LAB 4: DMVPN – OSPF

Disclaimer

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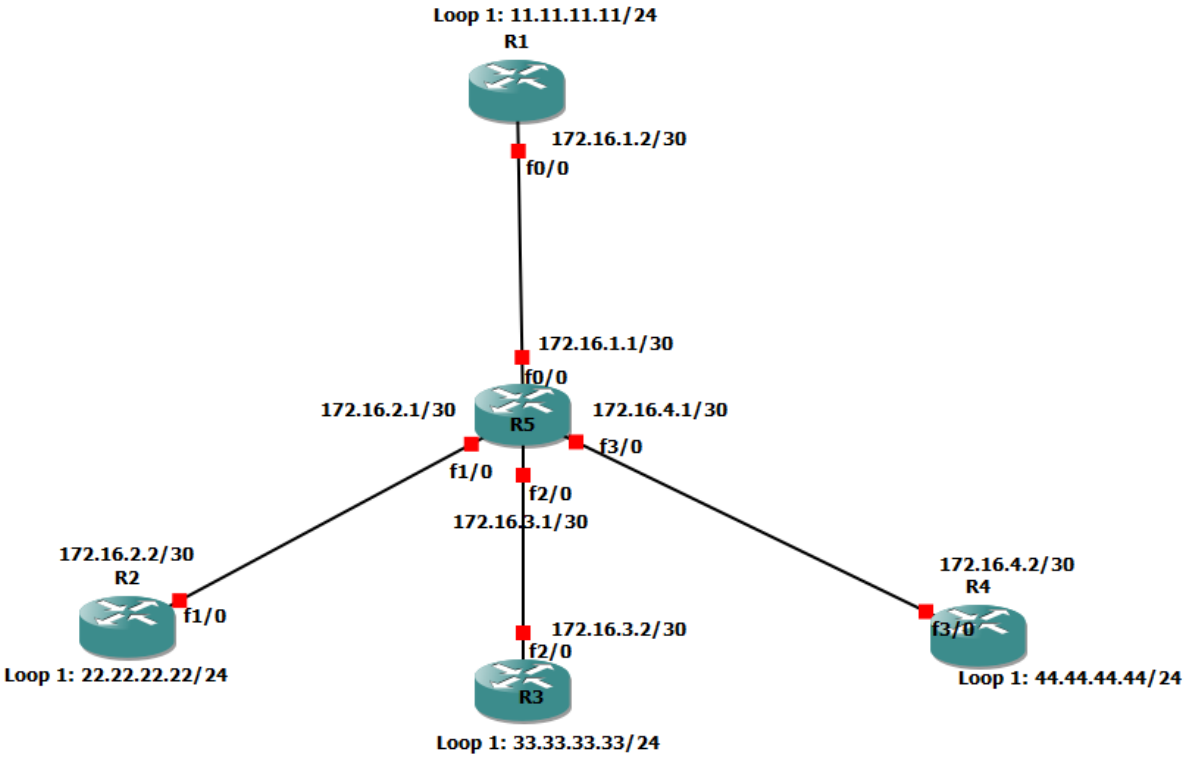
LAB 4: Diagram

Note: This Lab was developed on Cisco IOS Version15.2(4) M1 ADVENTERPRISEK9-M.



LAB 4: Configuration OSPF over DMVPN

Step 1: Enable loopback and physical interfaces on R1, R2, R3, R4 and R5.

R1:

```
interface FastEthernet0/0
ip address 172.16.1.2 255.255.255.252
no shutdown
exit

interface Loopback1
ip address 11.11.11.11 255.255.255.0
exit
```

R2:

```
interface FastEthernet1/0
ip address 172.16.2.2 255.255.255.252
no shutdown
exit

interface Loopback1
ip address 22.22.22.22 255.255.255.0
exit
```

R3:

```
interface FastEthernet2/0
ip address 172.16.3.2 255.255.255.252
no shutdown
exit

interface Loopback1
ip address 33.33.33.33 255.255.255.0
exit
```

R4:

```
interface FastEthernet3/0
ip address 172.16.4.2 255.255.255.252
no shutdown
exit
interface Loopback1
ip address 44.44.44.44 255.255.255.0
exit
```

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R5:

```
interface FastEthernet0/0
ip address 172.16.1.1 255.255.255.252
no shutdown
exit

interface FastEthernet1/0
ip address 172.16.2.1 255.255.255.252
no shutdown
exit

interface FastEthernet2/0
ip address 172.16.3.1 255.255.255.252
no shutdown
exit

interface FastEthernet3/0
ip address 172.16.4.1 255.255.255.252
no shutdown
exit
```

Step2: Assign default route pointing towards internet.

R1:

```
ip route 0.0.0.0 0.0.0.0 172.16.1.1
```

R2:

```
ip route 0.0.0.0 0.0.0.0 172.16.2.1
```

R3:

```
ip route 0.0.0.0 0.0.0.0 172.16.3.1
```

R4:

```
ip route 0.0.0.0 0.0.0.0 172.16.4.1
```

Step3: Configure DMVPN

R1:

```
interface Tunnel 0
ip address 192.168.0.1 255.255.255.0  !(logical ip address)
ip nhrp map multicast dynamic  !(enable multicast traffic)
ip nhrp network-id 5                    !(assign  same  network-id  else  tunnel
will not form)
tunnel source 172.16.1.2          !(physical address of HUB interface)
```

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```
tunnel mode gre multipoint                !(select gre mode)
ip mtu 1400                               !(change mtu for DMVPN header)
exit
```

R2:

```
interface Tunnel 0
ip address 192.168.0.2 255.255.255.0
ip nhrp network-id 5
tunnel source 172.16.2.2
ip nhrp map 192.168.0.1 172.16.1.2    !(pointing towards NHS server)
ip nhrp map multicast 172.16.1.2      !(allow multicast traffic from R2 (spoke) to R1 (Hub))
ip nhrp nhs 192.168.0.1               !(designates R1 as the NHS)
tunnel mode gre multipoint
ip mtu 1400
exit
```

R3:

```
interface Tunnel 0
ip address 192.168.0.3 255.255.255.0
ip nhrp network-id 5
tunnel source 172.16.3.2
ip nhrp map 192.168.0.1 172.16.1.2
ip nhrp map multicast 172.16.1.2
ip nhrp nhs 192.168.0.1
tunnel mode gre multipoint
ip mtu 1400
exit
```

R4:

```
interface Tunnel 0
ip address 192.168.0.4 255.255.255.0
ip nhrp network-id 5
tunnel source 172.16.4.2
ip nhrp map 192.168.0.1 172.16.1.2
ip nhrp map multicast 172.16.1.2
ip nhrp nhs 192.168.0.1
tunnel mode gre multipoint
ip mtu 1400
exit
```

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Step 4: Configure OSPF on router.

R1:

```
router ospf 1
network 192.168.0.1 255.255.255.0 area 0
network 11.11.11.11 255.255.255.0 area 0
exit
interface tunnel 0
ip ospf network broadcast
ip ospf priority 255
exit
```

R2:

```
router ospf 1
network 192.168.0.2 255.255.255.0 area 0
network 22.22.22.22 255.255.255.0 area 0
exit
interface tunnel 0
ip ospf network broadcast
ip ospf priority 255
exit
```

R3:

```
router ospf 1
network 192.168.0.3 255.255.255.0 area 0
network 33.33.33.33 255.255.255.0 area 0
exit
interface tunnel 0
ip ospf network broadcast
ip ospf priority 255
exit
```

R4:

```
router ospf 1
network 192.168.0.4 255.255.255.0 area 0
network 44.44.44.44 255.255.255.0 area 0
exit
interface tunnel 0
ip ospf network broadcast
ip ospf priority 255
exit
```

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Step 5: Verification

```
R1#show 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
       + - replicated route, % - next hop override

Gateway of last resort is 172.16.1.1 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 172.16.1.1
      11.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        11.11.11.0/24 is directly connected, Loopback1
L        11.11.11.11/32 is directly connected, Loopback1
      22.0.0.0/32 is subnetted, 1 subnets
O        22.22.22.22 [110/1001] via 192.168.0.2, 00:10:06, Tunnel0
      33.0.0.0/32 is subnetted, 1 subnets
O        33.33.33.33 [110/1001] via 192.168.0.3, 00:08:57, Tunnel0
      44.0.0.0/32 is subnetted, 1 subnets
O        44.44.44.44 [110/1001] via 192.168.0.4, 00:07:58, Tunnel0
      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.16.1.0/30 is directly connected, FastEthernet0/0
L        172.16.1.2/32 is directly connected, FastEthernet0/0
      192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.0.0/24 is directly connected, Tunnel0
L        192.168.0.1/32 is directly connected, Tunnel0

R2#show 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
       + - replicated route, % - next hop override

Gateway of last resort is 172.16.2.1 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 172.16.2.1
```

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```
     11.0.0.0/32 is subnetted, 1 subnets
O       11.11.11.11 [110/1001] via 192.168.0.1, 00:11:15, Tunnel0
     22.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       22.22.22.0/24 is directly connected, Loopback1
L       22.22.22.22/32 is directly connected, Loopback1
     33.0.0.0/32 is subnetted, 1 subnets
O       33.33.33.33 [110/1001] via 192.168.0.3, 00:10:04, Tunnel0
     44.0.0.0/32 is subnetted, 1 subnets
O       44.44.44.44 [110/1001] via 192.168.0.4, 00:09:05, Tunnel0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.2.0/30 is directly connected, FastEthernet1/0
L       172.16.2.2/32 is directly connected, FastEthernet1/0
     192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.0.0/24 is directly connected, Tunnel0
L       192.168.0.2/32 is directly connected, Tunnel0

R3#show 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
       + - replicated route, % - next hop override

Gateway of last resort is 172.16.3.1 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 172.16.3.1
     11.0.0.0/32 is subnetted, 1 subnets
O       11.11.11.11 [110/1001] via 192.168.0.1, 00:11:23, Tunnel0
     22.0.0.0/32 is subnetted, 1 subnets
O       22.22.22.22 [110/1001] via 192.168.0.2, 00:11:23, Tunnel0
     33.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       33.33.33.0/24 is directly connected, Loopback1
L       33.33.33.33/32 is directly connected, Loopback1
     44.0.0.0/32 is subnetted, 1 subnets
O       44.44.44.44 [110/1001] via 192.168.0.4, 00:10:05, Tunnel0
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.3.0/30 is directly connected, FastEthernet2/0
L       172.16.3.2/32 is directly connected, FastEthernet2/0
     192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.0.0/24 is directly connected, Tunnel0
L       192.168.0.3/32 is directly connected, Tunnel0
```

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```
R4#show 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
       + - replicated route, % - next hop override

Gateway of last resort is 172.16.4.1 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 172.16.4.1
      11.0.0.0/32 is subnetted, 1 subnets
O        11.11.11.11 [110/1001] via 192.168.0.1, 00:11:14, Tunnel0
      22.0.0.0/32 is subnetted, 1 subnets
O        22.22.22.22 [110/1001] via 192.168.0.2, 00:11:14, Tunnel0
      33.0.0.0/32 is subnetted, 1 subnets
O        33.33.33.33 [110/1001] via 192.168.0.3, 00:11:14, Tunnel0
      44.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        44.44.44.0/24 is directly connected, Loopback1
L        44.44.44.44/32 is directly connected, Loopback1
      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.16.4.0/30 is directly connected, FastEthernet3/0
L        172.16.4.2/32 is directly connected, FastEthernet3/0
      192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.0.0/24 is directly connected, Tunnel0
L        192.168.0.4/32 is directly connected, Tunnel0

R1#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
22.22.22.22       0   FULL/DROTHER    00:00:33    192.168.0.2     Tunnel0
33.33.33.33       0   FULL/DROTHER    00:00:39    192.168.0.3     Tunnel0
44.44.44.44       0   FULL/DROTHER    00:00:38    192.168.0.4     Tunnel0

R2#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
11.11.11.11     255   FULL/DR         00:00:34    192.168.0.1     Tunnel0

R3#show ip ospf neighbor
```

```
Neighbor ID     Pri   State           Dead Time   Address         Interface
11.11.11.11     255   FULL/DR         00:00:38    192.168.0.1     Tunnel0

R4#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
11.11.11.11     255   FULL/DR         00:00:34    192.168.0.1     Tunnel0

R1#show dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
      N - NATed, L - Local, X - No Socket
      # 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:3,

 # Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb
    1 172.16.2.2         192.168.0.2    UP 01:43:30     D
    1 172.16.3.2         192.168.0.3    UP 01:42:56     D
    1 172.16.4.2         192.168.0.4    UP 01:42:27     D

R2#show dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
      N - NATed, L - Local, X - No Socket
      # 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
    1 172.16.1.2         192.168.0.1    UP 01:43:15     S

R3#show dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
      N - NATed, L - Local, X - No Socket
      # 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:1,

 # Ent Peer NBMA Addr Peer Tunnel Add State UpDn Tm Attrb
    1 172.16.1.2   192.168.0.1   UP 01:41:40   S

R4#show dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
      N - NATed, L - Local, X - No Socket
      # 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
    1 172.16.1.2   192.168.0.1   UP 01:47:10   S

R2#ping 192.168.0.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 148/173/224 ms

R2#traceroute 192.168.0.4 source loopback 1
Type escape sequence to abort.
Tracing the route to 192.168.0.4
VRF info: (vrf in name/id, vrf out name/id)
  1 192.168.0.1 124 msec 92 msec
  2 192.168.0.4 130 msec 80 msec

(Spoke router R2 ia able to reach R4 via hub ie R1. A packet destined from R2 to R4 would need to be routed through R1to exit R2 tunnel and get re-encapsulated to enter R4 tunnel.)

R2#show dmvpn
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
      N - NATed, L - Local, X - No Socket
      # 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
 ----- --------------- --------------- ----- -------- -----
     1 172.16.1.2          192.168.0.1    UP 01:43:15     S
     2 172.16.4.2          192.168.0.4    UP 01:32:00     D
```

(Once the dynamically tunnel is formed between spoke to spoke router, DMVPN allows to spoke to spoke directly communication at next hop thus bypassing hub router completely.)