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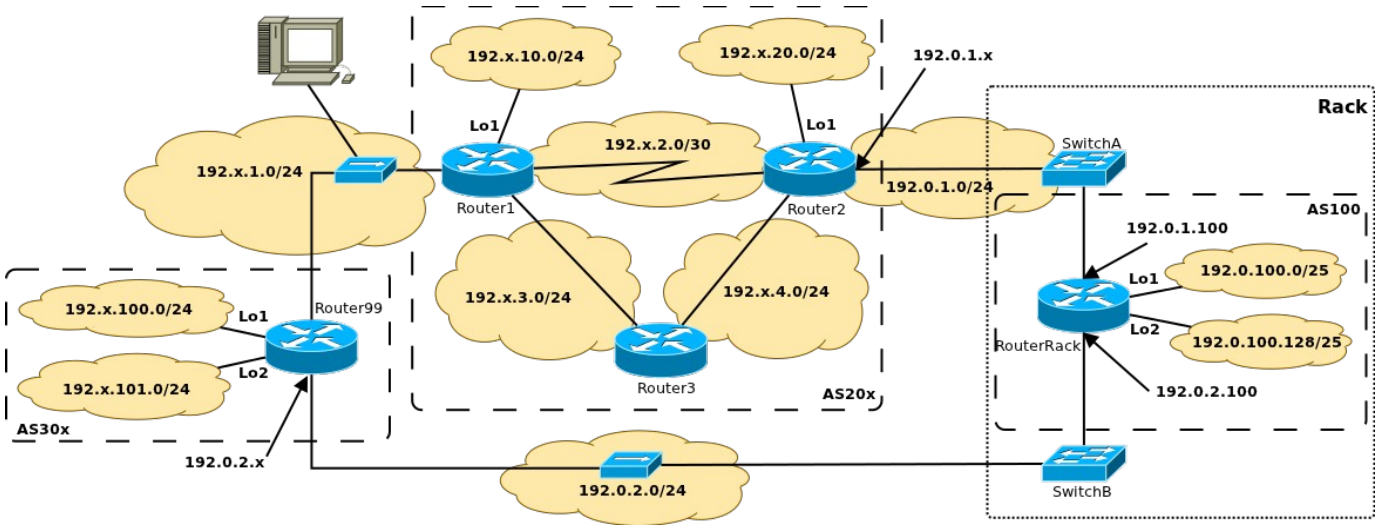
Arquitetura e Gestão de Redes

Laboratory Guide

Objectives

- BGP advanced topics.

BGP Neighboring



1. **<u>Considering x as your group number and that for all IP addresses not defined in the figure the last byte is equal to the router number</u>**, assemble the above depicted network and configure all IPv4 addresses. Perform all necessary configuration in order to obtain full connectivity between the inner-AS networks using only EBGP and IBGP neighbor relations. With Wireshark (at the PC) start a capture. Initiate the configuration at Router1 with the following commands:

```
Router1(config)#router bgp 20x
Router1(config-router)# neighbor 192.x.2.2 remote-as 20x    !IBGP Neighboring with R2
Router1(config-router)# neighbor 192.x.3.3 remote-as 20x    !IBGP Neighboring with R3
Router1(config-router)# neighbor 192.x.1.99 remote-as 30x   !EBGP Neighboring with RA
```

Configure the remaining routers. Using the following commands verify the state of the routing process:

```
Router1# show bgp summary
Router1# show ip route
Router1# show ip bgp
Router1# show ip bgp neighbors
```

Stop the capture and analyze the BGP packets. What can you conclude about the established BGP neighbor relations?

2. With Wireshark (at the PC) start a capture. Explicit add all networks (inside the AS) to the respective BGP routing process. Initiate the configuration at Router1 with the following commands:

```
Router1(config)# router bgp 20x
Router1(config-router)# network 192.x.2.0 mask 255.255.255.252
Router1(config-router)# network 192.x.3.0 mask 255.255.255.0
Router1(config-router)# network 192.x.10.0 mask 255.255.255.0
```

Configure the remaining routers. Verify and analyze the state of the routing process, stop the capture and analyze the BGP packets. After analyzing the BGP process in Router2 (`show ip bgp`) and its routing table, what can you conclude about the connectivity obtained and how the BGP's NEXT-HOP attribute is propagated inside the AS?

3. Override the way BGP's NEXT-HOP attribute is propagated inside the AS, reconfiguring the IBGP neighbor relations:

```
Router1(config)# router bgp 20x
Router1(config-router)# neighbor 192.x.2.2 next-hop-self
Router1(config-router)# neighbor 192.x.3.3 next-hop-self
```

Configure the remaining routers. Verify and analyze the state of the routing process. What can you

conclude about the connectivity obtained and how the BGP's attribute NEXT-HOP is now propagated inside the AS?

EBGP and IBGP Over OSPF

4. **Remove all `network` commands from Router1 and Router 2 BGP processes, remove the BGP process from Router3 and configure an OSPF routing process (with id 100) in all routers from AS20x.** A full mesh IBGP neighbor relations are mandatory between AS border routers (namely Router1 and Router2). In AS border routers BGP routes should be redistributed by OSPF:

```
Router1(config)# router ospf 100
Router1(config-router)# network 192.x.2.0 0.0.0.3 area 0
Router1(config-router)# network 192.x.3.0 0.0.0.255 area 0
Router1(config-router)# network 192.x.10.0 0.0.0.255 area 0
Router1(config-router)# redistribute bgp 20x
```

Configure also Router2. Verify and analyze the state of the routing process. What can you conclude about the connectivity obtained?

5. Include sub-netting information when redistributing BGP routes by OSPF:

```
Router1(config)# router ospf 100
Router1(config-router)# no redistribute bgp 20x
Router1(config-router)# redistribute bgp 20x subnets
```

Take reconfigurations actions where necessary. Verify and analyze the state of the routing process. Explain potential disadvantages of distributing all BGP routes in OSPF.

Redistribution of OSPF routes in BGP

6. In all AS20x's border routers reconfigure BGP process to redistribute all OSPF routes:

```
Router1(config)# router bgp 20x
Router1(config-router)# redistribute ospf 100
```

Take reconfigurations actions where necessary. Verify and analyze the state of the routing process in all AS.

Establish Neighbor relations between Loopback interfaces

7. In Router2 disable (`shut down`) the network interface(s) to which Router1 have establish the IBGP relation(s). Verify and analyze the state of the routing process.

8. Establish Router1-Router2 IBGP relations using as neighbor IP address the respective Loopback addresses:

```
Router1(config)# router bgp 20x
Router1(config-router)# no neighbor 192.x.2.2 remote-as 20x
Router1(config-router)# neighbor 192.x.20.2 remote-as 20x
Router1(config-router)# neighbor 192.x.20.2 next-hop-self
Router1(config-router)# neighbor 192.x.20.2 update-source <Lo-name>
```

Perform a similar configuration for other neighbors and in Router2. Verify and analyze the state of the BGP routing process. What can you conclude about the usage of Loopback interfaces to establish BGP neighbor relations?

Route Maps

9. Remove the link between Router99 and RouterRack. What do you conclude about the routing process?
Reestablish the link between Router99 and RouterRack.
To avoid that AS20x serves as transit AS to AS100 and AS30x the routes announced by BGP must be filtered using route-maps and communities. A route-map must be created and associated with routes being sent to other AS (internal routes):

```
Router1(config)# ip as-path access-list 1 permit ^$
Router1(config)# route-map routes-out
Router1(config-route-map)# match as-path 1
Router1(config-route-map)# router bgp 20x
Router1(config-router)# neighbor 192.x.1.99 route-map routes-out out
```

Perform a similar configuration in Router2. Verify and analyze the state of the routing process. Test the configuration by removing the link between Router99 and RouterRack. What do you conclude?

Communities

10. Communities can be used to filter or assign attribute values accordingly to multiple rules. With Wireshark (at the PC) start a capture. **In Router99** configure a community to all external routes and another to local networks and send that information to Router1. The community ID new format is *AS:any_number* (e.g 300:1):

```
Router99(config)# ip bgp-community new-format
Router99(config)# route-map routesA-out permit 10
Router99(config-route-map)# match route-type local
Router99(config-route-map)# set community <community_id_1>
Router99(config)# route-map routesA-out permit 20
Router99(config-route-map)# match route-type external
Router99(config-route-map)# set community <community_id_2>
Router99(config-route-map)# router bgp 30x
Router99(config-router)# neighbor 192.x.1.1 route-map routesA-out out
Router99(config-router)# neighbor 192.x.1.1 send-community
Router99(config-router)# end
Router99# clear ip bgp *
```

Stop the capture and analyze the BGP packets (COMMUNITIES attribute). Verify and analyze the state of the routing process.

"Local Preference" based on "Community" value

11. L*ocal preference* attribute can be used to chose (within the AS) between multiple routes to the same destination. In Router1, configure differentiated *local preference* values to the routes received from AS30x. Give low values to routes exterior to AS30x and high values to AS30x networks:

```
Router1(config)# ip bgp-community new-format
Router1(config)# ip community-list 1 permit <community_id_1>
Router1(config)# ip community-list 2 permit <community_id_2>
Router1(config)# route-map routes-in permit 10
Router1(config-route-map)# match community 1
Router1(config-route-map)# set local-preference 111
Router1(config-route-map)# route-map routes-in permit 20
Router1(config-route-map)# match community 2
Router1(config-route-map)# set local-preference 2
Router1(config-route-map)# router bgp 20x
Router1(config-router)# neighbor 192.x.1.99 route-map routes-in in
```

Verify and analyze the state of the routing process (`show ip bgp`).

BGP conflicts with IGP routing

12. **Physically remove network 192.x.2.0/30 and all BGP routes redistributions from OSPF configuration.** Update the respective OSPF configuration and configure Router 1 as OSPF's preferred default route (lower OSPF metric):

```
Router1(config)# router ospf 100
Router1(config-router)# no redistribute bgp 20x subnets
Router1(config-router)# default-information originate always metric 5
```

Perform a similar configuration (higher OSPF metric) in Router2:

```
Router2(config)# router ospf 100
Router1(config-router)# no redistribute bgp 20x subnets
Router2(config-router)# default-information originate always metric 10
```

Verify and analyze the state of the routing process. Perform a packet capture in 192.x.3.0/24 network. From Router3 ping RouterRack Lo1 interface. What can you conclude about the lack of connectivity? Explain the BGP and IGP conflicting routes.

13. Define Router 1 as BGP's default exit from the AS (higher local-preference)

```
Router1(config)# router bgp 20x
Router1(config-router)# bgp default local-preference 200
---
Router2(config)# router bgp 20x
Router2(config-router)# bgp default local-preference 100
```

Verify and analyze the state of the routing process. Perform a packet capture in 192.x.3.0/24 network. From Router3 ping RouterRack Lo1 interface.

Define now Router 2 as BGP's default exit from the AS (higher local-preference)

```
Router1(config)# router bgp 20x
Router1(config-router)# bgp default local-preference 200
---
Router2(config)# router bgp 20x
Router2(config-router)# bgp default local-preference 300
```

Verify and analyze the state of the routing process. Perform a packet capture in 192.x.3.0/24 network. From Router3 ping RouterRack Lo1 interface.

What can you conclude about the usage of BGP's local-preference values?

Establishing BGP Neighbor relations over IP-IP tunnels

14. Configure the IP-IP tunnel end-points (Loopback interfaces). In Router 1:

```
Router1(config)# interface Tunnel 0
Router1(config-if)# ip address 10.0.0.1 255.255.255.252
Router1(config-if)# tunnel source 192.x.10.1
Router1(config-if)# tunnel destination 192.x.20.2
Router1(config-if)# tunnel mode ipip
```

Perform a similar configuration in Router2:

```
Router2(config)# interface Tunnel 0
Router2(config-if)# ip address 10.0.0.2 255.255.255.252
Router2(config-if)# tunnel source 192.x.20.2
Router2(config-if)# tunnel destination 192.x.10.1
Router2(config-if)# tunnel mode ipip
```

Reestablish Router1-Router2 IBGP relations using as neighbor IP address the respective Tunnel 0 addresses:

```
Router1(config)# router bgp 20x
Router1(config-router)# no neighbor 192.x.20.2 remote-as 20x
Router1(config-router)# neighbor 10.0.0.2 remote-as 20x
Router1(config-router)# neighbor 10.0.0.2 next-hop-self
```

Perform a similar configuration in Router2. Verify and analyze the state of the routing process. Perform a

packet capture in 192.x.3.0/24 network. From Router3 ping RouterRack Lo1 interface. What can you conclude about the usage of IP-IP Tunnels to establish BGP neighbor relations?