Solutions

Multicast Groups and IGMP

IP PIM Dense Mode

IP PIM Sparse Mode with Static RP

IP PIM Sparse Mode with Auto RP

IP PIM Advanced and DVMRP

Before you begin...

Make sure you have Unicast routing connectivity between CE1, CE2, CE8, PE1, PE2, and PE3. Otherwise, you will get RPF checks failures and Multicast won't work. One of the workarounds is to use **ip mroute** static statements. RPF is checked against them before using Unicast IP routing table.

MULTICAST GROUPS AND IGMP

6.1: Enable multicast routing on CE1, CE2, CE8, PE1, PE2 and PE3.

Configure on all routers:
PE3-RACK1(config)#**ip multicast-routing**

```
PE3-RACK1#show ip multicast
  Multicast Routing: enabled
  Multicast Multipath: disabled
  Multicast Route limit: No limit
  Multicast Triggered RPF check: enabled
  Multicast Fallback group mode: Dense
```

6.2: Configure the following multicast groups on CE8 FastEthernet0/1 interface.

CE8-RACK1(config)#**int FastEthernet0/1**
CE8-RACK1(config-if)#**ip igmp join-group 224.8.8.8**
CE8-RACK1(config-if)#**ip igmp join-group 225.8.8.8**
CE8-RACK1(config-if)#**ip igmp join-group 235.235.235.235**
CE8-RACK1(config-if)#**ip igmp join-group 229.0.0.1**
CE8-RACK1(config-if)#**ip igmp join-group 229.0.0.2**

```
CE8-RACK1#show ip igmp groups
IGMP Connected Group Membership
Group Address    Interface            Uptime    Expires   Last Reporter
235.235.235.235  FastEthernet1/0      00:00:25  stopped   192.168.100.8
224.8.8.8        FastEthernet1/0      00:00:25  stopped   192.168.100.8
225.8.8.8        FastEthernet1/0      00:00:25  stopped   192.168.100.8
229.0.0.1        FastEthernet1/0      00:00:25  stopped   192.168.100.8
229.0.0.2        FastEthernet1/0      00:00:25  stopped   192.168.100.8
```

The IGMP **join-group** command makes a router advertise Multicast groups to itself. Now, CE8 wants to receive Multicast traffic on the specified Multicast group addresses.

6.3: Configure the following Multicast groups on CE2 Ethernet0/0 interface.

CE2-RACK1(config)#**int ethernet0/0**
CE2-RACK1(config-if)#**ip igmp join-group 224.2.2.2**
CE2-RACK1(config-if)#**ip igmp join-group 225.2.2.2**
CE2-RACK1(config-if)#**ip igmp join-group 235.235.235.235**

```
CE2-RACK1#show ip igmp groups
IGMP Connected Group Membership
Group Address    Interface            Uptime    Expires   Last Reporter
235.235.235.235  Ethernet0/0          00:00:17  never     10.23.1.1
224.2.2.2        Ethernet0/0          00:00:28  never     10.23.1.1
225.2.2.2        Ethernet0/0          00:00:23  never     10.23.1.1
```

6.4: Configure the following multicast groups on CE1 Ethernet0/0 interface.

CE1-RACK1(config)#**int ethernet0/0**
CE1-RACK1(config-if)#**ip igmp join-group 224.1.1.1**
CE1-RACK1(config-if)#**ip igmp join-group 225.1.1.1**
CE1-RACK1(config-if)#**ip igmp join-group 235.235.235.235**

```
CE1-RACK1#sh ip igmp groups
IGMP Connected Group Membership
Group Address    Interface            Uptime    Expires   Last Reporter
225.1.1.1        Ethernet0/0          00:01:30  stopped   10.13.1.1
224.1.1.1        Ethernet0/0          00:01:35  stopped   10.13.1.1
235.235.235.235  Ethernet0/0          00:01:24  stopped   10.13.1.1
```

6.5: IGMPv2 election should take place between PE3 and CE2.

So far you don't have **ip pim** enabled anywhere. To get this task done, you need to turn on Multicast routing protocol on these two interfaces: PE3 E0/0.23 and CE2 E0/0. IGMPv2 election process on one Ethernet segment happens by default when there's more than one interface with Multicast routing protocol enabled. This process will elect the IGMP querying router for the segment. IGMP router with the lowest IP address will be elected.

Before enabling IP PIM on these two interfaces, here's an output of the

show ip igmp int e0/0 command on CE2:

```
CE2-RACK1#sh ip igmp int e0/0
Ethernet0/0 is up, line protocol is up
  Internet address is 10.23.1.1/24
  IGMP is enabled on interface
  Current IGMP host version is 2
  Current IGMP router version is 2
  IGMP query interval is 60 seconds
  IGMP querier timeout is 120 seconds
  IGMP max query response time is 10 seconds
  Last member query count is 2
  Last member query response interval is 1000 ms
  Inbound IGMP access group is not set
  IGMP activity: 3 joins, 0 leaves
  Multicast routing is disabled on interface
  Multicast TTL threshold is 0
  Multicast groups joined (number of users):
      224.2.2.2(1)  225.2.2.2(1)  235.235.235.235(1)
```

Notice that IGMPv2 is enabled on the Ethernet0/0 interface but Multicast routing is not. These conditions won't allow IGMPv2 election process to start on this Ethernet segment. Also, notice that CE2 and PE3 right now only act as IGMP hosts, but not as IGMP routers. If you look at IGMP groups on PE3, you won't see CE2's groups:

```
PE3-RACK1#sh ip igmp groups
IGMP Connected Group Membership
Group Address   Interface   Uptime   Expires   Last Reporter
```

Configure one of the IP PIM modes on both routers. Start with PE3:

PE3-RACK1(config)#**int ethernet0/0.23**
PE3-RACK1(config-if)#**ip pim sparse-dense-mode**

As soon as you enable Multicast routing protocol on PE3 Ethernet0/0.23, PE3 will send out IGMPv2 report query on the segment and then accept IGMP joins from CE2 Ethernet0/0 interface and add the groups to its IGMP group table:

```
PE3-RACK1#sh ip igmp groups
IGMP Connected Group Membership
Group Address    Interface            Uptime    Expires   Last Reporter
235.235.235.235  Ethernet0/0.23       00:00:12  00:02:47  10.23.1.1
224.2.2.2        Ethernet0/0.23       00:00:11  00:02:48  10.23.1.1
225.2.2.2        Ethernet0/0.23       00:00:12  00:02:47  10.23.1.1
224.0.1.40       Ethernet0/0.23       00:00:14  00:02:45  10.23.1.3
```

Notice the new 224.0.1.40 group that PE3 has joined on Ethernet0/0.23 interface. It enables these routers to receive PIM Sparse Mode Auto-RP discovery messages sent to the 224.0.1.40 group address. Auto-RP will be configured later on.

Now, let's enable IP PIM on CE2:

CE2-RACK1(config)#**int ethernet0/0**
CE2-RACK1(config-if)#**ip pim sparse-dense-mode**

Go back to PE3:

```
PE3-RACK1#sh ip igmp interface ethernet0/0.23
Ethernet0/0.23 is up, line protocol is up
  Internet address is 10.23.1.3/24
  IGMP is enabled on interface
  Current IGMP host version is 2
  Current IGMP router version is 2
  IGMP query interval is 60 seconds
  IGMP querier timeout is 120 seconds
  IGMP max query response time is 10 seconds
  Last member query count is 2
  Last member query response interval is 1000 ms
  Inbound IGMP access group is not set
  IGMP activity: 4 joins, 0 leaves
  Multicast routing is enabled on interface
  Multicast TTL threshold is 0
  Multicast designated router (DR) is 10.23.1.3 (this system)
  IGMP querying router is 10.23.1.1
  Multicast groups joined (number of users):
      224.0.1.40(1)
```

Pay attention to the two bolded lines in the output.

The first bold line shows PIM Designated Router on this segment, which is PE3. Multicast routers automatically elect a PIM designated router for the LAN (subnet). This is the router with the highest IP address. The

designated router is responsible for sending IGMP host-query messages to all hosts on the LAN. In sparse mode, the designated router also sends PIM register and PIM join messages toward the RP router.

The second bold line shows IGMP elected querying router on this segment, which is CE2. This is the router with the lowest IP address. IGMPv2 Election process took place. Let's double check CE2:

```
CE2-RACK1#sh ip igmp int e0/0
Ethernet0/0 is up, line protocol is up
  Internet address is 10.23.1.1/24
  IGMP is enabled on interface
  Current IGMP host version is 2
  Current IGMP router version is 2
  IGMP query interval is 60 seconds
  IGMP querier timeout is 120 seconds
  IGMP max query response time is 10 seconds
  Last member query count is 2
  Last member query response interval is 1000 ms
  Inbound IGMP access group is not set
  IGMP activity: 5 joins, 1 leaves
  Multicast routing is enabled on interface
  Multicast TTL threshold is 0
  Multicast designated router (DR) is 10.23.1.3
  IGMP querying router is 10.23.1.1 (this system)
  Multicast groups joined (number of users):
      224.2.2.2(1)  225.2.2.2(1)  235.235.235.235(1)
      224.0.1.40(1)
```

```
PE3-RACK1#sh ip igmp groups
IGMP Connected Group Membership
Group Address    Interface            Uptime    Expires   Last Reporter
235.235.235.235  Ethernet0/0.23       00:00:12  00:02:47  10.23.1.1
224.2.2.2        Ethernet0/0.23       00:00:11  00:02:48  10.23.1.1
225.2.2.2        Ethernet0/0.23       00:00:12  00:02:47  10.23.1.1
224.0.1.40       Ethernet0/0.23       00:00:14  00:02:45  10.23.1.3
```

```
PE3-RACK1#sh ip igmp interface ethernet0/0.23
Ethernet0/0.23 is up, line protocol is up
  Internet address is 10.23.1.3/24
  IGMP is enabled on interface
  Current IGMP host version is 2
  Current IGMP router version is 2
  IGMP query interval is 60 seconds
  IGMP querier timeout is 120 seconds
  IGMP max query response time is 10 seconds
  Last member query count is 2
  Last member query response interval is 1000 ms
  Inbound IGMP access group is not set
  IGMP activity: 4 joins, 0 leaves
  Multicast routing is enabled on interface
  Multicast TTL threshold is 0
  Multicast designated router (DR) is 10.23.1.3 (this system)
  IGMP querying router is 10.23.1.1
  Multicast groups joined (number of users):
      224.0.1.40(1)
```