CCIE Lab Center

CLC

CCIE Security v6.0:

Practice Lab v3.0

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Workbook Description

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Level: Expert (CCIE)
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Lab: Lab v 3.0
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1: LAB Details

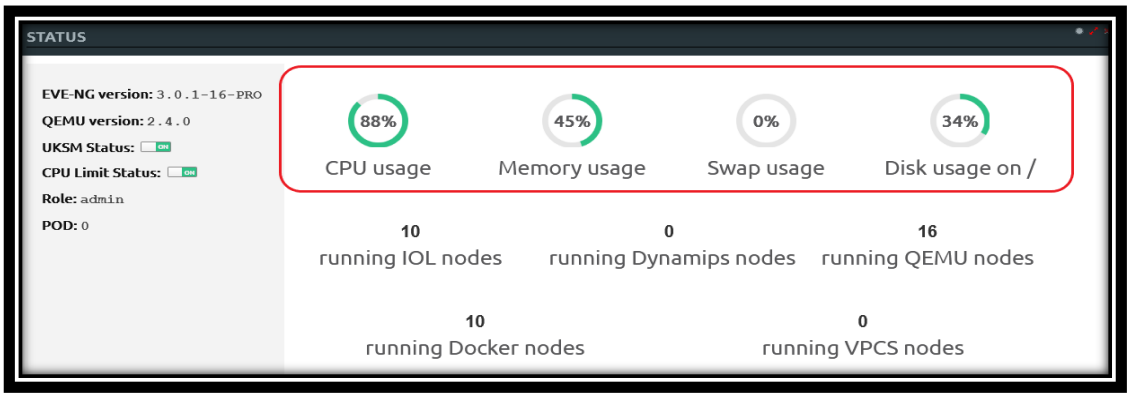
1.1: LAB Summary

1.1. a: Hardware details

Phase3:Hub & spoke with spoke to spoke direct communication allowed with better scalability using NHRP redirect.

CPU 4 core
RAM 8 GB
HDD 500 GB

Note: After starting all nodes wait for 10 minutes for CPU utilization getting back to normal.



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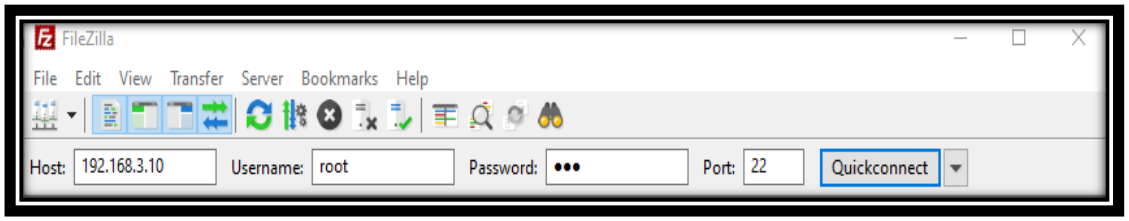
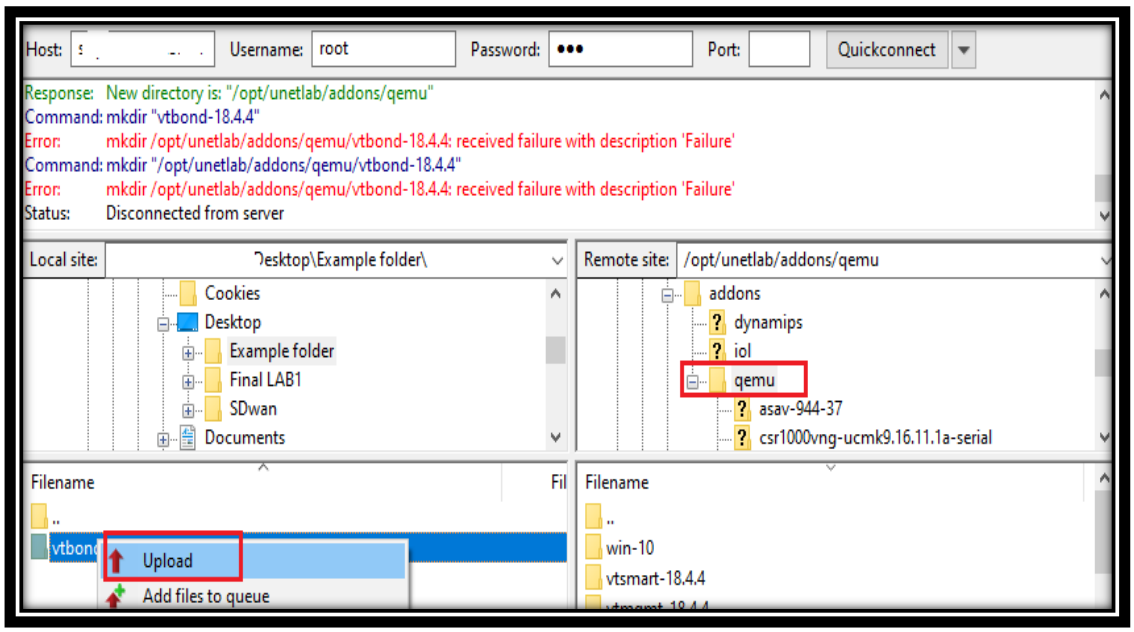
1.1. b: How to upload images into EVE-NG

Step1: After starting eve-ng instance Login with filezilla (with your displayed ip address using username & password as root & eve respectively)



Step2: Upload qemu images as shown below



Step3: Login to your eve-ng server/hypervisor/vmware/etc. with username root & password eve

Step4: Run below command using cli

/opt/unetlab/wrappers/unl_wrapper -a fixpermissions

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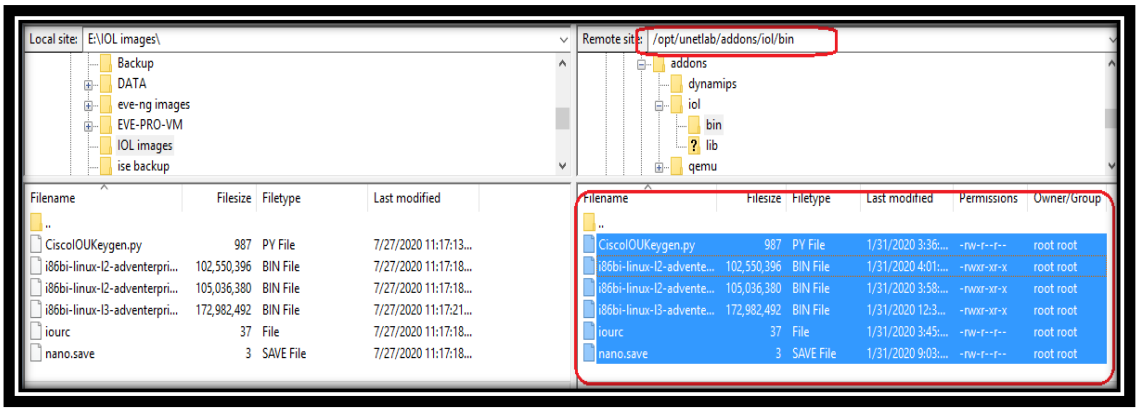
Step5: Uploading IOL images as shown below



Step6: Run below command using cli

/opt/unetlab/wrappers/unl_wrapper -a fixpermissions

For more details on uploading images you can visit the below link.
https://www.eve-ng.net/index.php/documentation/howtos/howto-add-cisco-iol-ios-on-linux/

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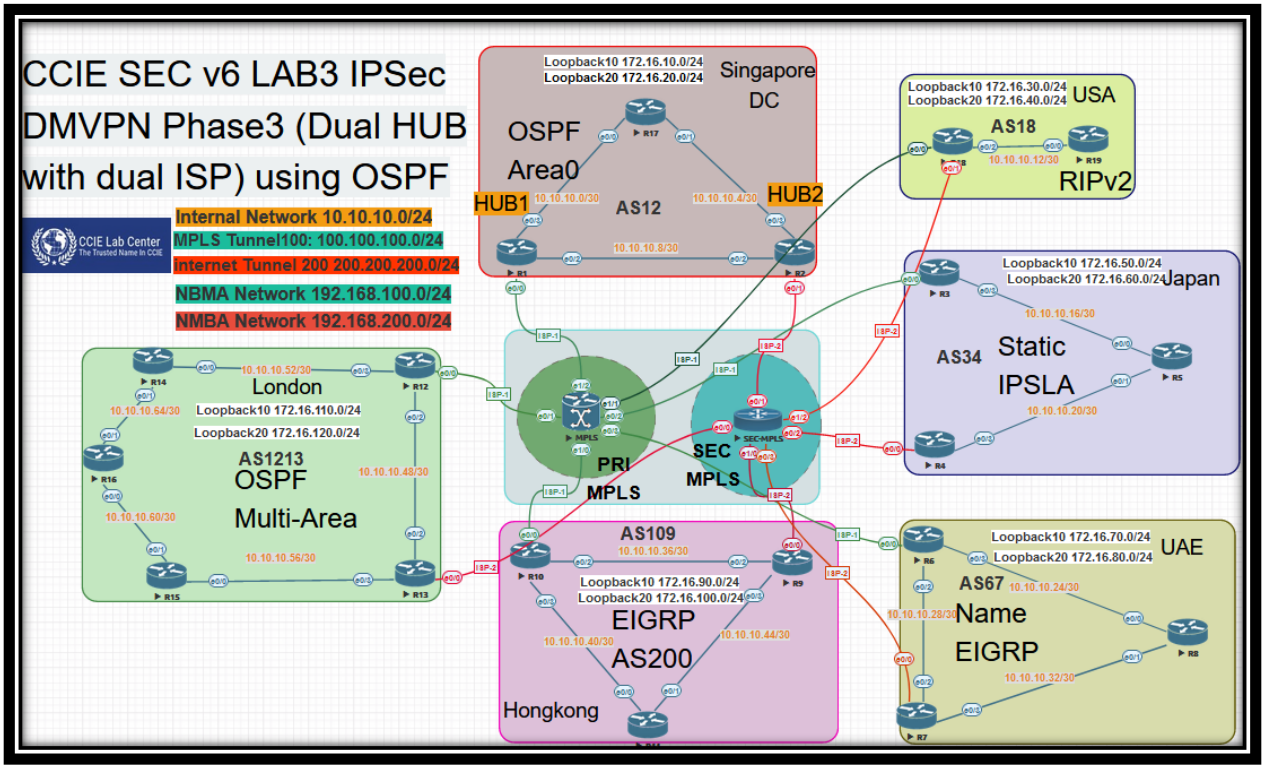
1.1. c: Lab Topology in Light Mode



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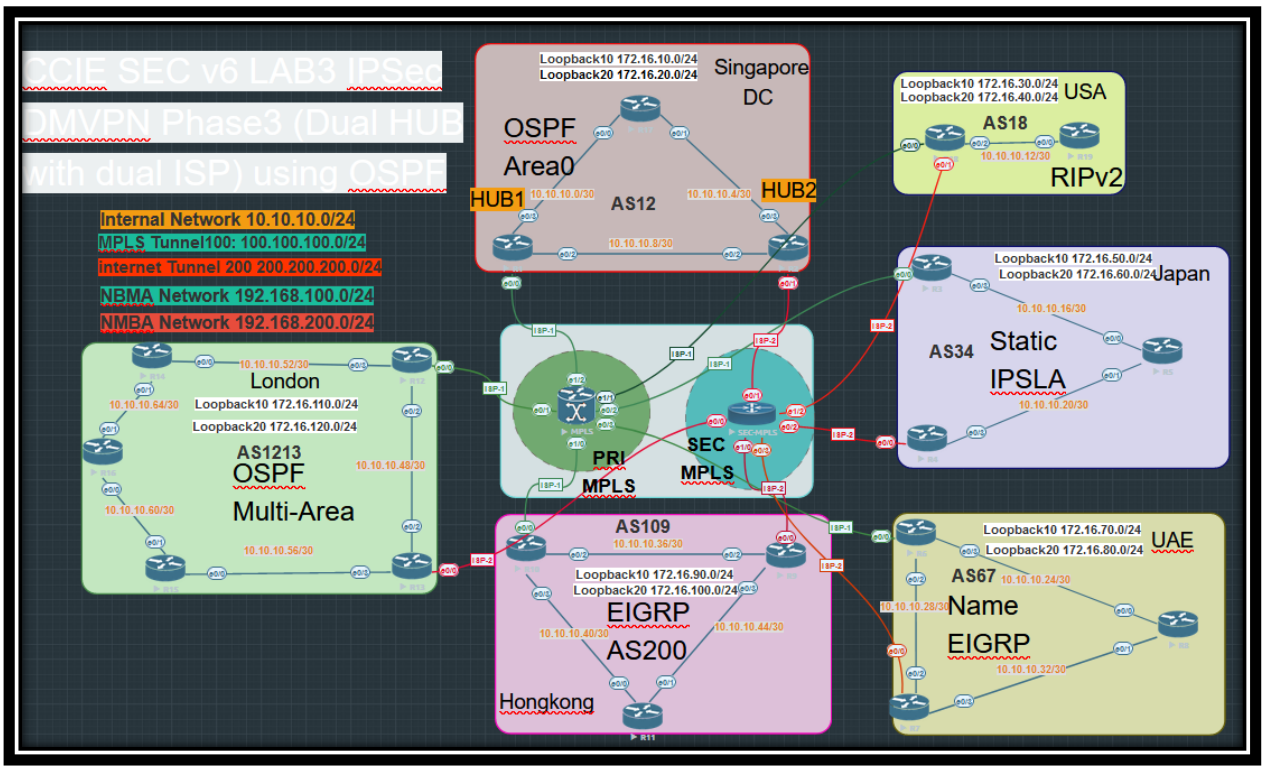
1.1. d: Lab Topology in Dark Mode



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1.1. e: IP Details

S/N	Router	Hub/Spoke	Tunnel0	Tunnel1	ASN	Loopback0
1	R1	Hub1	100.100.100.1/24	NA	12	1.1.1.1/24
2	R2	Hub2	NA	200.200.200.1/24	12	1.1.1.2/24
3	R18	Spoke	100.100.100.18/24	200.200.200.18/24	18	1.1.1.18/24
2	R3	Spoke	100.100.100.3/24	NA	34	1.1.1.3/24
3	R4	Spoke	NA	200.200.200.4/24	34	1.1.1.4/24
2	R6	Spoke	100.100.100.6/24	NA	67	1.1.1.6/24
3	R7	Spoke	NA	200.200.200.7/24	67	1.1.1.7/24
3	R9	Spoke	NA	200.200.200.9/24	109	1.1.1.9/24
2	R10	Spoke	100.100.100.10/24	NA	109	1.1.1.10/24
3	R12	Spoke	100.100.100.12/24	NA	1213	1.1.1.12/24
3	R13	Spoke	NA	200.200.200.13/24	1213	1.1.1.13/24

1.1. f: Lab Nodes Used

Image versions used in Lab.

- ISP Router: i86bi-linux-l3-adventerprisek9-15.5.bin
- HUB & Spoke Router: i86bi-linux-l3-adventerprisek9-15.5.bin

Web: https://ccielabcenter.com Mail: care@ccielabcenter.com Study Group: https://t.me/cciestudygroup

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1.2: Lab Objective

Configure DMVPN Phase 3 network between R1,R2,R18,R3,R4,R6,R7,R9,R10,R12 & R13 with below configuration

1. R1 & R2 are DMVPN Hubs
2. R18,R3,R4,R6,R7,R9,R10,R12 & R13 are DMVPN spokes.
3. Source the tunnel from the router's Ethernet0/0 & Ethernet0/1 interfaces
4. Use IP addressing of PRI Tunnel 0 100.100.100.X/24, & 200.200.200.X/24 where X is the router number.
5. Use an NHRP network ID of 100 of PRI & 200 of SEC.
6. Use an NHRP authentication string of CLC@123
7. Use GRE tunnel key of 100 of PRI & 200 of SEC.
8. Configure the DMVPN Hub to redirect NHRP requests for spoke-to-spoke resolutions.
9. Configure the DMVPN Spokes to be able to install NHRP shortcut routes for spoke-to-spoke routing.
10. Ensure that the spokes can send multicast traffic to the hub, and vice versa.
11. To prevent the tunnel endpoints from having to do IPsec fragmentation, configure the GRE tunnel's IP MTU to 1400 bytes, and set them to adjust the TCP MSS 1360 accordingly.
12. Configure point to multipoint @all Hubs & Spokes

Configure IGP routing over the DMVPN tunnel as follows:

1 Configuring OSPF Area 0 @all Routers in Singapore DC R1,R2,R17
2 Configuring OSPF Area 0 in R18 Router & RIP v2 in R19 router.
3 Configuring OSPF Area 0 in R3 & R4 Routers & R5 as Static routes using IPSLA.
4 Configuring OSPF & Name EIGRP of AS 100 in R7,R7 & R8 Routers.
5 Configuring OSPF & EIGRP of AS 100 in R9,R10 & R11 Routers.
6 Configuring OSPF Area 0 in R12,13,14,15,16 Routers

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Configure IPsec over the DMVPN tunnels as follows:

1 Use an ISAKMP Policy with the following options:

2 Pre-Shared Key: CLC@123

3 Encryption: AES

4 Hash: SHA1

5 Diffie-Hellman Group: 2

6 Use a single wildcard Pre-Shared Key for all DMVPN peers.

7 Use a Crypto IPsec Profile named CLC with the following options:

8 Encrypt the traffic using AES

9 Authenticate the traffic using SHA1

10 Use ESP Transport mode to save additional encapsulation overhead.

When all tasks are completed, ensure that R1,R2,R18,R3,R4,R6,R7,R9,R10,R12 & R13 can reach each other's Loopback0 network over the DMVPN network.

Additionally, ensure that spoke-to-spoke traffic does not transit the hub after initial NHRP mappings are formed.

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2. Deployment of Singapore DC

2.1: Initial Configuration

R1,R2 & R17 are normal router configurations are given below.

Start-up Configuration

I. Hub R1

Hostname R1

```
interface Loopback0
 ip address 1.1.1.1 255.255.255.0


interface Ethernet0/0
 description *** Connected to PRI MPLS ***
 ip address 192.168.100.1 255.255.255.0
 ip ospf network point-to-multipoint

interface Ethernet0/2
 description *** Connected to R2 ***
 ip address 10.10.10.9 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/3
 description *** Connected to R17 ***
 ip address 10.10.10.1 255.255.255.252
 ip ospf network point-to-point

router ospf 10
 router-id 1.1.1.1
 network 1.1.1.1 0.0.0.0 area 0
 network 10.10.10.0 0.0.0.3 area 0
 network 10.10.10.8 0.0.0.3 area 0
```

II. R2 (Hub)

```
hostname R2
```

```
interface Loopback0
 ip address 1.1.1.2 255.255.255.0

interface Ethernet0/1
 description *** Connected to SEC MPLS ***
 ip address 192.168.200.2 255.255.255.0
 ip ospf network point-to-multipoint
!
interface Ethernet0/2
 description *** Connected to R1 ***
 ip address 10.10.10.10 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/3
 description *** Connected to R17 ***
 ip address 10.10.10.5 255.255.255.252
 ip ospf network point-to-point
!
router ospf 10
 router-id 1.1.1.2
 network 1.1.1.2 0.0.0.0 area 0
 network 10.10.10.4 0.0.0.3 area 0
 network 10.10.10.8 0.0.0.3 area 0
```

III. R17

```
interface Loopback10
 ip address 172.16.10.1 255.255.255.0
 ip ospf network point-to-point
!
interface Loopback20
 ip address 172.16.20.1 255.255.255.0
 ip ospf network point-to-point
!
interface Ethernet0/0
 description *** Connected to R1 ***
 ip address 10.10.10.2 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/1
 description *** Connected to R2 ***
 ip address 10.10.10.6 255.255.255.252
 ip ospf network point-to-point

router ospf 10
 network 10.10.10.0 0.0.0.3 area 0
 network 10.10.10.4 0.0.0.3 area 0
 network 172.16.10.0 0.0.0.255 area 0
 network 172.16.20.0 0.0.0.255 area 0
```

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2.2: DMVPN Dual HUB Phase3 basic configuration

QUESTION

- Configure Hub-and-Spoke mGRE tunnels between R1 and R2 (hubs) is acting as a Hub.
- Use the following settings when configuring tunnels.

Solution

On Hub1 (R1)

Tunnel Parameters:

- IP address : 100.100.100.1/24
- IP MTU : 1400
- Tunnel Authentication Key : 100

NHRP Parameters

- NHRP ID : 100
- NHRP Authentication key : clc@123
- NHRP Hub : R1
- NHRP dynamic mapping :ip nhrp map multicast dynamic

Use the following settings when configuring tunnels.

ISAKMP Parameters:

- Authentication : Pre-Shared
- Encryption : AES
- Hashing : SHA
- DH Group : 2
- Pre-Shared Key : clc@123

IPSec Parameters

- Encryption : ESP-aes
- Authentication : ESP-SHA-HMAC

Others parameter

ip tcp adjust-mss 1360
ip ospf network point-to-multipoint

```
 ip ospf dead-interval 4
 ip ospf hello-interval 1
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
```

Final Configuration on R1

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC

interface Tunnel0
 description *** PRI Tunnel ***
 bandwidth 102400
 ip address 100.100.100.1 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map multicast dynamic
 ip nhrp network-id 100
ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 100
 tunnel protection ipsec profile CLC
```

On Hub1 (R2)

Tunnel Parameters:

- IP address : 200.200.200.1/24
- IP MTU : 1400
- Tunnel Authentication Key : 200

NHRP Parameters

- NHRP ID : 200
- NHRP Authentication key : clc@123
- NHRP Hub : R2
- NHRP dynamic mapping :ip nhrp map multicast dynamic

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Use the following settings when configuring tunnels.

ISAKMP Parameters:

- Authentication : Pre-Shared
- Encryption : AES
- Hashing : SHA
- DH Group : 2
- Pre-Shared Key : clc@123

IPSec Parameters

- Encryption : ESP-aes
- Authentication : ESP-SHA-HMAC

Others parameter

```
ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
```

Final Configuration on R2

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC

interface Tunnel1
 description *** SEC Tunnel ***
 bandwidth 92160
 ip address 200.200.200.2 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map multicast dynamic
 ip nhrp network-id 200
ip tcp adjust-mss 1360
```

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ip ospf network point-to-multipoint
ip ospf dead-interval 4
ip ospf hello-interval 1
tunnel source Ethernet0/0
tunnel mode gre multipoint
tunnel key 200
tunnel protection ipsec profile CLC

Verification

On R1

R1#sh ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
1.1.1.2	0	FULL/ -	00:00:35	10.10.10.10	Ethernet0/2
172.16.20.1	0	FULL/ -	00:00:35	10.10.10.2	Ethernet0/3

```
R1#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "ospf 10", distance 110, metric 11, type intra area
  Redistributing via nhrp
  Last update from 10.10.10.2 on Ethernet0/3, 1d07h ago
  Routing Descriptor Blocks:
  * 10.10.10.2, from 172.16.20.1, 1d07h ago, via Ethernet0/3
      Route metric is 11, traffic share count is 1
R1#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "ospf 10", distance 110, metric 11, type intra area
  Redistributing via nhrp
  Last update from 10.10.10.2 on Ethernet0/3, 1d07h ago
  Routing Descriptor Blocks:
  * 10.10.10.2, from 172.16.20.1, 1d07h ago, via Ethernet0/3
      Route metric is 11, traffic share count is 1
R1#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R1#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R1#sh ip os
R1#sh ip ospf in
R1#sh ip ospf interface b
R1#sh ip ospf interface br
R1#sh ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          10    0               1.1.1.1/24         1     LOOP  0/0
Tu0          10    0               100.100.100.1/24   1     P2MP  5/5
Et0/2        10    0               10.10.10.9/30      10    P2P   1/1
Et0/3        10    0               10.10.10.1/30      10    P2P   1/1
R1#
```

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```
R1#sh int tunnel 0
Tunnel0 is up, line protocol is up
  Hardware is Tunnel
  Description: *** PRI Tunnel ***
  Internet address is 100.100.100.1/24
  MTU 17912 bytes, BW 102400 Kbit/sec, DLY 50000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation TUNNEL, loopback not set
  Keepalive not set
  Tunnel linestate evaluation up
  Tunnel source 192.168.100.1 (Ethernet0/0)
   Tunnel Subblocks:
      src-track:
         Tunnel0 source tracking subblock associated with Ethernet0/0
          Set of tunnels with source Ethernet0/0, 1 member (includes iterators), on interface <OK>
  Tunnel protocol/transport multi-GRE/IP
    Key 0x64, sequencing disabled
    Checksumming of packets disabled
  Tunnel TTL 255, Fast tunneling enabled
  Tunnel transport MTU 1472 bytes
  Tunnel transmit bandwidth 8000 (kbps)
  Tunnel receive bandwidth 8000 (kbps)
  Tunnel protection via IPSec (profile "CLC")
  Last input 00:00:00, output never, output hang never
  Last clearing of "show interface" counters 1d07h
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 3
  Queueing strategy: fifo
  Output queue: 0/0 (size/max)
  5 minute input rate 5000 bits/sec, 5 packets/sec
  5 minute output rate 5000 bits/sec, 6 packets/sec
     590276 packets input, 63979409 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     599185 packets output, 74698133 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 unknown protocol drops
     0 output buffer failures, 0 output buffers swapped out
R1#
```

On R2

R2#sh ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
1.1.1.1	0	FULL/ -	00:00:39	10.10.10.9	Ethernet0/2
172.16.20.1	0	FULL/ -	00:00:38	10.10.10.6	Ethernet0/3

```
R2#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "ospf 10", distance 110, metric 11, type intra area
  Last update from 10.10.10.6 on Ethernet0/3, 1d07h ago
  Routing Descriptor Blocks:
  * 10.10.10.6, from 172.16.20.1, 1d07h ago, via Ethernet0/3
      Route metric is 11, traffic share count is 1
R2#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "ospf 10", distance 110, metric 11, type intra area
  Last update from 10.10.10.6 on Ethernet0/3, 1d07h ago
  Routing Descriptor Blocks:
  * 10.10.10.6, from 172.16.20.1, 1d07h ago, via Ethernet0/3
      Route metric is 11, traffic share count is 1
R2#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R2#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R2#sh ip os
R2#sh ip ospf in
R2#sh ip ospf interface br
R2#sh ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Lo0          10    0               1.1.1.2/24         1     LOOP  0/0
Tu1          10    0               200.200.200.2/24   1     P2MP  5/5
Et0/2        10    0               10.10.10.10/30     10    P2P   1/1
Et0/3        10    0               10.10.10.5/30      10    P2P   1/1
R2#
```

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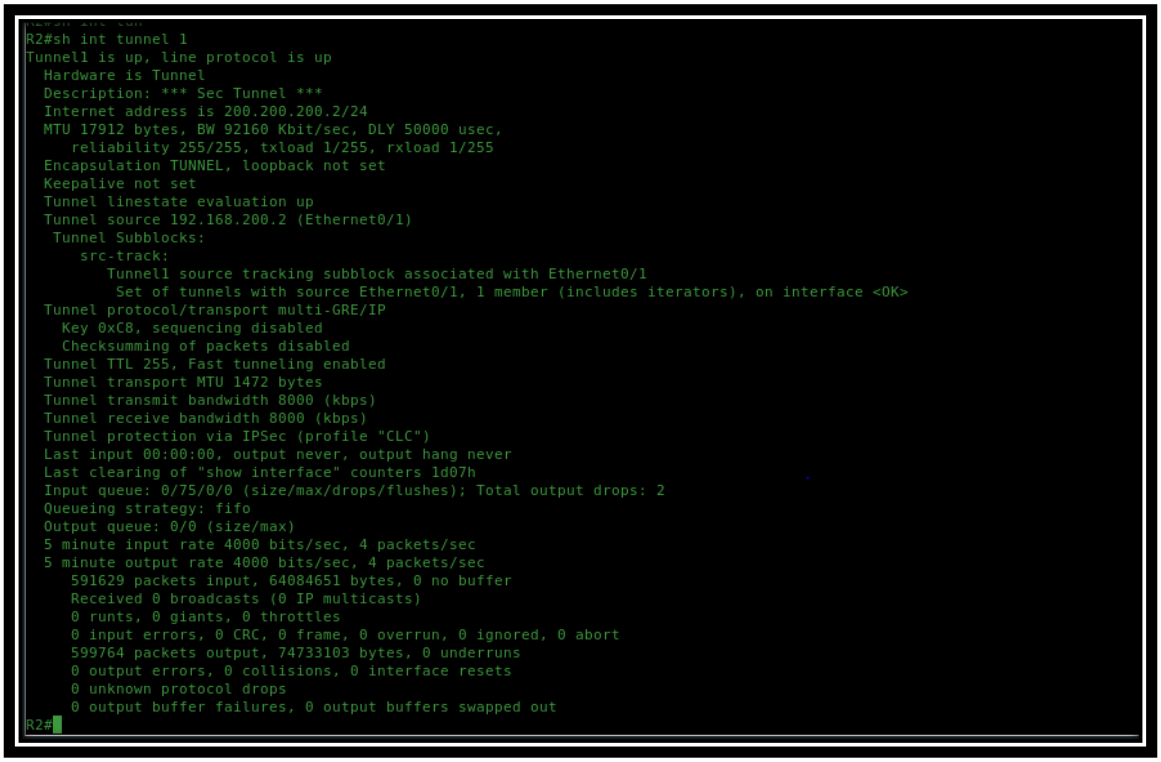

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3. Deployment of USA Spoke site

3.1: Initial Configuration

Start-up Configuration

I. Spoke R18

```
hostname R18

interface Loopback0
 ip address 1.1.1.18 255.255.255.0
!

interface Ethernet0/0
 description *** Connected to PRI DMVPN Cloud ***
 ip address 192.168.100.18 255.255.255.0
 ip ospf network point-to-multipoint
!
interface Ethernet0/1
 description *** Connected to SEC DMVPN Cloud ***
 ip address 192.168.200.18 255.255.255.0
 ip ospf network point-to-multipoint
!
interface Ethernet0/2
 description *** Connected to R19 ***
 ip address 10.10.10.13 255.255.255.252


router ospf 10
 router-id 1.1.1.18
  network 1.1.1.18 0.0.0.0 area 0
 network 100.100.100.0 0.0.0.255 area 0
 network 200.200.200.0 0.0.0.255 area 0
!
router rip
 version 2
  network 10.0.0.0
 no auto-summary
```

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3.2: Configuring DMVPN basic configuration

On R18

```
interface Tunnel0
 description *** PRI Tunnel ***
 ip address 100.100.100.18 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 100.100.100.1 192.168.100.1
 ip nhrp map multicast 192.168.100.1
 ip nhrp network-id 100
 ip nhrp nhs 100.100.100.1
 ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 100
 tunnel protection ipsec profile CLC

interface Tunnel1
 description *** SEC Tunnel ***
 ip address 200.200.200.18 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 200.200.200.2 192.168.200.2
 ip nhrp map multicast 192.168.200.2
 ip nhrp network-id 200
 ip nhrp nhs 200.200.200.2
 ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
 tunnel source Ethernet0/1
 tunnel mode gre multipoint
 tunnel key 200
 tunnel protection ipsec profile CLC

crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport

crypto ipsec profile CLC
set transform-set CLC
```

CCIE Lab Center

3.3: Redistributing OSPF into RIP & vice versa

On R18

```
router ospf 10
redistribute rip metric 20 subnets

router rip
redistribute ospf 10 metric 10
```

3.4: Tunnel 0 should PRI path for all outgoing traffic

On R18

```
interface Tunnel0
ip ospf cost 50
```

On R19

```
hostname R19
interface Loopback10
 ip address 172.16.30.1 255.255.255.0
!
interface Loopback20
 ip address 172.16.40.1 255.255.255.0
!
interface Ethernet0/0
 ip address 10.10.10.14 255.255.255.252

router rip
 version 2
 network 10.0.0.0
 network 172.16.0.0
 no auto-summary
```

CCIE Lab Center

Verification

On R19

```
R19#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "rip", distance 120, metric 10
  Redistributing via rip
  Last update from 10.10.10.13 on Ethernet0/0, 00:00:14 ago
  Routing Descriptor Blocks:
  * 10.10.10.13, from 10.10.10.13, 00:00:14 ago, via Ethernet0/0
      Route metric is 10, traffic share count is 1
R19#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "rip", distance 120, metric 10
  Redistributing via rip
  Last update from 10.10.10.13 on Ethernet0/0, 00:00:20 ago
  Routing Descriptor Blocks:
  * 10.10.10.13, from 10.10.10.13, 00:00:20 ago, via Ethernet0/0
      Route metric is 10, traffic share count is 1
R19#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/2/3 ms
R19#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/3/5 ms
R19#tr
R19#traceroute 172.16.10.1 nu
R19#traceroute 172.16.10.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.10.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.13 1 msec 1 msec 1 msec
  2 100.100.100.1 3 msec 3 msec 2 msec
  3 10.10.10.2 4 msec *  3 msec
R19#traceroute 172.16.20.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.20.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.13 1 msec 1 msec 1 msec
  2 100.100.100.1 2 msec 2 msec 2 msec
  3 10.10.10.2 3 msec *  4 msec
R19#
```

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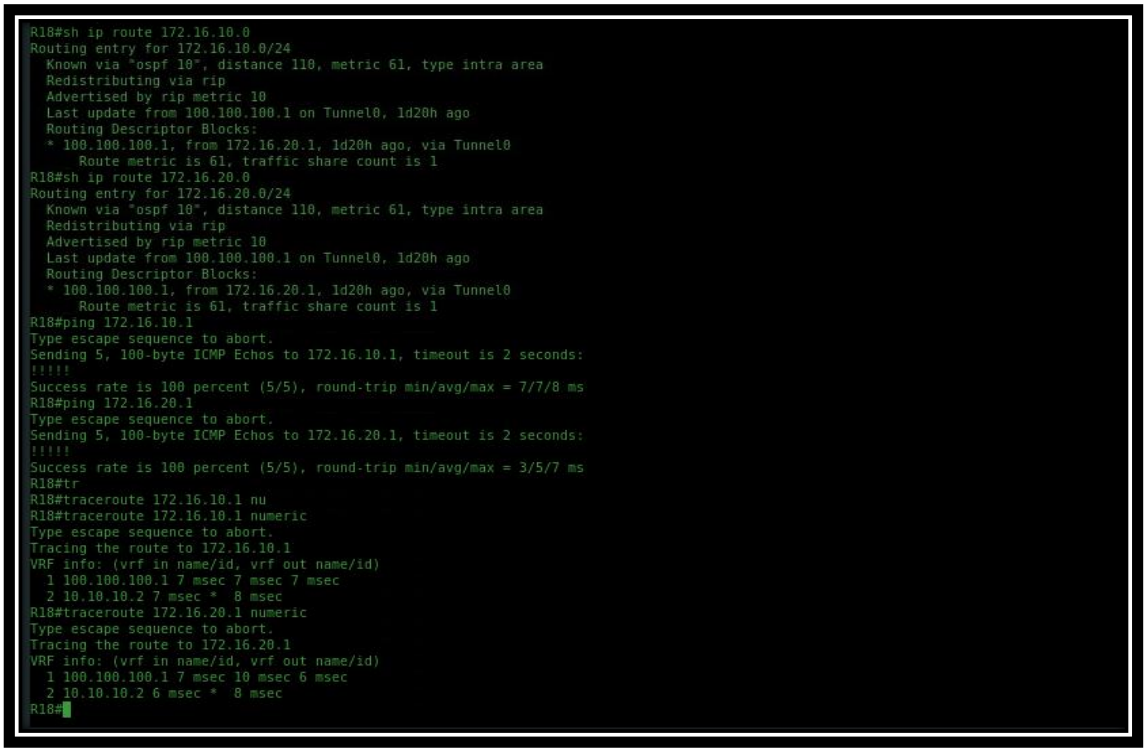
On R18



CCIE Lab Center

4. Deployment of Japan Spoke site

4.1: Initial Configuration

Start-up Configuration

I. Spoke R3

```
interface Loopback0
 ip address 1.1.1.3 255.255.255.0

interface Ethernet0/0
 description *** Connected to PRI MPLS ***
 ip address 192.168.100.3 255.255.255.0
 ip ospf network point-to-multipoint

interface Ethernet0/3
 description *** Connected to R5 ***
ip address 10.10.10.17 255.255.255.252


router ospf 10
 router-id 1.1.1.3
network 1.1.1.3 0.0.0.0 area 0
 network 100.100.100.0 0.0.0.255 area 0
!

ip route 172.16.50.0 255.255.255.0 10.10.10.18
ip route 172.16.60.0 255.255.255.0 10.10.10.18
```

CCIE Lab Center

4.2: DMVPN Basic configuration

On R3

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC

!
interface Tunnel0
 description *** PRI Tunnel ***
 ip address 100.100.100.3 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 100.100.100.1 192.168.100.1
 ip nhrp map multicast 192.168.100.1
 ip nhrp network-id 100
 ip nhrp nhs 100.100.100.1
ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
 ip ospf cost 50
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 100
 tunnel protection ipsec profile CLC
!
```

CCIE Lab Center

4.3: Redistributing Static, Connected Routes into OSPF

On R3

```
router ospf 10
 redistribute connected subnets
 redistribute static subnets
```

I. Spoke R4

```
interface Loopback0
 ip address 1.1.1.4 255.255.255.0

interface Ethernet0/0
 description *** Connected to Sec DMVPN Cloud ***
 ip address 192.168.200.4 255.255.255.0
 ip ospf network point-to-multipoint


interface Ethernet0/3
 description *** Connected to R5 ***
 ip address 10.10.10.21 255.255.255.252
!
router ospf 10
 router-id 1.1.1.4
  network 1.1.1.4 0.0.0.0 area 0
 network 200.200.200.0 0.0.0.255 area 0

ip route 172.16.50.0 255.255.255.0 10.10.10.22
ip route 172.16.60.0 255.255.255.0 10.10.10.22
```

CCIE Lab Center

4.4: DMVPN Basic configuration

On R4

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC



interface Tunnel1
 description *** PRI Tunnel ***
 ip address 200.200.200.4 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 200.200.200.2 192.168.200.2
 ip nhrp map multicast 192.168.200.2
 ip nhrp network-id 200
 ip nhrp nhs 200.200.200.2
ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 200
 tunnel protection ipsec profile CLC
```

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4.5 : Redistributing Static, connected routes into OSPF

On R4

```
router ospf 10
 router-id 1.1.1.4
 redistribute connected subnets
 redistribute static subnets
```

On R5

```
interface Loopback10
 ip address 172.16.50.1 255.255.255.0
!
interface Loopback20
 ip address 172.16.60.1 255.255.255.0
!
interface Ethernet0/0
 description *** Connected to R3 ***
 ip address 10.10.10.18 255.255.255.252
!
interface Ethernet0/1
 description *** Connected to R4 ***
 ip address 10.10.10.22 255.255.255.252


ip route 0.0.0.0 0.0.0.0 10.10.10.17 name PRI-MPLS
ip route 0.0.0.0 0.0.0.0 10.10.10.21 10 name SEC-MPLS
```

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4.6: Configuring IPSLA & make tunnel 0 has PRI path (10.10.10.17)

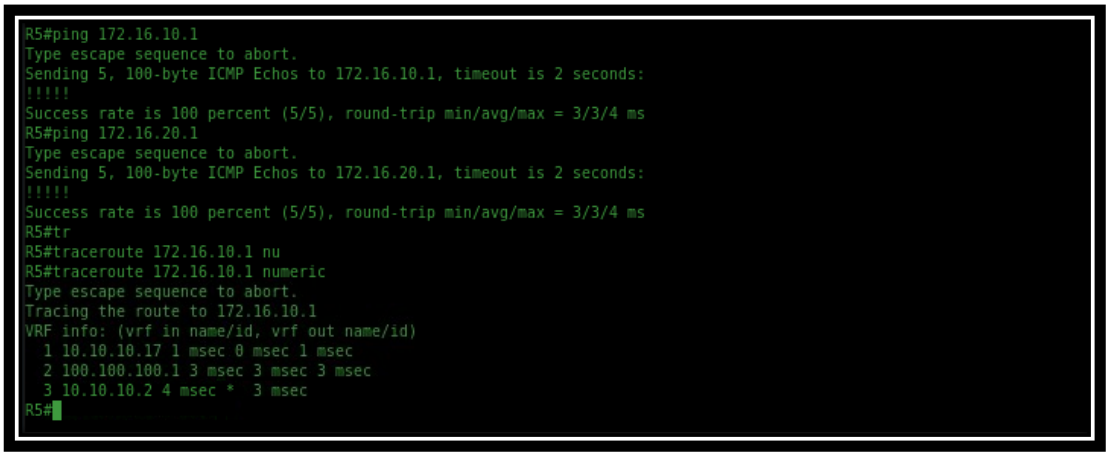
On R5

```
ip sla 1
 icmp-echo 100.100.100.1 source-interface Ethernet0/0
 threshold 2
 frequency 5
ip sla schedule 1 life forever start-time now

track 1 ip sla 1 reachability

ip route 0.0.0.0 0.0.0.0 10.10.10.17 name PRI-MPLS track 1
ip route 0.0.0.0 0.0.0.0 10.10.10.21 10 name SEC-MPLS
```

Verification

On R5

Now PRI path is 10.10.10.17



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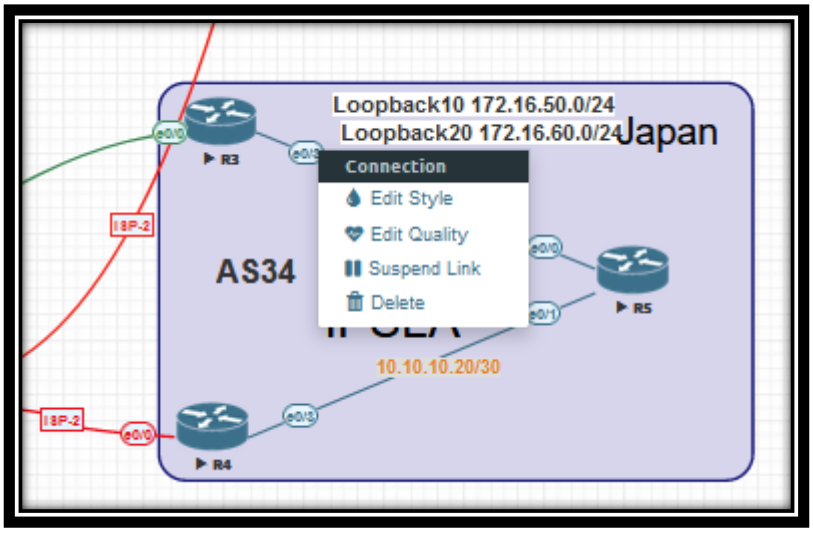
Lets suspended 10.10.10.17




```
R5#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/3/5 ms
R5#traceroute 172.16.10.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.10.1
VRF info: (vrf in name/id, vrf out name/id)
  1  *
     10.10.10.21 2 msec 0 msec
  2 200.200.200.2 2 msec 2 msec 2 msec
  3 10.10.10.6 2 msec
*Oct 23 07:19:56.214: %LINK-3-UPDOWN: Interface Ethernet0/0, changed state to down
*Oct 23 07:19:57.214: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0/0, changed state to down *  4 msec
R5#traceroute 172.16.10.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.10.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.21 1 msec 1 msec 1 msec
  2 200.200.200.2 3 msec 2 msec 2 msec
  3 10.10.10.6 3 msec
*Oct 23 07:20:05.797: %TRACK-6-STATE: 1 ip sla 1 reachability Up -> Down *  3 msec
R5#
```

Traffic shifted to 10.10.10.21 on Secondary Path

```
R5#sh ip sla summary
IPSLAs Latest Operation Summary
Codes: * active, ^ inactive, ~ pending

ID           Type        Destination       Stats       Return      Last
                                           (ms)        Code        Run
---------------------------------------------------------------------
*1           icmp-echo   10.10.10.17       -           Timeout     9 seconds ago



R5#sh ip route
R5#sh ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "static", distance 10, metric 0, candidate default path
  Routing Descriptor Blocks:
  * 10.10.10.21
      Route metric is 0, traffic share count is 1
R5#
```

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On R3

```
R3#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/5/7 ms
R3#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/6/7 ms
R3#tr
R3#sh ip route
R3#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "ospf 10", distance 110, metric 61, type intra area
  Last update from 100.100.100.1 on Tunnel0, 1d21h ago
  Routing Descriptor Blocks:
  * 100.100.100.1, from 172.16.20.1, 1d21h ago, via Tunnel0
      Route metric is 61, traffic share count is 1
R3#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "ospf 10", distance 110, metric 61, type intra area
  Last update from 100.100.100.1 on Tunnel0, 1d21h ago
  Routing Descriptor Blocks:
  * 100.100.100.1, from 172.16.20.1, 1d21h ago, via Tunnel0
      Route metric is 61, traffic share count is 1
R3#tr
R3#traceroute 172.16.10.1 nu
R3#traceroute 172.16.10.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.10.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 7 msec 6 msec
  2 10.10.10.2 7 msec *  7 msec
R3#traceroute 172.16.20.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.20.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 7 msec 6 msec
  2 10.10.10.2 7 msec *  8 msec
R3#
```

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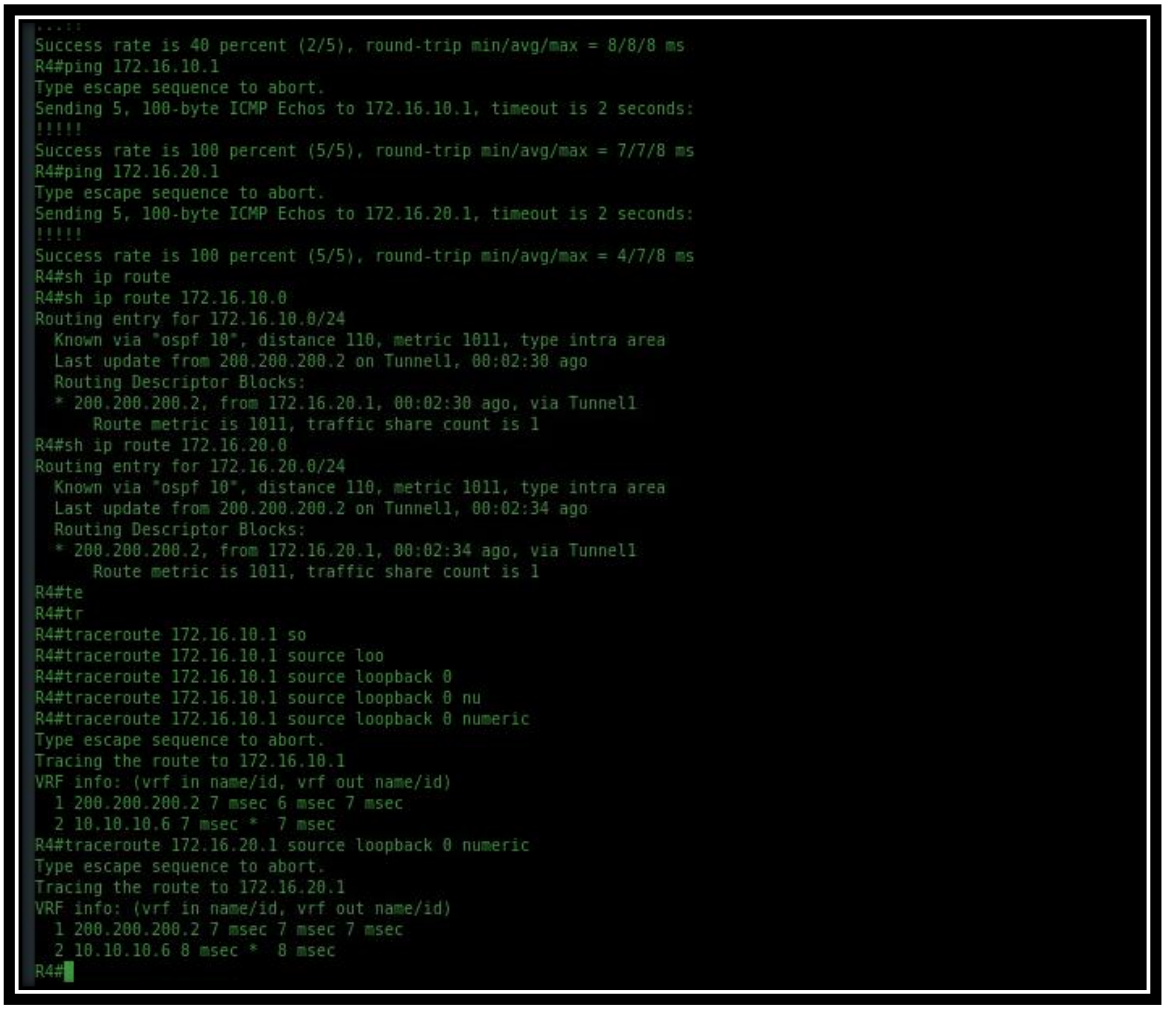
On R4



CCIE Lab Center

5. Deployment of UAE Spoke site

5.1: Initial Configuration

On R6

```
interface Ethernet0/0
 description *** Connected to PRI MPLS ***
 ip address 192.168.100.6 255.255.255.0
 ip ospf network point-to-multipoint
!
interface Ethernet0/2
 description *** Connected to R7 ***
 ip address 10.10.10.29 255.255.255.252
!
interface Ethernet0/3
 description *** Connected to R8 ***
 ip address 10.10.10.25 255.255.255.252
!
!
router eigrp CLC
 !
 address-family ipv4 unicast autonomous-system 100
  !
  topology base
     exit-af-topology
  network 10.10.10.24 0.0.0.3
  network 10.10.10.28 0.0.0.3
 exit-address-family
!
router ospf 10
 router-id 1.1.1.6
network 1.1.1.6 0.0.0.0 area 0
 network 100.100.100.0 0.0.0.255 area 0
```

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5.2: Redistributing EIGRP into OSPF & vice versa

On R6

```
router eigrp CLC
 !
 address-family ipv4 unicast autonomous-system 100
  !
  topology base
   redistribute ospf 10 metric 10000 1000 255 1 1500


router ospf 10
redistribute eigrp 100 metric 50 subnets
```

5.3: DMVPN Basic configuration

On R6

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC


nterface Tunnel0
 description *** PRI Tunnel ***
 ip address 100.100.100.6 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 100.100.100.1 192.168.100.1
 ip nhrp map multicast 192.168.100.1
 ip nhrp network-id 100
 ip nhrp nhs 100.100.100.1
 ip tcp adjust-mss 1360
```

```
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
 ip ospf cost 50
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 100
 tunnel protection ipsec profile CLC
```

On R7

```
interface Loopback0
 ip address 1.1.1.7 255.255.255.0


interface Ethernet0/0
 description *** Connected to SEC MPLS ***
 ip address 192.168.200.7 255.255.255.0
 ip ospf network point-to-multipoint
!
interface Ethernet0/2
 description *** Connected to R6 ***
 ip address 10.10.10.30 255.255.255.252
!
interface Ethernet0/3
 description *** Connected to R8 ***
 ip address 10.10.10.33 255.255.255.252



router eigrp CLC
 !
 address-family ipv4 unicast autonomous-system 100
  !
  topology base
     exit-af-topology
  network 10.10.10.28 0.0.0.3
  network 10.10.10.32 0.0.0.3
 exit-address-family
!
router ospf 10
 router-id 1.1.1.7
 network 1.1.1.7 0.0.0.0 area 0
 network 50.50.50.12 0.0.0.3 area 0
 network 200.200.200.0 0.0.0.255 area 0
```

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5.4: Redistributing EIGRP into OSPF & vice versa

On R7

```
router eigrp CLC
 !
 address-family ipv4 unicast autonomous-system 100
  !
  topology base
   redistribute ospf 10 metric 1000 1000 255 1 1500


router ospf 10
redistribute eigrp 100 metric 100 subnets
```

5.5: DMVPN Basic configuration

On R7

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC

interface Tunnel1
 description *** SEC Tunnel ***
 ip address 200.200.200.7 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 200.200.200.2 192.168.200.2
 ip nhrp map multicast 192.168.200.2
 ip nhrp network-id 200
 ip nhrp nhs 200.200.200.2
 ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
```

```
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 200
 tunnel protection ipsec profile CLC
```

On R8

```
nterface Loopback10
 ip address 172.16.70.1 255.255.255.0
!
interface Loopback20
 ip address 172.16.80.1 255.255.255.0
!
interface Ethernet0/0
 ip address 10.10.10.26 255.255.255.252
!
interface Ethernet0/1
 ip address 10.10.10.34 255.255.255.252


router eigrp CLC
 !
 address-family ipv4 unicast autonomous-system 100
  !
  topology base
  exit-af-topology
  network 10.10.10.24 0.0.0.3
  network 10.10.10.32 0.0.0.3
  network 172.16.70.0 0.0.0.255
  network 172.16.80.0 0.0.0.255
 exit-address-family
```

CCIE Lab Center

Verification

On R6

```
R6#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/2/4 ms
R6#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/3/4 ms
R6#sh ip route
R6#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "eigrp 100", distance 170, metric 10752000, type external
  Redistributing via eigrp 100, ospf 10
  Advertised by ospf 10 metric 50 subnets
  Last update from 10.10.10.30 on Ethernet0/2, 07:16:13 ago
  Routing Descriptor Blocks:
  * 10.10.10.30, from 10.10.10.30, 07:16:13 ago, via Ethernet0/2
      Route metric is 10752000, traffic share count is 1
      Total delay is 11000 microseconds, minimum bandwidth is 1000 Kbit
      Reliability 255/255, minimum MTU 1500 bytes
      Loading 1/255, Hops 1
R6#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "eigrp 100", distance 170, metric 10752000, type external
  Redistributing via eigrp 100, ospf 10
  Advertised by ospf 10 metric 50 subnets
  Last update from 10.10.10.30 on Ethernet0/2, 07:16:17 ago
  Routing Descriptor Blocks:
  * 10.10.10.30, from 10.10.10.30, 07:16:17 ago, via Ethernet0/2
      Route metric is 10752000, traffic share count is 1
      Total delay is 11000 microseconds, minimum bandwidth is 1000 Kbit
      Reliability 255/255, minimum MTU 1500 bytes
      Loading 1/255, Hops 1
```

```
R6#traceroute 172.16.10.1 source loopback 0
Type escape sequence to abort.
Tracing the route to 172.16.10.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 7 msec 6 msec
  2 10.10.10.2 7 msec 7 msec *
R6#traceroute 172.16.20.1 source loopback 0
Type escape sequence to abort.
Tracing the route to 172.16.20.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 6 msec 6 msec
  2 10.10.10.2 6 msec 8 msec *
R6#
```

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On R7

```
R7#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 7/7/8 ms
R7#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 7/7/8 ms
R7#sh ip route
R7#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "ospf 10", distance 110, metric 1011, type intra area
  Redistributing via eigrp 100
  Advertised by eigrp 100 metric 1000 1000 255 1 1500
  Last update from 200.200.200.2 on Tunnel1, 07:25:02 ago
  Routing Descriptor Blocks:
  * 200.200.200.2, from 172.16.20.1, 07:25:02 ago, via Tunnel1
      Route metric is 1011, traffic share count is 1
R7#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "ospf 10", distance 110, metric 1011, type intra area
  Redistributing via eigrp 100
  Advertised by eigrp 100 metric 1000 1000 255 1 1500
  Last update from 200.200.200.2 on Tunnel1, 07:25:05 ago
  Routing Descriptor Blocks:
  * 200.200.200.2, from 172.16.20.1, 07:25:05 ago, via Tunnel1
      Route metric is 1011, traffic share count is 1
R7#
```

```
R7#traceroute 172.16.10.1 source loo
R7#traceroute 172.16.10.1 source loopback 0
Type escape sequence to abort.
Tracing the route to 172.16.10.1
VRF info: (vrf in name/id, vrf out name/id)
  1 200.200.200.2 8 msec 7 msec 6 msec
  2 10.10.10.6 8 msec 9 msec *
R7#traceroute 172.16.20.1 source loopback 0 nu
R7#traceroute 172.16.20.1 source loopback 0 numeric
Type escape sequence to abort.
Tracing the route to 172.16.20.1
VRF info: (vrf in name/id, vrf out name/id)
  1 200.200.200.2 8 msec 6 msec 4 msec
  2 10.10.10.6 8 msec *  7 msec
R7#
```

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On R8

```
R8#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/3/5 ms
R8#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/3/4 ms
R8#tr
R8#sh ip route
R8#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "eigrp 100", distance 170, metric 6144000, type external
  Redistributing via eigrp 100
  Last update from 10.10.10.25 on Ethernet0/0, 00:05:39 ago
  Routing Descriptor Blocks:
  * 10.10.10.25, from 10.10.10.25, 00:05:39 ago, via Ethernet0/0
      Route metric is 6144000, traffic share count is 1
      Total delay is 11000 microseconds, minimum bandwidth is 10000 Kbit
      Reliability 255/255, minimum MTU 1500 bytes
      Loading 1/255, Hops 1
R8#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "eigrp 100", distance 170, metric 6144000, type external
  Redistributing via eigrp 100
  Last update from 10.10.10.25 on Ethernet0/0, 00:05:44 ago
  Routing Descriptor Blocks:
  * 10.10.10.25, from 10.10.10.25, 00:05:44 ago, via Ethernet0/0
      Route metric is 6144000, traffic share count is 1
      Total delay is 11000 microseconds, minimum bandwidth is 10000 Kbit
      Reliability 255/255, minimum MTU 1500 bytes
      Loading 1/255, Hops 1
R8#
```

```
R8#traceroute 172.16.10.1 nu
R8#traceroute 172.16.10.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.10.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.25 1 msec 1 msec 1 msec
  2 100.100.100.1 3 msec 3 msec 2 msec
  3 10.10.10.2 3 msec *  3 msec
R8#traceroute 172.16.20.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.20.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.25 1 msec 0 msec 0 msec
  2 100.100.100.1 3 msec 3 msec 3 msec
  3 10.10.10.2 4 msec *  5 msec
R8#
```

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6. Deployment of Hong Kong Spoke site

6.1: Initial Configuration

On R10

```
interface Loopback0
 ip address 1.1.1.10 255.255.255.0

interface Ethernet0/0
 description *** Connected to PRI MPLS ***
 ip address 192.168.100.10 255.255.255.0
 ip ospf network point-to-multipoint

!
interface Ethernet0/2
 description connected to R9 ***
 ip address 10.10.10.37 255.255.255.252
!
interface Ethernet0/3
 description connected to R11 ***
 ip address 10.10.10.41 255.255.255.252
!
!
router eigrp 200
 network 10.10.10.36 0.0.0.3
 network 10.10.10.40 0.0.0.3
 redistribute ospf 10 metric 100000 100 255 1 1500
!
router ospf 10
 router-id 1.1.1.10
 redistribute eigrp 200 metric 50 subnets
 network 1.1.1.10 0.0.0.0 area 1
 network 100.100.100.0 0.0.0.255 area 0
 network 192.168.10.16 0.0.0.3 area 0
```

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6.2: Redistributing EIGRP into OSPF & vice versa

On R10

```
router eigrp 200
redistribute ospf 10 metric 100000 100 255 1 1500
!
router ospf 10
redistribute eigrp 200 metric 50 subnets
```

6.3: DMVPN Basic configuration

On R10

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC
!
interface Tunnel0
 description *** PRI Tunnel ***
 ip address 100.100.100.10 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 100.100.100.1 192.168.100.1
 ip nhrp map multicast 192.168.100.1
 ip nhrp network-id 100
 ip nhrp nhs 100.100.100.1
 ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf cost 50
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 100
 tunnel protection ipsec profile CLC
```

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on R9

```
interface Loopback0
 ip address 1.1.1.9 255.255.255.0


interface Ethernet0/0
 description *** Connected to SEC-MPLS ***
 ip address 192.168.200.9 255.255.255.0
 ip ospf network point-to-multipoint
!
interface Ethernet0/1
 no ip address
 shutdown
!
interface Ethernet0/2
 description *** Conected to R10 ***
 ip address 10.10.10.38 255.255.255.252
!
interface Ethernet0/3
 description *** Conected to R11 ***
 ip address 10.10.10.45 255.255.255.252
!
!
router eigrp 200
 network 10.10.10.36 0.0.0.3
 network 10.10.10.44 0.0.0.3
 redistribute ospf 10 metric 1000 100 255 1 1500


router ospf 10
 router-id 1.1.1.9
 redistribute eigrp 200 metric 100 subnets
 network 1.1.1.9 0.0.0.0 area 0
 network 50.50.50.16 0.0.0.3 area 0
 network 200.200.200.0 0.0.0.255 area 0
```

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6.4: Redistributing EIGRP into OSPF & vice versa

On R9

```
router eigrp 200
redistribute ospf 10 metric 1000 100 255 1 1500


router ospf 10
redistribute eigrp 200 metric 100 subnets
```

6.5: DMVPN Basic configuration

On R9

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC

interface Tunnel1
 description *** SEC Tunnel ***
 ip address 200.200.200.9 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 200.200.200.2 192.168.200.2
 ip nhrp map multicast 192.168.200.2
 ip nhrp network-id 200
 ip nhrp holdtime 300
 ip nhrp nhs 200.200.200.2
ip ospf dead-interval 4
 ip ospf hello-interval 1
ip ospf network point-to-multipoint
tunnel source Ethernet0/0
 tunnel mode gre multipoint
```

```
 tunnel key 200
 tunnel protection ipsec profile CLC
```

On R11

```
interface Loopback10
 ip address 172.16.90.1 255.255.255.0
!
interface Loopback20
 ip address 172.16.100.1 255.255.255.0
!
interface Ethernet0/0
 description *** Connected to R10 ***
 ip address 10.10.10.42 255.255.255.252
!
interface Ethernet0/1
 description *** Connected to R10 ***
 ip address 10.10.10.46 255.255.255.252


router eigrp 200
 network 10.10.10.40 0.0.0.3
 network 10.10.10.44 0.0.0.3
 network 172.16.90.0 0.0.0.255
 network 172.16.100.0 0.0.0.255
```

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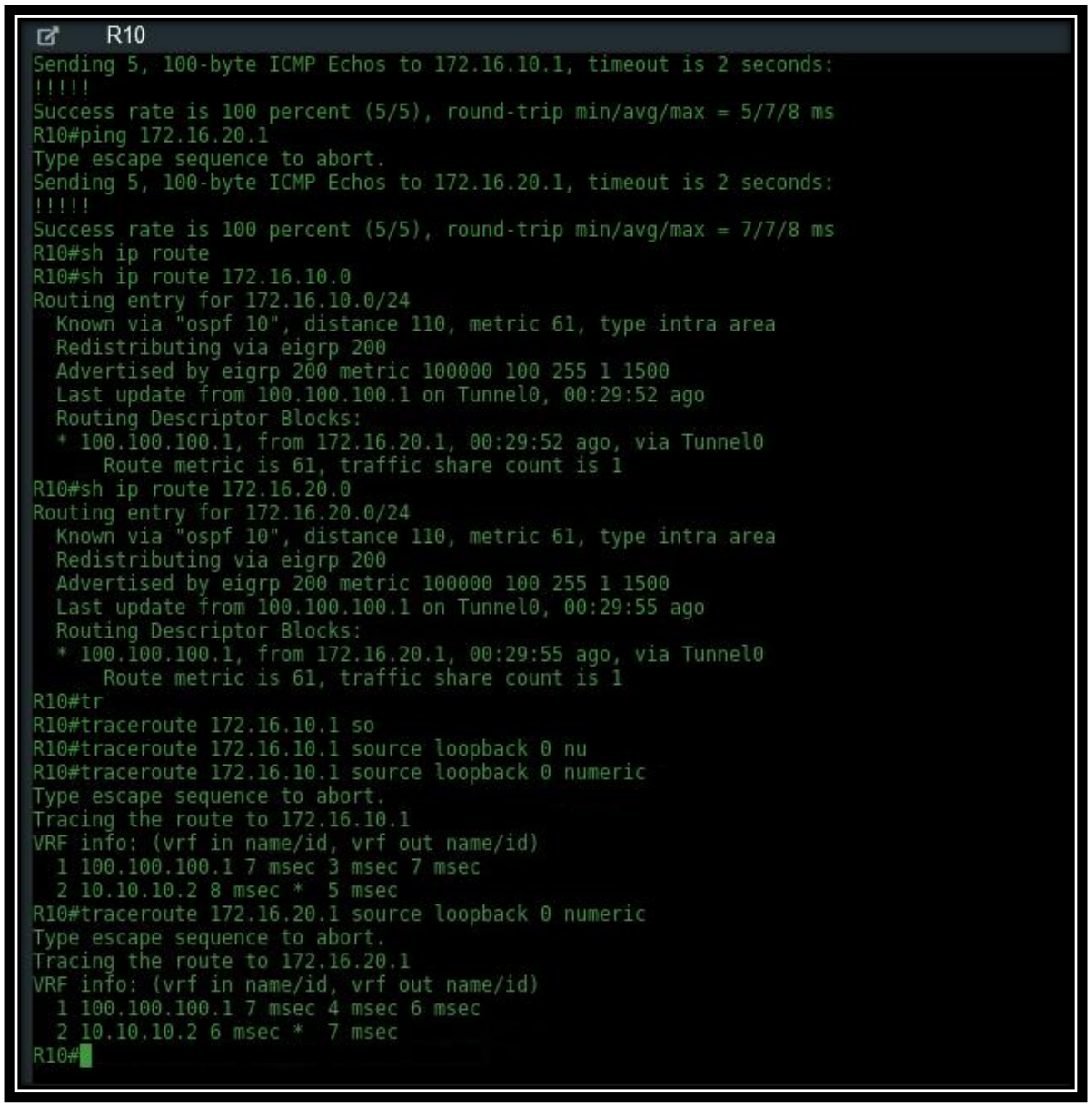
Verification

On R10



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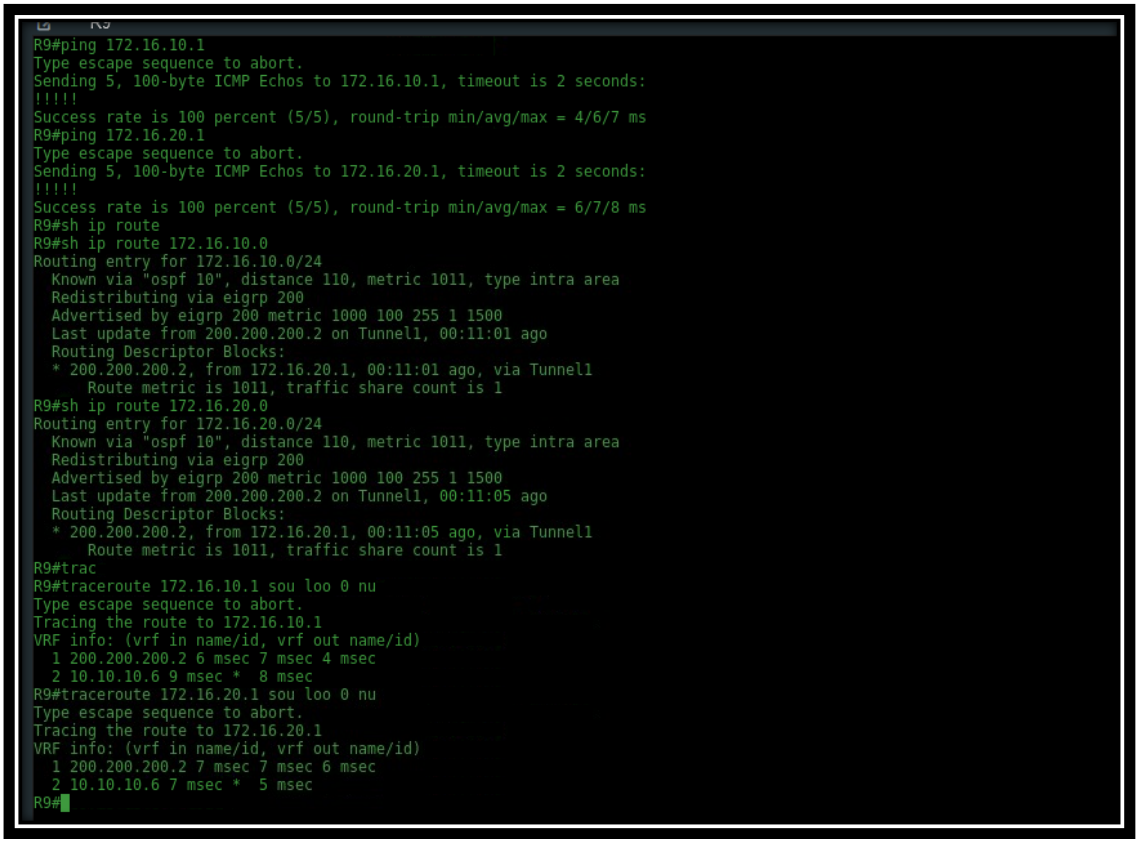
On R9



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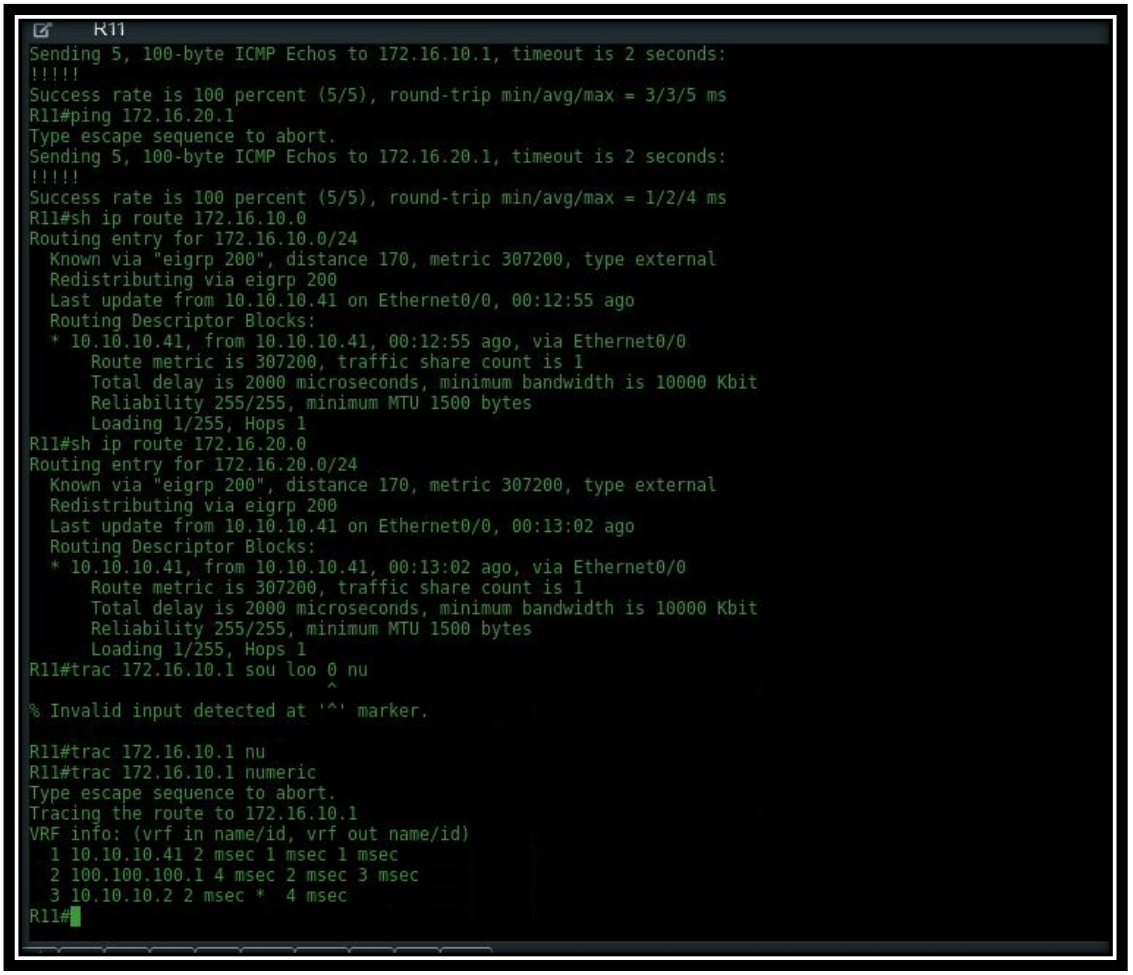
On R11



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7. Deployment of London Spoke site

7.1: Initial Configuration

On R12

```
interface Loopback0
 ip address 1.1.1.12 255.255.255.0


interface Ethernet0/0
 description *** Connected to PRI MPLS ***
 ip address 192.168.100.12 255.255.255.0
 ip ospf network point-to-multipoint
!
!
interface Ethernet0/2
 description *** Connected to R13 ***
 ip address 10.10.10.49 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/3
 description *** Connected to R14 ***
 ip address 10.10.10.53 255.255.255.252
 ip ospf network point-to-point
!
router ospf 10
 router-id 1.1.1.12
 network 1.1.1.12 0.0.0.0 area 0
 network 10.10.10.48 0.0.0.3 area 0
 network 10.10.10.52 0.0.0.3 area 0
 network 100.100.100.0 0.0.0.255 area 0
```

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7.2: DMVPN Basic configuration

On R12

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC
!
interface Tunnel0
 description *** PRI Tunnel ***
 ip address 100.100.100.12 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 100.100.100.1 192.168.100.1
 ip nhrp map multicast 192.168.100.1
 ip nhrp network-id 100
 ip nhrp nhs 100.100.100.1
ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 100
 tunnel protection ipsec profile CLC
```

on R13

```
interface Loopback0
 ip address 1.1.1.13 255.255.255.0

interface Ethernet0/0
 description *** Connected to PRI MPLS ***
 ip address 192.168.200.13 255.255.255.0
 ip ospf network point-to-multipoint
!
interface Ethernet0/1
 no ip address
 shutdown
```

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```
!
interface Ethernet0/2
 description *** Connected to R12 ***
 ip address 10.10.10.50 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/3
 description *** Connected to R15 ***
 ip address 10.10.10.57 255.255.255.252
 ip ospf network point-to-point
!
router ospf 10
 router-id 1.1.1.13
 network 1.1.1.13 0.0.0.0 area 0
 network 10.10.10.48 0.0.0.3 area 0
 network 10.10.10.56 0.0.0.3 area 0
 network 50.50.50.20 0.0.0.3 area 0
network 200.200.200.0 0.0.0.255 area 0
```

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7.3: DMVPN Basic configuration

On R13

```
crypto isakmp policy 10
 encr aes
 authentication pre-share
 group 2
crypto isakmp key clc@123 address 0.0.0.0
!
!
crypto ipsec transform-set CLC esp-aes esp-sha-hmac
 mode transport
!
crypto ipsec profile CLC
 set transform-set CLC
!
interface Loopback0
 ip address 1.1.1.13 255.255.255.0
!
interface Tunnel1
 description *** SEC Tunnel ***
 ip address 200.200.200.13 255.255.255.0
 no ip redirects
 ip mtu 1400
 ip nhrp authentication clc@123
 ip nhrp map 200.200.200.2 192.168.200.2
 ip nhrp map multicast 192.168.200.2
 ip nhrp network-id 200
 ip nhrp nhs 200.200.200.2
 ip tcp adjust-mss 1360
 ip ospf network point-to-multipoint
 ip ospf dead-interval 4
 ip ospf hello-interval 1
 tunnel source Ethernet0/0
 tunnel mode gre multipoint
 tunnel key 200
 tunnel protection ipsec profile CLC
```

On R14

```
interface Ethernet0/0
 description *** Connected to R12 ***
 ip address 10.10.10.54 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/1
 description *** Connected to R16 ***
 ip address 10.10.10.65 255.255.255.252
```

```
 ip ospf network point-to-point
!

router ospf 10
 network 10.10.10.52 0.0.0.3 area 0
 network 10.10.10.64 0.0.0.3 area 1
```

On R16

```
interface Loopback10
 ip address 172.16.110.1 255.255.255.0
 ip ospf network point-to-point
!
interface Loopback20
 ip address 172.16.120.1 255.255.255.0
 ip ospf network point-to-point
!
interface Ethernet0/0
 description *** Connected to R15 ***
 ip address 10.10.10.62 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/1
 description *** Connected to R14 ***
 ip address 10.10.10.66 255.255.255.252
 ip ospf network point-to-point
!
!
router ospf 10
 network 10.10.10.60 0.0.0.3 area 1
 network 10.10.10.64 0.0.0.3 area 1
 network 172.16.110.0 0.0.0.255 area 1
 network 172.16.120.0 0.0.0.255 area 1
```

On R15

```
interface Ethernet0/0
 description *** COnnected to R13 ***
 ip address 10.10.10.58 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/1
 description *** COnnected to R16 ***
 ip address 10.10.10.61 255.255.255.252
 ip ospf network point-to-point
!
interface Ethernet0/2
 no ip address
 shutdown
```

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```
!
interface Ethernet0/3
 no ip address
 shutdown
!
router ospf 10
 network 10.10.10.56 0.0.0.3 area 0
 network 10.10.10.60 0.0.0.3 area 1
```

Verification

On R12

```
R12>en
R12#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 7/7/8 ms
R12#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 7/7/8 ms
R12#sh ip route
R12#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "ospf 10", distance 110, metric 1011, type intra area
  Last update from 100.100.100.1 on Tunnel0, 02:38:39 ago
  Routing Descriptor Blocks:
  * 100.100.100.1, from 172.16.20.1, 02:38:39 ago, via Tunnel0
      Route metric is 1011, traffic share count is 1
R12#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "ospf 10", distance 110, metric 1011, type intra area
  Last update from 100.100.100.1 on Tunnel0, 02:38:42 ago
  Routing Descriptor Blocks:
  * 100.100.100.1, from 172.16.20.1, 02:38:42 ago, via Tunnel0
      Route metric is 1011, traffic share count is 1
R12#trac 172.16.10.1 sou loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.10.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 7 msec 6 msec
  2 10.10.10.2 8 msec *  7 msec
R12#trac 172.16.20.1 sou loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.20.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 6 msec 7 msec
  2 10.10.10.2 5 msec *  7 msec
R12#
```

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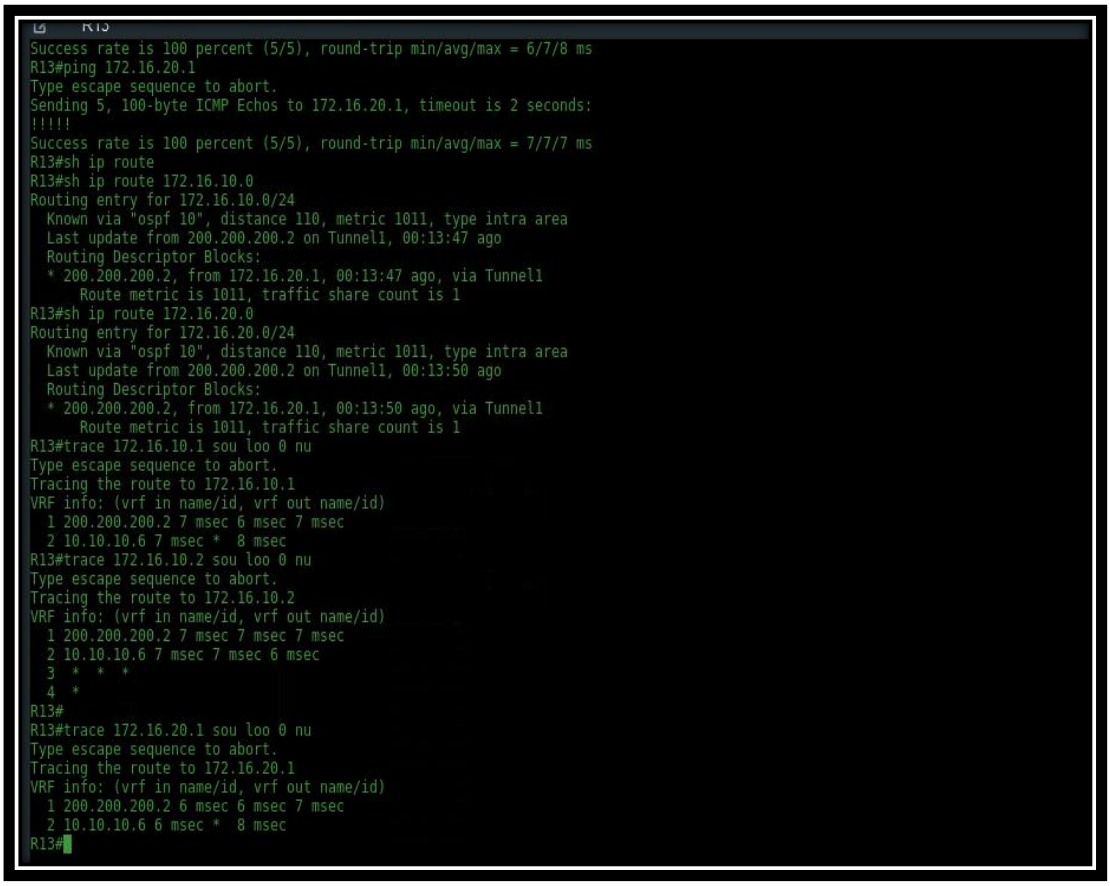
On R13



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On R16

Make PRI MPLS as preferred Secondary MPLS

```
R16#ping 172.16.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/3/5 ms
R16#ping 172.16.20.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/3/5 ms
R16#sh ip route
R16#sh ip route 172.16.10.0
Routing entry for 172.16.10.0/24
  Known via "ospf 10", distance 110, metric 1031, type inter area
  Last update from 10.10.10.65 on Ethernet0/1, 02:41:42 ago
  Routing Descriptor Blocks:
    10.10.10.65, from 10.10.10.65, 02:41:42 ago, via Ethernet0/1
      Route metric is 1031, traffic share count is 1
  * 10.10.10.61, from 10.10.10.61, 10:16:46 ago, via Ethernet0/0
      Route metric is 1031, traffic share count is 1
R16#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "ospf 10", distance 110, metric 1031, type inter area
  Last update from 10.10.10.65 on Ethernet0/1, 02:41:46 ago
  Routing Descriptor Blocks:
    10.10.10.65, from 10.10.10.65, 02:41:46 ago, via Ethernet0/1
      Route metric is 1031, traffic share count is 1
  * 10.10.10.61, from 10.10.10.61, 10:16:50 ago, via Ethernet0/0
      Route metric is 1031, traffic share count is 1
```

Configuring ip ospf cost 50 on Tunnel0 at R12 router

Interface tunnel 0
Configuring ip ospf cost 50

```
      Route metric is 1031, traffic share count is 1
R16#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "ospf 10", distance 110, metric 81, type inter area
  Last update from 10.10.10.65 on Ethernet0/1, 00:00:00 ago
  Routing Descriptor Blocks:
  * 10.10.10.65, from 10.10.10.65, 00:00:00 ago, via Ethernet0/1
      Route metric is 81, traffic share count is 1
R16#sh ip route 172.16.20.0
Routing entry for 172.16.20.0/24
  Known via "ospf 10", distance 110, metric 81, type inter area
  Last update from 10.10.10.65 on Ethernet0/1, 00:00:02 ago
  Routing Descriptor Blocks:
  * 10.10.10.65, from 10.10.10.65, 00:00:02 ago, via Ethernet0/1
      Route metric is 81, traffic share count is 1
R16#
```

Now its preferred

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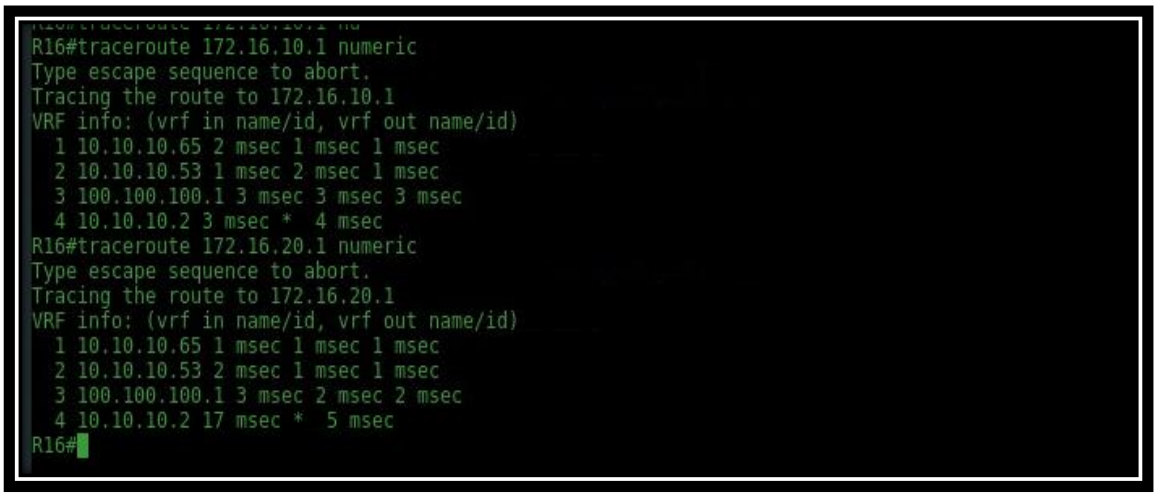
R16>R14>R12



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8. Configuring DMVPN Phase3 in all Hubs & Spokes

Configure DMVPN Hub to redirect NHRP requests for spoke-to-spoke resolutions.

8.1: Phase3 Configuration on R1 & R2 (Hubs)

On R1

```
interface Tunnel0
ip nhrp redirect
```

On R2

```
interface Tunnel1
ip nhrp redirect
```

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8.2: Phase3 Configuration on R18,R3,4,6,7,9,10,12 & 13 (Spokes)

Configure the DMVPN Spokes to be able to install NHRP shortcut routes for spoke-to-spoke routing.

On R18

```
interface Tunnel0
ip nhrp shortcut
```

on R2

```
interface Tunnel1
ip nhrp shortcut
```

on R3

```
interface Tunnel0
ip nhrp shortcut
```

on R4

```
interface Tunnel1
ip nhrp shortcut
```

on R6

```
interface Tunnel0
ip nhrp shortcut
```

on R7

```
interface Tunnel1
ip nhrp shortcut
```

on R12

```
interface Tunnel0
ip nhrp shortcut
```

on R13

```
interface Tunnel1
ip nhrp shortcut
```

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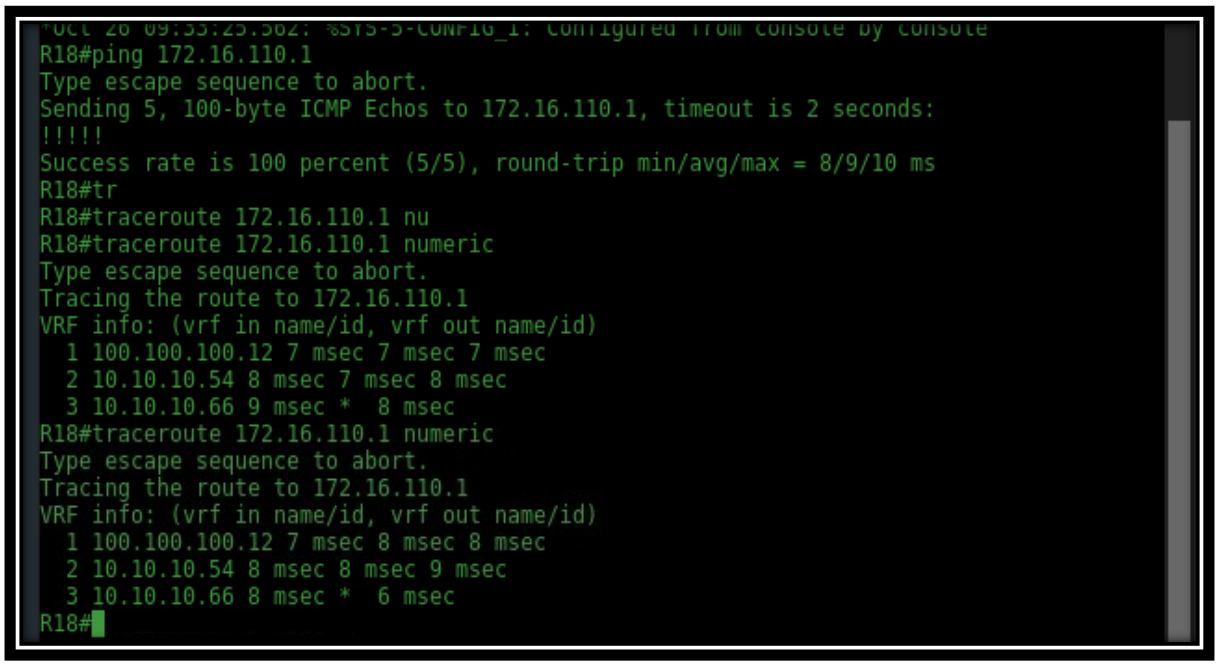
8.3: Verification of DMVPN Phase3

On R18

Task

Ping 172.16.110.1,120.1 & check traceroute



1st time its goes via hub & 2nd time its goes to spoke directly

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```
R18#sh dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
        N - NATed, L - Local, X - No Socket
        T1 - Route Installed, T2 - Nexthop-override
        C - CTS Capable
        # Ent --> Number of NHRP entries with same NBMA peer
        NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting
        UpDn Time --> Up or Down Time for a Tunnel
==========================================================================

Interface: Tunnel0, IPv4 NHRP Details
Type:Spoke, NHRP Peers:2,

 # Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb
 ----- --------------- --------------- ----- -------- -----
     1 192.168.100.1     100.100.100.1    UP    1d02h     S
     2 192.168.100.12   100.100.100.12    UP 00:01:33   DT2
                        100.100.100.12    UP 00:01:33   DT2

Interface: Tunnel1, IPv4 NHRP Details
Type:Spoke, NHRP Peers:1,

 # Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb
 ----- --------------- --------------- ----- -------- -----
     1 192.168.200.2     200.200.200.2    UP    1d02h     S

R18#
```

All traffic is going to PRI DMVPN

```
R18#traceroute 172.16.110.1 source loopback 0 nu
R18#traceroute 172.16.110.1 source loopback 0 numeric
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.12 7 msec 8 msec 7 msec
  2 10.10.10.54 8 msec 8 msec 8 msec
  3 10.10.10.66 9 msec *  9 msec
R18#
```

On R1

```
R1#sh dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
        N - NATed, L - Local, X - No Socket
        T1 - Route Installed, T2 - Nexthop-override
        C - CTS Capable
        # Ent --> Number of NHRP entries with same NBMA peer
        NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting
        UpDn Time --> Up or Down Time for a Tunnel
==========================================================================

Interface: Tunnel0, IPv4 NHRP Details
Type:Hub, NHRP Peers:5,

 # Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb
 ----- --------------- --------------- ----- -------- -----
     1 192.168.100.3     100.100.100.3    UP    1d02h     D
     1 192.168.100.6     100.100.100.6    UP    1d02h     D
     1 192.168.100.10   100.100.100.10    UP    1d02h     D
     1 192.168.100.12   100.100.100.12    UP    1d02h     D
     1 192.168.100.18   100.100.100.18    UP    1d02h     D

R1#
```

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Lets check route % - next hop override

```
R18#sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      1.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
C        1.1.1.0/24 is directly connected, Loopback0
O        1.1.1.1/32 [110/51] via 100.100.100.1, 19:00:18, Tunnel0
O        1.1.1.2/32 [110/61] via 100.100.100.1, 19:00:18, Tunnel0
O        1.1.1.4/32 [110/62] via 100.100.100.1, 19:00:18, Tunnel0
O        1.1.1.6/32 [110/52] via 100.100.100.1, 19:00:18, Tunnel0
O        1.1.1.7/32 [110/62] via 100.100.100.1, 19:00:18, Tunnel0
O        1.1.1.9/32 [110/62] via 100.100.100.1, 18:38:23, Tunnel0
O IA     1.1.1.10/32 [110/52] via 100.100.100.1, 18:59:03, Tunnel0
O        1.1.1.12/32 [110/52] via 100.100.100.1, 18:58:41, Tunnel0
O        1.1.1.13/32 [110/62] via 100.100.100.1, 19:00:18, Tunnel0
L        1.1.1.18/32 is directly connected, Loopback0
      10.0.0.0/8 is variably subnetted, 17 subnets, 2 masks
O        10.10.10.0/30 [110/60] via 100.100.100.1, 19:00:18, Tunnel0
O        10.10.10.4/30 [110/70] via 100.100.100.1, 19:00:18, Tunnel0
O        10.10.10.8/30 [110/60] via 100.100.100.1, 19:00:18, Tunnel0
C        10.10.10.12/30 is directly connected, Ethernet0/2
L        10.10.10.13/32 is directly connected, Ethernet0/2
O E2     10.10.10.20/30 [110/20] via 100.100.100.1, 19:00:18, Tunnel0
O E2     10.10.10.24/30 [110/50] via 100.100.100.1, 19:00:18, Tunnel0
O E2     10.10.10.28/30 [110/50] via 100.100.100.1, 19:00:18, Tunnel0
O E2     10.10.10.32/30 [110/50] via 100.100.100.1, 19:00:18, Tunnel0
O E2     10.10.10.36/30 [110/50] via 100.100.100.1, 18:59:03, Tunnel0
O E2     10.10.10.40/30 [110/50] via 100.100.100.1, 18:59:03, Tunnel0
O E2     10.10.10.44/30 [110/50] via 100.100.100.1, 18:59:03, Tunnel0
O        10.10.10.48/30 [110/61] via 100.100.100.1, 18:58:41, Tunnel0
```

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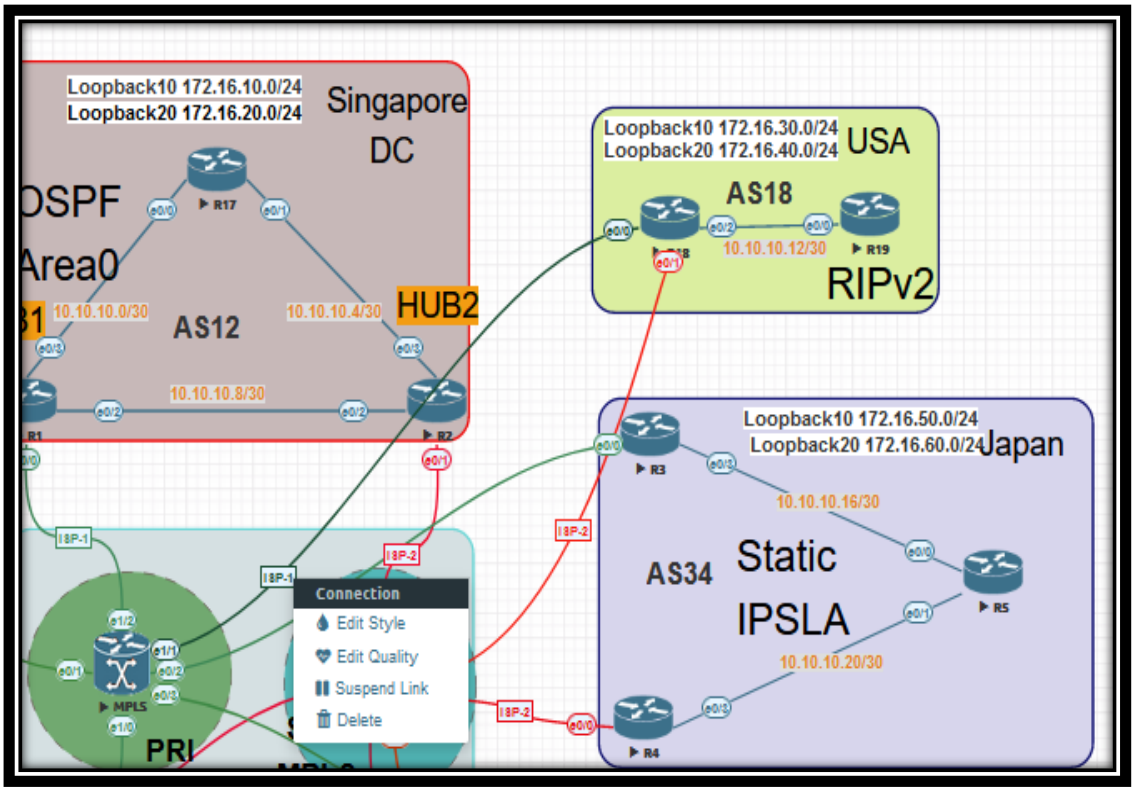
```
C        100.100.100.0/24 is directly connected, Tunnel0
O        100.100.100.1/32 [110/50] via 100.100.100.1, 19:00:18, Tunnel0
O        100.100.100.6/32 [110/51] via 100.100.100.1, 19:00:18, Tunnel0
O        100.100.100.10/32 [110/51] via 100.100.100.1, 18:59:03, Tunnel0
O   %    100.100.100.12/32 [110/51] via 100.100.100.1, 18:58:41, Tunnel0
L        100.100.100.18/32 is directly connected, Tunnel0
      172.16.0.0/24 is subnetted, 12 subnets
O        172.16.10.0 [110/61] via 100.100.100.1, 19:00:18, Tunnel0
O        172.16.20.0 [110/61] via 100.100.100.1, 19:00:18, Tunnel0
R        172.16.30.0 [120/1] via 10.10.10.14, 00:00:01, Ethernet0/2
R        172.16.40.0 [120/1] via 10.10.10.14, 00:00:01, Ethernet0/2
O E2     172.16.50.0 [110/20] via 100.100.100.1, 19:00:18, Tunnel0
O E2     172.16.60.0 [110/20] via 100.100.100.1, 19:00:18, Tunnel0
O E2     172.16.70.0 [110/50] via 100.100.100.1, 19:00:18, Tunnel0
O E2     172.16.80.0 [110/50] via 100.100.100.1, 19:00:18, Tunnel0
O E2     172.16.90.0 [110/50] via 100.100.100.1, 18:35:30, Tunnel0
O E2     172.16.100.0 [110/50] via 100.100.100.1, 18:35:22, Tunnel0
O IA%    172.16.110.0 [110/72] via 100.100.100.1, 18:58:41, Tunnel0
O IA     172.16.120.0 [110/72] via 100.100.100.1, 18:58:41, Tunnel0
      192.168.100.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.100.0/24 is directly connected, Ethernet0/0
L        192.168.100.18/32 is directly connected, Ethernet0/0
      192.168.200.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.200.0/24 is directly connected, Ethernet0/1
L        192.168.200.18/32 is directly connected, Ethernet0/1
      200.200.200.0/24 is variably subnetted, 7 subnets, 2 masks
C        200.200.200.0/24 is directly connected, Tunnel1
O        200.200.200.2/32 [110/60] via 100.100.100.1, 19:00:18, Tunnel0
O        200.200.200.4/32 [110/61] via 100.100.100.1, 19:00:18, Tunnel0
O        200.200.200.7/32 [110/61] via 100.100.100.1, 19:00:18, Tunnel0
O        200.200.200.9/32 [110/61] via 100.100.100.1, 18:38:23, Tunnel0
O        200.200.200.13/32 [110/61] via 100.100.100.1, 19:00:18, Tunnel0
L        200.200.200.18/32 is directly connected, Tunnel1
R18#
R18#
R18#
```

Let's do the failover suspending PRI tunnel 0



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```
R18#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
.
*Oct 26 09:47:27.610: %LINK-3-UPDOWN: Interface Ethernet0/0, changed state to down.
*Oct 26 09:47:28.610: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0/0, changed state to down...
Success rate is 0 percent (0/5)
R18#
*Oct 26 09:47:34.617: %LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel0, changed state to down
*Oct 26 09:47:34.618: %OSPF-5-ADJCHG: Process 10, Nbr 1.1.1.1 on Tunnel0 from FULL to DOWN, Neighbor Down: Interface down or detached
R18#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 7/8/10 ms
R18#tr
R18#traceroute 172.16.110.1 sou
R18#traceroute 172.16.110.1 source loo
R18#traceroute 172.16.110.1 source loopback 0 nu
R18#traceroute 172.16.110.1 source loopback 0 numeric
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 200.200.200.2 7 msec 7 msec 7 msec
  2 200.200.200.13 10 msec 9 msec 8 msec
  3 10.10.10.58 9 msec 9 msec 4 msec
  4 10.10.10.62 10 msec *  13 msec
```

Now it's going to SEC DMVPN path.

On R2

```
R2#sh dm
R2#sh dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
        N - NATed, L - Local, X - No Socket
        T1 - Route Installed, T2 - Nexthop-override
        C - CTS Capable
        # Ent --> Number of NHRP entries with same NBMA peer
        NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting
        UpDn Time --> Up or Down Time for a Tunnel
==========================================================================

Interface: Tunnel1, IPv4 NHRP Details
Type:Hub, NHRP Peers:5,

 # Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb
 ----- --------------- --------------- ----- -------- -----
     1 192.168.200.4     200.200.200.4    UP    1d02h     D
     1 192.168.200.7     200.200.200.7    UP    1d02h     D
     1 192.168.200.9     200.200.200.9    UP    1d02h     D
     1 192.168.200.13    200.200.200.13   UP    1d02h     D
     1 192.168.200.18    200.200.200.18   UP    1d02h     D

R2#
```

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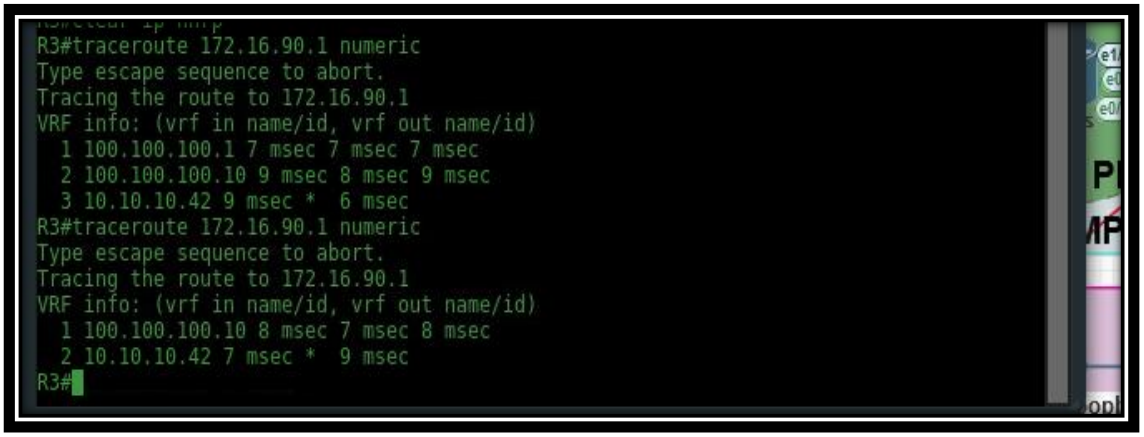
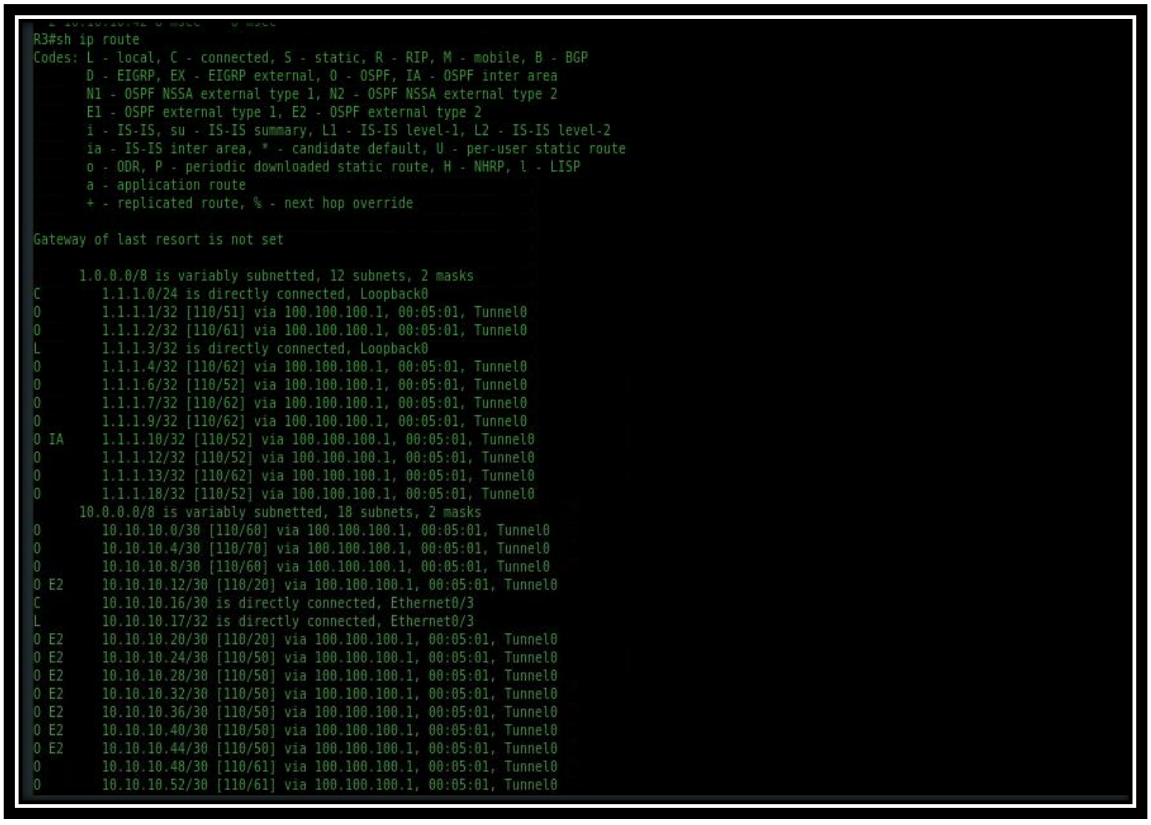
On R3



Next hop override



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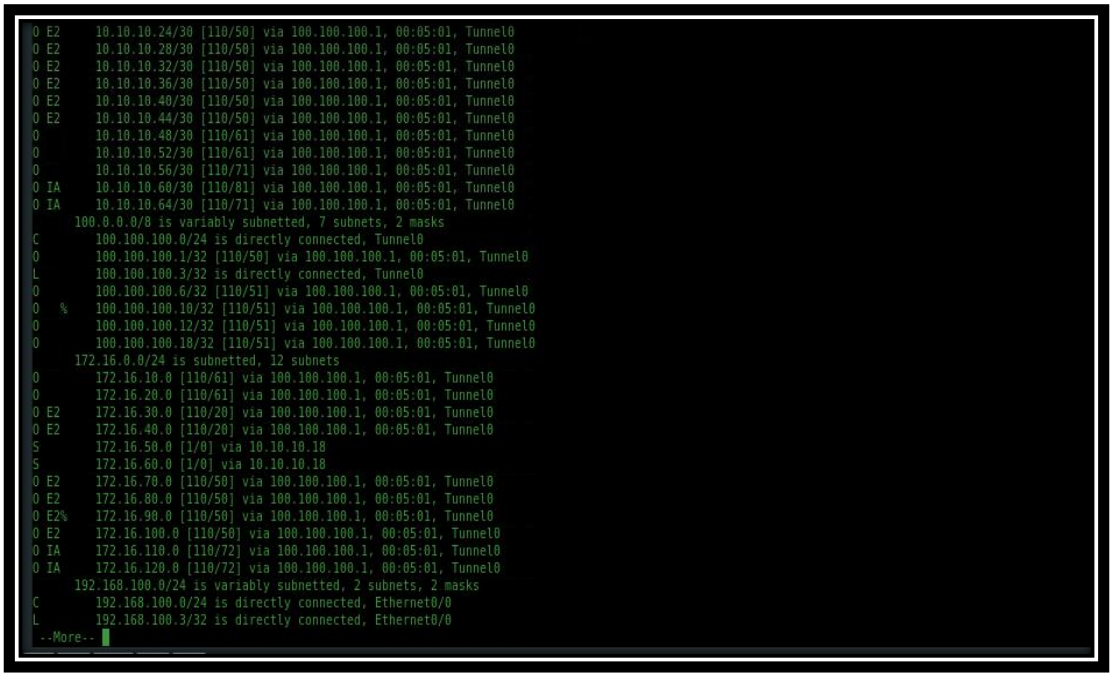

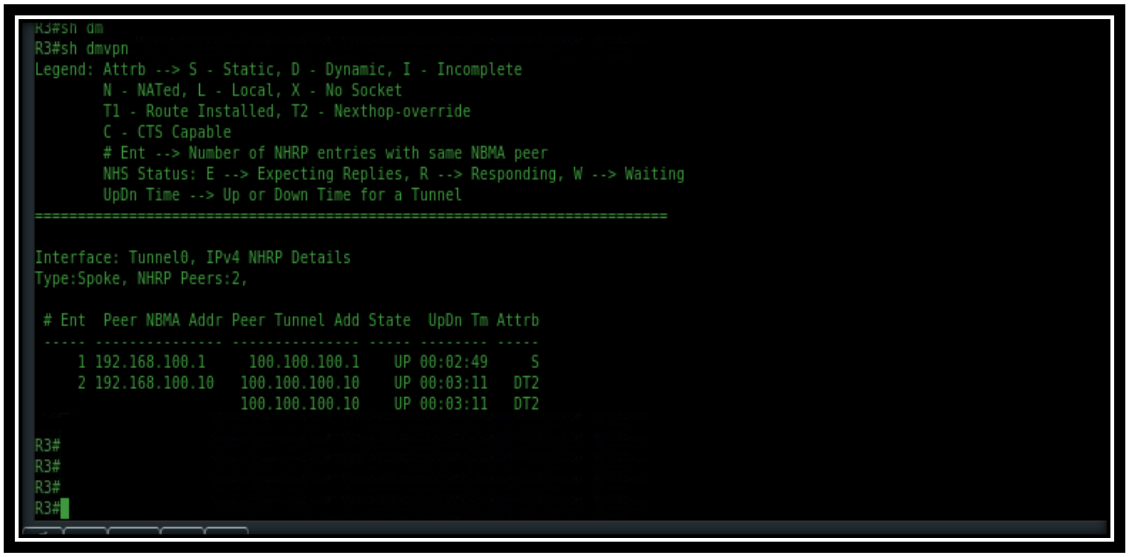

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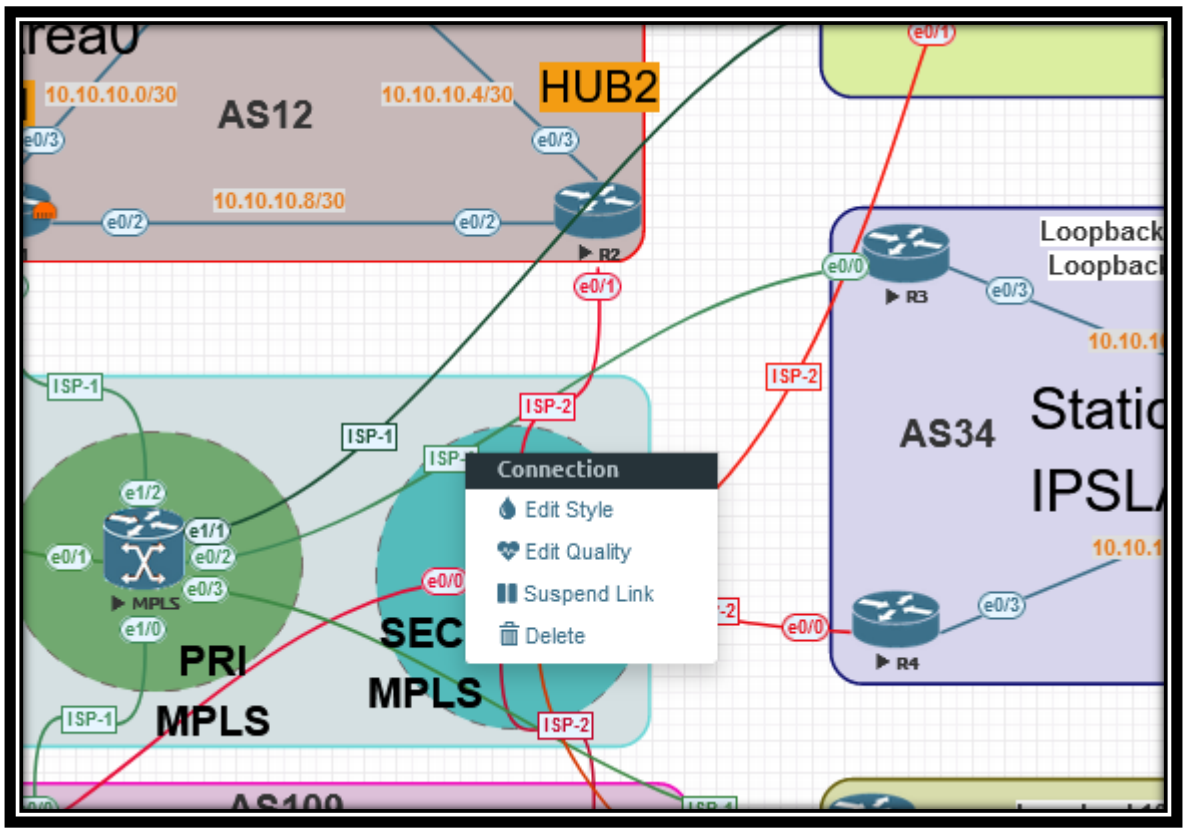
On R1

```
R1#sh ip nh
R1#sh ip nhrp
100.100.100.3/32 via 100.100.100.3
   Tunnel0 created 00:00:06, expire 01:59:53
   Type: dynamic, Flags: unique registered used nhop
   NBMA address: 192.168.100.3
100.100.100.6/32 via 100.100.100.6
   Tunnel0 created 00:00:05, expire 01:59:54
   Type: dynamic, Flags: unique registered used nhop
   NBMA address: 192.168.100.6
100.100.100.10/32 via 100.100.100.10
   Tunnel0 created 00:00:05, expire 01:59:54
   Type: dynamic, Flags: unique registered used nhop
   NBMA address: 192.168.100.10
100.100.100.12/32 via 100.100.100.12
   Tunnel0 created 00:00:05, expire 01:59:54
   Type: dynamic, Flags: unique registered used nhop
   NBMA address: 192.168.100.12
100.100.100.18/32 via 100.100.100.18
   Tunnel0 created 00:00:05, expire 01:59:54
   Type: dynamic, Flags: unique registered used nhop
   NBMA address: 192.168.100.18
R1#
```

Let's check failover on R5



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```
R5#sh ip sla su
R5#sh ip sla summary
IPSLAs Latest Operation Summary
Codes: * active, ^ inactive, ~ pending

ID           Type        Destination       Stats       Return      Last
                                           (ms)        Code        Run
---------------------------------------------------------------------
*1           icmp-echo   100.100.100.1     RTT=4       Over thresh 2 seconds ago
                                                       old



R5#
```

After suspending PRI tunnel 0

```
R5#ping 172.16.90.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.90.1, timeout is 2 seconds:
....!
Success rate is 20 percent (1/5), round-trip min/avg/max = 6/6/6 ms
R5#
*Oct 26 15:20:06.055: %TRACK-6-STATE: 1 ip sla 1 reachability Up -> Down
R5#ping 172.16.90.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.90.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/5/8 ms
R5#sh ip route 172.16.90.0
% Subnet not in table
R5#sh ip route
R5#sh ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "static", distance 10, metric 0, candidate default path
  Routing Descriptor Blocks:
  * 10.10.10.21
      Route metric is 0, traffic share count is 1
```

```
R5#traceroute 172.16.90.1 nu
R5#traceroute 172.16.90.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.90.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.21 1 msec 1 msec 1 msec
  2 200.200.200.2 3 msec 2 msec 2 msec
  3 10.10.10.9 3 msec 3 msec 3 msec
  4 100.100.100.10 6 msec 5 msec 5 msec
  5 10.10.10.42 4 msec *  7 msec
R5#
```

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Let's enable PRI Tunnel 0

```
R5#traceroute 172.16.90.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.90.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.17 1 msec 1 msec 0 msec
  2 100.100.100.1 3 msec 3 msec 2 msec
  3 100.100.100.10 4 msec 3 msec 4 msec
  4 10.10.10.42 4 msec *  6 msec
```

On R4

```
R4#
R4#ping 172.16.90.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.90.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 9/10/11 ms
R4#sh ip route
R4#sh ip route 172.16.90.1 nu
R4#sh ip route 172.16.90.1 nu
R4#sh ip route 172.16.90.1
Routing entry for 172.16.90.0/24
  Known via "ospf 10", distance 110, metric 50, type extern 2, forward metric 1011
  Last update from 200.200.200.2 on Tunnel1, 1d00h ago
  Routing Descriptor Blocks:
  * 200.200.200.2, from 1.1.1.10, 1d00h ago, via Tunnel1
      Route metric is 50, traffic share count is 1
R4#trace 172.16.90.1 sou
R4#trace 172.16.90.1 source loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.90.1
VRF info: (vrf in name/id, vrf out name/id)
  1 200.200.200.2 7 msec 6 msec 6 msec
  2 10.10.10.9 7 msec 6 msec 5 msec
  3 100.100.100.10 8 msec 8 msec 8 msec
  4 10.10.10.42 9 msec *  10 msec
R4#
```

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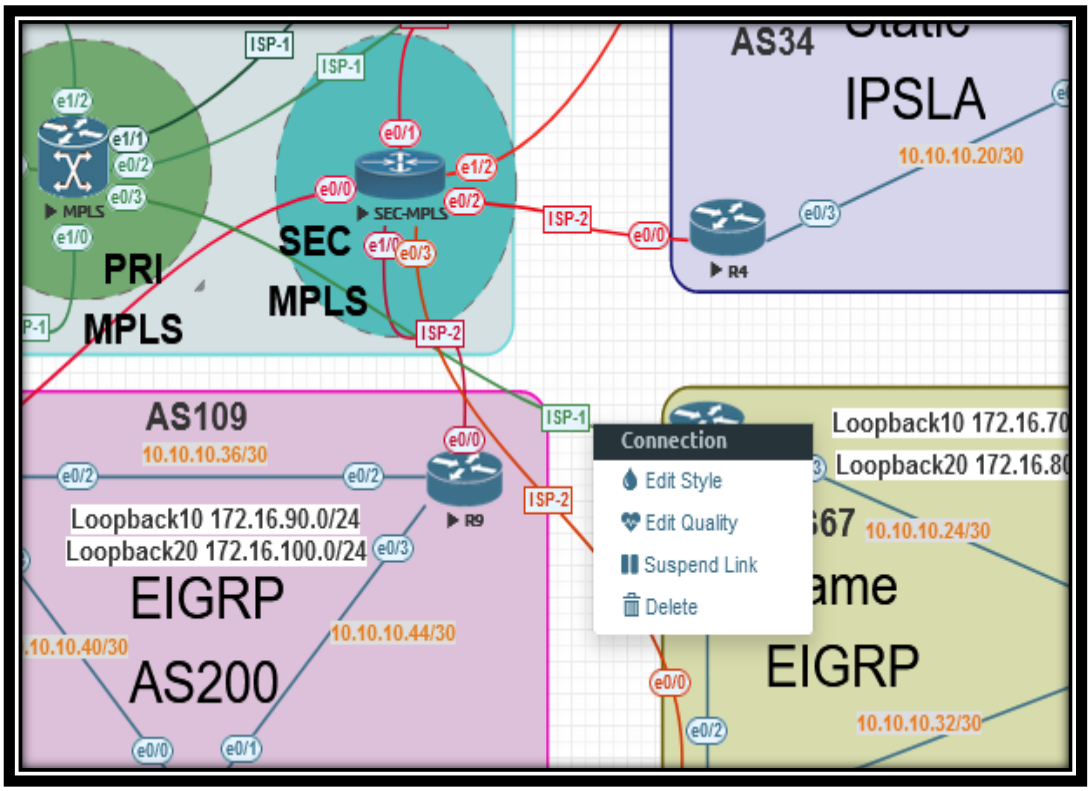
On R6

```
R6#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 10/10/11 ms
R6#tra
R6#traceroute 172.16.110.1 so loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.12 7 msec 6 msec 8 msec
  2 10.10.10.54 7 msec 7 msec 8 msec
  3 10.10.10.66 8 msec *  9 msec
R6#cle
R6#clear ip ng
R6#clear ip n
R6#clear ip nh
R6#clear ip nhrp
R6#traceroute 172.16.110.1 so loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 7 msec 6 msec
  2 100.100.100.12 12 msec 7 msec 7 msec
  3 10.10.10.54 6 msec 13 msec 16 msec
  4 10.10.10.66 8 msec *  10 msec
R6#traceroute 172.16.110.1 so loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.12 8 msec 7 msec 8 msec
  2 10.10.10.54 8 msec 8 msec 7 msec
  3 10.10.10.66 8 msec *  9 msec
R6#
```

Let’s do failover test, suspend PRI Tunnel 0 on R6



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```
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 6/6/7 ms
R6#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/8/9 ms
R6#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
.
*Oct 26 15:34:59.456: %LINK-3-UPDOWN: Interface Ethernet0/0, changed state to down
*Oct 26 15:34:59.465: %ADJ-5-PARENT: Midchain parent maintenance for IP midchain out o
f Tunnel0, addr 100.100.100.1 - looped chain attempting to stack
*Oct 26 15:35:00.457: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0/0, cha
nged state to down..
*Oct 26 15:35:03.867: %LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel0, changed
 state to down
*Oct 26 15:35:03.868: %OSPF-5-ADJCHG: Process 10, Nbr 1.1.1.1 on Tunnel0 from FULL to
DOWN, Neighbor Down: Interface down or detached..
Success rate is 0 percent (0/5)
R6#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R6#sh ip ei
R6#sh ip eigrp ne
R6#sh ip eigrp neighbors
EIGRP-IPv4 VR(CLC) Address-Family Neighbors for AS(100)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
1   10.10.10.30             Et0/2                    14 1d08h       4   100  0  83
0   10.10.10.26             Et0/3                    11 1d08h       1   100  0  110
R6#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

```
R6#sh ip eigrp ne
R6#sh ip eigrp neighbors
EIGRP-IPv4 VR(CLC) Address-Family Neighbors for AS(100)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
1   10.10.10.30             Et0/2                    14 1d08h       4   100  0  83
0   10.10.10.26             Et0/3                    11 1d08h       1   100  0  110
R6#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R6#sh ip route
R6#sh ip route 172.16.110.0
Routing entry for 172.16.110.0/24
  Known via "eigrp 100", distance 170, metric 10752000, type external
  Redistributing via eigrp 100, ospf 10
  Advertised by ospf 10 metric 50 subnets
  Last update from 10.10.10.30 on Ethernet0/2, 00:00:49 ago
  Routing Descriptor Blocks:
  * 10.10.10.30, from 10.10.10.30, 00:00:49 ago, via Ethernet0/2
      Route metric is 10752000, traffic share count is 1
      Total delay is 11000 microseconds, minimum bandwidth is 1000 Kbit
      Reliability 255/255, minimum MTU 1500 bytes
      Loading 1/255, Hops 1
R6#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

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```
R6#traceroute 172.16.110.1 nu
R6#traceroute 172.16.110.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.30 2 msec 0 msec 1 msec
  2  *
    200.200.200.2 3 msec 2 msec
  3 200.200.200.13 5 msec 17 msec 3 msec
  4 10.10.10.58 4 msec 4 msec 4 msec
  5 10.10.10.62 5 msec *  8 msec
R6#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/4/6 ms
R6#
```

We can verify from R8

```
R8#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/4/6 ms
R8#tr
R8#traceroute 172.16.110.1 nu
R8#traceroute 172.16.110.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.33 2 msec 1 msec 1 msec
  2 200.200.200.2 3 msec 3 msec 2 msec
  3 200.200.200.13 4 msec 4 msec 4 msec
  4 10.10.10.58 5 msec 5 msec 6 msec
  5 10.10.10.62 6 msec *  8 msec
R8#
```

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Let's make it normal

```
R8#traceroute 172.16.110.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.33 2 msec 1 msec 0 msec
  2 200.200.200.2 2 msec 2 msec 2 msec
  3 200.200.200.13 4 msec 3 msec 4 msec
  4 10.10.10.58 5 msec 4 msec 4 msec
  5 10.10.10.62 5 msec *
    10.10.10.66 7 msec
R8#traceroute 172.16.110.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.25 2 msec 1 msec 1 msec
  2 100.100.100.1 3 msec 2 msec 3 msec
  3 100.100.100.12 5 msec 4 msec 4 msec
  4 10.10.10.54 5 msec 5 msec 5 msec
  5 10.10.10.66 5 msec *  5 msec
R8#
```

On R7

```
R7#ping 172.16.110.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.110.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 9/10/14 ms
R7#trace 172.16.110.1 so loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.110.1
VRF info: (vrf in name/id, vrf out name/id)
  1 200.200.200.2 7 msec 6 msec 7 msec
  2 200.200.200.13 10 msec 5 msec 8 msec
  3 10.10.10.58 9 msec 9 msec 6 msec
  4 10.10.10.62 10 msec *  9 msec
R7#sh ip route 172.16.110.1
Routing entry for 172.16.110.0/24
  Known via "ospf 10", distance 110, metric 1022, type inter area
  Redistributing via eigrp 100
  Advertised by eigrp 100 metric 1000 1000 255 1 1500
  Last update from 200.200.200.2 on Tunnel1, 1d08h ago
  Routing Descriptor Blocks:
  * 200.200.200.2, from 10.10.10.61, 1d08h ago, via Tunnel1
      Route metric is 1022, traffic share count is 1
```

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On R10

```
R10#
R10#ping 172.16.50.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.50.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/6/9 ms
R10#tr
R10#traceroute 172.16.50.1 nu
R10#traceroute 172.16.50.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.50.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.3 8 msec 6 msec 6 msec
  2 10.10.10.18 11 msec *  8 msec
R10#cle
R10#clear ip nh
R10#clear ip nhrp
R10#traceroute 172.16.50.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.50.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 6 msec 6 msec
  2 100.100.100.3 7 msec 7 msec 8 msec
  3 10.10.10.18 9 msec *  9 msec
R10#traceroute 172.16.50.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.50.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.3 6 msec 8 msec 4 msec
  2 10.10.10.18 9 msec *  9 msec
R10#
```

```
R10#sh dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
        N - NATed, L - Local, X - No Socket
        T1 - Route Installed, T2 - Nexthop-override
        C - CTS Capable
        # Ent --> Number of NHRP entries with same NBMA peer
        NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting
        UpDn Time --> Up or Down Time for a Tunnel
==========================================================================

Interface: Tunnel0, IPv4 NHRP Details
Type:Spoke, NHRP Peers:2,

 # Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb
 ----- --------------- --------------- ----- -------- -----
     1 192.168.100.1     100.100.100.1    UP 05:41:18     S
     2 192.168.100.3     100.100.100.3    UP 00:00:32   DT2
                         100.100.100.3    UP 00:00:32   DT2

R10#
```

CCIE Lab Center

```
R10#sh ip route
R10#sh ip route 172.16.50.0
Routing entry for 172.16.50.0/24
  Known via "ospf 10", distance 110, metric 20, type extern 2, forward metric 51
  Redistributing via eigrp 200
  Advertised by eigrp 200 metric 100000 100 255 1 1500
  Last update from 100.100.100.1 on Tunnel0, 00:25:13 ago
  Routing Descriptor Blocks:
  * 100.100.100.1, from 1.1.1.3, 00:25:13 ago, via Tunnel0
      Route metric is 20, traffic share count is 1
R10#sh ip route 172.16.50.1
Routing entry for 172.16.50.0/24
  Known via "ospf 10", distance 110, metric 20, type extern 2, forward metric 51
  Redistributing via eigrp 200
  Advertised by eigrp 200 metric 100000 100 255 1 1500
  Last update from 100.100.100.1 on Tunnel0, 00:25:21 ago
  Routing Descriptor Blocks:
  * 100.100.100.1, from 1.1.1.3, 00:25:21 ago, via Tunnel0
      Route metric is 20, traffic share count is 1
R10#
```

```
      Route metric is 20, traffic share count is 1
R10#sh ip route | i %
       + - replicated route, % - next hop override
O    %    100.100.100.3/32 [110/51] via 100.100.100.1, 00:25:47, Tunnel0
O E2%     172.16.50.0 [110/20] via 100.100.100.1, 00:25:47, Tunnel0
R10#
```

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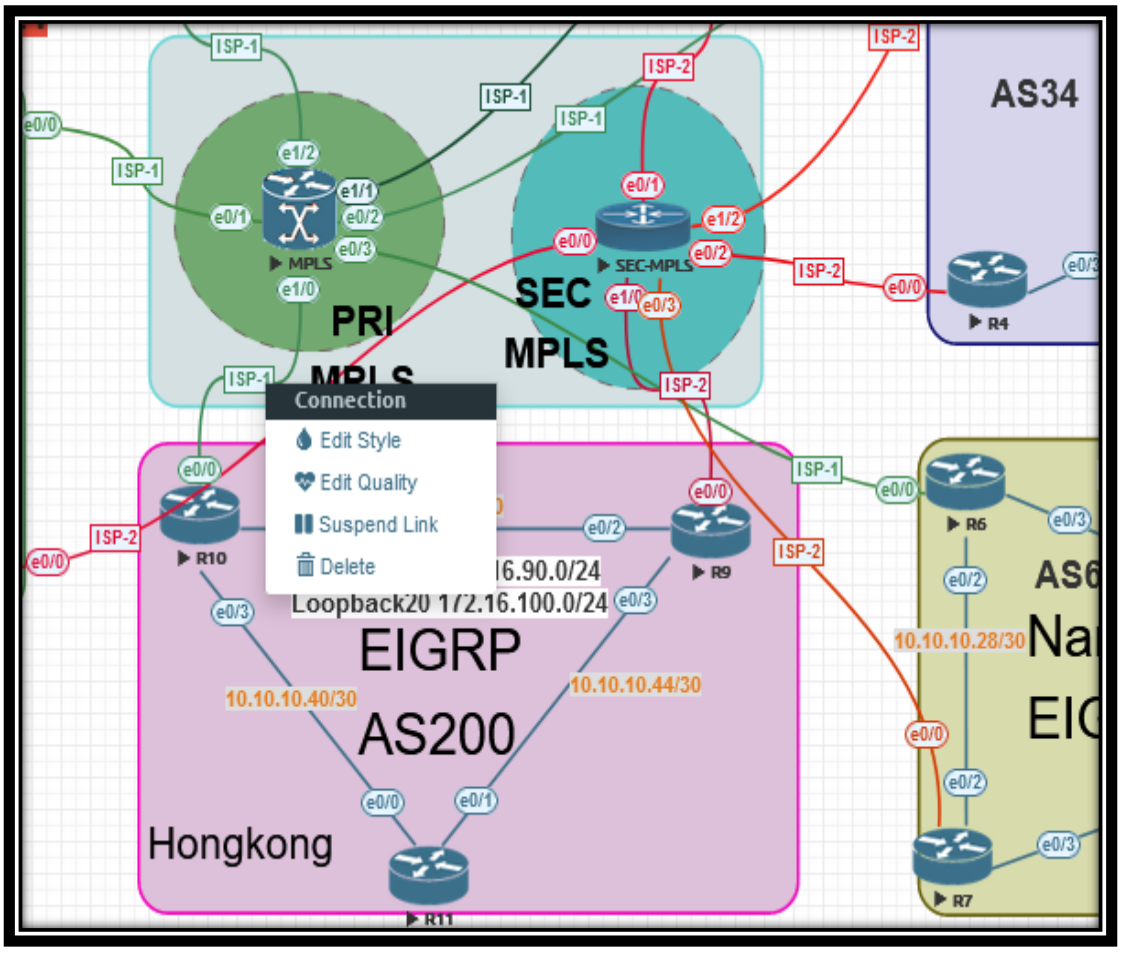
Let's do failover test of suspending tunnel 0 of R10

Before suspending tunnel 0

```
R11#
R11#ping 172.16.50.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.50.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/4/5 ms
R11#tr
R11#traceroute 172.16.50.1 nu
R11#traceroute 172.16.50.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.50.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.41 1 msec 1 msec 0 msec
  2 100.100.100.3 3 msec 1 msec 1 msec
  3 10.10.10.18 2 msec *  4 msec
R11#
```



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```
R11#traceroute 172.16.50.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.50.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.41 2 msec 1 msec 1 msec
  2 100.100.100.3 2 msec 2 msec 2 msec
  3 10.10.10.18 2 msec *  4 msec
R11#traceroute 172.16.50.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.50.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.41 1 msec 1 msec 1 msec
  2  *  *  *
  3  *
R11#
R11#traceroute 172.16.50.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.50.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.45 1 msec 1 msec 1 msec
  2  *  *  *
  3  *  *  *
  4  *  *  *
  5
R11#ping 172.16.50.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.50.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R11#ping 172.16.50.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.50.1, timeout is 2 seconds:
.....
```

```
R11#sh ip route
R11#sh ip route 172.16.50.0
Routing entry for 172.16.50.0/24
  Known via "eigrp 200", distance 170, metric 2611200, type external
  Redistributing via eigrp 200
  Last update from 10.10.10.45 on Ethernet0/1, 00:01:19 ago
  Routing Descriptor Blocks:
  * 10.10.10.45, from 10.10.10.45, 00:01:19 ago, via Ethernet0/1
      Route metric is 2611200, traffic share count is 1
      Total delay is 2000 microseconds, minimum bandwidth is 1000 Kbit
      Reliability 255/255, minimum MTU 1500 bytes
      Loading 1/255, Hops 1
R11#ping 172.16.50.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.50.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R11#ping 172.16.50.1 re
R11#ping 172.16.50.1 repeat 1000
Type escape sequence to abort.
Sending 1000, 100-byte ICMP Echos to 172.16.50.1, timeout is 2 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

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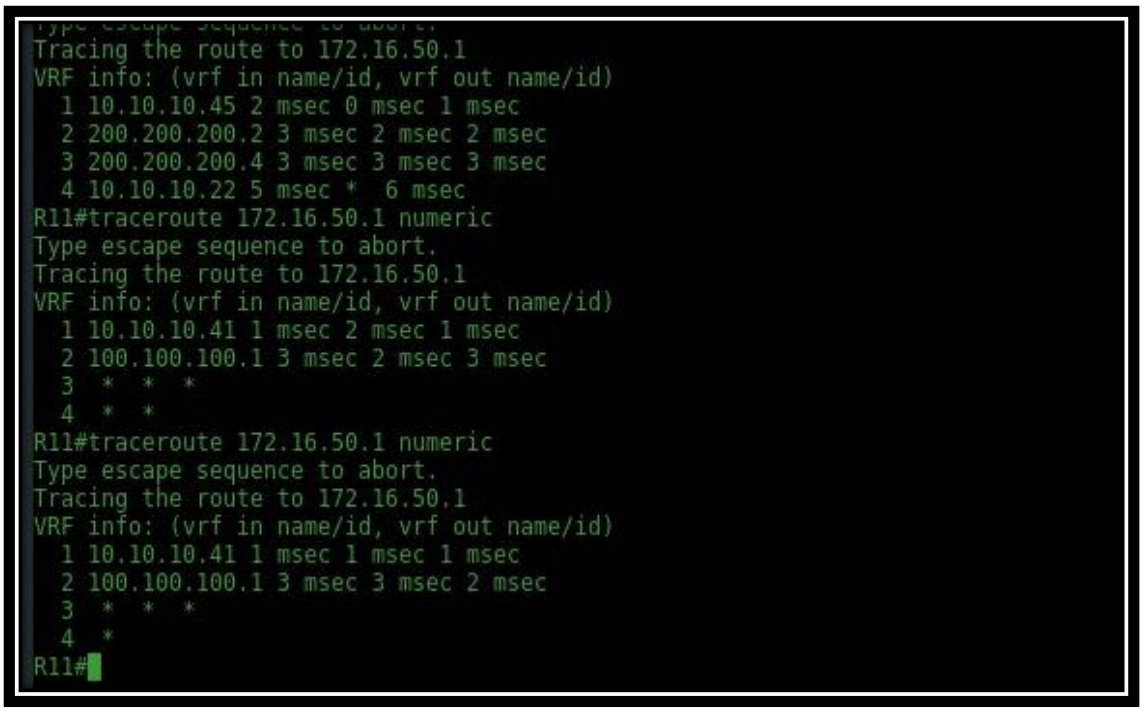
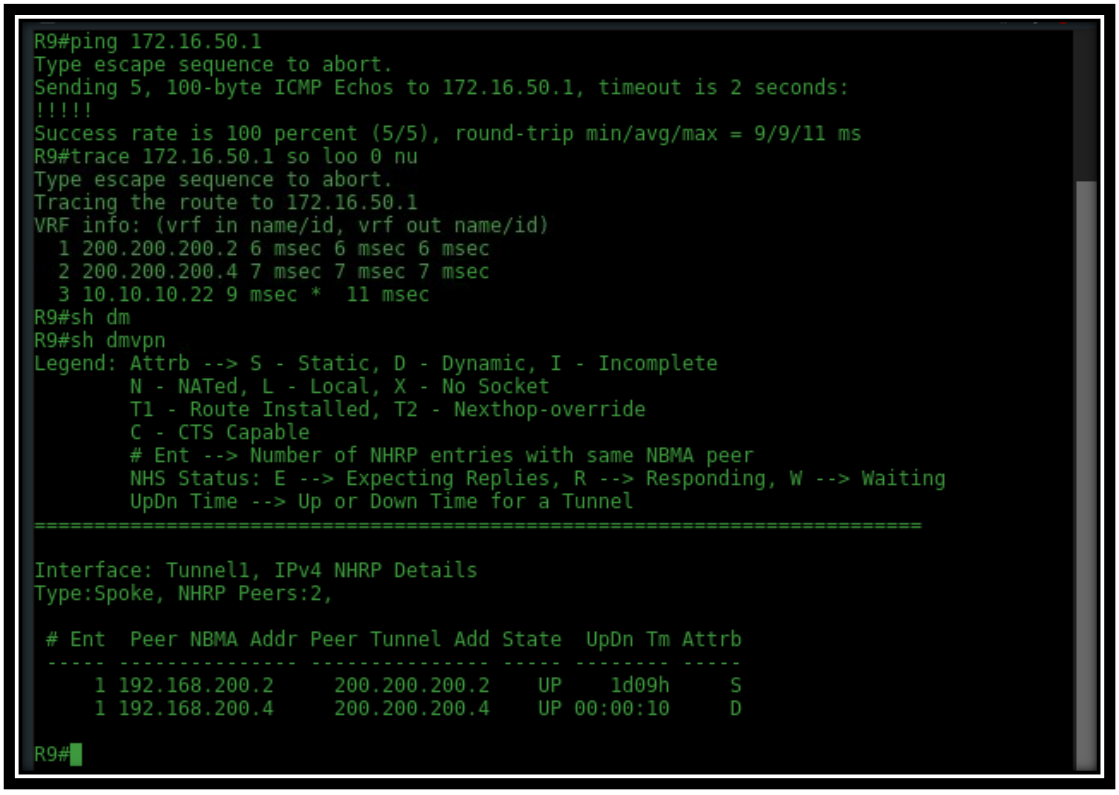
Lets make it normal



It switched to PRI tunnel

On R9



CCIE Lab Center

On R12

```
R12#ping 172.16.70.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.70.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 5/7/10 ms
R12#trace 172.16.70.1 sou loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.6 8 msec 7 msec 8 msec
  2 10.10.10.26 9 msec *  8 msec
R12#cle
R12#clear ip nh
R12#clear ip nhrp
R12#trace 172.16.70.1 sou loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.1 7 msec 6 msec 7 msec
  2 100.100.100.6 8 msec 8 msec 8 msec
  3 10.10.10.26 5 msec *  8 msec
R12#trace 172.16.70.1 sou loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 100.100.100.6 8 msec 7 msec 7 msec
  2 10.10.10.26 8 msec *  8 msec
R12#
```

```
R12#sh ip route
R12#sh ip route 172.16.70.0
Routing entry for 172.16.70.0/24
  Known via "ospf 10", distance 110, metric 50, type extern 2, forward metric 51
  Redistributing via nhrp
  Last update from 100.100.100.1 on Tunnel0, 00:45:36 ago
  Routing Descriptor Blocks:
  * 100.100.100.1, from 1.1.1.6, 00:45:36 ago, via Tunnel0
      Route metric is 50, traffic share count is 1
R12#sh ip route | i %
       + - replicated route, % - next hop override
O    %    100.100.100.6/32 [110/51] via 100.100.100.1, 00:45:45, Tunnel0
O E2%    172.16.70.0 [110/50] via 100.100.100.1, 00:45:45, Tunnel0
R12#
```

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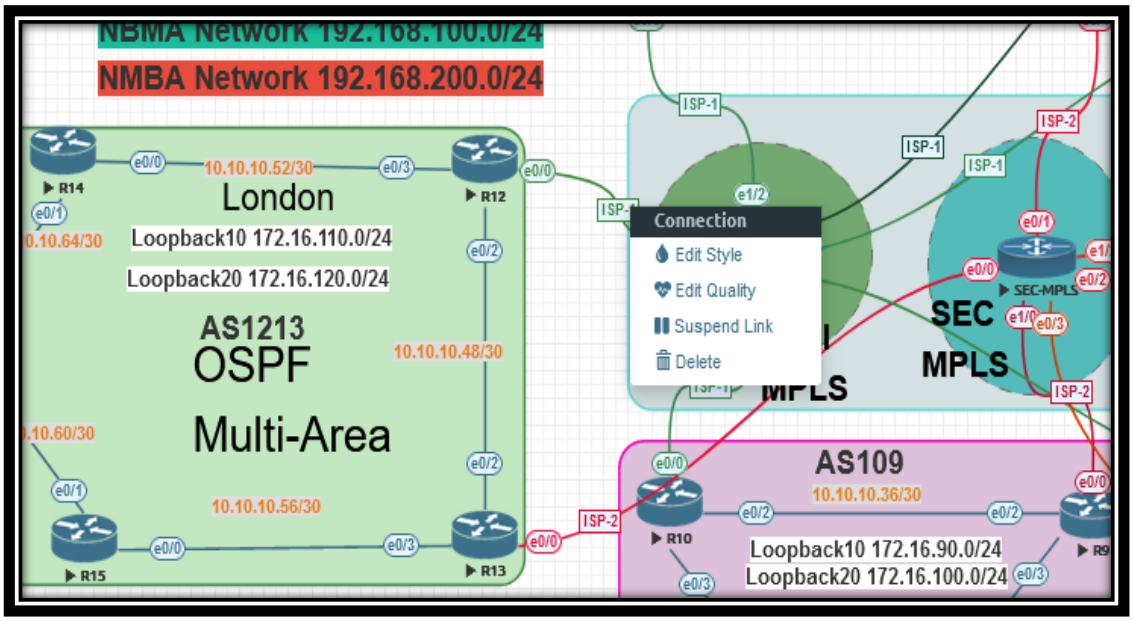
Let's make it failover test to suspend tunnel 0 on R12

on R16

Before suspending PRI tunnel 0

```
R16#
R16#ping 172.16.70.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.70.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/5/9 ms
R16#trace 172.16.70.1 nu
R16#trace 172.16.70.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.65 1 msec 1 msec 1 msec
  2 10.10.10.53 1 msec 2 msec 1 msec
  3 100.100.100.6 3 msec 2 msec 3 msec
  4 10.10.10.26 4 msec *  5 msec
R16#
```



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Traffic shifted to Sec Tunnel 1

```
  4 10.10.10.26 4 msec *  4 msec
R16#trace 172.16.70.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.65 1 msec 2 msec 1 msec
  2 10.10.10.53 2 msec 2 msec 1 msec
  3 100.100.100.6 3 msec 2 msec 2 msec
  4 10.10.10.26 3 msec *  *
R16#trace 172.16.70.1 numeric
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.65 1 msec 1 msec 1 msec
  2 10.10.10.53 1 msec 1 msec 2 msec
  3  *
    10.10.10.50 2 msec 2 msec
  4 200.200.200.2 3 msec 2 msec 3 msec
  5 10.10.10.9 4 msec 3 msec 3 msec
  6  *
    10.10.10.26 7 msec *
R16#
```

```
R16#sh ip route
R16#sh ip route 172.16.70.0
Routing entry for 172.16.70.0/24
  Known via "ospf 10", distance 110, metric 50, type extern 2, forward metric 1031
  Last update from 10.10.10.61 on Ethernet0/0, 00:02:10 ago
  Routing Descriptor Blocks:
  * 10.10.10.61, from 1.1.1.6, 00:02:10 ago, via Ethernet0/0
      Route metric is 50, traffic share count is 1
R16#
```

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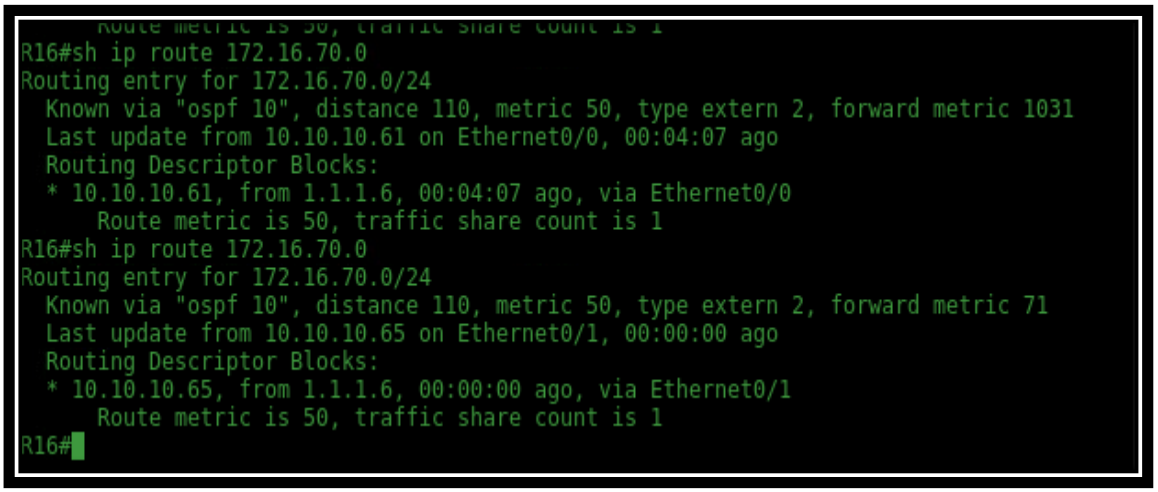
Traffic is going via

R16>R15>R13

Lets back to normal



Traffic shifted to PRI tunnel

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On R13

```
R13#trace 172.16.70.1 sou loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.49 2 msec 2 msec 1 msec
  2 100.100.100.1 3 msec 2 msec 2 msec
  3 100.100.100.6 4 msec 3 msec 4 msec
  4  *
     10.10.10.26 6 msec *
R13#trace 172.16.70.1 sou loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 10.10.10.49 1 msec 1 msec 1 msec
  2 100.100.100.6 5 msec 4 msec 3 msec
  3 10.10.10.26 4 msec *  6 msec
R13#sh ip route
R13#sh ip route 172.16.70.0
Routing entry for 172.16.70.0/24
  Known via "ospf 10", distance 110, metric 50, type extern 2, forward metric 61
  Redistributing via nhrp
  Last update from 10.10.10.49 on Ethernet0/2, 00:04:25 ago
  Routing Descriptor Blocks:
  * 10.10.10.49, from 1.1.1.6, 00:04:25 ago, via Ethernet0/2
      Route metric is 50, traffic share count is 1
R13#sh dm
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
        N - NATed, L - Local, X - No Socket
        T1 - Route Installed, T2 - Nexthop-override
        C - CTS Capable
        # Ent --> Number of NHRP entries with same NBMA peer
        NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting
        UpDn Time --> Up or Down Time for a Tunnel
==========================================================================

Interface: Tunnel1, IPv4 NHRP Details
Type:Spoke, NHRP Peers:1,

 # Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb
 ----- --------------- --------------- ----- -------- -----
     1 192.168.200.2     200.200.200.2    UP    1d09h     S

R13#
```

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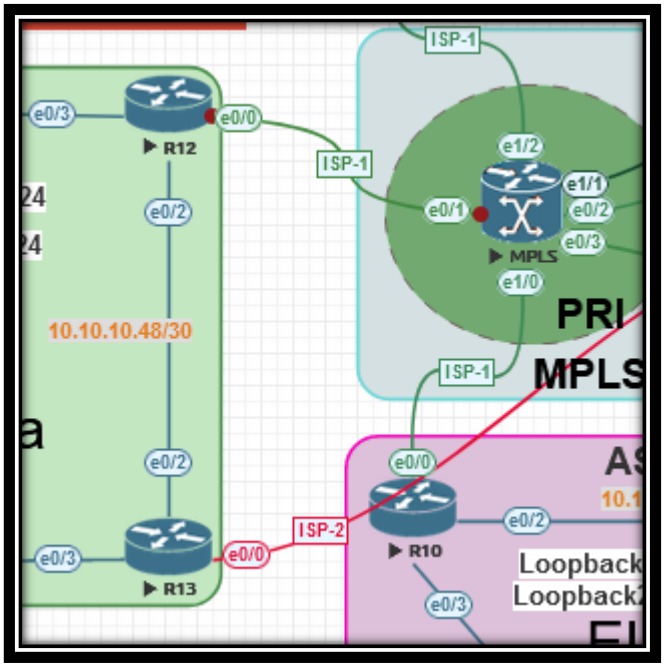
We'll shutdown PRI path.




```
Routing entry for 172.16.70.0/24
  Known via "ospf 10", distance 110, metric 50, type extern 2, forward metric 1011
  Redistributing via nhrp
  Last update from 200.200.200.2 on Tunnel1, 00:01:54 ago
  Routing Descriptor Blocks:
  * 200.200.200.2, from 1.1.1.6, 00:01:54 ago, via Tunnel1
      Route metric is 50, traffic share count is 1
R13#ping 172.16.70.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.70.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/9/10 ms
R13#tr
R13#traceroute 172.16.70.1 sou loo 0 nu
Type escape sequence to abort.
Tracing the route to 172.16.70.1
VRF info: (vrf in name/id, vrf out name/id)
  1 200.200.200.2 6 msec 7 msec 6 msec
  2 10.10.10.9 6 msec 7 msec 6 msec
  3 100.100.100.6 9 msec 7 msec 8 msec
  4 10.10.10.26 8 msec *  10 msec
R13#
```

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Thank You

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