P4 - Policy-Based Routing

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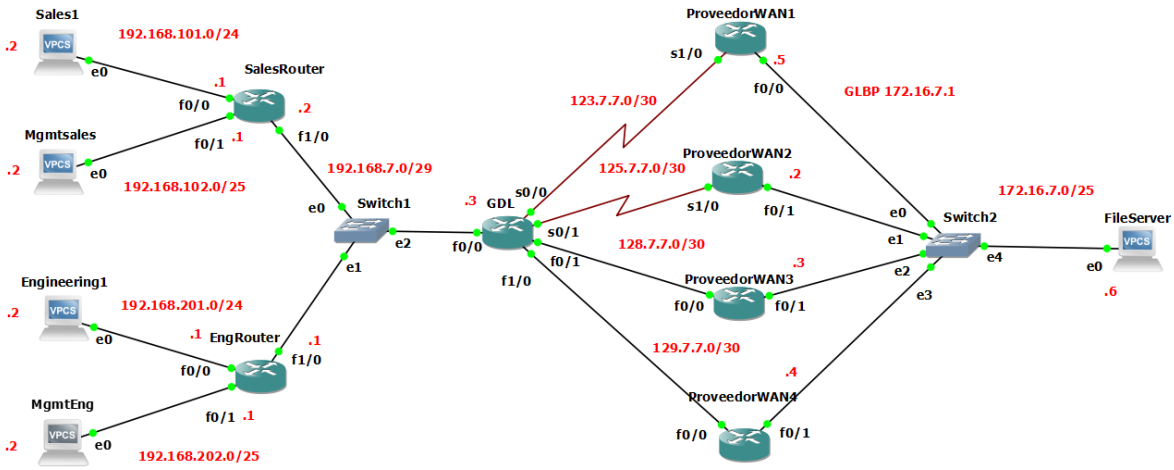
Introduction

Policy-based routing provides a tool for forwarding and routing data packets based on policies defined by network administrators. In effect, it is a way for politics to override routing protocol decisions. Policy-based routing includes a mechanism to selectively apply policies based on access list, packet size, or other criteria. Actions taken may include routing packets on user-defined routes or establishing precedence.

To implement the policies we use routing maps, these use access lists to define the matching criteria. Access lists allow you to specify conditions based on source and destination IP addresses, ports, protocols, and more. Route-maps are more advanced structures that combine policy definition with enforcement. Through routing maps, we can manipulate how routes are installed in the routing table, set priorities, and define specific routes for certain types of traffic.

There are cases where an access list is not directly available for use. In these cases, routing maps can use other matching conditions, such as packet size or service type, to enforce appropriate policies. This provides additional flexibility for network administrators when defining and enforcing routing policies based on specific network needs.



Development

First, we configure the IP addresses with our computer number, which is 7, and we write down the addresses to have more clarity when configuring the practice.

We configure GLBP to remove the redundancy between the ROUTERS WAN1 to WAN4 and the File Server, we give it the virtual IP so that it has a connection and each ROUTER with a different priority for the distribution of traffic.

```
ProveedorWAN1#show glbp
FastEthernet0/0 - Group 1
  State is Active
    2 state changes, last state change 01:02:11
  Virtual IP address is 172.16.7.1
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.608 secs
  Redirect time 600 sec, forwarder time-out 14400 sec
  Preemption enabled, min delay 0 sec
  Active is local
  Standby is 172.16.7.2, priority 100 (expires in 5.956 sec)
  Priority 110 (configured)
  Weighting 100 (default 100), thresholds: lower 1, upper 100
  Load balancing: round-robin
  Group members:
    c204.4c4c.0000 (172.16.7.5) local
    c205.2ebc.0001 (172.16.7.2)
    c206.1010.0001 (172.16.7.3)
    c207.2f40.0001 (172.16.7.4)
  There are 4 forwarders (1 active)
```

Then we configure the EIGRP routing protocol on each ROUTER to have connectivity.

EIGRP of GDL router as a reference.

```
router eigrp 1
 network 123.7.7.0 0.0.0.3
 network 125.7.7.0 0.0.0.3
 network 128.7.7.0 0.0.0.3
 network 129.7.7.0 0.0.0.3
 network 192.168.7.0 0.0.0.7
 no auto-summary
```

Now that you have all this and have connectivity, you need to create the access-lists to allow network traffic through specific IPs:

In the GDL ROUTER:

```
access-list 100 permit ip 192.168.101.0 0.0.0.255 any
access-list 101 permit ip 192.168.102.0 0.0.0.127 any
access-list 102 permit ip 192.168.201.0 0.0.0.255 any
access-list 103 permit ip 192.168.202.0 0.0.0.127 any
```

Then using the access-lists, with route-maps we create the permissions of the policies by matching the access-list addresses and indicate the routes/hops where they should exit:

```
route-map PR permit 10
 match ip address 100
 set ip next-hop 123.7.7.2
!
route-map PR permit 20
 match ip address 101
 set ip next-hop 125.7.7.2
!
route-map PR permit 30
 match ip address 102
 set ip next-hop 128.7.7.2
!
route-map PR permit 40
 match ip address 103
 set ip next-hop 129.7.7.2
```

We created the name PR (Policy Routing) to identify the route-map and generated the process numbers 10,20,30,40 to identify the particular permission policies.

Having this we assign the route-map to the interface connected to switch1 because we are going to receive all the traffic from the side of this interface. With this we ensure that the policies are going to be applied.

```
interface FastEthernet0/0
 ip address 192.168.7.3 255.255.255.248
 ip policy route-map PR
 duplex auto
 speed auto
!
```

Evidence of Connectivity to File Server

Sales

```
Sales1> ping  172.16.7.6
84 bytes from 172.16.7.6 icmp_seq=1 ttl=61 time=76.983 ms
84 bytes from 172.16.7.6 icmp_seq=2 ttl=61 time=76.741 ms
84 bytes from 172.16.7.6 icmp_seq=3 ttl=61 time=76.752 ms
84 bytes from 172.16.7.6 icmp_seq=4 ttl=61 time=76.566 ms
84 bytes from 172.16.7.6 icmp_seq=5 ttl=61 time=76.867 ms

Sales1>
```

```
Sales1> trace 172.16.7.6
trace to 172.16.7.6, 8 hops max, press Ctrl+C to stop
 1   192.168.101.1   15.389 ms  15.630 ms  15.735 ms
 2   192.168.7.3   46.271 ms  46.697 ms  46.966 ms
 3   123.7.7.2   77.179 ms  77.316 ms  76.659 ms
 4     *  *  *
 5     **172.16.7.6   92.848 ms (ICMP type:3, code:3, Destination port unreachab
le)  0.320 ms

Sales1>
```

Mgmtsales

```
Mgmtsales> ping 172.16.7.6
84 bytes from 172.16.7.6 icmp_seq=1 ttl=61 time=77.294 ms
84 bytes from 172.16.7.6 icmp_seq=2 ttl=61 time=76.955 ms
84 bytes from 172.16.7.6 icmp_seq=3 ttl=61 time=76.802 ms
84 bytes from 172.16.7.6 icmp_seq=4 ttl=61 time=77.213 ms
84 bytes from 172.16.7.6 icmp_seq=5 ttl=61 time=76.524 ms
```

```
Mgmtsales> trace 172.16.7.6
trace to 172.16.7.6, 8 hops max, press Ctrl+C to stop
 1   192.168.102.1   15.556 ms  15.306 ms  15.154 ms
 2   192.168.7.3   46.448 ms  46.408 ms  46.559 ms
 3   125.7.7.2   76.564 ms  76.926 ms  76.917 ms
 4     **172.16.7.6   92.477 ms (ICMP type:3, code:3, Destination port unreachab
le)

Mgmtsales>
```

Engineering1

```
Engineering1> ping 172.16.7.6
84 bytes from 172.16.7.6 icmp_seq=1 ttl=61 time=93.042 ms
84 bytes from 172.16.7.6 icmp_seq=2 ttl=61 time=107.848 ms
84 bytes from 172.16.7.6 icmp_seq=3 ttl=61 time=92.466 ms
84 bytes from 172.16.7.6 icmp_seq=4 ttl=61 time=92.001 ms
84 bytes from 172.16.7.6 icmp_seq=5 ttl=61 time=91.529 ms
```

```
Engineering1> trace 172.16.7.6
trace to 172.16.7.6, 8 hops max, press Ctrl+C to stop
 1   192.168.201.1   15.588 ms  15.519 ms  15.826 ms
 2   192.168.7.3   46.033 ms  46.552 ms  46.410 ms
 3   128.7.7.2   76.700 ms  76.857 ms  76.567 ms
 4     **172.16.7.6   107.420 ms (ICMP type:3, code:3, Destination port unreacha
ble)

Engineering1>
```

MgmtEng

```
MgmtEng> ping 172.16.7.2
84 bytes from 172.16.7.2 icmp_seq=1 ttl=252 time=107.694 ms
84 bytes from 172.16.7.2 icmp_seq=2 ttl=252 time=106.829 ms
84 bytes from 172.16.7.2 icmp_seq=3 ttl=252 time=107.215 ms
84 bytes from 172.16.7.2 icmp_seq=4 ttl=252 time=107.718 ms
84 bytes from 172.16.7.2 icmp_seq=5 ttl=252 time=107.336 ms
```

```
MgmtEng> trace 172.16.7.2
trace to 172.16.7.2, 8 hops max, press Ctrl+C to stop
 1   192.168.202.1   15.252 ms  15.826 ms  15.890 ms
 2   192.168.7.3   46.393 ms  46.301 ms  46.829 ms
 3   129.7.7.2   76.374 ms  76.660 ms  76.626 ms
 4   *172.16.7.2   107.976 ms (ICMP type:3, code:3, Destination port unreachable
)

MgmtEng>
```

Conclusion

Luis Carlos:

In conclusion, I learned how things are used in real life, like when you have an issue with an interface, for example, if it's overloaded, you can change the routes and decide where you want to send the overloaded traffic in order to balance the load.

Regarding the configuration, it was quite easy. We set up EIGRP as the routing protocol, then created the access lists for each corresponding VPC. Once we had the access lists, we created route maps, which we named PR, and made one for each access. One thing that was difficult to understand was where we needed to apply these whether on the switch1 interface or on each interface leading to the providers. We realized that since the traffic was flowing from left to right, we had to apply it to the switch interface, and with that, we successfully completed the practice.

Diego Gutiérrez:
I was somewhat confused with the use of route-maps because as I mentioned in the review, I believed that using Vlans the packets would go through the ports we needed depending on this Vlan but, I could realize that this configuration of policies works on a network that has correct connectivity, only that we will use them to "mold" the traffic in case the characteristics of the requirements in the policies created are met.

Apart from routing with policies, this practice helped me to think about redundancy resolution as a point to check of equal importance to the configuration of IPs or routing, since there are cases like what happened in the File Server and its "4 gateways", where obviously 4 different ones cannot be configured and we must create a Virtual IP as a Gateway to connect the ROUTERS to the File Server.

Sources

- Cisco Community. (2008, September 17). *Cisco - Route-map vs. access-list*. Cisco Systems. https://community.cisco.com/t5/routing/cisco-route-map-vs-access-list/td-p/1112180
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- Donahue, G. A. (2011). *Network Warrior* (2nd ed.). O'Reilly Media.