

BGP MVPN PE-PE Ingress Replication

The BGP-mVPN PE-PE Ingress Replication feature enables creating a Point-to-Multipoint (P2MP) tree where ingress devices replicate the multicast packets, encapsulate the packets in a unicast tunnel and send the packets to egress devices.

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Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for BGP MVPN PE-PE Ingress Replication

- Label switched paths (LSPs) are assumed to exist between PE routers ("PEs").
- Multiprotocol Label Switching (MPLS) Label Distribution Protocol (LDP) and unicast routing must be enabled.

Restrictions for BGP MVPN PE-PE Ingress Replication

- For Cisco IOS XE Denali 16.3.1 the PE to PE Ingress Replication (PE-PE IR) is only supported on the Cisco CSR 1000v Series Cloud Services Router.
- The Partitioned MDT IR profile only supports MVPN BGP C-Route Signaling.
- Inter-AS option C is only supported.
- High Availability is not supported.
- BGP Auto Discovery (AD) must be used for PE-PE IR.
- The Partitioned-MDT profile supports only BGP C-multicast route signaling. The Default-MDT profile supports both BGP and PIM C-multicast signaling. The Data-MDT profile is also supported.
- Only PIM ASM and SSM are supported for deployments of multicast control plane protocols. PIM BIDIR and PIM Dense-mode are not supported.

Information about BGP MVPN PE-PE Ingress Replication

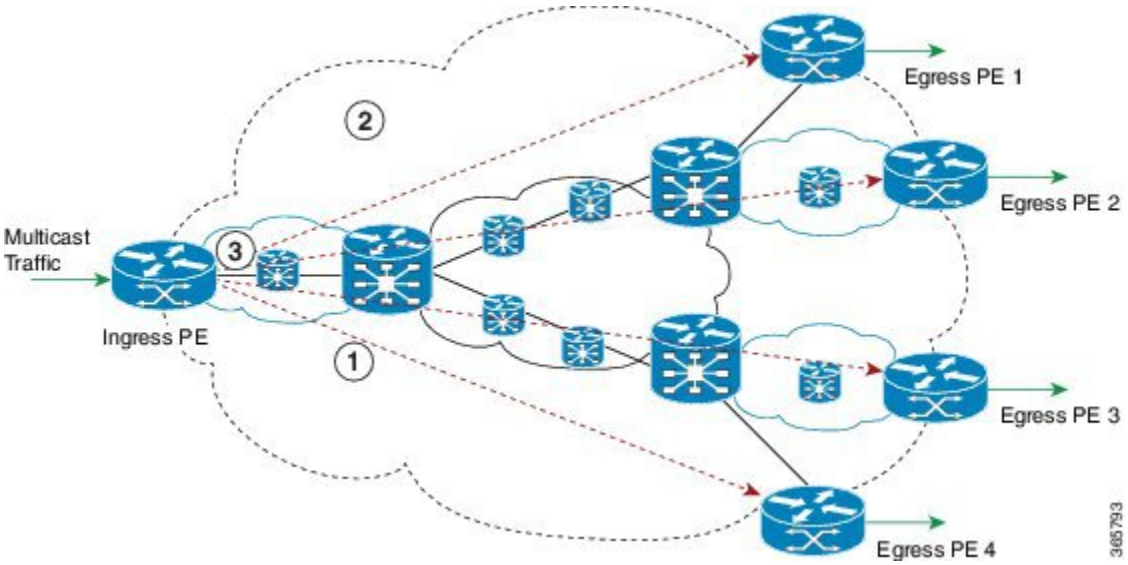
In Multicast VPN (MVPN) using Multipoint to Multipoint LDP (MLDP), multicast traffic received by an ingress provider edge (PE) router is replicated/copied and passes through the core to egress PE routers. State is maintained in the core and this may lead to some dynamic fluctuation of state in the service provider core routers.

In PE to PE IR, multicast traffic from an ingress PE router is replicated/copied and tunneled over multiple LSPs directly from the ingress PE to egress PE. State is not maintained as the traffic passes through the core.

The primary advantage of using PE to PE Ingress Replication (IR) is not having to maintain state in the core as mentioned above. A potential disadvantage to using PE-PE IR, is that the bandwidth utilization in the core increases in some parts of the core; For example, at the point in the network shown in the figure below, at callout 3, there are multiple copies of traffic going from the Ingress PE in a path towards the egress PEs.

BGP MVPN AD is the control plane that is used between PEs for PE-PE IR.

Figure 1: PE-PE Ingress Replication Topology



Callout	Description
1	Red-dashed line, which shows the route taken by one copy or replication of traffic from an Ingress PE to an Egress PE.
2	Cloud showing the network core.
3	On this route, a multicast packet is replicated four times by PE-PE Ingress Replication.

In the figure above, when the Ingress PE router receives multicast traffic, it sends a copy of the traffic to each of the egress PE routers: Egress PE 1, Egress PE 2, Egress PE 3 and Egress PE 4. The egress PE routers inform the ingress PE routers of their interest in receiving multicast traffic by originating BGP Leaf Auto-Discovery routes.

Each replication is sent over a MPLS Label Switched Path (LSP) to the specific destination PE router. MVPN sites that are connected to a particular egress PE are allowed to send multicast traffic to other sites in the same MVPN.

LSPs are assumed to exist before PE-PE IR is configured. LSPs can be setup using a variety of types of LSP. e.g BGP labeled unicast SAFI LSPs can be used with PE-PE IR but it is better to use P2P (TE) LDP LSPs, which are verified and tested.

Ingress Replication MVPN Profiles

For Ingress Replication, the MVPN Profile may be one of the following two profiles. Data MDT is supported within either of the following two profiles:

- Partitioned MDT Profile
- Default MDT Profile

Partitioned MDT Profile

In a partitioned MDT profile, only those egress PE routers that receive traffic requests from a particular ingress PE are associated with that ingress PE. This results in a low number of ingress PE routers in the network and a limited number of trees in the core.

When a Partitioned MDT profile is used in PE-PE IR, egress PEs may need identify traffic from ingress PEs, which uses an internal RPF-ID. A strict RPF check is done using the RPF-ID.

Note Interface-based strict RPF check is not supported. If the PE-PE IR MVPN is configured to include both IPv4 and IPv6 address-families of a VRF, the default or partitioned MDT profile must be same in both the IPv4 and the IPv6 address-families.

Default MDT Profile

In a default MDT Profile, the MDT carries control plane and data traffic. All PE routers in the MVPN need to join the default MDT tree. The number of MDT trees that are set up for every PE equals the number of PEs in the MVPN.

Note If the PE-PE IR MVPN is configured to include both IPv4 and IPv6 address-families of a VRF, the default or partitioned MDT profile must be same in both the IPv4 and the IPv6 address-families.

PE-PE IR profile must be same in IPv4. mLDP and PE-PE IR cannot exist together

Similar to the Partitioned MDT profile, PE-PE IR cannot exist alongside an mLDP MVPN profile under the same address family of the same VRF. Also, a PE-PE IR cannot exist with mLDP inband signaling in the same address family of a VRF.

Data MDT

By default, the number of data MDTs that can be used in either a partitioned or default MDT profile for PE-PE IR is unlimited. However, each data MDT consumes system resources; therefore, optionally, the number of data MDTs can be limited between 1 and 20000.

An ACL can be optionally configured, via the list keyword, to control the multicast flows that can use a data MDT. When the data MDT threshold is 0, a PIM-SSM (multicast) state is assigned to a data MDT as soon as it is instantiated. Using the immediate-switch keyword, the first packet of the (multicast) flow switches onto the data MDT. Without this immediate-switch keyword, a three second delay occurs before flow packets transition to the data MDT.

Receiver-only Sites

BGP auto-discovery (AD) control plane states are reduced by not announcing certain BGP AD routes. Note that receiver-only sites are not specific to PE-PE IR but also apply to mLDP. In a PE-PE IR configuration, each egress PE must be connected to a receiver-only site. The PE-PE IR C-multicast protocol is BGP C-routes.

How to Configure BGP MVPN PE-PE Ingress Replication

Configuring BGP MVPN PE-PE Ingress Replication

In the following configuration, partitioned MDT is set up in two address families. To configure BGP MVPN PE-PE Ingress Replication:

```
enable
configure terminal
vrf definition vrf2
rd 100:2
route-target export 100:2
route-target import 100:2
!
address-family ipv4
mdt auto-discovery ingress-replication
mdt strict-rpf interface
mdt partitioned ingress-replication
mdt overlay use-bgp

exit-address-family
!
address-family ipv6
mdt auto-discovery ingress-replication
mdt strict-rpf interface
mdt partitioned ingress-replication
mdt overlay use-bgp
exit-address-family
router bgp 1009
address-family ipv4 MVPN
neighbor 13.3.3.3 activate
neighbor 13.3.3.3 send-community extended
exit-address-family
!
address-family ipv6 MVPN
neighbor 13.3.3.3 activate
neighbor 13.3.3.3 send-community extended
exit-address-family
```

Displaying and Verifying BGP MVPN PE-PE Ingress Replication

Use the **show MVPN ipv4 vrf red auto-discovery** command to display a summary of the MVPN IPv4 VRF auto-discovery routes. Some parts of the following output is removed for brevity:

```
Device# show MVPN ipv4 vrf red auto-discovery
Orig: L - Local, R-Remote
Route-Type: I-PMSI - Intra-AS Inclusive-PMSI, S-PMSI - Selective-PMSI
* - Indicates Wildcard source or group address

Orig Route   (VRF-S, VRF-G)                        Originator    Type  Uptime
R    I-PMSI  N/A                                   55.1.1.2      None  00:07:19
...<output removed for brevity>
R    S-PMSI  (*,*)                                 55.1.1.2      IR    00:07:19
...<output removed for brevity>
R    S-PMSI  (*,224.0.1.39)                        65.1.1.3      IR    00:07:14
...<output removed for brevity>
R    S-PMSI  (101.0.8.3,232.1.1.1)                 65.1.1.2      IR    00:06:48
L    I-PMSI  N/A                                   55.1.1.1      None  00:07:19
```

```
L    S-PMSI  (*,*)                                  55.1.1.1      IR    00:07:19
```

Use the **show MVPN ipv4 vrf red auto-discovery detail** command to display detailed summary of MVPN IPv4 VRF auto-discovery routes.

```
Device# show MVPN ipv4 vrf red auto-discovery detail
I-PMSI - Intra-AS Inclusive-PMSI, S-PMSI - Selective-PMSI
* - Indicates Wildcard source or group address

 [I-PMSI][10:1][10.1.1.1], Joined
  Orig: Remote Uptime: 03:54:20 Type: NONE

 [I-PMSI][10:3][10.1.1.3], Joined
  Orig: Remote Uptime: 03:55:07 Type: NONE

[S-PMSI][10:1][*][*][10.1.1.1],
  Orig: Remote Uptime: 03:54:20 Type: IR
  Leaf-Info-Req IR-label: 0 IR-address: 10.1.1.1 IR-Egress-Id: 0
  PPMP-label: 25

 [S-PMSI][10:2][*][*][10.1.1.2], Joined
  Orig: Local Uptime: 03:54:16 Type: IR
  Leaf-Info-Req IR-label: 0 IR-address: 10.1.1.2 Replication-Id: 100000
  PPMP-label: 25

 [S-PMSI][10:2][192.168.1.1][232.1.1.1][10.1.1.2], Joined
  Orig: Local Uptime: 03:49:20 Type: IR
  Leaf-Info-Req IR-label: 0 IR-address: 10.1.1.2 Replication-Id: 100002

 [S-PMSI][10:2][192.168.60.6][232.1.1.1][10.1.1.2], Joined
  Orig: Local Uptime: 03:54:15 Type: IR
  Leaf-Info-Req IR-label: 0 IR-address: 10.1.1.2 Replication-Id: 100001
```

Use the **show MVPN ipv4 vrf red leaf** command to display a summary of MVPN BGP Leaf Auto-Discovery.

```
Device# show MVPN ipv4 vrf red leaf
Orig: L - Local, R-Remote
Route-Type: 1 - Intra-AS Inclusive-PMSI, 3 - Selective-PMSI
* - Indicates Wildcard source or group address
Orig Originator     Type Route-Key
R   55.1.1.1        IR   [3][65:12][*][*][65.1.1.2]
...<output removed for brevity>
R   55.1.1.1        IR   [3][65:12][101.0.8.3][232.1.1.1][65.1.1.2]
R   55.1.1.2        IR   [3][65:12][101.0.8.3][232.1.1.1][65.1.1.2]
R   65.1.1.4        IR   [3][65:12][101.0.8.3][232.1.1.1][65.1.1.2]
L   65.1.1.2        IR   [3][65:13][*][224.0.1.39][65.1.1.3]
L   65.1.1.2        IR   [3][65:14][*][224.0.1.39][65.1.1.4]
L   65.1.1.2        IR   [3][65:14][*][224.0.1.40][65.1.1.4]
```

Use the **show MVPN ipv4 vrf red leaf detail** command to display a detailed summary of MVPN BGP Leaf Auto-Discovery.

```
Device# show MVPN ipv4 vrf red leaf detail
Route-Type: 1 - Intra-AS Inclusive-PMSI, 3 - Selective-PMSI
* - Indicates Wildcard source or group address

[3][65:12][*][*][65.1.1.2], Joined
  Remote Orig: 55.1.1.1 UMH: 0.0.0.0 Uptime: 00:12:06 Type: IR
  IR-label: 47 IR-address: 55.1.1.1 Replication-Id: 200000

[3][65:12][*][*][65.1.1.2], Joined
  Remote Orig: 55.1.1.2 UMH: 0.0.0.0 Uptime: 00:12:06 Type: IR
  IR-label: 46 IR-address: 55.1.1.2 Replication-Id: 200000
```

```
[3][65:13][*][224.0.1.39][65.1.1.3], Joined
  Local Orig: 65.1.1.2 UMH: 65.1.1.3 Uptime: 00:12:16 Type: IR
  IR-label: 39 IR-address: 65.1.1.2 IR-Egress-Id: 15

[3][65:14][*][224.0.1.39][65.1.1.4], Joined
  Local Orig: 65.1.1.2 UMH: 65.1.1.4 Uptime: 00:12:16 Type: IR
  IR-label: 47 IR-address: 65.1.1.2 IR-Egress-Id: 11
```

Use the **show MVPN replication** command to display MVPN replication state information.

```
Device# show MVPN replication
Repl ID : 200000   LSM ID : 1   Uptime : 00:16:50
  PPMP Label          : 37
  PPMP Path Set ID    : 1B
  Path Set ID         : 12
  Replication branches: 3
   IR (55.1.1.1)
      Uptime         : 00:16:40      Refcount  : 1
      Remote Label   : 47
   IR (55.1.1.2)
      Uptime         : 00:16:40      Refcount  : 1
      Remote Label   : 46
   IR (65.1.1.4)
      Uptime         : 00:16:50      Refcount  : 1
      Remote Label   : 45

Repl ID : 200001   LSM ID : 3   Uptime : 00:16:19
  Path Set ID         : 1C
  Replication branches: 3
   IR (55.1.1.1)
      Uptime         : 00:16:14      Refcount  : 1
      Remote Label   : 47
   IR (55.1.1.2)
      Uptime         : 00:16:14      Refcount  : 1
      Remote Label   : 46
   IR (65.1.1.4)
      Uptime         : 00:16:19      Refcount  : 1
      Remote Label   : 45
```

Use the **show MVPN pe** command to display MVPN PE state information at egress PEs.

```
Device# show MVPN pe
PE: 65.1.1.1 RD: 65:11
  Refcount: 1 RPF-ID: 0x5

PE: 65.1.1.2 RD: 65:12
  Refcount: 2 RPF-ID: 0x4
  Ingress-Replication Info:
    IR-Egress-Label: 47 Egress-Id: 14

PE: 65.1.1.3 RD: 65:13
  Refcount: 2 RPF-ID: 0x6
  Ingress-Replication Info:
    IR-Egress-Label: 49 Egress-Id: 15
```

Use the **show MVPN <ipv4|ipv6> vrf <name> ingress-replication egress-info** command to display IR default profile egress information.

```
Device# show MVPN ipv6 vrf blue ingress-replication egress-info
Default IR-label: 43 IR-Egress-Id: 21
```

Additional References for BGP MVPN PE-PE Ingress Replication

Related Documents

Related Topic	Document Title
IP multicast commands	Cisco IOS IP Multicast Command Reference

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for BGP MVPN PE-PE Ingress Replication

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 1: Feature Information for BGP-mVPN PE-PE Ingress Replication

Feature Name	Releases	Feature Information
BGP-mVPN PE-PE Ingress Replication	Cisco IOS XE Denali 16.3.1	The BGP-mVPN PE-PE Ingress Replication feature extends BGP support for PE-PE IR feature.
PE-PE IR	Cisco IOS XE Denali 16.3.1	The PE-PE Ingress Replication (IR) feature supports replication of multicast traffic from an ingress PE router. The replicated multicast traffic from ingress PE router is tunneled over multiple LSPs directly from the ingress PE to egress PE. State is not maintained as the traffic passes through the core. This feature was introduced on Cisco Cloud Services Router 1000V Series.