MPLS L3 VPN with EIGRP

« MPLS L3 VPN with RIPv2 (/workbook/view/service-provider-v4/task/mpls-l3-vpn-with-ripv2-Mjg1Ng%3D%3D) | MPLS L3 VPN with OSPF (/workbook/view/service-provider-v4/task/mpls-l3-vpn-with-ospf-Mjg1OA%3D%3D) »

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Note:

Initial Configuration & Diagrams: Load the initial configuration files for the section named **OSPFv2 and LDP**, which can be found in CCIE SPv4 Topology Diagrams & Initial Configurations (http://labs.ine.com/workbook/view/service-provider-v4/task/ccie-spv4-topology-diagrams-initial-configs). Refer to the **Base IPv4 Diagram** in order to complete this task.

Task

- Configure a VRF on R2 and XR1 as follows:
  - VRF Name: VPN_A
  - Route Distinguisher: 100:1
  - Route Target Import: 100:1
  - Route Target Export: 100:1
  - Assign the VRF to the links connecting to R1 and XR2 respectively.
- Configure EIGRP routing for the VRF as follows:
  - Use EIGRP AS 1.
  - Enable EIGRP between R1 & R2.
  - Enable EIGRP between XR1 & XR2.
  - Advertise the Loopback0 networks of R1 & XR2 into RIP.
- Configure BGP on R2 and XR1 as follows:
  - Use BGP AS 100.
  - R2 and XR1 should be iBGP peers for the VPNv4 Address Family.
  - Use their Loopback0 interfaces as the source of the BGP session.
- Redistribute between BGP and the EIGRP.
- Once complete R1 and XR2 should have reachability to each other's Loopback0 interfaces and PE-CE links.

Configuration **Click to *collapse***

```
R1:
router eigrp 1
 network 1.0.0.0
 network 10.0.0.0
 no auto-summary

R2:
vrf definition VPN_A
 rd 100:1
 route-target export 100:1
 route-target import 100:1
 !
 address-family ipv4
 exit-address-family
!
interface GigabitEthernet1.12
 vrf forwarding VPN_A
 ip address 10.1.2.2 255.255.255.0
!
router eigrp PE_CE
 !
 address-family ipv4 unicast vrf VPN_A autonomous-system 1
  !
  topology base
   redistribute bgp 100
  exit-af-topology
  network 10.0.0.0
 exit-address-family
!
router bgp 100
 no bgp default ipv4-unicast
 bgp log-neighbor-changes
 neighbor 19.19.19.19 remote-as 100
 neighbor 19.19.19.19 update-source Loopback0
!
address-family vpnv4
 neighbor 19.19.19.19 activate
 neighbor 19.19.19.19 send-community extended
exit-address-family
!
address-family ipv4 vrf VPN_A
 redistribute eigrp 1
exit-address-family
!

XR1:
vrf VPN_A
 address-family ipv4 unicast
  import route-target
   100:1
  !
  export route-target
   100:1
```

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```
  !
 !
!
interface GigabitEthernet0/0/0/0.1920
 vrf VPN_A
 ipv4 address 10.19.20.19 255.255.255.0
!
router bgp 100
 address-family vpnv4 unicast
 !
 neighbor 2.2.2.2
  remote-as 100
  update-source Loopback0
  address-family vpnv4 unicast
 !
!
vrf VPN_A
 rd 100:1
 address-family ipv4 unicast
   redistribute eigrp 1
  !
 !
!
router eigrp PE_CE
 vrf VPN_A
  address-family ipv4
   autonomous-system 1
   redistribute bgp 100
   interface GigabitEthernet0/0/0/0.1920
   !
  !
 !
!
end

XR2:
router eigrp 1
  address-family ipv4
   no auto-summary
   interface Loopback0
   !
   interface GigabitEthernet0/0/0/0.1920
  !
 !
!
```

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Verification

Like RIP, the VRF aware EIGRP process uses one global process, with sub-processes for each VRF table. In this example, since EIGRP is not used for routing in the global table, an arbitrary global EIGRP AS number of PE_CE is used. The only AS number that matters in this example is the one assigned to the VRF VPN_A address family, as this is the one that must match on the PE to CE link.

Similar to the verification of a global EIGRP process, the first step in making sure that this configuration is functional is to verify that the EIGRP adjacencies have occurred. In this case this would be on the PE-CE links.

```
R1#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(1)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
 0   10.1.2.2                Gi1.12                   14 04:48:00    1   100  0  5

R2#show eigrp address-family ipv4 vrf VPN_A neighbors
EIGRP-IPv4 VR(PE_CE) Address-Family Neighbors for AS(1)
           VRF(VPN_A)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
 0   10.1.2.1                Gi1.12                   13 04:48:34    2   100  0  4

RP/0/0/CPU0:XR1#show eigrp vrf VPN_A ipv4 neighbors
Sun May  3 22:37:47.444 UTC

IPv4-EIGRP VR(PE_CE) Neighbors for AS(1) VRF VPN_A

H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
 0   10.19.20.20             Gi0/0/0/0.1920    13 04:42:03   23   200  0  3

RP/0/3/CPU0:XR2#show eigrp ipv4 neighbors
Sun May  3 22:38:19.142 UTC

IPv4-EIGRP Neighbors for AS(1) VRF default

H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
 0   10.19.20.19             Gi0/0/0/0.1920    11 04:42:35   24   200  0  3
```

Redistribution of VPNv4 BGP to EIGRP and vice versa does not require a metric to be set, because the individual vectors of the EIGRP composite metric are encoded in the VPNv4 BGP update as extended communities. This can be seen on the PE routers as follows.

```
R2#show ip eigrp vrf VPN_A topology
EIGRP-IPv4 VR(PE_CE) Topology Table for AS(1)/ID(10.1.2.2)
           Topology(base) TID(0) VRF(VPN_A)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 10.19.20.0/24, 1 successors, FD is 1310720
        via VPNv4 Sourced (1310720/0)
P 20.20.20.20/32, 1 successors, FD is 1966080
        via VPNv4 Sourced (1966080/0)
P 10.1.2.0/24, 1 successors, FD is 1310720
        via Connected, GigabitEthernet1.12
 P 1.1.1.1/32, 1 successors, FD is 328990720
    via 10.1.2.1 (328990720/327761920), GigabitEthernet1.12
```


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The EIGRP topology consists of four prefixes, two from the R1 & R2 side and two from the XR1 & XR2 side. The details of one of these prefixes is verified as follows.

```
R2#show eigrp address-family ipv4 vrf VPN_A topology 1.1.1.1/32
EIGRP-IPv4 VR(PE_CE) Topology Entry for AS(1)/ID(10.1.2.2)
           Topology(base) TID(0) VRF(VPN_A)
EIGRP-IPv4(1): Topology base(0) entry for 1.1.1.1/32
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 328990720, RIB is 2570240
  Descriptor Blocks:
  10.1.2.1 (GigabitEthernet1.12), from 10.1.2.1, Send flag is 0x0
      Composite metric is (328990720/327761920), route is Internal
      Vector metric:
        Minimum bandwidth is 1000000 Kbit
        Total delay is 5010000000 picoseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 1
        Originating router is 1.1.1.1
```

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The individual vector attributes are then encoded as BGP extended communities in the VPNv4 prefix.

```
R2#show bgp vpnv4 unicast all 1.1.1.1/32
BGP routing table entry for 100:1:1.1.1.1/32, version 44
Paths: (1 available, best #1, table VPN_A)
  Advertised to update-groups:
     1
  Refresh Epoch 1
  Local
    10.1.2.1 (via vrf VPN_A) from 0.0.0.0 (2.2.2.2)
      Origin incomplete, metric 2570240, localpref 100, weight 32768, valid, sourced, best
      Extended Community: RT:100:1
        Cost:pre-bestpath:128:2570240 (default-2144913407) 0x8800:32768:0
        0x8801:1:128256 0x8802:65281:2560 0x8803:65281:1500 0x8806:0:16843009
      mpls labels in/out 17/nolabel
  rx pathid: 0, tx pathid: 0x0
```

The following table describes what the individual values within the extended communities represent:

Attributes	Usage	Values
Type 0x8800	EIGRP General Route Information	Route Flag and Tag
Type 0x8801	EIGRP Route Metric Information and Autonomous System	Autonomous System and Delay
Type 0x8802	EIGRP Route Metric Information	Reliability, Next Hop, and Bandwidth
Type 0x8803	EIGRP Route Metric Information	Reserve, Load and MTU
Type		Remote Autonomous System and

0x8804	EIGRP External Route Information	Remote ID
Type 0x8805	EIGRP External Route Information	Remote Protocol and Remote Metric
Type 0x8806	EIGRP Vector Metric Information	Vector Metric, Reserved, and Router-ID

This encoding is maintained as the routes are advertised to the remote PE routers.

```
RP/0/0/CPU0:XR1#show bgp vpnv4 unicast vrf VPN_A 1.1.1.1/32
Sun May  3 22:53:23.890 UTC
BGP routing table entry for 1.1.1.1/32, Route Distinguisher: 100:1
Versions:
  Process           bRIB/RIB  SendTblVer
  Speaker                 49         49
Last Modified: May  3 17:47:47.451 for 05:05:36
Paths: (1 available, best #1)
  Not advertised to any peer
  Path #1: Received by speaker 0
  Not advertised to any peer
  Local
    2.2.2.2 (metric 4) from 2.2.2.2 (2.2.2.2)
      Received Label 17
      Origin incomplete, metric 2570240, localpref 100, valid, internal, best, group-best, import-candidate, imported
      Received Path ID 0, Local Path ID 1, version 49
      Extended community: COST:128:128:2570240 EIGRP route-info:0x8000:0 EIGRP AD:1:128256 EIGRP RHB:255:1:2560 EIGRP LM:0xff:1:1500 0x880
6:0x00:0x00:0x01:0x01:0x01:0x01 RT:100:1
      Source VRF: VPN_A, Source Route Distinguisher: 100:1
```

These individual vector attributes are then copied back into the EIGRP topology when BGP is redistributed back into EIGRP. This is the reason the metric does not need to be manually set, and why the routes appear as Internal EIGRP even though they went through redistribution.

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```
RP/0/0/CPU0:XR2#show route ipv4 eigrp

Sun May  3 23:05:50.209 UTC


D    1.1.1.1/32 [90/2575360] via 10.19.20.19, 05:09:47, GigabitEthernet0/0/0/0.1920

D    10.1.2.0/24 [90/15360] via 10.19.20.19, 05:09:47, GigabitEthernet0/0/0/0.1920



RP/0/3/CPU0:XR2#show eigrp ipv4 topology 1.1.1.1/32

Sun May  3 23:06:15.577 UTC


IPv4-EIGRP AS(1): Topology entry for 1.1.1.1/32

  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 329646080, RIB is 2575360

  Routing Descriptor Blocks:

  10.19.20.19 (GigabitEthernet0/0/0/0.1920), from 10.19.20.19, Send flag is 0x0

      Composite metric is (329646080/328990720), Route is Internal

      Vector metric:

        Minimum bandwidth is 1000000 Kbit

        Total delay is 5020000000 picoseconds

        Reliability is 255/255

        Load is 1/255

        Minimum MTU is 1500

        Hop count is 2

    Originating router is 19.19.19.19
```

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Notice that the MPLS network is transparent to the CE devices. R2 sees 1.1.1.1/32 with a hop count of 1, and XR2 sees it with a hop count of 2. Additionally, the delay increased from 5010000000 to 5020000000 picoseconds - indicative of the update traversing through a single GigE link.

The final result is that both customer sites have full reachability to each other.

```
R1#ping 20.20.20.20 source 1.1.1.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 20.20.20.20, timeout is 2 seconds:

Packet sent with a source address of 1.1.1.1

 !!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 11/12/16 ms



RP/0/0/CPU0:XR2#ping 1.1.1.1 source 20.20.20.20

Sun May  3 23:09:40.063 UTC

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:

 !!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/7/9 ms
```

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