



Configuring Multicast in LISP VXLAN Fabric

Multicast traffic forwarding is used to simultaneously distribute copies of data to multiple network destinations. In a LISP VXLAN fabric, multicast traffic flow can be handled in the overlay or the underlay, depending on whether the underlay network supports multicast replication or not. This chapter describes how to configure overlay multicast in a LISP VXLAN Fabric.

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LISP VXLAN Fabric Multicast Overview



Note This document assumes that the reader is familiar with the fundamentals of Multicast technology. To understand the basics of Multicast technology, refer [IP Multicast Technology Overview](#).

LISP VXLAN Fabric supports the following:

- Layer 2 overlay Broadcast, Unknown Unicast, and Multicast (BUM) traffic to be transported over IP multicast in the underlay network
- Layer 3 overlay multicast

Layer 2 Overlay Broadcast, Unknown Unicast, and Multicast

Multidestination Layer 2 traffic in a network is typically referred to as broadcast, unknown unicast, and multicast (BUM) traffic. In a LISP VXLAN Fabric, the underlay network forwards the BUM traffic to all the endpoints connected to a common Layer 2 broadcast domain in the VXLAN overlay. The BUM functionality is achieved using the Any Source Multicast (ASM) model in the underlay network. The rendezvous points (RPs) are configured on the border nodes. The RLOC devices, which are the source and receivers, join the shared multicast group that is attached to the RPs. We recommend a dual border topology with the RPs configured on both the border nodes for redundancy.



Note Only IPv4 traffic is supported in the underlay.

Layer 3 Overlay Multicast

LISP VXLAN Fabric supports both PIM Any Source Multicast (ASM) and PIM Source Specific Multicast (SSM) in the overlay. Layer 3 overlay multicast supports only IPv4 multicast traffic.

The multicast source can either be outside the fabric site or can be in the fabric overlay, connected to the fabric edge node. Multicast receivers can be located outside the fabric site or be directly connected to the fabric edge nodes.

Multicast forwarding in the Layer 3 overlay uses two methods to distribute the traffic through the underlay: Headend Replication and Underlay Multicast. You can configure either Headend Replication or Underlay Multicast in a virtual network. Both cannot be configured together.



Note Bidirectional PIM (Bidir-PIM) is not supported in the overlay and the underlay network.

Any Source Multicast

Any Source Multicast (ASM) is a multicast distribution mode that requires the use of rendezvous points (RPs) to act as a shared root between sources and receivers of multicast data. You can configure a single RP or multiple RPs in the network.

To configure ASM mode in the Layer 3 overlay, you configure the RP selection method, where you indicate the distribution mode and assigns the range of multicast groups.

External RP

External devices can be designated as the RP for the multicast tree in a fabric. To function as an external RP, a device must be a router with PIM enabled. This device is located external to the fabric and is connected to the fabric through one or more border nodes. The External RP address must be reachable in the VRF routing table on the border nodes.



Note This release of LISP VXLAN Fabric supports only external RP for overlay multicast traffic.

Source Specific Multicast

Source Specific Multicast (SSM) creates an optimal path between the multicast source and receiver without the need for a rendezvous point.

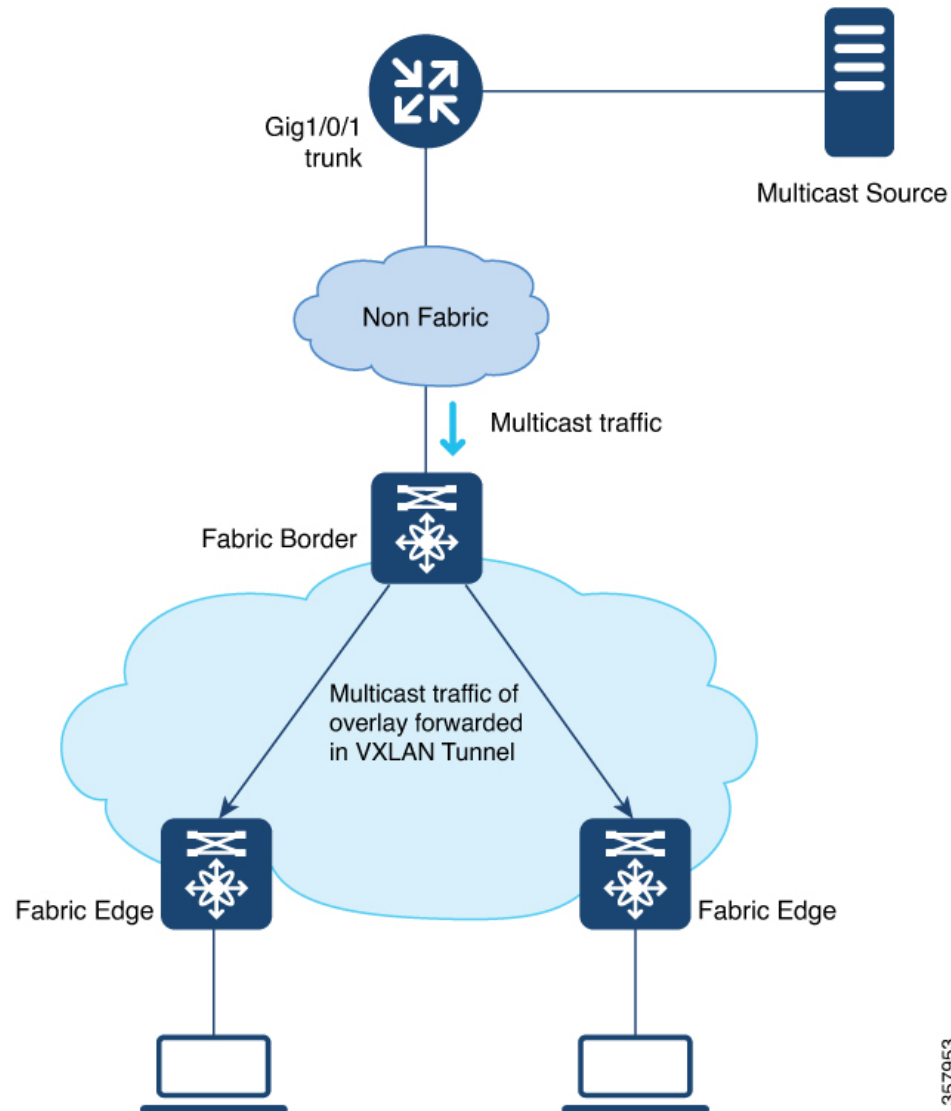
You can configure the SSM multicast range that can be supported by the fabric.

Headend Replication

Headend replication is performed by the multicast first-hop router. The first fabric node (FHR) that receives the multicast traffic replicates multiple copies of the VXLAN-encapsulated data packet and unicasts a copy to each of the remote fabric edge nodes where the multicast receivers are located.

The advantage of headend replication is that it does not require multicast in the underlay network to transport the overlay multicast packets. However, it can create a high overhead on the FHRs and result in high bandwidth and CPU utilization.

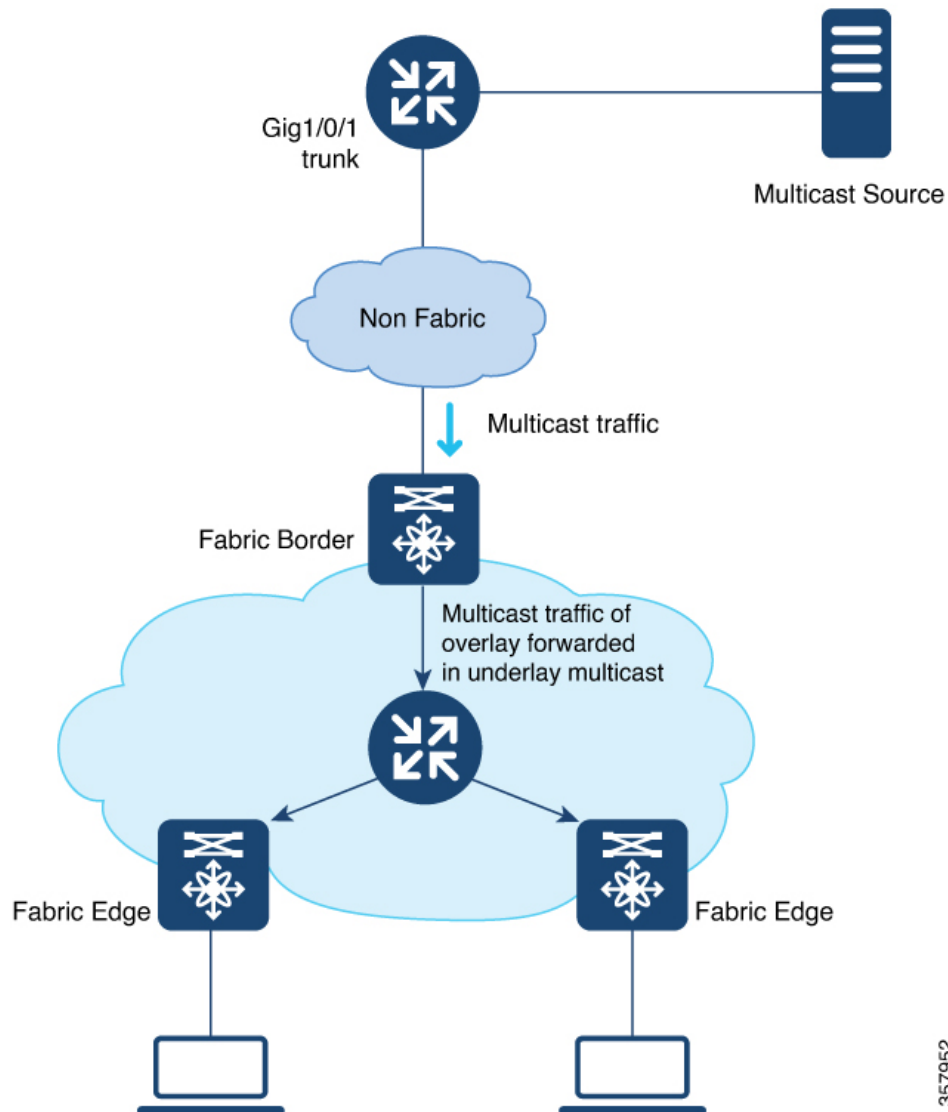
Figure 1: Headend Replication in a LISP VXLAN



Underlay Multicast

Underlay multicast works by performing multicast-in-multicast encapsulation. The multicast packets in the overlay network are transported as multicast in the underlay. The load of packet replication is shared across all the devices in the underlay network. To support underlay multicast, the FHRs, Last Hop Routers (LHRs), and all network infrastructure between them must be enabled for multicast. PIM SSM is used in the underlay for multicast transport.

Figure 2: Underlay Multicast Forwarding in LISP VXLAN



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Layer 3 Overlay Multicast Support in LISP VXLAN Fabric

The following multicast methods are supported in this release of LISP VXLAN Fabric:

Layer 3 Overlay Multicast

- SSM with Underlay Multicast
- SSM with Headend Replication
- ASM with Underlay Multicast, External Rendezvous Point
- ASM with Headend Replication, External Rendezvous Point

How to Configure Broadcast, Unknown Unicast, Multicast

Layer 2 multicast supports only IPv4 multicast traffic in the underlay. Configure ASM mode in the underlay, with the RPs located on the border nodes. If the network has more than one border, configure the RPs on two border nodes with Multicast Source Discovery Protocol (MSDP) to provide redundancy in the network. Configure the fabric edge nodes or the RLOC devices as the multicast source and receivers.

Configure Layer 2 Overlay Broadcast, Unknown Unicast, and Multicast

Do the following configurations on the border node and edge node devices to configure Layer 2 overlay Broadcast, Unknown Unicast, and Multicast (BUM) traffic in the underlay network.

Before you begin

- Ensure that multicast is enabled in the underlay.
- Configure the border node device as the underlay rendezvous point.
- Ensure that Multicast Source Discovery Protocol (MSDP) is enabled between the border nodes in the underlay network.
- Ensure that PIM sparse-mode is enabled on Loopback 0 and all point-to-point interfaces.

Procedure

Step 1 Configure Multicast Source Discovery Protocol (MSDP) on the border nodes in the underlay.

If your fabric network has dual borders, configure MSDP on each of the borders to exchange multicast source information. MSDP also provides redundancy and load sharing between the two borders.

a) **ip msdp peer** *peer-address* **connect-source** *type* [*interface-path-id*]

Example:

```
Device(config)# ip msdp peer 172.16.1.67 connect-source Loopback0
```

Configures the MSDP peer and specifies the Loopback interface of the device as the source address for the MSDP connection. *peer-address* is the loopback0 address of the other border node.

b) **ip msdp cache-sa-state**

Example:

```
Device(config)# ip msdp cache-sa-state
```

Configures the Source-Active (SA) cache to store the SA messages that are received from the peer.

The SA cache holds the information for all sources learned through SA messages.

c) **ip msdp originator-id** *type* [*interface-path-id*]

Example:

```
Device(config)# ip msdp originator-id Loopback0
```

Allows an MSDP speaker that originates an SA message to use the loopback0 address of the interface as the RP address in the SA message.

Step 2 Configure the Loopback interface for the anycast RP on the border nodes and enable PIM sparse mode on it.

Example:

```
Device(config)# interface Loopback100
Device(config-if)# ip address 172.16.1.100 255.255.255.255
Device(config-if)# ip pim sparse-mode
```

Step 3 **ip multicast-routing**

Example:

```
Device(config)# ip multicast-routing
```

Enables IP multicast routing.

Step 4 **ip pim register-source** *interface*

Example:

```
Device(config)# ip pim register-source Loopback0
```

Configures the loopback address of the device as the source address of a PIM Register message.

Step 5 **ip pim rp-address** *address*

Example:

```
Device(config)# ip pim rp-address 172.16.1.100
```

Configures a static rendezvous point (RP) address.

Step 6 **ip pim ssm default**

Example:

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

Defines a default range of SSM multicast address.

Step 7 Do the following configurations on the fabric edge node:

a) **router lisp**

Example:

```
Device(config)# router lisp
```

Enters LISP configuration mode.

b) **instance-id** *id*

Example:

```
Device(config-router-lisp)# instance-id 8188
```

Specifies the instance ID.

c) **service ethernet**

Example:

```
Device(config-router-lisp-inst)# service ethernet
```

Enables Layer 2 network services.

d) **eid-table vlan** *vlan-id*

Example:

```
Device(config-router-lisp-inst-serv-ethernet)# eid-table vlan 50
```

Associates the VLAN with this Layer 2 service instance.

e) **broadcast-underlay** *multicast-ip*

Example:

```
Device(config-router-lisp-inst-serv-ethernet)# broadcast-underlay 239.0.17.1
```

Enables the broadcast functionality on the fabric edge node.

f) **flood unknown-unicast**

Example:

```
Device(config-router-lisp-inst-serv-ethernet)# flood unknown-unicast
```

Floods the unknown broadcast, unicast packets in the Layer 2 domain.

g) **flood arp-nd**

Example:

```
Device(config-router-lisp-inst-serv-ethernet)# flood arp-nd
```

Enables Address Resolution Protocol (ARP) flooding in the Layer 2 domain.

h) **exit-service-ethernet**

Example:

```
Device(config-router-lisp-inst-serv-ethernet)# exit-service-ethernet
```

Exits service Ethernet configuration mode, and enters LISP instance configuration mode.

i) **exit-instance-id**

Example:

```
Device(config-router-lisp-inst)# exit-instance-id
```

Exits instance configuration mode, and enters LISP configuration mode.

j) **end**

Example:

```
Device(config-router-lisp)# end
```

Returns to privileged EXEC mode.

Repeat the steps to enable broadcast, unknown unicast, and multicast functionality for all the Layer 2 instances that were created while configuring the fabric edge node

Refer the [Configuring Fabric Edge Node](#) chapter to see the Layer 2 instances that are created.

Configuration Example for Layer 2 Overlay Broadcast, Unknown Unicast, Multicast

Here is a sample configuration for Layer 2 overlay BUM traffic. The fabric network has two colocated border and control plane nodes. The underlay anycast RP is configured on the dual border nodes.

Note that the table shows only the snippet of the configurations that are required to enable Layer 2 overlay BUM.

Table 1: Fabric Edge and Border Node Configurations for Layer 2 BUM

Border Node Configurations	Fabric Edge Node Configurations
<pre> Border Node 1 interface Loopback0 ip address 172.16.1.66 255.255.255.255 ip pim sparse-mode ! interface Loopback100 ip address 172.16.1.100 255.255.255.255 ip pim sparse-mode ip multicast-routing ip pim rp-address 172.16.1.100 ip pim register-source Loopback0 ip pim ssm default !! ip msdp peer 172.16.1.67 connect-source Loopback0 ip msdp cache-sa-state ip msdp originator-id Loopback0 Border Node 2 interface Loopback0 ip address 172.16.1.67 255.255.255.255 ip pim sparse-mode ! interface Loopback100 ip address 172.16.1.100 255.255.255.255 ip pim sparse-mode ! ip multicast-routing ip pim rp-address 172.16.1.100 ip pim register-source Loopback0 ip pim ssm default ! ip msdp peer 172.16.1.66 connect-source Loopback0 ip msdp cache-sa-state ip msdp originator-id Loopback0 </pre>	<pre> instance-id 8197 service ethernet eid-table vlan 50 broadcast-underlay 239.0.17.1 flood arp-nd flood unknown-unicast exit-service-ethernet ! ip multicast-routing ip pim rp-address 172.16.1.100 ip pim register-source Loopback0 ip pim ssm default </pre>

How to Configure Layer 3 Overlay Multicast in a LISP VXLAN Fabric

This section uses a single procedure to describe the configuration steps for the Headend Replication (ASM and SSM) and Underlay Multicast (ASM and SSM) forwarding methods. Some steps are applicable only to a particular method, either Headend Replication or Underlay Multicast. Such steps are called out clearly at the beginning of the respective step.

The configuration procedure is followed by configuration examples.

Configure Layer 3 Overlay Multicast in a LISP VXLAN Fabric

This task describes how to configure multicast in the overlay network, and assumes that multicast is already configured in the underlay network.



Note Unless otherwise noted, perform the following steps on both the border node and fabric edge node.

Before you begin

- Ensure that multicast is enabled in the underlay network.
- Ensure that the control plane node, border node, and edge nodes of the overlay are configured and virtual routing and forwarding (VRF) routing table instances are configured for unicast communication. Refer earlier chapters of this document for information on configuring the fabric.



Note Ensure that you configure PIM Sparse mode on all the core-facing fabric devices.

Procedure

Step 1 Enable multicast routing for the overlay network, using the **ip multicast-routing vrf *vrf-name*** command in the global configuration mode.

Example:

```
Device(config)# ip multicast-routing vrf VN3
```

Enables IP multicast routing on the specified VRF.

Step 2 Configure a Loopback interface for multicast segment.

a) **interface Loopback** *multicast-segment-interface*

Example:

```
Device(config)# interface Loopback4099
```

Configures the loopback interface and enters the interface configuration mode.

- b) **vrf forwarding** *vrf-name*

Example:

```
Device(config-if)# vrf forwarding VN3
```

Enables VRF forwarding on the interface.

- c) **ip address** *address mask*

Example:

```
Device(config-if)# ip address 10.22.1.1 255.255.255.255
```

Assigns an IP address to the interface.

- d) **ip pim sparse-mode**

Example:

```
Device(config-if)# ip pim sparse-mode
```

Enables Protocol Independent Multicast (PIM) on the interface for sparse-mode operation.

- e) **exit**

Example:

```
Device(config-if)# exit
Device(Config)#
```

Returns to the global configuration mode.

Step 3

Enable PIM on the LISP interface.

- a) **interface** *interface-name*

Example:

```
Device(config)# interface LISP0.4099
```

Configures the LISP interface and enters the LISP interface configuration mode.

- b) **Perform this step only for Underlay Multicast: ip pim lisp transport multicast**

Example:

```
Device(config-if)# ip pim lisp transport multicast
```

Enables multicast on the LISP interface.

- c) **Perform this step only for Headend Replication: ip pim sparse-mode**

Example:

```
Device(config-if)# ip pim sparse-mode
```

Enables Protocol Independent Multicast (PIM) on the interface for sparse-mode operation.

Execute this step only if you are configuring Headend Replication.

- d) **Perform this step only for Headend Replication with SSM:** `ip pim lisp core-group-range start-SSM-address range-size`

Example:

```
Device(config-if)# ip pim lisp core-group-range 232.0.0.1 1000
```

Configures the group of IP addresses for SSM on a LISP interface, to transport multicast traffic.

- e) **exit**

Example:

```
Device(config-if)# exit
Device(config)#
```

Returns to the global configuration mode.

Step 4

On the border node, if Layer 3 handoff is configured, configure PIM on the Layer 3 overlay.

- a) **interface** *interface-number*

Example:

```
Device(config)# interface Vlan222
```

Enters the Layer 3 overlay SVI configuration mode.

- b) **ip pim sparse-mode**

Example:

```
Device(config-if)#ip pim sparse-mode
```

Enables Protocol Independent Multicast (PIM) on the SVI for sparse-mode operation.

- c) **exit**

Example:

```
Device(config-if)# exit
Device(config)#
```

Returns to the global configuration mode.

Step 5

On the edge node, enable PIM and IGMP for the user-defined VRF.

- a) **interface** *interface-number*

Example:

```
Device(config)# interface Vlan50
```

Enters the interface configuration mode for the user-defined VRF.

- b) **vrf forwarding** *vrf-name*

Example:

```
Device(config-if)# vrf forwarding VN3
```

Enables VRF forwarding on the interface.

- c) **ip pim passive**

Example:

```
Device(config-if)# ip pim passive
```

Configures a PIM passive interface.

A PIM passive interface does not send or receive any PIM control messages. However, a PIM passive interface acts as designated router (DR) and designated forwarder (DF)-election winner, and it can accept and forward multicast data.

d) **ip igmp version {1 | 2 | 3}****Example:**

```
Device(config-if)# ip igmp version 3
```

Configures the version of the Internet Group Management Protocol (IGMP) for the device to use.

e) **exit****Example:**

```
Device(config-if)# exit
Device(config)#
```

Returns to the global configuration mode.

Step 6

Map the multicast EID database to the instance ID of the VRF.

a) **router lisp****Example:**

```
Device(config)# router lisp
```

Enters LISP configuration mode.

b) **instance-id id****Example:**

```
Device(config-router-lisp)# instance-id 4099
```

Specifies the instance ID of the VRF.

c) **service ipv4****Example:**

```
Device(config-router-lisp-inst)# service ipv4
```

Enables Layer 3 network services for this instance-id.

d) **database-mapping eid-prefix/prefix-length locator-set RLOC_name****Example:**

```
Device(config-router-lisp-inst-serv-ipv4)# database-mapping 10.22.1.2/32 locator-set
eid_LOCATOR
```

Configures EID-to-RLOC relationship in the LISP database.

e) **exit-service-ipv4**

Example:

```
Device(config-router-lisp-inst-serv-ipv4)# exit-service-ipv4
```

Exits service IPv4 configuration mode, and enters LISP instance configuration mode

f) **exit-instance-id****Example:**

```
Device(config-router-lisp-inst)# exit-instance-id
```

Exits instance configuration mode, and enters LISP configuration mode.

Step 7

(Optional) On the border node, advertise the loopback interface of the multicast segment to the external domain, using the BGP routing process.

a) **router bgp** *autonomous-system-number***Example:**

```
Device(config)# router bgp 700
```

Configures a BGP routing process, and enters router configuration mode for the specified routing process.

b) **address-family** {**ipv4** | **ipv6**} [**vrf** *vrf-name*]**Example:**

```
Device(config-router)# address-family ipv4 vrf VN3
```

Specifies the VRF instance with which the subsequent address family configuration commands are associated.

c) **network** *network-number* [**mask** *network-mask*] [**route-map** *route-map-name*]**Example:**

```
Device(config-router-af)# network 10.22.1.1 mask 255.255.255.255
```

Specifies the network to be advertised by BGP and adds it to the BGP routing table.

d) **aggregate-address** *address mask* [**summary-only**]**Example:**

```
Device(config-router-af)# aggregate-address 10.22.1.0 255.255.255.0 summary-only
```

Generates an aggregate entry in the BGP database.

Use the optional **summary-only** keyword to create the aggregate route (for example, 10.*.*.*) and also suppresses advertisements of more-specific routes to all neighbors.

e) **exit-address-family****Example:**

```
Device(config-router-af)# exit-address-family
```

Exits the address family configuration mode.

f) **exit**

Example:

```
Device(config-router)# exit
Device(config)#
```

Returns to the global configuration mode.

Step 8 Perform this step only for SSM: Define the range of SSM multicast address.

- a) **ip pim vrf** *vrf-name* **ssm range** *access-list*

Example:

```
Device(config)# ip pim vrf VN3 ssm range SSM_RANGE_VN3
```

Configures the SSM service for the IP address range defined by the access list.

- b) **ip access-list standard** *access-list-name*

Example:

```
Device(config)# ip access-list standard SSM_RANGE_VN3
Device(config)# 10 permit 232.0.0.0 0.255.255.255
Device(config)# exit
```

Define the the access list for the SSM multicast IP address.

Step 9 Perform this step only for ASM: Create a loopback for PIM and configure a static rendezvous point.

- a) **ip pim vrf** *vrf-name* **register-source** *interface-type interface number*

Example:

```
Device(config)# ip pim vrf VN3 register-source Loopback4099
```

Configures the loopback address of the VRF as the source address of a PIM Register message.

- b) **ip pim vrf** *vrf-name* **rp-address** *rp-address* [*access-list*]

Example:

```
Device(config)# ip pim vrf VN3 rp-address 172.16.3.1 ASM_ACL_IPV4_VN3_172.16.3.1
```

Configures the IP address of the rendezvous point to be used for the static group-to-RP mapping and specifies the access list that defines the multicast groups to be statically mapped to the rendezvous point.

Step 10 Enable PIM sparse mode on all the core-facing interfaces of the underlay network.

Example:

```
Device(config)# interface GigabitEthernet1/0/1
```

```
Device(config)# ip pim sparse
```

Repeat this step for all the core-facing interfaces of the fabric devices.

Configuration Example for Underlay Multicast with SSM

This is a sample configuration for Underlay Multicast with SSM. In this sample, 10.22.1.0/24 is the multicast subnet. Multicast source is located outside the fabric. The multicast listeners are within the fabric overlay. This configuration assumes that multicast is already configured in the underlay and the LISP VXLAN fabric edge nodes, border node, and control plane node are also up and running.

Table 2: Configurations on the Fabric Edge and Border Nodes

Border Node Configurations	Edge Node Configurations
<pre> ip multicast-routing vrf VN3 ! interface Loopback4099 vrf forwarding VN3 ip address 10.22.1.1 255.255.255.255 ip pim sparse-mode ! interface LISP0.4099 ip pim lisp transport multicast ip pim lisp core-group-range 232.0.0.1 1000 ! interface Vlan222 ip pim sparse-mode router lisp instance-id 4099 service ipv4 database-mapping 10.22.1.1/32 locator-set eid_LOCATOR exit-service-ipv4 ! exit-instance-id ! router bgp 700 ! address-family ipv4 vrf VN3 network 10.22.1.1 mask 255.255.255.255 aggregate-address 10.22.1.0 255.255.255.0 summary-only exit-address-family ! ! ip pim vrf VN3 ssm range SSM_RANGE_VN3 ! ip access-list standard SSM_RANGE_VN3 10 permit 232.0.0.0 0.255.255.255 ! interface Gig/Tengig/Hunderxxx ip pim sparse </pre>	<pre> ip multicast-routing vrf VN3 ! interface Loopback4099 vrf forwarding VN3 ip address 10.22.1.2 255.255.255.255 ip pim sparse-mode ! interface LISP0.4099 ip pim lisp transport multicast ip pim lisp core-group-range 232.0.0.1 1000 ! interface Vlan50 vrf forwarding VN3 ip pim passive ip igmp version 3 ip igmp explicit-tracking router lisp instance-id 4099 service ipv4 database-mapping 10.22.1.2/32 locator-set eid_LOCATOR exit-service-ipv4 ! exit-instance-id ! ip pim vrf VN3 ssm range SSM_RANGE_VN3 ! ip access-list standard SSM_RANGE_VN3 10 permit 232.0.0.0 0.255.255.255 ! interface Gig/Tengig/Hunderxxx ip pim sparse </pre>

Configuration Example for Underlay Multicast with ASM, External RP

This is a sample configuration for Underlay Multicast with ASM. In this sample, 10.22.1.0/24 is the multicast subnet. Multicast source is located outside the fabric. The multicast listeners are within the fabric overlay. The rendezvous point (RP) is located external to the fabric. This configuration assumes that multicast is already configured in the underlay and the LISP VXLAN fabric edge nodes, border node, and control plane node are also up and running.

Table 3: Configurations on the Fabric Edge and Border Nodes

Border Node Configurations	Edge Node Configurations
<pre> ip multicast-routing vrf VN3 ! interface Loopback4099 vrf forwarding VN3 ip address 10.22.1.1 255.255.255.255 ip pim sparse-mode ! interface LISP0.4099 ip pim lisp transport multicast ip pim lisp core-group-range 232.0.0.1 1000 ! interface Vlan222 ip pim sparse-mode router lisp instance-id 4099 service ipv4 database-mapping 10.22.1.1/32 locator-set eid_LOCATOR exit-service-ipv4 ! exit-instance-id ! router bgp 700 ! address-family ipv4 vrf VN3 network 10.22.1.1 mask 255.255.255.255 aggregate-address 10.22.1.0 255.255.255.0 summary-only exit-address-family ! ! ip pim vrf VN3 rp-address 172.16.3.1 ASM_ACL_IPV4_VN3_172.16.3.1 ip pim vrf VN3 register-source Loopback4099 ! ! ip access-list standard ASM_ACL_IPV4_VN3_172.16.3.1 10 permit 229.1.1.0 0.0.0.255 ! interface Gig/Tengig/Hunderxxx ip pim sparse </pre>	<pre> ip multicast-routing vrf VN3 ! interface Loopback4099 vrf forwarding VN3 ip address 10.22.1.2 255.255.255.255 ip pim sparse-mode ! ! interface LISP0.4099 ip pim lisp transport multicast ip pim lisp core-group-range 232.0.0.1 1000 ! ! interface Vlan50 vrf forwarding VN3 ip pim passive ip igmp version 3 ip igmp explicit-tracking ipv6 mld explicit-tracking ipv6 pim passive router lisp instance-id 4099 service ipv4 database-mapping 10.22.1.2/32 locator-set eid_LOCATOR exit-service-ipv4 ! ! exit-instance-id ! ip pim vrf VN3 rp-address 172.16.3.1 ASM_ACL_IPV4_VN3_172.16.3.1 ip pim vrf VN3 register-source Loopback4099 ! ! ip access-list standard ASM_ACL_IPV4_VN3_172.16.3.1 10 permit 229.1.1.0 0.0.0.255 ! interface Gig/Tengig/Hunderxxx ip pim sparse </pre>

Configuration Example for Headend Replication with SSM

This is a sample configuration for Headend Replication with SSM. In this sample, 10.22.1.0/24 is the multicast subnet. Multicast source is located outside the fabric. The multicast listeners are within the fabric overlay.

This configuration assumes that multicast is already configured in the underlay and the LISP VXLAN fabric edge nodes, border node, and control plane node are also up and running.

Table 4: Configurations on the Fabric Edge and Border Nodes

Border Node Configurations	Edge Node Configurations
<pre> ip multicast-routing vrf VN3 ! ! interface Loopback4099 vrf forwarding VN3 ip address 10.22.1.1 255.255.255.255 ip pim sparse-mode! interface LISP0.4099 ip pim sparse-mode ! interface Vlan222 ip pim sparse-mode router lisp instance-id 4099 service ipv4 database-mapping 10.22.1.1/32 locator-set eid_LOCATOR exit-service-ipv4 ! exit-instance-id ! router bgp 700 ! address-family ipv4 vrf VN3 network 10.22.1.1 mask 255.255.255.255 aggregate-address 10.22.1.0 255.255.255.0 summary-only exit-address-family ! ! ip pim vrf VN3 ssm range SSM_RANGE_VN3 ! ! ip access-list standard SSM_RANGE_VN3 10 permit 232.0.0.0 0.255.255.255 ! </pre>	<pre> ip multicast-routing vrf VN3 ! ! interface Loopback4099 vrf forwarding VN3 ip address 10.22.1.2 255.255.255.255 ip pim sparse-mode ! interface LISP0.4099 ip pim sparse-mode ! interface Vlan50 vrf forwarding VN3 ip pim passive ip igmp version 3 ip igmp explicit-tracking router lisp instance-id 4099 service ipv4 database-mapping 10.22.1.2/32 locator-set eid_LOCATOR exit-service-ipv4 ! ip pim vrf VN3 ssm range SSM_RANGE_VN3 ! ip access-list standard SSM_RANGE_VN3 10 permit 232.0.0.0 0.255.255.255 ! ipv6 pim vrf VN3 register-source Loopback4099 </pre>

Configuration Example for Headend Replication with ASM, External RP

This is a sample configuration for Headend Replication with ASM. In this sample, 10.22.1.0/24 is the multicast subnets. Multicast source is located outside the fabric. The multicast listeners are within the fabric overlay. The rendezvous point (RP) is located external to the fabric. This configuration assumes that multicast is already configured in the underlay and the LISP VXLAN fabric edge nodes, border node, and control plane node are also up and running.

Table 5: Configurations on the Fabric Edge and Border Nodes

Border Node Configurations	Edge Node Configurations
<pre> ip multicast-routing vrf VN3 ! interface Loopback4099 vrf forwarding VN3 ip address 10.22.1.1 255.255.255.255 ip pim sparse-mode ! interface LISP0.4099 ip pim sparse-mode ! interface Vlan222 ip pim sparse-mode router lisp instance-id 4099 service ipv4 database-mapping 10.22.1.1/32 locator-set eid_LOCATOR exit-service-ipv4 ! exit-instance-id ! ! router bgp 700 ! address-family ipv4 vrf VN3 network 10.22.1.1 mask 255.255.255.255 aggregate-address 10.22.1.0 255.255.255.0 summary-only exit-address-family ! ! ip pim vrf VN3 rp-address 172.16.3.1 ASM_ACL_IPV4_VN3_172.16.3.1 ip pim vrf VN3 register-source Loopback4099 ! ip access-list standard ASM_ACL_IPV4_VN3_172.16.3.1 10 permit 229.1.1.0 0.0.0.255 ! </pre>	<pre> ip multicast-routing vrf VN3 ! ! interface Loopback4099 vrf forwarding VN3 ip address 10.22.1.2 255.255.255.255 ip pim sparse-mode! interface LISP0.4099 ip pim sparse-mode ! interface Vlan50 vrf forwarding VN3 ip pim passive ip igmp version 3 ip igmp explicit-tracking router lisp instance-id 4099 service ipv4 database-mapping 10.22.1.2/32 locator- exit-service-ipv4 ! ! ! ip pim vrf VN3 rp-address 172.16.3.1 ASM_ACL_IPV4_VN3_172.16.3.1 ip pim vrf VN3 register-source Loopback4099 ! ip access-list standard ASM_ACL_IPV4_VN3_172.16.3.1 10 permit 229.1.1.0 0.0.0.255 ! </pre>

Verify the Multicast Configuration in LISP VXLAN Fabric

This section provides sample outputs for the **show** commands to verify the multicast configuration on the fabric edge and border nodes.

Verify Layer 2 BUM

```

FabricEdge# show ip mfib 239.0.17.1
Entry Flags:      C - Directly Connected, S - Signal, IA - Inherit A flag,
                  ET - Data Rate Exceeds Threshold, K - Keepalive
                  DDE - Data Driven Event, HW - Hardware Installed
                  ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
                  MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
                  MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,

```

```

e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
NS - Negate Signalling, SP - Signal Present,
A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
MA - MFIB Accept, A2 - Accept backup,
RA2 - MRIB Accept backup, MA2 - MFIB Accept backup

Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts:      Total/RPF failed/Other drops
I/O Item Counts:  HW Pkt Count/FS Pkt Count/PS Pkt Count   Egress Rate in pps
Default
(*,239.0.17.1) Flags: C HW
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  HW Forwarding:  11/0/172/0, Other: 0/0/0
  TwentyFiveGigE1/0/15 Flags: A NS
  L2LISP0.8197, L2LISP Decap Flags: F NS
    Pkts: 0/0/0   Rate: 0 pps
  L2LISP0.8194, L2LISP Decap Flags: F NS
    Pkts: 0/0/0   Rate: 0 pps
(172.16.1.69,239.0.17.1) Flags: HW
  SW Forwarding: 2/0/154/0, Other: 0/0/0
  HW Forwarding:  4710/0/172/0, Other: 0/0/0
  TwentyFiveGigE1/0/15 Flags: A NS
  L2LISP0.8197, L2LISP Decap Flags: F NS
    Pkts: 0/0/2   Rate: 0 pps
  L2LISP0.8194, L2LISP Decap Flags: F NS
    Pkts: 0/0/2   Rate: 0 pps
(172.16.1.68,239.0.17.1) Flags: HW
  SW Forwarding: 2/0/154/0, Other: 762/762/0
  HW Forwarding:  4476/0/145/0, Other: 0/0/0
  Null0 Flags: A
FabricEdge#

```

```
FabricEdge# show lisp instance-id 8197 ethernet map-cache
```

```
LISP MAC Mapping Cache for LISP 0 EID-table Vlan 50 (IID 8197), 1 entries
```

```
000c.29c6.6069/48, uptime: 20:50:25, expires: 03:09:34, via map-reply, complete
```

Locator	Uptime	State	Pri/Wgt	Encap-IID
172.16.1.68	20:50:25	up	10/10	-

```
FabricEdge# show lisp instance-id 8197 ethernet database
```

```
LISP ETR MAC Mapping Database for LISP 0 EID-table Vlan 50 (IID 8197), LSBs: 0x1
```

```
Entries total 3, no-route 0, inactive 0, do-not-register 1
```

```
0000.0c9f.f18e/48, dynamic-eid Auto-L2-group-8197, do not register, inherited from default
locator-set rloc_set2
```

Locator	Pri/Wgt	Source	State
172.16.1.69	10/10	cfg-intf	site-self, reachable

```
000c.2966.f195/48, dynamic-eid Auto-L2-group-8197, inherited from default locator-set
rloc_set2
```

Locator	Pri/Wgt	Source	State
172.16.1.69	10/10	cfg-intf	site-self, reachable

```
000c.2979.439d/48, dynamic-eid Auto-L2-group-8197, inherited from default locator-set
rloc_set2
```

Locator	Pri/Wgt	Source	State
172.16.1.69	10/10	cfg-intf	site-self, reachable

```
Service-Insertion: N/A
Locator   Pri/Wgt  Source      State
172.16.1.69  10/10  cfg-intf   site-self, reachable
```

```
FabricEdge# show mac address-table vlan 50
Mac Address Table
```

```
-----
Vlan      Mac Address      Type      Ports
-----
50        0000.0c9f.f18e   STATIC    V150
50        000c.2966.f195   DYNAMIC   Gi1/0/31
50        000c.2979.439d   DYNAMIC   Gi1/0/30
50        6c03.09cb.7a68   STATIC    V150
50        000c.29c6.6069   CP_LEARN  L2LI0
```

```
Total Mac Addresses for this criterion: 4
Total Mac Addresses installed by LISP: REMOTE: 1
```

```
Border# show ip msdp summary
```

```
MSDP Peer Status Summary
Peer Address      AS      State      Uptime/  Reset SA      Peer Name
                  AS      State      Downtime Count Count
172.16.1.66      6502   Up         5d02h    0      0      ?
```

Check the multicast groups on RP

```
Border# show ip pim rp
```

```
Group: 239.0.17.1, RP: 172.16.1.100
```

View the IP Multicast Routing Table for the VRF:

```
FabricEdge# show ip mroute vrf VN3 summary
```

```
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, c - PFP-SA cache created entry,
* - determined by Assert, # - iif-starg configured on rpf intf,
e - encap-helper tunnel flag, l - LISP decap ref count contributor
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
t - LISP transit group
```

```
Timers: Uptime/Expires
```

```
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```
(* , 229.1.1.1), 17:46:37/stopped, RP 10.22.1.1, OIF count: 1, flags: SJC
(12.12.12.124, 229.1.1.1), 00:38:27/00:01:52, OIF count: 1, flags: JT
```

```
(* , 224.0.1.40), 17:47:10/00:02:51, RP 10.22.1.1, OIF count: 1, flags: SJ
```

View the multicast interfaces for the VRF:

```
Border# show ip pim vrf VN3 interface
```

Verify the Multicast Configuration in LISP VXLAN Fabric

Address	Interface	Ver/ Mode	Nbr Count	Query Intvl	DR Prior	DR
10.22.1.1	Loopback4099	v2/S	0	30	1	10.22.1.1
10.22.1.1	LISP0.4099	v2/S	0	30	1	10.22.1.1
10.20.1.1	Vlan222	v2/S	0	30	1	10.20.1.1
Border#						

```
Border# show ip pim vrf VN3 tunnel
```

```
Tunnel5
  Type      : PIM Encap
  RP        : 10.22.1.1*
  Source    : 10.22.1.1
  State     : UP
  Last event : Created (18:06:00)
Tunnel7*
  Type      : PIM Decap
  RP        : 10.22.1.1*
  Source    : -
  State     : UP
  Last event : Created (18:06:00)
```

View the multicast groups in the VRFs:

```
FabricEdge# show ip mfib vrf VN3
```

```
Entry Flags:  C - Directly Connected, S - Signal, IA - Inherit A flag,
               ET - Data Rate Exceeds Threshold, K - Keepalive
               DDE - Data Driven Event, HW - Hardware Installed
               ME - MoFRR ECMP entry, MNE - MoFRR Non-ECMP entry, MP - MFIB
               MoFRR Primary, RP - MRIB MoFRR Primary, P - MoFRR Primary
               MS - MoFRR Entry in Sync, MC - MoFRR entry in MoFRR Client,
               e - Encap helper tunnel flag.
I/O Item Flags: IC - Internal Copy, NP - Not platform switched,
                NS - Negate Signalling, SP - Signal Present,
                A - Accept, F - Forward, RA - MRIB Accept, RF - MRIB Forward,
                MA - MFIB Accept, A2 - Accept backup,
                RA2 - MRIB Accept backup, MA2 - MFIB Accept backup
```

```
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kbits per second
Other counts:      Total/RPF failed/Other drops
I/O Item Counts:  HW Pkt Count/FS Pkt Count/PS Pkt Count   Egress Rate in pps
VRF VN5
```

```
(* ,224.0.0.0/4) Flags: C HW
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  HW Forwarding:  NA/NA/NA/NA, Other: NA/NA/NA
(* ,224.0.1.40) Flags: C HW
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  HW Forwarding:  NA/NA/NA/NA, Other: NA/NA/NA
LISP0.4099 Flags: A NS
Loopback4099 Flags: F IC NS
  Pkts: 0/0/0   Rate: 0 pps
(* ,232.0.0.0/8) Flags: HW
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  HW Forwarding:  NA/NA/NA/NA, Other: NA/NA/NA
(12.12.12.124,232.1.1.1) Flags: HW
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  HW Forwarding:  NA/NA/NA/NA, Other: NA/NA/NA
LISP0.4099 Flags: A
Vlan20 Flags: F NS
  Pkts: 0/0/0   Rate: 0 pps
```

Verify Underlay SSM Configuration