# 下一代组播 — 默认MDT GRE(BGP AD - PIM C:简档3)

## 目录



## 简介

本文档介绍用于VPN组播(mVPN)的默认组播分发树(MDT)GRE(BGP AD - PIM C)。 它使用Cisco IOS中的示例和实施来说明该行为。

## 什么是默认MDT?

它用于将组播连接到一个VRF中的所有PE。默认值表示它连接所有PE路由器。默认情况下，它传输所有流量。所有PIM控制流量和数据平面流量。示例：(*,G)流量和(S，G)流量。默认为必须。此默认MDT连接所有要连接的PE路由器。这表示多点对多点。任何人都可以发送，每个人都可以从树上接收。

## 什么是数据MDT?

它是可选的，是按需创建的。它传输特定(S，G)流量。在最新的IOS版本中，您将阈值配置为0和infinite。当第一个数据包到达VRF时，数据MDT会初始化，如果无穷大，则不会创建数据MDT，并且流量在默认MDT中前进。数据MDT始终是接收树，它们从不发送任何流量。数据MDT仅用于(S，G)流量。

创建数据MDT的阈值可以按路由器或按VRF配置。当组播传输超过定义的阈值时，发送方PE路由器会创建数据MDT并发送用户数据报协议(UDP)消息，该消息包含有关数据MDT的信息，该消息将发送到默认MDT上的所有路由器。每秒检查一次用于确定组播流是否超过数据MDT阈值的统计数据。

> **注意**：PE路由器发送UDP消息后，会再等待3秒后再进行交换；13秒是最坏情况切换时间，3秒是最佳情况。

仅为VRF组播路由表中的(S， G)组播路由条目创建数据MDT。不为(*, G)条目创建它们，而不考虑单个源数据速率的值

- 允许PE直接加入MDT的源树。
- 网络中不需要交汇点。
- RP是潜在的故障点和额外的开销。
- 但它们允许共享树和BiDir树（较少状态）。
- 减少转发延迟。
- 避免管理组/RP映射和冗余RP以实现可靠性的管理开销。
- 更需要省/自治区/直辖市/自治区。
- (S， G)。

如果每个有5个PE保持mVRF RED，则有5个x(S， G)条目。

1. 在P和PE路由器上配置ip pim ssm range命令(避免创建不必要的(*, G)条目)。
2. 建议用于Data-MDT的SSM。
3. 如果可能，请对Default-MDT使用BiDir（BiDir支持特定于平台）。

如果SSM不用于设置数据MDT:

- 每个VRF需要配置一组唯一的组播P地址；同一MD中的两个VRF不能配置相同的地址集。
- 需要更多组播P地址。
- 操作和管理复杂。
- SSM要求PE加入(S， G)，而不是(*, G)。

G称为配置，但PE不直接知道MP-BGP传播的默认MDT的S(S， G)值。

SSM的优点是它不依赖于使用RP为特定MDT组派生源PE路由器。

源PE和默认MDT组的IP地址通过边界网关协议(BGP)发送

BGP可以通过两种方式发送此信息：

- 扩展社区 思科专有解决方案非传递属性（不适用于AS间）
- BGP地址系列MDT SAFI(66) **draft-nalawade-idr-mdt-safi**

  **注意**：使用MDT SAFI之前支持GRE MVPN;实际上，即使在使用RD类型2的MDT SAFI之前也是如此。从技术上讲，对于配置文件3,MDT SAFI不应进行配置，但同时支持两个SAFI进行迁移。

# 调试输出中显示"BGP

- 源PE和MDT默认组在MP_REACH_NLRI的NLRI**中编码**。
- RD与配置MDT默认组的MVRF相同。
- RD类型为0或1

```
▼ Path Attribute - MP_REACH_NLRI
  ▶ Flags: 0x80, Optional: Optional, Non-transitive, Complete
    Type Code: MP_REACH_NLRI (14)
    Length: 23
    Address family identifier (AFI): IPv4 (1)
    Subsequent address family identifier (SAFI): MCAST-VPN (5)
    Next hop network address (4 bytes)
    Number of Subnetwork points of attachment (SNPA): 0
  ▼ Network layer reachability information (14 bytes)
      Route Type: Intra-AS I-PMSI A-D route (1)
      Length: 12
▶ Path Attribute - ORIGIN: INCOMPLETE
▶ Path Attribute - AS_PATH: empty
▶ Path Attribute - MULTI_EXIT_DISC: 0
▶ Path Attribute - LOCAL_PREF: 100
▶ Path Attribute - COMMUNITIES: NO_EXPORT
▶ Path Attribute - EXTENDED_COMMUNITIES
▼ Path Attribute - PMSI_TUNNEL_ATTRIBUTE
  ▶ Flags: 0xc0, Optional, Transitive: Optional, Transitive, Complete
    Type Code: PMSI_TUNNEL_ATTRIBUTE (22)
    Length: 13
    Flags: 0
    Tunnel Type: PIM SSM Tree (3)
  ▶ MPLS Label Stack:  (withdrawn)
  ▼ Tunnel ID: < 1.1.1.1, 239.232.0.0 >
      PIM-SSM Tree tunnel Root Node: 1.1.1.1
      PIM-SSM Tree tunnel P-multicast group: 239.232.0.0
```

PMSI属性传送源地址和组地址。以形成MT隧道。

## SSM组的组播编址

232.0.0.0 - 232.255.255.255**已为全**局源特定组播应用保留。

239.0.0.0 - 239.255.255.255**是管**理范围的IPv4组播地址空间范围

IPv4组织本地范围 — 239.192.0.0/14

本地范围是最小的封闭范围，因此不能进一步分。

范围**239.0.0.0/10**、**239.64.0.0/10**和**239.128.0.0/10**未分配，可用于扩展此空间。

在239.192.0.0/14空间不再足**够之前，**应保留这些范围的未分配。

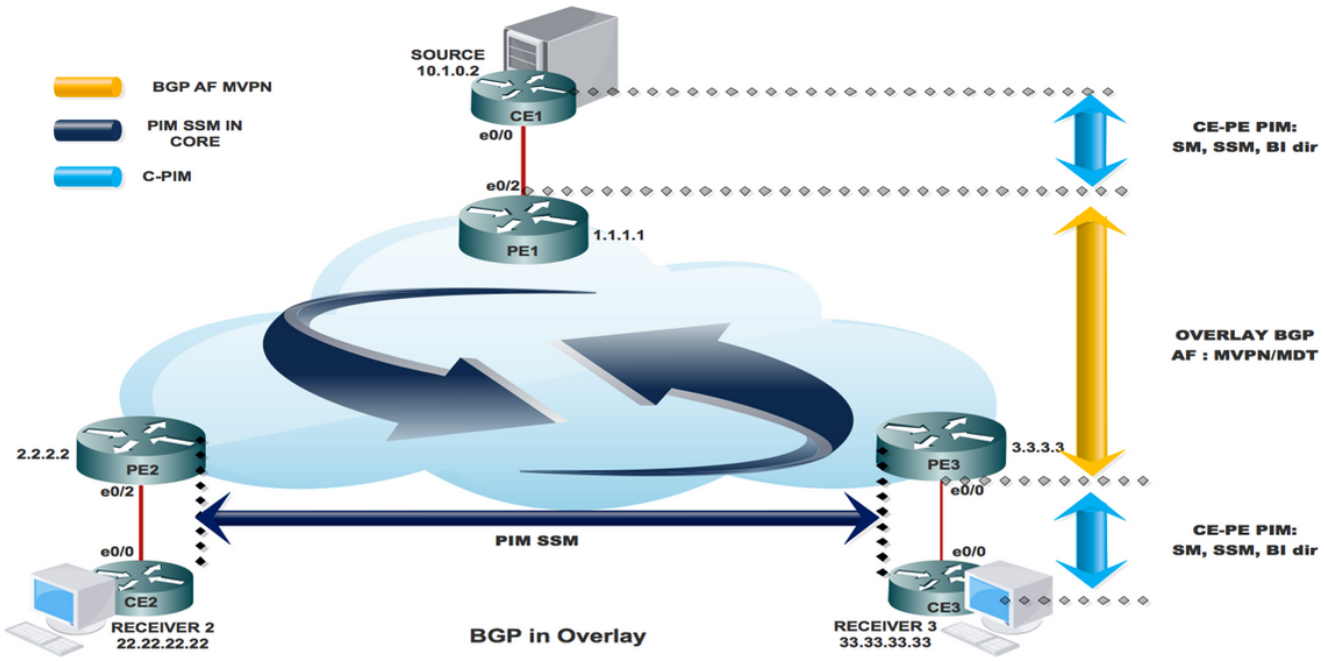
### 建议

- Default-MDT应从239/8空间提取地址，起始范围为组织本地范围239.192.0.0/14
- Data-MDT应从组织本地范围中提取地址。
- 也可以使用SSM全局范围232.0.0.0 - 232.255.255.255
- 由于SSM始终使用唯一(S， G)状态，因此不可能重叠，因为SSM组播流将由不同源（使用不同地址）发起，无论它们是在提供商网络内还是更大的Internet内。
- 对特定组播域（其中Default-MDT是常用的）内的每个mVRF使用相同的Data-MDT池。

例如，所有使用Default-MDT 239.192.10.1的VRF都应使用相同的数据MDT 239.232.1.0/24范围

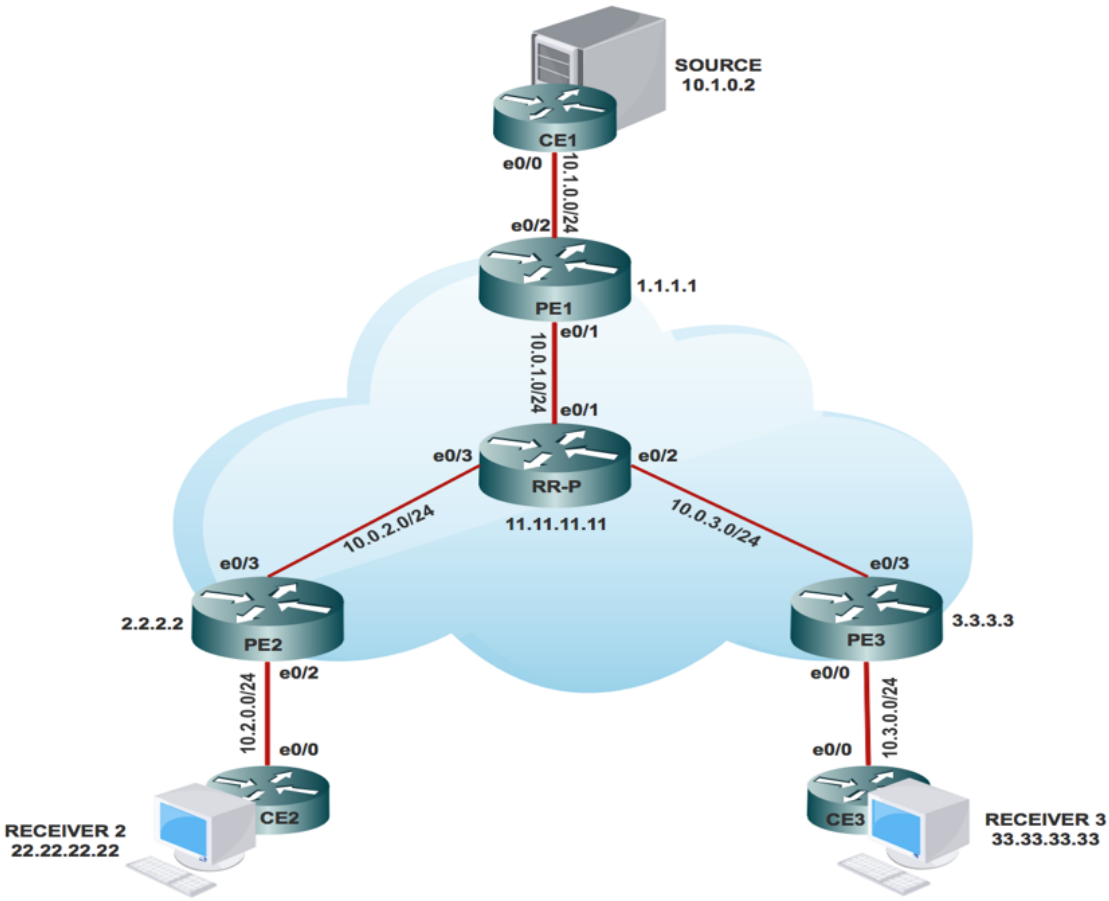
## 重叠信令

Rosen GRE的重叠信令如图所示。




### 拓扑

Rosen GRE的拓扑如图所示。




# 组播VPN路由和转发以及组播域

MVPN将组播路由信息引入VPN路由和转发表。当提供商边缘(PE)路由器从客户边缘(CE)路由器接收组播数据或控制数据包时，根据组播VPN路由和转发实例(MVRF)中的信息执行转发。MVPN不使用标签交换。

可相互发送组播流量的一组MVRF构成组播域。例如，客户希望向所有全球员工发送特定类型组播流量的组播域将包含与该企业关联的所有CE路由器。

## 配置任务

1. 在所有节点上启用组播路由。
2. 在所有接口上启用协议独立组播(PIM)稀疏模式。
3. 使用现有VRF配置默认MDT。
4. 在接口Ethernet0/x上配置VRF。
5. 在VRF上启用组播路由。
6. 在核心内的所有节点中配置PIM SSM默认值。
7. 配置BGP地址系列MVPN。

8. 在CE节点中配置BSR RP。

9. 预配置：

```
VRF SSM-BGP
mBGP: Address family VPNv4
VRF Routing Protocol
```

**Configuration Steps:**

**Enable Multicast Routing**

On All Nodes

```
(conf) # ip multicast-routing
```

Enable "ip multicast-routing" in global mode on all nodes.

**Enable PIM Sparse Mode**

Enable on all connected Interface

```
(config)#interface Ethernet0/x
(config-if)#ip pim sparse-mode

(config)# interface lo0
(config-if)# ip pim sparse-mode
```

"x" represents the connected interface number on all nodes

---

**Configure Default MDT Group in VRF**

On PE1, PE2 and PE3

```
(config)#ip vrf SSM-BGP
(config-vrf)# mdt auto-discovery pim
(config-vrf)# mdt default 239.232.0.0
```

SERVICE PROVIDER : Group : 239.232.0.0 Source : 1.1.1.1

---

**Configure the VRF on the interface Ethernet0/x**

On PE1, PE2 and PE3

```
(config)#interface Ethernet0/x
(config-if)# ip vrf forwarding SSM-BGP
(config-if)# ip address 10.x.0.1 255.255.255.0
(config-if)# ip pim sparse-mode
```

"x" represent the interface number that PE connected to CE.

**Enable Multicast Routing on VRF**

On PE1, PE2 and PE3

```
(conf) # ip multicast-routing vrf SSM-BGP
```

Enable "ip multicast-routing m-GRE" in global mode.

**Configure PIM SSM Default in all nodes inside the core.**

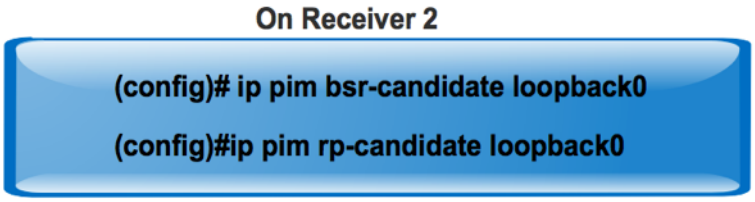
On PE1, PE2, PE3 and RR-P Node

```
(config) # ip pim ssm default
```

Static RP configuration in the core in global mode.

---

**Configure BSR RP in CE Node (Receiver)**




BSR RP configuration in the Receiver 2 in global mode.

---

# 验证

## 任务 1：验证物理连接.

验证所有连接的接口都是UP。

## 任务 2：检验BGP地址系列VPNv4单播。

- 验证AF VPNv4单播和BGP邻居处于UP状态的所有路由器中是否启用了BGP。
- 验证BGP VPNv4单播表具有所有客户前缀。

## 任务 3：检验BGP地址系列MVPN单播。

- 验证AF IPV4 MVPN的所有路由器中是否启用了BGP，且BGP邻居处于UP。
- 使用第1类路由检验所有PE发现是否彼此。

## 任务 4：检验端到端组播流量。

- 检查PIM邻居关系。
- 验证组播状态是在VRF中创建的。
- 验证PE1、PE2和PE3上的mRIB条目。
- 验证(S， G)mFIB条目，数据包在软件转发时递增。
- 检验从CE到CE的ICMP数据包是否到达。

## Task 1: Verify Physical Connectivity

**Verify all the connected interface are "UP"**

```
#sh ip interface brief
```

## Task 2: Verify Address Family VPNv4 unicast

**Address Family VPNv4 unicast and BGP neighbors**

```
# show running-config | s r bgp
# show bgp vpnv4 unicast summary all
```

**VPNv4 unicast table has all the Customer prefixes**

```
PE1#sh bgp vpnv4 unicast all

BGP table version is 31, local router ID is 1.1.1.1

     Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 100:100 (default for vrf m-GRE)

 *>i 22.22.22.22/32   2.2.2.2                  0    100      0 20 i
 *>i 33.33.33.33/32   3.3.3.3                  0    100      0 30 i
 *>  111.111.111.111/32
                       10.1.0.2                 0             0 10 i
```

Check on all the PE nodes (PE1, PE2 and PE3)

---

## Task 3: Verify Address Family IPv4 MVPN

**Address Family IPv4 MVPN and BGP neighbors**

```
# show running-config | s r bgp
# #sh bgp ipv4 mvpn all
```

**IPv4 MVPN table has all the PE routes with Type 1 routes**

```
PE1#sh bgp ipv4 mvpn all
BGP table version is 15, local router ID is 1.1.1.1

Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 1:1 (default for vrf SSM-BGP)
 *>   [1][1:1][1.1.1.1]/12
                      0.0.0.0                            32768 ?
 *>i  [1][1:1][2.2.2.2]/12
                      2.2.2.2                  0    100      0 ?
 *>i  [1][1:1][3.3.3.3]/12
                      3.3.3.3                  0    100      0 ?
Route Distinguisher: 2:2
 *>i  [1][2:2][2.2.2.2]/12
                      2.2.2.2                  0    100      0 ?
Route Distinguisher: 3:3
     Network          Next Hop            Metric LocPrf Weight Path
 *>i  [1][3:3][3.3.3.3]/12
                      3.3.3.3                  0    100      0 ?
```

Check on all the PE nodes (PE1, PE2 and PE3)

**Verify that (S,G) mFIB entry, packet getting incremented**

```
PE1#sh ip mfib vrf SSM-BGP 225.1.1.1 verbose

I/O Item Flags:
                NS - Negate Signalling, SP - Signal Present,
                A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
                MA - MFIB Accept,

Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts:      Total/RPF failed/Other drops
I/O Item Counts:   FS Pkt Count/PS Pkt Count
VRF SSM-BGP
 (10.1.0.2,225.1.1.1) Flags: K DDE
   SW Forwarding: 10/0/100/0, Other: 2/1/1
   Ethernet0/2 Flags: RA A MA
   Tunnel0, MDT/239.232.0.0 Flags: RF F NS
     CEF: Adjacency with MAC: 4500000000000000FF2FC9E401010101EFE8000000000800
     Pkts: 10/0
```

**Verify that multicast state is created in the VRF**

```
PE1#sh ip mroute vrf SSM-BGP verbose
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, p - PIM Joins on route,


(10.1.0.2, 225.1.1.1), 00:00:03/00:02:56, flags: Tp
  Incoming interface: Ethernet0/2, RPF nbr 10.1.0.2
  Outgoing interface list:
    Tunnel0, GRE MDT: 239.232.0.0 (default), Forward/Sparse, 00:00:03/00:03:26, p
```

Check on all the PE nodes (PE1, PE2 and PE3)

**Verify that (S,G) mFIB entry, packet getting incremented**

```
PE1#sh ip mfib vrf SSM-BGP 225.1.1.1 verbose

I/O Item Flags:
                NS - Negate Signalling, SP - Signal Present,
                A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
                MA - MFIB Accept,

Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts:      Total/RPF failed/Other drops
I/O Item Counts:   FS Pkt Count/PS Pkt Count
VRF SSM-BGP
 (10.1.0.2,225.1.1.1) Flags: K DDE
   SW Forwarding: 10/0/100/0, Other: 2/1/1
   Ethernet0/2 Flags: RA A MA
   Tunnel0, MDT/239.232.0.0 Flags: RF F NS
     CEF: Adjacency with MAC: 4500000000000000FF2FC9E401010101EFE8000000000800
     Pkts: 10/0
```

mRIB in the Service Provider Core.

```
PE1#sh ip mroute verbose
IP Multicast Routing Table
Flags: s - SSM Group, C - Connected,
       T - SPT-bit set,
       I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,
       p - PIM Joins on route,

(1.1.1.1, 239.232.0.0), 01:00:33/00:03:03, flags: sTp
  Incoming interface: Loopback0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse, 01:00:33/00:03:03, p

(3.3.3.3, 239.232.0.0), 01:00:33/stopped, flags: sTIZ
  Incoming interface: Ethernet0/1, RPF nbr 10.0.1.2
  Outgoing interface list:
    MVRF SSM-BGP, Forward/Sparse, 01:00:33/00:02:26

(2.2.2.2, 239.232.0.0), 01:00:33/stopped, flags: sTIZ
  Incoming interface: Ethernet0/1, RPF nbr 10.0.1.2
  Outgoing interface list:
    MVRF SSM-BGP, Forward/Sparse, 01:00:33/00:02:26
```

Check on all the PE nodes (PE1, PE2 and PE3)

---

Verify ICMP packets getting reach from CE to CE

```
SOURCE1#ping 225.1.1.1
Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 225.1.1.1, timeout is 2 seconds:

Reply to request 0 from 10.3.0.2, 29 ms
Reply to request 0 from 10.3.0.2, 29 ms
```

---

# 如何创建隧道接口？

## MDT隧道创建

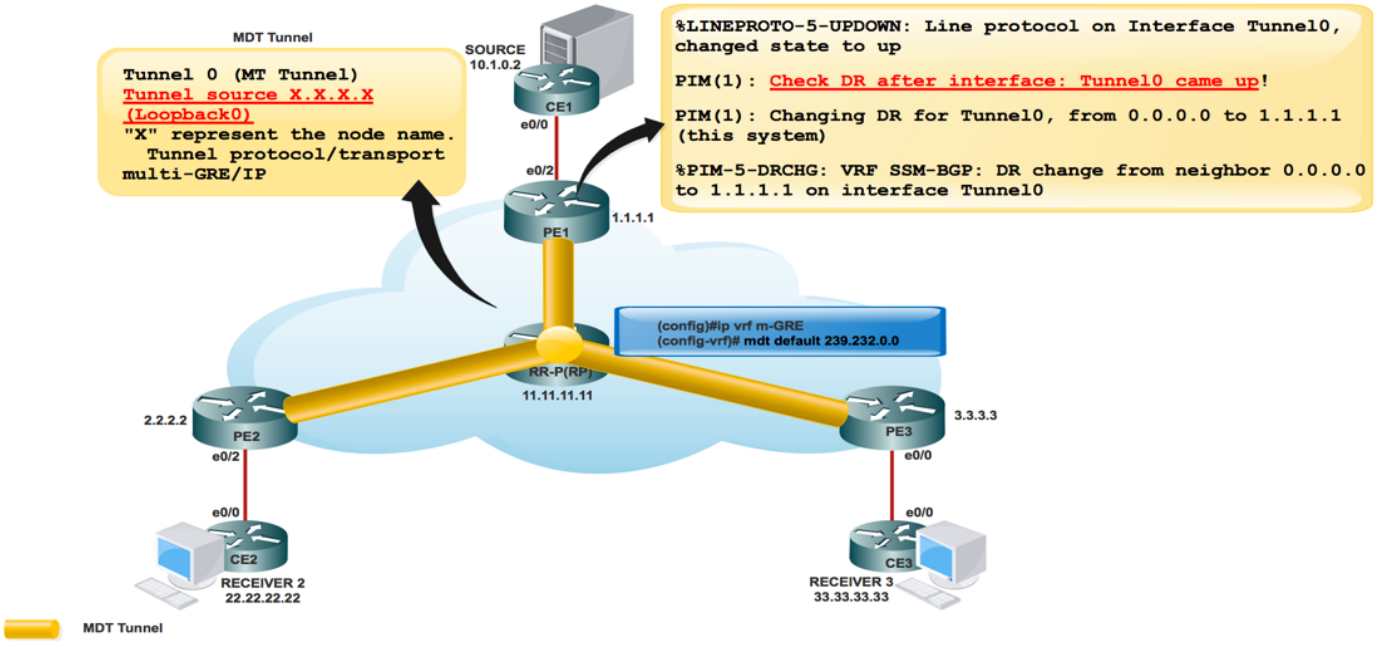
配置mdt默认239.232.0.0后

隧道0启动并分配其Loopback 0地址作为源。

%LINEPROTO-5-UPDOWN:接口Tunnel0上的线路协议，状态更改为up

```
PIM(1): Check DR after interface: Tunnel0 came up!
PIM(1): Changing DR for Tunnel0, from 0.0.0.0 to 1.1.1.1 (this system)
%PIM-5-DRCHG: VRF SSM-BGP: DR change from neighbor 0.0.0.0 to 1.1.1.1 on interface Tunnel0
```

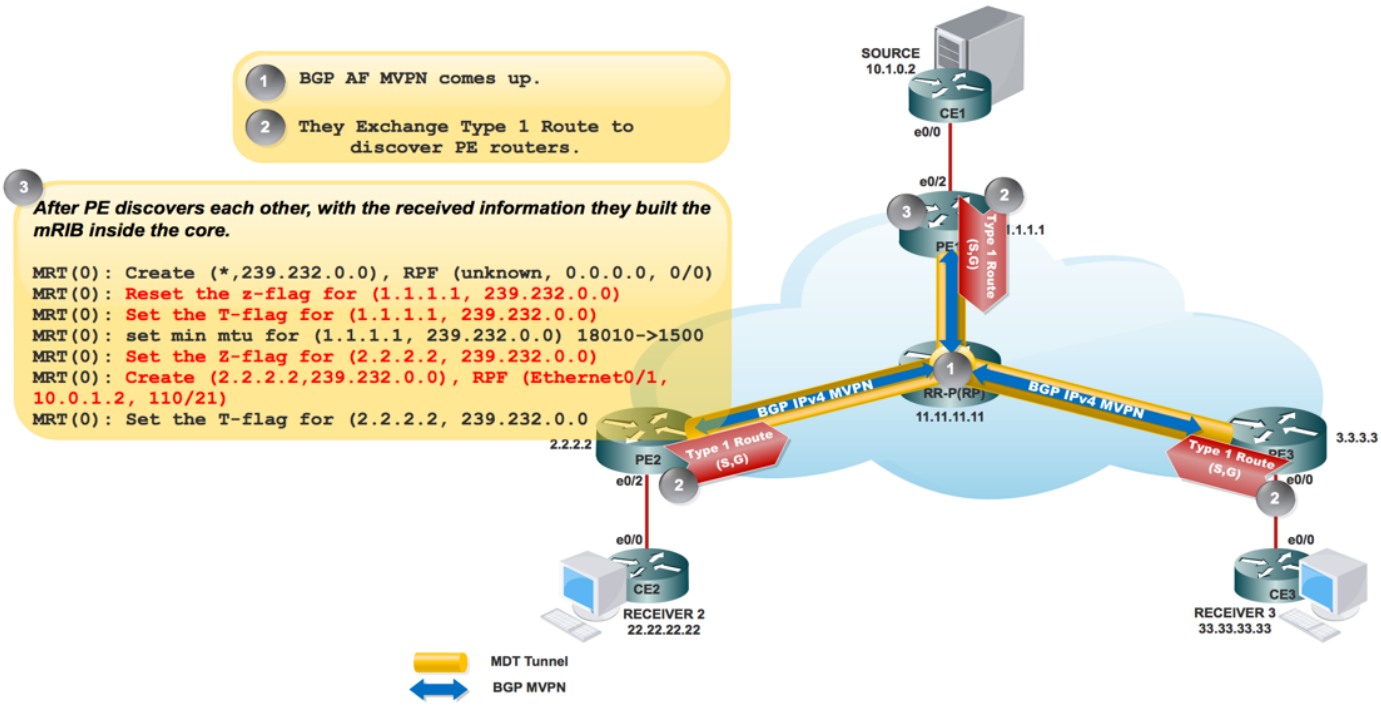
此图显示MDT隧道创建。




```
PE1#sh int tunnel 0
Tunnel0 is up, line protocol is up
  Hardware is Tunnel
  Interface is unnumbered. Using address of Loopback0 (1.1.1.1)
  MTU 17916 bytes, BW 100 Kbit/sec, DLY 50000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation TUNNEL, loopback not set
  Keepalive not set
  Tunnel source 1.1.1.1 (Loopback0)
   Tunnel Subblocks:
      src-track:
         Tunnel0 source tracking subblock associated with Loopback0
          Set of tunnels with source Loopback0, 1 member (includes iterators), on interface <OK>
  Tunnel protocol/transport multi-GRE/IP
    Key disabled, sequencing disabled
    Checksumming of packets disabled
```

一旦BGP MVPN启动，所有PE都通过第1类路由发现彼此。组播隧道已形成。BGP在PMSI属性中传输所有组和源PE地址。

此图显示第1类路由的交换。




此图显示PCAP-1。

```
▼ Path attributes
  ▼ Path Attribute — MP_REACH_NLRI
    ▶ Flags: 0x80, Optional: Optional, Non-transitive, Complete
      Type Code: MP_REACH_NLRI (14)
      Length: 23
      Address family identifier (AFI): IPv4 (1)
      Subsequent address family identifier (SAFI): MCAST-VPN (5)
      Next hop network address (4 bytes)
      Number of Subnetwork points of attachment (SNPA): 0
    ▼ Network layer reachability information (14 bytes)
        Route Type: Intra-AS I-PMSI A-D route (1)  ──────►  Type 1 Route
        Length: 12
  ▶ Path Attribute — ORIGIN: INCOMPLETE
  ▶ Path Attribute — AS_PATH: empty
  ▶ Path Attribute — MULTI_EXIT_DISC: 0
  ▶ Path Attribute — LOCAL_PREF: 100
  ▶ Path Attribute — COMMUNITIES: NO_EXPORT
  ▶ Path Attribute — EXTENDED_COMMUNITIES
  ▼ Path Attribute — PMSI_TUNNEL_ATTRIBUTE
    ▶ Flags: 0xc0, Optional, Transitive: Optional, Transitive, Complete
      Type Code: PMSI_TUNNEL_ATTRIBUTE (22)
      Length: 13
      Flags: 0
      Tunnel Type: PIM SSM Tree (3)  ──────►  PIM SSM TREE (Tunnel Type)
    ▶ MPLS Label Stack:  (withdrawn)
    ▼ Tunnel ID: < 1.1.1.1, 239.232.0.0 >
        PIM-SSM Tree tunnel Root Node: 1.1.1.1
        PIM-SSM Tree tunnel P-multicast group: 239.232.0.0  ◄──►  PIM SSM Tree Tunnel Root and Group
```

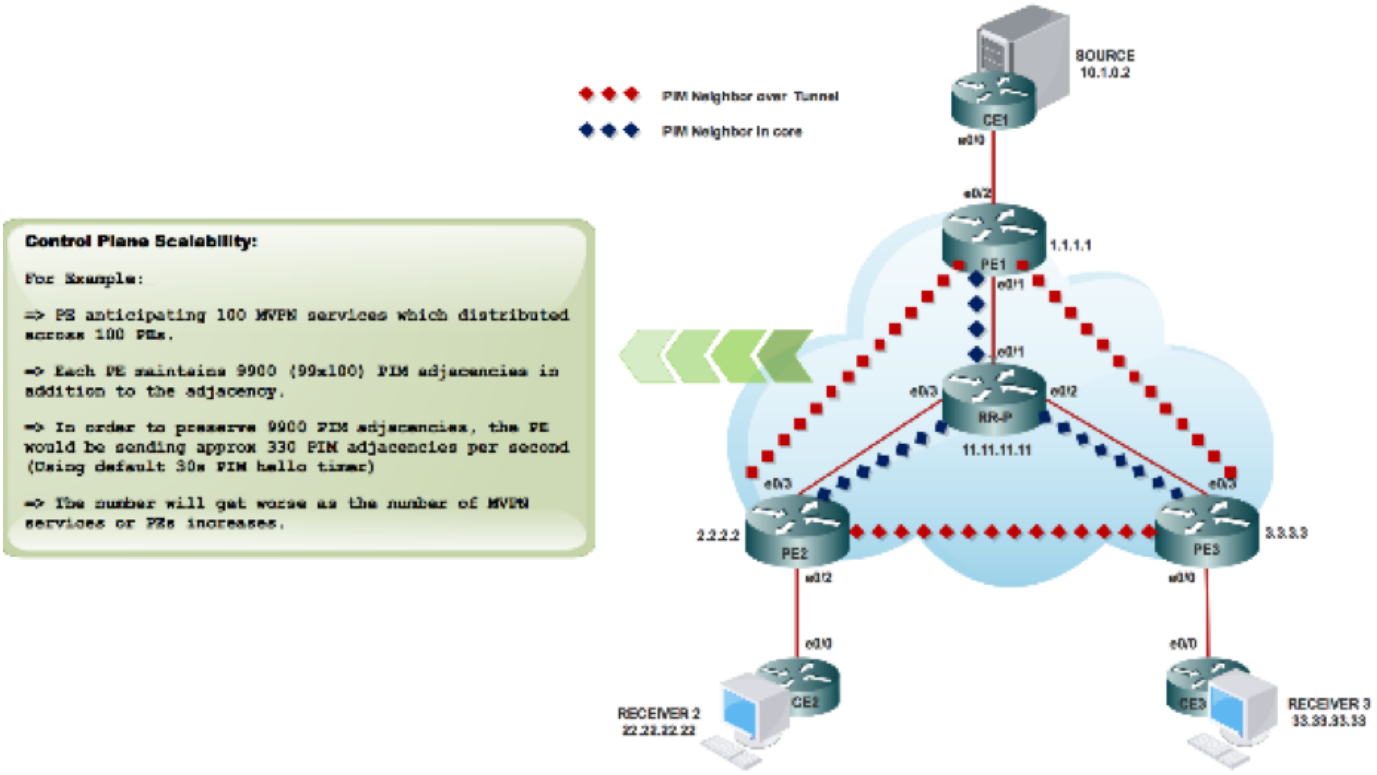
```
PE1#sh ip mroute
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
       X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
       U - URD, I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,

 (3.3.3.3, 239.232.0.0), 00:01:41/00:01:18, flags: sTIZ
  Incoming interface: Ethernet0/1, RPF nbr 10.0.1.2
  Outgoing interface list:
    MVRF SSM-BGP, Forward/Sparse, 00:01:41/00:01:18

(2.2.2.2, 239.232.0.0), 00:01:41/00:01:18, flags: sTIZ
  Incoming interface: Ethernet0/1, RPF nbr 10.0.1.2
```

```
  Outgoing interface list:
    MVRF SSM-BGP, Forward/Sparse, 00:01:41/00:01:18
```

“Z” Multicast Tunnel formed after BGP mVPN comes up, as it advertises the Source PE and Group Address in PMSI attribute.

## PIM邻居关系

```
PE1#sh ip pim vrf SSM-BGP neighbor
PIM Neighbor Table
Mode: B - Bidir Capable, DR - Designated Router, N - Default DR Priority,
      P - Proxy Capable, S - State Refresh Capable, G - GenID Capable
Neighbor          Interface                Uptime/Expires    Ver   DR
Address                                                            Prio/Mode
10.1.0.2          Ethernet0/2           00:58:18/00:01:31 v2  1 / DR S P G
3.3.3.3           Tunnel0                00:27:44/00:01:32 v2    1 / S P G
2.2.2.2           Tunnel0                00:27:44/00:01:34 v2    1 / S P G
```



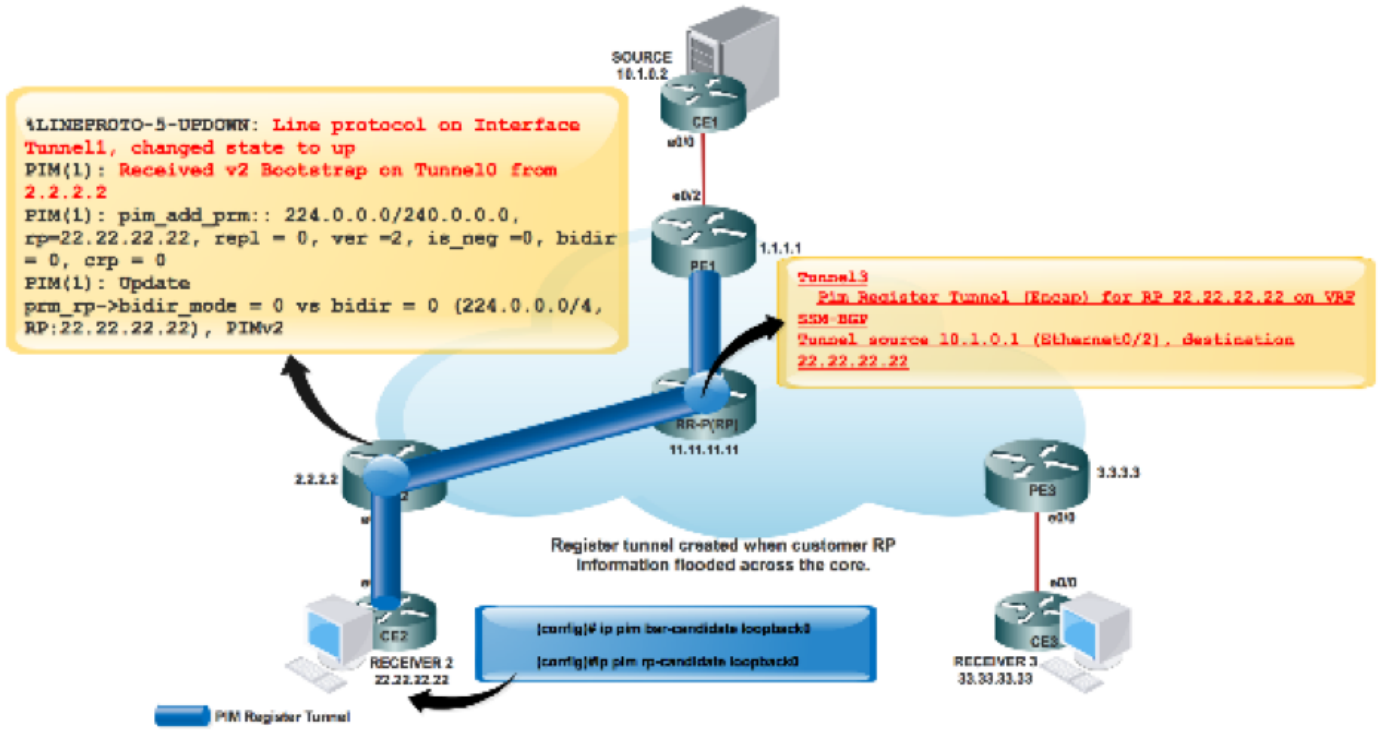

配置RP信息后：

%LINEPROTO-5-UPDOWN:**接口Tunnel1上的线路协议，状态更改为up**

通过MDT隧道的引导消息交换

```
PIM(1): Received v2 Bootstrap on Tunnel0 from 2.2.2.2
PIM(1): pim_add_prm:: 224.0.0.0/240.0.0.0, rp=22.22.22.22, repl = 0, ver =2, is_neg =0, bidir =
0, crp = 0
PIM(1): Update
prm_rp->bidir_mode = 0 vs bidir = 0 (224.0.0.0/4, RP:22.22.22.22), PIMv2
*May 18 10:28:42.764: PIM(1): Received RP-Reachable on Tunnel0 from 22.22.22.22
```

此图显示通过MDT隧道进行的引导消息交换。




```
PE2#sh int tunnel 1
Tunnel1 is up, line protocol is up
  Hardware is Tunnel
  Description: Pim Register Tunnel (Encap) for RP 22.22.22.22 on VRF SSM-BGP
  Interface is unnumbered. Using address of Ethernet0/2 (10.2.0.1)
  MTU 17912 bytes, BW 100 Kbit/sec, DLY 50000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation TUNNEL, loopback not set
  Keepalive not set
  Tunnel source 10.2.0.1 (Ethernet0/2), destination 22.22.22.22
   Tunnel Subblocks:
      src-track:
         Tunnel1 source tracking subblock associated with Ethernet0/2
          Set of tunnels with source Ethernet0/2, 1 member (includes iterators), on interface
<OK>
  Tunnel protocol/transport PIM/IPv4
  Tunnel TOS/Traffic Class 0xC0,  Tunnel TTL 255
  Tunnel transport MTU 1472 bytes
  Tunnel is transmit only
```

两个隧道形成PIM寄存器隧道和MDT隧道。

- 隧道0用于发送PIM加入和低带宽组播流量。
- 隧道1用于发送PIM封装的注册消息。

要检查的命令：

**MDT BGP:

**PE1#sh ip pim vrf m-SSM mdt bgp**

**发送数据FHR:

**PE1#sh ip pim vrf m-SSM mdt**

| Flag | Name | Description |
| --- | --- | --- |
| Z | Multicast Tunnel | Indicates that this entry is an IP multicast group that belongs to the Default or Data MDT tunnel. All packets received for this IP multicast state are sent to the MDT tunnel for decapsulation .<br>Set on receiving PE.<br>Global mulitcast routing table |
| Y | Joined MDT-data group | Indicates that the traffic was received through a Data MDT tunnel that was set up specifically for this source and group.<br>MVRF multicast routing table |
| z | MDT-data group sender | Set on sending PE.<br>Global mulitcast routing table |
| y | Sending to MDT-data group | Indicates that the traffic was sent through a Data MDT tunnel that was set up specifically for this source and group.<br>MVRF multicast routing table |
| V | RD & Vector | |
| v | Vecor | |
| E | Extranet source mroute entry | Indicates that a (*, G) or (S, G) entry in the VRF routing table is a source Multicast VRF (MVRF) entry and has extranet receiver MVRF entries linked to it |

## 相关信息

- https://tools.ietf.org/html/rfc4760
- https://tools.ietf.org/html/rfc5110
- https://tools.ietf.org/html/rfc6513
- 技术支持和文档 - Cisco Systems