LAB 6: DYNAMIC ROUTING CONFIGURATION: RIP, EIGRP, OSPF, BGP

OBJECTIVES:

The objectives of this lab are:

- To understand the concept of dynamic routing.
- To configure RIP, EIGRP, OSPF and BGP routing protocols.
- To study the working mechanism of each routing protocol.
- To compare different dynamic routing protocols.
- To verify routing using routing tables and connectivity tests.

HARDWARE AND SOFTWARE REQUIREMENTS

1. Cisco Packet Tracer
2. Windows PC/Laptop

THEORY:

Dynamic Routing

Dynamic routing is a routing technique in which routers automatically learn and update routes using routing protocols. Routers exchange routing information and select the best path based on protocol metrics.

Advantages of Dynamic Routing

- Automatically adapts to network changes
- Suitable for large networks
- Less manual configuration

Disadvantages

- More CPU and bandwidth usage
- More complex than static routing

ROUTING PROTOCOL OVERVIEW

- **RIP**

RIP is a dynamic distance-vector routing protocol used to exchange routing information within a network. It uses hop count as its metric to determine the best path, and the route with the least number of hops is selected. RIP has a maximum hop count of 15, which limits the size of the network. Routers using RIP periodically share their entire routing tables with neighboring routers, usually every 30 seconds. Due to its simplicity, RIP is easy to configure but is not suitable for large or complex networks.

Working of RIP (Routing Information Protocol)

RIP works by sharing routing information periodically between neighboring routers. Each router sends its entire routing table every 30 seconds. The best path is selected based on the lowest hop count. If a route exceeds 15 hops, it is considered unreachable. When a link fails, RIP updates are sent to inform other routers, but convergence is slow.

- **EIGRP**

EIGRP is an advanced dynamic routing protocol developed by Cisco. It uses the DUAL (Diffusing Update Algorithm) to ensure fast convergence and loop-free routing. EIGRP selects the best route based on metrics such as bandwidth, delay, reliability, and load. It maintains neighbor, topology, and routing tables, which helps in efficient route selection. EIGRP is highly scalable and performs better than RIP in large networks.

Working of EIGRP (Enhanced Interior Gateway Routing Protocol)

EIGRP works using the DUAL algorithm, which ensures fast and loop-free routing. Routers discover neighbors and exchange routing information only when changes occur. The best route is selected based on bandwidth and delay. EIGRP maintains neighbor, topology, and routing tables, allowing quick recovery when a link fails.

- **OSPF**

OSPF is a link-state dynamic routing protocol that uses cost as its routing metric. It works by exchanging link-state advertisements (LSAs) to build a complete map of the network topology. Using Dijkstra's shortest path algorithm, OSPF calculates the most efficient path to each destination. It supports hierarchical routing using areas, which improves scalability and performance in large enterprise networks.

Working of OSPF (Open Shortest Path First)

OSPF works by exchanging link-state advertisements (LSAs) to build a complete network topology. Each router calculates the shortest path using Dijkstra's algorithm. Routes are selected based on cost, which depends on bandwidth. OSPF supports areas, which reduces routing overhead and improves scalability.

- **BGP**

BGP is a path-vector routing protocol used to exchange routing information between different Autonomous Systems (AS). It selects routes based on various attributes such as AS path, next-hop, and policies, rather than simple metrics. BGP uses TCP port 179, ensuring reliable communication. It is the core routing protocol of the Internet and is designed for scalability, stability, and policy-based routing.

Working of BGP (Border Gateway Protocol)

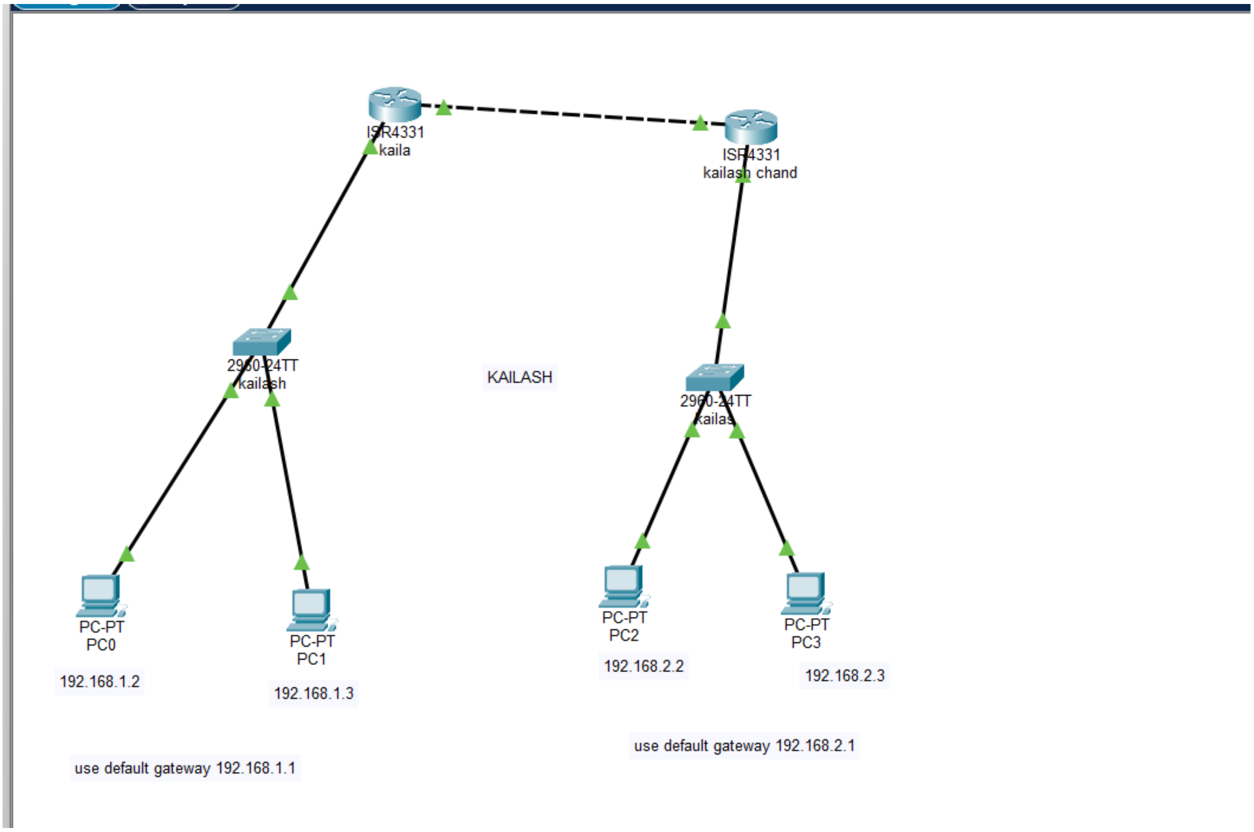
BGP works by exchanging routing information between routers in different Autonomous Systems. Routers establish a reliable connection using TCP port 179. The best path is selected based on attributes such as path and policies, not distance. BGP is designed for stable and scalable routing across the Internet.

PROCEDURE

- Design the network topology in Cisco Packet Tracer.
- Connect routers and PCs using appropriate cables.
- Assign IP addresses to all router interfaces and PCs.
- Enable router interfaces using no shutdown.
- Configure dynamic routing protocols (RIP / EIGRP / OSPF / BGP) on routers.
- Verify routing tables using show ip route.
- Test network connectivity using ping.

OBSERVATION

NETWORK TOPOLOGY



A topology was created using Router0(kaila) and Router1(Kailash chand) connected via a serial/WAN link. Switch0 connects PC0 and PC1 to Router0 (Network 192.168.1.0/24). Switch1 connects PC2 and PC3 to Router1 (Network 192.168.2.0/24)

CONFIGURATION TABLE

Device	**Interface**	**IPV4 address**	**Subnet mask**	**Default gateway**
Router 0	Gig0/1	192.168.1.1	255.255.255.0	N/A
Router 0	Gig0/0	10.0.0.1	255.0.0.0	N/A
Router 1	Gig0/0	10.0.0.2	255.0.0.0	N/A
Router 1	Gig0/1	192.168.2.1	255.255.255.0	N/A
PC0	FastEthernet0	192.168.1.2	255.255.255.0	192.168.1.1
PC1	FastEthernet0	192.168.1.3	255.255.255.0	192.168.1.1
PC2	FastEthernet0	192.168.2.2	255.255.255.0	192.168.2.1
PC3	FastEthernet0	192.168.2.3	255.255.255.0	192.168.2.1

CONFIGURATION COMMANDS

1.RIP Configuration Commands

Router0:

Router(config)# router rip

Router(config-router)# version 2

Router(config-router)# network 192.168.1.0

Router(config-router)# network 10.0.0.0

Router(config-router)# no auto-summary

Router1:

Router(config)# router rip

Router(config-router)# version 2

Router(config-router)# network 192.168.2.0

Router(config-router)# network 10.0.0.0

Router(config-router)# no auto-summary

2. EIGRP Configuration Commands

Router0:

Router(config)# router eigrp 100

Router(config-router)# network 192.168.1.0 0.0.0.255

Router(config-router)# network 10.0.0.0 0.0.0.255

Router(config-router)# no auto-summary

Router1:

Router(config)# router eigrp 100

Router(config-router)# network 192.168.2.0 0.0.0.255Router(config-router)# network 10.0.0.0 0.0.0.255

Router(config-router)# no auto-summary

3. OSPF Configuration Commands

Router0:

Router(config)# router ospf 1

Router(config-router)# network 192.168.1.0 0.0.0.255 area 0

Router(config-router)# network 10.0.0.0 0.0.0.255 area 0

Router1:

Router(config)# router ospf 1

Router(config-router)# network 192.168.2.0 0.0.0.255 area 0

Router(config-router)# network 10.0.0.0 0.0.0.255 area 0

4. BGP Configuration Commands

Router0 (AS 65001):

Router(config)# router bgp 65001

Router(config-router)# neighbor 10.0.0.2 remote-as 65002

Router(config-router)# network 192.168.1.0 mask 255.255.255.0

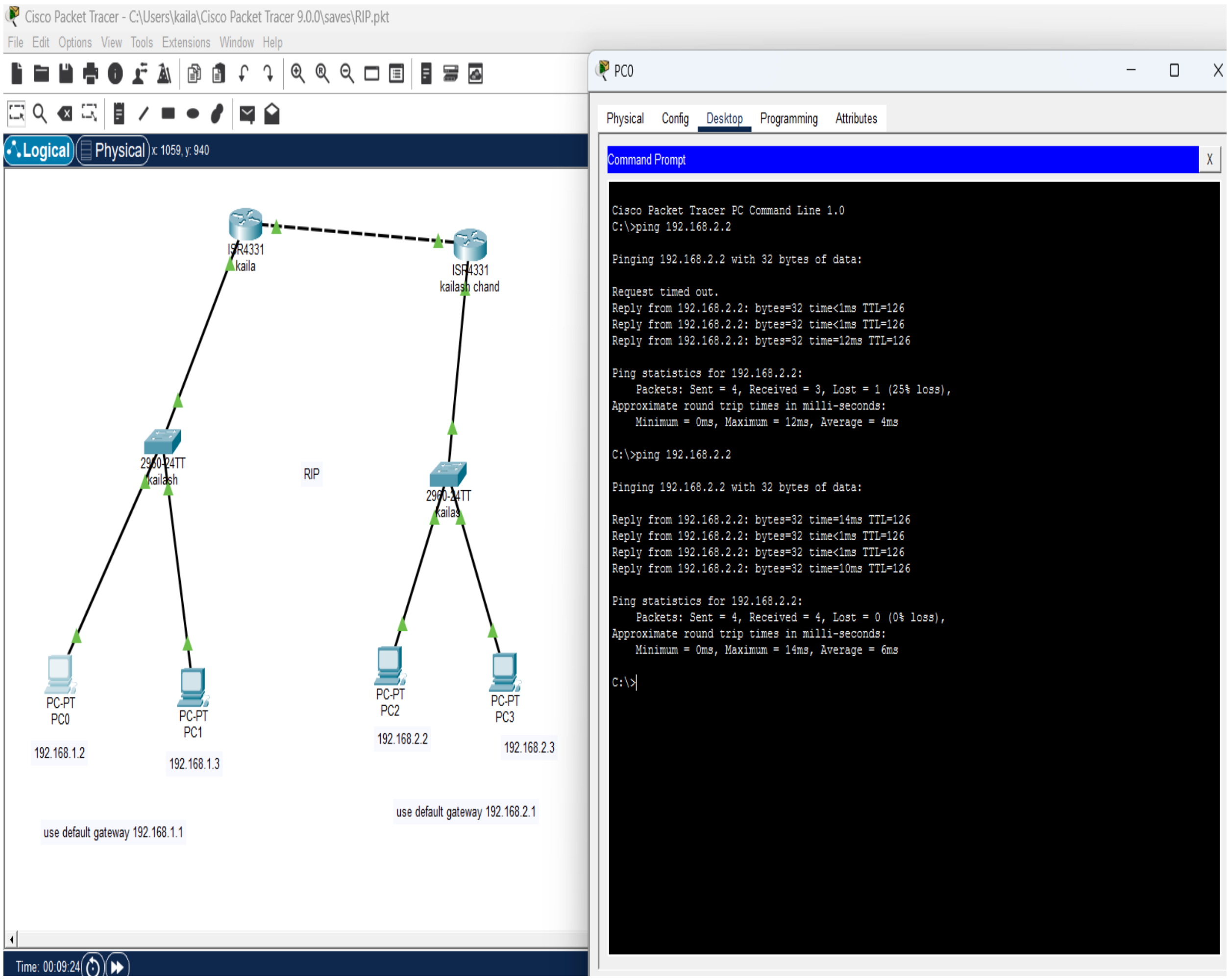
Router1 (AS 65002):

Router(config)# router bgp 65002

Router(config-router)# neighbor 10.0.0.1 remote-as 65001

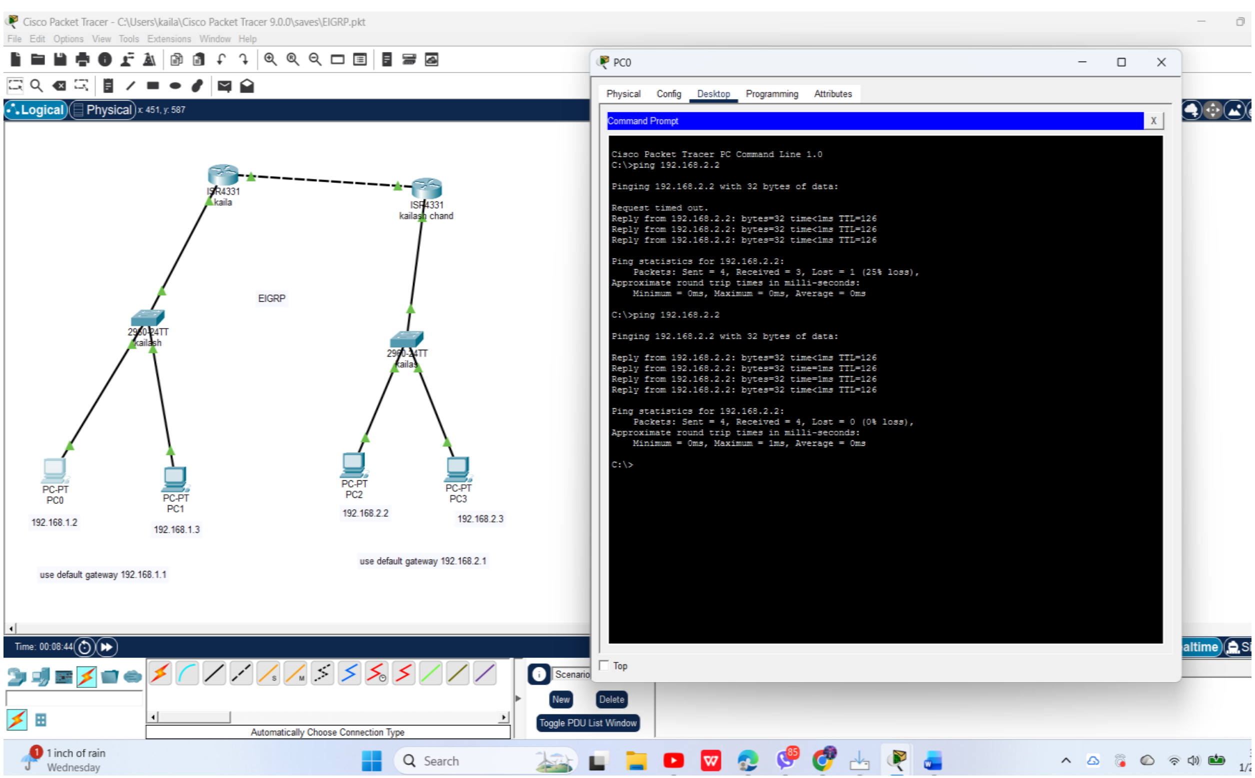
Router(config-router)# network 192.168.2.0 mask 255.255.255.0

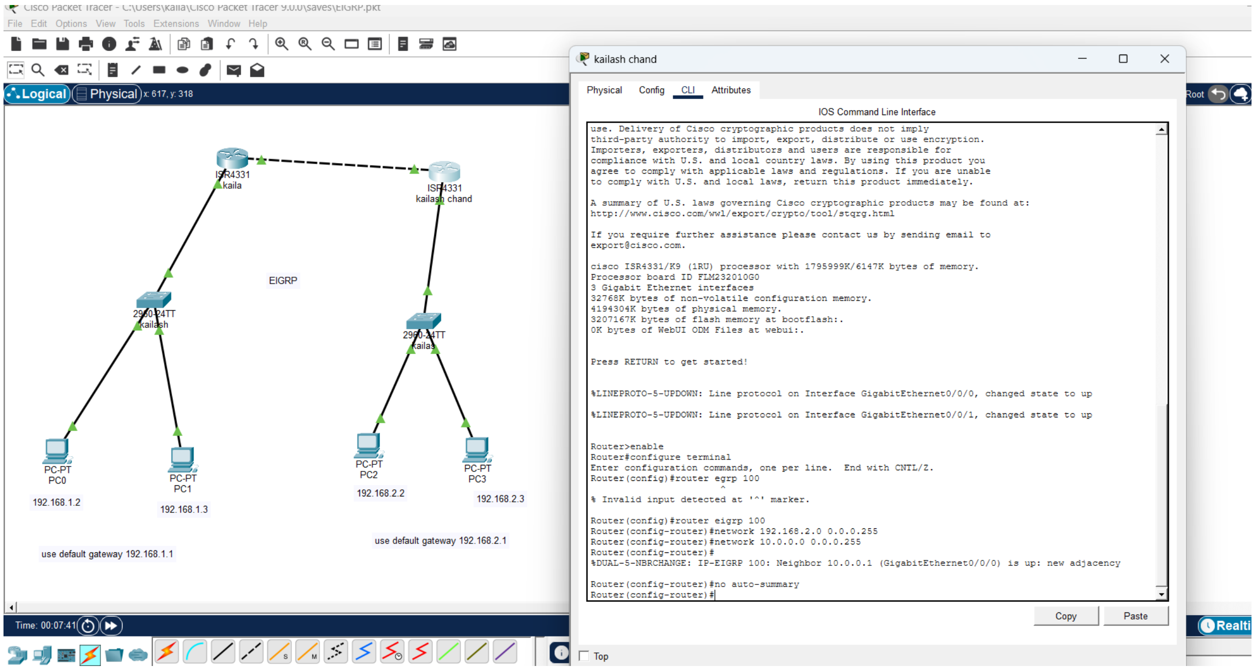
RIP


Cisco Packet Tracer - C:\Users\kaila\Cisco Packet Tracer 9.0.0\saves\RIP.pkt
File Edit Options View Tools Extensions Window Help
Logical
Physical
x: 1059, y: 940
ISR4331
kaila
ISR4331
kailash chand
2960-24TT
kailash
RIP
2960-24TT
kailas
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2
PC-PT
PC3
192.168.1.2
192.168.1.3
192.168.2.2
192.168.2.3
use default gateway 192.168.2.1
use default gateway 192.168.1.1
Time: 00:09:24
PC0
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time=12ms TTL=126
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 12ms, Average = 4ms
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time=14ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time=10ms TTL=126
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 14ms, Average = 6ms
C:\>

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

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/1, changed state to up


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 192.168.1.0
Router(config-router)#network 10.0.0.0
Router(config-router)#no auto-summary
Router(config-router)#
Router(config-router)#end
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#
%SYS-5-CONFIG_I: Configured from console by console

Router(config-router)#end
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#
%SYS-5-CONFIG_I: Configured from console by console

Router(config-router)#end
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#
%SYS-5-CONFIG_I: Configured from console by console

Router(config)#router rip
Router(config-router)#
Router(config-router)#end
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#
%SYS-5-CONFIG_I: Configured from console by console
```

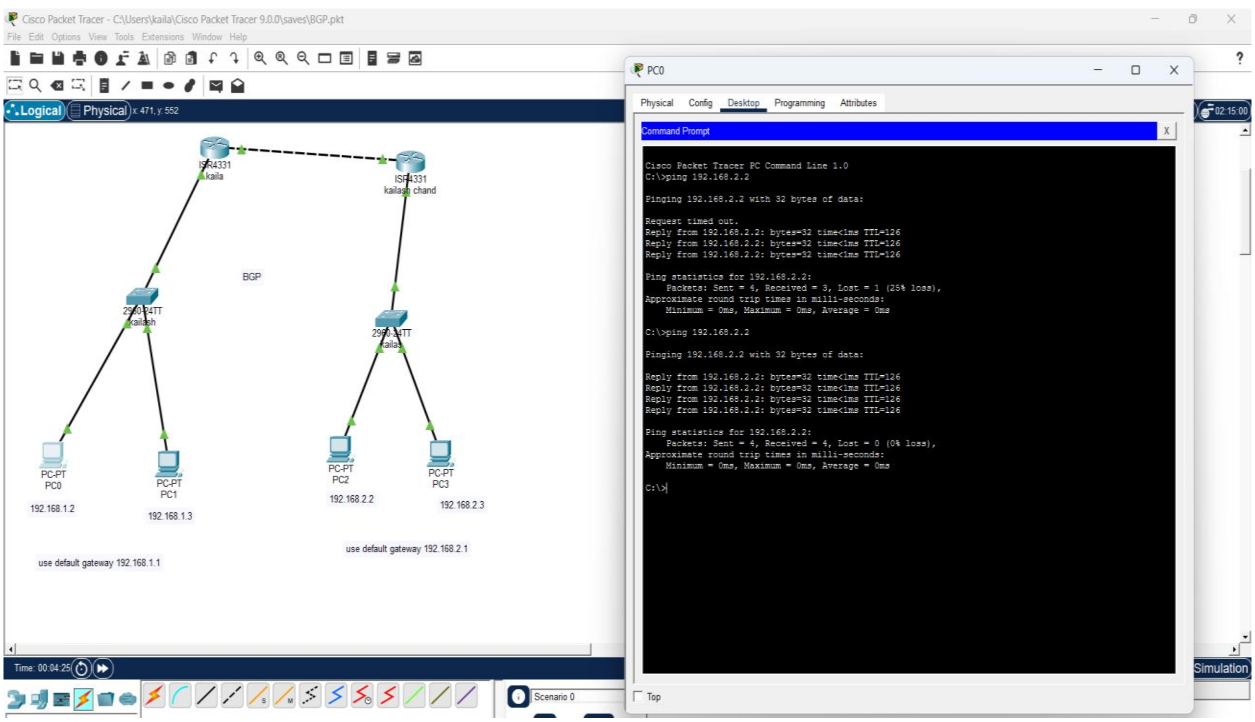
EIGRP





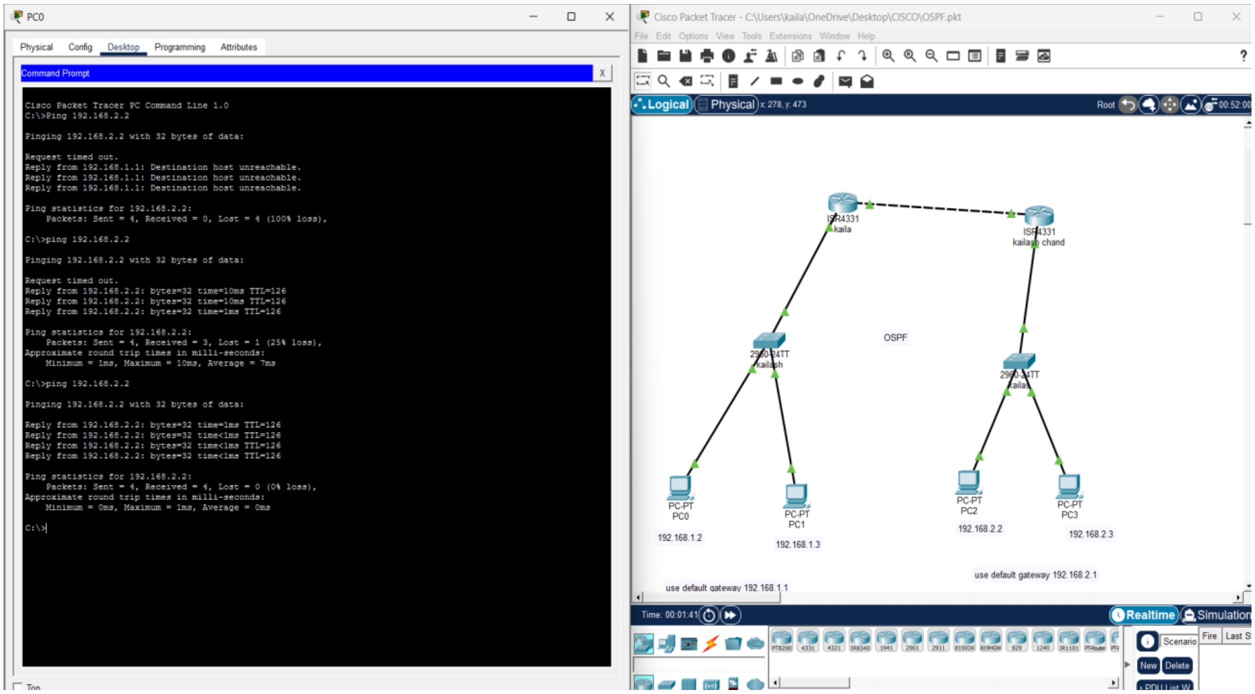
Cisco Packet Tracer - C:\Users\kaila\Cisco Packet Tracer 9.0.0\saves\EIGRP.pkt
ISR4331
kaila
ISR4331
kailash chand
EIGRP
2960-24TT
kailash
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2
PC-PT
PC3
192.168.1.2
192.168.1.3
192.168.2.2
192.168.2.3
use default gateway 192.168.1.1
use default gateway 192.168.2.1
kailash chand
Physical
Config
CLI
Attributes
IOS Command Line Interface
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.
A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html
If you require further assistance please contact us by sending email to
export@cisco.com.
cisco ISR4331/K9 (1RU) processor with 1795999K/6147K bytes of memory.
Processor board ID FLM232010G0
3 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
3207167K bytes of flash memory at bootflash:.
0K bytes of WebUI ODM Files at webui:.
Press RETURN to get started!
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/1, changed state to up
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router egrp 100
% Invalid input detected at '^' marker.
Router(config)#router eigrp 100
Router(config-router)#network 192.168.2.0 0.0.0.255
Router(config-router)#network 10.0.0.0 0.0.0.255
Router(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 10.0.0.1 (GigabitEthernet0/0/0) is up: new adjacency
Router(config-router)#no auto-summary
Router(config-router)#
Copy
Paste
Top

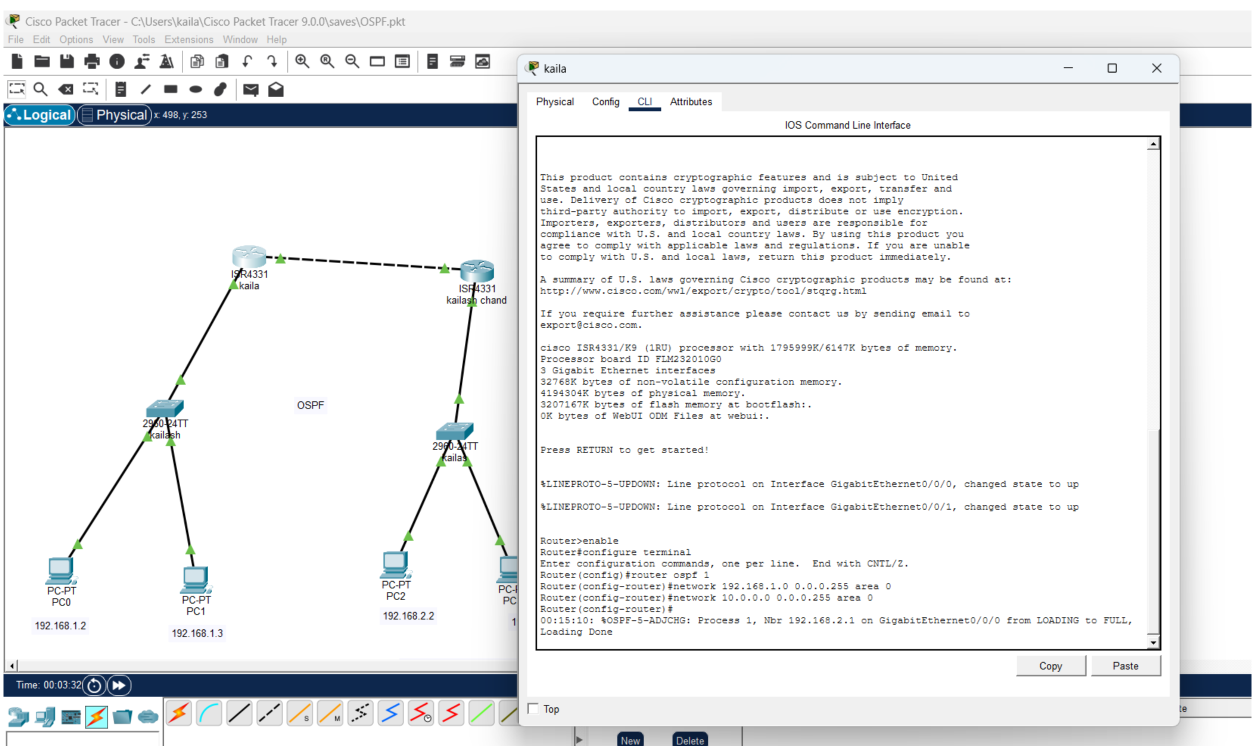
BGP



Cisco Packet Tracer - C:\Users\kaila\Cisco Packet Tracer 9.0.0\saves\BGP.pkt
ISR4331
kaila
ISR4331
kailash chand
BGP
2960-24TT
kailash
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2
PC-PT
PC3
192.168.1.2
192.168.1.3
192.168.2.2
192.168.2.3
use default gateway 192.168.1.1
use default gateway 192.168.2.1
PC0
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>
Top

<u>OSPF</u>


PC0
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>Ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Request timed out.
Reply from 192.168.2.2: bytes=32 time=10ms TTL=126
Reply from 192.168.2.2: bytes=32 time=10ms TTL=126
Reply from 192.168.2.2: bytes=32 time=1ms TTL=126
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 1ms, Maximum = 10ms, Average = 7ms
C:\>ping 192.168.2.2
Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time=1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Reply from 192.168.2.2: bytes=32 time<1ms TTL=126
Ping statistics for 192.168.2.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>
Cisco Packet Tracer - C:\Users\kaila\OneDrive\Desktop\CISCO\OSPF.pkt
Logical
Physical
ISR4331
kaila
ISR4331
kailash chand
OSPF
2960-24TT
kailash
PC-PT
PC0
192.168.1.2
PC-PT
PC1
192.168.1.3
PC-PT
PC2
192.168.2.2
PC-PT
PC3
192.168.2.3
use default gateway 192.168.1.1
use default gateway 192.168.2.1
Realtime
Simulation


Cisco Packet Tracer - C:\Users\kaila\Cisco Packet Tracer 9.0.0\saves\OSPF.pkt
Logical
Physical
ISR4331
kaila
ISR4331
kailash chand
OSPF
2960-24TT
kailash
PC-PT
PC0
192.168.1.2
PC-PT
PC1
192.168.1.3
PC-PT
PC2
192.168.2.2
kaila
Physical
Config
CLI
Attributes
IOS Command Line Interface
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
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.
A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html
If you require further assistance please contact us by sending email to
export@cisco.com.
cisco ISR4331/K9 (1RU) processor with 1795999K/6147K bytes of memory.
Processor board ID FLM232010G0
3 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
4194304K bytes of physical memory.
3207167K bytes of flash memory at bootflash:.
0K bytes of WebUI ODM Files at webui:.
Press RETURN to get started!
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/1, changed state to up
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 192.168.1.0 0.0.0.255 area 0
Router(config-router)#network 10.0.0.0 0.0.0.255 area 0
Router(config-router)#
00:15:10: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.1 on GigabitEthernet0/0/0 from LOADING to FULL, Loading Done
Copy
Paste
Top

PRECAUTION

- Ensure correct IP addressing and subnet masks.
- Use correct AS number and area ID while configuring protocols.
- Enable all router interfaces.
- Avoid IP address conflicts.
- Save the configuration after completion

RESULT

Dynamic routing protocols RIP, EIGRP, OSPF and BGP were successfully configured. Routers dynamically exchanged routing information and ensured connectivity between all networks.

CONCLUSION

This lab demonstrated the configuration and working of different dynamic routing protocols. RIP is simple but limited, EIGRP provides fast convergence, OSPF is scalable and efficient, while BGP is essential for inter-domain routing on the Internet.