

在Cisco IOS-XR上配置mVPN外联网并排除故障

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简介

本文档介绍外联网mVPN，并提供Cisco IOS®XR中的配置示例。

先决条件

要求

本文档没有任何特定的要求。

使用的组件

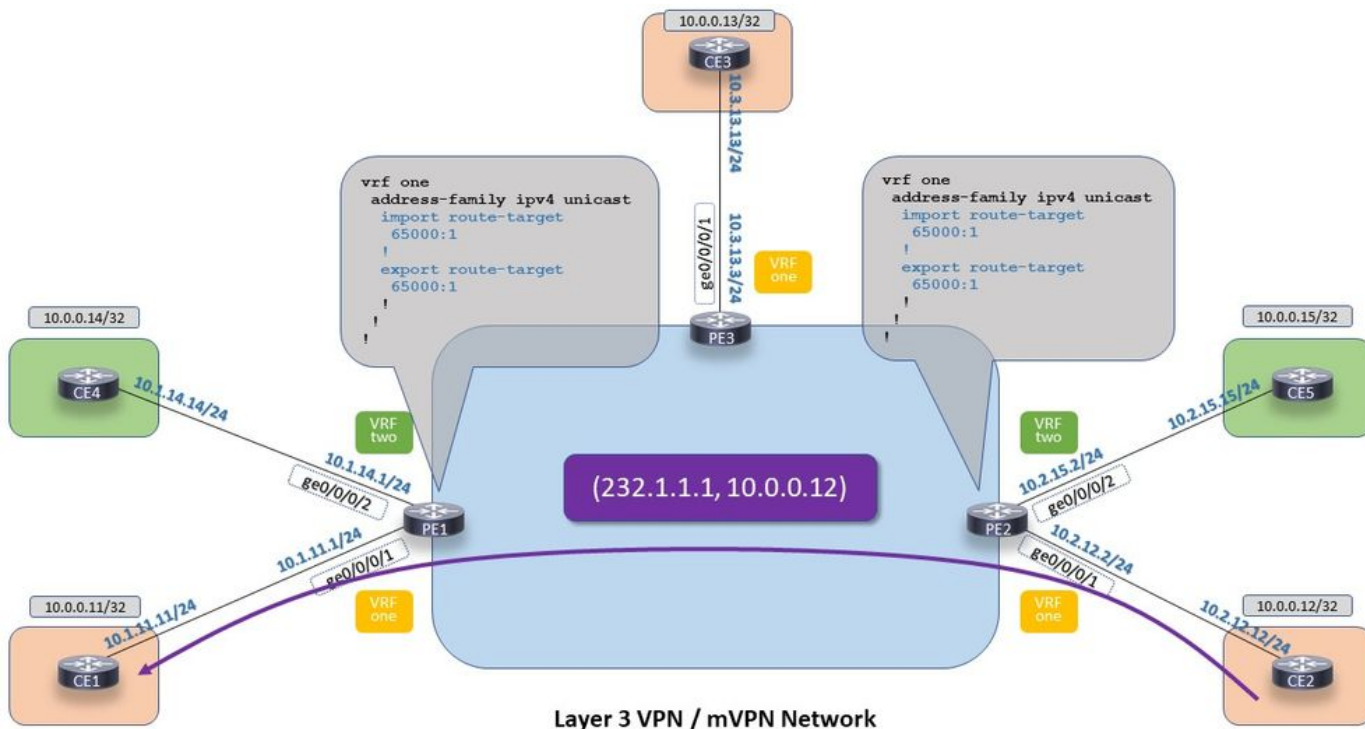
本文档特定于思科IOS XR，但不限于特定软件版本或硬件。

本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原始（默认）配置。如果您的网络处于活动状态，请确保您了解所有命令的潜在影响。

mVPN简介

支持组播的VPN(mVPN)支持组播。mVPN使用与单播第3层VPN网络使用的相同的虚拟路由和转发(VRF)概念。

此图显示VRF内组播转发 (使用配置文件0)。



IOS-XR上的mVPN外联网：内部网MVRF的组播数据包流

图1.内联网MVRF的组播数据包流

组播依赖于反向路径转发(RPF)。这同样适用于VRF间组播流量。这意味着为了组播从一个VRF流到另一个VRF，需要有一个VRF到RPF，以便组播流量源到另一个VRF。因此，组播源的路由需要在PE路由器的接收方VRF路由表中可用。有两种方法可确保RPF在VRF环境中成功。

1. 基于路由信息库(RIB)。这意味着来自一个VRF (源VRF) 的路由需要泄漏到另一个VRF (接收器VRF) 中。这将通过使用路由目标(RT)的导入和导出功能来实现。
2. 基于路由策略语言(RPL)。这意味着RPF成功，这要归功于路由策略强制RPF向VRF和/或接口 (在另一个VRF中) 发送。

PE路由器不会重新通告VPN路由。如果PE路由器从远程PE路由器收到VPN路由并将其导入VRF 1，则它无法将该VPN前缀从VRF 1导出到本地VRF 2。无论此PE路由器上是否存在从VRF 1到VRF 2的本地路由目标导入路由，都不会导入VRF 2。

组播完全是RPF成功的关键。请务必留意RPF。要使外联网组播正常工作，RPF必须从一个VRF到另一个VRF，从接收方到源VRF。因此，接收方VRF中的源必须有单播路由返回源VRF。

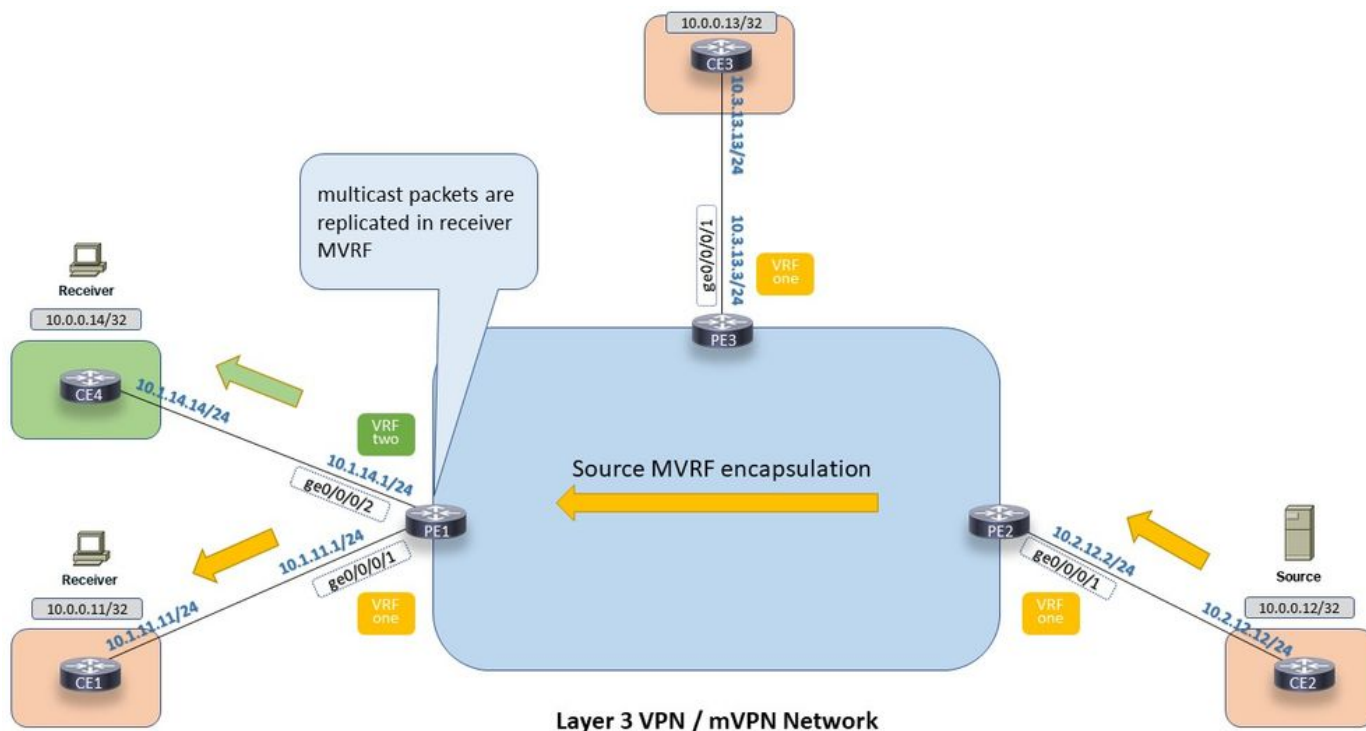
Lmdt:标记的组播分布树

方案

Cisco IOS XE还支持外联网mVPN。过去，IOS(-XE)引入了两种实现外联网mVPN的方案。它们称为选项1和选项2。IOS-XR支持采用相同方案的外联网。

选项 1：源组播虚拟路由和转发(MVRF)位于接收方MVRF上。这意味着，在具有相应路由目标的出口PE路由器上，还配置了用于组播流量的入口PE路由器上的VRF（源VRF）。

查看图2。它显示选项1的组播数据包流。



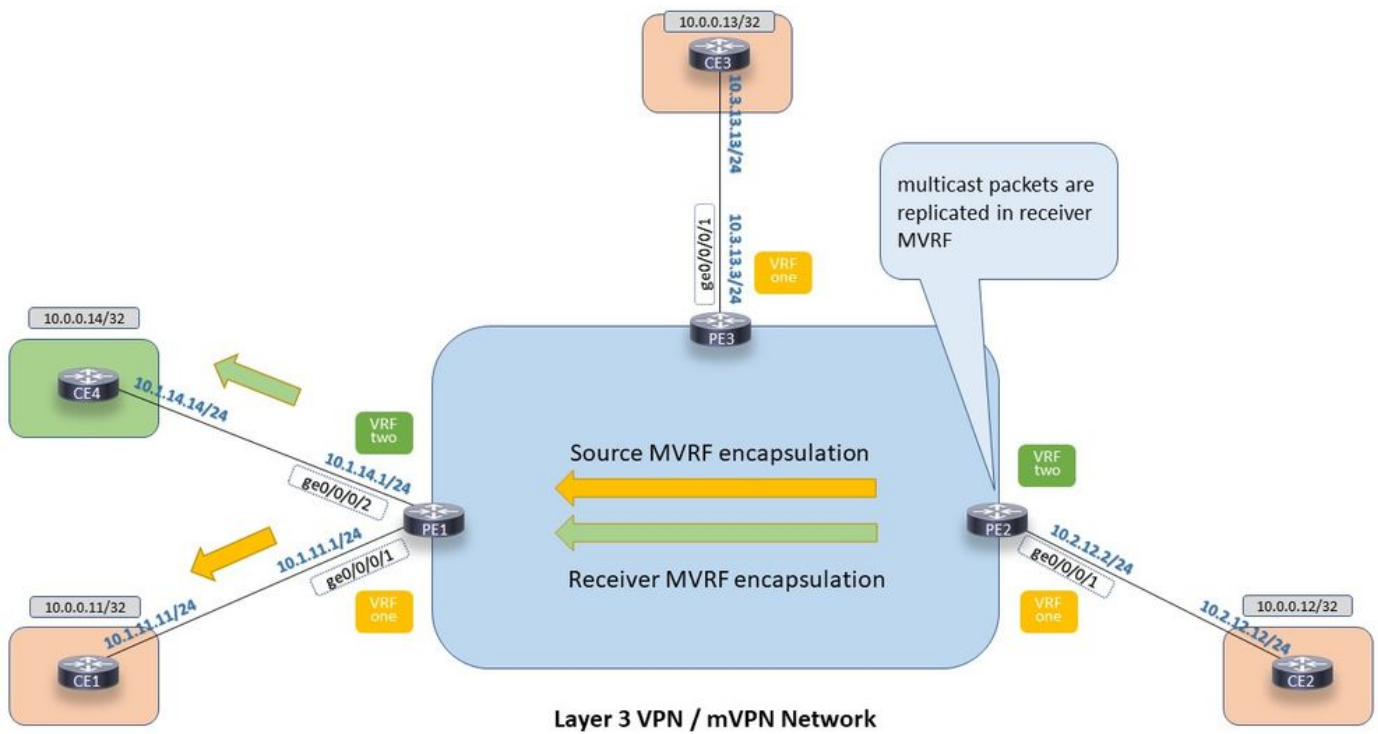
IOS-XR上的mVPN外联网：外联网的组播数据包流选项1

图2.外联网选项1的组播数据包流。

组播流量通过核心网络并使用源MVRF的封装。

选项 2：接收方MVRF位于源MVRF上。这意味着，在具有适当路由目标的入口PE路由器上，也为组播流量配置了出口PE路由器上的VRF（接收器VRF）。

查看图3。它显示选项2的组播数据包流。



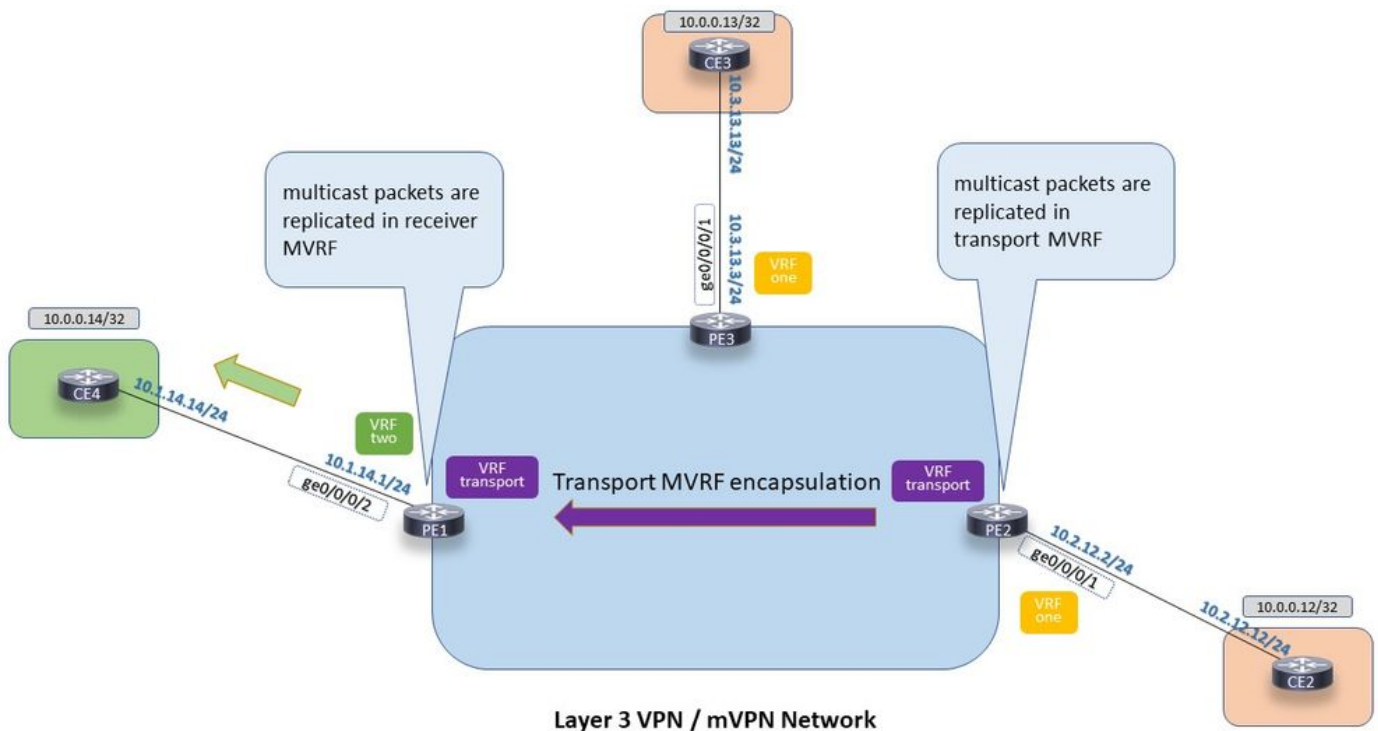
IOS-XR上的mVPN外联网：外联网的组播数据包流选项2

图3.外联网选项2的组播数据包流。

组播流量通过核心网络，并使用源MVRF和接收方MVRF的封装。因此，组播流量使用的带宽量是核心网络中带宽量的两倍。

第三个选项，选项1和选项2之间的混合解决方案。

选项 3：使用传输MVRF。入口PE路由器将组播流量从源VRF外部到传输VRF。出口PE路由器将组播流量从传输VRF外部到接收方VRF。此传输MVRF没有与其关联的面向客户的接口。



IOS-XR上的mVPN外联网：使用第三个VRF（传输VRF）的外联网组播数据包流

图4.使用第三个VRF（传输VRF）的外联网组播数据包流。

支持概述

选项 1 支持

所有配置文件都提供基于RPL的支持。

只有使用组播核心树协议（配置文件0、3和11）的配置文件支持基于RIB的外联网mVPN。

选项 2 支持

所有配置文件都支持基于RPL和基于RIB的支持，但使用客户信令与BGP的配置文件除外（例如配置文件2、11、...）。最后这些仅以特殊方式支持选项2。示例2.2说明了这一点。

查看此处，了解不同配置文件的概述和配置：[在Cisco IOS-XR中配置mVPN配置文件](#)

Examples

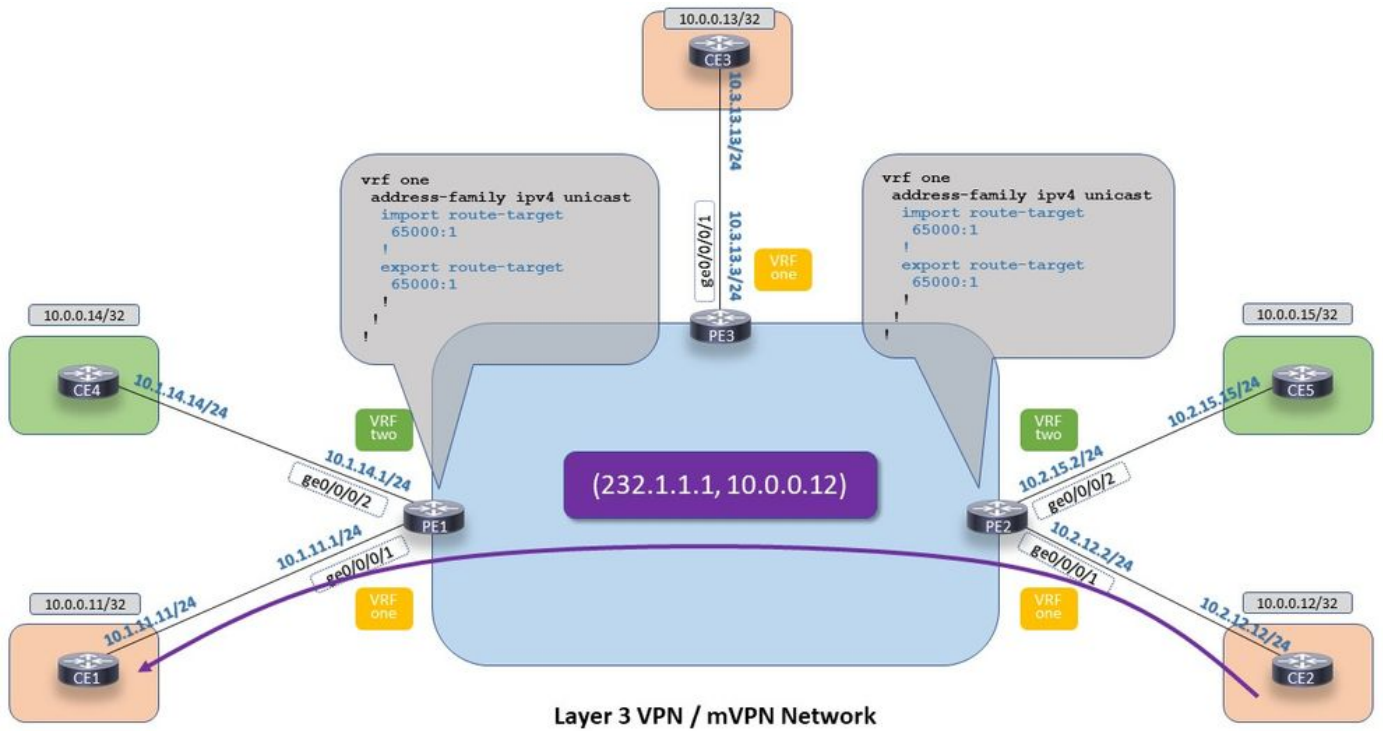
注意组播RIB(MRIB)条目上的EX或外联网标志。它们存在于源和接收方VRF、组播条目和接口上。

配置文件0

配置文件0使用默认MDT，在底层和重叠（VRF环境）中使用PIM组播信令。

此配置文件支持选项1和2（以及3）。

图5显示VRF内组播流量，VRF 1到VRF 1。



IOS-XR上的mVPN外联网：配置文件0 — 内联网MVRF的组播数据包流

映像5配置文件0 — 内联网MVRF的组播数据包流

配置文件0的配置。

```
multicast-routing
vrf one
address-family ipv4
interface GigabitEthernet0/0/0/1
enable
!
mdt source Loopback0
mdt default ipv4 239.1.1.1
!
!
```

```
router pim
vrf one
address-family ipv4
ssm range SSM-range-vrf-one
!
!
```

请注意，配置文件0是不要求RPF拓扑命令的唯一配置文件。

或者，您可以为配置文件0配置RPF拓扑命令。

```
router pim
vrf one
address-family ipv4
rpf topology route-policy profile-0
ssm range SSM-range-vrf-one
```

```
!  
!  
!  
route-policy profile-0  
  set core-tree pim-default  
end-policy  
!
```

出口PE 1上MRIB条目的输出如下所示：

```
RP/0/0/CPU0:PE1#show mrib vrf one route 232.1.1.1 10.0.0.12  
  
IP Multicast Routing Information Base  
Entry flags: L - Domain-Local Source, E - External Source to the Domain,  
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,  
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,  
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle  
  CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet  
  MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary  
  MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN  
Interface flags: F - Forward, A - Accept, IC - Internal Copy,  
  NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,  
  II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,  
  LD - Local Disinterest, DI - Decapsulation Interface  
  EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,  
  EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,  
  MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface  
  IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface  
  
(10.0.0.12,232.1.1.1) RPF nbr: 10.0.0.2 Flags: RPF  
Up: 01:15:06  
Incoming Interface List  
  mdtone Flags: A MI, Up: 01:06:10  
Outgoing Interface List  
  GigabitEthernet0/0/0/1 Flags: F NS, Up: 01:15:06
```

RPF指向mdtone，即VRF1的组播分布树(MDT)。

```
RP/0/0/CPU0:PE1#show pim vrf one rpf 10.0.0.12  
Table: IPv4-Unicast-default  
* 10.0.0.12/32 [200/0]  
  via mdtone with rpf neighbor 10.0.0.2  
  Connector: 65000:1002:10.0.0.2, Nexthop: 10.0.0.2
```

```
RP/0/0/CPU0:PE2#show mrib vrf one route 232.1.1.1 10.0.0.12  
  
IP Multicast Routing Information Base  
Entry flags: L - Domain-Local Source, E - External Source to the Domain,  
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,  
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,  
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle  
  CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet  
  MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary  
  MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN  
Interface flags: F - Forward, A - Accept, IC - Internal Copy,  
  NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,  
  II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,  
  LD - Local Disinterest, DI - Decapsulation Interface  
  EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,  
  EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,  
  MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
```

IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

```
(10.0.0.12,232.1.1.1) RPF nbr: 10.2.12.12 Flags: RPF
Up: 01:14:26
Incoming Interface List
  GigabitEthernet0/0/0/1 Flags: A, Up: 01:14:26
Outgoing Interface List
  mdtone Flags: F MI, Up: 01:06:51
```

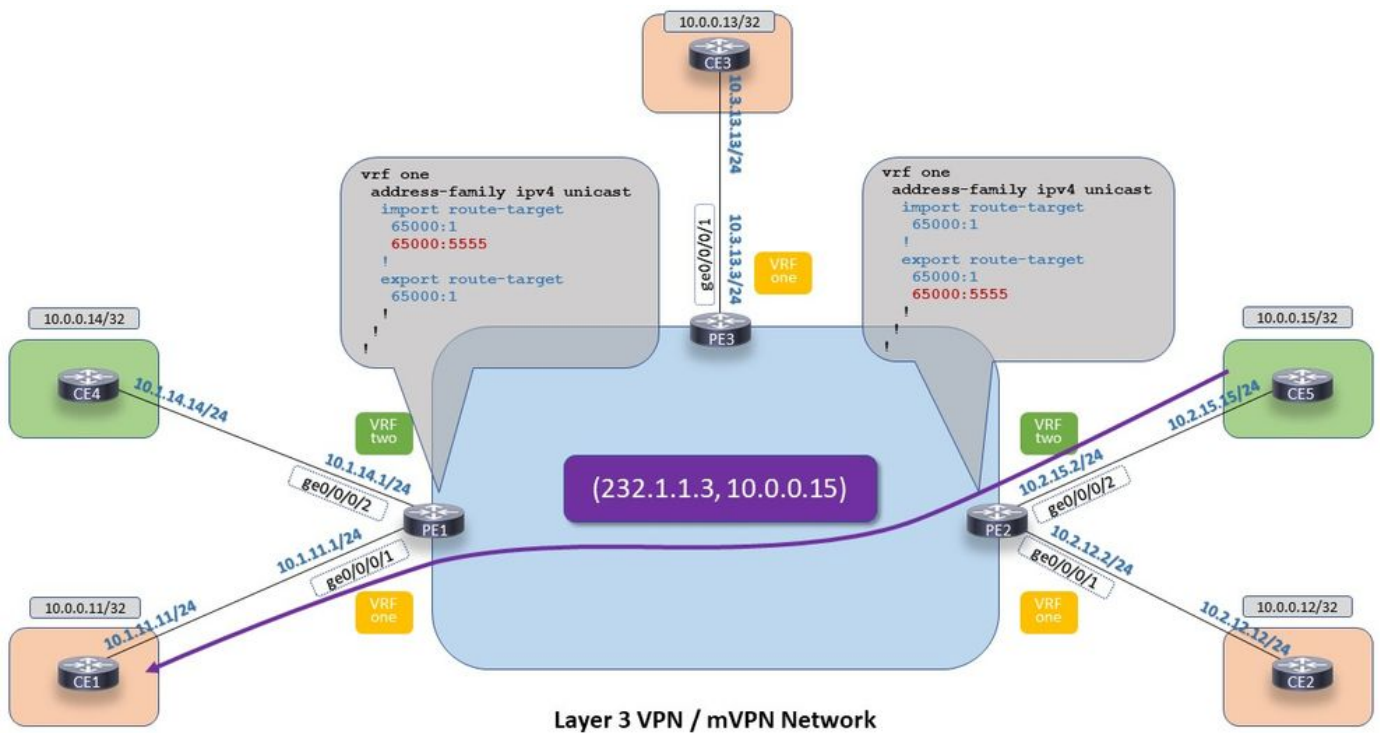
```
RP/0/0/CPU0:PE2#show pim vrf one rpf 10.0.0.12
```

Table: IPv4-Unicast-default

```
* 10.0.0.12/32 [20/0]
  via GigabitEthernet0/0/0/1 with rpf neighbor 10.2.12.12
```

示例1.1.选项1.源MVRF位于接收方MVRF上

配置文件0支持基于RIB的选项1。返回源的路由需要存在于接收方VRF中。



IOS-XR上的mVPN外联网：配置文件0 — 选项1源MVRF位于接收方MVRF上

图6.配置文件0 — 选项1。源MVRF位于接收方MVRF上

图6显示，入口PE路由器PE2从VRF 2（源VRF）通告源路由，路由目标为65000:5555。出口PE路由器PE1将具有此路由目标的路由导入VRF1，即接收方VRF。

VRF 1和VRF 2使用配置文件0。

```
multicast-routing
address-family ipv4
interface Loopback0
  enable
!
interface GigabitEthernet0/0/0/0
  enable
```



```

!
!
vrf one
address-family ipv4
 interface GigabitEthernet0/0/0/1
   enable
!
 mdt source Loopback0
 mdt default ipv4 239.1.1.1
!
!
vrf two
address-family ipv4
 interface GigabitEthernet0/0/0/2
   enable
!
 mdt source Loopback0
 mdt default ipv4 239.1.1.2
!

router pim
address-family ipv4
 ssm range SSM-range
!
vrf one
address-family ipv4
 ssm range SSM-range-vrf-one
!
!
vrf two
address-family ipv4
 ssm range SSM-range-vrf-two
!
!
!

```

入口PE路由器PE2使用路由目标65000:5555导出源路由。出口PE路由器PE1将此路由与路由目标65000:5555导入VRF1。

```
RP/0/0/CPU0:PE1#show mrib vrf one route 232.1.1.3 10.0.0.15
```

```

IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
  CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
  MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
  MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
  NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
  II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
  LD - Local Disinterest, DI - Decapsulation Interface
  EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
  EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
  MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
  IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.3) RPF TID: 0xe0000011 Flags: RPF EX
Up: 01:36:16
Outgoing Interface List
  GigabitEthernet0/0/0/1 Flags: F NS, Up: 01:36:16

```

```
RP/0/0/CPU0:PE1#show pim vrf one rpf 10.0.0.15
Table: IPv4-Unicast-default
* 10.0.0.15/32 [200/0]
  via VRF:two with rpf neighbor 10.0.0.2
  Connector: 65000:2002:10.0.0.2, Nexthop: 10.0.0.2
出口PE路由器PE1如何知道RPF必须在VRF 2中发生？
```

VRF1中的BGP vpn4单播路由如下所示：

```
RP/0/0/CPU0:PE1#show bgp vpnv4 unicast vrf one 10.0.0.15/32
BGP routing table entry for 10.0.0.15/32, Route Distinguisher: 65000:1001
Versions:
  Process          bRIB/RIB  SendTblVer
  Speaker          65        65
Last Modified: Nov 21 19:09:22.469 for 00:14:33
Paths: (1 available, best #1)
  Not advertised to any peer
  Path #1: Received by speaker 0
  Not advertised to any peer
  65005
    10.0.0.2 (metric 3) from 10.0.0.4 (10.0.0.2)
      Received Label 24006
      Origin IGP, metric 0, localpref 100, valid, internal, best, group-best, import-candidate,
imported
      Received Path ID 0, Local Path ID 1, version 65
      Extended community: RT:65000:2 RT:65000:5555
      Originator: 10.0.0.2, Cluster list: 10.0.0.4
      Connector: type: 1, Value:65000:2002:10.0.0.2
      Source AFI: VPNv4 Unicast, Source VRF: default, Source Route Distinguisher: 65000:2002
```

此路由标识符与VRF关联。PE1通过在BGP地址系列ipv4 mdt表中查找RD来找回用于此RD (路由识别器) 的组播组地址。

```
RP/0/0/CPU0:PE1#show bgp ipv4 mdt rd 65000:2002 10.0.0.2
BGP routing table entry for 10.0.0.2/96, Route Distinguisher: 65000:2002
Versions:
  Process          bRIB/RIB  SendTblVer
  Speaker          6         6
Last Modified: Nov 21 17:26:11.469 for 01:58:30
Paths: (1 available, best #1)
  Not advertised to any peer
  Path #1: Received by speaker 0
  Not advertised to any peer
  Local
    10.0.0.2 (metric 3) from 10.0.0.4 (10.0.0.2)
      Origin IGP, localpref 100, valid, internal, best, group-best
      Received Path ID 0, Local Path ID 1, version 6
      Originator: 10.0.0.2, Cluster list: 10.0.0.4
      MDT group address: 239.1.1.2
```

此组地址239.1.1.2是VRF 2使用的组地址。每个PE路由器 (包括此路由器PE1) 都将此组配置为VRF 2的默认MDT组地址。

```
RP/0/0/CPU0:PE1#show mrib vrf two route 232.1.1.3 10.0.0.15

IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
```

```
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.15,232.1.1.3) RPF nbr: 10.0.0.2 Flags: RPF EX
```

```
Up: 00:05:11
```

```
Incoming Interface List
```

```
mdttwo Flags: A MI, Up: 00:05:11
```

```
Outgoing Interface List
```

```
GigabitEthernet0/0/0/1 Flags: F NS EX, Up 00:05:11
```

```
RP/0/0/CPU0:PE1#show pim vrf two rpf 10.0.0.15
```

```
Table: IPv4-Unicast-default
```

```
* 10.0.0.15/32 [200/0]
```

```
via mdttwo with rpf neighbor 10.0.0.2
```

```
Connector: 65000:2002:10.0.0.2, Nexthop: 10.0.0.2
```

组播流量使用VRF 2的默认或一个数据MDT来穿越核心网络。

```
RP/0/0/CPU0:PE2#show mrib vrf two route 232.1.1.3 10.0.0.15
```

```
IP Multicast Routing Information Base
```

```
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
```

```
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
```

```
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
```

```
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
```

```
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
```

```
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
```

```
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
```

```
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
```

```
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
```

```
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
```

```
LD - Local Disinterest, DI - Decapsulation Interface
```

```
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
```

```
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
```

```
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
```

```
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.15,232.1.1.3) RPF nbr: 10.2.15.15 Flags: RPF
```

```
Up: 00:02:49
```

```
Incoming Interface List
```

```
GigabitEthernet0/0/0/2 Flags: A, Up: 00:02:49
```

```
Outgoing Interface List
```

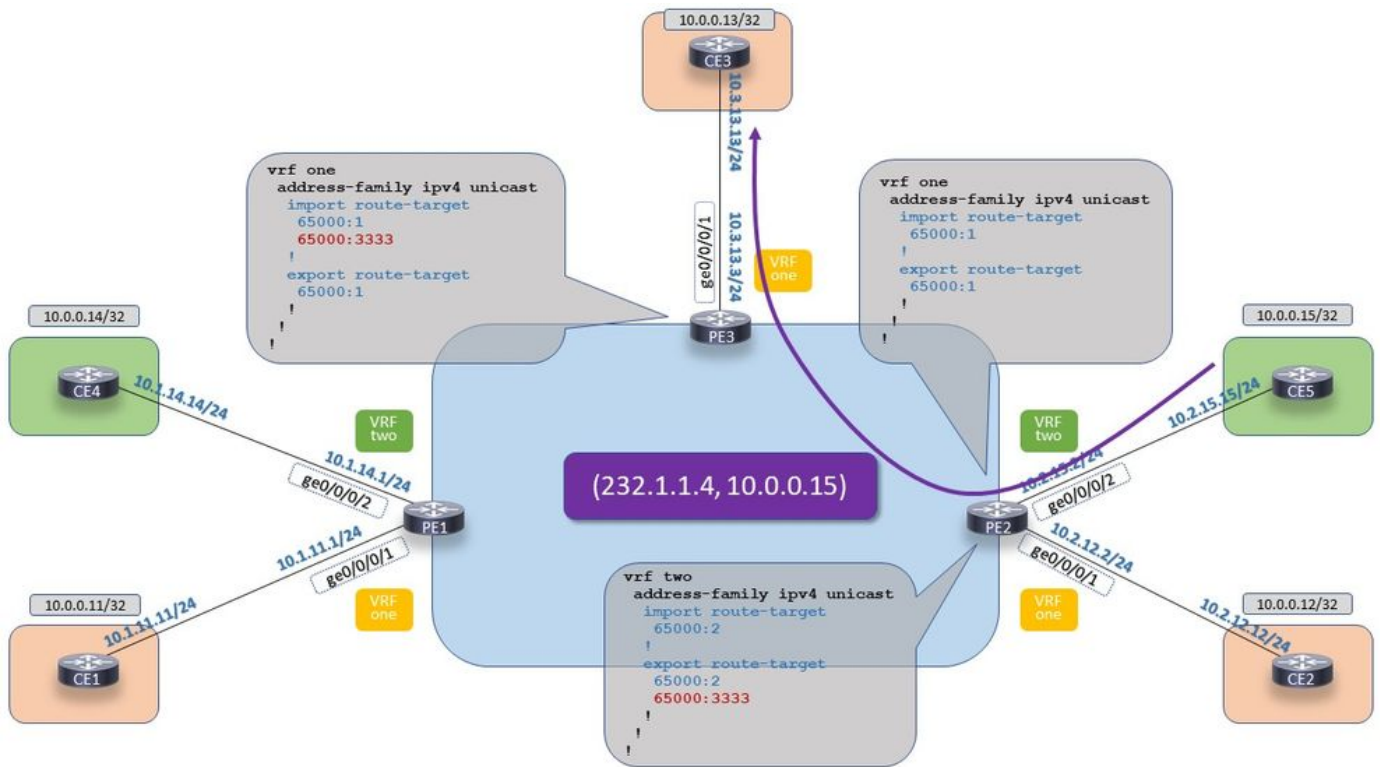
```
mdttwo Flags: F MI, Up: 00:02:49
```

如果VRF1在入口PE、PE2上甚至存在于入口PE路由器PE2上，则(10.0.0.15、232.1.1.3)没有状态。

基于RIB方法的替代方法是基于RPL的方法。这意味着路由策略用于更改RPF。有关此RPF路由策略的示例，请参阅示例2.1。

示例1.2.选项2.接收方MVRF位于源MVRF上

这是基于RIB的方法。



IOS-XR上的mVPN外联网：配置文件0 — 选项2接收方MVRF位于源MVRF上

图像7配置文件0 — 选项2接收器MVRF位于源MVRF上

路由目标用于将VRF两个路由导入接收器PE、PE3上的VRF一个。

入口PE PE2需要VRF 1 (接收器VRF) 中指向VRF 2 (源VRF) 的静态路由，以便RPF在入口PE路由器PE2上成功。

PE3:

```
vrf one
address-family ipv4 unicast
import route-target
65000:1
65000:3333
!
export route-target
65000:1
!
```

PE2:

```
vrf one
address-family ipv4 unicast
import route-target
65000:1
!
export route-target
65000:1
!
```

vrf two

```
address-family ipv4 unicast
import route-target
 65000:2
!
export route-target
 65000:2
 65000:3333
```

```
router static
 vrf one
 address-family ipv4 unicast
 10.0.0.15/32 vrf two GigabitEthernet0/0/0/2 10.2.15.15
!
```

无需将此静态路由重分布到BGP。此路由在VRF 2 (源VRF) 中通告。出口PE路由器PE3收到此路由，因为它由入口PE路由器PE1在VRF 2中通告，路由目标为65000:3333，该路由导入PE3上的VRF 1中。要使RPF在入口PE路由器PE上的VRF 1上成功，需要使用静态路由2。

组播流量使用来自VRF的MDT通过核心网络。

```
RP/0/0/CPU0:PE3#show mrib vrf one route 232.1.1.4 10.0.0.15
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
  CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
  MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
  MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
  NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
  II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
  LD - Local Disinterest, DI - Decapsulation Interface
  EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
  EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
  MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
  IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.15,232.1.1.4) RPF nbr: 10.0.0.2 Flags: RPF
Up: 14:54:08
Incoming Interface List
  mdtone Flags: A MI, Up: 00:16:47
Outgoing Interface List
  GigabitEthernet0/0/0/1 Flags: F NS, Up: 14:54:08
```

```
RP/0/0/CPU0:PE3#show route vrf one 10.0.0.15/32
Routing entry for 10.0.0.15/32
Known via "bgp 65000", distance 200, metric 0, type internal
Installed Nov 22 08:02:19.808 for 00:25:24
Routing Descriptor Blocks
 10.0.0.2, from 10.0.0.4
  Nexthop in Vrf: "default", Table: "default", IPv4 Unicast, Table Id: 0xe0000000
  Route metric is 0
No advertising protos.
```

```
RP/0/0/CPU0:PE3#show bgp vpnv4 unicast vrf one 10.0.0.15/32
BGP routing table entry for 10.0.0.15/32, Route Distinguisher: 65000:1003
Versions:
  Process          bRIB/RIB  SendTblVer
  Speaker          51        51
Last Modified: Nov 22 09:24:32.318 for 00:02:38
```

```
Paths: (1 available, best #1)
Not advertised to any peer
Path #1: Received by speaker 0
Not advertised to any peer
65005
  10.0.0.2 (metric 3) from 10.0.0.4 (10.0.0.2)
    Received Label 24006
    Origin IGP, metric 0, localpref 100, valid, internal, best, group-best, import-candidate,
imported
    Received Path ID 0, Local Path ID 1, version 51
    Extended community: RT:65000:2 RT:65000:3333
    Originator: 10.0.0.2, Cluster list: 10.0.0.4
    Connector: type: 1, Value:65000:2002:10.0.0.2
    Source AFI: VPNv4 Unicast, Source VRF: default, Source Route Distinguisher: 65000:2002
```

```
RP/0/0/CPU0:PE3#show pim vrf one rpf 10.0.0.15
Table: IPv4-Unicast-default
* 10.0.0.15/32 [200/0]
  via mdtone with rpf neighbor 10.0.0.2
  Connector: 65000:1002:10.0.0.2, Nexthop: 10.0.0.2
```

PE2在VRF ONE中为MRIB条目 (VRF ONE的MDT接口) 提供传出接口mdtone。

```
RP/0/0/CPU0:PE2#show mrib vrf one route 232.1.1.4 10.0.0.15

IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
  CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
  MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
  MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
  NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
  II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
  LD - Local Disinterest, DI - Decapsulation Interface
  EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
  EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
  MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
  IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.4) RPF TID: 0xe0000011 Flags: RPF EX
Up: 00:21:58
Incoming Interface List
  GigabitEthernet0/0/0/2 Flags: A EX, Up: 00:21:58
Outgoing Interface List
  mdtone Flags: F MI, Up: 00:21:58
```

PE2在VRF 2中也有用于MRIB条目的传出接口mdtone , 即VRF 1的MDT接口。

```
RP/0/0/CPU0:PE2#show mrib vrf two route 232.1.1.4 10.0.0.15

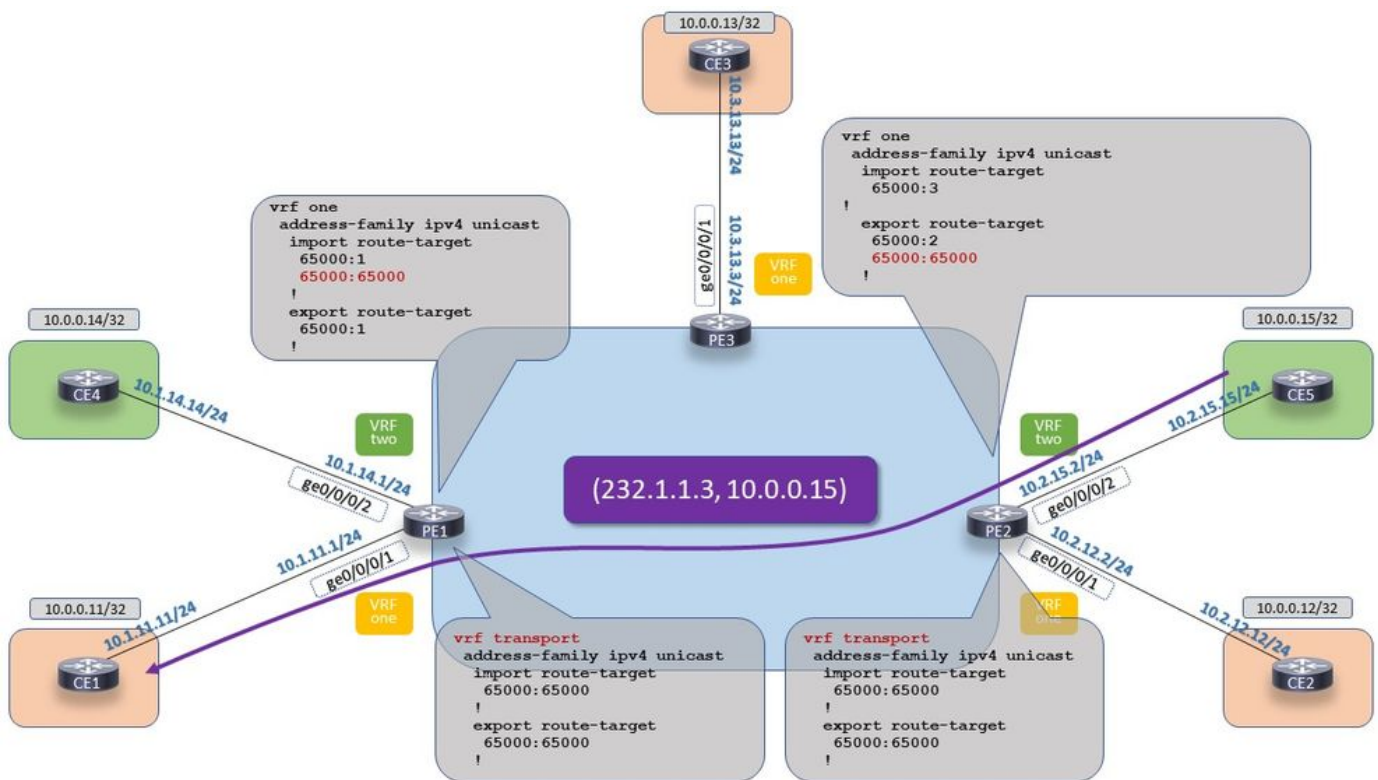
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
  CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
  MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
  MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
```

NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
 II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
 LD - Local Disinterest, DI - Decapsulation Interface
 EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
 EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
 MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
 IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

```
(10.0.0.15,232.1.1.4) RPF nbr: 10.2.15.15 Flags: RPF EX
Up: 00:18:39
Incoming Interface List
  GigabitEthernet0/0/0/2 Flags: A, Up: 00:18:39
Outgoing Interface List
  mdtone Flags: F MI EX, Up: 00:18:39
```

```
RP/0/0/CPU0:PE2#show pim vrf one rpf 10.0.0.15
Table: IPv4-Unicast-default
* 10.0.0.15/32 [1/0]
  via VRF:two,GigabitEthernet0/0/0/2 with rpf neighbor 10.2.15.15
```

示例1.3.选项3.使用传输MVRF



IOS-XR上的mVPN外联网：配置文件0 — 选项3使用传输MVRF

图8.配置文件0 — 选项3使用传输MVRF

传输MVRF不需要任何接口。但是，其他所有东西都需要存在：VRF配置、BGP配置、组播路由配置和路由器PIM配置。

选项1的配置在出口PE、PE1上，而选项2的配置在入口PE、PE2上。

PE1:

```
vrf one
  address-family ipv4 unicast
```

```
import route-target
 65000:1
 65000:65000
!
export route-target
 65000:1
!

vrf transport
address-family ipv4 unicast
import route-target
 65000:65000
!
export route-target
 65000:65000
!

router bgp 65000
...
vrf one
rd 65000:1001
bgp unsafe-ebgp-policy
address-family ipv4 unicast
 redistribute connected
!
address-family ipv4 mvpn
!
neighbor 10.1.11.11
 remote-as 65001
 address-family ipv4 unicast
  route-policy pass-all in
  route-policy pass-all out
!
!
!
vrf transport
rd 65000:123
address-family ipv4 unicast
 redistribute static
!
address-family ipv4 mvpn
!

multicast-routing
vrf one
address-family ipv4
 interface GigabitEthernet0/0/0/1
  enable
!
 mdt source Loopback0
 mdt default ipv4 239.1.1.1
!
!
!

multicast-routing
vrf transport
address-family ipv4
 mdt source Loopback0
 mdt default ipv4 239.1.1.3
!
!

router pim
```



```
vrf one
address-family ipv4
  ssm range SSM-range-vrf-one
!
!
```

```
router pim
vrf transport
address-family ipv4
  ssm range SSM-range-vrf-transport
!
```

PE2:

```
vrf two
address-family ipv4 unicast
import route-target
  65000:2
!
export route-target
  65000:2
  65000:65000
!
```

```
vrf transport
address-family ipv4 unicast
import route-target
  65000:65000
!
export route-target
  65000:65000
!
```

```
router bgp 65000
```

```
...
!
vrf two
rd 65000:2002
bgp unsafe-ebgp-policy
address-family ipv4 unicast
  redistribute connected
!
address-family ipv4 mvpn
!
neighbor 10.2.15.15
  remote-as 65005
  address-family ipv4 unicast
    route-policy pass-all in
    route-policy pass-all out
!
!
```

```
router static
!
vrf transport
address-family ipv4 unicast
  10.0.0.15/32 vrf two GigabitEthernet0/0/0/2 10.2.15.15
!
```

```
vrf transport
rd 65000:123
```

```

address-family ipv4 unicast
  redistribute static
!
address-family ipv4 mvpn
!

multicast-routing
vrf two
address-family ipv4
interface GigabitEthernet0/0/0/2
  enable
!
mdt source Loopback0
mdt default ipv4 239.1.1.2
!
!
!

```

```

multicast-routing
vrf transport
address-family ipv4
  mdt source Loopback0
  mdt default ipv4 239.1.1.3
!

```

RP/0/0/CPU0:PE1#show mrib vrf one route 232.1.1.3 10.0.0.15

IP Multicast Routing Information Base

Entry flags: L - Domain-Local Source, E - External Source to the Domain,
 C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
 IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
 MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
 CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
 MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
 MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN

Interface flags: F - Forward, A - Accept, IC - Internal Copy,
 NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
 II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
 LD - Local Disinterest, DI - Decapsulation Interface
 EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
 EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
 MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
 IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.3) RPF TID: 0xe0000012 Flags: RPF EX

Up: 16:41:11

Outgoing Interface List

GigabitEthernet0/0/0/1 Flags: F NS, Up: 16:41:11

RP/0/0/CPU0:PE1#show pim vrf one rpf 10.0.0.15

Table: IPv4-Unicast-default

* 10.0.0.15/32 [200/0]

via VRF:transport with rpf neighbor 10.0.0.2

Connector: 65000:123:10.0.0.2, Nexthop: 10.0.0.2

RP/0/0/CPU0:PE1#show mrib vrf transport route 232.1.1.3 10.0.0.15

IP Multicast Routing Information Base

Entry flags: L - Domain-Local Source, E - External Source to the Domain,
 C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
 IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
 MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
 CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet

MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.3) RPF nbr: 10.0.0.2 Flags: RPF EX

Up: 00:08:14

Incoming Interface List

mdttransport Flags: A MI, Up: 00:08:14

Outgoing Interface List

GigabitEthernet0/0/0/1 Flags: F NS EX, Up: 00:00:14

RP/0/0/CPU0:PE1#show pim vrf transport rpf 10.0.0.15

Table: IPv4-Unicast-default

* 10.0.0.15/32 [200/0]

via mdttransport with rpf neighbor 10.0.0.2

Connector: 65000:123:10.0.0.2, Nexthop: 10.0.0.2

源的路由必须在出口PE路由器的VRF传输中已知。

RP/0/0/CPU0:PE1#show route vrf transport 10.0.0.15/32

Routing entry for 10.0.0.15/32

Known via "bgp 65000", distance 200, metric 0, type internal

Installed Nov 22 09:57:13.255 for 00:15:30

Routing Descriptor Blocks

10.0.0.2, from 10.0.0.4

Nexthop in Vrf: "default", Table: "default", IPv4 Unicast, Table Id: 0xe0000000

Route metric is 0

No advertising protos.

入口PE、PE2:

RP/0/0/CPU0:PE2#show mrib vrf two route 232.1.1.3 10.0.0.15

IP Multicast Routing Information Base

Entry flags: L - Domain-Local Source, E - External Source to the Domain,

C - Directly-Connected Check, S - Signal, IA - Inherit Accept,

IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,

MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle

CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet

MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary

MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN

Interface flags: F - Forward, A - Accept, IC - Internal Copy,

NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,

II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,

LD - Local Disinterest, DI - Decapsulation Interface

EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,

EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,

MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface

IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.3) RPF nbr: 10.2.15.15 Flags: RPF EX

Up: 00:10:37

Incoming Interface List

GigabitEthernet0/0/0/2 Flags: A, Up: 00:10:37

Outgoing Interface List

```
mdttransport Flags: F NS MI EX, Up: 00:10:37
```

```
RP/0/0/CPU0:PE2#show pim vrf two rpf 10.0.0.15
```

```
Table: IPv4-Unicast-default
```

```
* 10.0.0.15/32 [20/0]
```

```
via GigabitEthernet0/0/0/2 with rpf neighbor 10.2.15.15
```

```
RP/0/0/CPU0:PE2#show mrib vrf transport route 232.1.1.3 10.0.0.15
```

```
IP Multicast Routing Information Base
```

```
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
```

```
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
```

```
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
```

```
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
```

```
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
```

```
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
```

```
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
```

```
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
```

```
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
```

```
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
```

```
LD - Local Disinterest, DI - Decapsulation Interface
```

```
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
```

```
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
```

```
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
```

```
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.15,232.1.1.3) RPF TID: 0xe0000011 Flags: RPF EX
```

```
Up: 00:11:44
```

```
Incoming Interface List
```

```
GigabitEthernet0/0/0/2 Flags: A EX, Up: 00:11:44
```

```
Outgoing Interface List
```

```
mdttransport Flags: F NS MI, Up: 00:11:44
```

```
RP/0/0/CPU0:PE2#show pim vrf transport rpf 10.0.0.15
```

```
Table: IPv4-Unicast-default
```

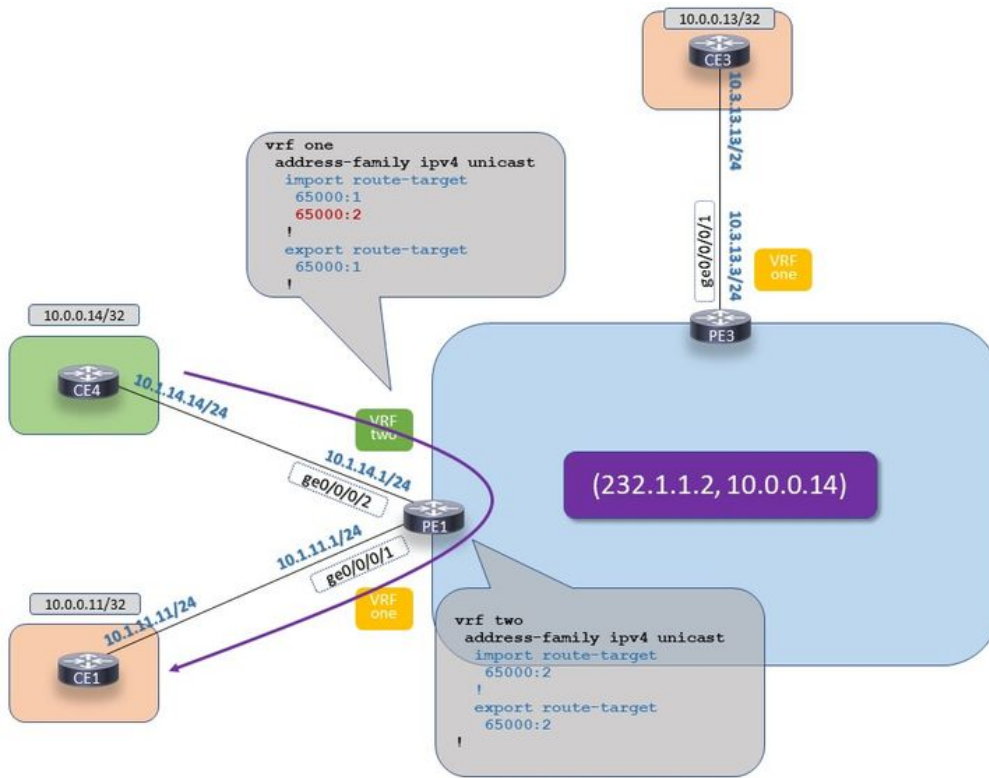
```
* 10.0.0.15/32 [1/0]
```

```
via VRF:two,GigabitEthernet0/0/0/2 with rpf neighbor 10.2.15.15
```

示例1.4.本地外联网

只涉及一个PE路由器。在接收方VRF中将路由返回到源VRF是基于RIB的解决方案的唯一要求。

一种解决方案是使用适当的路由目标，让VRF 1（源VRF）从VRF 2（接收器VRF）导入路由。



IOS-XR上的mVPN外联网：配置文件0 — 本地外联网

图9.配置文件0 — 本地外联网

PE1:

```
vrf one
address-family ipv4 unicast
import route-target
65000:1
65000:2
!
export route-target
65000:1 !
!
!
```

```
vrf two
address-family ipv4 unicast
import route-target
65000:2
!
export route-target
65000:2
!
```

```
RP/0/0/CPU0:PE1#show mrib vrf one route 232.1.1.2 10.0.0.14
```

IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,

NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.14,232.1.1.2) RPF TID: 0xe0000011 Flags: RPF EX
Up: 17:02:25

Incoming Interface List

GigabitEthernet0/0/0/2 Flags: A EX, Up: 00:02:32

Outgoing Interface List

GigabitEthernet0/0/0/1 Flags: F NS, Up: 1702:25

RP/0/0/CPU0:PE1#show route vrf one 10.0.0.14/32

Routing entry for 10.0.0.14/32

Known via "bgp 65000", distance 20, metric 0

Tag 65004, type external

Installed Nov 22 10:24:52.002 for 00:01:10

Routing Descriptor Blocks

10.1.14.14, from 10.1.14.14, BGP external

Nexthop in Vrf: "two", Table: "default", IPv4 Unicast, Table Id: 0xe0000011

Route metric is 0

No advertising protos.

RP/0/0/CPU0:PE1#show pim vrf one rpf 10.0.0.14

Table: IPv4-Unicast-default

* 10.0.0.14/32 [20/0]

via VRF:two with rpf neighbor 10.1.14.14

RP/0/0/CPU0:PE1#show mrib vrf two route 232.1.1.2 10.0.0.14

IP Multicast Routing Information Base

Entry flags: L - Domain-Local Source, E - External Source to the Domain,

C - Directly-Connected Check, S - Signal, IA - Inherit Accept,

IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,

MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle

CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet

MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary

MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN

Interface flags: F - Forward, A - Accept, IC - Internal Copy,

NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,

II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,

LD - Local Disinterest, DI - Decapsulation Interface

EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,

EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,

MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface

IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.14,232.1.1.2) RPF nbr: 10.1.14.14 Flags: RPF EX

Up: 00:03:06

Incoming Interface List

GigabitEthernet0/0/0/2 Flags: A, Up: 00:03:06

Outgoing Interface List

GigabitEthernet0/0/0/1 Flags: F NS EX, Up: 00:03:06

RP/0/0/CPU0:PE1#show pim vrf two rpf 10.0.0.14

Table: IPv4-Unicast-default

* 10.0.0.14/32 [20/0]

via GigabitEthernet0/0/0/2 with rpf neighbor 10.1.14.14

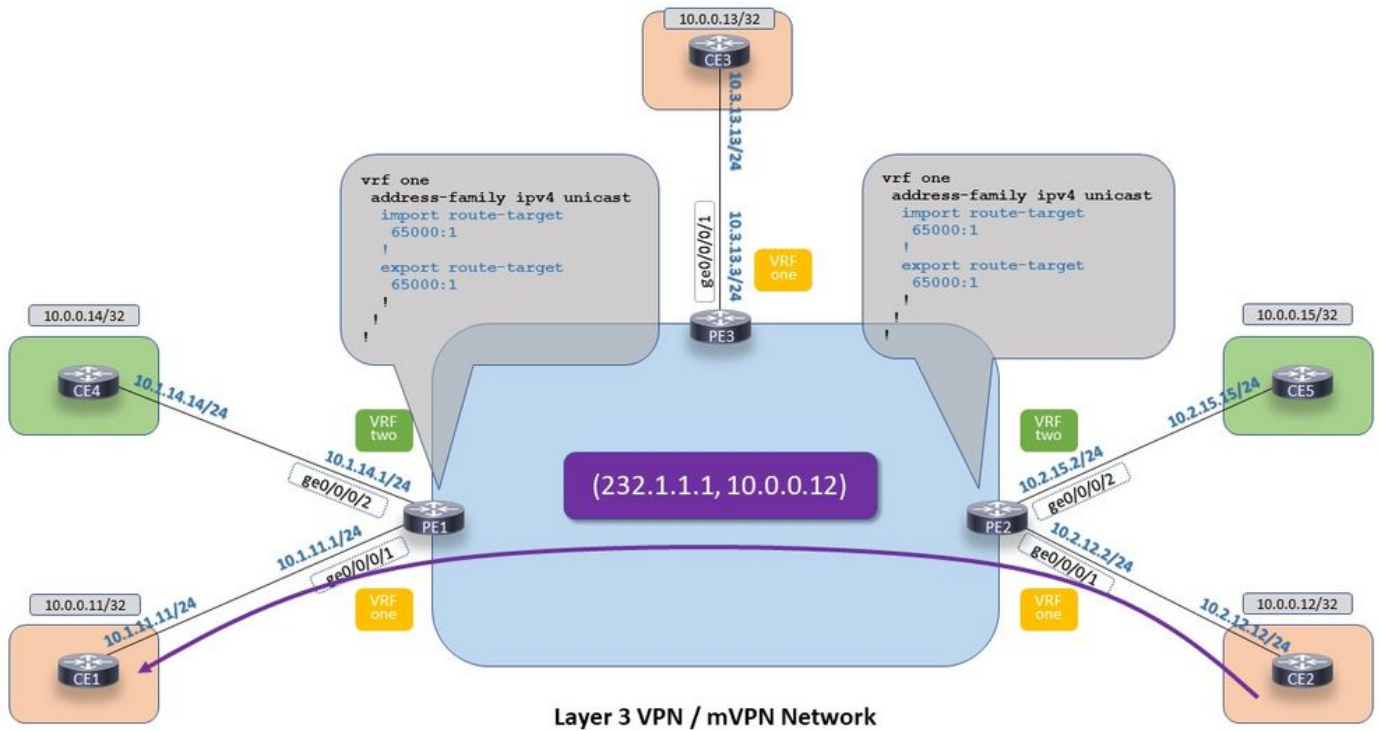
简档14

配置文件14使用分区MDT，在底层使用mLDP组播信令，在重叠（VRF环境）中使用BGP（客户）信令。

此配置文件支持选项1。

选项2和3可用于路由技巧。

图10显示VRF内组播流量，VRF 1到VRF 1。



IOS-XR上的mVPN外联网：配置文件14 - VRF内组播流量

映像10配置文件14 - VRF内组播流量

出口PE 1上MRIB条目的输出如下所示：

```
RP/0/0/CPU0:PE1#show mrib vrf one route 232.1.1.1 10.0.0.12
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
```

IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

```
(10.0.0.12,232.1.1.1) RPF nbr: 10.0.0.2 Flags: RPF
Up: 02:06:44
Incoming Interface List
  Lmdtone Flags: A LMI, Up: 02:05:18
Outgoing Interface List
  GigabitEthernet0/0/0/1 Flags: F NS, Up: 02:06:44
```

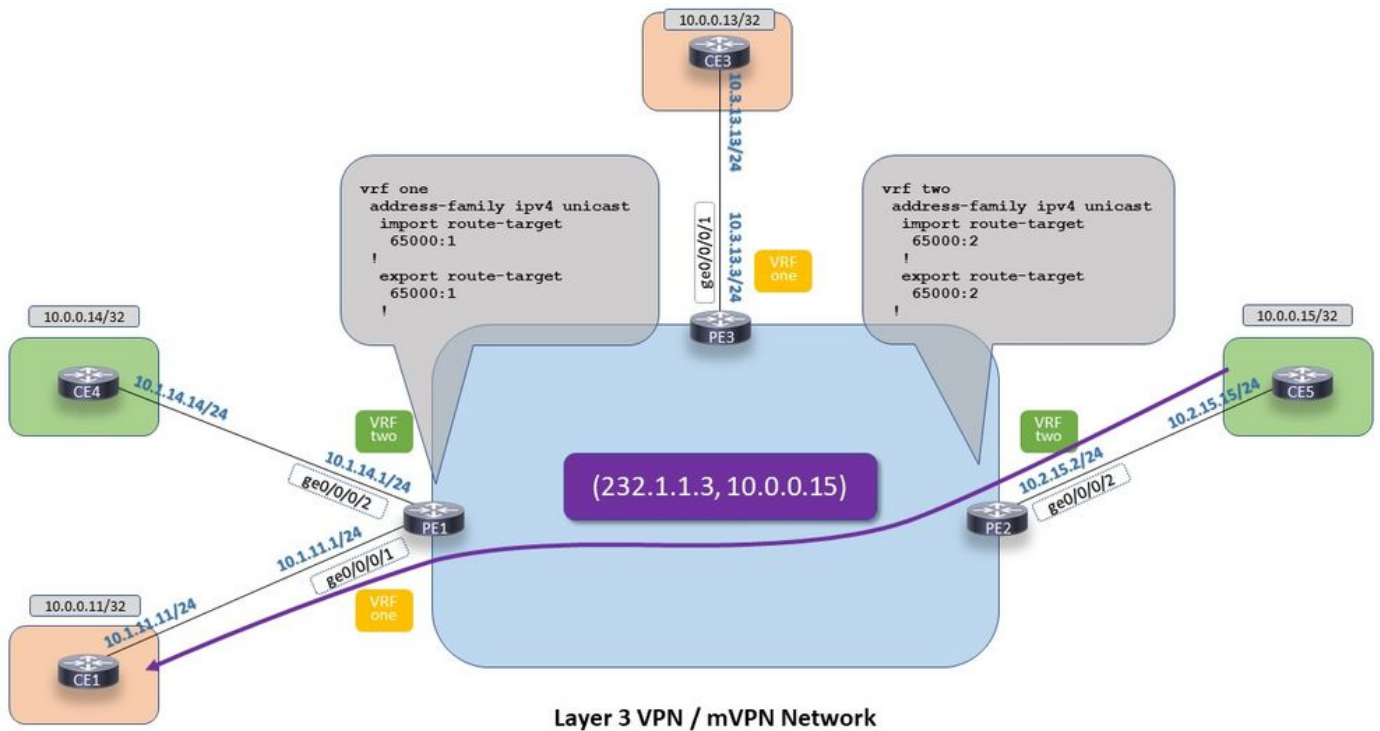
RP/0/0/CPU0:PE1#show pim vrf one rpf 10.0.0.12

```
Table: IPv4-Unicast-default
* 10.0.0.12/32 [200/0]
  via Lmdtone with rpf neighbor 10.0.0.2
  Connector: 65000:1002:10.0.0.2, Nexthop: 10.0.0.2
```

```
router pim
vrf one
address-family ipv4
rpf topology route-policy profile-14
mdt c-multicast-routing bgp
!
ssm range SSM-range-vrf-one
!
```

```
route-policy profile-14
set core-tree mldp-partitioned-p2mp
end-policy
!
```

示例2.1。选项1.源MVRF位于接收方MVRF上



IOS-XR上的mVPN外联网：配置文件14 — 选项1源MVRF位于接收方MVRF上

图11配置文件14 — 选项1源MVRF位于接收方MVRF上

必须在接收机PE的接收机VRF上更改RPF。

对于VRF 1和VRF 2，导入和导出语句保持不变。

```
router pim
vrf one
address-family ipv4
rpf topology route-policy profile-14-extranet
mdt c-multicast-routing bgp
!
ssm range SSM-range-vrf-one
!
!
!
router pim
vrf two
address-family ipv4
rpf topology route-policy profile-14
mdt c-multicast-routing bgp
!
ssm range SSM-range-vrf-two
!
!
!

route-policy profile-14
set core-tree mldp-partitioned-p2mp
end-policy
!

route-policy profile-14-extranet
if destination in (232.1.1.3/32) then
set rpf-topology vrf two
else
set core-tree mldp-partitioned-p2mp
endif
end-policy
!
```

组播组232.1.1.3的VRF 1中的RPF指向VRF 2。

```
RP/0/0/CPU0:PE1#show mrib vrf one route 232.1.1.3 10.0.0.15
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.15,232.1.1.3) RPF TID: 0xe0000011 Flags: EX
Up: 03:37:29
Outgoing Interface List
```

GigabitEthernet0/0/0/1 Flags: F NS, Up: 03:37:29

注意：VRF One中没有MRIB条目的传入接口。这对流量转发没有影响。

```
RP/0/0/CPU0:PE1#show pim vrf one rpf 10.0.0.15
Table: IPv4-Unicast-default
* 10.0.0.15/32 [4294967295/4294967295]
  via Null with rpf neighbor 0.0.0.0
```

注意：RPF在出口PE的VRF ONE中发生故障。这对流量转发没有影响。

```
RP/0/0/CPU0:PE1#show mrib vrf two route 232.1.1.3 10.0.0.15
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
             C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
             IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
             MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
             CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
             MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
             MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
                NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
                II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
                LD - Local Disinterest, DI - Decapsulation Interface
                EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
                EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
                MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
                IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.15,232.1.1.3) RPF nbr: 10.0.0.2 Flags: RPF EX
Up: 00:05:58
Incoming Interface List
  Lmdttwo Flags: A LMI, Up: 00:05:58
Outgoing Interface List
  GigabitEthernet0/0/0/1 Flags: F NS EX, Up: 00:05:58
```

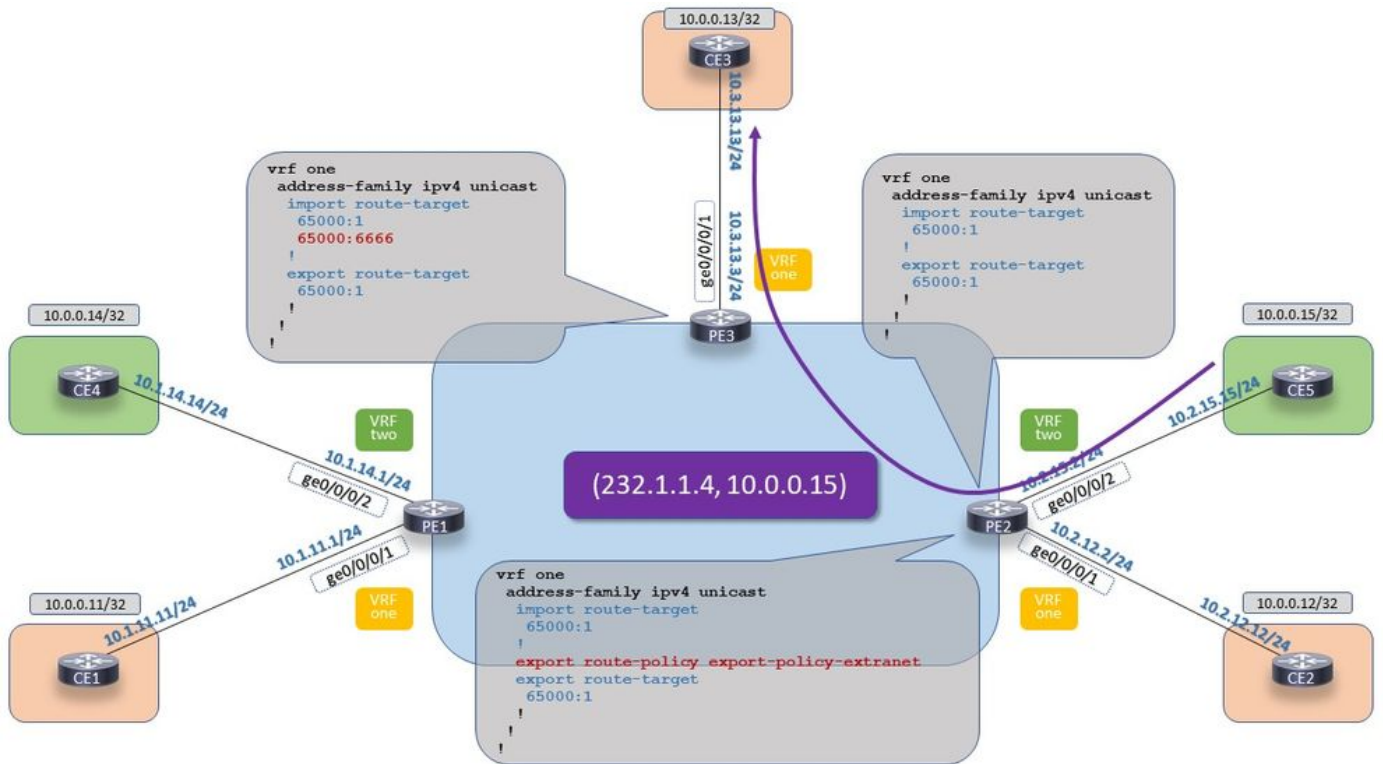
请注意，接口GE0/0/0/1在VRF 1中。

示例2.2.选项2.接收方MVRF位于源MVRF上

此解决方案无法通过操作路由目标的导入和导出语句或仅通过更改RPF使用的路由策略来运行。

技巧有助于修复入口PE路由器上的RPF。诀窍是在接收方VRF中添加静态路由，并将其指向入口PE路由器上的源VRF。

静态路由在接收方VRF中通告源地址。此静态路由在BGP中标记了新的唯一路由目标，以便此路由可以与源VRF中通告的相同路由区分。这避免了将入口PE上的接收方VRF的静态路由导入其他PE路由器的接收方VRF，从而导致路由问题。



IOS-XR上的mVPN外联网：配置文件14 — 选项2接收方MVRF位于源MVRF上

图像12配置文件14 — 选项2接收方MVRF位于源MVRF上

PE2:

```

router static
  vrf one
  address-family ipv4 unicast
    10.0.0.15/32 vrf two GigabitEthernet0/0/0/2 10.2.15.15
  !
  !
  !

router bgp 65000
  vrf one
  rd 65000:1002
  address-family ipv4 unicast
    redistribute connected
  redistribute static
  !

route-policy export-policy-extranet
  if destination in (10.0.0.15/32) then
    set extcommunity rt rt-set-static-extranet
  else
    pass
  endif
end-policy
!

extcommunity-set rt rt-set-static-extranet
  65000:6666
end-set
!

```

RP/0/0/CPU0:PE2#show route vrf one 10.0.0.15/32

```
Routing entry for 10.0.0.15/32
Known via "static", distance 1, metric 0
Installed Nov 20 13:48:25.525 for 04:50:15
Routing Descriptor Blocks
 10.2.15.15, via GigabitEthernet0/0/0/2
   NextHop in Vrf: "two", Table: "default", IPv4 Unicast, Table Id: 0xe0000011
   Route metric is 0, Wt is 1
No advertising protos.
```

```
RP/0/0/CPU0:PE2#show pim vrf one rpf 10.0.0.15
Table: IPv4-Unicast-default
* 10.0.0.15/32 [1/0]
  via VRF:two,GigabitEthernet0/0/0/2 with rpf neighbor 10.2.15.15
```

出口PE在入口PE上看到设置了路由目标的BGP路由。

```
RP/0/0/CPU0:PE3#show bgp vrf one 10.0.0.15/32
BGP routing table entry for 10.0.0.15/32, Route Distinguisher: 65000:1003
Versions:
Process          bRIB/RIB  SendTblVer
Speaker          8         8
Last Modified: Nov 20 13:49:49.569 for 04:51:19
Paths: (1 available, best #1)
Advertised to CE peers (in unique update groups):
 10.3.13.13
Path #1: Received by speaker 0
Advertised to CE peers (in unique update groups):
 10.3.13.13
Local
 10.0.0.2 (metric 3) from 10.0.0.4 (10.0.0.2)
  Received Label 24003
  Origin incomplete, metric 0, localpref 100, valid, internal, best, group-best, import-
candidate, imported
  Received Path ID 0, Local Path ID 1, version 8
  Extended community: VRF Route Import:10.0.0.2:16 Source AS:65000:0 RT:65000:6666
  Originator: 10.0.0.2, Cluster list: 10.0.0.4
  Connector: type: 1, Value:65000:1002:10.0.0.2
  Source AFI: VPNv4 Unicast, Source VRF: default, Source Route Distinguisher: 65000:1002
```

出口PE在源VRF、VRF PE中具有到入口PE的正确RPF条目。

```
RP/0/0/CPU0:PE3#show pim vrf one rpf 10.0.0.15
Table: IPv4-Unicast-default
* 10.0.0.15/32 [200/0]
  via Lmdtone with rpf neighbor 10.0.0.2
  Connector: 65000:1002:10.0.0.2, NextHop: 10.0.0.2
```

```
RP/0/0/CPU0:PE3#show mrib vrf one route 232.1.1.4 10.0.0.15
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
```

EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.4) RPF nbr: 10.0.0.2 Flags: RPF

Up: 04:54:24

Incoming Interface List

Lmdtone Flags: A LMI, Up: 00:05:48

Outgoing Interface List

GigabitEthernet0/0/0/1 Flags: F NS, Up: 04:54:24

入口PE在源和接收方VRF中都有外联网条目。源VRF:

RP/0/0/CPU0:PE2#show mrib vrf two route 232.1.1.4 10.0.0.15

IP Multicast Routing Information Base

Entry flags: L - Domain-Local Source, E - External Source to the Domain,
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN

Interface flags: F - Forward, A - Accept, IC - Internal Copy,

NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.4) RPF nbr: 10.2.15.15 Flags: RPF EX

Up: 00:06:36

Incoming Interface List

GigabitEthernet0/0/0/2 Flags: A, Up: 00:06:36

Outgoing Interface List

Lmdtone Flags: F LMI EX TR, Up: 00:06:36

接收器VRF:

RP/0/0/CPU0:PE2#show mrib vrf one route 232.1.1.4 10.0.0.15

IP Multicast Routing Information Base

Entry flags: L - Domain-Local Source, E - External Source to the Domain,
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN

Interface flags: F - Forward, A - Accept, IC - Internal Copy,

NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.4) RPF TID: 0xe0000011 Flags: RPF EX

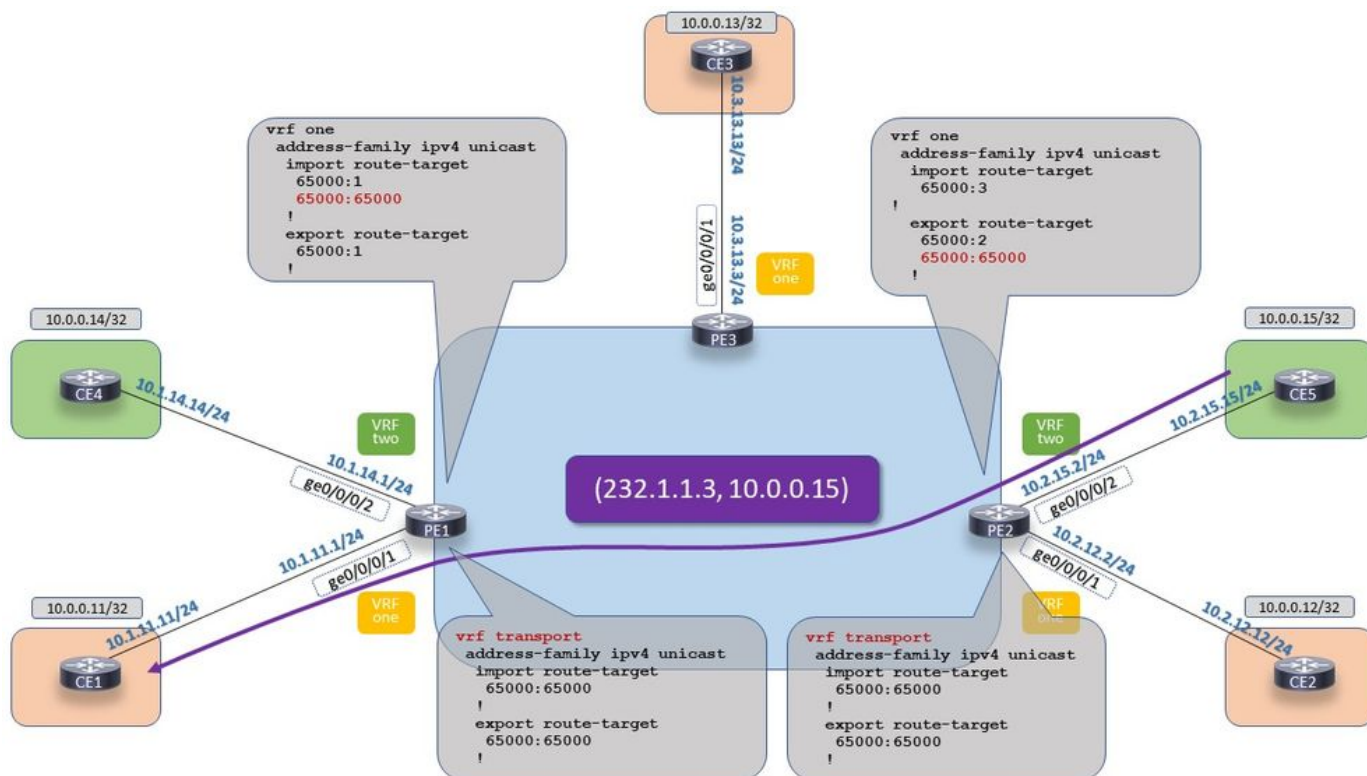
Up: 00:06:28

```

Incoming Interface List
  GigabitEthernet0/0/0/2 Flags: A EX, Up: 00:06:28
Outgoing Interface List
  Lmdtone Flags: F LMI TR, Up: 00:06:28

```

示例2.3.选项3.使用传输MVRF



IOS-XR上的mVPN外联网：配置文件14 — 选项3使用传输MVRF

图像13配置文件14 — 选项3使用传输MVRF

传输VRF不需要任何接口。但是，其他所有东西都需要存在：VRF配置、BGP配置、组播路由配置和路由器PIM配置。

选项1的配置在出口PE、PE1上，而选项2的配置在入口PE、PE2上。PE1:

```

vrf transport
 address-family ipv4 unicast
  import route-target
    65000:65000
  !
  export route-target
    65000:65000
  !

router bgp 65000
...
!
vrf transport
 rd 65000:123
 address-family ipv4 unicast
  redistribute static
  !
 address-family ipv4 mvpn
  !

```

```

multicast-routing
vrf one
address-family ipv4
  interface GigabitEthernet0/0/0/1
    enable
  !
  mdt source Loopback0
  bgp auto-discovery mldp
  !
  mdt partitioned mldp ipv4 p2mp
!
!
!
vrf transport
address-family ipv4
  mdt source Loopback0
  bgp auto-discovery mldp
  !
  mdt partitioned mldp ipv4 p2mp
!

```

```

router pim
vrf one
address-family ipv4
  rpf topology route-policy profile-14
  mdt c-multicast-routing bgp
  !
  ssm range SSM-range-vrf-one
!
!
vrf transport
address-family ipv4
  rpf topology route-policy profile-14
  mdt c-multicast-routing bgp
  !
  ssm range SSM-range-vrf-transport
!

```

PE2:

```

vrf transport
address-family ipv4 unicast
import route-target
  65000:65000
!
export route-target
  65000:65000
!
!
route-policy vrf-one-profile-14
  set core-tree mldp-partitioned-p2mp
end-policy
!
route-policy export-policy-extranet
  if destination in (10.0.0.15/32) then
    set extcommunity rt rt-set-static-extranet
  else
    pass
  endif
end-policy

```

```
!  
router static  
!  
vrf transport  
address-family ipv4 unicast  
10.0.0.15/32 vrf two GigabitEthernet0/0/0/2 10.2.15.15  
!  
!  
!  
  
router bgp 65000  
...  
vrf transport  
address-family ipv4  
mdt source Loopback0  
interface all enable  
bgp auto-discovery mldp  
!  
mdt partitioned mldp ipv4 p2mp  
!  
  
router pim  
address-family ipv4  
ssm range SSM-range  
!  
!  
vrf two  
address-family ipv4  
rpf topology route-policy profile-14  
mdt c-multicast-routing bgp  
!  
ssm range SSM-range-vrf-two  
!  
!  
vrf transport  
address-family ipv4  
rpf topology route-policy profile-14  
mdt c-multicast-routing bgp  
!  
ssm range SSM-range-vrf-transport  
!  
  
multicast-routing  
!  
vrf two  
address-family ipv4  
interface GigabitEthernet0/0/0/2  
enable  
!  
mdt source Loopback0  
bgp auto-discovery mldp  
!  
mdt partitioned mldp ipv4 p2mp  
!  
!  
vrf transport  
address-family ipv4  
mdt source Loopback0  
bgp auto-discovery mldp  
!  
mdt partitioned mldp ipv4 p2mp  
!  
!
```



```
RP/0/0/CPU0:PE1#show mrib vrf one route 232.1.1.3 10.0.0.15
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
             C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
             IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
             MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
             CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
             MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
             MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
                NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
                II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
                LD - Local Disinterest, DI - Decapsulation Interface
                EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
                EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
                MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
                IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.15,232.1.1.3) RPF TID: 0xe0000012 Flags: RPF EX
Up: 1d03h
```

```
Outgoing Interface List
```

```
GigabitEthernet0/0/0/1 Flags: F NS, Up: 1d03h
```

注意：VRF One中没有MRIB条目的传入接口。这对流量转发没有影响。

```
RP/0/0/CPU0:PE1#show pim vrf one rpf 10.0.0.15
```

```
Table: IPv4-Unicast-default
```

```
* 10.0.0.15/32 [4294967295/4294967295]
   via Null with rpf neighbor 0.0.0.0
```

注意：RPF在出口PE的VRF ONE中发生故障。这对流量转发没有影响。

```
RP/0/0/CPU0:PE1#show pim vrf transport rpf 10.0.0.15
```

```
Table: IPv4-Unicast-default
```

```
* 10.0.0.15/32 [200/0]
   via Lmdttransport with rpf neighbor 10.0.0.2
   Connector: 65000:456:10.0.0.2, Nexthop: 10.0.0.2
```

```
RP/0/0/CPU0:PE1#show mrib vrf transport route 232.1.1.3 10.0.0.15
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
             C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
             IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
             MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
             CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
             MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
             MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
                NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
                II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
                LD - Local Disinterest, DI - Decapsulation Interface
                EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
                EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
                MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
                IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.15,232.1.1.3) RPF nbr: 10.0.0.2 Flags: RPF EX
```

Up: 00:48:15

Incoming Interface List

Lmdttransport Flags: A LMI, Up: 00:22:51

Outgoing Interface List

GigabitEthernet0/0/0/1 Flags: F NS EX, Up: 00:48:15

RP/0/0/CPU0:PE1#show route vrf transport

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
U - per-user static route, o - ODR, L - local, G - DAGR, l - LISP
A - access/subscriber, a - Application route
M - mobile route, r - RPL, t - Traffic Engineering, (!) - FRR Backup path

Gateway of last resort is not set

B 10.0.0.15/32 [200/0] via 10.0.0.2 (nexthop in vrf default), 00:40:06

RP/0/0/CPU0:PE2#show mrib vrf transport route 232.1.1.3 10.0.0.15

IP Multicast Routing Information Base

Entry flags: L - Domain-Local Source, E - External Source to the Domain,
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN

Interface flags: F - Forward, A - Accept, IC - Internal Copy,
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

(10.0.0.15,232.1.1.3) RPF TID: 0xe0000011 Flags: RPF EX

Up: 00:25:25

Incoming Interface List

GigabitEthernet0/0/0/2 Flags: A EX, Up: 00:25:25

Outgoing Interface List

Lmdttransport Flags: F LMI TR, Up: 00:25:25

RP/0/0/CPU0:PE2#show mrib vrf two route 232.1.1.3 10.0.0.15

IP Multicast Routing Information Base

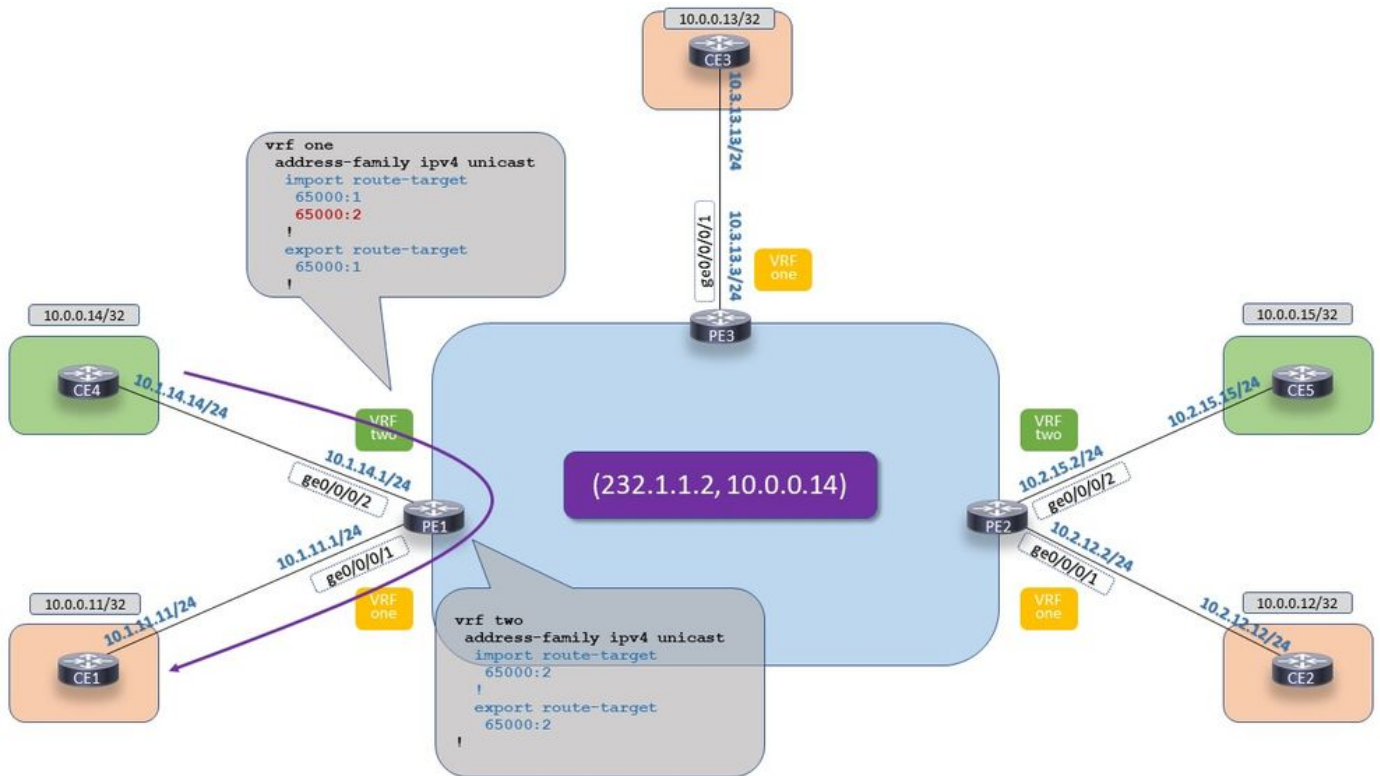
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN

Interface flags: F - Forward, A - Accept, IC - Internal Copy,
NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
LD - Local Disinterest, DI - Decapsulation Interface
EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,

MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface

```
(10.0.0.15,232.1.1.3) RPF nbr: 10.2.15.15 Flags: RPF EX  
Up: 00:25:55  
Incoming Interface List  
GigabitEthernet0/0/0/2 Flags: A, Up: 00:25:55  
Outgoing Interface List  
Lmdttransport Flags: F LMI EX TR, Up: 00:25:55
```

示例2.4.本地外联网



IOS-XR上的mVPN外联网：简档14 — 本地外联网

图14配置文件14 — 本地外联网

源VRF的源路由必须导入接收器VRF。

```
vrf one  
address-family ipv4 unicast  
import route-target  
65000:1  
65000:2  
!  
export route-target  
65000:1  
!
```

```
vrf two  
address-family ipv4 unicast  
import route-target  
65000:2  
!  
export route-target  
65000:2  
!
```

```
RP/0/0/CPU0:PE1#show route vrf one 10.0.0.14/32
Routing entry for 10.0.0.14/32
  Known via "bgp 65000", distance 20, metric 0
  Tag 65004, type external
  Installed Nov 22 10:52:10.451 for 00:01:22
  Routing Descriptor Blocks
    10.1.14.14, from 10.1.14.14, BGP external
      Nexthop in Vrf: "two", Table: "default", IPv4 Unicast, Table Id: 0xe0000011
      Route metric is 0
  No advertising protos.
```

```
RP/0/0/CPU0:PE1#show mrib vrf one route 232.1.1.2 10.0.0.14
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
  CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
  MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
  MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
  NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
  II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
  LD - Local Disinterest, DI - Decapsulation Interface
  EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
  EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
  MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
  IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.14,232.1.1.2) RPF TID: 0xe0000011 Flags: RPF EX
Up: 1d21h
Incoming Interface List
  GigabitEthernet0/0/0/2 Flags: A EX, Up: 00:02:07
Outgoing Interface List
  GigabitEthernet0/0/0/1 Flags: F NS, Up: 1d21h
```

```
RP/0/0/CPU0:PE1#show pim vrf one rpf 10.0.0.14
Table: IPv4-Unicast-default
* 10.0.0.14/32 [20/0]
  via VRF:two with rpf neighbor 10.0.0.1
```

```
RP/0/0/CPU0:PE1#show mrib vrf two route 232.1.1.2 10.0.0.14
```

```
IP Multicast Routing Information Base
Entry flags: L - Domain-Local Source, E - External Source to the Domain,
  C - Directly-Connected Check, S - Signal, IA - Inherit Accept,
  IF - Inherit From, D - Drop, ME - MDT Encap, EID - Encap ID,
  MD - MDT Decap, MT - MDT Threshold Crossed, MH - MDT interface handle
  CD - Conditional Decap, MPLS - MPLS Decap, EX - Extranet
  MoFE - MoFRR Enabled, MoFS - MoFRR State, MoFP - MoFRR Primary
  MoFB - MoFRR Backup, RPFID - RPF ID Set, X - VXLAN
Interface flags: F - Forward, A - Accept, IC - Internal Copy,
  NS - Negate Signal, DP - Don't Preserve, SP - Signal Present,
  II - Internal Interest, ID - Internal Disinterest, LI - Local Interest,
  LD - Local Disinterest, DI - Decapsulation Interface
  EI - Encapsulation Interface, MI - MDT Interface, LVIF - MPLS Encap,
  EX - Extranet, A2 - Secondary Accept, MT - MDT Threshold Crossed,
  MA - Data MDT Assigned, LMI - mLDP MDT Interface, TMI - P2MP-TE MDT Interface
  IRMI - IR MDT Interface, TRMI - TREE SID MDT Interface
```

```
(10.0.0.14,232.1.1.2) RPF nbr: 10.1.14.14 Flags: RPF EX
```

Up: 00:02:47

Incoming Interface List

GigabitEthernet0/0/0/2 Flags: A, Up: 00:02:47

Outgoing Interface List

GigabitEthernet0/0/0/1 Flags: F NS EX, Up: 00:02:47