CCIE Service Provider v3.0 Sample Lab
Part 4/7

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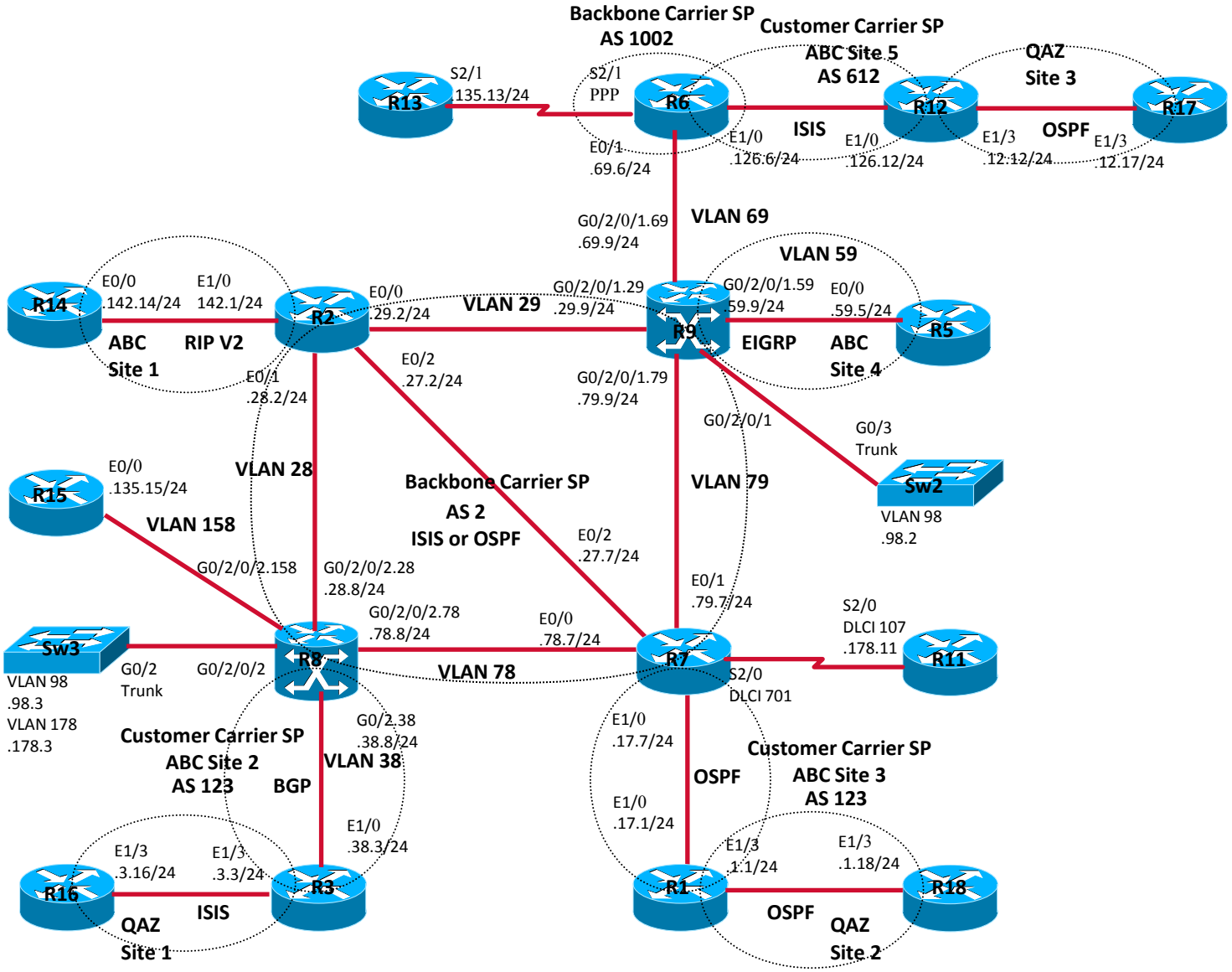
SP Sample Lab – Main Topology



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

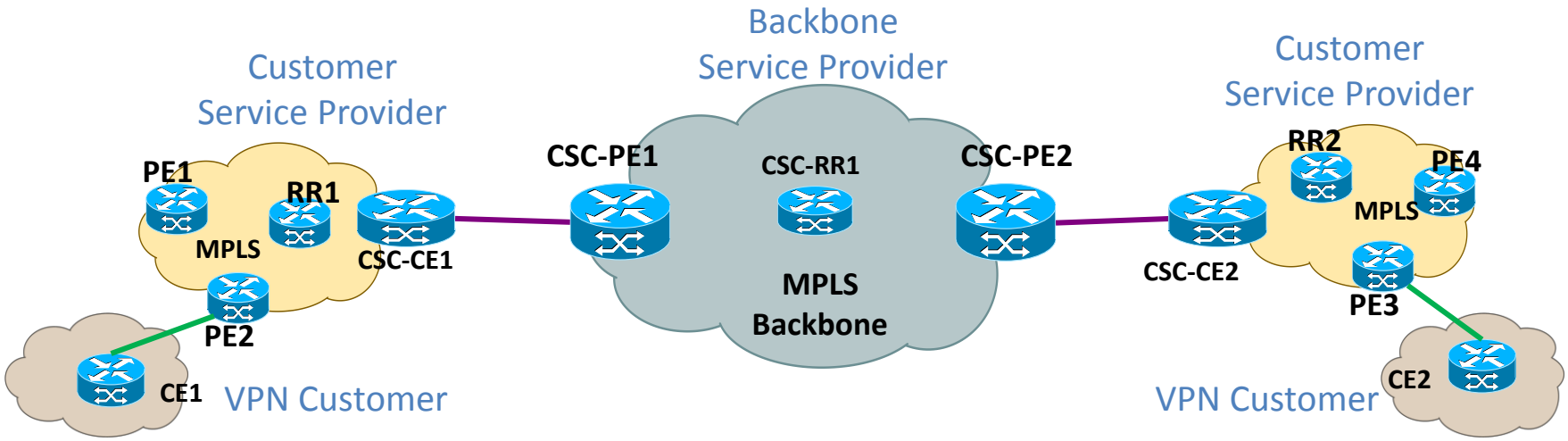
  c7200-spservices-mz.122-33.SRE2.bin

  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

CSC Building Blocks



- MPLS MPLS-VPN enabled Carrier's backbone
- CSC-PE: MPLS VPN PEs located in backbone Carrier's Core
- CSC-CE: Located at the Customer Carrier network edge and connects to a CSC-PE
- PE: located in Customer carrier networks & carries customer VPN routers
- CSC-RR: Route Reflectors located in MPLS Backbone provider network
- RR: Route Reflectors located in Customer Carrier Network
- MPLS Label exchange between backbone Carrier's PE and customer Carrier's CE

CSC Building Blocks (Cont.)

- Control Plane configuration is similar to single domain MPLS VPN
- CSC-CE to CSC-PE is a VPN link to exchange Customer Carrier's internal routes. These routes are redistributed into the BSP's CSC-PE using:

  1. Static Routes OR 2. Dynamic IGP OR 3. eBGP

- Customer Carriers don't exchange their Subscribers' (external) VPN routes with the Backbone Service Provider
- CSC-PE-to-CSC-CE links extend Label Switching Path using:

  IGP+LDP

  eBGPv4 + Labels

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

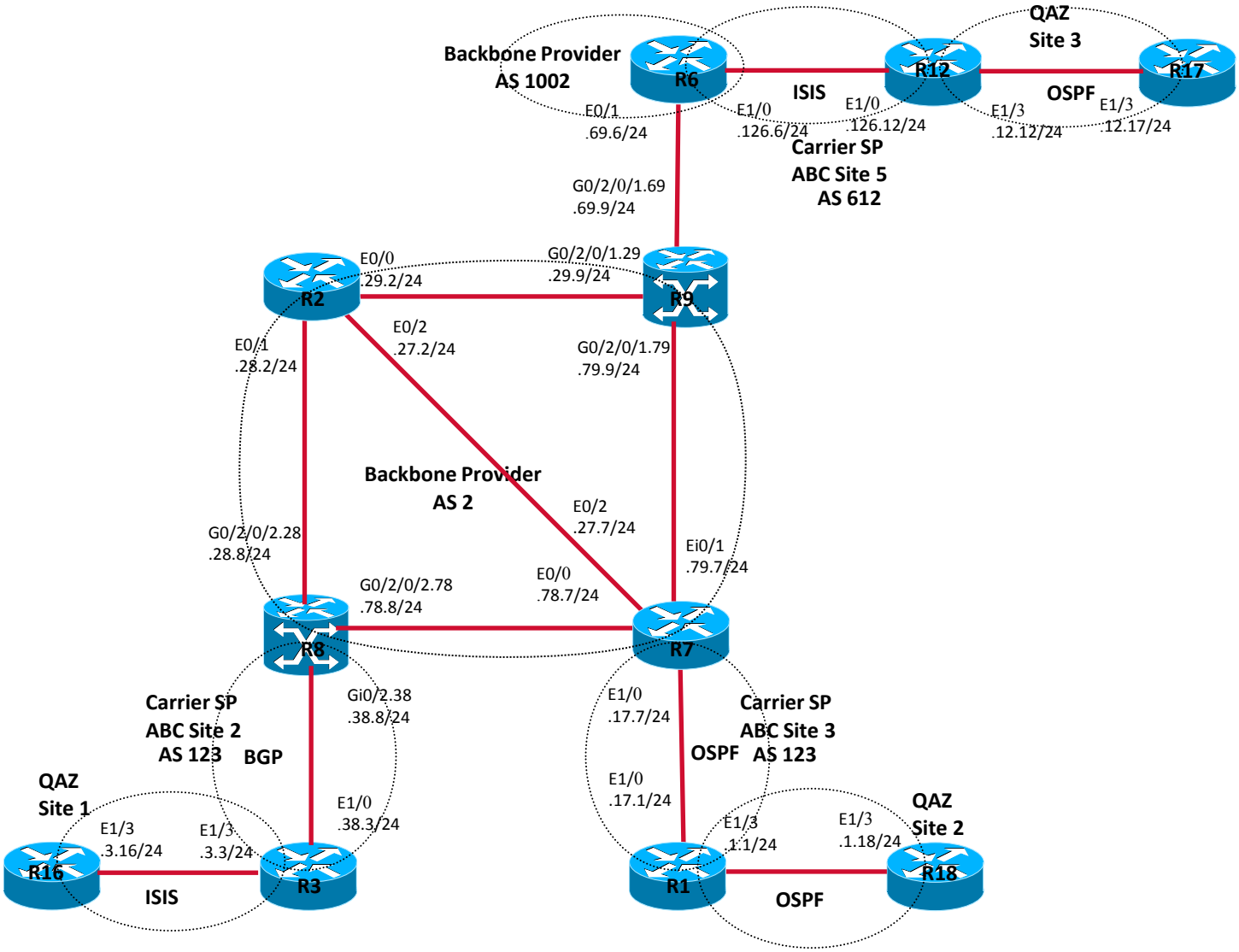
  3.0 – Implement, Optimize and Troubleshoot L3VPN Technologies

    3.3 – Implement, Optimize and Troubleshoot Carrier Supporting Carrier (CSC)

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

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

CSC – Sub Topology



CSC - Question

- R2, R7, R8 and R9 form Backbone Provider at AS 2. R6 is another Backbone Provider at AS 1002
- Configure EBGPv4+labels on R8 and R3 at ABC site 2
- Configure IGP+LDP on R7 and R1 at ABC site 3
- Configure R1 and R3 to establish IBGP VPNv4 to distribute VRF QAZ VPN information
- Ensure R16 and R18 can ping each other

- Configure IGP+LDP on R6 and R12 at ABC site 5
- Configure R3 and R12 to establish EBGP VPNv4 to distribute VRF QAZ VPN information, R1 and R12 are not be permitted to establish EBGP VPNv4 session
- Ensure R16, R17 and R18 can ping each other

CSC Configuration

R6 configuration

```
interface Ethernet1/0
 vrf forwarding ABC
 ip address 172.2.126.6 255.255.255.0
 mpls ip
!
```

R7 configuration

```
interface Ethernet1/0
 vrf forwarding ABC
 ip address 172.2.17.7 255.255.255.0
mpls ip
!
```

R8 configuration

```
router bgp 2
 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
   !
  !
```

CSC Configuration (Cont.)

R3 configuration

```
vrf definition QAZ
 rd 123:123
 !
 address-family ipv4
 route-target export 123:123
 route-target import 123:123
 exit-address-family
 !
interface Ethernet1/0
 ip address 172.2.38.3 255.255.255.0
 mpls bgp forwarding
!
interface Ethernet1/3
 vrf forwarding QAZ
 ip address 192.2.3.3 255.255.255.0
 ip router isis
!
router isis
 vrf QAZ
 net 47.0192.0000.0000.0003.00
 metric-style wide
 redistribute bgp 123
```

```
router bgp 123
 neighbor 172.2.0.1 remote-as 123
 neighbor 172.2.0.1 update-source Loopback0
 neighbor 172.2.0.12 remote-as 612
 neighbor 172.2.0.12 ebgp-multihop 255
 neighbor 172.2.0.12 update-source Loopback0
 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
  neighbor 172.2.38.8 send-community both
  neighbor 172.2.38.8 send-label
 exit-address-family
 !
 address-family vpnv4
  neighbor 172.2.0.1 activate
  neighbor 172.2.0.1 send-community both
  neighbor 172.2.0.12 activate
  neighbor 172.2.0.12 send-community both
  neighbor 172.2.0.12 next-hop-unchanged
 exit-address-family
 !
 address-family ipv4 vrf QAZ
 redistribute isis level-1-2 metric 10
 exit-address-family
```

CSC Configuration (Cont.)

R1 configuration

```
vrf definition QAZ
 rd 123:123
 !
 address-family ipv4
 route-target export 123:123
 route-target import 123:123
 exit-address-family
 !
interface Ethernet1/0
 ip address 172.2.17.1 255.255.255.0
 mpls ip
!
interface Ethernet1/3
 vrf forwarding QAZ
 ip address 192.2.1.1 255.255.255.0
!
router ospf 18 vrf QAZ
 redistribute bgp 123 subnets
 network 192.2.1.0 0.0.0.255 area 0
!
router bgp 123
 neighbor 172.2.0.3 remote-as 123
 neighbor 172.2.0.3 update-source Loopback0
 !
 address-family vpnv4
  neighbor 172.2.0.3 activate
  neighbor 172.2.0.3 send-community extended
 exit-address-family
 !
 address-family ipv4 vrf QAZ
  no synchronization
  redistribute ospf 18 vrf QAZ
 exit-address-family
 !
```

CSC Configuration (Cont.)

R12 configuration

```
vrf definition QAZ
 rd 12:12
 !
 address-family ipv4
 route-target export 123:123
 route-target import 123:123
!
interface Ethernet1/0
 ip address 172.2.126.12 255.255.255.0
 mpls ip
!
interface Ethernet1/3
 vrf forwarding QAZ
 ip address 192.2.12.12 255.255.255.0
!
router ospf 100 vrf QAZ
 redistribute bgp 612 metric 10 subnets
 network 192.2.12.0 0.0.0.255 area 0
!
```

```
router bgp 612
 neighbor 172.2.0.3 remote-as 123
 neighbor 172.2.0.3 ebgp-multihop 255
 neighbor 172.2.0.3 update-source Loopback0
 !
address-family vpnv4
  neighbor 172.2.0.3 activate
  neighbor 172.2.0.3 send-community both
 exit-address-family
 !
address-family ipv4 vrf QAZ
  no synchronization
 redistribute ospf 100 vrf QAZ metric 20
 exit-address-family
 !
```

CSC Configuration (Cont.)

R16 configuration

```
interface Loopback0
 ip address 192.2.0.16 255.255.255.255
 ip router isis
!
interface Ethernet1/3
 ip address 192.2.3.16 255.255.255.0
 ip router isis
!
router isis
 net 47.0192.0000.0000.0016.00
 metric-style wide
```

R17 configuration

```
interface Loopback0
 ip address 192.2.0.18 255.255.255.255
!
interface Ethernet1/3
 ip address 192.2.1.18 255.255.255.0
!
router ospf 18
 network 192.2.0.18 0.0.0.0 area 0
 network 192.2.1.0 0.0.0.255 area 0
```

R18 configuration

```
interface Loopback0
 ip address 192.2.0.17 255.255.255.255
!
interface Ethernet1/3
 ip address 192.2.12.17 255.255.255.0
!
router ospf 100
 network 192.2.0.17 0.0.0.0 area 0
 network 192.2.12.0 0.0.0.255 area 0
```

CSC VPNv4 Session

R3 VPNv4 neighbor

```
R3#show ip bgp vpnv4 all summary
BGP router identifier 172.2.0.3, local AS number 123
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
172.2.0.1       4   123    2950    2959       85    0    0 1d20h         2
172.2.0.12      4   612    2769    2771       85    0    0 1d17h         2
```

R1 VPNv4 neighbor

```
R1#show ip bgp vpnv4 all summary
BGP router identifier 172.2.0.1, local AS number 123
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
172.2.0.3       4   123    2960    2951      105    0    0 1d20h         5
```

R12 VPNv4 neighbor

```
R12#show ip bgp vpnv4 all summary
BGP router identifier 172.2.0.12, local AS number 612
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
172.2.0.3       4   123    2773    2770      159    0    0 1d17h         5
```

CSC VPNv4 table

R3 VPNv4 table

```
R3#show ip bgp vpnv4 vrf QAZ
   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 123:123 (default for vrf QAZ)
*> 192.2.0.16/32    192.2.3.16               10         32768 ?
*> 192.2.0.17/32    172.2.0.12               20             0 612 ?
*>i192.2.0.18/32    172.2.0.1                11    100      0 ?
*>i192.2.1.0        172.2.0.1                 0    100      0 ?
*> 192.2.3.0        0.0.0.0                   0         32768 ?
*> 192.2.12.0       172.2.0.12                0             0 612 ?
```

R1 VPNv4 table

```
R1#show ip bgp vpnv4 vrf QAZ
   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 123:123 (default for vrf QAZ)
*>i192.2.0.16/32    172.2.0.3                10    100      0 ?
*>i192.2.0.17/32    172.2.0.12               20    100      0 612 ?
*> 192.2.0.18/32    192.2.1.18               11         32768 ?
*> 192.2.1.0        0.0.0.0                   0         32768 ?
*>i192.2.3.0        172.2.0.3                 0    100      0 ?
*>i192.2.12.0       172.2.0.12                0    100      0 612 ?
```

CSC VPNv4 table (Cont.)

R12 VPNv4 table

```
R12#show ip bgp vpnv4 vrf QAZ
   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 12:12 (default for vrf QAZ)
*> 192.2.0.16/32    172.2.0.3                10         0 123 ?
*> 192.2.0.17/32    192.2.12.17              20         32768 ?
*> 192.2.0.18/32    172.2.0.1                           0 123 ?
*> 192.2.1.0        172.2.0.1                           0 123 ?
*> 192.2.3.0        172.2.0.3                0          0 123 ?
*> 192.2.12.0       0.0.0.0                  0          32768 ?
```

CSC VPN customer routes

R16 , R18 and R17 route

R16#show ip route isis

i L2 192.2.0.17 [115/10] via 192.2.3.3, Ethernet1/3
i L2 192.2.0.18 [115/10] via 192.2.3.3, Ethernet1/3
i L2 192.2.1.0/24 [115/10] via 192.2.3.3, Ethernet1/3
i L2 192.2.12.0/24 [115/10] via 192.2.3.3, Ethernet1/3

R18#show ip route ospf

O E2 192.2.0.16 [110/10] via 192.2.1.1, 1d20h, Ethernet1/3
O E2 192.2.0.17 [110/20] via 192.2.1.1, 1d03h, Ethernet1/3
O E2 192.2.3.0/24 [110/1] via 192.2.1.1, 1d20h, Ethernet1/3
O E2 192.2.12.0/24 [110/1] via 192.2.1.1, 1d03h, Ethernet1/3

R17#show ip route ospf

O E2 192.2.0.16 [110/10] via 192.2.12.12, 1d03h, Ethernet1/3
O E2 192.2.0.18 [110/10] via 192.2.12.12, 1d03h, Ethernet1/3
O E2 192.2.1.0/24 [110/10] via 192.2.12.12, 1d03h, Ethernet1/3
O E2 192.2.3.0/24 [110/10] via 192.2.12.12, 1d03h, Ethernet1/3

CSC VPN customer routes (Cont.)

R3 and R1 VRF QAZ routes

```
R3#show ip route vrf QAZ

i L1    192.2.0.16 [115/20] via 192.2.3.16, Ethernet1/3
B       192.2.0.17 [20/20] via 172.2.0.12, 1d03h
B       192.2.0.18 [200/11] via 172.2.0.1, 1d20h
B    192.2.1.0/24 [200/0] via 172.2.0.1, 1d20h
     192.2.3.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.2.3.0/24 is directly connected, Ethernet1/3
L       192.2.3.3/32 is directly connected, Ethernet1/3
B    192.2.12.0/24 [20/0] via 172.2.0.12, 1d03h

R1#show ip route vrf QAZ

B       192.2.0.16 [200/10] via 172.2.0.3, 1d20h
B       192.2.0.17 [200/20] via 172.2.0.12, 1d03h
O       192.2.0.18 [110/11] via 192.2.1.18, 5d22h, Ethernet1/3
C       192.2.1.0/24 is directly connected, Ethernet1/3
L       192.2.1.1/32 is directly connected, Ethernet1/3
B    192.2.3.0/24 [200/0] via 172.2.0.3, 1d20h
B    192.2.12.0/24 [200/0] via 172.2.0.12, 1d03h
```

CSC VPN customer routes (Cont.)

R12 VRF QAZ routes

```
R12#show ip route vrf QAZ

B       192.2.0.16 [20/10] via 172.2.0.3, 1d03h
O       192.2.0.17 [110/11] via 192.2.12.17, 5d22h, Ethernet1/3
B       192.2.0.18 [20/0] via 172.2.0.1, 1d03h
B    192.2.1.0/24 [20/0] via 172.2.0.1, 1d03h
B    192.2.3.0/24 [20/0] via 172.2.0.3, 1d03h
C       192.2.12.0/24 is directly connected, Ethernet1/3
L       192.2.12.12/32 is directly connected, Ethernet1/3
```

CSC MPLS table

R3 and R1 mpls table

```
R3#show mpls forwarding-table
Local  Outgoing     Prefix          Bytes Label   Outgoing   Next Hop
Label  Label or VC  or Tunnel Id    Switched      interface
17     Pop Label    172.2.38.8/32   0             Et1/0      172.2.38.8
20     No Label     192.2.0.16/32[V]  1266        Et1/3      192.2.3.16
21     No Label     192.2.3.0/24[V]   0           aggregate/QAZ

R1#show mpls forwarding-table
Local  Outgoing     Prefix          Bytes Label   Outgoing   Next Hop
Label  Label or VC  or Tunnel Id    Switched      interface
16     No Label     192.2.0.18/32[V]  570         Et1/3      192.2.1.18
17     No Label     192.2.1.0/24[V]   570         aggregate/QAZ
18     45           172.2.0.12/32     0           Et1/0      172.2.17.7
39     31           172.2.0.3/32      0           Et1/0      172.2.17.7
43     37           172.2.38.0/24     0           Et1/0      172.2.17.7
45     44           172.2.126.0/24    0           Et1/0      172.2.17.7
```

CSC MPLS table (Cont.)

R12 MPLS table

```
R12#show mpls forwarding-table
Local  Outgoing     Prefix          Bytes Label   Outgoing   Next Hop
Label  Label or VC  or Tunnel Id    Switched      interface
17     No Label     192.2.0.17/32[V] 4751         Et1/3      192.2.12.17
18     No Label     192.2.12.0/24[V] 0            aggregate/QAZ
23     16038        172.2.0.3/32     0            Et1/0      172.2.126.6
24     16042        172.2.17.0/24    0            Et1/0      172.2.126.6
25     16043        172.2.38.0/24    0            Et1/0      172.2.126.6
51     16003        172.2.0.1/32     0            Et1/0      172.2.126.6
```

Connection and Path Verification

```
R16#ping 192.2.0.18 source loopback 0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.2.0.18, timeout is 2 seconds:
Packet sent with a source address of 192.2.0.16
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/20/20 ms

R16#traceroute 192.2.0.18 source loopback 0
Type escape sequence to abort.
Tracing the route to 192.2.0.18

  1 192.2.3.3 4 msec 0 msec 0 msec
  2 172.2.38.8 [MPLS: Labels 16021/16 Exp 0] 24 msec 20 msec 16 msec
  3 2.2.78.7 [MPLS: Labels 62/16 Exp 0] 20 msec 20 msec 20 msec
  4 192.2.1.1 [MPLS: Label 16 Exp 0] 16 msec 24 msec 20 msec
  5 192.2.1.18 20 msec *  20 msec
```

Connection and Path Verification (Cont.)

```
R16#ping 192.2.0.17 source loopback 0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.2.0.17, timeout is 2 seconds:
Packet sent with a source address of 192.2.0.16
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/42/52 ms

R16#trace 192.2.0.17 source loopback 0
Type escape sequence to abort.
Tracing the route to 192.2.0.17

  1 192.2.3.3 4 msec 0 msec 0 msec
  2 172.2.38.8 [MPLS: Labels 16028/17 Exp 0] 36 msec 36 msec 40 msec
  3 2.2.78.7 [MPLS: Labels 18/16048/17 Exp 0] 40 msec 40 msec 40 msec
  4 2.2.79.9 [MPLS: Labels 16048/17 Exp 0] 40 msec 40 msec 40 msec
  5 2.2.69.6 [MPLS: Labels 16021/17 Exp 0] 40 msec 40 msec 40 msec
  6 192.2.12.12 [MPLS: Label 17 Exp 0] 40 msec 40 msec 40 msec
  7 192.2.12.17 40 msec *  40 msec
```

Connection and Path Verification (Cont.)

```
R18#ping 192.2.0.16 source loopback 0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.2.0.16, timeout is 2 seconds:
Packet sent with a source address of 192.2.0.18
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms

R18#traceroute 192.2.0.16 source loopback 0

Type escape sequence to abort.
Tracing the route to 192.2.0.16

  1 192.2.1.1 0 msec 4 msec 0 msec
  2 172.2.17.7 [MPLS: Labels 28/20 Exp 0] 4 msec 4 msec 0 msec
  3 2.2.78.8 [MPLS: Labels 16020/20 Exp 0] 8 msec 4 msec 4 msec
  4 192.2.3.3 [MPLS: Label 20 Exp 0] 0 msec 4 msec 0 msec
  5 192.2.3.16 4 msec *  4 msec
```

Connection and Path Verification (Cont.)

```
R18#ping 192.2.0.17 source loopback 0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.2.0.17, timeout is 2 seconds:
Packet sent with a source address of 192.2.0.18
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/19/20 ms

R18#traceroute 192.2.0.17 source loopback 0
Type escape sequence to abort.
Tracing the route to 192.2.0.17

  1 192.2.1.1 4 msec 0 msec 0 msec
  2 172.2.17.7 [MPLS: Labels 45/17 Exp 0] 24 msec 20 msec 20 msec
  3 2.2.79.9 [MPLS: Labels 16048/17 Exp 0] 20 msec 20 msec 20 msec
  4 2.2.69.6 [MPLS: Labels 16021/17 Exp 0] 20 msec 20 msec 20 msec
  5 192.2.12.12 [MPLS: Label 17 Exp 0] 20 msec 20 msec 20 msec
  6 192.2.12.17 20 msec *  20 msec
```

Connection and Path Verification (Cont.)

```
R17#ping 192.2.0.16 source loopback 0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.2.0.16, timeout is 2 seconds:
Packet sent with a source address of 192.2.0.17
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/4/8 ms

R17#traceroute 192.2.0.16 source loopback 0
Type escape sequence to abort.
Tracing the route to 192.2.0.16

 1 192.2.12.12 [MPLS: Label 34 Exp 0] 8 msec 4 msec 4 msec
 2 172.2.126.6 [MPLS: Labels 121/20 Exp 0] 4 msec 4 msec 4 msec
 3 2.2.69.9 [MPLS: Labels 16019/20 Exp 0] 4 msec 8 msec 8 msec
 4 2.2.79.7 [MPLS: Labels 20/16020/20 Exp 0] 4 msec 4 msec 4 msec
 5 2.2.78.8 [MPLS: Labels 16020/20 Exp 0] 4 msec 8 msec 8 msec
 6 192.2.3.3 [MPLS: Label 20 Exp 0] 4 msec 4 msec 0 msec
 7 192.2.3.16 4 msec *  4 msec
```

Connection and Path Verification (Cont.)

```
R17#ping 192.2.0.18 source loopback 0
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.2.0.18, timeout is 2 seconds:
Packet sent with a source address of 192.2.0.17
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/4/8 ms

R17#traceroute 192.2.0.18 source loopback 0
Type escape sequence to abort.
Tracing the route to 192.2.0.18

  1 192.2.12.12 [MPLS: Label 18 Exp 0] 8 msec 4 msec 4 msec
  2 172.2.126.6 [MPLS: Labels 120/23 Exp 0] 4 msec 4 msec 4 msec
  3 2.2.69.9 [MPLS: Labels 16018/23 Exp 0] 4 msec 8 msec 8 msec
  4 2.2.79.7 [MPLS: Labels 35/23 Exp 0] 4 msec 4 msec 4 msec
  5 192.2.1.1 [MPLS: Label 23 Exp 0] 0 msec 0 msec 4 msec
  6 192.2.1.18 4 msec *  4 msec
```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