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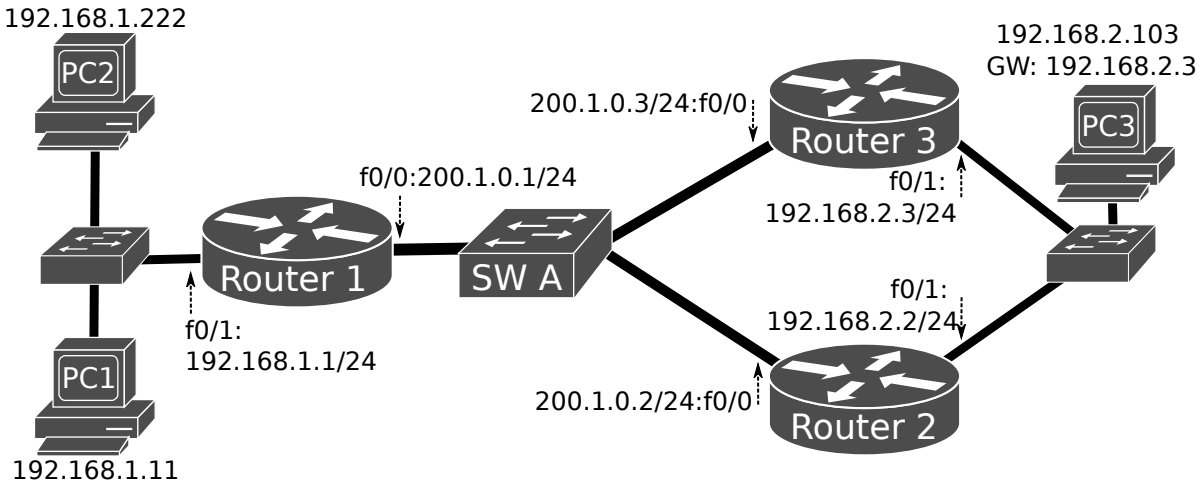
Redes de Comunicações 2

PBR with Route-Maps



1. Set up the above depicted network using Routers and VPCS. Activate OSPF in all interface routers (all in area 0):

```
Router*(config)# interface f0/1
Router*(config-if)# ip ospf 1 area 0
...
```

Verify the routing tables in all routers. Start a capture in network 200.1.0.0/24 (between Router 1 and the switch). Start packet captures on the links between ports f0/0 from Router2 and Router3, and the switch SW A. From PC1 and PC2 ping different IPv4 addresses from network 192.168.2.0/24 (does not require that the destination address exists).

```
PC1> ping 192.168.2.101
PC1> ping 192.168.2.102
PC1> ping 192.168.2.103
...
PC1> ping 192.168.2.109
```

>> Analyze Router1's routing table and identify the multiple paths to network 192.168.2.0/24.

>> Analyze the captured ICMP packets (on both captures), and identify how Router 1 uses the two available routes to network 192.168.2.0/24 for each set of pings. Is a destination-based flow decision?

2. Define in Router1 the following Policy-Based Routing route-map. First, configure two rule (access-list) that defines which traffic will be processed by each branch of the route-map:

```
Router1(config)# access-list 101 permit ip 192.168.1.0 0.0.0.127 192.168.2.0 0.0.0.255
Router1(config)# access-list 102 permit ip 192.168.1.128 0.0.0.127 192.168.2.0 0.0.0.255
```

Then, define the route-map that will change the next-hops (to be RouterA or RouterB) for the traffic defined in the access lists101 and 102:

```
Router1(config)# route-map ForceRouting permit 10
Router1(config-route-map)# match ip address 101
Router1(config-route-map)# set ip next-hop 200.1.0.2
Router1(config)# route-map ForceRouting permit 20
Router1(config-route-map)# match ip address 102
Router1(config-route-map)# set ip next-hop 200.1.0.3
```

Note: The underlined part of the commands are user defined names/strings (i.e. the name of the route-map) and the numeric values (10 and 20) defines the order of processing when multiple rules are present in a route-map.

Apply the route-map to Router1 interface f0/1 (receiving interface):

```
Router1(config)# interface f0/1
Router1(config-if)# ip policy route-map ForceRouting
```

Re-verify the routing table in Router 1. Start a capture in network 200.1.0.0/24 (between Router 1 and the switch). From Router 1, PC1 and PC3 ping different IPv4 addresses from network 192.168.2.0/24.

>> Explain why the routing table of Router 1 does not reflect the PBR configured.

>> Explain why Router1 still uses both paths.

>> Analyze the captured packets (from PC1 and PC2) and explain the propose of the route-map.

3. Start packet captures on the links between ports f0/0 from Router2 and Router3, and the switch SW A. From PC1 and PC2 ping 192.168.2.103, and identify the Router used to reach the destination. Change the used path (Router 2 or 3) to reach 192.168.2.103.

Configure another rule (access-list 103) that identifies all traffic to IP address 192.168.2.103:

```
Router1(config)# access-list 103 permit ip any host 192.168.2.103
```

Then, define another rule in route-map (with higher order of processing: **30**) that will change the next-hop (to be Router2) for the traffic defined in the access list 103 (traffic to 192.168.2.103):

```
Router1(config)# route-map ForceRouting permit 30
Router1(config-route-map)# match ip address 103
Router1(config-route-map)# set ip next-hop 200.1.0.2          ! for Router 2
(or) Router1(config-route-map)# set ip next-hop 200.1.0.3     ! for Router 3
```

Start packet captures on the links between ports f0/0 from Router2 and Router3, and the switch SW A. From PC1 and PC2 ping different IPv4 addresses from network 192.168.2.0/24, including 192.168.2.103.

>> Is there any change on the routing behavior?

4. Erase the last rule and define another rule in the original route-map (with lower order of processing: **5**) that will change the next-hop (to be Router2) for the traffic defined in the access list 103 (traffic to 192.168.2.103):

```
Router1(config)# no route-map ForceRouting permit 30
Router1(config)# route-map ForceRouting permit 5
Router1(config-route-map)# set ip next-hop 200.1.0.2          ! for Router 2
(or) Router1(config-route-map)# set ip next-hop 200.1.0.3     ! for Router 3
```

Start packet captures on the links between ports f0/0 from Router2 and Router3, and the switch SW A. From PC1 and PC2 ping different IPv4 addresses from network 192.168.2.0/24, including 192.168.2.103.

>> Is there any change on the routing behavior? Why?

>> What is the importance of the PBR rule sequence order?

5. Erase the route map and define another route-map that routes all HTTP(S) traffic (TCP ports 80 and 443) to network 192.168.2.0/24 via Router 2 and all other traffic via Router 3:

```
Router1(config)# no route-map ForceRouting
Router1(config)# access-list 110 permit tcp any 192.168.2.0 0.0.0.255 eq 80
Router1(config)# access-list 110 permit tcp any 192.168.2.0 0.0.0.255 eq 443
Router1(config)# route-map ForceRouting permit 5
Router1(config-route-map)# match ip address 110
Router1(config-route-map)# set ip next-hop 200.1.0.2
Router1(config-route-map)# route-map ForceRouting permit 10
Router1(config-route-map)# set ip next-hop 200.1.0.3
```

Note: a route-map branch without a match condition, when reached, will always perform the set action.

Start packet captures on the links between ports f0/0 from Router2 and Router3, and the switch SW A. From PC1 and PC2 ping PC3 using TCP packets and ports 22, 80, 443 and 3000.

```
PC1> ping 192.168.2.103 -P 6 -p 22
PC1> ping 192.168.2.103 -P 6 -p 80
PC1> ping 192.168.2.103 -P 6 -p 443
PC1> ping 192.168.2.103 -P 6 -p 3000
```

>> Analyze the captured packets (from PC1 and PC2) and analyze the behavior of the route-map.