在mVPN的双重归属来源和数据MDT

目录

简介

本文描述mVPN (组播虚拟供应商网络)与双重址的来源和数据MDT (组播分配树)。在Cisco IOS的一示例用于为了说明行为。

问题

如果在mVPN世界的一来源双重址的到两入口服务商边缘路由器，可能是可能的为两个入口PE路由器对两一个的向前流量(S， G)到多协议标签交换(MPLS)网云里。这是可能的，如果，例如，有两个出口PE路由器和每反向路径转发(RPF)对一个不同的入口PE路由器。如果在默认MDT上的两入口PE路由器转发，主张机制起动然后，并且一个入口PE赢取主张机制，并且其他丢失，以便仅有的一个入口PE继续转发客户(C-) (S， G)在MDT上。然而，如果主张机制在默认MDT因故没有启动，然后他们启动的两个入口PE路由器是可能的开始传送C- (S， G)在一数据MDT上的组播数据流。由于流量不再没有在默认MDT，然而在数据MDTs，两个入口PE路由器不接收C- (S， G)从彼此的流量在MDT/Tunnel接口。这能导致不变重复的流量下行。本文解释解决方案对此问题。

主张在默认MDT的机制

不管核心树协议，在此部分的信息为默认MDT适用。选定的核心树协议是独立于协议的组播(PIM)。

Cisco IOS使用示例，但是被提及的一切为Cisco IOS XR同等适用。所有组播组使用是源特定组播(SSM)组。

查看图1. Dual-Homed-Source-1。有两个入口PE路由器(PE1及PE2)和两个出口PE路由器(PE3和PE4)。来源在与IP地址10.100.1.6的CE1。CE1双重址的对PE1及PE2。

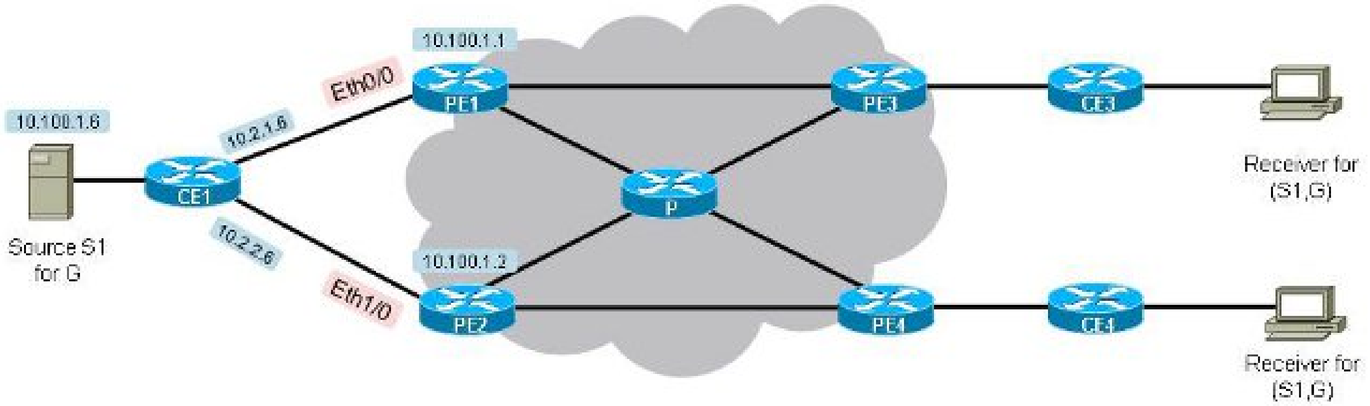

图1. Dual-Homed-Source-1

在所有PE路由器的配置(路由辨别器(RD)可以是不同的在PE路由器)是：

```
vrf definition one
 rd 1:1
 !
 address-family ipv4
 mdt default 232.10.10.10
 route-target export 1:1
 route-target import 1:1
 exit-address-family
!
```

为了使两个入口PE路由器开始转发组播流(10.100.1.6,232.1.1.1)在默认MDT上，他们必须两个接收从出口PE的加入。查看图1的拓扑。Dual-Homed-Source-1.您能看到默认情况下，如果边缘链路的所有开销是相同的，并且所有核心链路的开销是相同的，然后PE3往PE1的RPF和PE4往PE2的RPF为(10.100.1.6,232.1.1.1)。他们对他们最接近的入口PE的RPF。此输出确认此：

```
PE3#show ip rpf vrf one 10.100.1.6
RPF information for ? (10.100.1.6)
 RPF interface: Tunnel0
 RPF neighbor: ? (10.100.1.1)
 RPF route/mask: 10.100.1.6/32
 RPF type: unicast (bgp 1)
 Doing distance-preferred lookups across tables
 BGP originator: 10.100.1.1
 RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```

PE3有RPF对PE1。

```
PE4#show ip rpf vrf one 10.100.1.6
RPF information for ? (10.100.1.6)
 RPF interface: Tunnel0
 RPF neighbor: ? (10.100.1.2)
```

```
 RPF route/mask: 10.100.1.6/32
 RPF type: unicast (bgp 1)
 Doing distance-preferred lookups across tables
 BGP originator: 10.100.1.2
 RPF topology: ipv4 multicast base, originated from ipv4 unicast base
```

PE4有RPF对PE2。原因PE3选择PE1，因为RPF邻居是往10.100.1.6/32的单播路由在虚拟路由/转发(VRF)一是最佳通过PE1。PE3实际上接收从两PE1及PE2的路由10.100.1.6/32。在边界网关协议(BGP)最佳路径计算算法的所有标准是相同的，除了往BGP下一跳地址的开销。

```
PE3#show bgp vpnv4 unicast vrf one  10.100.1.6/32
BGP routing table entry for 1:3:10.100.1.6/32, version 333
Paths: (2 available, best #1, table one)
 Advertised to update-groups:
    21
 Refresh Epoch 1
 Local, imported path from 1:1:10.100.1.6/32 (global)
   10.100.1.1 (metric 11) (via default) from 10.100.1.5 (10.100.1.5)
     Origin incomplete, metric 11, localpref 100, valid, internal,best
     Extended Community: RT:1:1 OSPF DOMAIN ID:0x0005:0x000000640200
       OSPF RT:0.0.0.0:2:0 OSPF ROUTER ID:10.2.4.1:0
     Originator: 10.100.1.1, Cluster list: 10.100.1.5
     Connector Attribute: count=1
      type 1 len 12 value 1:1:10.100.1.1
     mpls labels in/out nolabel/32
     rx pathid: 0, tx pathid: 0x0
 Refresh Epoch 1
 Local, imported path from 1:2:10.100.1.6/32 (global)
   10.100.1.2 (metric 21) (via default) from 10.100.1.5 (10.100.1.5)
     Origin incomplete, metric 11, localpref 100, valid, internal
     Extended Community: RT:1:1 OSPF DOMAIN ID:0x0005:0x000000640200
       OSPF RT:0.0.0.0:2:0 OSPF ROUTER ID:10.2.2.2:0
     Originator: 10.100.1.2, Cluster list: 10.100.1.5
     Connector Attribute: count=1
      type 1 len 12 value 1:2:10.100.1.2
     mpls labels in/out nolabel/29
     rx pathid: 0, tx pathid: 0

PE4#show bgp vpnv4 unicast vrf one  10.100.1.6/32
BGP routing table entry for 1:4:10.100.1.6/32, version 1050
Paths: (2 available, best #2, table one)
 Advertised to update-groups:
    2
 Refresh Epoch 1
 Local, imported path from 1:1:10.100.1.6/32 (global)
   10.100.1.1 (metric 21) (via default) from 10.100.1.5 (10.100.1.5)
     Origin incomplete, metric 11, localpref 100, valid, internal
     Extended Community: RT:1:1 OSPF DOMAIN ID:0x0005:0x000000640200
       OSPF RT:0.0.0.0:2:0 OSPF ROUTER ID:10.2.4.1:0
     Originator: 10.100.1.1, Cluster list: 10.100.1.5
     Connector Attribute: count=1
      type 1 len 12 value 1:1:10.100.1.1
     mpls labels in/out nolabel/32
     rx pathid: 0, tx pathid: 0
 Refresh Epoch 1
 Local, imported path from 1:2:10.100.1.6/32 (global)
   10.100.1.2 (metric 11) (via default) from 10.100.1.5 (10.100.1.5)
     Origin incomplete, metric 11, localpref 100, valid, internal, best
     Extended Community: RT:1:1 OSPF DOMAIN ID:0x0005:0x000000640200
       OSPF RT:0.0.0.0:2:0 OSPF ROUTER ID:10.2.2.2:0
     Originator: 10.100.1.2, Cluster list: 10.100.1.5
     Connector Attribute: count=1
```

```
      type 1 len 12 value 1:2:10.100.1.2
     mpls labels in/out nolabel/29
     rx pathid: 0, tx pathid: 0x0
```

因为那有最低的内部网关路由协议(IGP)开销了(11)，与开销的IGP (21)往PE2， PE3选择的最佳路径是PE1通告的路径。对于PE4它是反向。拓扑表示从PE3到PE1只有一跳，而从PE3到PE2有两跳。因为所有链路有同一IGP开销， PE3选择从PE1的路径作为最佳。

组播路由情报基地(MRIB)为(10.100.1.6,232.1.1.1)看上去象这个在PE1及PE2，当没有组播数据流，时：

```
PE1#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
      Y - Joined MDT-data group, y - Sending to MDT-data group,
      G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
      N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
      Q - Received BGP S-A Route, q - Sent BGP S-A Route,
      V - RD & Vector, v - Vector, p - PIM Joins on route,
      x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:00:12/00:03:17, flags: sT
 Incoming interface: Ethernet0/0, RPF nbr 10.2.1.6
 Outgoing interface list:
   Tunnel0, Forward/Sparse, 00:00:12/00:03:17

PE2#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
      Y - Joined MDT-data group, y - Sending to MDT-data group,
      G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
      N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
      Q - Received BGP S-A Route, q - Sent BGP S-A Route,
      V - RD & Vector, v - Vector, p - PIM Joins on route,
      x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:00:47/00:02:55, flags: sT
 Incoming interface: Ethernet1/0, RPF nbr 10.2.2.6
 Outgoing interface list:
   Tunnel0, Forward/Sparse, 00:00:47/00:02:55
```

PE1及PE2两个接收PIM加入为(10.100.1.6,232.1.1.1)。隧道0接口在流出接口列表(油)在两路由器的组播条目的。

组播数据流开始流为(10.100.1.6,232.1.1.1)。“Debug ip pim VRF一232.1.1.1”和“debug ip mrouting VRF一232.1.1.1”表示我们，组播数据流到达在隧道0的(在油)两个入口PE路由器上，造成主张机制

运行。

PE1

```
PIM(1): Send v2 Assert on Tunnel0 for 232.1.1.1, source 10.100.1.6, metric [110/11]
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
MRT(1): not RPF interface, source address 10.100.1.6, group address 232.1.1.1
PIM(1): Received v2 Assert on Tunnel0 from 10.100.1.2
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
PIM(1): We lose, our metric [110/11]
PIM(1): Prune Tunnel0/232.10.10.10 from (10.100.1.6/32, 232.1.1.1)
MRT(1): Delete Tunnel0/232.10.10.10 from the olist of (10.100.1.6, 232.1.1.1)
MRT(1): Reset the PIM interest flag for (10.100.1.6, 232.1.1.1)
MRT(1): set min mtu for (10.100.1.6, 232.1.1.1) 1500->18010 - deleted
PIM(1): Received v2 Join/Prune on Tunnel0 from 10.100.1.3, not to us
PIM(1): Join-list: (10.100.1.6/32, 232.1.1.1), S-bit set
```

PE2

```
PIM(1): Received v2 Assert on Tunnel0 from 10.100.1.1
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
PIM(1): We win, our metric [110/11]
PIM(1): (10.100.1.6/32, 232.1.1.1) oif Tunnel0 in Forward state
PIM(1): Send v2 Assert on Tunnel0 for 232.1.1.1, source 10.100.1.6, metric [110/11]
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
PIM(1): Received v2 Join/Prune on Tunnel0 from 10.100.1.3, to us
PIM(1): Join-list: (10.100.1.6/32, 232.1.1.1), S-bit set
PIM(1): Update Tunnel0/10.100.1.3 to (10.100.1.6, 232.1.1.1), Forward state, by PIM SG Join
```

如果量度和距离是同样往来源10.100.1.6的两路由器，则有同分决赛为了确定主张赢利地区。同分决赛是PIM邻居的最高的IP地址隧道0的(默认MDT)。在这种情况下，这是PE2 ：

```
PE1#show ip pim vrf one 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,
     L - DR Load-balancing Capable
Neighbor          Interface                Uptime/Expires    Ver   DR
Address                                                            Prio/Mode
10.100.1.4        Tunnel0                  06:27:57/00:01:29 v2    1 / DR S P G
10.100.1.3        Tunnel0                  06:28:56/00:01:24 v2    1 / S P G
10.100.1.2        Tunnel0                  06:29:00/00:01:41 v2    1 / S P G

PE1#show ip pim vrf one interface

Address          Interface                Ver/   Nbr    Query  DR         DR
                                          Mode   Count  Intvl  Prior
10.2.1.1         Ethernet0/0               v2/S   0      30     1          10.2.1.1
10.2.4.1         Ethernet1/0               v2/S   0      30     1          10.2.4.1
10.100.1.1       Lspvif1                   v2/S   0      30     1          10.100.1.1
10.100.1.1       Tunnel0                   v2/S   3      30     1          10.100.1.4
```

PE1从组播条目的油的删除的隧道0由于主张。因为油变得空，组播条目被修剪。

```
PE1#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
       Y - Joined MDT-data group, y - Sending to MDT-data group,
       G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
       N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
       Q - Received BGP S-A Route, q - Sent BGP S-A Route,
       V - RD & Vector, v - Vector, p - PIM Joins on route,
       x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:17:24/00:00:01, flags: sPT
 Incoming interface: Ethernet0/0, RPF nbr 10.2.1.6
 Outgoing interface list: Null
```

因为它是主张赢利地区， PE2有在接口隧道0设置的标志。

```
PE2#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
       Y - Joined MDT-data group, y - Sending to MDT-data group,
       G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
       N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
       Q - Received BGP S-A Route, q - Sent BGP S-A Route,
       V - RD & Vector, v - Vector, p - PIM Joins on route,
       x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:17:20/00:02:54, flags: sT
 Incoming interface: Ethernet1/0, RPF nbr 10.2.2.6
 Outgoing interface list:
   Tunnel0, Forward/Sparse, 00:17:20/00:02:54, A
```

PE2周期地发送在隧道0 (默认MDT)的一主张，在主张计时器之前超时。这样PE2保持主张赢利地区。

```
PE2#
PIM(1): Send v2 Assert on Tunnel0 for 232.1.1.1, source 10.100.1.6, metric [110/11]
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
```

结论

主张机制也与在油的一个隧道接口一起使用。主张在默认MDT交换，当入口PE路由器接收C-时(S，G)在油的相关的隧道接口的组播数据流。

主张有数据MDTs的机制

多数时间，当数据MDTs配置，主张机制在默认MDT将运行作为C- (S， G)流量从默认MDT只交换到数据MDTs在三秒之后。然后同样如前所述发生。注意**只有每个支持组播的VRF一个隧道接口**：默认MDT和所有数据MDTs使用仅一个隧道接口。此隧道接口用于油在入口PE路由器或作为在出

口PE路由器的一个RPF接口。

有时很可能，主张机制没有被触发，在数据MDTs发信号前。然后很可能， C- (S， G)组播数据流在两入口PE路由器PE1及PE2的一数据MDT开始转发。在这类情况下，这可能导致永久性重复项C- (S， G)在间MPLS核心网络的组播数据流。为了避免此，此解决方案实现：当入口PE路由器看到另一个入口PE路由器宣布PE路由器也是一个入口PE路由器的数据MDT时，加入该数据MDT。原则上，出口有一个下行接收方)只有的PE路由器(会加入数据MDT。由于入口PE路由器加入其他入口PE路由器宣布的数据MDT，导致接收组播数据流的入口PE路由器从是存在油的隧道接口，并且这触发主张机制并且导致其中一个入口PE路由器停止转发C- (S， G)在其数据MDT上的组播数据流(与隧道接口)，而另一个入口PE (主张赢利地区)能继续转发C- (S， G)在其数据MDT上的组播数据流。

对于下一个示例，假设，入口PE路由器PE1及PE2未曾看到C- (S， G)从彼此的组播数据流在默认MDT。流量只在默认MDT三秒，并且了解是不难的这能发生，如果有，例如，在核心网络的临时数据流损失。

数据MDT的配置被添加到所有PE路由器。在所有PE路由器的配置(RD可以是不同的在PE路由器)是：

```
vrf definition one
 rd 1:1
 !
 address-family ipv4
 mdt default 232.10.10.10
mdt data 232.11.11.0 0.0.0.0
 route-target export 1:1
 route-target import 1:1
 exit-address-family
!
```

当PE1及PE2看到从来源的流量，他们创建a.c. - (S， G)条目。两个入口PE路由器转发C- (S， G)在默认MDT上的组播数据流。出口PE路由器PE3和PE4收到组播数据流并且转发它。由于一个临时问题， PE2看不到从PE1的流量和反过来也是一样地在默认MDT。他们发送一个数据MDT加入类型长度值(TLV)在默认MDT。

如果没有C- (S， G)流量，您看到入口PE路由器的此组播状态：

```
PE1#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
      Y - Joined MDT-data group, y - Sending to MDT-data group,
      G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
      N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
      Q - Received BGP S-A Route, q - Sent BGP S-A Route,
      V - RD & Vector, v - Vector, p - PIM Joins on route,
      x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:00:45/00:02:44, flags: sT
 Incoming interface: Ethernet0/0, RPF nbr 10.2.1.6
 Outgoing interface list:
```

```
   Tunnel0, Forward/Sparse, 00:00:45/00:02:42

PE2#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
      Y - Joined MDT-data group, y - Sending to MDT-data group,
      G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
      N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
      Q - Received BGP S-A Route, q - Sent BGP S-A Route,
      V - RD & Vector, v - Vector, p - PIM Joins on route,
      x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:02:18/00:03:28, flags: sT
 Incoming interface: Ethernet1/0, RPF nbr 10.2.2.6
 Outgoing interface list:
   Tunnel0, Forward/Sparse, 00:02:18/00:03:28
```

y标志没有设置。两个入口PE路由器有隧道0接口在油。这归结于事实PE3有往PE1的RPF，并且PE4有往PE2的RPF C-的(S， G)。

当C-的组播数据流(S， G)开始流，两PE1及PE2转发流量。数据MDT的阈值在两个入口PE路由器被超过，并且两个在三秒在他们的数据MDT上的启动转发以后派出数据MDT加入TLV和。注意PE1加入PE2和PE2来源的数据MDT加入PE1来源的数据MDT。

```
PE1#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
      Y - Joined MDT-data group, y - Sending to MDT-data group,
      G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
      N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
      Q - Received BGP S-A Route, q - Sent BGP S-A Route,
      V - RD & Vector, v - Vector, p - PIM Joins on route,
      x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:01:26/00:03:02, flags: sTy
 Incoming interface: Ethernet0/0, RPF nbr 10.2.1.6
 Outgoing interface list:
   Tunnel0, Forward/Sparse, 00:01:26/00:03:02

PE2#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
      Y - Joined MDT-data group, y - Sending to MDT-data group,
      G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
      N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
      Q - Received BGP S-A Route, q - Sent BGP S-A Route,
      V - RD & Vector, v - Vector, p - PIM Joins on route,
      x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:00:41/00:02:48, flags: sTy
 Incoming interface: Ethernet1/0, RPF nbr 10.2.2.6
 Outgoing interface list:
   Tunnel0, Forward/Sparse, 00:00:41/00:02:48
```

PE1和PE C-的接收流量(S， G)在隧道0接口(但是当前从数据MDT，不是默认MDT)和主张机制起动。仅PE2继续转发C- (S， G)在其数据MDT的流量：

```
PE1#
PIM(1): Send v2 Assert on Tunnel0 for 232.1.1.1, source 10.100.1.6, metric [110/11]
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
MRT(1): not RPF interface, source address 10.100.1.6, group address 232.1.1.1
PIM(1): Received v2 Assert on Tunnel0 from 10.100.1.2
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
PIM(1): We lose, our metric [110/11]
PIM(1): Prune Tunnel0/232.11.11.0 from (10.100.1.6/32, 232.1.1.1)
MRT(1): Delete Tunnel0/232.11.11.0 from the olist of (10.100.1.6, 232.1.1.1)
MRT(1): Reset the PIM interest flag for (10.100.1.6, 232.1.1.1)
PIM(1): MDT Tunnel0 removed from (10.100.1.6,232.1.1.1)
MRT(1): Reset the y-flag for (10.100.1.6,232.1.1.1)
PIM(1): MDT next_hop change from: 232.11.11.0 to 232.10.10.10 for (10.100.1.6, 232.1.1.1)
Tunnel0
MRT(1): set min mtu for (10.100.1.6, 232.1.1.1) 1500->18010 - deleted
PIM(1): MDT threshold dropped for (10.100.1.6,232.1.1.1)
PIM(1): Receive MDT Packet (9889) from 10.100.1.2 (Tunnel0), length (ip: 44, udp: 24), ttl: 1
PIM(1): TLV type: 1 length: 16 MDT Packet length: 16

PE2#
PIM(1): Received v2 Assert on Tunnel0 from 10.100.1.1
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
PIM(1): We win, our metric [110/11]
PIM(1): (10.100.1.6/32, 232.1.1.1) oif Tunnel0 in Forward state
PIM(1): Send v2 Assert on Tunnel0 for 232.1.1.1, source 10.100.1.6, metric [110/11]
PIM(1): Assert metric to source 10.100.1.6 is [110/11]
PE2#
PIM(1): Received v2 Join/Prune on Tunnel0 from 10.100.1.3, to us
PIM(1): Join-list: (10.100.1.6/32, 232.1.1.1), S-bit set
PIM(1): Update Tunnel0/10.100.1.3 to (10.100.1.6, 232.1.1.1), Forward state, by PIM SG Join
MRT(1): Update Tunnel0/232.10.10.10 in the olist of (10.100.1.6, 232.1.1.1), Forward state - MAC
built
MRT(1): Set the y-flag for (10.100.1.6,232.1.1.1)
PIM(1): MDT next_hop change from: 232.10.10.10 to 232.11.11.0 for (10.100.1.6, 232.1.1.1)
Tunnel0
```

PE1不再有隧道接口在油。

```
PE1#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
       Y - Joined MDT-data group, y - Sending to MDT-data group,
       G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
       N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
       Q - Received BGP S-A Route, q - Sent BGP S-A Route,
       V - RD & Vector, v - Vector, p - PIM Joins on route,
       x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:10:23/00:00:04, flags: sPT
 Incoming interface: Ethernet0/0, RPF nbr 10.2.1.6
 Outgoing interface list: Null
```

PE2有在隧道0接口设置的标志：

```
PE2#show ip mroute vrf one 232.1.1.1 10.100.1.6
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,
       Y - Joined MDT-data group, y - Sending to MDT-data group,
       G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
       N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
       Q - Received BGP S-A Route, q - Sent BGP S-A Route,
       V - RD & Vector, v - Vector, p - PIM Joins on route,
       x - VxLAN group
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(10.100.1.6, 232.1.1.1), 00:10:00/00:02:48, flags: sTy
 Incoming interface: Ethernet1/0, RPF nbr 10.2.2.6
 Outgoing interface list:
   Tunnel0, Forward/Sparse, 00:08:40/00:02:48, A
```

结论

当使用时，主张机制也运转数据MDTs。主张在默认MDT交换，当入口PE路由器接收C-时(S，G)在油的相关的隧道接口的组播数据流。