CCIE Service Provider v3.0 Sample Lab

Part 6/7

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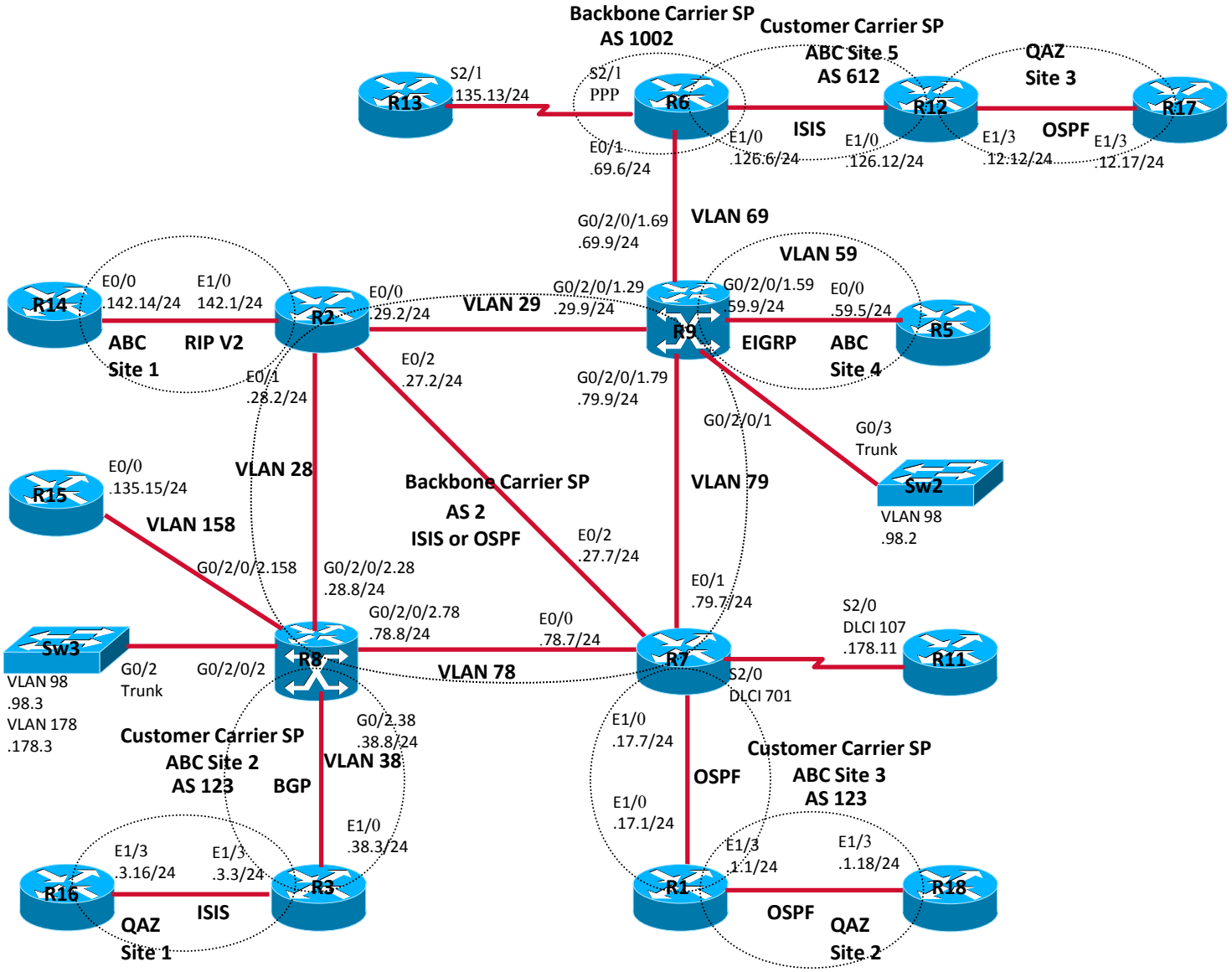
Cisco Systems

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

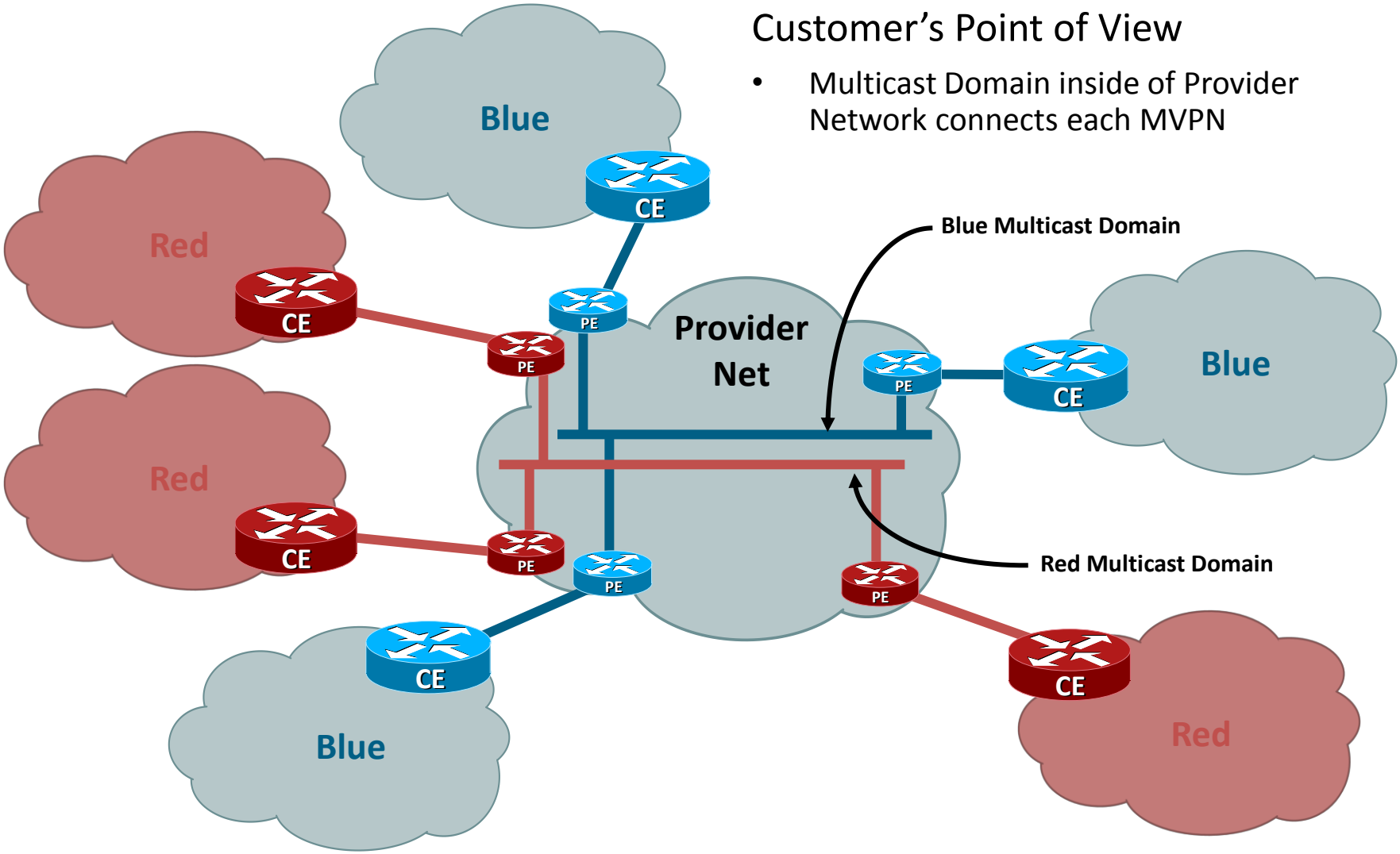
  c7200-spservices-mz.122-33.SRE2.bin

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

SP Sample Lab Questions

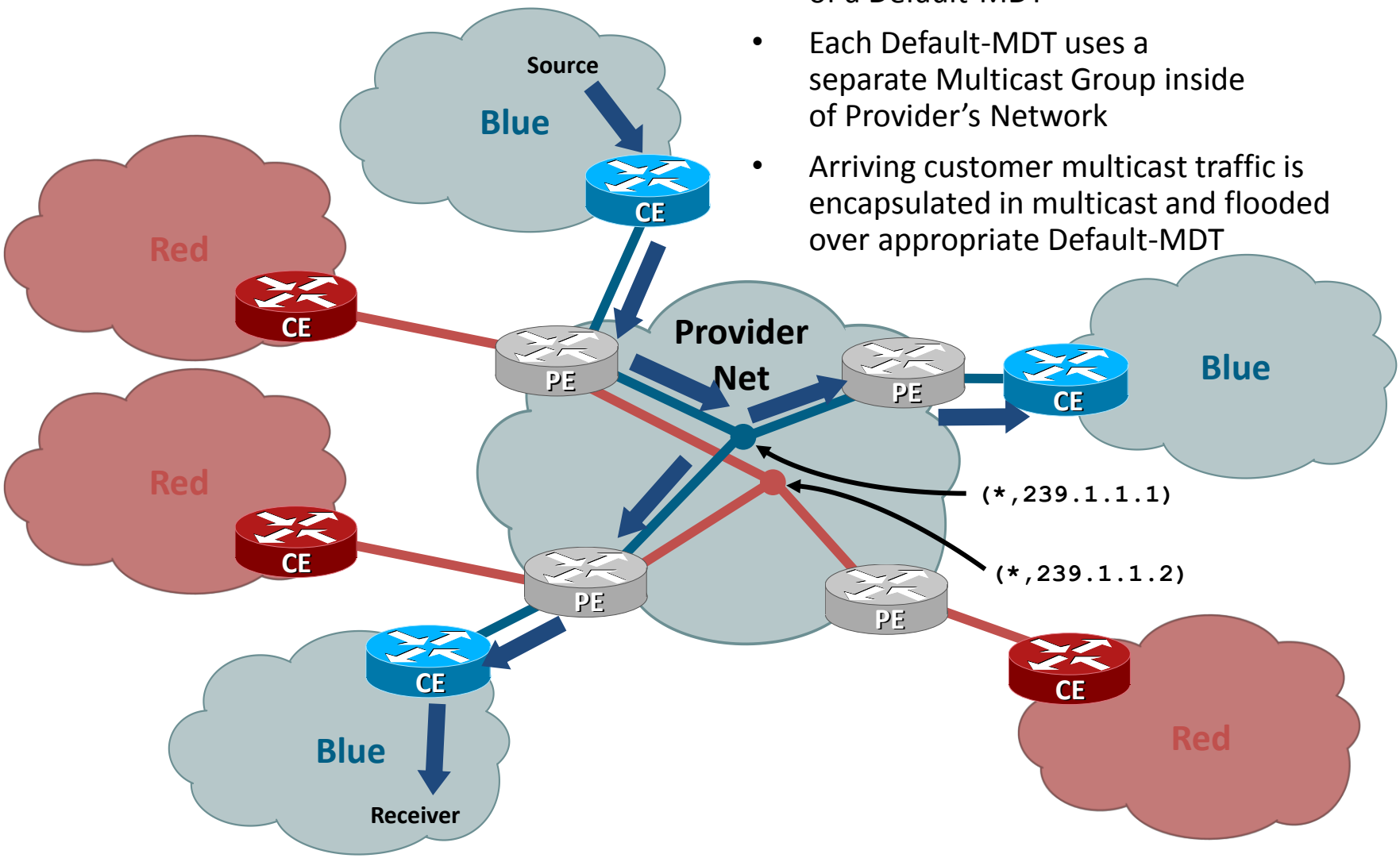
	Question, Configuration and Verification
1	IS-IS IPv4/IPv6
2	OSPF IPv4/IPv6
3	BGP unicast IPv4/IPv6
4	MPLS LDP
5	MPLS TE
6	MPLS TE FRR
7	MP-BGP intra-AS VPNv4
8	MP-BGP inter-AS VPNv4
9	CSC
10	MP-BGP VPNv6 - 6VPE
11	Multicast VPN
12	AToM
13	VPLS
14	L2TPv3

Multicast VPN: Overview



Multicast VPN: Overview (Cont.)

- Each Multicast Domain consists of a Default-MDT
- Each Default-MDT uses a separate Multicast Group inside of Provider's Network
- Arriving customer multicast traffic is encapsulated in multicast and flooded over appropriate Default-MDT



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

  1.0 – Implement, Optimize and Troubleshoot Core IP Technologies

    1.7 – Implement, Optimize and Troubleshoot Muliticast

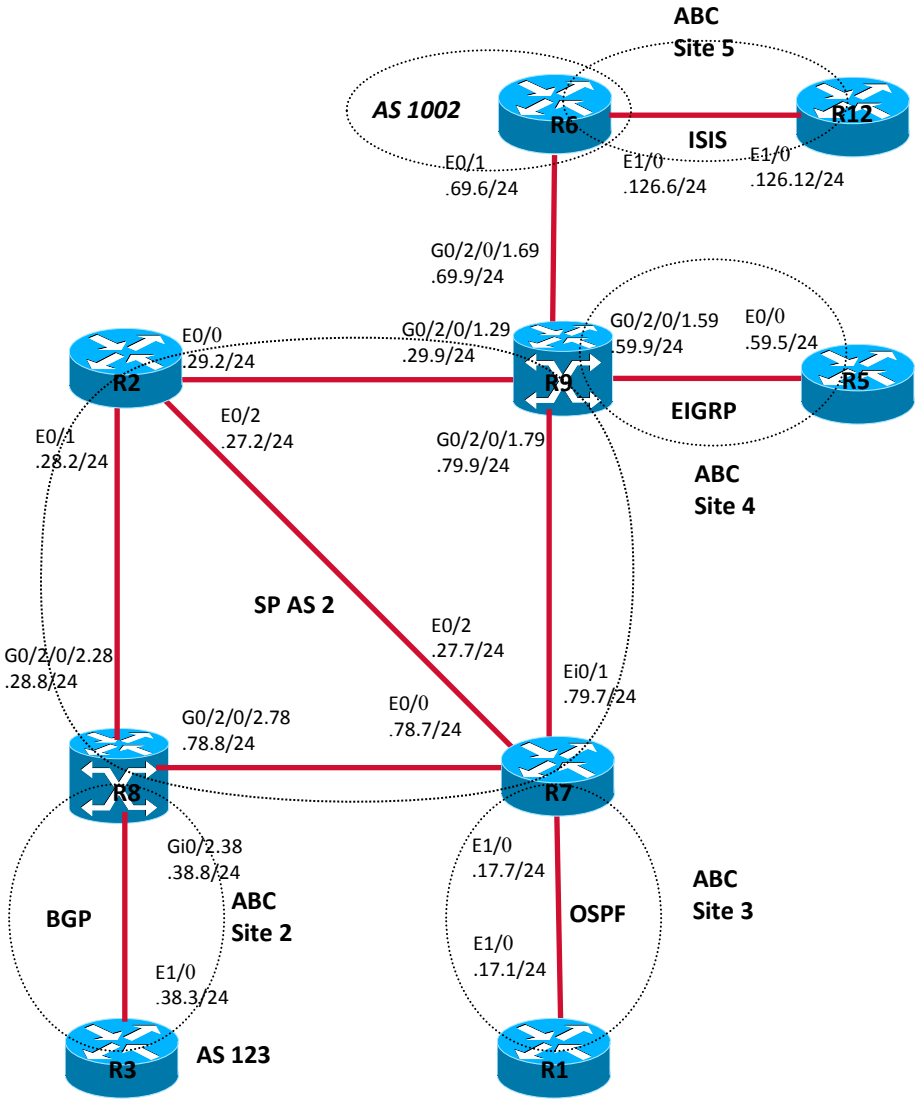
  3.0 – Implement, Optimize and Troubleshoot L3VPN Technologies

    3.6 – Implement, Optimize and Troubleshoot Multicast VPN

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

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

Multicast VPN – Sub Topology



Multicast VPN - Question

- Configure default MDT address 239.255.13.27
- Configure R2 looback 0 as RP for AS 2 , use BSR method to distribute RP. Configure R6 loopback0 is RP for AS 1002
- Configure MSDP between R2 and R6, use loopback 0 IP address as source IP
- Configure R1 loopback0 as RP for ABC site 2, 3, 4 and 5. Use static method to define RP
- Configure R1, R3, R5 and R12 looback0 to join multicast group of 239.255.X.X (X is router number). Ensure R1, R3, R5 and R12 can ping these multicast group

- Configure MP-BGP IPv4 MDT between R2, R7, R8 and R9, R9 is route-reflector
- Configure MP-BGP IPv4 MDT between R6 and R9
- Ensure multicast VPN source and group information be distributed among R2, R7, R8, R9 and R6

Multicast VPN Configuration

R2 (IOS) 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
 mdt default 239.255.13.27
!
ip multicast-routing
ip multicast-routing vrf ABC
!
interface Loopback0
 ip address 2.2.0.2 255.255.255.255
 ip pim sparse-mode
!
interface Ethernet0/0
 ip address 2.2.29.2 255.255.255.0
 ip pim sparse-mode
!
interface Ethernet0/1
 ip address 2.2.28.2 255.255.255.0
 ip pim sparse-mode
!
interface Ethernet0/2
 ip address 2.2.27.2 255.255.255.0
 ip pim sparse-mode
!
interface Ethernet1/0
 vrf forwarding ABC
 ip address 172.2.142.2 255.255.255.0
 ip pim sparse-mode
!
router bgp 2
 neighbor 2.2.0.9 remote-as 2
 neighbor 2.2.0.9 update-source Loopback0
 !
 address-family ipv4 mdt
  no bgp nexthop trigger enable
  neighbor 2.2.0.9 activate
  neighbor 2.2.0.9 send-community extended
!
ip pim bsr-candidate Loopback0 0 255
ip pim rp-candidate Loopback0 priority 255
ip pim vrf ABC rp-address 172.2.0.1
ip msdp peer 2.2.0.6 connect-source Loopback0
```

Multicast VPN Configuration (Cont.)

R7 (IOS) 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
 mdt default 239.255.13.27
!
ip multicast-routing
ip multicast-routing vrf ABC
!
interface Loopback0
 ip address 2.2.0.7 255.255.255.255
 ip pim sparse-mode
!
interface Ethernet0/0
 ip address 2.2.78.7 255.255.255.0
 ip pim sparse-mode
!
interface Ethernet0/1
 ip address 2.2.79.7 255.255.255.0
 ip pim sparse-mode
!
interface Ethernet0/2
 ip address 2.2.27.7 255.255.255.0
 ip pim sparse-mode
!
interface Ethernet1/0
 vrf forwarding ABC
 ip address 172.2.17.7 255.255.255.0
 ip pim sparse-mode
!
router bgp 2
 neighbor 2.2.0.9 remote-as 2
 neighbor 2.2.0.9 update-source Loopback0
 !
 address-family ipv4 mdt
  no bgp nexthop trigger enable
  neighbor 2.2.0.9 activate
  neighbor 2.2.0.9 send-community extended
 exit-address-family
 !
ip pim vrf ABC rp-address 172.2.0.1
!
```

Multicast VPN Configuration (Cont.)

R8 (IOS-XR) configuration

```
router bgp 2
 address-family ipv4 mdt
 !
 neighbor 2.2.0.9
  remote-as 2
  update-source Loopback0
  address-family ipv4 mdt
  !
 !
multicast-routing
 vrf ABC address-family ipv4
  interface GigabitEthernet0/2/0/2.38
   enable
  !
  mdt default ipv4 239.255.13.27
  rate-per-route
 !
 address-family ipv4
  interface Loopback0
   enable
  !
  interface GigabitEthernet0/2/0/2.28
   enable
  !
  interface GigabitEthernet0/2/0/2.78
   enable
  !
  mdt source Loopback0
  rate-per-route
 !
router pim vrf ABC address-family ipv4
 rp-address 172.2.0.1
 interface GigabitEthernet0/2/0/2.38
  enable
!
router pim vrf default address-family ipv4
 interface Loopback0
  enable
 !
 interface GigabitEthernet0/2/0/2.28
  enable
 !
 interface GigabitEthernet0/2/0/2.78
  enable
 !
```

Multicast VPN Configuration (Cont.)

R9 (IOS-XR) configuration

```
router bgp 2
 address-family ipv4 mdt
 !
 neighbor 2.2.0.2
  remote-as 2
  update-source Loopback0
  address-family ipv4 mdt
   route-reflector-client
   next-hop-self
  !
 !
 neighbor 2.2.0.7
  remote-as 2
  update-source Loopback0
  address-family ipv4 mdt
   route-reflector-client
   next-hop-self
  !
 !
 neighbor 2.2.0.8
  remote-as 2
  update-source Loopback0
  address-family ipv4 mdt
   route-reflector-client
   next-hop-self
  !
 !
 neighbor 2.2.69.6
  remote-as 1002
  address-family ipv4 mdt
   route-policy default_policy_pass_all in
   route-policy default_policy_pass_all out
  !
multicast-routing
 vrf ABC address-family ipv4
  interface GigabitEthernet0/2/0/1.59
   enable
  !
  mdt default ipv4 239.255.13.27
 !
 address-family ipv4
  interface Loopback0
   enable
  !
  interface GigabitEthernet0/2/0/1.29
   enable
  !
  interface GigabitEthernet0/2/0/1.69
   enable
  !
  interface GigabitEthernet0/2/0/1.79
   enable
  !
  mdt source Loopback0
router pim vrf ABC address-family ipv4
 rp-address 172.2.0.1
 interface GigabitEthernet0/2/0/1.59
  enable
 !
!
router pim vrf default address-family ipv4
 interface Loopback0
  enable
 !
 interface GigabitEthernet0/2/0/1.29
  enable
 !
 interface GigabitEthernet0/2/0/1.69
  bsr-border
  enable
 !
 interface GigabitEthernet0/2/0/1.79
  enable
 !
!
```

Multicast VPN Configuration (Cont.)

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
 mdt default 239.255.13.27
!
ip multicast-routing
ip multicast-routing vrf ABC
!
interface Ethernet0/0
 ip address 2.2.46.6 255.255.255.0
 ip pim sparse-mode
!
interface Ethernet0/1
 ip address 2.2.69.6 255.255.255.0
 ip pim bsr-border
 ip pim sparse-mode
!
interface Ethernet1/0
 vrf forwarding ABC
 ip address 172.2.126.6 255.255.255.0
 ip pim sparse-mode
!
router bgp 1002
 neighbor 2.2.69.9 remote-as 2
 !
 address-family ipv4 mdt
  neighbor 2.2.69.9 activate
  neighbor 2.2.69.9 send-community extended
 exit-address-family
 !
ip pim bsr-candidate Loopback0 0
ip pim rp-candidate Loopback0
ip pim vrf ABC rp-address 172.2.0.1
ip msdp peer 2.2.0.2 connect-source Loopback0
```

Multicast VPN Configuration (Cont.)

R3 configuration

```
ip multicast-routing
!
interface Loopback0
 ip address 172.2.0.3 255.255.255.255
 ip pim sparse-mode
 ip igmp join-group 239.255.3.3
!
interface Ethernet1/0
 ip address 172.2.38.3 255.255.255.0
 ip pim sparse-mode
!
ip pim rp-address 172.2.0.1
```

R1 configuration

```
ip multicast-routing
!
interface Loopback0
 ip address 172.2.0.1 255.255.255.255
 ip pim sparse-mode
 ip igmp join-group 239.255.1.1
!
interface Ethernet1/0
 ip address 172.2.17.1 255.255.255.0
 ip pim sparse-mode
!
ip pim rp-address 172.2.0.1
```

Multicast VPN Configuration (Cont.)

R5 configuration

```
ip multicast-routing
!
interface Loopback0
 ip address 172.2.0.5 255.255.255.255
 ip pim sparse-mode
 ip igmp join-group 239.255.5.5
!
interface Ethernet1/0
 ip address 172.2.59.5 255.255.255.0
 ip pim sparse-mode
!
ip pim rp-address 172.2.0.1
```

R12 configuration

```
ip multicast-routing
!
interface Loopback0
 ip address 172.2.0.12 255.255.255.255
 ip pim sparse-mode
 ip igmp join-group 239.255.5.5
!
interface Ethernet1/0
 ip address 172.2.126.12 255.255.255.0
 ip pim sparse-mode
!
ip pim rp-address 172.2.0.1
```

RP group map

R2 RP group map

```
R2#show ip pim rp mapping
PIM Group-to-RP Mappings
This system is a candidate RP (v2)
This system is the Bootstrap Router (v2)
Group(s) 224.0.0.0/4
  RP 2.2.0.2 (?), v2
    Info source: 2.2.0.2 (?), via bootstrap, priority 255, holdtime 150
         Uptime: 6d02h, expires: 00:01:35
```

R7 RP group map

```
R7#show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 2.2.0.2 (?), v2
    Info source: 2.2.0.2 (?), via bootstrap, priority 255, holdtime 150
         Uptime: 6d01h, expires: 00:01:59
```

RP group map (Cont.)

R8 RP group map

```
RP/0/0/CPU0:R8#show pim group-map
Group Range        Proto Client   Groups RP address      Info
224.0.1.39/32*      DM    perm     0      0.0.0.0
224.0.1.40/32*      DM    perm     1      0.0.0.0
224.0.0.0/24*       NO    perm     0      0.0.0.0
232.0.0.0/8*        SSM   config   0      0.0.0.0
224.0.0.0/4*        SM    bsr+     2      2.2.0.2        RPF: Gi0/2/0/2.28,2.2.28.2
224.0.0.0/4         SM    static   0      0.0.0.0        RPF: Null,0.0.0.0
```

R9 RP group map

```
RP/0/0/CPU0:R9#show pim group-map
Group Range        Proto Client   Groups RP address      Info
224.0.1.39/32*      DM    perm     0      0.0.0.0
224.0.1.40/32*      DM    perm     1      0.0.0.0
224.0.0.0/24*       NO    perm     0      0.0.0.0
232.0.0.0/8*        SSM   config   0      0.0.0.0
224.0.0.0/4*        SM    bsr+     2      2.2.0.2        RPF: Gi0/2/0/1.29,2.2.29.2
224.0.0.0/4         SM    static   0      0.0.0.0        RPF: Null,0.0.0.0
```

MSDP connection

```
R2#show ip msdp summary
MSDP Peer Status Summary
Peer Address     AS    State    Uptime/  Reset SA    Peer Name
                       Downtime Count Count
2.2.0.6          1002    Up      5d01h    3     1     ?

R6#show ip msdp summary
MSDP Peer Status Summary
Peer Address     AS    State    Uptime/  Reset SA    Peer Name
                       Downtime Count Count
2.2.0.2          2       Up      5d01h    1     4     ?
```

MSDP Active Source

R2#show ip msdp sa-cache
MSDP Source-Active Cache - 1 entries
(2.2.0.6, 239.255.13.27), RP 2.2.0.6, BGP/AS 1002, 1d02h/00:05:53, Peer 2.2.0.6

R6#show ip msdp sa-cache
MSDP Source-Active Cache - 4 entries
(2.2.0.2, 239.255.13.27), RP 2.2.0.2, BGP/AS 2, 1d02h/00:05:50, Peer 2.2.0.2
(2.2.0.7, 239.255.13.27), RP 2.2.0.2, BGP/AS 2, 1d02h/00:05:50, Peer 2.2.0.2
(2.2.0.8, 239.255.13.27), RP 2.2.0.2, BGP/AS 2, 1d02h/00:05:50, Peer 2.2.0.2
(2.2.0.9, 239.255.13.27), RP 2.2.0.2, BGP/AS 2, 1d02h/00:05:50, Peer 2.2.0.2

VRF Site RP group map

R8 VRF ABC RP group map

```
RP/0/0/CPU0:R8#show pim vrf ABC group-map
Group Range        Proto Client   Groups RP address      Info

224.0.1.39/32*     DM    perm     0      0.0.0.0
224.0.1.40/32*     DM    perm     1      0.0.0.0
224.0.0.0/24*      NO    perm     0      0.0.0.0
232.0.0.0/8*       SSM   config   0      0.0.0.0
224.0.0.0/4*       SM    config   2      172.2.0.1       RPF: md,2.2.0.7
224.0.0.0/4        SM    static   0      0.0.0.0         RPF: Null,0.0.0.0
```

R7 VRF RP ABC RP group map

```
R2#show ip pim vrf ABC rp mapping
PIM Group-to-RP Mappings

Group(s): 224.0.0.0/4, Static
   RP: 172.2.0.1 (?)
```

VRF Site RP group map (Cont.)

R9 VRF ABC RP group map

```
RP/0/0/CPU0:R9#show pim vrf ABC group-map
Group Range        Proto Client   Groups RP address      Info

224.0.1.39/32*     DM    perm     0      0.0.0.0
224.0.1.40/32*     DM    perm     1      0.0.0.0
224.0.0.0/24*      NO    perm     0      0.0.0.0
232.0.0.0/8*       SSM   config   0      0.0.0.0
224.0.0.0/4*       SM    config   2      172.2.0.1       RPF: md,2.2.0.7
224.0.0.0/4        SM    static   0      0.0.0.0         RPF: Null,0.0.0.0
```

R6 VRF ABC RP group map

```
R6#show ip pim vrf ABC rp mapping
PIM Group-to-RP Mappings

Group(s): 224.0.0.0/4, Static
    RP: 172.2.0.1 (?)
```

Multicast VPN Tunnel Adjacency

R8 Tunnel neighbor

RP/0/0/CPU0:R8#show pim vrf ABC neighbor

Neighbor Address	Interface	Uptime	Expires	DR pri	Flags
2.2.0.2	mdtABC	6d02h	00:01:28	1	P
2.2.0.6	mdtABC	4d05h	00:01:16	1	P
2.2.0.7	mdtABC	6d01h	00:01:44	1	P
2.2.0.8*	mdtABC	10w2d	00:01:34	1	B
2.2.0.9	mdtABC	6d02h	00:01:17	1 (DR)	B
172.2.38.3	GigabitEthernet0/2/0/2.38	6d02h	00:01:17	1	P
172.2.38.8*	GigabitEthernet0/2/0/2.38	8w6d	00:01:36	1 (DR)	B P

R7 Tunnel neighbor

R7#show ip pim vrf ABC neighbor

Neighbor Address	Interface	Uptime/Expires	Ver	DR Prio/Mode
172.2.17.1	Ethernet1/0	6d01h/00:01:17	v2	1 / S P
2.2.0.6	Tunnel1	4d05h/00:01:42	v2	1 / S P
2.2.0.9	Tunnel1	6d01h/00:01:44	v2	1 / DR
2.2.0.8	Tunnel1	6d01h/00:01:31	v2	1 /
2.2.0.2	Tunnel1	6d01h/00:01:24	v2	1 / S P

Multicast VPN Tunnel Adjacency (Cont.)

R9 Tunnel neighbor

```
RP/0/0/CPU0:R9#show pim vrf ABC neighbor
Neighbor Address    Interface          Uptime    Expires  DR pri   Flags
2.2.0.2             mdtABC             6d23h     00:01:29 1       P
2.2.0.6             mdtABC             5d02h     00:01:25 1       P
2.2.0.7             mdtABC             6d22h     00:01:27 1       P
2.2.0.8             mdtABC             6d23h     00:01:36 1       B
2.2.0.9*            mdtABC             10w3d     00:01:39 1 (DR) B A
172.2.59.5          GigabitEthernet0/2/0/1.59 6d23h     00:01:41 1       P
172.2.59.9*         GigabitEthernet0/2/0/1.59 10w3d     00:01:21 1 (DR) B P A
```

R6 Tunnel neighbor

```
R6#show ip pim vrf ABC neighbor
Neighbor        Interface            Uptime/Expires    Ver   DR
Address                                                      Prio/Mode
172.2.126.12    Ethernet1/0          2d05h/00:01:18    v2    1 / S P
2.2.0.9         Tunnel0              5d02h/00:01:21    v2    1 / DR
2.2.0.8         Tunnel0              5d02h/00:01:18    v2    1 /
2.2.0.2         Tunnel0              5d02h/00:01:41    v2    1 / S P
2.2.0.7         Tunnel0              5d02h/00:01:39    v2    1 / S P
```

Multicast VPN Multicast routes

R7 MVPN mroute

```
R7#show ip mroute 239.255.13.27

(*, 239.255.13.27), 01:11:12/stopped, RP 2.2.0.2, flags: SJCFZ
  Incoming interface: Ethernet0/2, RPF nbr 2.2.27.2
  Outgoing interface list:
    MVRF ABC, Forward/Sparse, 01:11:12/00:00:46

(2.2.0.2, 239.255.13.27), 01:10:44/00:02:39, flags: JTZ
  Incoming interface: Ethernet0/2, RPF nbr 2.2.27.2
  Outgoing interface list:
    MVRF ABC, Forward/Sparse, 01:10:44/00:01:15

(2.2.0.8, 239.255.13.27), 01:11:08/00:03:19, flags: TZ
  Incoming interface: Ethernet0/0, RPF nbr 2.2.78.8
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse, 01:10:25/00:03:05
    MVRF ABC, Forward/Sparse, 01:11:08/00:00:51

(2.2.0.6, 239.255.13.27), 01:11:09/00:03:19, flags: TZ
  Incoming interface: Ethernet0/1, RPF nbr 2.2.79.9
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 01:10:54/00:02:34
    MVRF ABC, Forward/Sparse, 01:11:12/00:00:47

(2.2.0.7, 239.255.13.27), 01:11:13/00:03:26, flags: FT
  Incoming interface: Loopback0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse, 01:10:38/00:02:52
    Ethernet0/0, Forward/Sparse, 01:10:54/00:02:34
    Ethernet0/2, Forward/Sparse, 01:11:13/00:03:13

(2.2.0.9, 239.255.13.27), 01:11:14/00:03:26, flags: TZ
  Incoming interface: Ethernet0/1, RPF nbr 2.2.79.9
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 01:10:54/00:02:34
    MVRF ABC, Forward/Sparse, 01:11:14/00:00:45
```

Multicast VPN Multicast routes(Cont.)

R8 MVPN mroute

RP/0/0/CPU0:R8#show mrib ipv4 route 239.255.13.27

(*,239.255.13.27) RPF nbr: 2.2.28.2 Flags: C MD MH CD
  Incoming Interface List
    GigabitEthernet0/2/0/2.28 Flags: A NS, Up: 6d22h
  Outgoing Interface List
    Loopback0 Flags: F NS, Up: 10w3d

(2.2.0.2,239.255.13.27) RPF nbr: 2.2.28.2 Flags: MD MH CD
  MVPN TID: 0xe0000001
  Incoming Interface List
    GigabitEthernet0/2/0/2.28 Flags: A, Up: 6d22h
  Outgoing Interface List
    Loopback0 Flags: F NS, Up: 6d23h

(2.2.0.6,239.255.13.27) RPF nbr: 2.2.78.7 Flags: MD MH CD
  Incoming Interface List
    GigabitEthernet0/2/0/2.78 Flags: A, Up: 2d17h
  Outgoing Interface List
    Loopback0 Flags: F NS, Up: 6d23h

(2.2.0.7,239.255.13.27) RPF nbr: 2.2.78.7 Flags: MD MH CD
  Incoming Interface List
    GigabitEthernet0/2/0/2.78 Flags: A, Up: 2d17h
  Outgoing Interface List
    Loopback0 Flags: F NS, Up: 4w5d

(2.2.0.8,239.255.13.27) RPF nbr: 2.2.0.8 Flags: ME MH
  Incoming Interface List
    Loopback0 Flags: F A, Up: 10w3d
  Outgoing Interface List
    GigabitEthernet0/2/0/2.28 Flags: F NS, Up: 5d03h
    GigabitEthernet0/2/0/2.78 Flags: F NS, Up: 5d03h
    Loopback0 Flags: F A, Up: 10w3d

(2.2.0.9,239.255.13.27) RPF nbr: 2.2.78.7 Flags: MD MH CD
  Incoming Interface List
    GigabitEthernet0/2/0/2.78 Flags: A, Up: 2d17h
  Outgoing Interface List
    Loopback0 Flags: F NS, Up: 4w5d

Multicast VPN Multicast routes(Cont.)

R9 MVPN mroute

```
RP/0/0/CPU0:R9#show mrib ipv4 route 239.255.13.27

(*,239.255.13.27) RPF nbr: 2.2.29.2 Flags: C MD MH CD
  Incoming Interface List
    GigabitEthernet0/2/0/1.29 Flags: A NS, Up: 3d20h
  Outgoing Interface List
    Loopback0 Flags: F NS, Up: 10w3d

(2.2.0.2,239.255.13.27) RPF nbr: 2.2.29.2 Flags: MD MH
  Incoming Interface List
    GigabitEthernet0/2/0/1.29 Flags: A, Up: 3d20h
  Outgoing Interface List
    GigabitEthernet0/2/0/1.69 Flags: F NS, Up: 5d03h
    Loopback0 Flags: F NS, Up: 6d23h

(2.2.0.6,239.255.13.27) RPF nbr: 2.2.69.6 Flags: MD MH
  Incoming Interface List
    GigabitEthernet0/2/0/1.69 Flags: A, Up: 5d03h
  Outgoing Interface List
    GigabitEthernet0/2/0/1.29 Flags: F NS, Up: 3d20h
    GigabitEthernet0/2/0/1.79 Flags: F NS, Up: 4d22h
    Loopback0 Flags: F NS, Up: 6d23h

(2.2.0.7,239.255.13.27) RPF nbr: 2.2.79.7 Flags: MD MH
  Incoming Interface List
    GigabitEthernet0/2/0/1.79 Flags: A, Up: 6d22h
  Outgoing Interface List
    GigabitEthernet0/2/0/1.69 Flags: F NS, Up: 5d03h
    Loopback0 Flags: F NS, Up: 6d23h

(2.2.0.8,239.255.13.27) RPF nbr: 2.2.79.7 Flags: MD MH
  Incoming Interface List
    GigabitEthernet0/2/0/1.79 Flags: A, Up: 2d18h
  Outgoing Interface List
    GigabitEthernet0/2/0/1.69 Flags: F NS, Up: 5d03h
    Loopback0 Flags: F NS, Up: 6d23h

(2.2.0.9,239.255.13.27) RPF nbr: 2.2.0.9 Flags: ME MH
  Incoming Interface List
    Loopback0 Flags: F A, Up: 10w3d
  Outgoing Interface List
    GigabitEthernet0/2/0/1.29 Flags: F NS, Up: 3d20h
    GigabitEthernet0/2/0/1.69 Flags: F NS, Up: 5d03h
    GigabitEthernet0/2/0/1.79 Flags: F NS, Up: 5d04h
    Loopback0 Flags: F A, Up: 10w3d
```

Multicast VPN Multicast routes(Cont.)

R6 MVPN mroute

```
R6#show ip mroute 239.255.13.27

(*, 239.255.13.27), 01:37:35/stopped, RP 2.2.0.6, flags: SJCZ
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    MVRF ABC, Forward/Sparse, 01:37:35/00:01:24

(2.2.0.2, 239.255.13.27), 01:37:28/00:02:31, flags: JTZ
  Incoming interface: Ethernet0/1, RPF nbr 2.2.69.9
  Outgoing interface list:
    MVRF ABC, Forward/Sparse, 01:37:28/00:01:31

(2.2.0.6, 239.255.13.27), 01:37:32/00:03:21, flags: T
  Incoming interface: Loopback0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse, 01:37:29/00:03:02

(2.2.0.7, 239.255.13.27), 01:37:35/00:02:51, flags: JTZ
  Incoming interface: Ethernet0/1, RPF nbr 2.2.69.9
  Outgoing interface list:
    MVRF ABC, Forward/Sparse, 01:37:35/00:01:24

(2.2.0.8, 239.255.13.27), 01:37:36/00:02:59, flags: JTZ
  Incoming interface: Ethernet0/1, RPF nbr 2.2.69.9
  Outgoing interface list:
    MVRF ABC, Forward/Sparse, 01:37:36/00:01:22

(2.2.0.9, 239.255.13.27), 01:37:36/00:02:59, flags: JTZ
  Incoming interface: Ethernet0/1, RPF nbr 2.2.69.9
  Outgoing interface list:
    MVRF ABC, Forward/Sparse, 01:37:36/00:01:22
```

Multicast ping Verification

R3

```
R3#ping 239.255.5.5 source loopback 0 repeat 2
Type escape sequence to abort.
Sending 2, 100-byte ICMP Echos to 239.255.5.5, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.3
Reply to request 0 from 172.2.59.5, 56 ms
Reply to request 1 from 172.2.59.5, 60 ms

R3#ping 239.255.1.1 source loopback 0 repeat 2
Type escape sequence to abort.
Sending 2, 100-byte ICMP Echos to 239.255.1.1, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.3
Reply to request 0 from 172.2.17.1, 20 ms
Reply to request 1 from 172.2.17.1, 32 ms

R3#ping 239.255.12.12 source loopback 0 repeat 2
Type escape sequence to abort.
Sending 2, 100-byte ICMP Echos to 239.255.12.12, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.3
Reply to request 0 from 172.2.126.12, 52 ms
Reply to request 1 from 172.2.126.12, 48 ms
```

Multicast ping Verification (Cont.)

R5

```
R1#ping 239.255.5.5 source loopback 0 repeat 2
Type escape sequence to abort.
Sending 2, 100-byte ICMP Echos to 239.255.5.5, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.1
Reply to request 0 from 172.2.59.5, 24 ms
Reply to request 0 from 172.2.59.5, 24 ms
Reply to request 1 from 172.2.59.5, 20 ms
Reply to request 1 from 172.2.59.5, 28 ms

R1#ping 239.255.12.12 source loopback 0 repeat 2
Type escape sequence to abort.
Sending 2, 100-byte ICMP Echos to 239.255.12.12, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.1
Reply to request 0 from 172.2.126.12, 24 ms
Reply to request 0 from 172.2.126.12, 24 ms
Reply to request 1 from 172.2.126.12, 20 ms
Reply to request 1 from 172.2.126.12, 32 ms
```

Multicast ping Verification (Cont.)

R12

```
R12#ping 239.255.1.1 source loopback 0 repeat 2
Type escape sequence to abort.
Sending 2, 100-byte ICMP Echos to 239.255.1.1, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.12
Reply to request 0 from 172.2.17.1, 20 ms
Reply to request 0 from 172.2.17.1, 28 ms
Reply to request 1 from 172.2.17.1, 20 ms
Reply to request 1 from 172.2.17.1, 28 ms

R12#ping 239.255.3.3 source loopback 0 repeat 2
Type escape sequence to abort.
Sending 2, 100-byte ICMP Echos to 239.255.3.3, timeout is 2 seconds:
Packet sent with a source address of 172.2.0.12
Reply to request 0 from 172.2.38.3, 48 ms
Reply to request 0 from 172.2.38.3, 48 ms
Reply to request 1 from 172.2.38.3, 44 ms
Reply to request 1 from 172.2.38.3, 52 ms
```

Multicast VPN MDT table

R2 MVPN mdt table

```
R2#show ip bgp ipv4 mdt all
BGP table version is 31, local router ID is 2.2.0.2
   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 2:2 (default for vrf ABC)
*> 2.2.0.2/32       0.0.0.0                  0         0 ?
*>i2.2.0.7/32       2.2.0.7                  0    100      0 ?
*>i2.2.0.8/32       2.2.0.8                       100      0 i
*>i2.2.0.9/32       2.2.0.9                       100      0 i
Route Distinguisher: 1002:2
*>i2.2.0.6/32       2.2.0.9                  0    100      0 1002 ?
```

R8 MVPN mdt table

```
RP/0/0/CPU0:R8#show bgp ipv4 mdt
BGP router identifier 2.2.0.8, local AS number 2
   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 2:2
*>i2.2.0.2/96       2.2.0.2                  0    100      0 ?
*>i2.2.0.7/96       2.2.0.7                  0    100      0 ?
*> 2.2.0.8/96       0.0.0.0                             0 i
*>i2.2.0.9/96       2.2.0.9                       100      0 i
Route Distinguisher: 1002:2
*>i2.2.0.6/96       2.2.0.9                  0    100      0 1002 ?
```

Multicast VPN MDT table (Cont.)

R7 MVPN mdt table

```
R7#show ip bgp ipv4 mdt all
BGP table version is 21, local router ID is 2.2.0.77
  Network          Next Hop          Metric LocPrf Weight Path
Route Distinguisher: 2:2 (default for vrf ABC)
*>i2.2.0.2/32      2.2.0.2                0    100      0 ?
*> 2.2.0.7/32      0.0.0.0                             0 ?
*>i2.2.0.8/32      2.2.0.8                   100      0 i
*>i2.2.0.9/32      2.2.0.9                   100      0 i
Route Distinguisher: 1002:2
*>i2.2.0.6/32      2.2.0.9                0    100      0 100
```

R9 MVPN mdt table

```
RP/0/0/CPU0:R9#show bgp ipv4 mdt
BGP router identifier 2.2.0.9, local AS number 2
  Network          Next Hop          Metric LocPrf Weight Path
Route Distinguisher: 2:2
*>i2.2.0.2/96      2.2.0.2                0    100      0 ?
*>i2.2.0.7/96      2.2.0.7                0    100      0 ?
*>i2.2.0.8/96      2.2.0.8                   100      0 i
*> 2.2.0.9/96      0.0.0.0                             0 i
Route Distinguisher: 1002:2
*> 2.2.0.6/96      2.2.69.6                0           0 1002 ?
```

Multicast VPN MDT table (Cont.)

R6 MVPN mdt table

```
R6#show ip bgp ipv4 mdt all
BGP table version is 7, local router ID is 2.2.0.6

   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 2:2
*> 2.2.0.2/32       2.2.69.9                 0 2 ?
*> 2.2.0.7/32       2.2.69.9                 0 2 ?
*> 2.2.0.8/32       2.2.69.9                 0 2 i
*> 2.2.0.9/32       2.2.69.9                 0 2 i
Route Distinguisher: 1002:2 (default for vrf ABC)
*> 2.2.0.6/32       0.0.0.0                  0 ?
```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