Dynamic Routing

Participated Groups:
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Group Number: 6
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Group Number: 5
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Before starting we'd like to note that our router's name was Router-Section-1-Group-1, likely left over from the previous section as we were the GROUP 4 in section 2 but we did not change the name in the lab.

Step 1: We recreated lab topology from Lab09- Routing Experiment.

In today's experiment, we connected 3 computers to the same router.

- Our computer IPs were in **10.100.7.X** format.
- We set our routers interfaces IPs to be: FastEthernet0/0 **10.100.7.254**
  Serial0/0/0 **10.200.7.1**
- Our router group had 3 computers: **10.100.7.1, 10.100.7.2, and 10.100.7.3**.
- The router's console connection was via computer **10.100.7.3**.

Step 2: Assigning all the interfaces(FastEthernet, Serial)

```
Router-Section-1-Group-1#show ip i
*Jan  1 00:12:57.435: %SYS-5-CONFIG_I: Configured from console by consolen
Router-Section-1-Group-1#show ip interface  bri
Router-Section-1-Group-1#show ip interface  brief
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            10.100.7.254    YES manual up                    up
FastEthernet0/1            unassigned      YES NVRAM  administratively down down
Serial0/0/0                10.200.7.1      YES manual up                    up
Serial0/0/1                unassigned      YES NVRAM  administratively down down
Router-Section-1-Group-1#router rip
                         ^
```

Figure 1: Show interfaces

STEP 3: Routing Protocol Commands

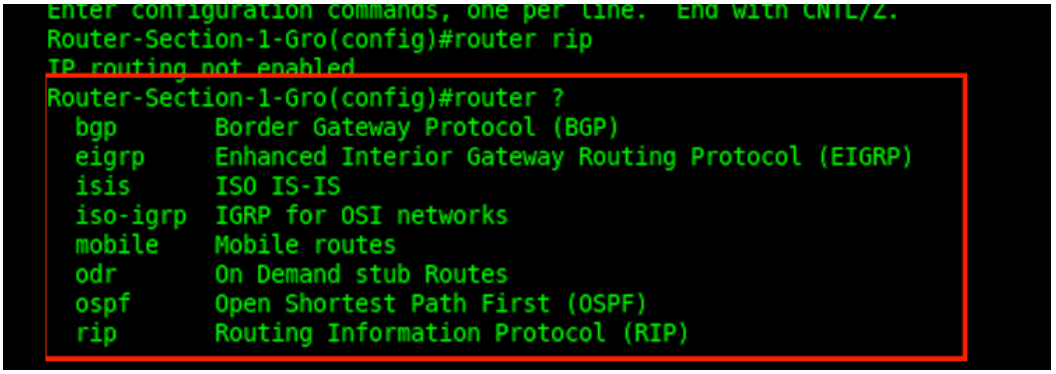

Figure 2: Router protocol commands

- **bgp (Border Gateway Protocol):**
  BGP is an inter-domain routing protocol used to exchange routing and reachability information between different autonomous systems on the Internet.
- **eigrp (Enhanced Interior Gateway Routing Protocol):**
  EIGRP is a Cisco proprietary routing protocol designed for use within an autonomous system (intra-domain). It incorporates features of both distance vector and link-state routing protocols.
  It supports :
  - rapid convergence,
  - load balancing,
  - and route summarization.
- **isis (ISO IS-IS):**
  This is used for intra-domain routing. It's a link-state routing protocol that operates based on the Open System Interconnection (OSI) reference model and is often used in large, hierarchical networks.
- **iso-igrp (IGRP for OSI networks):**
  It's a distance vector routing protocol developed by Cisco.
- **mobile (Mobile routes):**
  Protocols like AODV (Ad hoc On-Demand Distance Vector) and OLSR (Optimized Link State Routing) are commonly used for mobile networks.
- **odr (On Demand stub Routes):**
  ODR is a Cisco proprietary routing protocol that allows routers to dynamically learn routes for stub networks (networks with only one exit point) on-demand.
- **ospf (Open Shortest Path First):**
  This is a link-state routing protocol used for intra-domain routing. It is designed to scale well within large networks and calculate the shortest path to a destination based on the cost associated with each link.
- **rip (Routing Information Protocol)**
  RIP is one of the oldest distance vector routing protocols. It is used for intra-domain routing and makes routing decisions based on the number of hops to reach a destination.

Step 3: Configuring RIP Protocol

```
Router-Section-1-Gro(config)#router rip
Router-Section-1-Gro(config-router)#network 10.0.0.0
Router-Section-1-Gro(config-router)#~~
```

Figure 3: Configuration of RIP Protocol

```
--- 10.100.7.2 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 3999ms
, pipe 3
[root@localhost ~]# ping 10.100.7.1
PING 10.100.7.1 (10.100.7.1) 56(84) bytes of data.
64 bytes from 10.100.7.1: icmp_seq=1 ttl=64 time=0.157 ms
64 bytes from 10.100.7.1: icmp_seq=2 ttl=64 time=0.148 ms
64 bytes from 10.100.7.1: icmp_seq=3 ttl=64 time=0.150 ms
64 bytes from 10.100.7.1: icmp_seq=4 ttl=64 time=0.152 ms

--- 10.100.7.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2999ms
rtt min/avg/max/mdev = 0.148/0.151/0.157/0.015 ms
[root@localhost ~]# ping 10.100.7.2
PING 10.100.7.2 (10.100.7.2) 56(84) bytes of data.
64 bytes from 10.100.7.2: icmp_seq=1 ttl=64 time=1.10 ms
64 bytes from 10.100.7.2: icmp_seq=2 ttl=64 time=0.142 ms
64 bytes from 10.100.7.2: icmp_seq=3 ttl=64 time=0.141 ms

--- 10.100.7.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 1999ms
rtt min/avg/max/mdev = 0.141/0.463/1.106/0.454 ms
[root@localhost ~]#
```

Figure 4: Pinging the computers that were in our group

```
Router-Section-1-Gro(config)#exit
Router-Section-1-Group-1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 7 subnets
R       10.100.10.0 [120/3] via 10.200.7.2, 00:00:04, Serial0/0/0
R       10.100.8.0 [120/1] via 10.200.7.2, 00:00:04, Serial0/0/0
R       10.100.9.0 [120/2] via 10.200.7.2, 00:00:04, Serial0/0/0
C       10.100.7.0 is directly connected, FastEthernet0/0
C       10.200.7.0 is directly connected, Serial0/0/0
R       10.200.8.0 [120/1] via 10.200.7.2, 00:00:04, Serial0/0/0
R       10.200.9.0 [120/2] via 10.200.7.2, 00:00:04, Serial0/0/0
Router-Section-1-Group-1#
*Jan  1 00:32:31.035: %SYS-5-CONFIG_I: Configured from console by console
```

Figure 5: Our routers IP Routing Table

```
[root@localhost ~]# ping 10.100.8.1
PING 10.100.8.1 (10.100.8.1) 56(84) bytes of data.

--- 10.100.8.1 ping statistics ---
6 packets transmitted, 0 received, 100% packet loss, time 4999ms

[root@localhost ~]# ping 10.100.8.2
PING 10.100.8.2 (10.100.8.2) 56(84) bytes of data.
64 bytes from 10.100.8.2: icmp_seq=1 ttl=62 time=26.3 ms
64 bytes from 10.100.8.2: icmp_seq=2 ttl=62 time=23.8 ms
64 bytes from 10.100.8.2: icmp_seq=3 ttl=62 time=23.8 ms

--- 10.100.8.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 23.820/24.676/26.324/1.165 ms
[root@localhost ~]# ping 10.100.8.3
PING 10.100.8.3 (10.100.8.3) 56(84) bytes of data.
64 bytes from 10.100.8.3: icmp_seq=1 ttl=62 time=23.8 ms
64 bytes from 10.100.8.3: icmp_seq=2 ttl=62 time=23.8 ms
64 bytes from 10.100.8.3: icmp_seq=3 ttl=62 time=23.8 ms

--- 10.100.8.3 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 23.809/23.849/23.888/0.130 ms
[root@localhost ~]# ping 10.100.9.1
PING 10.100.9.1 (10.100.9.1) 56(84) bytes of data.
64 bytes from 10.100.9.1: icmp_seq=1 ttl=61 time=47.6 ms
64 bytes from 10.100.9.1: icmp_seq=2 ttl=61 time=47.3 ms
64 bytes from 10.100.9.1: icmp_seq=3 ttl=61 time=47.3 ms

--- 10.100.9.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 47.313/47.412/47.601/0.133 ms
[root@localhost ~]# ping 10.100.9.2
PING 10.100.9.2 (10.100.9.2) 56(84) bytes of data.
64 bytes from 10.100.9.2: icmp_seq=2 ttl=61 time=47.9 ms
64 bytes from 10.100.9.2: icmp_seq=3 ttl=61 time=47.5 ms

--- 10.100.9.2 ping statistics ---
3 packets transmitted, 2 received, 33% packet loss, time 2000ms
rtt min/avg/max/mdev = 47.502/47.721/47.941/0.309 ms
[root@localhost ~]# ping 10.100.9.3
PING 10.100.9.3 (10.100.9.3) 56(84) bytes of data.
64 bytes from 10.100.9.3: icmp_seq=1 ttl=61 time=47.5 ms
64 bytes from 10.100.9.3: icmp_seq=2 ttl=61 time=47.7 ms

--- 10.100.9.3 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1000ms
rtt min/avg/max/mdev = 47.599/47.688/47.778/0.236 ms
```

```
[root@localhost ~]# ping 10.100.10.1
PING 10.100.10.1 (10.100.10.1) 56(84) bytes of data.
64 bytes from 10.100.10.1: icmp_seq=1 ttl=60 time=71.3 ms
64 bytes from 10.100.10.1: icmp_seq=2 ttl=60 time=71.0 ms
64 bytes from 10.100.10.1: icmp_seq=3 ttl=60 time=71.1 ms
64 bytes from 10.100.10.1: icmp_seq=4 ttl=60 time=71.2 ms

--- 10.100.10.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2999ms
rtt min/avg/max/mdev = 71.087/71.215/71.348/0.340 ms
```

Figure 6: Pinging other groups' computers

We could successfully ping the computers in our group as well as the remote computers in the lab while RIP protocol was set. Although we could successfully ping the said devices with RIP, it likely calculated suboptimal paths due to its simplicity. As the RIP is considered a “less intelligent” protocol[1] used for smaller size organizations, and calculates paths using hop counts.

Step 4: Configure OSPF Protocol

First, we disable RIP routing.

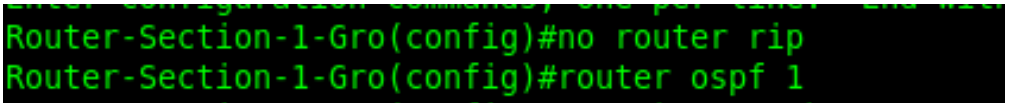

Figure 7: Disabling RIP protocol

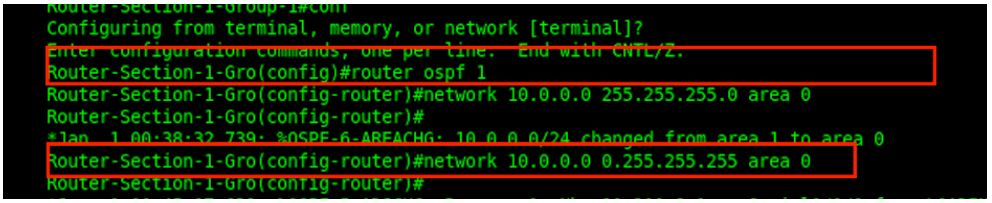

Figure 8: Configuring OSPF protocol

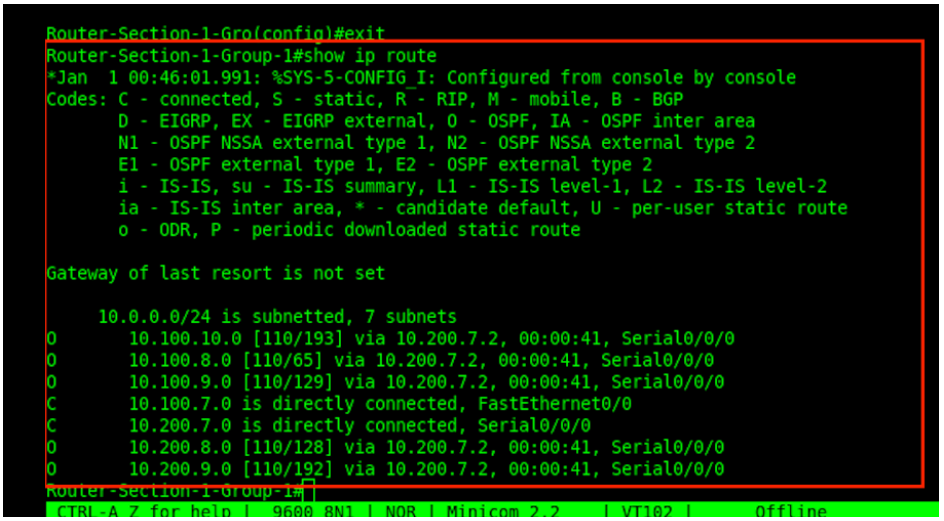

Figure 9: Router’s IP Routing Table after configuring OSPF

```
[root@localhost ~]# ping 10.100.10.1
PING 10.100.10.1 (10.100.10.1) 56(84) bytes of data.
64 bytes from 10.100.10.1: icmp_seq=1 ttl=60 time=72.1 ms
64 bytes from 10.100.10.1: icmp_seq=2 ttl=60 time=71.0 ms
64 bytes from 10.100.10.1: icmp_seq=3 ttl=60 time=71.2 ms
64 bytes from 10.100.10.1: icmp_seq=4 ttl=60 time=99.5 ms
64 bytes from 10.100.10.1: icmp_seq=5 ttl=60 time=71.1 ms
^C
--- 10.100.10.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4004ms
rtt min/avg/max/mdev = 71.060/77.055/99.589/11.276 ms
```

```
[root@localhost ~]# ping 10.100.8.2
PING 10.100.8.2 (10.100.8.2) 56(84) bytes of data.
64 bytes from 10.100.8.2: icmp_seq=1 ttl=62 time=25.9 ms
64 bytes from 10.100.8.2: icmp_seq=2 ttl=62 time=24.0 ms
64 bytes from 10.100.8.2: icmp_seq=3 ttl=62 time=23.9 ms
^C
--- 10.100.8.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2001ms
rtt min/avg/max/mdev = 23.943/24.648/25.999/0.955 ms
[root@localhost ~]# ping 10.100.9.1
PING 10.100.9.1 (10.100.9.1) 56(84) bytes of data.
64 bytes from 10.100.9.1: icmp_seq=1 ttl=61 time=49.5 ms
64 bytes from 10.100.9.1: icmp_seq=2 ttl=61 time=47.4 ms
64 bytes from 10.100.9.1: icmp_seq=3 ttl=61 time=47.4 ms
64 bytes from 10.100.9.1: icmp_seq=4 ttl=61 time=47.3 ms
64 bytes from 10.100.9.1: icmp_seq=5 ttl=61 time=47.6 ms
^C
--- 10.100.9.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4003ms
```

Figure 10: Ping from 10.100.7.1 to other computers

As with RIPs case, we were able to ping hosts from every network in the lab, probably in a much more efficient manner, since OSPF is a link-state protocol and it analyzes different sources like the speed, cost and path congestion while identifying the shortest path[1].

Step 5: Configuring EIGRP Protocol

```
Router-Section-1-Gro(config)#no router ospf 1
Router-Section-1-Gro(config)#
*Jan  1 00:47:02.823: %OSPF-5-ADJCHG: Process 1, Nbr 10.200.8.1 on Serial0/0/0 from FULL to DOWN, Neighbor Down: Interface down or detached
% Incomplete command.

Router-Section-1-Gro(config)#router eigrp 1
Router-Section-1-Gro(config-router)#network 10.0.0.0
Router-Section-1-Gro(config-router)#
```

Figure 11:Remove OSPF configuration and configure EIGRP protocol.

```
Router-Section-1-Group-1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 7 subnets
D       10.100.10.0 [90/3196416] via 10.200.7.2, 00:01:05, Serial0/0/0
D       10.100.8.0 [90/2172416] via 10.200.7.2, 00:01:05, Serial0/0/0
D       10.100.9.0 [90/2684416] via 10.200.7.2, 00:01:05, Serial0/0/0
C       10.100.7.0 is directly connected, FastEthernet0/0
C       10.200.7.0 is directly connected, Serial0/0/0
D       10.200.8.0 [90/2681856] via 10.200.7.2, 00:01:05, Serial0/0/0
D       10.200.9.0 [90/3193856] via 10.200.7.2, 00:01:05, Serial0/0/0
Router-Section-1-Group-1#
```

Figure 12: The routing table after configuring EIGRP

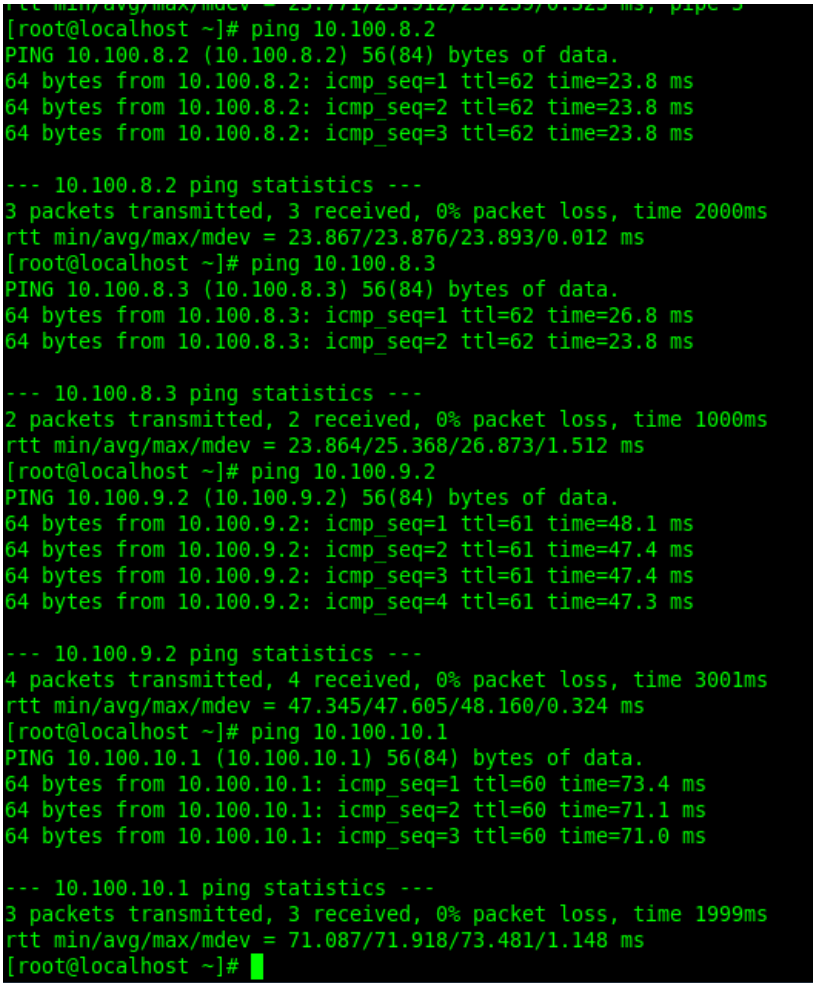

Figure 13: Pinging from our computer the remote computers

In this part, further increasing the efficiency of our network's performance, we've set EIGRP to be our routing protocol and we were able to successfully ping computers in our own group as well as the remote computers. EIGRP protocol is a hybrid protocol combining both the difference vector and the link-state algorithms, performing an even more efficient path calculation, especially within a Cisco networking environment as it is a proprietary protocol.[2]

Conclusion

In this experiment, we tried different routing protocols and saw how network devices communicate with each other in a single wide area network. The proper configuration of OSPF, EIGRP, and RIP, involving the accurate setup of parameters and protocols, ensured that each routing protocol operated within the network appropriately.

This success was the result of:

- Proper configuration of routing protocols,
- Effective dynamic routing information exchange,
- Load balancing and path selection optimization.

The routers quickly converged and updated routing tables to maintain uninterrupted connectivity.

While RIP initially provided basic connectivity reliant on hop counts, the transition to OSPF and EIGRP exhibited discernible enhancements in optimizing routing paths, thereby improving network performance. Even within a modest-scale network, the shift to OSPF and EIGRP underscored their superiority over RIP by showcasing faster convergence and more efficient routing strategies, affirming the significance of selecting appropriate routing protocols tailored to even moderate-sized networks for optimal functionality.

References

- [1] GeeksforGeeks, "Difference between RIP and OSPF," GeeksforGeeks. [Online]. Available: https://www.geeksforgeeks.org/difference-between-rip-and-ospf/. [Accessed: December 30th, 2023].
- [2] GeeksforGeeks, "Difference between EIGRP and OSPF," GeeksforGeeks. [Online]. Available: https://www.geeksforgeeks.org/difference-between-eigrp-and-ospf/. [Accessed: December 30th, 2023].