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LAB 5 REPORT
Dynamic Routing 3 (Path Vector) BGP

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Abstract

There are various protocols to utilize in order to implement dynamic routing within networks. However, among commonly used protocols like RIP, EIGRP, OSPF, and BGP, only BGP can be used for exterior routing between different autonomous systems. This made it the protocol of choice for internet providers and large organizations. This experiment will shed light on the usage of interior and exterior routing, autonomous systems, and simulate routing using BGP using Cisco software.

1 Table of Contents

2 Introduction

An autonomous system (AS) "is a large network or group of networks that has a unified routing policy." (Cloudflare, n.d.)[1]. Autonomous systems are considered external networks that can't be reached with OSPF nor other local routing protocols alone. This is where BGP comes in; it can be used for routing between different autonomous systems easily. While BGP is a great solution for external routing, it is worth mentioning that it can also be used for internal routing as well through what's called iBGP.

This experiment will utilize eBGP for routing between two different autonomous systems, as well as OSPF for routing among the networks of each autonomous system. See Fig. 2-1.

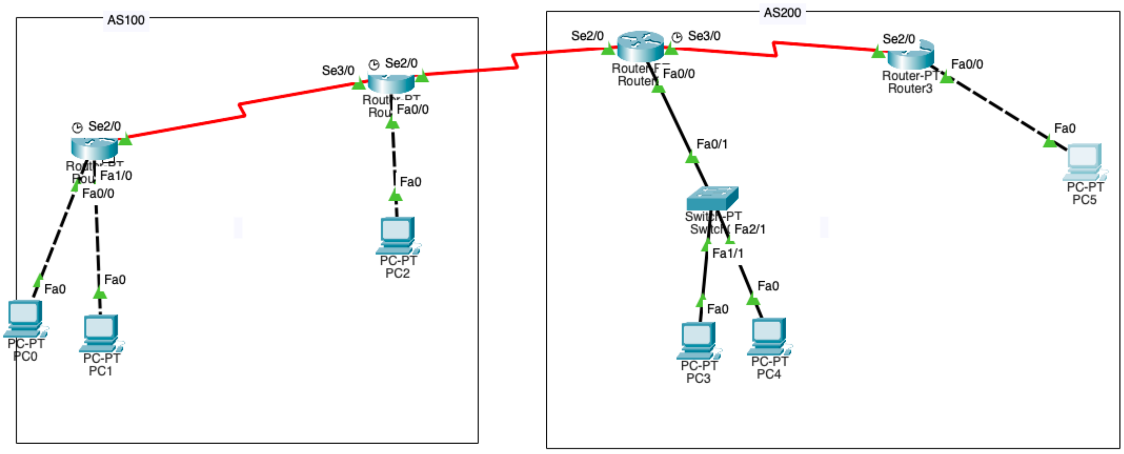

Figure 2-1 The topology of the experiment showing two ASs AS100 and AS200

As can be seen from Fig. 2-1, the two autonomous systems are connected via Router 1 and Router 2. Therefore, BGP routing will need to be configured on those routers. Moreover, for the devices in the internal networks of each autonomous systems to communicate with those of the other autonomous system, OSPF over BGP and BGP over OSPF configurations need to be set up. Therefore, at the end of this experiment there need to be 3 types of connections, ones that are direct between the routers and devices directly connected to them, ones using OSPF between routers and the end devices of other routers in the same autonomous system, and ones that are using BGP across the two autonomous system.

3 Procedure and Discussion

In the simulation for this experiment, we are using four routers to make two autonomous systems. AS100 and AS200.

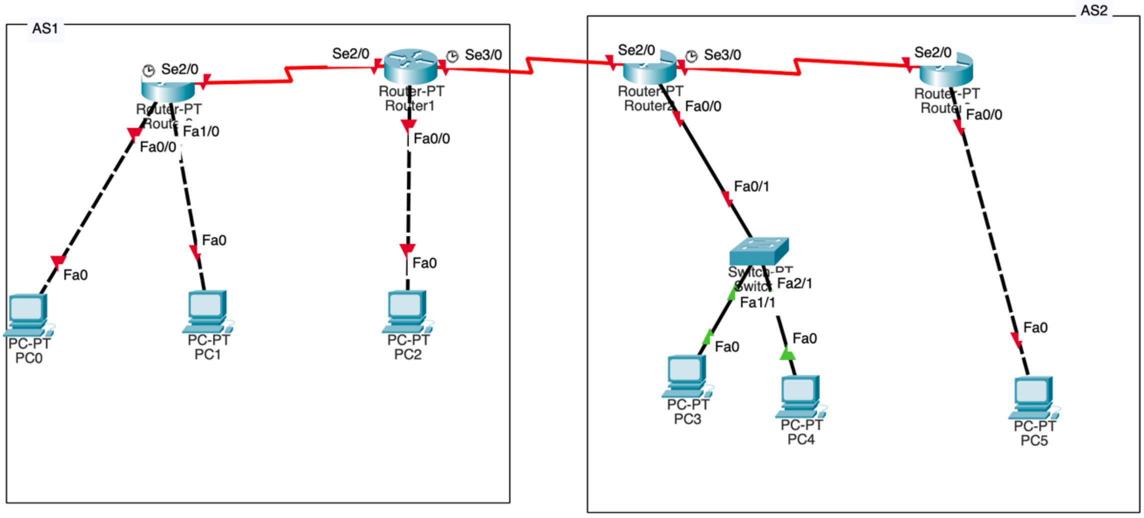

Figure 3-1 Experiment Topology

The idea was to configure routing using OSPF in the same autonomous system and using BGP between the two autonomous systems, AS100 and AS200.

Area/AS & BGP Links	Network	Device	Interface	IP	Subnet Mask	Wildcard Mask
Area 0 / AS 100	192.X.0.0/30	Router 0	Se2/0	192.168.0.1	255.255.255.252	0.0.0.3
		Router 1	Se2/0	192.168.0.2	255.255.255.252	0.0.0.3
	192. X.1.0/27	Router 0	Fa0/0	192.168.1.1	255.255.255.224	0.0.0.31
		PC0	Fa0	192.168.1.2	255.255.255.224	0.0.0.31
	192. X.1.32/27	Router 0	Fa1/0	192.168.1.33	255.255.255.224	0.0.0.31
		PC1	Fa0	192.168.1.34	255.255.255.224	0.0.0.31
	192. X.1.64/26	Router 1	Fa0/0	192.168.1.65	255.255.255.192	0.0.0.63
		PC2	Fa0	192.168.1.66	255.255.255.192	0.0.0.63
Area 0 / AS 200	192.X.0.8/30	Router 2	Se3/0	192.X.0.9	255.255.255.252	0.0.0.3
		Router 3	Se2/0	192.X.0.10	255.255.255.252	0.0.0.3
	192.X.1.128/26	Router 2	Fa0/0	192.X.1.129	255.255.255.192	0.0.0.63
		PC 3	Fa0	192.X.1.130	255.255.255.192	0.0.0.63
		PC 4	Fa0	192.X.1.131	255.255.255.192	0.0.0.63
	192.X.1.192/26	Router 3	Fa0/0	192.X.1.193	255.255.255.192	0.0.0.63
		PC 5	Fa0	192.X.1.194	255.255.255.192	0.0.0.63
BGP Links	192.X.0.4/30	Router 1	Se3/0	192.X.0.5	255.255.255.252	0.0.0.3
		Router 2	Se2/0	192.X.0.6	255.255.255.252	0.0.0.3

Figure 3-2 Topology Configuration

To start off the topology as shown in Fig. 3-1 should be built using automatic connection between each connected pair of devices.

3.1 Configuring PCs IP addresses

Then the IP addresses, net mask, and gateway addresses were configured for each one of the PCs, PC0 – PC5 as can be seen in Fig. 3-2. This can be done by filling in each PCs prespective IP and Netmask as well as the IP address of the router from the same network for the default gateway. The configuration for the whole topology is shown in Fig. 3-2 as taken from the experimnet manual.

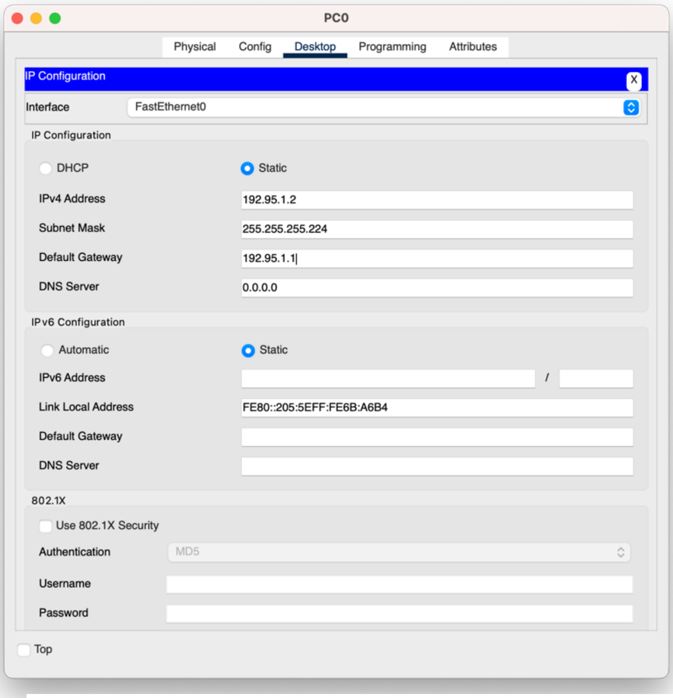

Figure 3-3 IP configs for PC0

3.2 Configuring Routers Interfaces

Next, the routers interfaces were configured through each router's CLI.

This can be done for each router by enabling the router using the *enable* then *config* commands. After that each interface was configured according to the details provided in Fig. 3-2:

```
int Fa0/0
no shutdown
ip address 192.X.1.1 255.255.255.224
exit
```

Figure 3-4 The configuration for interface Fa0/0 of router 0 in the topology

3.3 Configuring OSPF

After that starts the procedure to configure OSPF for each of the autonomous systems. Below are rhe commands used to configure router 2 OSPF. It should be noted that these commands should be excuted after excuting the *config* command for the respective router.

router ospf 1

network 192.95.0.8 0.0.0.3 area 0

network 192.95.1.128 0.0.0.63 area 0

Figure 3-5 The configuration commands of OSPF for router 2

This should be done for all routers in the topology except for the network between router 2 and router 1 which will be configured using BGP.

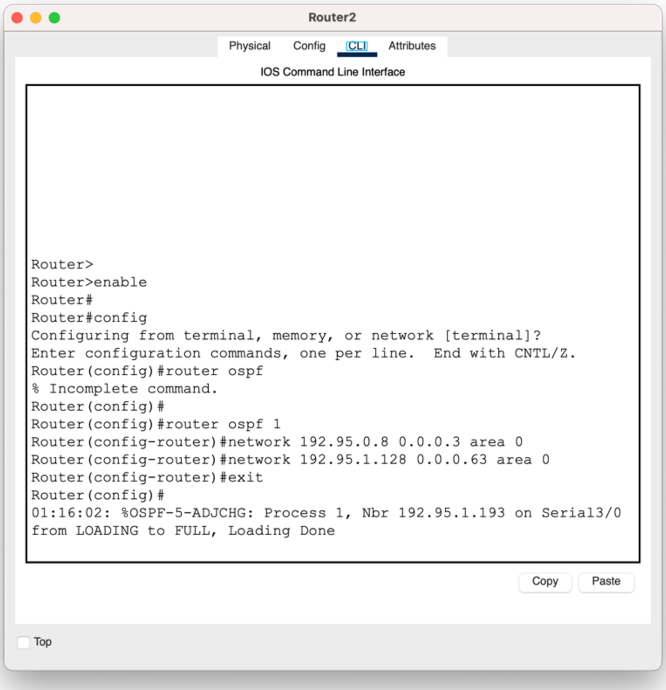

Figure 3-6 OSPF Configuration for router 2

3.4 Configuring BGP Routing

Next up is the process of configuring BGP between router 1 and router 2. Since we have the topology split into two autonomous systems, we need to use BGP and redistribute it over OSPF. To start off, the autonomous systems need to be set up. This can be done via the command

```
router bgp 100
```

Figure 3-7 setting up the autonomous system for router 1.

Where 100 is the number of the autonomous system. Same should be done for router 2 but using the number 200 for its AS.

Next we need to define the two autonomous we have as neighbors. This can be done with the command

```
neighbor 192.95.0.6 remote-as 200
```

Figure 3-8 Defining the neighbor autonomous system for router 1

Where 200 is the AS number of the neighbor and the IP address is the IP of the connected interface.

3.5 Enabling OSPF BGP connection

To allow the connection between OSPF and BGP, we need to redistribute OSPF over BGP and BGP over OSPF for each of router 1 and router 2. This will enable the internal networks in each autonomous system which are connected via OSPF to connect with devices in the other autonomous system.

To do that the following commands can be used.

```
router ospf 1
redistribute bgp 100 subnets
```

Figure 3-9 Redistributing BGP over OSPF for router 1.

Where 100 is the AS number for the same router we are configuring. The same should be done with router 2 and its respective AS number.

For redistributing OSPF over BGP we can use:

```
router bgp 100
redistribute ospf 1
```

Figure 3-10 Redistributing OSPF over BGP

Where 100 is the AS number of the same router being configured and 1 is the process ID for OSPF.

After executing all these commands properly for both routers, we can check the routing the configuration by executing *show ip route* command as shown in Fig. 3-11 where the networks of router 2 are discoverable for router 1 through BGP, hence the ‘B’ label next to each one of them.

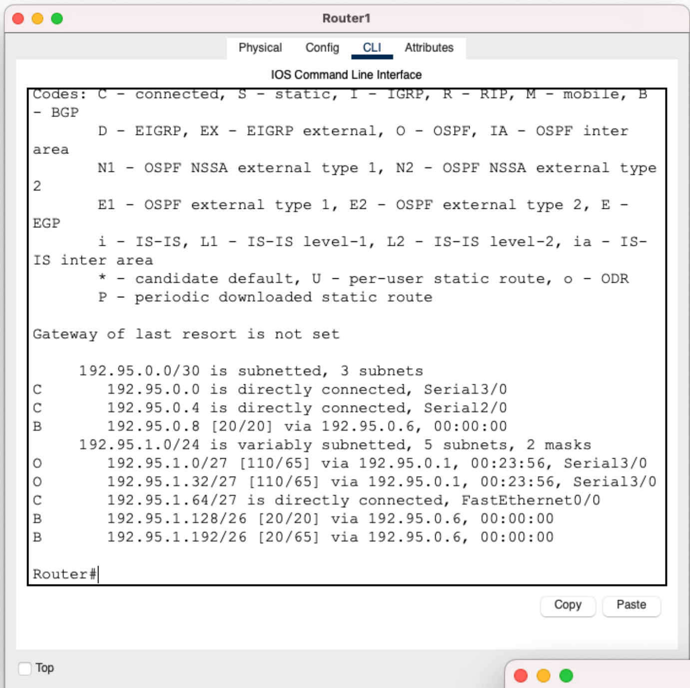

Figure 3-11 Output of "show ip route" command showing the network addresses of router 2

To further ensure that the routing is set up and working between the two autonomous systems, we can ping one of the devices by a device from the other autonomous system. Fig. 3-11 renders PC1 of AS100 successfully pinging PC5 of AS200.

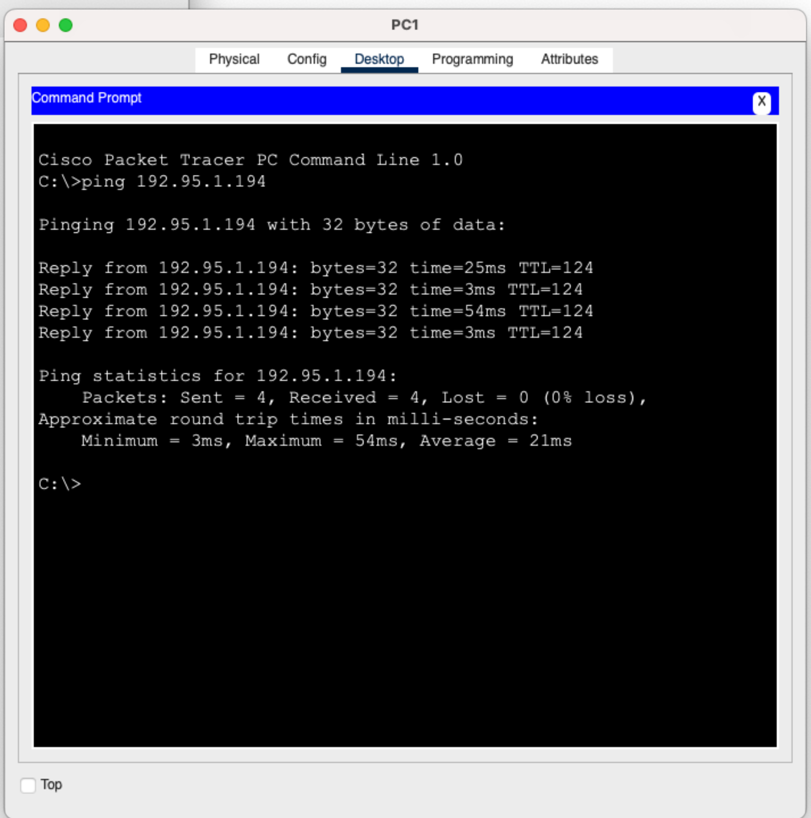

Figure 3-12 The result of pinging PC5 via PC1 command prompt

4 Results

```
Router#show ip bgp summary
BGP router identifier 192.95.1.129, local AS number 200
BGP table version is 24, main routing table version 6
9 network entries using 1188 bytes of memory
9 path entries using 468 bytes of memory
4/4 BGP path/bestpath attribute entries using 736 bytes of memory
2 BGP AS-PATH entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
BGP using 2472 total bytes of memory
BGP activity 7/0 prefixes, 9/0 paths, scan interval 60 secs

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.95.0.5      4   100     153     144       24    0    0 01:20:19        4

Router#
```

Figure 4-1 Router 1 visible to Router 2 through BGP

As can be seen in the ping process shown in Fig. 3-12, the experiment succeeded in establishing routing configured by OSPF and BGP. OSPF worked properly between end devices of different routers in the same autonomous system. BGP also worked between the routers connecting the two autonomous systems since both routers were visible to each other (see Fig. 4-2). Lastly, BGP was set up over OSPF and the other way around, this made it possible for devices in each autonomous system to communicate (see Fig. 3-11).

5 Conclusion

The experiment successfully explained the use case for BGP in contrast to OSPF and other routing methods and its vital role in external routing. It introduced the topic of autonomous systems, which is a prominent methodology that is still used in our present day. It also demonstrated that use case clearly for two different autonomous systems through simulation via Cisco proprietary software. All on all, this experiment was informant and handy for present day network management.

6 Reference

1 (Cloudflare, n.d.) https://www.cloudflare.com/learning/network-layer/what-is-an-autonomous-system/