REDES DE COMUNICAÇÕES 2

PBR with Route-Maps

192.168.1.222
192.168.2.103
200.1.0.3/24:f0/0
Router 3
f0/0:200.1.0.1/24
f0/1:
192.168.2.3/24
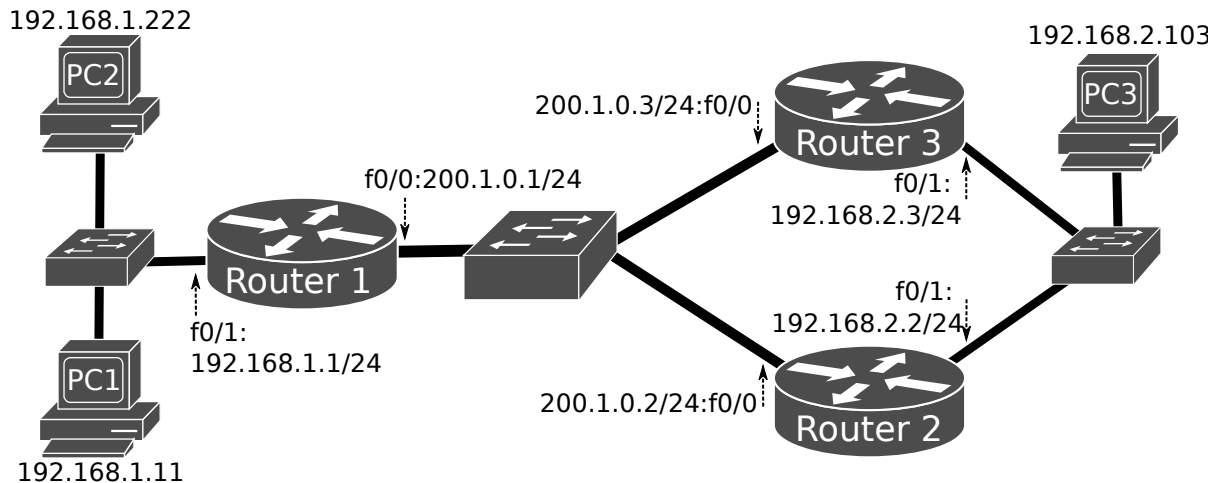Router 1
f0/1:
192.168.1.1/24
f0/1:
192.168.2.2/24
192.168.1.11
200.1.0.2/24:f0/0
Router 2

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

    Router*(config)# interface loopback 0
    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). From PC1 ping PC3 using UDP packets and ports 3000,3001,3002, …, 3005.

    PC1> ping 192.168.2.103 -P 17 -p 3000
    PC1> ping 192.168.2.103 -P 17 -p 3001
    ...
    PC1> ping 192.168.2.103 -P 17 -p 3005

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

>> Analyze the captured UDP packets (the destination MAC address), and identify how Router 1 uses the two available routes to network 192.168.2.0/24 for each set of UDP pings (traffic flow to the same port).

Note: to identify the MAC addresses of interfaces f0/0 in both Router2 and Router3, use the command:

    Router2# show interface f0/0 | include address

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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 <u>ForceRouting</u> 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 <u>ForceRouting</u> 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 <u>ForceRouting</u>

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 ping PC3. From PC1 and PC2 ping PC3 using UDP packets and ports 3000,3001,3002, …, 3005.

>> 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. Configure another rule (access-list 103) that identifies all traffic to IP address 192.168.2.22:

    Router1(config)# access-list 103 permit ip **any** 192.168.2.0 0.0.0.255

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 102 (traffic to 192.168.2.0/24):

    Router1(config)# route-map ForceRouting permit **30**
    Router1(config-route-map)# match ip address 102
    Router1(config-route-map)# set ip next-hop 200.1.0.2

Start a capture in network 200.1.0.0/24 (between Router 1 and the switch). From PC1 and PC2 ping PC3 using UDP packets and ports 3000,3001,3002, …, 3005.

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

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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 102 (traffic to 192.168.2.0/24):

    Router1(config)# no route-map ForceRouting permit 30
    Router1(config)# route-map ForceRouting permit **5**
    Router1(config-route-map)# match ip address 102
    Router1(config-route-map)# set ip next-hop 200.1.0.2

Start a capture in network 200.1.0.0/24 (between Router 1 and the switch). From PC1 and PC2 ping PC3 using UDP packets and ports 3000,3001,3002, …, 3005.

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

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

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5. (Optional) 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 a capture in network 200.1.0.0/24 (between Router 1 and the switch). 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.