LAB 6

Dynamic Routing Configurations : RIP, EIGRP, OSPF, BGP

OBJECTIVES

- To understand how routers can automatically identify distant networks and update routing tables without manually defining every route.
- To configure and study the behavior of RIP, EIGRP, OSPF, and BGP, with emphasis on how Distance Vector, Link-State, and Path Vector algorithms discover network paths and populate routing information automatically.

THEORY

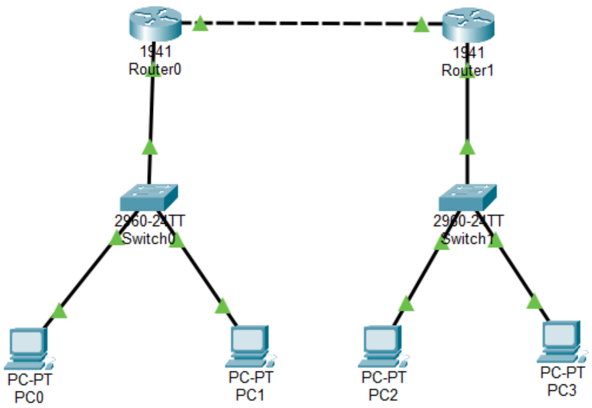
Dynamic routing protocols enable routers to exchange routing information with each other so that they can independently learn about remote networks. Unlike static routing, these protocols respond automatically to network changes, such as link failures or topology modifications, without requiring manual reconfiguration.

1. Routing Information Protocol (RIP)

RIP is one of the earliest routing protocols and follows the distance vector approach. Although it is easy to configure, it is not suitable for large or complex networks due to its limitations.

- Algorithm: Distance Vector
- Metric: Hop count is used to determine the shortest path, with a maximum limit of 15 hops.
- Operation: Routing updates containing the full routing table are sent to neighboring routers every 30 seconds.
- Versions: RIP version 1 is classful and does not support subnetting, whereas RIP version 2 is classless and supports CIDR.

Network Topology



Configuration

PC configurations

Device	IPv4 Address	Subnet Mask	Default Gateway
PC0	192.168.1.2	255.255.255.0	192.168.1.1
PC1	192.168.1.3	255.255.255.0	192.168.1.1
PC2	192.168.2.2	255.255.255.0	192.168.2.1
PC3	192.168.2.3	255.255.255.0	192.168.2.1

Router Configurations

Device	Network	Subnet Mask	Next Hop	Interface	Default Gateway
Router 1	192.168.2.0	255.255.255.0	10.0.0.2	G0/0	10.0.0.1
				G0/1	192.168.1.1
Router 2	192.168.1.0	255.255.255.0	10.0.0.1	G0/0	10.0.0.2
				G0/1	192.168.2.1

Commands

Router 0:

router rip

version 2

network 192.168.1.0

network 10.0.0.0

no auto-summary

Router 1:

router rip

version 2

network 192.168.2.0

network 10.0.0.0

no auto-summary

Observation

```
C:\>ping 192.168.2.3

Pinging 192.168.2.3 with 32 bytes of data:

Reply from 192.168.2.3: bytes=32 time<1ms TTL=126
Reply from 192.168.2.3: bytes=32 time=1ms TTL=126
Reply from 192.168.2.3: bytes=32 time<1ms TTL=126
Reply from 192.168.2.3: bytes=32 time=10ms TTL=126

Ping statistics for 192.168.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

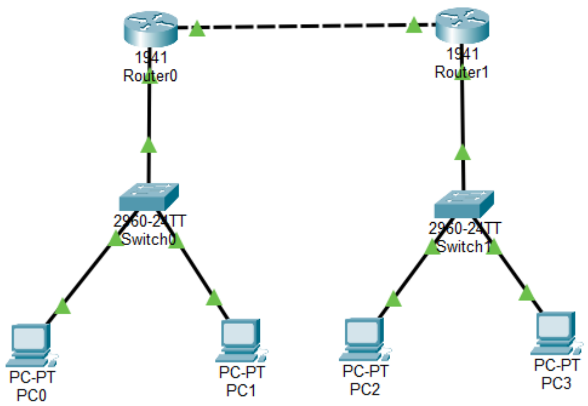
Connectivity between all networks was confirmed after RIP routing updates were exchanged successfully.

2. Enhanced Interior Gateway Routing Protocol (EIGRP)

EIGRP is a hybrid routing protocol that integrates features of both distance vector and link-state routing. It is known for its fast convergence and efficient use of bandwidth.

- Algorithm: Diffusing Update Algorithm (DUAL), which prevents routing loops.
- Metric: Composite metric calculated primarily using bandwidth and delay.
- Operation: Routing updates are sent only when a network change occurs.
- Special Feature: Supports unequal-cost load balancing.

Network Topology



Configuration

PC Configuration

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Router Configuration

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				G0/1	192.168.1.1
Router 2	192.168.1.0	255.255.255.0	10.0.0.1	G0/0	10.0.0.2
				G0/1	192.168.2.1

Commands

Router 0:

router eigrp 100

network 192.168.1.0 0.0.0.255

network 10.0.0.0 0.0.0.255

no auto-summary

Router 1:

router eigrp 100

network 192.168.2.0 0.0.0.255

network 10.0.0.0 0.0.0.255

no auto-summary

Observation

```
C:\>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Reply from 192.168.1.3: bytes=32 time<1ms TTL=126
Reply from 192.168.1.3: bytes=32 time<1ms TTL=126
Reply from 192.168.1.3: bytes=32 time=4ms TTL=126
Reply from 192.168.1.3: bytes=32 time<1ms TTL=126

Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 4ms, Average = 1ms
```

Routes were learned dynamically, and network communication was established efficiently with minimal update traffic.

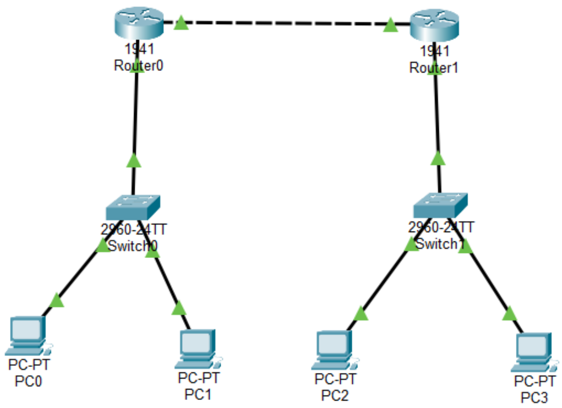
3. Open Shortest Path First (OSPF)

OSPF is a link-state routing protocol designed for large and scalable networks, offering rapid convergence and accurate path selection.

- Algorithm: Dijkstra's Shortest Path First (SPF).
- Metric: Cost, calculated using reference bandwidth divided by the actual interface bandwidth.

- Operation: Routers exchange Hello packets to discover neighbors and share LSAs to build a complete topology database.
- Advantage: Converges faster than RIP and is more suitable for enterprise networks.

Network Topology



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				G0/1	192.168.2.1

Commands

Router 0:

router ospf 1

network 192.168.1.0 0.0.0.255 area 0

network 10.0.0.0 0.0.0.255 area 0

Router 1:

router ospf 1

network 192.168.2.0 0.0.0.255 area 0

network 10.0.0.0 0.0.0.255 area 0

Observation

```
C:\>ping 192.168.2.3

Pinging 192.168.2.3 with 32 bytes of data:

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Reply from 192.168.2.3: bytes=32 time<1ms TTL=126
Reply from 192.168.2.3: bytes=32 time=1ms TTL=126
Reply from 192.168.2.3: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

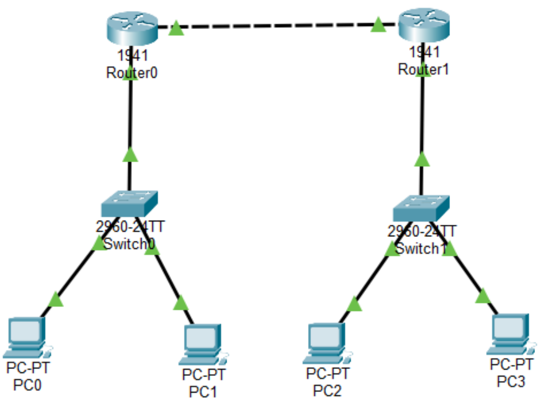
OSPF successfully synchronized routing information between routers, allowing efficient packet forwarding across networks.

4. Border Gateway Protocol (BGP)

BGP is a path vector routing protocol and serves as the backbone routing protocol of the internet.

- Purpose: Connects different Autonomous Systems (AS) under separate administrative domains.
- Operation: Selects routes based on path attributes such as AS-Path instead of simple metrics.
- Reliability: Uses TCP port 179 to ensure reliable communication.
- Scalability: Capable of handling the massive global routing table of the internet.

Network Topology



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				G0/1	192.168.1.1
Router 2	192.168.1.0	255.255.255.0	10.0.0.1	G0/0	10.0.0.2
				G0/1	192.168.2.1

<u>Assumptions</u>

- Router 1 belongs to AS 65001
- Router 2 belongs to AS 65002

Commands

<u>Router 0:</u>

router bgp 65001

neighbor 10.0.0.2 remote-as 65002

network 192.168.1.0 mask 255.255.255.0

<u>Router 1:</u>

router bgp 65002

neighbor 10.0.0.1 remote-as 65001

network 192.168.2.0 mask 255.255.255.0

Observation

```
C:\>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time<1ms TTL=126
Reply from 192.168.1.2: bytes=32 time<1ms TTL=126
Reply from 192.168.1.2: bytes=32 time<1ms TTL=126
Reply from 192.168.1.2: bytes=32 time=7ms TTL=126

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 7ms, Average = 1ms
```

BGP neighbors were established successfully, and routing information was exchanged between autonomous systems.

RESULT

This experiment successfully demonstrated the configuration of multiple dynamic routing protocols, including RIP, EIGRP, OSPF, and BGP. In each case, routers automatically exchanged routing information and populated their routing tables without manual route entry. Successful ping tests across all networks confirmed proper connectivity.

DISCUSSION

During this lab, various dynamic routing protocols were implemented and compared. RIP was the easiest to configure but proved to be limited due to its hop-count-based metric. OSPF appeared more advanced, as it calculates routes based on bandwidth and provides faster convergence. EIGRP responded most quickly to topology changes, making it highly efficient. BGP offered insight into how large-scale networks, such as the internet, manage routing between autonomous systems. Connectivity was verified using multiple ping tests.

CONCLUSION

This laboratory session successfully implemented and analyzed multiple dynamic routing protocols, demonstrating how different routing algorithms operate and adapt automatically to network conditions.