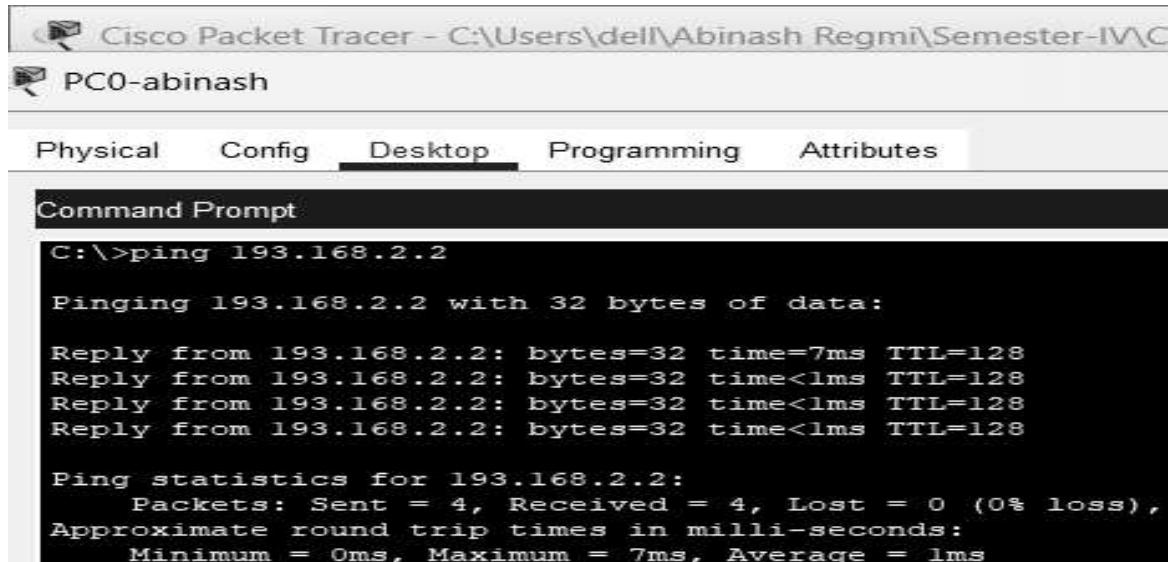
```
Router>enable
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 193.168.1.0 0.0.0.255 area 0
Router(config-router)#network 193.168.3.0 0.0.0.255 area 0
Router(config-router)#exit

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.



Cisco Packet Tracer - C:\Users\dell\Abinash Regmi\Semester-IV\C

PC0-abinash

Physical Config Desktop Programming Attributes

Command Prompt

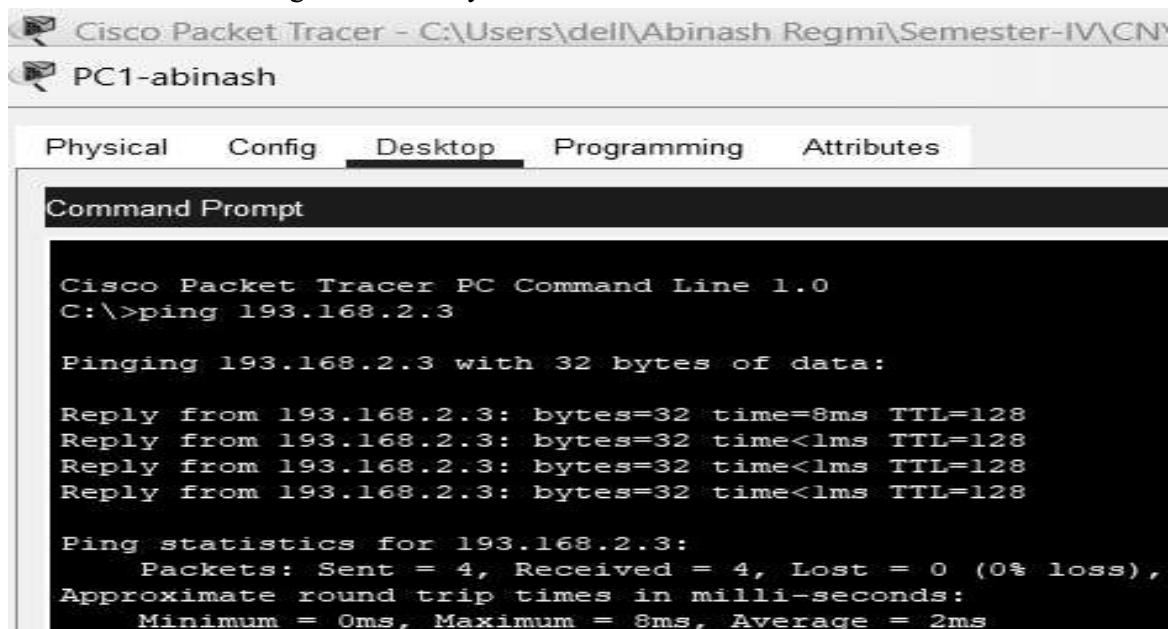
```
C:\>ping 193.168.2.2

Pinging 193.168.2.2 with 32 bytes of data:

Reply from 193.168.2.2: bytes=32 time=7ms TTL=128
Reply from 193.168.2.2: bytes=32 time<1ms TTL=128
Reply from 193.168.2.2: bytes=32 time<1ms TTL=128
Reply from 193.168.2.2: bytes=32 time<1ms TTL=128

Ping statistics for 193.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 7ms, Average = 1ms
```

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



Cisco Packet Tracer - C:\Users\dell\Abinash Regmi\Semester-IV\CN

PC1-abinash

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 193.168.2.3

Pinging 193.168.2.3 with 32 bytes of data:

Reply from 193.168.2.3: bytes=32 time=8ms TTL=128
Reply from 193.168.2.3: bytes=32 time<1ms TTL=128
Reply from 193.168.2.3: bytes=32 time<1ms TTL=128
Reply from 193.168.2.3: bytes=32 time<1ms TTL=128

Ping statistics for 193.168.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 8ms, Average = 2ms
```

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

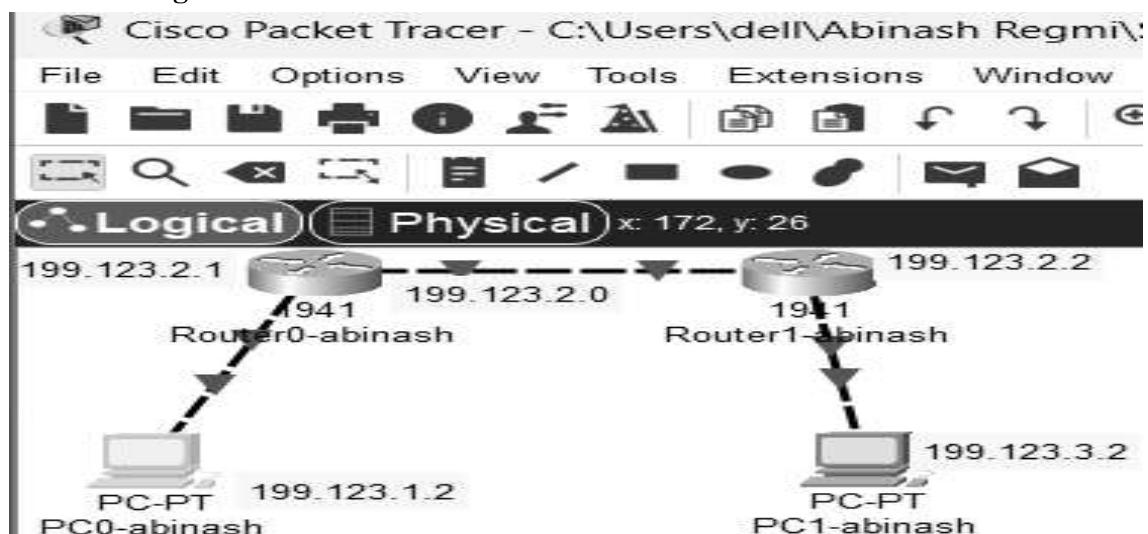


Fig: Network Diagram

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).

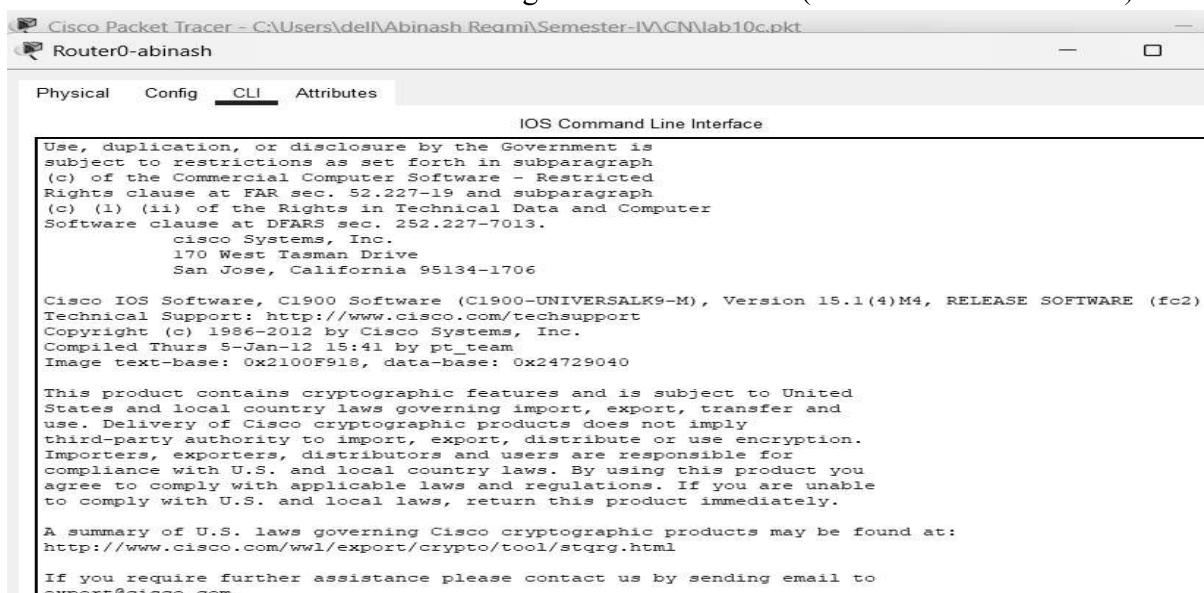


Fig: Accessing Router CLI via Console Cable

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.

```

Cisco Packet Tracer - C:\Users\dell\Abinash Reami\Semester-IV\CN
PC0-abinash

Physical Config Desktop Programming Attributes

Command Prompt
C:\>ping 199.123.3.2

Pinging 199.123.3.2 with 32 bytes of data:

Reply from 199.123.3.2: bytes=32 time=9ms TTL=128
Reply from 199.123.3.2: bytes=32 time<1ms TTL=128
Reply from 199.123.3.2: bytes=32 time=60ms TTL=128
Reply from 199.123.3.2: bytes=32 time=5ms TTL=128

Ping statistics for 199.123.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 60ms, Average = 18ms

```

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

```

Cisco Packet Tracer - C:\Users\dell\Abinash Reami\Semester-IV\CN
PC1-abinash

Physical Config Desktop Programming Attributes

Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 199.123.1.2

Pinging 199.123.1.2 with 32 bytes of data:

Reply from 199.123.1.2: bytes=32 time=8ms TTL=128
Reply from 199.123.1.2: bytes=32 time<1ms TTL=128
Reply from 199.123.1.2: bytes=32 time=1ms TTL=128
Reply from 199.123.1.2: bytes=32 time=7ms TTL=128

Ping statistics for 199.123.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 8ms, Average = 4ms

```

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.