CCIE Service Provider v3.0 Sample Lab

Part 3/7

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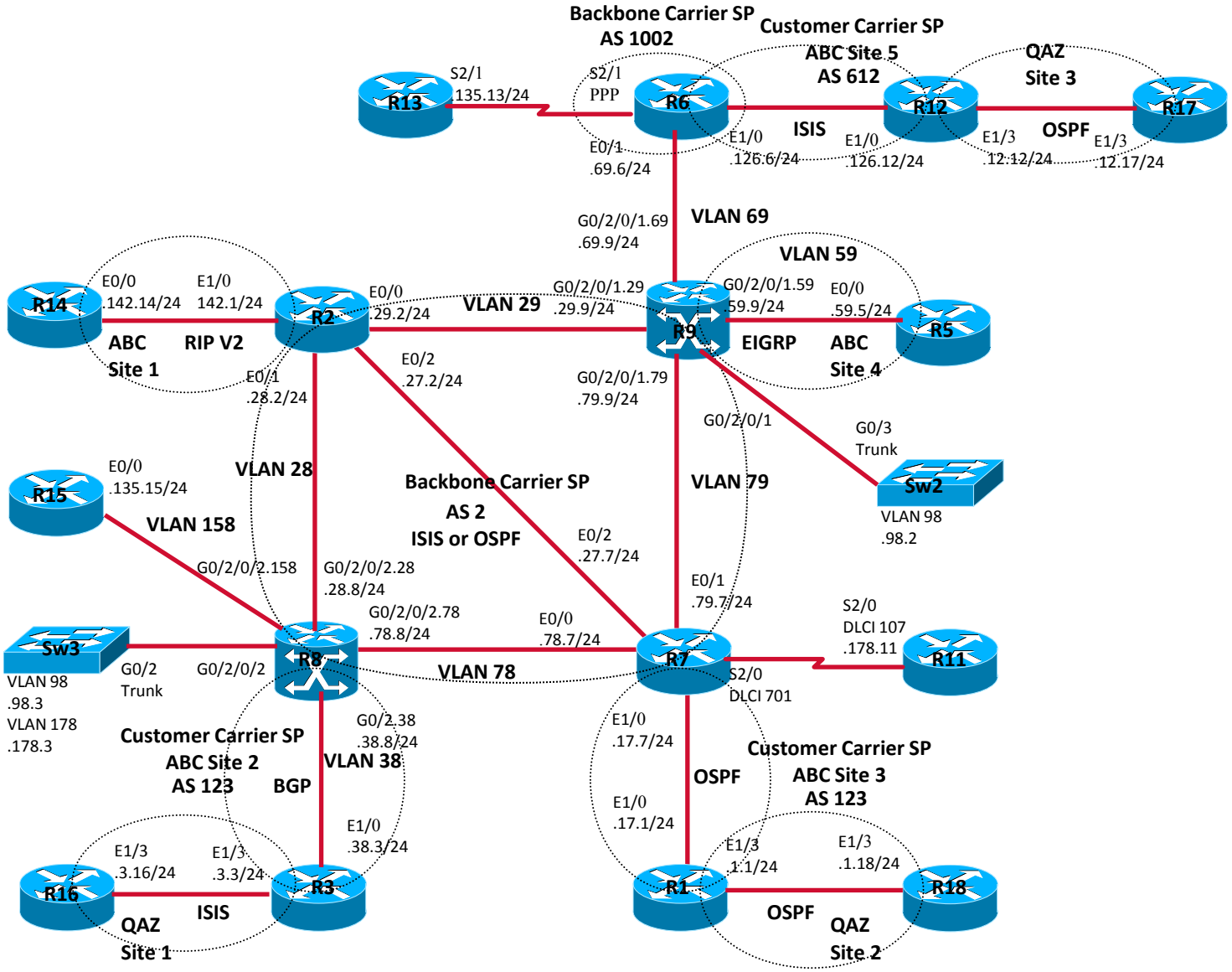
Cisco Systems

SP Sample Lab – Main Topology



SP Sample Lab – Addressing Scheme

- Backbone Carrier SP network Prefix: 2.2.0.0/24, 2002:2:2::/64
- Backbone Carrier SP router Loopback0: 2.2.0.Z/32, 2002:2:2::Z/128
- Customer Carrier SP/VPN network Prefix: 172.2.0.0/24, 2002:172:2::/64
- Customer Carrier SP/VPN router Loopback0: 172.2.0.Z/32, 2002:172:2::Z/128
- End Customer VPN network Prefix: 192.2.0.0/24
- End Customer VPN router Loopback0: 192.2.0.Z/32
- L2 VPN Customer network Prefix: 172.2.0.0/24
- L2 VPN Customer router Loopback0: 172.2.0.Z/32

“Z” is router number, for example “Z” value for R12 is “12”

SP Sample Lab – Setup

- Hardware

  Two XR-12404 with two GigabitEthernet interfaces or equivalent

  Thirteen Cisco 7200 series routers with Ethernet interfaces or equivalent

  Three Cisco 3560G series or equivalent

- Software Operating System

  XR12000-iosxr-k9-3.9.1.tar

  c7200-spservices-mz.122-33.SRE2.bin

  c3560-advipservicesk9-mz.122-46.SE.bin

SP Sample Lab Questions

	Question, Configuration and Verification
1	IS-IS IPv4/IPv6
2	OSPF IPv4/IPv6
3	BGP unicast IPv4/IPv6
4	MPLS LDP
5	MPLS TE
6	MPLS TE FRR
7	MP-BGP intra-AS VPNv4
8	MP-BGP inter-AS VPNv4
9	CSC
10	MP-BGP VPNv6 - 6VPE
11	Multicast VPN
12	AToM
13	VPLS
14	L2TPv3

MPLS VPN Terminology

- LSR: Label switch router
- LSP: Label switched path
  - The chain of labels that are swapped at each hop to get from one LSR to another
- VRF: VPN routing and forwarding
  - Mechanism in Cisco IOS® used to build per-interface RIB and FIB
- MP-BGP: Multiprotocol BGP
- PE: Provider edge router interfaces with CE routers
- P: Provider (core) router, without knowledge of VPN
- VPNv4: Address family used in BGP to carry MPLS-VPN routes
- RD: Route distinguisher
  - Distinguish same network/mask prefix in different VRFs
- RT: Route target
  - Extended community attribute used to control import and export policies of VPN routes
- LFIB: Label forwarding information base
- FIB: Forwarding information base

Mapping to Lab Exam Blueprint

- This question of the sample lab maps to following sections/sub-sections in the Lab Exam Blueprint document below;

  https://learningnetwork.cisco.com/docs/DOC-9991

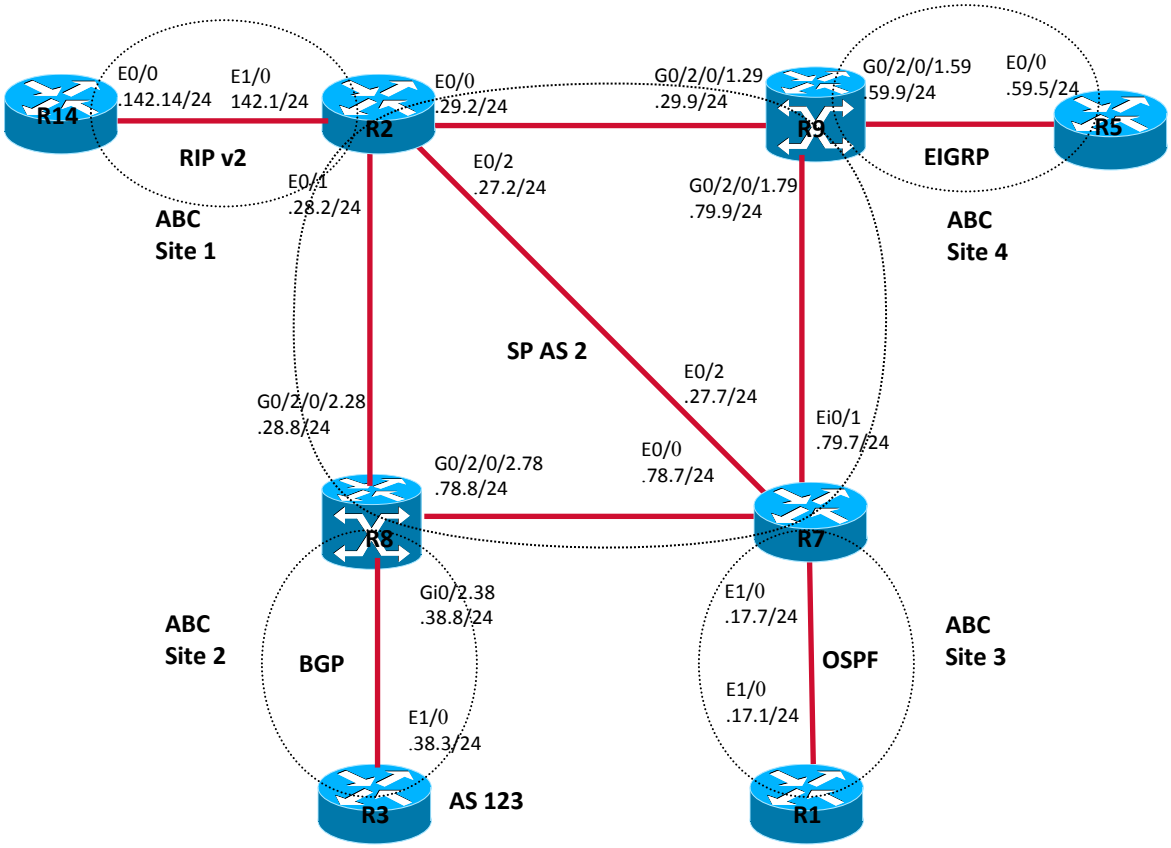
  3.0 – Implement, Optimize and Troubleshoot L3VPN Technologies

    3.1 – Implement, Optimize and Troubleshoot Intra-AS L3VPN

- For more details, please review the Lab Exam Checklist document below;

  https://learningnetwork.cisco.com/docs/DOC-10145

MP-BGP Intra-AS VPNv4 – Sub Topology and Question



- Configure BGP VPNv4 on R2, R7, R8 and R9, configure R9 as VPNv4 Route-reflector for R2, R7 and R8
- Configure ABC sites router R14, R3, R1 and R5, ensure the Four sites can ping each other

MP-BGP VPNv4 Configuration

R2 (IOS) configuration

```
vrf definition ABC
 rd 2:2
 !
 address-family ipv4
 route-target export 2:2
 route-target import 2:2
!
interface Ethernet0/0
 ip address 2.2.29.2 255.255.255.0
 mpls ip
!
interface Ethernet0/1
 ip address 2.2.28.2 255.255.255.0
 mpls ip
!
interface Ethernet0/2
 ip address 2.2.27.2 255.255.255.0
 mpls ip
!
interface Ethernet1/0
 vrf forwarding ABC
 ip address 172.2.142.2 255.255.255.0
```

```
router rip
 version 2
 !
 address-family ipv4 vrf ABC
  redistribute bgp 2 metric 1
  network 172.2.0.0
  version 2
 exit-address-family
!
router bgp 2
 neighbor 2.2.0.9 remote-as 2
 neighbor 2.2.0.9 update-source Loopback0
 !
 address-family vpnv4
  neighbor 2.2.0.9 activate
  neighbor 2.2.0.9 send-community extended
  neighbor 2.2.0.9 next-hop-self
 !
 address-family ipv4 vrf ABC
  no synchronization
  redistribute rip
 exit-address-family
 !
```

MP-BGP VPNv4 Configuration (Cont.)

R7 (IOS) configuration

```
vrf definition ABC
 rd 2:2
 !
 address-family ipv4
 route-target export 2:2
 route-target import 2:2
!
interface Ethernet0/0
 ip address 2.2.78.7 255.255.255.0
 mpls ip
!
interface Ethernet0/1
 ip address 2.2.79.7 255.255.255.0
 mpls ip
!
interface Ethernet0/2
 ip address 2.2.27.7 255.255.255.0
 mpls ip
!
interface Ethernet1/0
 vrf forwarding ABC
 ip address 172.2.17.7 255.255.255.0
```

```
router ospf 100 vrf ABC
 redistribute bgp 2 subnets
 network 172.2.0.0 0.0.255.255 area 0
!
router bgp 2
 neighbor 2.2.0.9 remote-as 2
 neighbor 2.2.0.9 update-source Loopback0
 !
 address-family vpnv4
  neighbor 2.2.0.9 activate
  neighbor 2.2.0.9 send-community extended
 exit-address-family
 !
 address-family ipv4 vrf ABC
  no synchronization
  redistribute ospf 100 vrf ABC
 exit-address-family
 !
```

MP-BGP VPNv4 Configuration (Cont.)

R8 (IOS-XR) configuration

```
interface GigabitEthernet0/2/0/2.28
 ipv4 address 2.2.28.8 255.255.255.0
 dot1q vlan 28
!
interface GigabitEthernet0/2/0/2.78
 ipv4 address 2.2.78.8 255.255.255.0
 dot1q vlan 78
!
interface GigabitEthernet0/2/0/2.38
 vrf ABC
 ipv4 address 172.2.38.8 255.255.255.0
 dot1q vlan 38
!
router bgp 2
 address-family vpnv4 unicast
 !
 neighbor 2.2.0.9
  remote-as 2
  update-source Loopback0
  !
  address-family vpnv4 unicast
  !
 vrf ABC
  rd 2:2
  address-family ipv4 unicast
  allocate-label all
  !
  neighbor 172.2.38.3
   remote-as 123
   address-family ipv4 labeled-unicast
    route-policy default_policy_pass_all in
    route-policy default_policy_pass_all out
    as-override
    send-extended-community-ebgp
   !
mpls ldp
 router-id 2.2.0.8
 interface GigabitEthernet0/2/0/2.28
 !
 interface GigabitEthernet0/2/0/2.78
 !
!
vrf ABC
 address-family ipv4 unicast
  import route-target
   2:2
!
  export route-target
   2:2
```

MP-BGP VPNv4 Configuration (Cont.)

R9 (IOS-XR) configuration

```
vrf ABC
 address-family ipv4 unicast
  import route-target
   2:2
  !
  export route-target
   2:2
  !
interface GigabitEthernet0/2/0/1.29
 ipv4 address 2.2.29.9 255.255.255.0
 dot1q vlan 29
!
interface GigabitEthernet0/2/0/1.59
 vrf ABC
 ipv4 address 172.2.59.9 255.255.255.0
 dot1q vlan 59
!
interface GigabitEthernet0/2/0/1.79
 ipv4 address 2.2.79.9 255.255.255.0
 dot1q vlan 79
!
```

```
router bgp 2
 address-family vpnv4 unicast
 !
 neighbor 2.2.0.2
  remote-as 2
  update-source Loopback0
  address-family vpnv4 unicast
   route-reflector-client
!
 neighbor 2.2.0.7
  remote-as 2
  update-source Loopback0
  address-family vpnv4 unicast
   route-reflector-client
!
 neighbor 2.2.0.8
  remote-as 2
  update-source Loopback0
  address-family vpnv4 unicast
   route-reflector-client
 !
 vrf ABC
  rd 2:2
  address-family ipv4 unicast
   redistribute eigrp 100
  !
```

```
mpls ldp
 router-id 2.2.0.9
 !
 interface GigabitEthernet0/2/0/1.29
 !
 interface GigabitEthernet0/2/0/1.79
 !
router eigrp 100
 vrf ABC
  address-family ipv4
   default-metric 100000 10 250 1 1500
   autonomous-system 100
   redistribute bgp 2
   interface GigabitEthernet0/2/0/1.59
   !
!
```

MP-BGP VPNv4 Configuration (Cont.)

R14 configuration

```
interface Loopback0
 ip address 172.2.0.14 255.255.255.255
!
interface Ethernet0/0
 ip address 172.2.142.14 255.255.255.0
!
router rip
 version 2
 network 172.2.0.0
```

R1 configuration

```
interface Loopback0
 ip address 172.2.0.1 255.255.255.255
!
interface Ethernet1/0
 ip address 172.2.17.1 255.255.255.0
!
router ospf 100
 network 172.2.0.1 0.0.0.0 area 0
 network 172.2.17.1 0.0.0.0 area 0
```

R3 configuration

```
interface Loopback0
 ip address 172.2.0.3 255.255.255.255
!
interface Ethernet1/0
 ip address 172.2.38.3 255.255.255.0
!
router bgp 123
neighbor 172.2.38.8 remote-as 2
!
 address-family ipv4
 network 172.2.0.3 mask 255.255.255.255
  neighbor 172.2.38.8 activate
```

R5 configuration

```
interface Loopback0
 ip address 172.2.0.5 255.255.255.255
!
interface Ethernet0/0
 ip address 172.2.59.5 255.255.255.0
!
router eigrp 100
 network 172.2.0.5 0.0.0.0
 network 172.2.59.0 0.0.0.255
```

MP-BGP VPNv4 Adjacency

```
RP/0/0/CPU0:R9#show bgp vpnv4 unicast summary
BGP router identifier 2.2.0.9, local AS number 2
Neighbor        Spk    AS MsgRcvd MsgSent   TblVer  InQ OutQ  Up/Down  St/PfxRcd
2.2.0.2           0     2  111048  108531    13904    0    0    4d02h        18
2.2.0.7           0     2  109794  104739    13904    0    0    4d01h         2
2.2.0.8           0     2   99301  108712    13904    0    0    4d02h         3

R2#show ip bgp vpnv4 all summary
BGP router identifier 2.2.0.2, local AS number 2
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
2.2.0.9         4     2     185     183       29    0    0 02:28:55       10

R7#show ip bgp vpnv4 all summary
BGP router identifier 2.2.0.7, local AS number 2
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
2.2.0.9         4     2     181     177       31    0    0 02:33:17       12

RP/0/0/CPU0:R8#show bgp vpnv4 unicast summary
BGP router identifier 2.2.0.8, local AS number 2
Neighbor        Spk    AS MsgRcvd MsgSent   TblVer  InQ OutQ  Up/Down  St/PfxRcd
2.2.0.9           0     2  116418  107553    10590    0    0 03:44:31        11
```

MP-BGP VPNv4 table

R8 VPN table

```
RP/0/0/CPU0:R8#show bgp vpnv4 unicast vrf ABC
Route Distinguisher: 2:2 (default for vrf ABC)
*>i172.2.0.1/32      2.2.0.7            15    100      0 ?
*> 172.2.0.3/32      172.2.38.3          0             0 123 i
*>i172.2.0.5/32      2.2.0.9        130816    200      0 ?
*>i172.2.0.14/32     2.2.0.2             1    100      0 ?
*>i172.2.17.0/24     2.2.0.7            15    100      0 ?
*> 172.2.38.0/24     0.0.0.0             0          32768 ?
*>i172.2.59.0/24     2.2.0.9             0    200      0 ?
*>i172.2.142.0/24    2.2.0.2             0    100      0 ?
```

R9 VPN table

```
RP/0/0/CPU0:R9#show bgp vpnv4 unicast vrf ABC
*>i172.2.0.1/32      2.2.0.7            15    100      0 ?
*>i172.2.0.3/32      2.2.0.8             0    100      0 123 i
*> 172.2.0.5/32      172.2.59.5     130816          32768 ?
*>i172.2.0.14/32     2.2.0.2             1    100      0 ?
*>i172.2.17.0/24     2.2.0.7            15    100      0 ?
*>i172.2.38.0/24     2.2.0.8             0    100      0 ?
*> 172.2.59.0/24     0.0.0.0             0  32768      ?
*>i172.2.142.0/24    2.2.0.2             0    100      0 ?
```

MP-BGP VPNv4 table (Cont.)

R2 VPN table

```
R2#show ip bgp vpnv4 vrf ABC
Route Distinguisher: 2:2 (default for vrf ABC)
*>i172.2.0.1/32    2.2.0.7            15    100     0 ?
*>i172.2.0.3/32    2.2.0.8             0    100     0 123 i
*>i172.2.0.5/32    2.2.0.9        130816    200     0 ?
*> 172.2.0.14/32   172.2.142.14            1       32768 ?
*>i172.2.17.0/24   2.2.0.7            15    100     0 ?
*>i172.2.38.0/24   2.2.0.8             0    100     0 ?
*>i172.2.59.0/24   2.2.0.9             0    200     0 ?
*> 172.2.142.0/24  0.0.0.0              0       32768 ?
```

R7 VPN table

```
R7#show ip bgp vpnv4 vrf ABC
*> 172.2.0.1/32    172.2.17.1             15       32768 ?
*>i172.2.0.3/32    2.2.0.8             0    100     0 123 i
*>i172.2.0.5/32    2.2.0.9        130816    200     0 ?
*>i172.2.0.14/32   2.2.0.2             1    100     0 ?
*> 172.2.17.0/24   0.0.0.0            15       32768 ?
*>i172.2.38.0/24   2.2.0.8             0    100     0 ?
*>i172.2.59.0/24   2.2.0.9             0    200     0 ?
*>i172.2.142.0/24  2.2.0.2              0    100     0 ?
```

MPLS VPNv4 routes

R14 and R3 route

```
R14#show ip route rip
R       172.2.0.1/32 [120/1] via 172.2.142.2, 00:00:12, Ethernet0/0
R       172.2.0.3/32 [120/1] via 172.2.142.2, 00:00:12, Ethernet0/0
R       172.2.0.5/32 [120/1] via 172.2.142.2, 00:00:12, Ethernet0/0
R       172.2.17.0/24 [120/1] via 172.2.142.2, 00:00:19, Ethernet0/0
R       172.2.38.0/24 [120/1] via 172.2.142.2, 00:00:19, Ethernet0/0
R       172.2.59.0/24 [120/1] via 172.2.142.2, 00:00:19, Ethernet0/0

R3#show ip route bgp
B       172.2.0.1/32 [20/0] via 172.2.38.8, 01:29:23
B       172.2.0.5/32 [20/0] via 172.2.38.8, 01:26:09
B       172.2.0.14/32 [20/0] via 172.2.38.8, 01:02:08
B       172.2.17.0/24 [20/0] via 172.2.38.8, 01:41:59
B       172.2.59.0/24 [20/0] via 172.2.38.8, 01:38:45
B       172.2.142.0/24 [20/0] via 172.2.38.8, 01:16:00
```

MP-BGP VPNv4 routes (Cont.)

R1 and R5 routes

```
R1#show ip route ospf
O E2    172.2.0.3/32 [110/1] via 172.2.17.7, 01:30:15, Ethernet1/0
O E2    172.2.0.5/32 [110/130816] via 172.2.17.7, 01:27:00, Ethernet1/0
O E2    172.2.0.14/32 [110/1] via 172.2.17.7, 01:02:54, Ethernet1/0
O E2    172.2.38.0/24 [110/1] via 172.2.17.7, 01:40:49, Ethernet1/0
O E2    172.2.59.0/24 [110/1] via 172.2.17.7, 01:40:49, Ethernet1/0
O E2    172.2.142.0/24 [110/1] via 172.2.17.7, 01:14:43, Ethernet1/0

R5#show ip route eigrp
D EX    172.2.0.1/32 [170/284160] via 172.2.59.9, 01:27:05, Ethernet0/0
D EX    172.2.0.3/32 [170/284160] via 172.2.59.9, 01:27:05, Ethernet0/0
D EX    172.2.0.14/32 [170/284160] via 172.2.59.9, 01:03:55, Ethernet0/0
D EX    172.2.17.0/24 [170/284160] via 172.2.59.9, 01:38:43, Ethernet0/0
D EX    172.2.38.0/24 [170/284160] via 172.2.59.9, 01:38:43, Ethernet0/0
D EX    172.2.142.0/24 [170/284160] via 172.2.59.9, 01:16:48, Ethernet0/0
```

MP-BGP VPNv4 routes (Cont.)

R2 and R7 VRF ABC routes

```
R2#show ip route vrf ABC
B       172.2.0.1/32 [200/15] via 2.2.0.7, 01:56:52
B       172.2.0.3/32 [200/0] via 2.2.0.8, 4d01h
B       172.2.0.5/32 [200/130816] via 2.2.0.9, 01:53:36
R       172.2.0.14/32 [120/1] via 172.2.142.14, 00:00:19, Ethernet1/0
B       172.2.17.0/24 [200/15] via 2.2.0.7, 01:57:00
B       172.2.38.0/24 [200/0] via 2.2.0.8, 4d01h
B       172.2.59.0/24 [200/0] via 2.2.0.9, 01:53:45
C       172.2.142.0/24 is directly connected, Ethernet1/0
L       172.2.142.2/32 is directly connected, Ethernet1/0

R7#show ip route vrf ABC
O       172.2.0.1/32 [110/11] via 172.2.17.1, 01:58:04, Ethernet1/0
B       172.2.0.3/32 [200/0] via 2.2.0.8, 01:58:04
B       172.2.0.5/32 [200/130816] via 2.2.0.9, 01:54:41
B       172.2.0.14/32 [200/1] via 2.2.0.2, 01:30:35
C       172.2.17.0/24 is directly connected, Ethernet1/0
L       172.2.17.7/32 is directly connected, Ethernet1/0
B       172.2.38.0/24 [200/0] via 2.2.0.8, 01:58:04
B       172.2.59.0/24 [200/0] via 2.2.0.9, 01:54:53
B       172.2.142.0/24 [200/0] via 2.2.0.2, 01:31:53
```

MP-BGP VPNv4 routes (Cont.)

R8 and R9 VRF ABC routes

```
RP/0/0/CPU0:R8#show route vrf ABC ipv4
B    172.2.0.1/32 [200/15] via 2.2.0.7 (nexthop in vrf default), 01:59:19
B    172.2.0.3/32 [20/0] via 172.2.38.3, 4d03h
B    172.2.0.5/32 [200/130816] via 2.2.0.9 (nexthop in vrf default), 01:56:05
B    172.2.0.14/32 [200/1] via 2.2.0.2 (nexthop in vrf default), 01:32:04
B    172.2.17.0/24 [200/15] via 2.2.0.7 (nexthop in vrf default), 01:59:19
C    172.2.38.0/24 is directly connected, 8w4d, GigabitEthernet0/2/0/2.38
L    172.2.38.8/32 is directly connected, 8w4d, GigabitEthernet0/2/0/2.38
B    172.2.59.0/24 [200/0] via 2.2.0.9 (nexthop in vrf default), 01:56:05
B    172.2.124.0/24 [200/0] via 2.2.0.9 (nexthop in vrf default), 2d06h

RP/0/0/CPU0:R9#show route vrf ABC ipv4
B    172.2.0.1/32 [200/15] via 2.2.0.7 (nexthop in vrf default), 02:00:34
B    172.2.0.3/32 [200/0] via 2.2.0.8 (nexthop in vrf default), 4d01h
D    172.2.0.5/32 [90/130816] via 172.2.59.5, 01:59:03, GigabitEthernet0/2/0/1.59
B    172.2.0.14/32 [200/1] via 2.2.0.2 (nexthop in vrf default), 01:33:20
B    172.2.17.0/24 [200/15] via 2.2.0.7 (nexthop in vrf default), 02:00:34
B    172.2.38.0/24 [200/0] via 2.2.0.8 (nexthop in vrf default), 4d01h
C    172.2.59.0/24 is directly connected, 10w0d, GigabitEthernet0/2/0/1.59
L    172.2.59.9/32 is directly connected, 10w0d, GigabitEthernet0/2/0/1.59
B    172.2.142.0/24 [200/0] via 2.2.0.2 (nexthop in vrf default), 01:34:35
```

MP-BGP VPNv4 connection verification

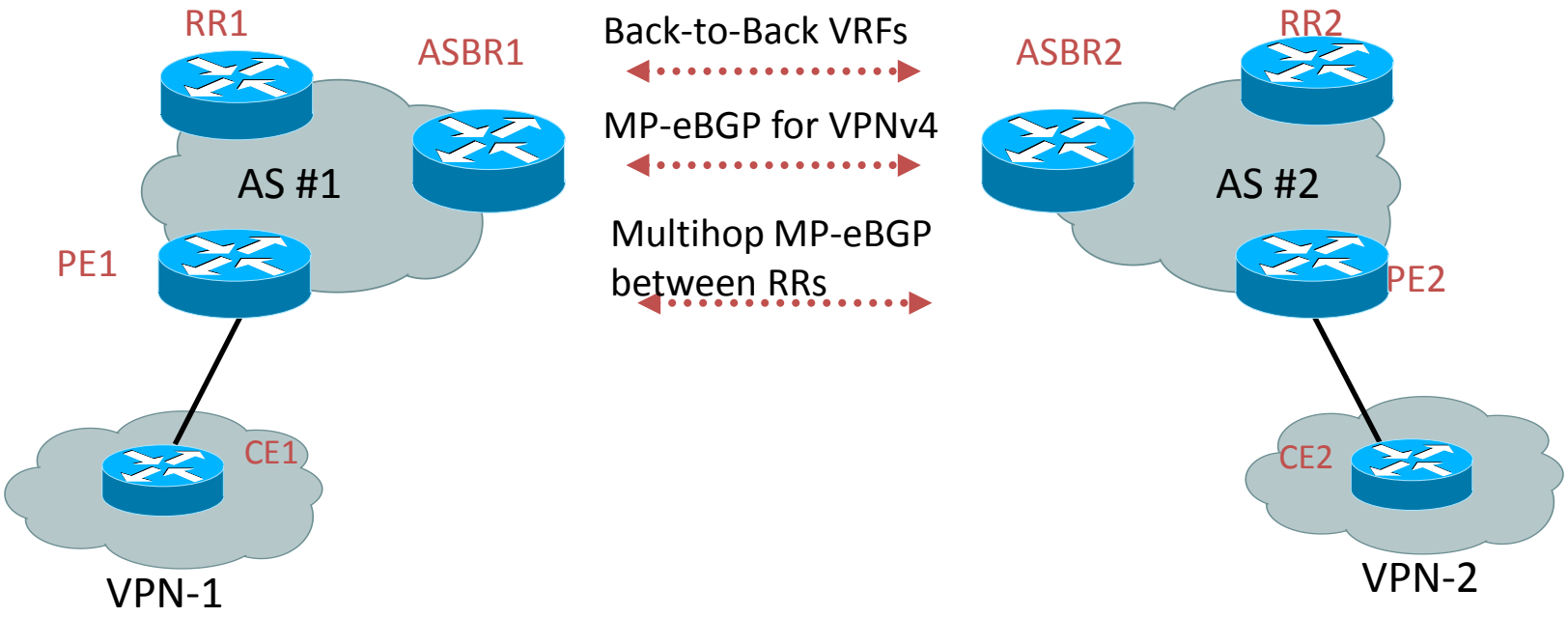
```
R1#ping 172.2.0.3 source loopback 0
Sending 5, 100-byte ICMP Echos to 172.2.0.3, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/19/20 ms

R1#ping 172.2.0.5 source loopback 0
Sending 5, 100-byte ICMP Echos to 172.2.0.5, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/20/24 ms

R1#ping 172.2.0.14 source loopback 0
Sending 5, 100-byte ICMP Echos to 172.2.0.14, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

R3#ping 172.2.0.5 source loopback 0
Sending 5, 100-byte ICMP Echos to 172.2.0.5, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/40/44 ms
```

MP-BGP Inter-AS VPNv4 Distribution Options



VPN Sites Attached to Different MPLS VPN Service Providers

Mapping to Lab Exam Blueprint

- This question of the sample lab maps to following sections/sub-sections in the Lab Exam Blueprint document below;

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  3.0 – Implement, Optimize and Troubleshoot L3VPN Technologies

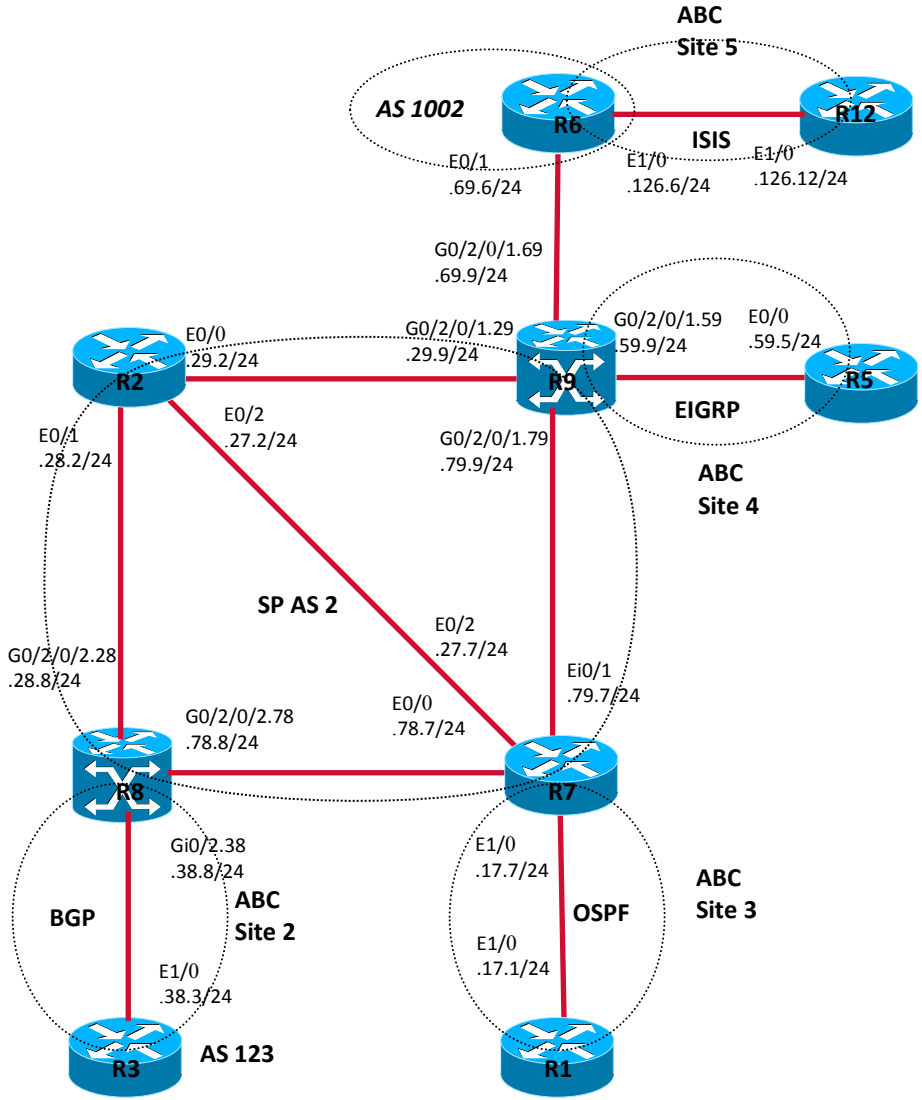
    3.2 – Implement, Optimize and Troubleshoot Inter-AS L3VPN

- For more details, please review the Lab Exam Checklist document below;

  https://learningnetwork.cisco.com/docs/DOC-10145

MP-BGP Inter-AS VPNv4 – Sub Topology and Question

- Configure Inter-AS BGP VPNv4 unicast on R6 and R9, ensure they can exchange VPNv4 unicast information
- Configure VPN site 2, 3, 4 and 5. Ensure these sites have full reach ability between each other
- You are permitted to define static host route on R9



MP-BGP VPNv4 Configuration

R6 (IOS) configuration

```
vrf definition ABC
 rd 1002:2
 !
 address-family ipv4
 route-target export 1002:2
 route-target import 1002:2
 route-target import 2:2
!
interface Ethernet0/1
 ip address 2.2.69.6 255.255.255.0
!
interface Ethernet1/0
 vrf forwarding ABC
 ip address 172.2.126.6 255.255.255.0
!
router isis ABC
 vrf ABC
 net 47.0172.0000.0000.0006.00
 metric-style wide
 redistribute bgp 1002
!
```

```
router bgp 1002
 no bgp default route-target filter
 neighbor 2.2.69.9 remote-as 2
!
 address-family vpnv4
  neighbor 2.2.69.9 activate
  neighbor 2.2.69.9 send-community extended
 exit-address-family
!
 address-family ipv4 vrf ABC
  no synchronization
  redistribute isis ABC level-1-2
 exit-address-family
```

MP-BGP VPNv4 Configuration (Cont.)

R9 (IOS-XR) configuration

```
vrf ABC
 address-family ipv4 unicast
  import route-target
   2:2
   1002:2
  !
  export route-target
   2:2
  !
 !
router bgp 2
 address-family vpnv4 unicast
  !
 neighbor 2.2.69.6
  remote-as 1002
  address-family vpnv4 unicast
   route-policy default_policy_pass_all in
   route-policy default_policy_pass_all out
  !
```

```
vrf ABC
  rd 2:2
  address-family ipv4 unicast
   redistribute eigrp 100
  !
router eigrp 100
 vrf ABC
  address-family ipv4
   default-metric 100000 10 250 1 1500
   autonomous-system 100
   redistribute bgp 2
   interface GigabitEthernet0/2/0/1.59
   !
router static
 address-family ipv4 unicast
  2.2.69.6/32 GigabitEthernet0/2/0/1.69
!
```

Note: IOS-XR does not automatically learn directly connected host route, static host route request to ensure MPLS forwarding

MP-BGP VPNv4 Configuration (Cont.)

R12 configuration

```
interface Loopback0
 ip address 172.2.0.12 255.255.255.255
 ip router isis
!
interface Ethernet1/0
 ip address 172.2.126.12 255.255.255.0
 ip pim sparse-mode
 ip router isis
!
router isis
 net 47.0172.0000.0000.0012.00
 metric-style wide
!
```

R2 and R7 configuration

```
vrf definition ABC
 rd 2:2
 !
 address-family ipv4
 route-target export 2:2
 route-target import 2:2
 route-target import 1002:2
 exit-address-family
 !
```

R8 configuration

```
vrf ABC
 address-family ipv4 unicast
  import route-target
   2:2
   1002:2
  !
  export route-target
   2:2
  !
```

MP-BGP VPNv4 Adjacency

R9 VPNv4 neighbor

```
RP/0/0/CPU0:R9#show bgp vpnv4 unicast summary
BGP router identifier 2.2.0.9, local AS number 2
Neighbor        Spk    AS MsgRcvd MsgSent   TblVer  InQ OutQ  Up/Down  St/PfxRcd
2.2.0.2         0     2  111048  108531    13904    0    0    4d02h       18
2.2.0.7         0     2  109794  104739    13904    0    0    4d01h        2
2.2.0.8         0     2   99301  108712    13904    0    0    4d02h        3
2.2.69.6        0  1002  112963  104627    13918    0    0    2d22h        2
```

R6 VPNv4 neighbor

```
R6#show ip bgp vpnv4 all summary
BGP router identifier 2.2.0.6, local AS number 1002
BGP table version is 158, main routing table version 158

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
2.2.69.9        4     2    4245    4658      158    0    0 2d22h        26
```

MP-BGP VPNv4 table

R6 VPNv4 table

```
R6#show ip bgp vpnv4 vrf ABC
BGP table version is 158, local router ID is 2.2.0.6
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? – incomplete
   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 1002:2 (default for vrf ABC)
*> 172.2.0.1/32     2.2.69.9                 0             0 2 ?
*> 172.2.0.3/32     2.2.69.9                 0             0 2 123 i
*> 172.2.0.5/32     2.2.69.9            130816             0 2 ?
*> 172.2.0.12/32    172.2.126.12            20         32768 ?
*> 172.2.17.0/24    2.2.69.9                 0             0 2 ?
*> 172.2.38.0/24    2.2.69.9                 0             0 2 ?
*> 172.2.59.0/24    2.2.69.9                 0             0 2 ?
*> 172.2.126.0/24   0.0.0.0                  0         32768 ?
```

MP-BGP VPNv4 table (Cont.)

R9 VPNv4 table

```
RP/0/0/CPU0:R9#show bgp vpnv4 unicast vrf ABC
BGP router identifier 2.2.0.9, local AS number 2
BGP generic scan interval 60 secs
Status codes: s suppressed, d damped, h history, * valid, > best
              i - internal, S stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop          Metric LocPrf Weight Path
Route Distinguisher: 2:2 (default for vrf ABC)
*>i172.2.0.1/32     2.2.0.7                15    100      0 ?
*>i172.2.0.3/32     2.2.0.8                 0    100      0 123 i
*> 172.2.0.5/32     172.2.59.5         130816        32768 ?
*> 172.2.0.12/32    2.2.69.6               20             0 1002 ?
*>i172.2.17.0/24    2.2.0.7                15    100      0 ?
*>i172.2.38.0/24    2.2.0.8                 0    100      0 ?
*> 172.2.59.0/24    0.0.0.0                 0    32768    ?
*> 172.2.126.0/24   2.2.69.6                  0           0 1002 ?
```

MP-BGP VPNv4 table (Cont.)

R7 VPNv4 table

```
R7#show ip bgp vpnv4 vrf ABC
BGP table version is 342, local router ID is 2.2.0.7
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 2:2 (default for vrf ABC)
*> 172.2.0.1/32     172.2.17.1               15         32768 ?
*>i172.2.0.3/32     2.2.0.8                   0    100      0 123 i
*>i172.2.0.5/32     2.2.0.9              130816    200      0 ?
*>i172.2.0.12/32    2.2.0.9                  20    200      0 1002 ?
*> 172.2.17.0/24    0.0.0.0                  15         32768 ?
*>i172.2.38.0/24    2.2.0.8                   0    100      0 ?
*>i172.2.59.0/24    2.2.0.9                   0    200      0 ?
*>i172.2.126.0/24   2.2.0.9                   0    200      0 1002 ?
```

VPNv4 routes

R12 and R5 route

```
R12#show ip route isis

i L2    172.2.0.1/32 [115/10] via 172.2.126.6, Ethernet1/0
i L2    172.2.0.3/32 [115/10] via 172.2.126.6, Ethernet1/0
i L2    172.2.0.5/32 [115/10] via 172.2.126.6, Ethernet1/0
i L2    172.2.17.0/24 [115/10] via 172.2.126.6, Ethernet1/0
i L2    172.2.38.0/24 [115/10] via 172.2.126.6, Ethernet1/0
i L2    172.2.59.0/24 [115/10] via 172.2.126.6, Ethernet1/0

R5#show ip route eigrp

D EX    172.2.0.1/32 [170/284160] via 172.2.59.9, 17:31:10, Ethernet0/0
D EX    172.2.0.3/32 [170/284160] via 172.2.59.9, 17:31:10, Ethernet0/0
D EX    172.2.0.12/32 [170/284160] via 172.2.59.9, 00:40:57, Ethernet0/0
D EX    172.2.17.0/24 [170/284160] via 172.2.59.9, 17:31:10, Ethernet0/0
D EX    172.2.38.0/24 [170/284160] via 172.2.59.9, 17:31:10, Ethernet0/0
D EX    172.2.126.0/24 [170/284160] via 172.2.59.9, 00:41:27, Ethernet0/0
```

VPNv4 routes (Cont.)

R1 and R3 routes

R1#show ip route ospf

O E2 172.2.0.3/32 [110/1] via 172.2.17.7, 17:35:44, Ethernet1/0
O E2 172.2.0.5/32 [110/130816] via 172.2.17.7, 17:32:29, Ethernet1/0
O E2 172.2.0.12/32 [110/20] via 172.2.17.7, 00:41:31, Ethernet1/0
O E2 172.2.38.0/24 [110/1] via 172.2.17.7, 17:35:44, Ethernet1/0
O E2 172.2.59.0/24 [110/1] via 172.2.17.7, 17:35:44, Ethernet1/0
O E2 172.2.126.0/24 [110/1] via 172.2.17.7, 00:42:01, Ethernet1/0

R3#show ip route bgp

B 172.2.0.1/32 [20/0] via 172.2.38.8, 17:48:55
B 172.2.0.5/32 [20/0] via 172.2.38.8, 17:45:41
B 172.2.0.12/32 [20/0] via 172.2.38.8, 00:54:38
B 172.2.17.0/24 [20/0] via 172.2.38.8, 17:48:55
B 172.2.59.0/24 [20/0] via 172.2.38.8, 17:45:41
B 172.2.126.0/24 [20/0] via 172.2.38.8, 00:55:08

VPNv4 routes (Cont.)

R6 and R9 VRF route

```
R6#show ip route vrf ABC
B       172.2.0.1/32 [20/0] via 2.2.69.9, 15:04:01
B       172.2.0.3/32 [20/0] via 2.2.69.9, 15:04:01
B       172.2.0.5/32 [20/130816] via 2.2.69.9, 15:04:01
i L1    172.2.0.12/32 [115/20] via 172.2.126.12, Ethernet1/0
B       172.2.17.0/24 [20/0] via 2.2.69.9, 15:04:01
B       172.2.38.0/24 [20/0] via 2.2.69.9, 15:04:01
B       172.2.59.0/24 [20/0] via 2.2.69.9, 15:04:01
C       172.2.126.0/24 is directly connected, Ethernet1/0
L       172.2.126.6/32 is directly connected, Ethernet1/0

RP/0/0/CPU0:R9#show route vrf ABC ipv4
B    172.2.0.1/32 [200/15] via 2.2.0.7 (nexthop in vrf default), 17:36:28
B    172.2.0.3/32 [200/0] via 2.2.0.8 (nexthop in vrf default), 4d17h
D    172.2.0.5/32 [90/130816] via 172.2.59.5, 17:34:57, GigabitEthernet0/2/0/1.59
B    172.2.0.12/32 [20/20] via 2.2.69.6 (nexthop in vrf default), 00:42:30
B    172.2.17.0/24 [200/15] via 2.2.0.7 (nexthop in vrf default), 17:36:28
B    172.2.38.0/24 [200/0] via 2.2.0.8 (nexthop in vrf default), 4d17h
C    172.2.59.0/24 is directly connected, 10w1d, GigabitEthernet0/2/0/1.59
L    172.2.59.9/32 is directly connected, 10w1d, GigabitEthernet0/2/0/1.59
B    172.2.126.0/24 [20/0] via 2.2.69.6 (nexthop in vrf default), 00:43:00
```

MPLS forwarding table

R6 MPLS label table

```
R6#show mpls forwarding-table vrf ABC
Local  Outgoing     Prefix          Bytes Label   Outgoing   Next Hop
Label  Label or VC  or Tunnel Id    Switched      interface
16003  16026       172.2.0.1/32[V]  194740        Et0/1      2.2.69.9
16021  No Label    172.2.0.12/32[V] 3360895       Et1/0      172.2.126.12
16022  No Label    172.2.126.0/24[V] 98070        aggregate/ABC
16037  16011       172.2.0.5/32[V]  118           Et0/1      2.2.69.9
16038  16015       172.2.0.3/32[V]  10478523      Et0/1      2.2.69.9
16042  16027       172.2.17.0/24[V] 0             Et0/1      2.2.69.9
16043  16052       172.2.38.0/24[V] 0             Et0/1      2.2.69.9
16044  16029       172.2.59.0/24[V] 118           Et0/1      2.2.69.9
```

MPLS forwarding table (Cont.)

R9 MPLS label table

```
RP/0/0/CPU0:R9#show mpls forwarding
Local  Outgoing    Prefix           Outgoing     Next Hop       Bytes
Label  Label       or ID            Interface                   Switched
------ ----------- ---------------- ------------ --------------- ------------
16011  Unlabelled  172.2.0.5/32[V]  Gi0/2/0/1.59 172.2.59.5      516064
16015  16009       172.2.0.3/32[V]               2.2.0.8         0
16026  62          172.2.0.1/32[V]               2.2.0.7         884
16027  27          172.2.17.0/24[V]              2.2.0.7         0
16028  16022       1002:2:172.2.126.0/24   \
                       Gi0/2/0/1.69 2.2.69.6       0
16048  16021       1002:2:172.2.0.12/32    \
                       Gi0/2/0/1.69 2.2.69.6       3156
16052  16019       172.2.38.0/24[V]              2.2.0.8         0
```

MPLS forwarding table (Cont.)

R8 MPLS label table

```
RP/0/0/CPU0:R8#show mpls forwarding vrf ABC
Local  Outgoing    Prefix           Outgoing     Next Hop       Bytes
Label  Label       or ID            Interface                   Switched
------ ----------- ---------------- ------------ --------------- ------------
16001  Pop         172.2.38.3/32[V]  Gi0/2/0/2.38 172.2.38.3      56468989
16013  Pop         172.2.0.3/32[V]   Gi0/2/0/2.38 172.2.38.3      1650
16018  30          172.2.0.1/32[V]                2.2.0.7         0
16020  16015       172.2.0.5/32[V]                2.2.0.9         0
16022  29          172.2.17.0/24[V]               2.2.0.7         0
16023  16029       172.2.59.0/24[V]               2.2.0.9         0
16024  16028       172.2.0.12/32[V]               2.2.0.9         2547
16025  16030       172.2.126.0/24[V]              2.2.0.9         0
```

Connection verification

```
R3#ping 172.2.0.12 source loopback 0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.2.0.12, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/40/44 ms

R3#traceroute 172.2.0.12 source loopback 0
Type escape sequence to abort.
Tracing the route to 172.2.0.12

  1 172.2.38.8 [AS 2] [MPLS: Label 16024 Exp 0] 40 msec 40 msec 40 msec
  2 2.2.28.2 [MPLS: Labels 17/16028 Exp 0] 40 msec 40 msec 40 msec
  3 2.2.29.9 [MPLS: Label 16028 Exp 0] 40 msec 40 msec 40 msec
  4 172.2.126.6 [AS 1002] [MPLS: Label 16004 Exp 0] 40 msec 40 msec 40 msec
  5 172.2.126.12 [AS 1002] 36 msec *  40 msec
```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