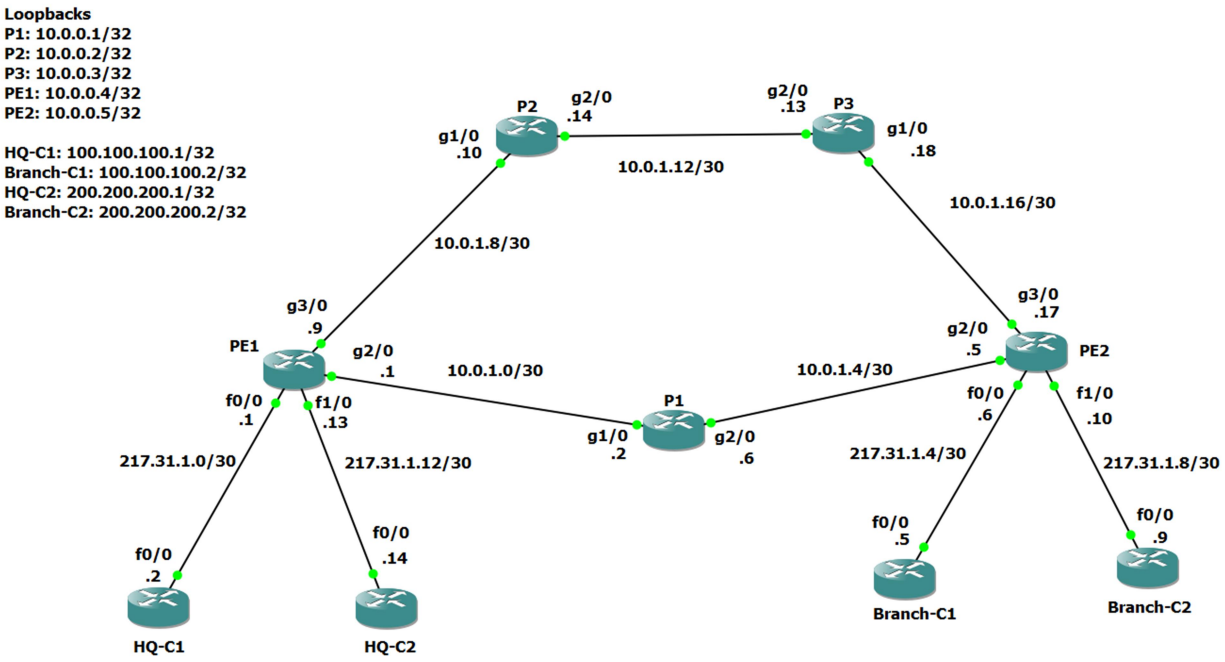
Traffic engineering part 1: building topology



Objectives: Build and configure the network. Customers C1 and C2 each has a HQ and a branch. Create a VPN between HQ and branch of each customer.
With a successful configuration, you should be able to ping between C1 promises and similarly between C2 promises.

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1 Assign IP to interfaces

Router	Configuration
HQ-C1	Router#configure terminal Router(config)#interface f0/0 Router(config-if)#ip address 217.31.1.2 255.255.255.252 Router(config-if)#no shutdown Router(config-if)#interface loopback 0 Router(config-if)#ip address 100.100.100.1 255.255.255.255
HQ-C2	HQ-C2#configure terminal HQ-C2(config)#interface f0/0 HQ-C2(config-if)#ip address 217.31.1.14 255.255.255.252 HQ-C2(config-if)#no shutdown HQ-C2(config-if)#interface loopback 0 HQ-C2(config-if)#ip address 200.200.200.1 255.255.255.255
Branch-C1	Branch-C1#configure terminal Branch-C1(config)#interface f0/0 Branch-C1(config-if)#ip address 217.31.1.5 255.255.255.252 Branch-C1(config-if)#no shutdown Branch-C1(config-if)#interface loopback 0 Branch-C1(config-if)#ip address 100.100.100.2 255.255.255.255
Branch-C2	Branch-C2#configure terminal Branch-C2(config)#interface f0/0 Branch-C2(config-if)#ip address 217.31.1.9 255.255.255.252 Branch-C2(config-if)#no shutdown Branch-C2(config-if)#interface loopback 0 Branch-C2(config-if)#ip address 200.200.200.2 255.255.255.255
PE1	PE1#configure terminal PE1(config)#interface f0/0 PE1(config-if)#ip address 217.31.1.1 255.255.255.252 PE1(config-if)#no shutdown PE1(config-if)#interface f1/0 PE1(config-if)#ip address 217.31.1.13 255.255.255.252 PE1(config-if)#no shutdown PE1(config-if)#interface g3/0 PE1(config-if)#ip address 10.0.1.9 255.255.255.252 PE1(config-if)#no shutdown PE1(config-if)#interface g2/0 PE1(config-if)#ip address 10.0.1.1 255.255.255.252 PE1(config-if)#no shutdown PE1(config-if)#interface loopback 0 PE1(config-if)#ip address 10.0.0.4 255.255.255.255

Q1- Why are loopback interfaces used here?
Q2- Is it mandatory to use loopback interfaces while doing the configuration?
Q3- What are the advantages of defining these loopback interfaces?
Q4- Notice that we are not enabling the loopback interfaces (we did not write "no shutdown"), why?

P1	P1#configure terminal P1(config)#interface g1/0 P1(config-if)#ip address 10.0.1.2 255.255.255.252 P1(config-if)#no shutdown P1(config-if)#interface g2/0 P1(config-if)#ip address 10.0.1.6 255.255.255.252 P1(config-if)#no shutdown P1(config-if)#interface loopback 0 P1(config-if)#ip addres 10.0.0.1 255.255.255.255
P2	R2#configure terminal R2(config)#interface g1/0 R2(config-if)#ip address 10.0.1.10 255.255.255.252 R2(config-if)#no shutdown R2(config-if)#interface g2/0 R2(config-if)#ip address 10.0.1.14 255.255.255.252 R2(config-if)#no shutdown R2(config-if)#interface loopback 0 R2(config-if)#ip address 10.0.0.2 255.255.255.255
P3	P3#configure terminal P3(config)#interface g2/0 P3(config-if)#ip address 10.0.1.13 255.255.255.252 P3(config-if)#no shutdown P3(config-if)#interface g1/0 P3(config-if)#ip address 10.0.1.17 255.255.255.252 P3(config-if)#no shutdown P3(config-if)#interface loopback 0 P3(config-if)#ip address 10.0.0.3 255.255.255.255
PE2	PE2#configure terminal PE2(config)#interface g3/0 PE2(config-if)#ip address 10.0.1.17 255.255.255.252 PE2(config-if)#no shutdown PE2(config-if)#interface g2/0 PE2(config-if)#ip address 10.0.1.5 255.255.255.252 PE2(config-if)#no shutdown PE2(config-if)#interface f0/0 PE2(config-if)#ip address 217.31.1.6 255.255.255.252 PE2(config-if)#no shutdown PE2(config-if)#interface f1/0 PE2(config-if)#ip address 217.31.1.10 255.255.255.252 PE2(config-if)#interface loopback 0 PE2(config-if)#ip address 10.0.0.5 255.255.255.255

2 Configure MPLS in backbone area (area limited by the two provider edges)

Router	**Configuration**

PE1	PE1#configure terminal PE1(config)#interface g2/0 PE1(config-if)#mpls ip PE1(config-if)#interface g3/0 PE1(config-if)#mpls ip
P1	P1#configure terminal P1(config)#interface g1/0 P1(config-if)#mpls ip P1(config-if)#interface g2/0 P1(config-if)#mpls ip
P2	R2#configure terminal R2(config)#interface g1/0 R2(config-if)#mpls ip R2(config-if)#interface g2/0 R2(config-if)#mpls ip
P3	P3#configure terminal P3(config)#interface g1/0 P3(config-if)#mpls ip P3(config-if)#interface g2/0 P3(config-if)#mpls ip
PE2	PE2#configure terminal PE2(config)#interface g2/0 PE2(config-if)#mpls ip PE2(config-if)#interface g3/0 PE2(config-if)#mpls ip

Q5- What does mpls ip mean? and why we wrote it for g2 and g3 interfaces only? Why not for f0 and f1?

3 Routing

3.1 Configure OSPF in backbone (area limited by the two provider edges)

Router	Configuration
PE1	PE1#configure terminal PE1(config)#router ospf 1 PE1(config-router)#network 10.0.1.8 0.0.0.3 area 0 PE1(config-router)#network 10.0.1.0 0.0.0.3 area 0 PE1(config-router)#network 10.0.0.4 0.0.0.0 area 0 PE1(config-router)#passive-interface f0/0 PE1(config-router)#passive-interface f1/0
P1	P1#configure terminal P1(config)#router ospf 1 P1(config-router)#network 10.0.1.0 0.0.0.3 area 0 P1(config-router)#network 10.0.1.4 0.0.0.3 area 0 P1(config-router)#network 10.0.0.1 0.0.0.0 area 0
P2	R2#configure terminal R2(config)#router ospf 1 R2(config-router)#network 10.0.1.8 0.0.0.3 area 0 R2(config-router)#network 10.0.1.12 0.0.0.3 area 0 R2(config-router)#network 10.0.0.2 0.0.0.0 area 0

Q6- What does passive-interface mean? and why on f0 and f1 only? What happens if we don't specify it?

Q7- What does ospf 1 mean? Can we write ospf 2?

P3	P3#configure terminal P3(config)#router ospf 1 P3(config-router)#network 10.0.1.12 0.0.0.3 area 0 P3(config-router)#network 10.0.1.16 0.0.0.3 area 0 P3(config-router)#network 10.0.0.3 0.0.0.0 area 0
PE2	PE2#configure terminal PE2(config)#router ospf 1 PE2(config-router)#network 10.0.1.16 0.0.0.3 area 0 PE2(config-router)#network 10.0.1.4 0.0.0.3 area 0 PE2(config-router)#network 10.0.0.5 0.0.0.0 area 0 PE2(config-router)#passive-interface f0/0 PE2(config-router)#passive-interface f1/0

3.2 VRF for each customer

Router	**Configuration**
PE1	PE1#configure terminal PE1(config)#ip vrf C1 PE1(config-vrf)#rd 100:100 PE1(config-vrf)#route-target both 100:100 PE1(config-vrf)#exit PE1(config)#ip vrf C2 PE1(config-vrf)#rd 200:200 PE1(config-vrf)#route-target both 200:200 PE1(config-vrf)#exit PE1(config)#interface f0/0 PE1(config-if)#ip vrf forwarding C1 PE1(config-if)#ip address 217.31.1.1 255.255.255.252 PE1(config-if)#no shutdown PE1(config-if)#exit PE1(config)#interface f1/0 PE1(config-if)#ip vrf forwarding C2 PE1(config-if)#ip address 217.31.1.13 255.255.255.252 PE1(config-if)#no shutdown

Q8- What does VRF mean? What is C1?

Q9- What is meant by rd? why rd 100:100? Could it be rd 1000:1000 or any other numbers?

Q10- What is route target? what does both mean here?

Q11- Why are we defining VRF C2 other than C1? and rd 200:200 other than 100:100?

Q12- What does forwarding mean? Why is it used on f0 and f1 interfaces of PE1?

PE2	PE2#configure terminal PE2(config)#ip vrf C1 PE2(config-vrf)#rd 100:100 PE2(config-vrf)#route-target both 100:100 PE2(config-vrf)#exit PE2(config)#ip vrf C2 PE2(config-vrf)#rd 200:200 PE2(config-vrf)#route-target both 200:200 PE2(config-vrf)#exit PE2(config)#interface f0/0 PE2(config-if)#ip vrf forwarding C1 PE2(config-if)#ip address 217.31.1.6 255.255.255.252 PE2(config-if)#no shutdown PE2(config-if)#exit PE2(config)#interface f1/0 PE2(config-if)#ip vrf forwarding C2 PE2(config-if)#ip address 217.31.1.10 255.255.255.252 PE2(config-if)#no shutdown

Q13- Assume that on PE1, we defined VRF C1 and rd 100:100, So on PE2, can we change C1 and 100:100 to any other values ?

3.3 Configure EIGRP on customer side

Router	Configuration
HQ-C1	HQ-C1#configure terminal HQ-C1(config)#router eigrp 100 HQ-C1(config-router)#network 217.31.1.0 0.0.0.3 HQ-C1(config-router)#network 100.100.100.1 0.0.0.0 HQ-C1(config-router)#no auto-summary
HQ-C2	HQ-C2#configure terminal HQ-C2(config)#router eigrp 200 HQ-C2(config-router)#network 217.31.1.12 0.0.0.3 HQ-C2(config-router)#network 200.200.200.1 0.0.0.0 HQ-C2(config-router)#no auto-summary
Branch-C1	Branch-C1#configure terminal Branch-C1(config)#router eigrp 100 Branch-C1(config-router)#network 217.31.1.4 0.0.0.3 Branch-C1(config-router)#network 100.100.100.2 0.0.0.0 Branch-C1(config-router)#no auto-summary
Branch-C2	Branch-C2#configure terminal Branch-C2(config)#router eigrp 200 Branch-C2(config-router)#network 217.31.1.8 0.0.0.3 Branch-C2(config-router)#network 200.200.200.2 0.0.0.0 Branch-C2(config-router)#no auto-summary

Q14- What does 100 mean here?

Q15-What is meant by no auto-summary? What if we dont specify it?

Q16- What does 200 mean? Could we use 100 instead?

3.4 Configure EIGRP on provider edge side

Router	Configuration

PE1	PE1#configure terminal PE1(config)#router eigrp 1 PE1(config-router)#address-family ipv4 vrf C1 PE1(config-router-af)#autonomous-system 100 PE1(config-router-af)#network 217.31.1.0 0.0.0.3 PE1(config-router-af)#network 100.100.100.1 0.0.0.0 PE1(config-router-af)#no auto-summary PE1(config-router-af)#exit PE1(config-router)#address-family ipv4 vrf C2 PE1(config-router-af)#autonomous-system 200 PE1(config-router-af)#network 217.31.1.12 0.0.0.3 PE1(config-router-af)#network 200.200.200.1 0.0.0.0 PE1(config-router-af)#no auto-summary
PE2	PE2#configure ter PE2(config)#router eigrp 1 PE2(config-router)#address-family ipv4 vrf C1 PE2(config-router-af)#autonomous-system 100 PE2(config-router-af)#network 100.100.100.2 0.0.0.0 PE2(config-router-af)#network 217.31.1.4 0.0.0.3 PE2(config-router-af)#no auto-summary PE2(config-router-af)#exit PE2(config-router)#address-family ipv4 vrf C2 PE2(config-router-af)#autonomous-system 200 PE2(config-router-af)#network 217.31.1.8 0.0.0.3 PE2(config-router-af)#network 200.200.200.2 0.0.0.0 PE2(config-router-af)#no auto-summary

Q17- What does the value 1 mean here?

Q18- What does these 2 green lines mean?

3.5 Configure bgp to advertise eigrp between customer branches

Router	**Configuration**

PE2	PE2#configure terminal PE2(config)#router bgp 1 PE2(config-router)#neighbor 10.0.0.4 remote-as 1 PE2(config-router)#neighbor 10.0.0.4 update-source loopback 0 PE2(config-router)#address-family vpnv4 PE2(config-router-af)#neighbor 10.0.0.4 activate PE2(config-router-af)#neighbor 10.0.0.4 send-community both PE2(config-router-af)#exit PE2(config-router)#exit PE2(config)#router eigrp 1 PE2(config-router)#address-family ipv4 vrf C1 PE2(config-router-af)#redistribute bgp 1 metric 64 1000 255 1 1500 PE2(config-router-af)#exit PE2(config-router)#address-family ipv4 vrf C2 PE2(config-router-af)#redistribute bgp 1 metric 64 1000 255 1 1500 PE2(config-router-af)#exit PE2(config-router)#exit PE2(config)#router bgp 1 PE2(config-router)#address-family ipv4 vrf C1 PE2(config-router-af)#redistribute eigrp 100 PE2(config-router-af)#exit PE2(config-router)#address-family ipv4 vrf C2 PE2(config-router-af)#redistribute eigrp 200 PE2(config-router-af)#end
PE1	PE1#configure terminal PE1(config)#router bgp 1 PE1(config-router)#neighbor 10.0.0.5 remote-as 1 PE1(config-router)#neighbor 10.0.0.5 update-source loopback 0 PE1(config-router)#address-family vpnv4 PE1(config-router-af)#neighbor 10.0.0.5 activate PE1(config-router-af)#neighbor 10.0.0.5 send-community both PE1(config-router-af)#exit PE1(config-router)#exit PE1(config)#router eigrp 1 PE1(config-router)#address-family ipv4 vrf C1 PE1(config-router-af)#redistribute bgp 1 metric 64 1000 255 1 1500 PE1(config-router-af)#exit PE1(config-router)#address-family ipv4 vrf C2 PE1(config-router-af)#redistribute bgp 1 metric 64 1000 255 1 1500 PE1(config-router-af)#exit PE1(config-router)#exit PE1(config)#router bgp 1 PE1(config-router)#address-family ipv4 vrf C1 PE1(config-router-af)#redistribute eigrp 100 PE1(config-router-af)#exit PE1(config-router)#address-family ipv4 vrf C2 PE1(config-router-af)#redistribute eigrp 200 PE1(config-router-af)#end

Q19- What does the green lines mean? Elaborate on the meaning of "redistribute bgp, eigrp", metric ....