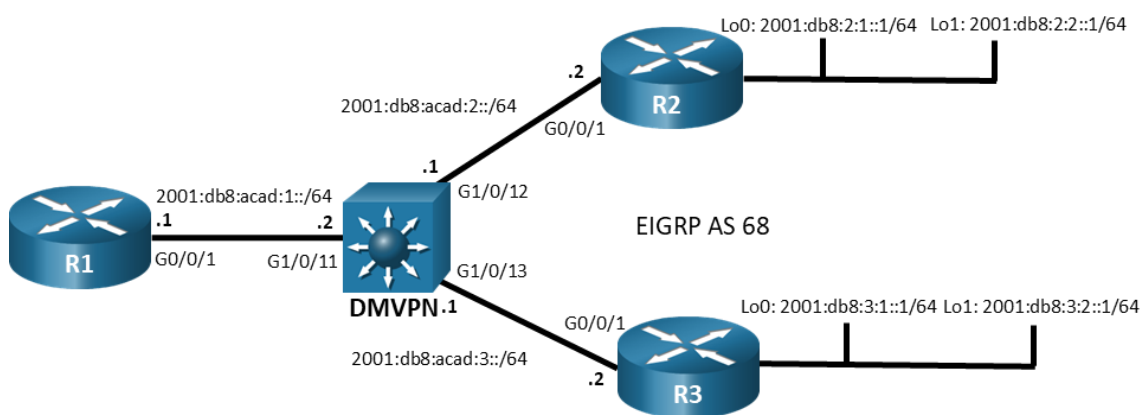


Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology (Instructor Version)

Instructor Note: Red font color or gray highlights indicate text that appears in the instructor copy only.

Answers: [19.1.5 Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology](#)

Topology



Addressing Table

Device	Interface	IPv6 Address	Link Local
R1	G0/0/0	2001.db8:acad:1::1/64	fe80::1
	Tunnel 1	2001:db8:cafe:100::1/64	fe80::2001
R2	G0/0/0	2001:db8:acad:2::2/64	fe80::2
	Loopback 0	2001:db8:2:1::1/64	fe80::2
	Loopback 1	2001:db8:2:2::1/64	fe80::2
	Tunnel 1	2001:db8:cafe:100::2/64	fe80::2002
R3	G0/0/0	2001:db8:acad:3::2/64	fe80::3
	Loopback 0	2001:db8:3:1::1/64	fe80::3
	Loopback 1	2001:db8:3:2::1/64	fe80::3
	Tunnel 1	2001:db8:cafe:100::3/64	fe80::2003

Objectives

In this lab, you will create a Dynamic Multipoint Virtual Private Network (DMVPN) that consists of a hub router with two spoke routers. You will implement a DMVPN Phase 3 spoke-to-spoke topology using IPv6.

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Implement IPv6 DMVPN Phase 3

Part 3: Configure EIGRP for IPv6

Background / Scenario

In this lab you will configure IPv6 DMVPN Phase 3, which is very similar to the configuration with IPv4. Most of the tunnel and NHRP commands have direct parallels in IPv6. In addition, the configuration process and the differences between hub and spoke configuration is also similar. You will dynamically route overlay and transport networks over EIGRP for IPv6.

IPv6 DMVPN can be implemented in three different address type scenarios:

- **IPv4 over IPv6** - IPv4 is the protocol that is used on the tunnel and IPv6 is used in the physical transport network.
- **IPv6 over IPv4** - IPv6 is the tunnel protocol and IPv4 is the protocol that is used in the physical transport network.
- **IPv6 over IPv6** - Both the transport and tunnel networks use IPv6.

In this lab, you will configure the IPv6 over IPv6 scenario.

Note: This lab does not include the configuration of IPsec to secure the tunnels. This essential procedure will be covered in a later lab.

Note: This lab is an exercise in configuring and verifying various implementations of DMVPN topologies and does not reflect networking best practices.

Note: The routers used with CCNP hands-on labs are Cisco 4221s with Cisco IOS XE Release 16.9.4 (universalk9 image). The Layer 3 switch is a Cisco Catalyst 3650 with Cisco IOS XE Release 16.9.4 (universalk9 image). Other routers, Layer 3 switches, and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and the output produced might vary from what is shown in the labs.

Note: Make sure that the routers and switches have been erased and have no startup configurations. If you are unsure, please contact your instructor.

Instructor Note: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

Required Resources

- 3 Routers (Cisco 4221 with Cisco IOS XE Release 16.9.4 universal image or comparable)
- 1 Layer 3 switch (Cisco 3650 with Cisco IOS Release 16.9.4 universal image or comparable)
- 1 PC (Choice of operating system with a terminal emulation program installed)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet cables as shown in the topology

Instructions

Part 1: Build the Network and Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings.

Step 1: Cable the network as shown in the topology.

Connect the devices as shown in the topology diagram.

Step 2: Configure initial settings for each router and the Layer 3 switch.

- Console into each device, enter global configuration mode, and apply the initial settings for the lab. Initial configurations for each device are provided below:

Hub Router R1

```
hostname R1
ipv6 unicast-routing
no ip domain lookup
banner motd # R1, Implement a DMVPN hub #
line con 0
  exec-timeout 0 0
  logging synchronous
  exit
line vty 0 4
  privilege level 15
  password cisco123
  exec-timeout 0 0
  logging synchronous
  login
  exit
ipv6 route ::/0 2001:db8:acad:1::2
interface g0/0/1
  ipv6 address 2001:db8:acad:1::1/64
  ipv6 address fe80::1 link-local
  no shutdown
end
```

Spoke Router R2

```
hostname R2
ipv6 unicast-routing
no ip domain lookup
banner motd # R2, Implement DMVPN Spoke 1 #
line con 0
  exec-timeout 0 0
  logging synchronous
  exit
line vty 0 4
  privilege level 15
  password cisco123
  exec-timeout 0 0
  logging synchronous
  login
  exit
ipv6 route ::/0 2001:db8:acad:2::1
interface g0/0/1
  ipv6 address 2001:db8:acad:2::2/64
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
    ipv6 address fe80::2 link-local
    no shutdown
    exit
interface loopback 0
    ipv6 address 2001:db8:2:1::1/64
    ipv6 address fe80::2 link-local
    no shutdown
    exit
interface loopback 1
    ipv6 address 2001:db8:2:2::1/64
    ipv6 address fe80::2 link-local
    no shutdown
    exit
```

Spoke Router R3

```
hostname R3
ipv6 unicast-routing
no ip domain lookup
banner motd # R3, Implement DMVPN Spoke 2 #
line con 0
    exec-timeout 0 0
    logging synchronous
    exit
line vty 0 4
    privilege level 15
    password cisco123
    exec-timeout 0 0
    logging synchronous
    login
    exit
ipv6 route ::/0 2001:db8:acad:3::1
interface g0/0/1
    ipv6 address 2001:db8:acad:3::2/64
    ipv6 address fe80::3 link-local
    no shutdown
    exit
interface loopback 0
    ipv6 address 2001:db8:3:1::1/64
    ipv6 address fe80::3 link-local
    exit
interface loopback 1
    ipv6 address 2001:db8:3:2::1/64
    ipv6 address fe80::3 link-local
    exit
end
```

DMVPN Layer 3 Switch

```
hostname DMVPN
ipv6 unicast-routing
ip routing
no ip domain lookup
banner motd # DMVPN, DMVPN cloud switch #
line con 0
  exec-timeout 0 0
  logging synchronous
  exit
line vty 0 4
  privilege level 15
  password cisco123
  exec-timeout 0 0
  logging synchronous
  login
interface g1/0/11
  no switchport
  ipv6 address 2001:db8:acad:1::2/64
  ipv6 address fe80::4 link-local
  no shutdown
  exit
interface g1/0/12
  no switchport
  ipv6 address 2001:db8:acad:2::1/64
  ipv6 address fe80::4 link-local
  no shutdown
  exit
interface g1/0/13
  no switchport
  ipv6 address 2001:db8:acad:3::1/64
  ipv6 address fe80::4 link-local
  no shutdown
  exit
ipv6 route 2001:db8:2:1::/64 2001:db8:acad:2::2
ipv6 route 2001:db8:2:2::/64 2001:db8:acad:2::2
ipv6 route 2001:db8:3:1::/64 2001:db8:acad:3::2
ipv6 route 2001:db8:3:2::/64 2001:db8:acad:3::2
end
```

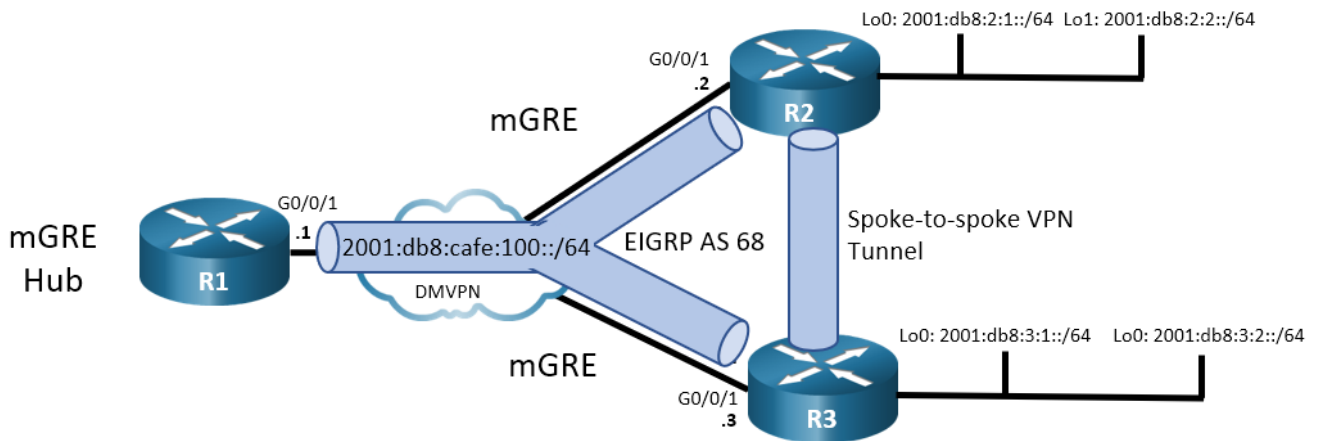
- b. Set the clock on each device to UTC time.
- c. Save the running configuration to the startup configuration.

Note: In this lab, you will need to preconfigure the DMVPN Layer 3 switch. Normally, you would not need to configure this device. The DMVPN switch is simulating the ISP transport network.

Part 2: Implement IPv6 DMVPN Phase 3

In this part of the lab, you will configure IPv6 DMVPN Phase 3 to create DMVPN tunnels between the spoke routers R2 and R3, and the hub router, R1. DMVPN is very flexible and there are many options for implementation beyond what is being done in this lab.

In Phase 3 DMVPN, dynamic IPv6 spoke-to-spoke tunnels will be created between spoke routers after the initiating spoke router sends initial traffic to the hub.



Step 1: Verify connectivity in the underlay network.

From R1, ping the Loopback 0 interfaces of R2 and R3.

```
R1# ping 2001:db8:2:1::1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:DB8:2:1::1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R1# ping 2001:db8:3:1::1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:DB8:3:1::1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Step 2: Configure the tunnel interface on the hub router.

As you know, DMVPN requires configuration of tunnel interfaces like GRE. Unlike GRE tunnels, DMVPN Phase 3 uses multipoint GRE (mGRE) mode tunnels. When configuring tunnel interfaces, care must be taken to use unique IPv6 link local addresses on all tunnel interfaces. The tunnel interfaces do not require a tunnel destination because the tunnel interfaces are multipoint.

- On R1, create the tunnel interface, set the tunnel mode to mGRE, and establish the tunnel source as Loopback 0. A tunnel key is also required when multiple tunnels will be established from a single interface. Finally, address the interface. The overlay network will use the same IPv6 network for all tunnel interfaces of the DMVPN.

```
R1(config)# interface tunnel 1
R1(config-if)# tunnel mode gre multipoint ipv6
R1(config-if)# tunnel source GigabitEthernet0/0/1
R1(config-if)# tunnel key 999
R1(config-if)# ipv6 address 2001:db8:cafe:100::1/64
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
R1(config-if)# ipv6 address fe80::2001 link-local
```

- b. Configure the hub router as a NHRP server (NHS). Spoke routers require the services of the NHS to establish dynamic tunnels.

NHRP enables DMVPN to dynamically learn the NBMA physical addresses of devices in the network. The NHRP network ID must be consistent between the hub and spokes in the DMVPN network. You configure authentication to add a layer of security. Finally, configure the interface as multicast dynamic, which enables the NHS to dynamically add spoke routers to the NHRP table when spokes initiate a tunnel. This enables the use of dynamic routing protocols between the hub and spoke routers.

The **ipv6 nhrp redirect** command is required to enable the hub router to support DMVPN Phase 3.

```
R1(config-if)# ipv6 nhrp network-id 1
R1(config-if)# ipv6 nhrp authentication NHRPauth
R1(config-if)# ipv6 nhrp map multicast dynamic
R1(config-if)# ipv6 nhrp redirect
```

- c. Because DMVPN networks add information to packet headers, the interface should be fine-tuned to participate in the DMVPN network. In addition, configure the interface bandwidth so that routing protocols that use bandwidth values will function properly.

```
R1(config-if)# bandwidth 4000
R1(config-if)# ipv6 mtu 1380
R1(config-if)# ipv6 tcp adjust-mss 1360
```

- d. Verify the tunnel interface configuration with the **show interface tunnel 1** and **show ipv6 interface tunnel 1** commands.

```
R1# show interface tunnel 1
Tunnell is up, line protocol is up
  Hardware is Tunnel
  MTU 1452 bytes, BW 4000 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 2001:DB8:ACAD:1::1 (GigabitEthernet0/0/1)
  Tunnel Subblocks:
    src-track:
      Tunnell source tracking subblock associated with GigabitEthernet0/0/1
      Set of tunnels with source GigabitEthernet0/0/1, 1 member (includes
  iterators), on interface <OK>
  Tunnel protocol/transport multi-GRE/IPv6
    Key 0x3E7, sequencing disabled
    Checksumming of packets disabled
  Tunnel TTL 255
  Path MTU Discovery, ager 10 mins, min MTU 1280
  Tunnel transport MTU 1452 bytes
  Tunnel transmit bandwidth 8000 (kbps)
  Tunnel receive bandwidth 8000 (kbps)
  Last input never, output never, output hang never
  Last clearing of "show interface" counters 00:02:45
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 20
  Queueing strategy: fifo
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
Output queue: 0/0 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  0 packets input, 0 bytes, 0 no buffer
  Received 0 broadcasts (0 IP multicasts)
  0 runs, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  0 packets output, 0 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# show ipv6 interface tunnel 1
Tunnell1 is up, line protocol is up
IPv6 is enabled, link-local address is FE80::2001
No Virtual link-local address(es):
Global unicast address(es):
  2001:DB8:CAFE:100::1, subnet is 2001:DB8:CAFE:100::/64
Joined group address(es):
  FF02::1
  FF02::2
  FF02::1:FF00:1
  FF02::1:FF00:2001
MTU is 1380 bytes
ICMP error messages limited to one every 100 milliseconds
ICMP redirects are enabled
ICMP unreachable are sent
Input features: IPv6 TCP Adjust MSS
Output features: IPv6 TCP Adjust MSS
ND DAD is not supported
ND reachable time is 30000 milliseconds (using 30000)
ND advertised reachable time is 0 (unspecified)
ND advertised retransmit interval is 0 (unspecified)
ND router advertisements live for 1800 seconds
ND advertised default router preference is Medium
ND RAs are suppressed (periodic)
Hosts use stateless autoconfig for addresses.
```

Step 3: Configure the R2 and R3 spoke router tunnel interfaces.

In DMVPN Phase 3, the NHRP client (NHC) tunnel interfaces use mGRE as does the NHS hub router. Much of the interface configuration is the same as for the NHS tunnel interface. However, instead of the interfaces being configured to send NHRP redirect messages, the interfaces are configured to create shortcuts, or spoke-to-spoke tunnels.

- On R2, create the tunnel interface and configure the mGRE tunnel parameters. Configuring the tunnel source as the Loopback 0 interface provides a stable source for the tunnel. The tunnel key must match the key that is configured on the hub router. Configure the overlay network IPv6 addresses for the tunnel interface. Note that no static tunnel destination is configured, because these are multipoint interfaces.

```
R2(config)# interface tunnel 1
R2(config-if)# tunnel mode gre multipoint ipv6
```


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```
R2(config-if)# tunnel source loopback 0
R2(config-if)# tunnel key 999
R2(config-if)# ipv6 address 2001:db8:cafe:100::2/64
R2(config-if)# ipv6 address fe80::2002 link-local
```

- b. Configure the tunnel interface as an NHRP client. You will need to designate the underlay address of the NHRP server and map the NHRP server underlay address to its overlay address.

```
R2(config-if)# ipv6 nhrp network-id 1
R2(config-if)# ipv6 nhrp authentication NHRPauth
R2(config-if)# ipv6 nhrp nhs 2001:db8:cafe:100::1 nbma 2001:db8:acad:1::1 multicast
R2(config-if)# ipv6 nhrp map multicast dynamic
R2(config-if)# ipv6 nhrp shortcut
```

- c. Adjust settings on the interface to accommodate the GRE packet overhead.

```
R2(config-if)# bandwidth 4000
R2(config-if)# ipv6 mtu 1380
R2(config-if)# ipv6 tcp adjust-mss 1360
```

- d. Repeat this configuration on router R3 using the commands above and information from the addressing table.

```
R3(config)# interface tunnel 1
R3(config-if)# tunnel mode gre multipoint ipv6
R3(config-if)# tunnel source loopback 0
R3(config-if)# tunnel key 999
R3(config-if)# ipv6 address 2001:db8:cafe:100::3/64
R3(config-if)# ipv6 address fe80::2003 link-local
R3(config-if)# ipv6 nhrp network-id 1
R3(config-if)# ipv6 nhrp authentication NHRPauth
R3(config-if)# ipv6 nhrp nhs 2001:db8:cafe:100::1 nbma 2001:db8:acad:1::1 multicast
R3(config-if)# ipv6 nhrp map multicast dynamic
R3(config-if)# ipv6 nhrp shortcut
R3(config-if)# bandwidth 4000
R3(config-if)# ipv6 mtu 1380
R3(config-if)# ipv6 tcp adjust-mss 1360
```

- e. Verify your configurations with the **show interface** command. If your configurations are correct, you should be able to successfully ping the interface addresses of the overlay network from each router.
- f. Go to R1 and view the status of DMVPN with the **show dmvpn** and **show dmvpn detail** commands. Become familiar with the output of each.

```
R1# show dmvpn detail
```

```
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete
         N - NATed, L - Local, X - No Socket
         T1 - Route Installed, T2 - Nexthop-override
         C - CTS Capable, I2 - Temporary
         # 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 is up/up, Addr. is 2001:DB8:CAFE:100::1, VRF ""
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
Tunnel Src./Dest. addr: 2001:DB8:ACAD:1::1/Multipoint, Tunnel VRF ""
Protocol/Transport: "multi-GRE/IPv6", Protect ""
Interface State Control: Disabled
nhrp event-publisher : Disabled
Type:Hub, Total NBMA Peers (v4/v6): 2
  1.Peer NBMA Address: 2001:DB8:2:1::1
    Tunnel IPv6 Address: 2001:DB8:CAFE:100::2
    IPv6 Target Network: 2001:DB8:CAFE:100::2/128
    # Ent: 2, Status: UP, UpDn Time: 00:12:54, Cache Attrib: D
  2.Peer NBMA Address: 2001:DB8:2:1::1
    Tunnel IPv6 Address: 2001:DB8:CAFE:100::2
    IPv6 Target Network: FE80::2002/128
    # Ent: 0, Status: UP, UpDn Time: 00:12:54, Cache Attrib: D
  3.Peer NBMA Address: 2001:DB8:3:1::1
    Tunnel IPv6 Address: 2001:DB8:CAFE:100::3
    IPv6 Target Network: 2001:DB8:CAFE:100::3/128
    # Ent: 2, Status: UP, UpDn Time: 00:06:32, Cache Attrib: D
  4.Peer NBMA Address: 2001:DB8:3:1::1
    Tunnel IPv6 Address: 2001:DB8:CAFE:100::3
    IPv6 Target Network: FE80::2003/128
    # Ent: 0, Status: UP, UpDn Time: 00:06:32, Cache Attrib: D
```

Crypto Session Details:

Pending DMVPN Sessions:

The output shows the status of the tunnel, the tunnel address and the tunnel source address. The list of peers shows the NBMA (underlay) addresses of the DMVPN peers that were learned by NHRP. These addresses come from the tunnel source Loopback 0 addresses. Although there are only two peers known (R2 and R3), there are two entries for each. The first entry shows the tunnel target network interface address, and the second gives the link local address. The status of the entries in the table must be UP for data to travel on the tunnels. The attribute D indicates the tunnels are dynamic. If configured, the crypto settings for the tunnel would be shown. You will secure the tunnels in a later lab.

Repeat this command on the spoke routers so that you become familiar with the command output.

- g. Verify the status of NHRP by viewing the contents of the NHRP cache with the **show ipv6 nhrp detail** command. Output is shown for the hub router. Note that it displays information for both of the dynamic tunnels between the spoke routers and the hub.

```
R1# show ipv6 nhrp detail
2001:DB8:CAFE:100::2/128 via 2001:DB8:CAFE:100::2
  Tunnel1 created 00:27:29, expire 00:07:21
  Type: dynamic, Flags: registered nhop
  NBMA address: 2001:DB8:2:1::1
  Preference: 255
2001:DB8:CAFE:100::3/128 via 2001:DB8:CAFE:100::3
  Tunnel1 created 00:21:07, expire 00:08:52
  Type: dynamic, Flags: registered nhop
  NBMA address: 2001:DB8:3:1::1
```

```
Preference: 255
FE80::2002/128 via 2001:DB8:CAFE:100::2
Tunnell created 00:27:29, expire 00:07:21
Type: dynamic, Flags: registered
NBMA address: 2001:DB8:2:1::1
Preference: 255
FE80::2003/128 via 2001:DB8:CAFE:100::3
Tunnell created 00:21:07, expire 00:08:52
Type: dynamic, Flags: registered
NBMA address: 2001:DB8:3:1::1
Preference: 255
```

This output provides details about the tunnel endpoints that are known to NHRP. This includes the overlay and transport interface addresses for the known peers.

Part 3: Configure EIGRP for IPv6

In this scenario, you will create two EIGRP for IPv6 routing processes for two different ASs. AS 68 will route the tunnel network and the LANs to be accessed across the tunnels. AS 168 will route the transport network in order to ensure connectivity between the underlay networks that the tunnel network relies upon.

Initially, static routes were configured in the topology to enable initial testing of network connectivity after the topology was set up for the lab. You no longer need these static routes and will replace them with EIGRPv6.

Step 1: Remove static routes.

- Remove the preconfigured static routes from the three routers by pasting the commands below into the console of the appropriate devices.

R1

```
no ipv6 route ::/0 2001:db8:acad:1::2
```

R2

```
no ipv6 route ::/0 2001:db8:acad:2::1
```

R3

```
no ipv6 route ::/0 2001:db8:acad:3::1
```

DMVPN

```
no ipv6 route 2001:db8:2:1::/64 2001:db8:acad:2::2
```

```
no ipv6 route 2001:db8:2:2::/64 2001:db8:acad:2::2
```

```
no ipv6 route 2001:db8:3:1::/64 2001:db8:acad:3::2
```

```
no ipv6 route 2001:db8:3:2::/64 2001:db8:acad:3::2
```

Note: Normally devices in the DMVPN cloud would require no intervention from enterprise networking staff. However, for the purposes of this lab, some configuration of the DMVPN Layer 3 switch is required.

- Create classic mode IPv6 EIGRP processes with AS **68**. This process and AS will route the overlay network. Add the tunnel interface and Loopback 1 interface networks to the routing process. Loopback 1 simulates a LAN that will be sending traffic through the tunnel. Note that split horizon is disabled on the hub and spoke router tunnel interfaces. Also note that the two spoke routers are configured as stub routers. Configure the three routers as follows:

```
R1(config)# ipv6 router eigrp 68
```

```
R1(config-router)# eigrp router-id 1.1.1.1
R1(config-router)# interface tunnel 1
R1(config-if)# ipv6 eigrp 68
R1(config-if)# no ipv6 split-horizon eigrp 68

R2(config)# ipv6 router eigrp 68
R2(config-router)# eigrp router-id 2.2.2.2
R2(config-router)# interface tunnel 1
R2(config-if)# ipv6 eigrp 68
R2(config-if)# no ipv6 split-horizon eigrp 68
R2(config-if)# interface loopback 1
R2(config-if)# ipv6 eigrp 68

R3(config)# ipv6 router eigrp 68
R3(config-router)# eigrp router-id 3.3.3.3
R3(config-router)# interface tunnel 1
R3(config-if)# ipv6 eigrp 68
R3(config-if)# no ipv6 split-horizon eigrp 68
R3(config-if)# interface loopback 1
R3(config-if)# ipv6 eigrp 68
```

Step 2: Configure dynamic routing for the underlay network.

- Create new classic mode EIGRP processes for AS 168. This process and AS will route the underlay, or transport, network. Note that the DMVPN Layer 3 switch did not need to have routing knowledge for the tunnel network. However, it does need to be configured to route between the point-to-point underlay networks. Split horizon does not need to be disabled for this AS because the underlay network is a point-to-point network.

```
R1(config)# ipv6 router eigrp 168
R1(config-router)# eigrp router-id 10.1.1.1
R1(config-router)# interface GigabitEthernet 0/0/1
R1(config-if)# ipv6 eigrp 168

R2(config)# ipv6 router eigrp 168
R2(config-router)# eigrp router-id 20.2.2.2
R2(config-router)# interface GigabitEthernet 0/0/1
R2(config-if)# ipv6 eigrp 168
R2(config-if)# interface loopback 0
R2(config-if)# ipv6 eigrp 168

R3(config)# ipv6 router eigrp 168
R3(config-router)# eigrp router-id 30.3.3.3
R3(config-router)# interface GigabitEthernet 0/0/1
R3(config-if)# ipv6 eigrp 168
R3(config-if)# interface loopback 0
R3(config-if)# ipv6 eigrp 168

DMVPN(config)# ipv6 router eigrp 168
DMVPN(config-router)# eigrp router-id 40.4.4.4
DMVPN(config-router)# interface GigabitEthernet 1/0/11
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
DMVPN(config-if)# ipv6 eigrp 168
DMVPN(config-router)# interface GigabitEthernet 1/0/12
DMVPN(config-if)# ipv6 eigrp 168
DMVPN(config-router)# interface GigabitEthernet 1/0/13
DMVPN(config-if)# ipv6 eigrp 168
```

Note: Normally devices in the DMVPN cloud would require no intervention from enterprise networking staff. However, for the purposes of this lab, some configuration of the DMVPN Layer 3 switch is required.

- b. Verify dynamic routing on all three routers by using the **show ipv6 route eigrp** command. Do this on all three routers to verify that the underlay and overlay networks appear in the routing tables. Output is shown for the hub router.

```
R1# show ipv6 route eigrp
<output omitted>
D   2001:DB8:2:1::/64 [90/131072]
    via FE80::4, GigabitEthernet0/0/1
D   2001:DB8:2:2::/64 [90/2048000]
    via FE80::2002, Tunnel1
D   2001:DB8:3:1::/64 [90/131072]
    via FE80::4, GigabitEthernet0/0/1
D   2001:DB8:3:2::/64 [90/2048000]
    via FE80::2003, Tunnel1
D   2001:DB8:ACAD:2::/64 [90/3072]
    via FE80::4, GigabitEthernet0/0/1
D   2001:DB8:ACAD:3::/64 [90/3072]
    via FE80::4, GigabitEthernet0/0/1
```

Step 3: Verify DMVPN Phase 3 operation.

You have completed configuration of DMVPN Phase 3. Verify communication as follows:

- a. On R1, execute a **traceroute** to the Loopback 1 interface IP addresses on R2 and R3. You should see the path use the tunnel network.

```
R1# traceroute 2001:db8:2:2::1
Type escape sequence to abort.
Tracing the route to 2001:DB8:2:2::1

 1 2001:DB8:CAFE:100::2 2 msec 1 msec 1 msec
```

```
R1# traceroute 2001:db8:3:2::1
Type escape sequence to abort.
Tracing the route to 2001:DB8:3:2::1

 1 2001:DB8:CAFE:100::3 1 msec 1 msec 1 msec
```

- b. On R1, execute a **traceroute** to the Loopback 0 interface IP addresses on R2 and R3. You should see the path use the physical point-to-point networks of the underlay transport network.

```
R1# traceroute 2001:db8:2:1::1
Type escape sequence to abort.
Tracing the route to 2001:DB8:2:1::1
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```

1 2001:DB8:ACAD:1::2 2 msec 1 msec 2 msec
2 2001:DB8:ACAD:2::2 1 msec 0 msec 0 msec

```

```

R1# traceroute 2001:db8:3:1::1
Type escape sequence to abort.
Tracing the route to 2001:DB8:3:1::1

```

```

1 2001:DB8:ACAD:1::2 2 msec 2 msec 1 msec
2 2001:DB8:ACAD:3::2 1 msec 1 msec 1 msec

```

- c. Repeat the traceroute commands between R2 and R3.

Step 4: Observe dynamic tunnel creation.

- a. Return to R2. Initiate a **traceroute** to the simulated LAN interface (Loopback 1) on R3. The path will pass through R1 as it does in DMVPN Phase 1.

```

R2# traceroute 2001:db8:3:2::1
Type escape sequence to abort.
Tracing the route to 2001:DB8:3:2::1

```

```

1 2001:DB8:CAFE:100::1 1 msec 1 msec 1 msec
2 2001:DB8:CAFE:100::3 2 msec 1 msec

```

- b. Issue the **traceroute** command again. You will now see that DMVPN hub, R1, has enabled direct spoke-to-spoke communication between R2 and R3. R1 is no longer in the path, instead, the path is directly to R3. This tunnel will expire after ten minutes by default. The tunnel dynamically reopens after data is sent to the spoke router again.

```

R2# traceroute 2001:db8:3:2::1
Type escape sequence to abort.
Tracing the route to 2001:DB8:3:2::1

```

```

1 2001:DB8:CAFE:100::3 1 msec 1 msec 1 msec

```

- c. You have successfully configured a DMVPN Phase 3 network. Feel free to explore the IPv6 versions of the DMVPN Phase 3 verification commands you used for IPv4 DMVPN.

Router Interface Summary Table

Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
4221	Gigabit Ethernet 0/0/0 (G0/0/0)	Gigabit Ethernet 0/0/1 (G0/0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
4300	Gigabit Ethernet 0/0/0 (G0/0/0)	Gigabit Ethernet 0/0/1 (G0/0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Device Configs – Final (Use Lab Section and Lab Section Gray)

Router R1

```
enable
configure terminal
hostname R1
no ip domain lookup
ipv6 unicast-routing
interface Tunnell
  bandwidth 4000
  ipv6 address FE80::2001 link-local
  ipv6 address 2001:DB8:CAFE:100::1/64
  ipv6 mtu 1380
  ipv6 tcp adjust-mss 1360
  ipv6 eigrp 68
  no ipv6 split-horizon eigrp 68
  ipv6 nhrp authentication NHRPauth
  ipv6 nhrp network-id 1
  ipv6 nhrp map multicast dynamic
  ipv6 nhrp redirect
  tunnel source GigabitEthernet0/0/1
  tunnel mode gre multipoint ipv6
  tunnel key 999
interface GigabitEthernet0/0/1
  no ip address
  negotiation auto
  ipv6 address FE80::1 link-local
  ipv6 address 2001:DB8:ACAD:1::1/64
  ipv6 eigrp 168
  no shutdown
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
no ipv6 route ::/0 2001:db8:acad:1::2
ipv6 router eigrp 68
 eigrp router-id 1.1.1.1
ipv6 router eigrp 168
 eigrp router-id 10.1.1.1
banner motd ^C R1, Implement a DMVPN hub ^C
line con 0
 exec-timeout 0 0
 logging synchronous
 transport input none
 stopbits 1
line vty 0 4
 exec-timeout 0 0
 privilege level 15
 password cisco123
 logging synchronous
 login
end
```

Router R2

```
enable
configure terminal
hostname R2
no ip domain lookup
ipv6 unicast-routing
interface Loopback0
 no ip address
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:2:1::1/64
 ipv6 eigrp 168
interface Loopback1
 no ip address
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:2:2::1/64
 ipv6 eigrp 68
interface Tunnell1
 bandwidth 4000
 no ip address
 ipv6 address FE80::2002 link-local
 ipv6 address 2001:DB8:CAFE:100::2/64
 ipv6 mtu 1380
 ipv6 tcp adjust-mss 1360
 ipv6 eigrp 68
 no ipv6 split-horizon eigrp 68
 ipv6 nhrp authentication NHRPauth
 ipv6 nhrp network-id 1
 ipv6 nhrp nhs 2001:DB8:CAFE:100::1 nbma 2001:DB8:ACAD:1::1 multicast
 ipv6 nhrp map multicast dynamic
 ipv6 nhrp shortcut
```


Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
tunnel source Loopback0
tunnel mode gre multipoint ipv6
tunnel key 999
tunnel path-mtu-discovery
interface GigabitEthernet0/0/1
no ip address
negotiation auto
ipv6 address FE80::2 link-local
ipv6 address 2001:DB8:ACAD:2::2/64
ipv6 eigrp 168
no shutdown
no ipv6 route ::/0 2001:db8:acad:2::1
ipv6 router eigrp 68
eigrp router-id 2.2.2.2
ipv6 router eigrp 168
eigrp router-id 20.1.1.1
banner motd ^C R2, Implement DMVPN Spoke 1 ^C
line con 0
exec-timeout 0 0
logging synchronous
transport input none
stopbits 1
line vty 0 4
exec-timeout 0 0
privilege level 15
password cisco123
logging synchronous
login
end
```

Router R3

```
enable
configure terminal
hostname R3
no ip domain lookup
ipv6 unicast-routing
interface Loopback0
no ip address
ipv6 address FE80::3 link-local
ipv6 address 2001:DB8:3:1::1/64
ipv6 eigrp 168
interface Loopback1
no ip address
ipv6 address FE80::3 link-local
ipv6 address 2001:DB8:3:2::1/64
ipv6 eigrp 68
interface Tunnel1
bandwidth 4000
no ip address
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
ipv6 address FE80::2003 link-local
ipv6 address 2001:DB8:CAFE:100::3/64
ipv6 mtu 1380
ipv6 tcp adjust-mss 1360
ipv6 eigrp 68
no ipv6 split-horizon eigrp 68
ipv6 nhrp authentication NHRPauth
ipv6 nhrp network-id 1
ipv6 nhrp nhs 2001:DB8:CAFE:100::1 nbma 2001:DB8:ACAD:1::1 multicast
ipv6 nhrp map multicast dynamic
ipv6 nhrp shortcut
tunnel source Loopback0
tunnel mode gre multipoint ipv6
tunnel key 999
tunnel path-mtu-discovery
interface GigabitEthernet0/0/0
no ip address
negotiation auto
interface GigabitEthernet0/0/1
no ip address
negotiation auto
ipv6 address FE80::3 link-local
ipv6 address 2001:DB8:ACAD:3::2/64
ipv6 eigrp 168
no ipv6 route ::/0 2001:db8:acad:3::1
ipv6 router eigrp 68
eigrp router-id 3.3.3.3
ipv6 router eigrp 168
eigrp router-id 30.3.3.3
banner motd ^C R3, Implement DMVPN Spoke 2 ^C
line con 0
exec-timeout 0 0
logging synchronous
transport input none
stopbits 1
line vty 0 4
exec-timeout 0 0
privilege level 15
password cisco123
logging synchronous
login
end
```

Layer 3 Switch DMVPN

```
enable
configure terminal
hostname DMVPN
ip routing
no ip domain lookup
```

Lab - Implement an IPv6 DMVPN Phase 3 Spoke-to-Spoke Topology

```
ipv6 unicast-routing
interface GigabitEthernet1/0/11
 no switchport
 no ip address
 ipv6 address FE80::4 link-local
 ipv6 address 2001:DB8:ACAD:1::2/64
 ipv6 eigrp 168
interface GigabitEthernet1/0/12
 no switchport
 no ip address
 ipv6 address FE80::4 link-local
 ipv6 address 2001:DB8:ACAD:2::1/64
 ipv6 eigrp 168
interface GigabitEthernet1/0/13
 no switchport
 no ip address
 ipv6 address FE80::4 link-local
 ipv6 address 2001:DB8:ACAD:3::1/64
 ipv6 eigrp 168
no ipv6 route 2001:db8:2:1::/64 2001:db8:acad:2::2
no ipv6 route 2001:db8:2:2::/64 2001:db8:acad:2::2
no ipv6 route 2001:db8:3:1::/64 2001:db8:acad:3::2
no ipv6 route 2001:db8:3:2::/64 2001:db8:acad:3::2
ipv6 router eigrp 168
 eigrp router-id 40.4.4.4
!
banner motd ^C DMVPN, DMVPN cloud switch ^C
!
line con 0
 exec-timeout 0 0
 logging synchronous
 stopbits 1
line vty 0 4
 exec-timeout 0 0
 privilege level 15
 password cisco123
 logging synchronous
 login
line vty 5 15
 login
!
end
```