universidade de aveiro
theoria poiesis praxis

ARQUITETURA E GESTÃO DE REDES

LABORATORY GUIDE

MPLS VPN

. Objectives

- MPLS VPN configuration

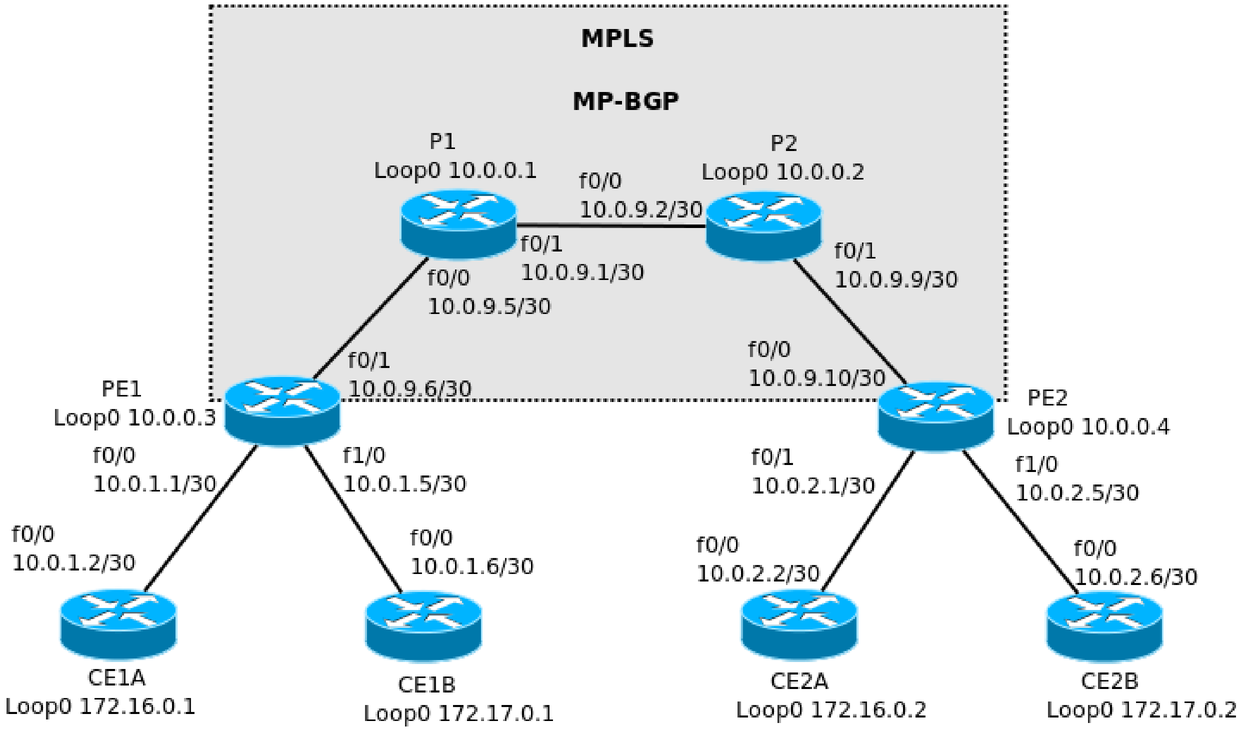
. MPLS VPN

1. Consider the following network that includes two customers, A and B, each one having two sites. P (provider) routers are ISP core routers that don't connect to customer routers and typically run only MPLS. PE (provider edge) routers connect to customer sites and form the edge of a VPN. CE (customer edge) routers exist at the edge of a customer site; they have no VPN awareness. An IGP (OSPF, in this case) running among all P and PE routers is used to support LDP and BGP adjacencies within the provider network. MP-BGP is run only among PE routers. An IGP (typically) is run between each CE router and its upstream PE router.

Configure OSPF as the IGP that provides basic routing connectivity inside the MPLS core. In order to perform that configuration, use the ***network 10.0.0.0 0.255.255.255 area 0*** command to announce the subnets of network 10.0.0.0 and the ***ip ospf network point-to-point*** command at loopback interfaces of each MPLS core router.

For now, do not configure the connections between the PEs and the CEs routers.

Check the routing tables and test the connectivity between the PEs and the Ps.



2. There are five core tasks we need to accomplish to get an MPLS VPN up and running:

- Enable MPLS on the provider backbone.
- Create VRFs and assign routed interfaces to them.
- Configure MP-BGP between the PE routers.
- Configure OSPF between each PE router and its attached CE routers.
- Enable route redistribution between the customer sites and the backbone.

Enable MPLS on all P-P and P-PE links with the following commands: ***ip cef*** in general configuration mode and ***mpls ip*** in general configuration mode and in each interface that is going to use MPLS. Remember that MPLS is *not* enabled on any CE-facing interfaces; CE routers do not run MPLS, just plain IP routing.

Check the MPLS forwarding table and the MPLS label bindings using the ***show mpls forwarding-table*** and the ***show mpls ldp bindings*** commands. Verify the configuration of MPLS interfaces using ***show mpls interfaces*** and the LDP adjacencies using the command ***show mpls ldp neighbor***.

3. Configure VRFs (VPN Routing or Forwarding instances) for customers A and B.

At both routers PE1 and PE2 enter the following commands:

PE1(config)#ip vrf Customer_A
PE1(config-vrf)#rd 65000:1 ***(route distinguisher inside a VPN)***
PE1(config-vrf)#route-target import 65000:1 ***(VPN ID)***
PE1(config-vrf)#route-target export 65000:1 ***(VPN ID)***
PE1(config)#ip vrf Customer_B
PE1(config-vrf)#rd 65000:2 ***(route distinguisher inside a VPN)***
PE1(config-vrf)#route-target import 65000:2 ***(VPN ID)***
PE1(config-vrf)#route-target export 65000:2 ***(VPN ID)***

<u>**Note that**</u> the route distinguisher will allow overlapping routes to be distinguished on the MP-BGP backbone.

Having defined VRFs, assign the appropriate interfaces to them and configure IP addresses:

PE1(config-vrf)#int F0/0
PE1(config-if)#no shut
PE1(config-if)#ip vrf forwarding Customer_A
PE1(config-if)#ip address 10.0.1.1 255.255.255.252

PE1(config-if)#int F1/0
PE1(config-if)#no shut
PE1(config-if)#ip vrf forwarding Customer_B
PE1(config-if)#ip address 10.0.1.5 255.255.255.252

Make a similar configuration for PE2 (the only difference lies on the IP addresses).

The command ***show ip vrf interfaces*** can be used to verify interface VRF assignment and addressing.

4. Now that VRFs are configured, we must have a way of communicating the routes contained in VRFs throughout the backbone. So, we have to configure **MP-BGP**, which supports multiple *address families* (e.g. IPv4 and IPv6) over a common BGP adjacency. It also supports the advertisement of VPN routes, which are longer than normal routes due to the addition of a 64-bit route distinguisher (which we assigned under VRF configuration).

At router PE1, enter the following commands:

PE1(config)#router bgp 65000
PE1(config-router)#neighbor 10.0.0.4 remote-as 65000
PE1(config-router)#neighbor 10.0.0.4 update-source loopback 0
PE1(config-router)#address-family vpnv4 ***Exchange VPNv4 routes***
PE1(config-router-af)#neighbor 10.0.0.4 activate ***Activate the neighbour***

At router PE2, enter the following commands:

PE2(config)#router bgp 65000
PE2(config-router)#neighbor 10.0.0.3 remote-as 65000
PE1(config-router)#neighbor 10.0.0.3 update-source loopback 0
PE1(config-router)#address-family vpnv4 — ***Exchange VPNv4 routes***
PE1(config-router-af)#neighbor 10.0.0.3 activate — ***Activate the neighbour***

Using the ***show ip bgp neighbor <neighbor_ip_address>*** command, verify the neighborhood relationships.

Verify that the MP-BGP adjacency between PE1 and PE2 was formed successfully with the command ***show bgp vpnv4 unicast all summary.***

5. Now, we have to configure an IGP to exchange routes with our customer sites. We will use RIPv2. The overall topology is illustrated in the following figure.

At router PE1, configure RIP per VRF as follows:

PE1(config)#router rip
PE1(config-router)#version 2
PE1(config-router)#address-family ipv4 vrf Customer_A
PE1(config-router-af)#version 2
PE1(config-router-af)#network 10.0.0.0
PE1(config-router-af)#no auto-summary
PE1(config-router)#address-family ipv4 vrf Customer_B
PE1(config-router-af)#version 2
PE1(config-router-af)#network 10.0.0.0
PE1(config-router-af)#no auto-summary

Make a similar configuration for PE2.

RIP is running between the PEs and CEs, and MP-BGP is running between the PEs. So, we have to redistribute between RIP and BGP and vice-versa:

PE1(config)#router bgp 65000
PE1(config-router)#address-family ipv4 vrf Customer_A
PE1(config-router-af)#redistribute rip metric 1
PE1(config-router-af)#address-family ipv4 vrf Customer_B
PE1(config-router-af)#redistribute rip metric 1

PE1(config-router-af)#router rip
PE1(config-router)#address-family ipv4 vrf Customer_A
PE1(config-router-af)#redistribute bgp 65000 metric 1
PE1(config-router-af)#address-family ipv4 vrf Customer_B
PE1(config-router-af)#redistribute bgp 65000 metric 1

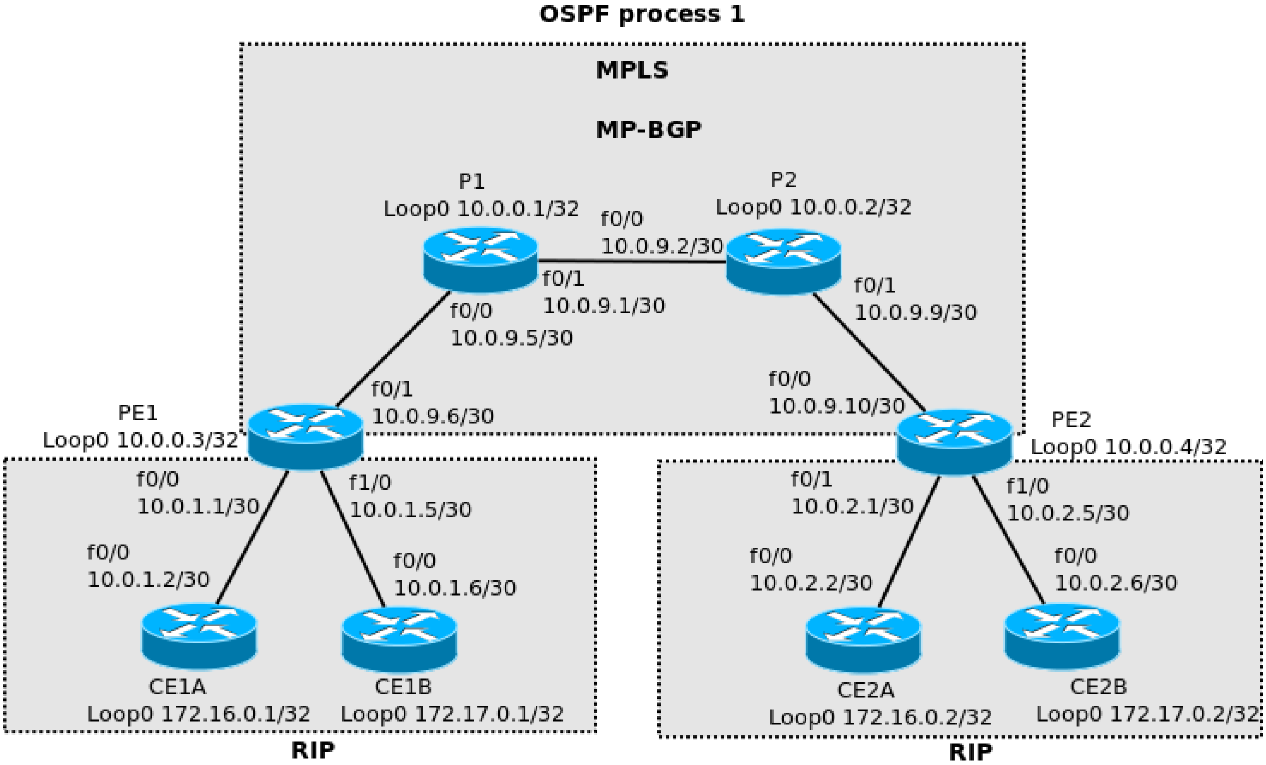
Make a similar configuration for PE2.

At all customers' routers CE1A, CE2A, CE1B and CE2B configure RIPv2 as follows:

CE1A(config)#router rip
CE1A(config-router)#version 2
CE1A(config-router)#network 10.0.0.0

CE1A(config-router)#network 172.16.0.1
CE1A(config-router)#no auto-summary

Using the ***show ip bgp vpnv4 all*** command, verify that redistribution is correctly functioning.



6. Check the routing tables at the customers' routers. Can CE1A now reach CE2A and CE1B reach CE2B?

7. Use the ***show ip vrf*** command to verify the correct VRFs, the ***show ip vrf interfaces*** command to verify the activated interfaces, the ***show ip route vrf Customer_A|Customer_B*** command to verify the routing information on the PE routers and the ***show ip cef vrf Customer_A|Customer_B [detail]*** command to verify the routing information on the PE routers.

•