Configuring Border Node

A LISP VXLAN fabric border node serves as a gateway between the fabric site and the sites external to the fabric. Traffic entering or leaving the fabric is encapsulated or decapsulated (respectively) by the border node.

The following devices can be configured as border nodes:

- Cisco Catalyst 9300 Series Switches
- Cisco Catalyst 9400 Series Switches
- Cisco Catalyst 9500 Series Switches
- Cisco Catalyst 9600 Series Switches

A fabric border node can be configured as an internal border node, or an external border node, or both internal and external border node.

An **internal border node** is used when traffic originating from within the fabric should follow a non-default route to reach an external destination. The Internal Border Node advertises endpoint reachability to the external network and imports external non-default routes into the fabric control plane.

An **external border node** is a default gateway for a Fabric Site. It is used as a gateway for traffic originating from within the fabric that is following a default route, such as traffic destined for the internet. It advertises endpoint reachability to the external network but does not import any external routes into the fabric control plane.

An **internal and external border node** both imports non-default routes into the fabric control plane and functions a default gateway for a fabric site. It advertises endpoint reachability to the external network and imports external non-default routes into the fabric.

Note In a border node configuration, each LISP instance-id should be associated with a routing table (global routing table or the VRF). A default border should have default routes configured in the routing table for each VRF, to dynamically register with the control plane node as a default border.

Functions of a Border Node

A fabric border node performs the following functions in the fabric:

- **Advertise EID subnets**: A border node exports the endpoint prefix space as an aggregate to the external networks, using the Border Gateway Protocol (BGP). This helps to direct the traffic from outside of the fabric destined for endpoints within the fabric.
- **Gateway between the Fabric and an external network**: A border node is an egress point for traffic to all those destinations that are outside the fabric.

  An external border acts like a default gateway. It handles the traffic destined to locations that are not known to the control plane. Internal border advertises external destinations into the fabric and should be used for traffic to known destinations outside the fabric.
- **Network virtualization extension to the external world**: A border node can extend network virtualization from inside the fabric to outside the fabric by using VRF-lite and VRF-aware routing protocols to preserve the segmentation.
- **Policy mapping**: A border node maps the SGT information from within the fabric to be appropriately maintained when the traffic exits that fabric. When a fabric packet is decapsulated at the border node, the SGT information can be directly mapped into the Cisco metadata field of packet, using inline tagging.
- **VXLAN encapsulation/decapsulation**: A border node encapsulates the packets received from external network, which are destined to the endpoints within the fabric. It decapsulates the packets that are sourced from the fabric endpoints and destined to locations outside the fabric.

How to Configure an External Border Node

Note Before you begin, ensure that routed access design is used to configure the underlay network.

Step	Task	Purpose
Step 1	Configure VRF	Configure a VRF to support IPv4 and IPv6 address routing tables. VRF maintains the routing and forwarding information for devices within a virtual network. A VRF instance has its own IP routing table, a forwarding table, and one or more interfaces assigned to it. The VRF tables help the routing device reach the locator address space.
Step 2	Configure Layer 3 Handoff SVI	Configure the SVI for Layer 3 handoff.

Step	Task	Purpose
Step 3	Configure the Interface that Connects to an Upstream Router	Configure a VLAN trunk port interface to connect to an upstream router. An upstream router is located external to the fabric and provides inter-VRF forwarding that is necessary for communication between the virtual networks (segments). It also provides access to shared services for the endpoints in the fabric.
Step 4	Configure Loopback for Overlay Segment in User-Defined VRF	• Configure a loopback interface for a overlay segment. This loopback is used to advertise the overlay subnet prefixes to the external network. • Configure a loopback interface for the default instance in LISP (Global Routing Table). The default instance is used to connect the network infrastructure elements like Access Points and Layer 2 switches to the fabric access layer.
Step 5	Configure LISP	• Set up the Proxy Ingress Tunnel Router (PITR) functionality for both IPv4 and IPv6 address families. A PITR encapsulates and forwards the incoming packets to provide non-LISP-to-LISP interworking. • Set up the Proxy Egress Tunnel Router (PETR) functionality for both IPv4 and IPv6 address families. A PETR decapsulates the LISP VXLAN encapsulated packets to the provide LISP-to-non-LISP interworking. • Define this border node as a default ETR and map the default route for each VRF.
Step 6	Configure Layer 3 Instance ID: • Create Layer 3 Instance ID for Default Instance • Create Layer 3 Instance ID for User-Defined VRF - External Border	• Configure a Layer 3 instance ID for the default instance. • Configure Layer 3 instance IDs for the VRFs that you define.
Step 7	Configure a BGP Routing Process	Configure Border Gateway Protocol (BGP) for route exchange with the external network.

Step	Task	Purpose
Step 8	(Optional) Redistribute Routing Information through External Border, on page 29	If your deployment has a scenario where the fabric site has an internal border that accepts prefixes to be routed to an external network through an external border, perform this step. This step redistributes LISP routes to BGP through an external border.

Step	Task	Purpose
Step 9	Verify the configurations on the border node using these **show** commands:	
	show lisp session	Displays the details of the LISP sessions that are established on the border node.
	show lisp locator-set	Displays the locator set information.
	show ip interface brief	Displays the usability status of all the interfaces that are configured on the device. Filter the output to view the dynamically created LISP interfaces, using the **show ip interface brief | i LISP** command.
	show lisp instance-id * ipv4 **show lisp instance-id * ipv6**	Displays the details of each of the LISP IPv4 or IPv6 instances that are configured on the border node. Use this command to view the operational status of the IPv4 or the IPv6 address family under each instance-id. This includes the status of the database, map-cache, publication entries, site registration entries, and so on.
	show ip route vrf *vrf*	Displays the route table that is created on the border node for a given VRF.
	show lisp service ipv4 summary **show lisp service ipv6 summary**	Displays a summary of the LISP IPv4 or IPv6 services on the border node. Use this command to check the number of EID tables and database entries, the total number of map-cache entries, and information about each VRF.
	show lisp service ipv4 statistics **show lisp service ipv6 statistics**	Displays the LISP IPv4 or IPv6 packet statistics for all EID prefixes. Use this command to check the total number of packet encapsulations, decapsulations, map requests, map replies, map registers, and other LISP-related packet information, for the IPv4 or IPv6 service.
	show lisp service ipv4 forwarding eid remote detail **show lisp service ipv6 forwarding eid remote detail**	Displays the forwarding information for the destination EID prefixes. Use this command to view the EID prefix, associated locator status bits, and total encapsulated packets and bytes for each destination EID-prefix.
	show lisp platform	

Step	Task	Purpose
		Displays the limits of the given platform or the device. This command shows the LISP instance limits, Layer 3 limits, Layer 2 limits, and the supported configuration style on the device. Use this command to understand the limits of the device and plan its usage and role in the fabric.

To see a sample configuration for an external border node, go to Configuration Example for an External Border Node.

To see the sample outputs of show commands on the border node, go to Verify Distributed Border and Control Plane Node, on page 37.

How to Configure an Internal Border Node

Note Before you begin, ensure that routed access design is used to configure the underlay network.

Step	Task	Purpose
Step 1	Configure VRF	Configure a VRF to support IPv4 and IPv6 address routing tables. VRF maintains the routing and forwarding information for devices within a virtual network. A VRF instance has its own IP routing table, a forwarding table, and one or more interfaces assigned to it. The VRF tables help the routing device reach the locator address space.
Step 2	Configure Layer 3 Handoff SVI	Configure the SVI for Layer 3 handoff.
Step 3	Configure the Interface that Connects to an Upstream Router	Configure a VLAN trunk port interface to connect to an upstream router. An upstream router is located external to the fabric and provides inter-VRF forwarding that is necessary for communication between the virtual networks (segments). It also provides access to shared services for the endpoints in the fabric.

Step	Task	Purpose
Step 4	Configure Loopback for Overlay Segment in User-Defined VRF	• Configure a loopback interface for a overlay segment. This loopback is used to advertise the overlay subnet prefixes to the external network. • Configure a loopback interface for the default instance in LISP (Global Routing Table). The default instance is used to connect the network infrastructure elements like Access Points and Layer 2 switches to the fabric access layer.
Step 5	Configure LISP	• Set up the Proxy Ingress Tunnel Router (PITR) functionality for both IPv4 and IPv6 address families. A PITR encapsulates and forwards the incoming packets to provide non-LISP-to-LISP interworking. • Set up the Proxy Egress Tunnel Router (PETR) functionality for both IPv4 and IPv6 address families. A PETR decapsulates the LISP VXLAN encapsulated packets to the provide LISP-to-non-LISP interworking. • Set up the route-import functionality to import external routes into each VRF that is configured.
Step 6	Configure Layer 3 Instance ID: • Create Layer 3 Instance ID for Default Instance • Create Layer 3 Instance ID for User-Defined VRF - Internal Border	• Configure a Layer 3 instance ID for the default instance. • Configure Layer 3 instance IDs for the VRFs that you define. Use the **route-import database** command to register the imported routes to the control plane. The routes that are learnt are filtered according to the **route-map** option specified, to prevent routing loops.
Step 7	Configure a BGP Routing Process	Configure Border Gateway Protocol (BGP) for route exchange with the external network.
Step 8	Configure Prefix-List and Route-Map	Define route maps with prefix lists to filter the routes that are imported into the fabric.

Step	Task	Purpose
Step 9	Verify the configurations on the border node using these **show** commands:	
	show lisp session	Displays the details of the LISP sessions that are established on the border node.
	show lisp locator-set	Displays the locator set information.
	show ip interface brief	Displays the usability status of all the interfaces that are configured on the device. Filter the output to view the dynamically created LISP interfaces, using the **show ip interface brief | i LISP** command.
	show lisp instance-id * ipv4 **show lisp instance-id * ipv6**	Displays the details of each of the LISP IPv4 or IPv6 instances that are configured on the border node. Use this command to view the operational status of the IPv4 address family under each instance-id. This includes the status of IPv4 database, map-cache, publication entries, site registration entries, and so on.
	show ip route vrf *vrf*	Displays the route table that is created on the border node for a given VRF.
	show lisp service ipv4 summary **show lisp service ipv6 summary**	Displays a summary of the LISP IPv4 or IPv6 services on the border node. Use this command to check the number of EID tables and database entries, the total number of map-cache entries, and information about each VRF.
	show lisp service ipv4 statistics **show lisp service ipv6 statistics**	Displays the LISP IPv4 or IPv6 packet statistics for all EID prefixes. Use this command to check the total number of packet encapsulations, decapsulations, map requests, map replies, map registers, and other LISP-related packet information, for the IPv4 or IPv6 service.
	show lisp service ipv4 forwarding eid remote detail **show lisp service ipv6 forwarding eid remote detail**	Displays the forwarding information for the remote or destination EID prefixes. Use this command to view the EID prefix, associated locator status bits, and total encapsulated packets and bytes for each remote EID-prefix.
	show lisp platform	

Step	Task	Purpose
		Displays the limits of the given platform or the device. This command shows the LISP instance limits, Layer 3 limits, Layer 2 limits, and the supported configuration style on the device. Use this command to understand the limits of the device and plan its usage and role in the fabric.

To see a sample configuration for an internal border node, go to Configuration Example for an Internal Border Node

To see a sample configuration for an internal and external border node, go to Configuration Example for an Internal and External Border

Detailed Steps to Configure a Border Node

This section describes the tasks involved in configuring an internal border, an external border, and an anywhere border which is both internal and external.

Configure VRF

To configure VRFs on a border node, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**vrf definition** *vrf-name* **Example:** `Device(config)# vrf definition VN3`	Configures a VRF table, and enters VRF configuration mode.
Step 4	**rd** *route-distinguisher* **Example:** `Device(config-vrf)# rd 1:4099`	Creates routing and forwarding tables for a VRF instance.
Step 5	**address-family ipv4** **Example:**	Specifies the address family, and enters address family configuration mode.

	Command or Action	Purpose
	`Device(config-vrf)# address-family ipv4`	
Step 6	**route-target export** *route-target-ext-community* **Example:** `Device(config-vrf-af)# route-target export 1:4099`	Creates a list of export route target communities for the specified VRF. Enter either an AS system number and an arbitrary number (xxx:y) or an IP address and an arbitrary number (A.B.C.D:y). The *route-target-ext-community* value should be the same as the *route-distinguisher* value entered in the earlier step.
Step 7	**route-target import** *route-target-ext-community* **Example:** `Device(config-vrf-af)# route-target import 1:4099`	Creates a list of import route target communities for the specified VRF.
Step 8	**exit-address-family** **Example:** `Device(config-vrf-af)# exit-address-family`	Exits address family configuration mode, and enters VRF configuration mode.
Step 9	**address-family ipv6** **Example:** `Device(config-vrf)# address-family ipv6`	Specifies the address family, and enters address family configuration mode.
Step 10	**route-target export** *route-target-ext-community* **Example:** `Device(config-vrf-af)# route-target export 1:4099`	Creates a list of export route target communities for the specified VRF. Enter either an AS system number and an arbitrary number (xxx:y) or an IP address and an arbitrary number (A.B.C.D:y). The *route-target-ext-community* value should be the same as the *route-distinguisher* value entered in the earlier step.
Step 11	**route-target import** *route-target-ext-community* **Example:** `Device(config-vrf-af)# route-target import 1:4099`	Creates a list of import route target communities for the specified VRF.
Step 12	**exit-address-family** **Example:** `Device(config-vrf-af)# exit-address-family`	Exits address family configuration mode, and enters VRF configuration mode.

	Command or Action	Purpose
Step 13	**end** **Example:** `Device(config-vrf)# end`	Returns to privileged EXEC mode.

Configure Layer 3 Handoff SVI

To configure Layer 3 handoff SVI on a border node, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**vlan** *vlan-id* **Example:** `Device(config)# vlan 222`	Specifies a VLAN ID, and enters VLAN configuration mode.
Step 4	**name** *vlan-name* **Example:** `Device(config-vlan)# name 222`	Specifies a name for the VLAN.
Step 5	**exit** **Example:** `Device(config-vlan)# exit`	Exits VLAN configuration mode, and enters global configuration mode.
Step 6	**interface** *vlan-id* **Example:** `Device(config)# interface Vlan222`	Specifies the interface for which you are adding a description, and enters interface configuration mode.
Step 7	**description** *string* **Example:** `Device(config-if)# description vrf-external`	Adds a description for the interface.
Step 8	**vrf forwarding** *name* **Example:** `Device(config-if)# vrf forwarding VN3`	Associates the VRF instance with the interface.

	Command or Action	Purpose
Step 9	**ip address** *ip_address subnet_mask* **Example:** `Device(config-if)# ip address 10.20.1.1 255.255.255.252`	Configures the IP address and IP subnet.
Step 10	**no ip redirects** **Example:** `Device(config-if)# no ip redirects`	Disables sending of Internet Control Message Protocol (ICMP) redirect messages.
Step 11	**ipv6 address** *address* **Example:** `Device(config-if)# ipv6 address 2001:DB8:20::1/126`	Configures an IPv6 address on the interface.
Step 12	**ipv6 enable** **Example:** `Device(config-if)# ipv6 enable`	Enables IPv6 on the interface.
Step 13	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configure the Interface that Connects to an Upstream Router

To configure the interface that connects to an upstream router, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-number* **Example:** `Device(config)# interface FortyGigabitEthernet1/0/4`	Creates an interface to connect to an upstream router, and enters interface configuration mode.
Step 4	**switchport mode trunk** **Example:**	Configures the interface as a VLAN trunk port.

	Command or Action	Purpose
	`Device(config-if)# switchport mode trunk`	
Step 5	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configure Loopback for Overlay Segment in User-Defined VRF

To configure loopback for the overlay segment in user-defined VRF on a border node, perform this task:

Note This loopback is used to advertise the overlay subnet prefixes to the external network.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface loopback 50** **Example:** `Device(config)# interface loopback 50`	Creates a loopback interface for the overlay segment, and enters interface configuration mode.
Step 4	**description** *name* **Example:** `Device(config-if)# description Loopback Border`	Adds a description for an interface.
Step 5	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding VN3`	Associates the VRF with the Layer 3 interface.
Step 6	**ip address** *address mask* **Example:** `Device(config-if)# ip address 10.50.1.1 255.255.255.255`	Assigns an IP address to the interface. Ensure that this is the IP address of the SVI for the user-defined VRF.

	Command or Action	Purpose
Step 7	**ipv6 address** *address* **Example:** `Device(config-if)# ipv6 address 2001:DB8:2050::1/128`	Assigns an IPv6 address to the interface.
Step 8	**ipv6 enable** **Example:** `Device(config-if)# ipv6 enable`	Enables IPv6 on the interface.
Step 9	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configure Loopback for Overlay Segment in the Default Instance of LISP (Global Routing Table)

To configure the overlay segment in the default instance of LISP, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface loopback 91** **Example:** `Device(config)# interface loopback 91`	Creates a loopback interface for the default instance, and enters interface configuration mode.
Step 4	**ip address** *address mask* **Example:** `Device(config-if)# ip address 10.91.1.1 255.255.255.255`	Assigns an IP address to the interface. Ensure that this is the IP address of the SVI for the default instance.
Step 5	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configure LISP

To configure LISP on a border node, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router lisp** **Example:** `Device(config)# router lisp`	Enters LISP configuration mode.
Step 4	**locator-table default** **Example:** `Device(config-router-lisp)# locator-table default`	Selects the default (global) routing table for association with the routing locator address space.
Step 5	**locator-set** *loc-set-name* **Example:** `Device(config-router-lisp)# locator-set default_etr_locator`	Specifies a locator-set, and enters the locator-set configuration mode. A locator-set identifies the routing-locator that LISP uses when it registers the local endpoints. In this step, configure a default locator set.
Step 6	**ipv4-interface Loopback** *loopback-interface-id* **priority** *locator-priority* **weight** *locator-weight* **Example:** `Device(config-router-lisp-locator-set)# ipv4-interface Loopback0 priority 10 weight 10`	Specifies that the IPv4 address of the loopback interface should be used to reach the locator. Priority and weight values are associated with the locator address to define traffic policies when multiple RLOCs are defined for the same EID-prefix block. A locator with a lower priority value takes preference. When multiple locators have the same priority, they can be used in a load-sharing manner. Weight is a value 0–100 and represents the percentage of traffic to be load-shared to that locator.
Step 7	**exit-locator-set** **Example:** `Device(config-router-lisp-locator-set)# exit-locator-set`	Exits locator-set configuration mode, and enters LISP configuration mode.

	Command or Action	Purpose
Step 8	**locator-set** *loc-set-name* **Example:** `Device(config-router-lisp)# locator-set eid_locator`	Specifies a locator-set, and enters the locator-set configuration mode. Ensure that this locator set is different from the default locator that was created in Step 5.
Step 9	**ipv4-interface Loopback** *loopback-interface-id* **priority** *locator-priority* **weight** *locator-weight* **Example:** `Device(config-router-lisp-locator-set)# IPv4-interface Loopback0 priority 10 weight 10`	Specifies that the IPv4 address of the loopback interface should be used to reach the locator. Priority and weight values are associated with the locator address to define traffic policies when multiple RLOCs are defined for the same EID-prefix block. A locator with a lower priority value takes preference. When multiple locators have the same priority, they can be used in a load-sharing manner. Weight is a value 0–100 and represents the percentage of traffic to be load-shared to that locator.
Step 10	**auto-discover-rlocs** **Example:** `Device(config-router-lisp-locator-set)# auto-discover-rlocs`	Auto discover the locators registered by other ingress or egress tunnel routers (xTRs).
Step 11	**exit-locator-set** **Example:** `Device(config-router-lisp-locator-set)# exit-locator-set`	Exits locator-set configuration mode, and enters LISP configuration mode.
Step 12	**locator default-set** *loc-set-name* **Example:** `Device(config-router-lisp)# locator default-set eid_locator`	Specifies a default locator-set.
Step 13	**service** { **ipv4** | **ipv6** } **Example:** `Device(config-router-lisp)# service ipv4`	Enables network services on the default instance. **service ipv4**: Enables Layer 3 network services for the IPv4 address family. **service ipv6**: Enables Layer 3 network services for the IPv6 address family.

Step 14	**encapsulation vxlan**
	Example:
	`Device(config-router-lisp-serv-ipv4)# encapsulation vxlan`
	`Device(config-router-lisp-serv-ipv6)# encapsulation vxlan`
		Specifies VXLAN-based encapsulation.

	Command or Action	Purpose

Step 15	**map-cache publications**
	Example:
	`Device(config-router-lisp-serv-ipv4)# map-cache publications`
	`Device(config-router-lisp-serv-ipv6)# map-cache publications`
		Exports the publication entries to the map cache. These entries are used for forwarding the traffic.

Step 16	**import publication publisher** *publisher-address*
	Example:
	`Device(config-router-lisp-serv-ipv4)# import publication publisher 172.16.1.66`
	`Device(config-router-lisp-serv-ipv6)# import publication publisher 172.16.1.66`
		Imports the publications from the publisher that is specified by the *publisher-address*. *publisher-address* is the IP address of the Loopback 0 interface of the control plane node.
		If your fabric site has more than one control plane node, there are as many publishers. Execute this command for each of those *publisher-address* (control plane nodes). Imported publications are stored in a publication table.

Step 17	**itr map-resolver** *map-resolver-address*
	Example:
	`Device(config-router-lisp-serv-ipv4)# itr map-resolver 172.16.1.66`
	`Device(config-router-lisp-serv-ipv6)# itr map-resolver 172.16.1.66`
		Configures a locator address for the LISP map resolver to which this router sends map request messages for EID-to-RLOC mapping resolutions.
		A control plane node is the LISP map resolver. *map-resolver-address* is the IP address of the Loopback 0 interface of the control plane node. If your fabric site has more than one control plane node, execute this command for each of the *map-resolver-address* (control plane nodes). Execute this command even if the border and control plane nodes are located on the same device.

Step 18	**etr map-server** *map-server-address* **key** *authentication-key*
	Example:
	`Device(config-router-lisp-serv-ipv4)# etr map-server 172.16.1.66 key some-key`
	`Device(config-router-lisp-serv-ipv6)# etr map-server 172.16.1.66 key some-key`
		Configures a map server to be used by the Egress Tunnel Router (ETR) for endpoint registrations, and specifies the authentication key to be used with this map server.
		A control plane node is the LISP map server. *map-server-address* is the IP address of the Loopback 0 interface of the control plane node. If your fabric site has more than one control plane node, execute this command for each of the *map-server-address* (control plane nodes). Execute this command even if the border and control plane nodes are located on the same device.

	Command or Action	Purpose
		Note Ensure that you use the same *authentication-key* that was configured on the control plane node.

Step 19	**etr map-server** *map-server-address* **proxy-reply**
	Example:
	`Device(config-router-lisp-serv-ipv4)# etr map-server 172.16.1.66 proxy-reply`
	`Device(config-router-lisp-serv-ipv6)# etr map-server 172.16.1.66 proxy-reply`
		Configures the map server to send map replies on behalf of the ETR.
		map-server-address is the IP address of the Loopback 0 interface of control plane node. If your fabric site has more than one control plane node, execute this command for each of the *map-server-address* (control plane nodes). Execute this command even if the border and control plane nodes are located on the same device.

Step 20	**etr**
	Example:
	`Device(config-router-lisp-serv-ipv4)# etr`
	`Device(config-router-lisp-serv-ipv6)# etr`
		Configures the device as an Egress Tunnel Router (ETR).

Step 21	**sgt**
	Example:
	`Device(config-router-lisp-serv-ipv4)# sgt`
	`Device(config-router-lisp-serv-ipv6)# sgt`
		(Optional) Enables the Security Group Tag (SGT) function for SGT tag propagation. Configure this command only if you need SGT propagation in your fabric network.

Step 22	**route-export publications**
	Example:
	`Device(config-router-lisp-serv-ipv4)# route-export publications`
	`Device(config-router-lisp-serv-ipv6)# route-export publications`
		Exports the LISP publications into the routing information base (RIB).

Step 23	**distance publications** *distance*
	Example:
	`Device(config-router-lisp-serv-ipv4)# distance publications 250`
	`Device(config-router-lisp-serv-ipv6)# distance publications 250`
		Specifies the administrative distance to RIB when the LISP publications are exported to the RIB.

Step 24	**proxy-etr** **Example:**	Enables Proxy Egress Tunnel Router (PETR) functionality for IPv4 EIDs.

	Command or Action	Purpose
	`Device(config-router-lisp-serv-ipv4)# proxy-etr` `Device(config-router-lisp-serv-ipv6)# proxy-etr`	

Step 25	**proxy-itr** *address*
	Example:
	`Device(config-router-lisp-serv-ipv4)# proxy-itr 172.16.1.67`
	`Device(config-router-lisp-serv-ipv6)# proxy-itr 172.16.1.67`
		Enables Proxy Ingress Tunnel Router (PITR) functionality for IPv4 or IPv6 EIDs.
		For *address*, specify the IP address of the Loopback 0 interface on the device.

Step 26	Do one of the following:
	• **exit-service-ipv4**
	• **exit-service-ipv6**
	Example:
	`Device(config-router-lisp-serv-ipv4)# exit-service-ipv4`
	`Device(config-router-lisp-serv-ipv4)# exit-service-ipv6`
		Exits service configuration mode, and enters LISP configuration mode.
		Use the appropriate command, depending on which service mode you are exiting from (IPv4 or IPv6 mode).

Step 27	**ipv4 locator reachability minimum-mask-length** *length* **Example:** `Device(config-router-lisp)# ipv4 locator reachability minimum-mask-length 32`	Specifies the shortest mask prefix to accept when looking up a remote RLOC in the RIB. LISP checks the host reachability from the routing locator.
Step 28	**ipv4 source-locator** *interface-number* **Example:** `Device(config-router-lisp)# ipv4 source-locator loopback0`	Configures the source locator for the outbound LISP packets. Set the loopback interface as the source locator.
Step 29	**exit-router-lisp** **Example:** `Device(config-router-lisp)# exit-router-lisp`	Exits LISP configuration mode, and enters global configuration mode.
Step 30	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Step 31	**show lisp locator-set**
	Example:
	`Device# show lisp locator-set`
	`LISP Locator-set information:`
	
	`172.16.1.67, local, reachable, loopback`
	`Device#`
		Displays the LISP Locator Set information configured on the device.

Create Layer 3 Instance ID for Default Instance

To create a Layer 3 instance ID for default instance on a border node, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router lisp** **Example:** `Device(config)# router lisp`	Enters LISP configuration mode.
Step 4	**instance-id** *id* **Example:** `Device(config-router-lisp)# instance-id 4097`	Specifies an instance ID. In this step, configure the Layer 3 default instance ID. The *id* of the instance can range from 1 to 16777200.
Step 5	**remote-rloc-probe on-route-change** **Example:** `Device(config-router-lisp-inst)# remote-rloc-probe on-route-change`	Configures parameters for probing of remote routing locators (RLOCs).
Step 6	**service ipv4** **Example:** `Device(config-router-lisp-inst)# service ipv4`	Enables Layer 3 network services for the IPv4 address family.
Step 7	**eid-table default** **Example:** `Device(config-router-lisp-inst-serv-ipv4)# eid-table default`	Configures the default (global) routing table for association with the configured instance-service.
Step 8	**map-cache** *address* **map-request** **Example:** `Device(config-router-lisp-inst-serv-ipv4)# map-cache 10.91.1.0/24 map-request`	Specifies the destination EID for which map-requests are sent.
Step 9	**exit-service-ipv4** **Example:**	Exits IPv4 service configuration mode, and enters LISP instance configuration mode.

	Command or Action	Purpose
	`Device(config-router-lisp-inst-serv-ipv4)# exit-service-ipv4`	
Step 10	**exit-instance-id** **Example:** `Device(config-router-lisp-inst)# exit-instance-id`	Exits instance configuration mode, and enters LISP configuration mode.
Step 11	**exit-router-lisp** **Example:** `Device(config-router-lisp)# exit-router-lisp`	Exits LISP configuration mode, and enters global configuration mode.
Step 12	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Create Layer 3 Instance ID for User-Defined VRF - External Border

To create a Layer 3 instance ID for the user-defined VRF on the external border node, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router lisp** **Example:** `Device(config)# router lisp`	Enters LISP configuration mode.
Step 4	**instance-id** *id* **Example:** `Device(config-router-lisp)# instance-id 4099`	In this step, specify the instance ID for a user-defined VRF. The *id* of the instance can range from 1 to 16777200.
Step 5	**remote-rloc-probe on-route-change** **Example:** `Device(config-router-lisp-inst)# remote-rloc-probe on-route-change`	Configures parameters for probing of remote routing locators (RLOCs).

	Command or Action	Purpose

Step 6	**service** {**ipv4** | **ipv6**}
	Example:
	`Device(config-router-lisp-inst)# service ipv4`
	`Device(config-router-lisp-inst)# service ipv6`
		Enables Layer 3 network services for the IPv4 or IPv6 address family.

Step 7	**eid-table vrf** *vrf-name*
	Example:
	`Device(config-router-lisp-inst-serv-ipv4)# eid-table vrf VN3`
	`Device(config-router-lisp-inst-serv-ipv6)# eid-table vrf VN3`
		Configures the VRF table for association with the configured instance-service.

Step 8	**database-mapping** *eid-prefix/prefix-length* **locator-set** *RLOC_name* **default-etr local**
	Example:
	`Device(config-router-lisp-inst-serv-ipv4)#`
	`database-mapping 0.0.0.0/0 locator-set default_etr_locator default-etr local`
	`Device(config-router-lisp-inst-serv-ipv6)#`
	`database-mapping ::/0 locator-set default_etr_locator default-etr local`
		Configures an IPv4 or IPv6 default ETR for a default route

Step 9	Do one of the following:**exit-service-ipv4**
	• **exit-service-ipv4**
	• **exit-service-ipv6**
	Example:
	`Device(config-router-lisp-inst-serv-ipv4)# exit-service-ipv4`
	`Device(config-router-lisp-inst-serv-ipv6)# exit-service-ipv6`
		Exits service configuration mode, and enters LISP instance configuration mode.
		Use the appropriate command, depending on which service mode you are exiting from (IPv4 or IPv6 service mode).

Step 10	**exit-instance-id** **Example:** `Device(config-router-lisp-inst)# exit-instance-id`	Exits instance configuration mode, and enters LISP configuration mode.
Step 11	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 12	**show lisp instance-id * ipv4** **Example:** `Device# show lisp instance-id * ipv4`	Displays details of each LISP instance that has the IPv4 service enabled.

	Command or Action	Purpose

	To view only the LISP instance IDs that have IPv4 enabled, filter the output as shown:
	`Device# show lisp instance-id * ipv4 | i Instance ID`
	`  Instance ID:`
	`      4097`
	`  Instance ID:`
	`      4099`
	`Device#`	

Create Layer 3 Instance ID for User-Defined VRF - Internal Border

An internal border imports and registers the routes advertised by an upstream router. The internal border uses the **route-import database** command to register these routes into Control Plane. The routes that are learnt are filtered according to the **route-map** option specified, to prevent routing loops.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router lisp** **Example:** `Device(config)# router lisp`	Enters LISP configuration mode.
Step 4	**instance-id** *id* **Example:** `Device(config-router-lisp)# instance-id 4099`	In this step, specify the instance ID for a user-defined VRF. The *id* of the instance can range from 1 to 16777200.
Step 5	**remote-rloc-probe on-route-change** **Example:** `Device(config-router-lisp-inst)# remote-rloc-probe on-route-change`	Configures parameters for probing of remote routing locators (RLOCs).
Step 6	**service** {**ipv4** | **ipv6**} **Example:** `Device(config-router-lisp-inst)# service ipv4`	Enables Layer 3 network services for the IPv4 or IPv6 address family.

	Command or Action	Purpose
	`Device(config-router-lisp-inst)# service ipv6`	

Step 7	**eid-table vrf** *vrf-name*
	Example:
	`Device(config-router-lisp-inst-serv-ipv4)# eid-table vrf VN3`
	`Device(config-router-lisp-inst-serv-ipv6)# eid-table vrf VN3`
		Configures the VRF table for association with the configured instance-service.

Step 8	**map-cache** *address* **map-request**
	Example:
	`Device(config-router-lisp-inst-serv-ipv4)# map-cache 0.0.0.0/0 map-request`
	`Device(config-router-lisp-inst-serv-ipv6)# map-cache ::/0 map-request`
		Specifies the destination EID to which map-requests are sent.

Step 9	**route-import database** *protocol autonomous-system-number* [**route-map** *map-name* **locator-set** *locator-set-name*]
	Example:
	`Device(config-router-lisp-inst-serv-ipv4)# route-import database bgp 600 route-map MATCH_DC_ROUTE locator-set eid_locator`
	`Device(config-router-lisp-inst-serv-ipv6)# route-import database bgp 600 route-map MATCH_DC_ROUTE_V6 locator-set eid_locator`
		Configures the import of Routing Information Base (RIB) routes to define local EID prefixes and associates them with the specified locator set.
		(Optional) The **route-map** keyword specifies that imported IP prefixes should be filtered according to the specified route-map name.

Step 10	Do one of the following:**exit-service-ipv4**
	• **exit-service-ipv4**
	• **exit-service-ipv6**
	Example:
	`Device(config-router-lisp-inst-serv-ipv4)# exit-service-ipv4`
	`Device(config-router-lisp-inst-serv-ipv6)# exit-service-ipv6`
		Exits service configuration mode, and enters LISP instance configuration mode.
		Use the appropriate command, depending on which service mode you are exiting from (IPv4 or IPv6 service mode).

Step 11	**exit-instance-id** **Example:** `Device(config-router-lisp-inst)# exit-instance-id`	Exits instance configuration mode, and enters LISP configuration mode.

Configure a BGP Routing Process

To configure a BGP routing process on a border node, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router bgp** *autonomous-system-number* **Example:** `Device(config)# router bgp 600`	Configures a BGP routing process, and enters router configuration mode for the specified routing process. • Use the *autonomous-system-number* argument to specify an integer, from 0 and 65534, that identifies the device to other BGP speakers.
Step 4	**bgp router-id** *ip-address* **Example:** `Device(config-router)# bgp router-id interface Loopback0`	(Optional) Configures a fixed 32-bit router ID as the identifier of the local device running BGP. • Use the *ip-address* argument to specify a unique router ID within the network. **Note** Configuring a router ID using the **bgp router-id** command resets all active BGP peering sessions.
Step 5	**bgp log-neighbor-changes** **Example:** `Device(config-router)# bgp log-neighbor-changes`	Enables logging of BGP neighbor status changes (up or down) and neighbor resets. • Use this command for troubleshooting network connectivity problems and measuring network stability. Unexpected neighbor resets might indicate high error rates or high packet loss in the network and should be investigated.
Step 6	**bgp graceful-restart** **Example:** `Device(config-router)# bgp graceful-restart`	Enables Nonstop Forwarding (NSF) awareness on the device. By default, NSF awareness is disabled.

	Command or Action	Purpose
Step 7	**address-family ipv4** **Example:** `Device(config-router)# address-family ipv4`	Enters address family configuration mode to configure routing sessions that use address family-specific command configurations.
Step 8	**bgp aggregate-timer** *seconds* **Example:** `Device(config-router-af)# bgp aggregate-timer 0`	Configures the interval at which the BGP routes are aggregated. A value of 0 (zero) disables timer-based aggregation and starts aggregation immediately.

Step 9	**network** *network-number* [**mask** *network-mask*] [**route-map** *route-map-name*]
	Example:
	`Device(config-router-af)# network 10.20.2.0 mask 255.255.255.252`
	`Device(config-router-af)# network 10.91.1.1 mask 255.255.255.255`
		Specifies the network to be advertised by BGP and adds it to the BGP routing table.
		• For exterior protocols, the **network** command controls which networks are advertised. Interior protocols use the **network** command to determine where to send updates.

Step 10	**aggregate-address** *address mask* **summary-only** **Example:** `Device(config-router-af)# aggregate-address 10.91.1.0 255.255.255.0 summary-only`	Creates an aggregate entry in a BGP database.
Step 11	**neighbor** *ip-address* **remote-as** *autonomous-system-number* **Example:** `Device(config-router-af)# neighbor 10.20.2.2 remote-as 300`	Adds the IP address of the neighbor in the specified autonomous system to the IPv4 multiprotocol BGP neighbor table of the local router.
Step 12	**neighbor** *ip-address* **update-source** *interface-type* interface-number **Example:** `Device(config-router-af)# neighbor 10.20.2.2 update-source Vlan111`	Allows the BGP sessions to use any operational interface for TCP connections.
Step 13	**neighbor** *ip-address* **activate** **Example:** `Device(config-router-af)# neighbor 10.20.2.2 activate`	Enables the exchange of information with a BGP neighbor.
Step 14	**neighbor** *ip-address* **send-community**[**both**] **Example:**	Specifies that a communities attribute should be sent to a BGP neighbor.

	Command or Action	Purpose
	`Device(config-router-af)# neighbor 10.20.2.2 send-community both`	
Step 15	**exit-address-family** **Example:** `Device(config-router-af)# exit-address-family`	Exits the address family configuration mode and enters router configuration mode.

Step 16	**address-family** {**ipv4** | **ipv6**} [**vrf** *vrf-name*]
	Example:
	`Device(config-router)# address-family ipv4 vrf VN3`
	`Device(config-router)# address-family ipv6 vrf VN3`
		Enters address family configuration mode to configure routing sessions that use address family-specific command configurations.
		Use the **vrf** option to specify the VRF instance with which the subsequent address family configuration commands are associated.

Step 17	**bgp aggregate-timer** *seconds* **Example:** `Device(config-router-af)# bgp aggregate-timer 0`	Configures the interval at which the BGP routes are aggregated. A value of 0 (zero) disables timer-based aggregation and starts aggregation immediately.

Step 18	**network** *network-number* [**mask** *network-mask*] [**route-map** *route-map-name*]
	Example:
	`Device(config-router-af)# network 10.20.1.0 mask 255.255.255.252`
	`Device(config-router-af)# network 10.50.1.1 mask 255.255.255.255`
	`Device(config-router-af)# network 2001:DB8:20::/126`
	`Device(config-router-af)# network 2001:DB8:2050::1/128`
		Specifies the network to be advertised by BGP and adds it to the BGP routing table.
		• For exterior protocols, the **network** command controls which networks are advertised. Interior protocols use the **network** command to determine where to send updates.

Step 19	**aggregate-address** *address mask* **summary-only**
	Example:
	`Device(config-router-af)# aggregate-address 10.50.1.0 255.255.255.0 summary-only`
	`Device(config-router-af)# aggregate-address 2001:DB8:50::/64 summary-only`
		Creates an aggregate entry in a BGP database.

Step 20	**neighbor** *ip-address* **remote-as** *autonomous-system-number* **Example:**	Adds the IP address of the neighbor in the specified autonomous system to the IPv4 or IPv6 multiprotocol BGP neighbor table of the local router.

	Command or Action	Purpose
	`Device(config-router-af)# neighbor 10.20.1.2 remote-as 300` `Device(config-router-af)# neighbor 2001:DB8:20::2 remote-as 300`	

Step 21	**neighbor** *ip-address* **update-source** *interface-type interface-number*
	Example:
	`Device(config-router-af)# neighbor 10.20.1.2 update-source Vlan222`
	`Device(config-router-af)# neighbor 2001:DB8:20::2 update-source Vlan222`
		Allows the BGP sessions to use any operational interface for TCP connections.

Step 22	**neighbor** *ip-address* **activate**
	Example:
	`Device(config-router-af)# neighbor 10.20.1.2 activate`
	`Device(config-router-af)# neighbor 2001:DB8:20::2 activate`
		Enables the exchange of information with a BGP neighbor.

Step 23	**neighbor** *ip-address* **send-community** [**both**]
	Example:
	`Device(config-router-af)# neighbor 10.20.1.2 send-community both`
	`Device(config-router-af)# neighbor 2001:DB8:20::2 send-community both`
		Specifies that a communities attribute should be sent to a BGP neighbor.

Step 24	**neighbor** *ip-address* **weight** [*number*]
	Example:
	`Device(config-router-af)# neighbor 10.20.1.2 weight 65535`
	`Device(config-router-af)# neighbor 2001:DB8:20::2 weight 65535`
		Assigns a weight to a neighbor connection.

Step 25	**exit-address-family** **Example:** `Device(config-router-af)# exit-address-family`	Exits the address family configuration mode and enters router configuration mode.
Step 26	**exit** **Example:** `Device(config-router)# exit`	Exits router configuration mode and enters global configuration mode.
Step 27	**end** **Example:** `Device(config-route-map)# end`	Exits router map configuration mode and returns to privileged EXEC mode.

	Command or Action	Purpose

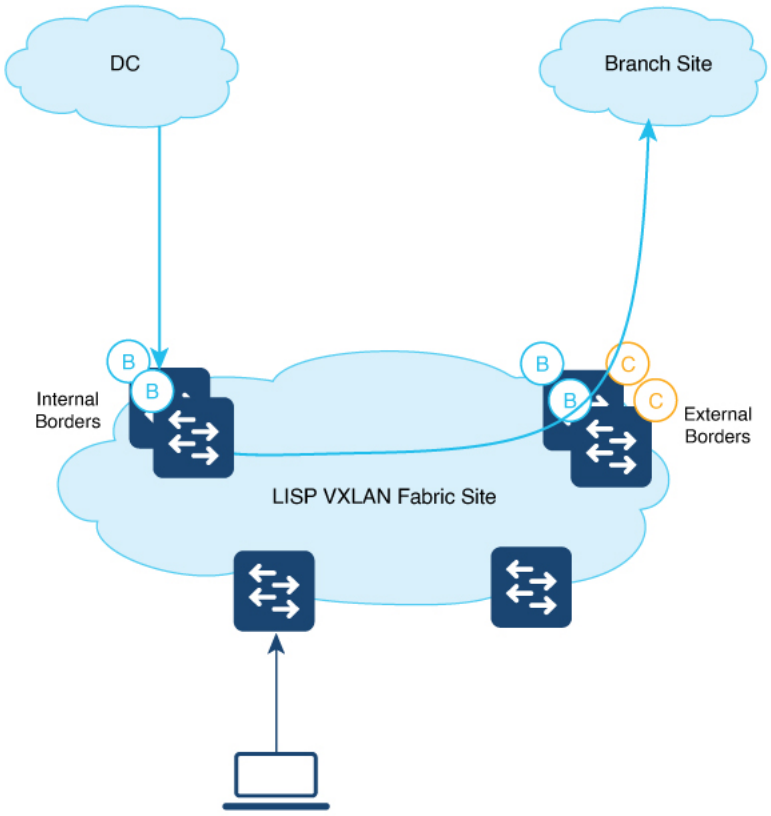
Step 28	**show ip route vrf** *vrf-name*
	Example:
	`Device# show ip route vrf VN3`
	
	`Routing Table: VN3`
	`Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP`
	`D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area`
	`N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2`
	`E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP`
	`n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA`
	`i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2`
	`ia - IS-IS inter area, * - candidate default, U - per-user static route`
	`H - NHRP, G - NHRP registered, g - NHRP registration summary`
	`o - ODR, P - periodic downloaded static route, l - LISP`
	`a - application route`
	`+ - replicated route, % - next hop override, p - overrides from PfR`
	`& - replicated local route overrides by connected`
	
	`Gateway of last resort is not set`
	
	`10.0.0.0/8 is variably subnetted, 4 subnets, 3 masks`
	`C 10.20.1.0/30 is directly connected, Vlan222`
	`L 10.20.1.1/32 is directly connected, Vlan222`
	`B 10.50.1.0/24 [200/0], 00:32:34, Null0`
	`C 10.50.1.1/32 is directly connected, Loopback50`
	`Device#`
		Displays the route table on the device, for a specified VRF.

Redistribute Routing Information through External Border

To redistribute routing information from LISP to other routing protocols, use the **redistribute lisp** command in the address-family configuration mode.

Consider a scenario where the LISP VXLAN fabric site is connected to a Data Center (DC) through its internal border. An external border connects the fabric to a non-fabric network, a Branch Site. Traffic from the Data Center that is destined to the Branch Site can transit through the LISP VXLAN fabric site. The prefixes from the internal border are routed to the external border which redistributes the routing information into BGP.

Here is an illustration that depicts the scenario described in this section.



To redistribute routes from LISP, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router bgp** *autonomous-system-number* **Example:** `Device(config)# router bgp 600`	Configures a BGP routing process, and enters router configuration mode for the specified routing process. • Use the *autonomous-system-number* argument to specify an integer, from 0 and 65534, that identifies the device to other BGP speakers.

	Command or Action	Purpose
Step 4	**address-family ipv4** **Example:** `Device(config-router)# address-family ipv4`	Enters address family configuration mode to configure routing sessions that use address family-specific command configurations.
Step 5	**redistribute** *protocol* **metric** *metric-value* **route-map** *map-tag* **Example:** `Device(config-router-af)# redistribute lisp metric 10 route-map LISP_TO_BGP`	Redistributes routes from one routing domain into another routing domain. Here, LISP routes are redistributed into the BGP domain. The **route-map LISP_TO_BGP** configuration filters the specific routes that are to be redistributed. Only the filtered routes are imported into the BGP domain.The LISP_TO_BGP route map is described in the following steps.
Step 6	**exit-address-family** **Example:** `Device(config-router-af)# exit-address-family`	Exits the address family configuration mode and enters router configuration mode.
Step 7	**exit** **Example:** `Device(config-router)# exit`	Exits router configuration mode and enters global configuration mode.
Step 8	**route-map** *map-name* [**permit** | **deny**] [*sequence-number*] **Example:** `Device(config)# route-map LISP_TO_BGP permit 10`	Configures a route map for the BGP and enters route map configuration mode. Route map entries are read in order. You can identify the order using the *sequence_number* argument.
Step 9	**description** *description* **Example:** `Device(config-route-map)# description AS-number tag`	Adds a description for the route map.
Step 10	**set as-path tag** **Example:** `Device(config-route-map)# set as-path tag`	Modifies an autonomous system path for BGP routes.
Step 11	**end** **Example:** `Device(config-route-map)# end`	Exits router map configuration mode and returns to privileged EXEC mode.

Configure Prefix-List and Route-Map

Note This procedure is applicable to an internal border node and both internal and external border node. It is not applicable to an external border node.

To configure prefix list and route map on a border node, perform this task:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	{**ip** | **ipv6**} **prefix-list** *prefix-list-name* [**seq** *seq-value*] {**deny** *network* / *length* | **permit** *network* / *length* }
	Example:
	`Device(config)# ip prefix-list DENY_0.0.0.0 seq 10 permit 0.0.0.0/0`
	`Device(config)# ip prefix-list L3HANDOFF_PREFIXES seq 828011002 permit 10.20.1.0/30`
	`Device(config)# ipv6 prefix-list DENY_IPV6_0 seq 10 permit ::/0`
	`Device(config)# ipv6 prefix-list L3HANDOFF_PREFIXES seq 568642686 permit 2001:DB8:20::/126`
		Creates a prefix list and defines a range of IP prefixes to import into the VRF table.

Step 4	**route-map** *map-name* [**permit** | **deny**] [*sequence-number*] **Example:** `Device(config)# route-map MATCH_DC_ROUTE deny 5`	Configures a route map and enters route map configuration mode.
Step 5	**description** *description* **Example:** `Device(config-route-map)# description Deny IPV4 default route`	(Optional) Adds a description for the route map.
Step 6	**match ip address** {*access-list-number* | *access-list-name*} [*... access-list-number* | *... access-list-name*]	(Optional) Creates a match clause to permit routes that match the specified

	Command or Action	Purpose
	Example: `Device(config-route-map)# match ip address prefix-list DENY_0.0.0.0`	*access-list-number* or *access-list-name* argument.

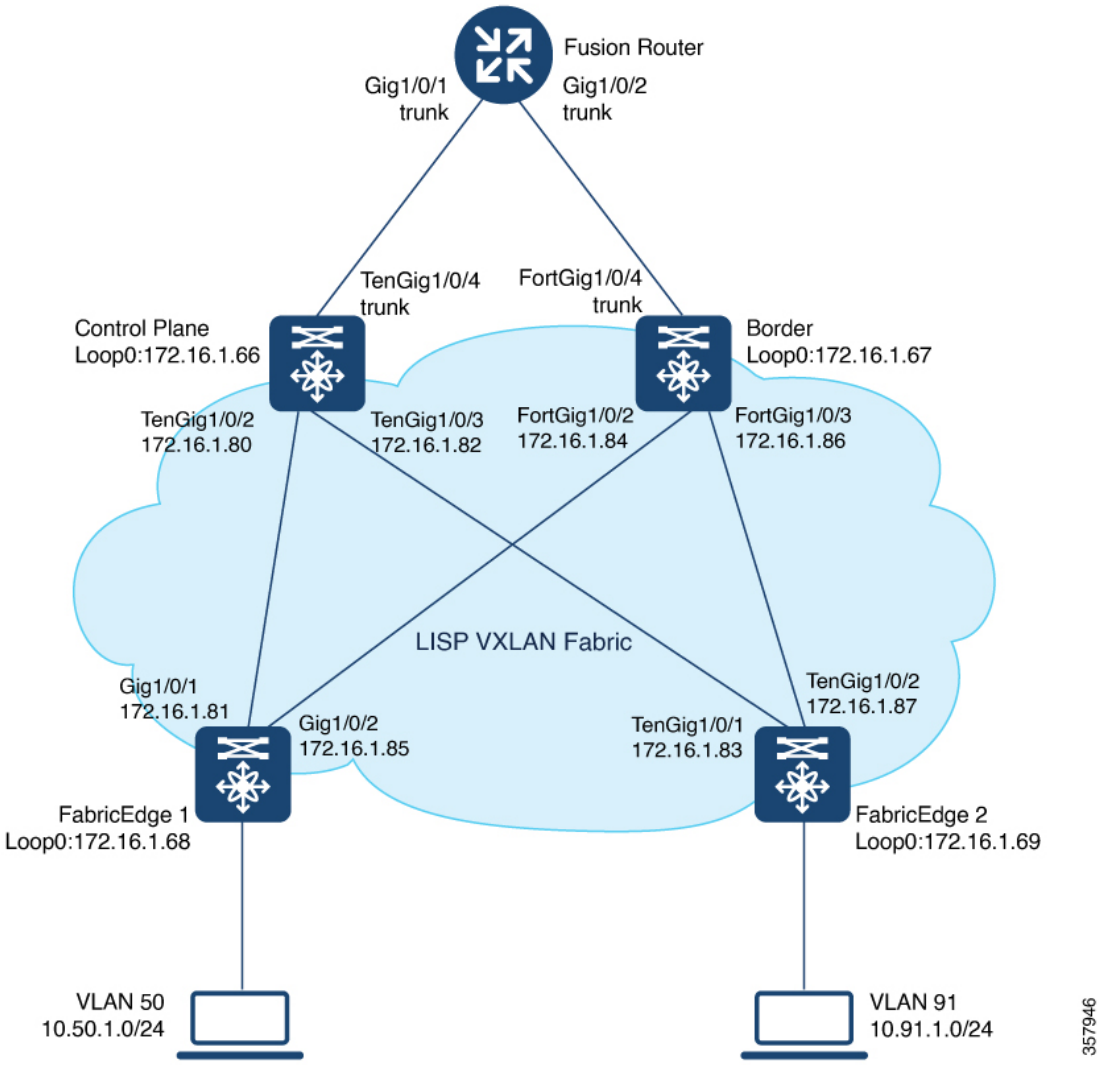
Step 7	Repeat steps 4 to 7 to configure more route maps.
	Example:
	`route-map MATCH_DC_ROUTE deny 17`
	` description Deny L3Handoff Prefixes`
	` match ip address prefix-list L3HANDOFF_PREFIXES`
	`!`
	`route-map MATCH_DC_ROUTE permit 20`
	` description Permit DC routes`
	` match tag 300`
	`!`
	`route-map MATCH_DC_ROUTE_V6 deny 5`
	` description Deny IPV6 default route`
	` match ipv6 address prefix-list DENY_IPV6_0`
	`!`
	`route-map MATCH_DC_ROUTE_V6 deny 17`
	` description Deny L3Handoff IPV6 Prefixes`
	` match ipv6 address prefix-list L3HANDOFF_PREFIXES`
	`!`
	`route-map MATCH_DC_ROUTE_V6 permit 20`
	` description Permit DC routes`
	` match tag 300`	

Step 8	**end** **Example:** `Device(config-route-map)# end`	Returns to privileged EXEC mode.

Configuration Examples for Border Node

The example configurations described in this section are for a border node of a LISP VXLAN fabric that is shown in the Figure 1: LISP VXLAN Fabric Topology. The fabric illustrated in the topology consists of a border node, a control plane node, and two fabric edge nodes. VLAN50 is configured on Fabric Edge 1 and VLAN91 is configured on Fabric Edge 2.

Figure 1: LISP VXLAN Fabric Topology



Configuration Example for an External Border Node

An external border node connects to the network that is external to the fabric, such as the internet. An external border is the default exit point for the virtual networks in the fabric. Ensure that you configure the external border with default routes to reach external unknown destinations.

Here is a sample configuration for an external border with Layer 3 handoff. In the Figure 1: LISP VXLAN Fabric Topology:

- External border has a Loopback0 address of 172.16.1.67
- Control plane node has a Loopback0 address of 172.16.1.66
- Layer 3 handoff segment for VN3 (user-defined VRF) is 10.20.1.0/30, 2001:DB8:20::/126
- Layer 3 handoff segment for Default Instance is 10.20.2.0/30

Ensure that there is IP reachability between all fabric nodes in the underlay.

EBN

```
vrf definition VN3
 rd 1:4099
 !
 address-family ipv4
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family
 !
 address-family ipv6
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family

vlan 222
 name 222
!
vlan 111
 name 111
!
interface Vlan111
 description interface to External router
 ip address 10.20.2.1 255.255.255.252
 no ip redirects
!
interface Vlan222
 description interface to External router
 vrf forwarding VN3
 ip address 10.20.1.1 255.255.255.252
 no ip redirects
 ipv6 address 2001:DB8:20::1/126
 ipv6 enable

!
interface FortyGigabitEthernet1/0/4
 switchport mode trunk

interface Loopback50
 description Loopback Border
 vrf forwarding VN3
 ip address 10.50.1.1 255.255.255.255
 ipv6 address 2001:DB8:2050::1/128
 ipv6 enable
 ipv6 dhcp relay trust
!

interface Loopback91
 description Loopback Border
 ip address 10.91.1.1 255.255.255.255
!

router lisp
 locator-table default
 locator-set default_etr_locator
  IPv4-interface Loopback0 priority 10 weight 10
  exit-locator-set
 !
 locator-set eid_locator
  IPv4-interface Loopback0 priority 10 weight 10
  auto-discover-rlocs
  exit-locator-set
 !
```

```
 locator default-set eid_locator
!
 service ipv4
  encapsulation vxlan
  map-cache publications
  import publication publisher 172.16.1.66
  itr map-resolver 172.16.1.66
  etr map-server 172.16.1.66 key some-key
  etr map-server 172.16.1.66 proxy-reply
  etr
  sgt
  route-export publications
  distance publications 250
  proxy-etr
  proxy-itr 172.16.1.67
  exit-service-ipv4
 !
 service ipv6
  encapsulation vxlan
  map-cache publications
  import publication publisher 172.16.1.66
  itr map-resolver 172.16.1.66
  etr map-server 172.16.1.66 key some-key
  etr map-server 172.16.1.66 proxy-reply
  etr
  sgt
  route-export publications
  distance publications 250
  proxy-etr
  proxy-itr 172.16.1.67
  exit-service-ipv6
 !
 instance-id 4097
  remote-rloc-probe on-route-change
  service ipv4
   eid-table default
   map-cache 10.91.1.0/24 map-request
   exit-service-ipv4
  !
  instance-id 4099
  remote-rloc-probe on-route-change
  service ipv4
   eid-table vrf VN3
   database-mapping 0.0.0.0/0 locator-set default_etr_locator default-etr local
   exit-service-ipv4
  !
  service ipv6
   eid-table vrf VN3
   database-mapping ::/0 locator-set default_etr_locator default-etr local
   exit-service-ipv6
  !
  exit-instance-id
 !
 ipv4 locator reachability minimum-mask-length 32
 ipv4 source-locator Loopback0
 exit-router-lisp
!
 router bgp 600
 bgp router-id interface Loopback0
 bgp log-neighbor-changes
 bgp graceful-restart
 !
 address-family ipv4
  bgp redistribute-internal
```

```
 bgp aggregate-timer 0
 network 10.20.2.0 mask 255.255.255.252
 network 10.91.1.1 mask 255.255.255.255
 aggregate-address 10.91.1.0 255.255.255.0 summary-only
 redistribute lisp metric 10 route-map LISP_TO_BGP
 neighbor 10.20.2.2 remote-as 300
 neighbor 10.20.2.2 update-source Vlan111
 neighbor 10.20.2.2 activate
 neighbor 10.20.2.2 send-community both
exit-address-family !
!
address-family ipv4 vrf VN3
 bgp aggregate-timer 0
 network 10.20.1.0 mask 255.255.255.252
 network 10.50.1.1 mask 255.255.255.255
 aggregate-address 10.50.1.0 255.255.255.0 summary-only
 redistribute lisp metric 10 route-map LISP_TO_BGP
 neighbor 10.20.1.2 remote-as 300
 neighbor 10.20.1.2 update-source Vlan222
 neighbor 10.20.1.2 activate
 neighbor 10.20.1.2 send-community both
 neighbor 10.20.1.2 weight 65535
exit-address-family
!
address-family ipv6 vrf VN3
 redistribute lisp metric 10 route-map LISP_TO_BGP
 bgp aggregate-timer 0
 network 2001:DB8:20::/126
 network 2001:DB8:2050::1/128
 aggregate-address 2001:DB8:50::/64 summary-only
 neighbor 2001:DB8:20::2 remote-as 300
 neighbor 2001:DB8:20::2 update-source Vlan222
 neighbor 2001:DB8:20::2 activate
 neighbor 2001:DB8:20::2 send-community both
 neighbor 2001:DB8:20::2 weight 65535
exit-address-family
!

route-map LISP_TO_BGP permit 10
 description AS-number tag
 set as-path tag
```

Verify Distributed Border and Control Plane Node

You can verify the configurations on the control plane node, border node and the fabric edge node using the **show** commands. This section provides sample outputs for the **show** commands on the fabric node devices in the topology wherein the border and control plane nodes are not colocated.

In the topology, 172.16.1.68 and 172.16.1.69 are Fabric Edge Nodes; 172.16.1.67 is the Border Node; 172.16.1.66 is the Control Plane Node.

Table 1: Show Commands for the Control Plane Node

View the LISP session details on the control plane node:

```
CP# show lisp session

Sessions for VRF default, total: 6, established: 3
Peer                          State      Up/Down        In/Out    Users
172.16.1.69:16244               Up         02:17:44        9/17     7
172.16.1.68:37085               Up         02:17:46        9/20     7
172.16.1.67:11364               Up         00:07:04       13/47     7

CP#
```

Table 2: Show Commands for the Border Node

View the LISP session details on the border node:

```
Border# show lisp session

Sessions for VRF default, total: 1, established: 1
Peer                          State      Up/Down        In/Out    Users
172.16.1.66:4342                Up         00:07:21       47/13     7
Border#
```

View the Locator Set information on the border node:

```
Border# show lisp locator-set
LISP Locator-set information:

172.16.1.67, local, reachable, loopback
Border#
```

View the information about LISP instance IDs for IPv4 service:

```
Border# show lisp instance-id * ipv4

================================================
Output for router lisp 0 instance-id 4097
================================================
  Instance ID:                                  4097
  Router-lisp ID:                               0
  Locator table:                                default
  EID table:                                    default
  Ingress Tunnel Router (ITR):                  disabled
  Egress Tunnel Router (ETR):                   enabled
  Proxy-ITR Router (PITR):                      enabled RLOCs: 172.16.1.67
  Proxy-ETR Router (PETR):                      enabled
  NAT-traversal Router (NAT-RTR):               disabled
  Mobility First-Hop Router:                    disabled
  Map Server (MS):                              disabled
  Map Resolver (MR):                            disabled
  Mr-use-petr:                                  disabled
  First-Packet pETR:                            disabled
  Multiple IP per MAC support:                  disabled
  Delegated Database Tree (DDT):                disabled
  Multicast Flood Access-Tunnel:                disabled
  Publication-Subscription:                     enabled
    Publisher(s):                               172.16.1.66
  Site Registration Limit:                      0
  Map-Request source:                           derived from EID destination
  ITR Map-Resolver(s):                          172.16.1.66
  ETR Map-Server(s):                            172.16.1.66 (never)
  xTR-ID:                                      0x585ED747-0x87D8E878-0xC58A505D-0x10E643FC

  site-ID:                                      unspecified
  ITR local RLOC (last resort):                 172.16.1.67
  ITR Solicit Map Request (SMR):                accept and process
    Max SMRs per map-cache entry:               8 more specifics
    Multiple SMR suppression time:              2 secs
  ETR accept mapping data:                      disabled, verify disabled
  ETR map-cache TTL:                            1d00h
  Locator Status Algorithms:
    RLOC-probe algorithm:                       disabled
    RLOC-probe on route change:                 N/A (periodic probing disabled)
    RLOC-probe on member change:                disabled
    LSB reports:                                process
    IPv4 RLOC minimum mask length:              /32
    IPv6 RLOC minimum mask length:              /0
  Map-cache:
    Static mappings configured:                 1
    Map-cache size/limit:                       1/214528
    Imported route count/limit:                 0/5000
    Map-cache activity check period:            60 secs
    Map-cache signal suppress:                  disabled
    Conservative-allocation:                    disabled
    Map-cache FIB updates:                      established
    Persistent map-cache:                       disabled
    Map-cache activity-tracking:                enabled
  Global Top Source locator configuration:
     Loopback0 (172.16.1.67)
  Database:
    Total database mapping size:                0
    static database size/limit:                 0/214528
    dynamic database size/limit:                0/214528
    route-import database size/limit:           0/5000
    import-site-reg database size/limit:        0/214528
```

```
    dummy database size/limit:              0/214528
    import-publication database size/limit: 0/214528
    import-publication-cfg-prop database siz0
    proxy database size:                    0
    Inactive (deconfig/away) size:          0
  Publication entries exported to:
    Map-cache:                              0
    RIB:                                    0
    Database:                               0
    Prefix-list:                            0
  Site-registeration entries exported to:
    Map-cache:                              0
    RIB:                                    0
  Publication (Type - Config Propagation) en
    Database:                               0
  Encapsulation type:                       vxlan

================================================
Output for router lisp 0 instance-id 4099
================================================
  Instance ID:                              4099
  Router-lisp ID:                           0
  Locator table:                            default
  EID table:                                vrf VN3
  Ingress Tunnel Router (ITR):              disabled
  Egress Tunnel Router (ETR):               enabled
  Proxy-ITR Router (PITR):                  enabled RLOCs: 172.16.1.67
  Proxy-ETR Router (PETR):                  enabled
  NAT-traversal Router (NAT-RTR):           disabled
  Mobility First-Hop Router:                disabled
  Map Server (MS):                          disabled
  Map Resolver (MR):                        disabled
  Mr-use-petr:                              disabled
  First-Packet pETR:                        disabled
  Multiple IP per MAC support:              disabled
  Delegated Database Tree (DDT):            disabled
  Multicast Flood Access-Tunnel:            disabled
  Publication-Subscription:                 enabled
    Publisher(s):                           172.16.1.66
  Site Registration Limit:                  0
  Map-Request source:                       derived from EID destination
  ITR Map-Resolver(s):                      172.16.1.66
  ETR Map-Server(s):                        172.16.1.66 (00:37:05)
  xTR-ID:                                  0x585ED747-0x87D8E878-0xC58A505D-0x10E643FC

  site-ID:                                  unspecified
  ITR local RLOC (last resort):             172.16.1.67
  ITR Solicit Map Request (SMR):            accept and process
    Max SMRs per map-cache entry:           8 more specifics
    Multiple SMR suppression time:          2 secs
  ETR accept mapping data:                  disabled, verify disabled
  ETR map-cache TTL:                        1d00h
  Locator Status Algorithms:
    RLOC-probe algorithm:                   disabled
    RLOC-probe on route change:             N/A (periodic probing disabled)
    RLOC-probe on member change:            disabled
    LSB reports:                            process
    IPv4 RLOC minimum mask length:          /32
    IPv6 RLOC minimum mask length:          /0
  Map-cache:
    Static mappings configured:             0
    Map-cache size/limit:                   1/214528
    Imported route count/limit:             0/5000
    Map-cache activity check period:        60 secs
```

```
    Map-cache signal suppress:              disabled
    Conservative-allocation:                disabled
    Map-cache FIB updates:                  established
    Persistent map-cache:                   disabled
    Map-cache activity-tracking:            enabled
  Global Top Source locator configuration:
     Loopback0 (172.16.1.67)
  Database:
    Total database mapping size:            2
    static database size/limit:             2/214528
    dynamic database size/limit:            0/214528
    route-import database size/limit:       0/5000
    import-site-reg database size/limit:    0/214528
    dummy database size/limit:              0/214528
    import-publication database size/limit: 0/214528
    import-publication-cfg-prop database siz0
    proxy database size:                    0
    Inactive (deconfig/away) size:          0
  Publication entries exported to:
    Map-cache:                              0
    RIB:                                    0
    Database:                               0
    Prefix-list:                            0
  Site-registeration entries exported to:
    Map-cache:                              0
    RIB:                                    0
  Publication (Type - Config Propagation) en
    Database:                               0
  Encapsulation type:                       vxlan
Border#
```

View the route table on the border node for the VN3 VRF:

```
Border# show ip route vrf VN3

Routing Table: VN3
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       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, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR
       & - replicated local route overrides by connected

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 4 subnets, 3 masks
C        10.20.1.0/30 is directly connected, Vlan222
L        10.20.1.1/32 is directly connected, Vlan222
B        10.50.1.0/24 [200/0], 00:32:34, Null0
C        10.50.1.1/32 is directly connected, Loopback50
Border#
```

Table 3: Show Commands for the Fabric Edge Node

View the LISP sessions on the fabric edge node:

```
FabricEdge# show lisp session

Sessions for VRF default, total: 2, established: 1
Peer                            State      Up/Down        In/Out    Users
172.16.1.66:4342                  Up         02:21:53       20/9      14
FabricEdge#
```

View the Locator Set information on the fabric edge node:

```
FabricEdge# show lisp locator-set
LISP Locator-set information:

172.16.1.68, local, reachable, loopback

FabricEdge#
```

View the route table on the fabric edge node for the VN3 VRF:

```
FabricEdge# show ip route vrf VN3

Routing Table: VN3
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       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, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR
       & - replicated local route overrides by connected

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.50.1.0/24 is directly connected, Vlan50
L        10.50.1.1/32 is directly connected, Vlan50
FabricEdge#
```

Configuration Example for an Internal Border Node

Here is a sample configuration for an internal border with Layer 3 handoff.

In the Figure 1: LISP VXLAN Fabric Topology:

- Internal border has a Loopback0 address of 172.16.1.67
- Control plane node has a Loopback0 address of 172.16.1.66
- Layer 3 handoff segment is 10.20.1.0/30, 2001:DB8:20::/126
- Layer 3 handoff segment for Default Instance is 10.20.2.0/30

Ensure that there is IP reachability between all fabric nodes in the underlay.

IBN

```
vrf definition VN3
 rd 1:4099
 !
 address-family ipv4
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family
 !
 address-family ipv6
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family
!

vlan 222
 name 222
!
vlan 111
 name 111
!
interface Vlan111
 description interface to External router
 ip address 10.20.2.1 255.255.255.252
 no ip redirects
!
interface Vlan222
 description interface to External router
 vrf forwarding VN3
 ip address 10.20.1.1 255.255.255.252
 no ip redirects
 ipv6 address 2001:DB8:20::1/126
 ipv6 enable
!
interface FortyGigabitEthernet1/0/4
 switchport mode trunk


interface Loopback50
 description Loopback Border
 vrf forwarding VN3
 ip address 10.50.1.1 255.255.255.255
 ipv6 address 2001:DB8:2050::1/128
 ipv6 enable
 ipv6 dhcp relay trust
!
interface Loopback91
 description Loopback Border
 ip address 10.91.1.1 255.255.255.255
!

router lisp
 locator-table default
 locator-set eid_locator
 IPv4-interface Loopback0 priority 10 weight 10
  auto-discover-rlocs
  exit-locator-set
 !
 locator default-set eid_locator
!
 service ipv4
  encapsulation vxlan
  map-cache publications
```

```
 import publication publisher 172.16.1.66
 itr map-resolver 172.16.1.66
 etr map-server 172.16.1.66 key some-key
 etr map-server 172.16.1.66 proxy-reply
 etr
 sgt
 route-export publications
 distance publications 250
 proxy-itr 172.16.1.67
 exit-service-ipv4
!
service ipv6
 encapsulation vxlan
 map-cache publications
 import publication publisher 172.16.1.66
 itr map-resolver 172.16.1.66
 etr map-server 172.16.1.66 key some-key
 etr map-server 172.16.1.66 proxy-reply
 etr
 sgt
 route-export publications
 distance publications 250
 proxy-itr 172.16.1.67
 exit-service-ipv6
!
instance-id 4097
 remote-rloc-probe on-route-change
 service ipv4
  eid-table default
  map-cache 10.91.1.0/24 map-request
  exit-service-ipv4
 !
 exit-instance-id
!
instance-id 4099
 remote-rloc-probe on-route-change
 service ipv4
  eid-table vrf VN3
  map-cache 0.0.0.0/0 map-request
  route-import database bgp 600 route-map MATCH_DC_ROUTE locator-set eid_locator
  exit-service-ipv4
 !
 service ipv6
  eid-table vrf VN3
  map-cache ::/0 map-request
  route-import database bgp 600 route-map MATCH_DC_ROUTE_V6 locator-set eid_locator
  exit-service-ipv6
 !
 exit-instance-id
!
ipv4 locator reachability minimum-mask-length 32
ipv4 source-locator Loopback0
exit-router-lisp


router bgp 600
 bgp router-id interface Loopback0
 bgp log-neighbor-changes
 bgp graceful-restart
 !
 address-family ipv4
  bgp redistribute-internal
  bgp aggregate-timer 0
  network 10.20.2.0 mask 255.255.255.252
```

```
  network 10.91.1.1 mask 255.255.255.255
  aggregate-address 10.91.1.0 255.255.255.0 summary-only
  redistribute lisp metric 10 route-map LISP_TO_BGP
  neighbor 10.20.2.2 remote-as 300
  neighbor 10.20.2.2 update-source Vlan111
  neighbor 10.20.2.2 activate
  neighbor 10.20.2.2 send-community both
 exit-address-family
 !
 address-family ipv4 vrf VN3
  bgp aggregate-timer 0
  network 10.20.1.0 mask 255.255.255.252
  network 10.50.1.1 mask 255.255.255.255
  aggregate-address 10.50.1.0 255.255.255.0 summary-only
  redistribute lisp metric 10 route-map LISP_TO_BGP
  neighbor 10.20.1.2 remote-as 300
  neighbor 10.20.1.2 update-source Vlan222
  neighbor 10.20.1.2 activate
  neighbor 10.20.1.2 send-community both
  neighbor 10.20.1.2 weight 65535
 exit-address-family
 !
 address-family ipv6 vrf VN3
  redistribute lisp metric 10 route-map LISP_TO_BGP
  bgp aggregate-timer 0
  network 2001:DB8:20::/126
  network 2001:DB8:2050::1/128
  aggregate-address 2001:DB8:2050::/64 summary-only
  neighbor 2001:DB8:20::2 remote-as 300
  neighbor 2001:DB8:20::2 update-source Vlan222
  neighbor 2001:DB8:20::2 activate
  neighbor 2001:DB8:20::2 send-community both
  neighbor 2001:DB8:20::2 weight 65535
 exit-address-family


!
route-map LISP_TO_BGP permit 10
 description AS-number tag
 set as-path tag
!

ip prefix-list DENY_0.0.0.0 seq 10 permit 0.0.0.0/0
!
ip prefix-list L3HANDOFF_PREFIXES seq 63755909 permit 10.20.2.0/30
ip prefix-list L3HANDOFF_PREFIXES seq 828011002 permit 10.20.1.0/30
!
ipv6 prefix-list DENY_IPV6_0 seq 10 permit ::/0
!
ipv6 prefix-list L3HANDOFF_PREFIXES seq 568642686 permit 2001:DB8:20::/126

route-map MATCH_DC_ROUTE deny 5
 description Deny IPV4 default route
 match ip address prefix-list DENY_0.0.0.0
!
route-map MATCH_DC_ROUTE deny 17
 description Deny L3Handoff Prefixes
 match ip address prefix-list L3HANDOFF_PREFIXES
!
route-map MATCH_DC_ROUTE permit 20
 description Permit DC routes
 match tag 300
!
route-map MATCH_DC_ROUTE_V6 deny 5
```

```
 description Deny IPV6 default route
 match ipv6 address prefix-list DENY_IPV6_0
!
route-map MATCH_DC_ROUTE_V6 deny 17
 description Deny L3Handoff IPV6 Prefixes
 match ipv6 address prefix-list L3HANDOFF_PREFIXES
!
route-map MATCH_DC_ROUTE_V6 permit 20
 description Permit DC routes
 match tag 300
```

Configuration Example for an Internal and External Border

Here is a sample configuration for an internal and external border with Layer 3 handoff.

In the Figure 1: LISP VXLAN Fabric Topology:

- Border has a Loopback0 address of 172.16.1.67
- Control plane node has a Loopback0 address of 172.16.1.66
- Layer 3 handoff segment for VN3 (user-defined VRF) is 10.20.1.0/30, 2001:DB8:20::/126
- Layer 3 handoff segment for Default Instance is 10.20.2.0/30

Ensure that there is IP reachability between all fabric nodes in the underlay.

Internal+External BN

```
vrf definition VN3
 rd 1:4099
 !
 address-family ipv4
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family
 !
 address-family ipv6
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family

vlan 222
 name 222
!
vlan 111
 name 111
!
interface Vlan111
 description interface to External router
 ip address 10.20.2.1 255.255.255.252
 no ip redirects
!
interface Vlan222
 description interface to External router
 vrf forwarding VN3
 ip address 10.20.1.1 255.255.255.252
 no ip redirects
 ipv6 address 2001:DB8:20::1/126
 ipv6 enable

!
```

```
interface FortyGigabitEthernet1/0/4
 switchport mode trunk


interface Loopback50
 description Loopback Border
 vrf forwarding VN3
 ip address 10.50.1.1 255.255.255.255
 ipv6 address 2001:DB8:2050::1/128
 ipv6 enable
 ipv6 dhcp relay trust
!


interface Loopback91
 description Loopback Border
 ip address 10.91.1.1 255.255.255.255
!

router lisp
 locator-table default
 locator-set default_etr_locator
  IPv4-interface Loopback0 priority 10 weight 10
  exit-locator-set
 !
 locator-set eid_locator
  IPv4-interface Loopback0 priority 10 weight 10
  auto-discover-rlocs
  exit-locator-set
 !
 locator default-set eid_locator
!
 service ipv4
  encapsulation vxlan
  map-cache publications
  import publication publisher 172.16.1.66
  itr map-resolver 172.16.1.66
  etr map-server 172.16.1.66 key some-key
  etr map-server 172.16.1.66 proxy-reply
  etr
  sgt
  route-export publications
  distance publications 250
  proxy-etr
  proxy-itr 172.16.1.67
  exit-service-ipv4
 !
 service ipv6
  encapsulation vxlan
  map-cache publications
  import publication publisher 172.16.1.66
  itr map-resolver 172.16.1.66
  etr map-server 172.16.1.66 key some-key
  etr map-server 172.16.1.66 proxy-reply
  etr
  sgt
  route-export publications
  distance publications 250
  proxy-etr
  proxy-itr 172.16.1.67
  exit-service-ipv6
 !
 instance-id 4097
  remote-rloc-probe on-route-change
```

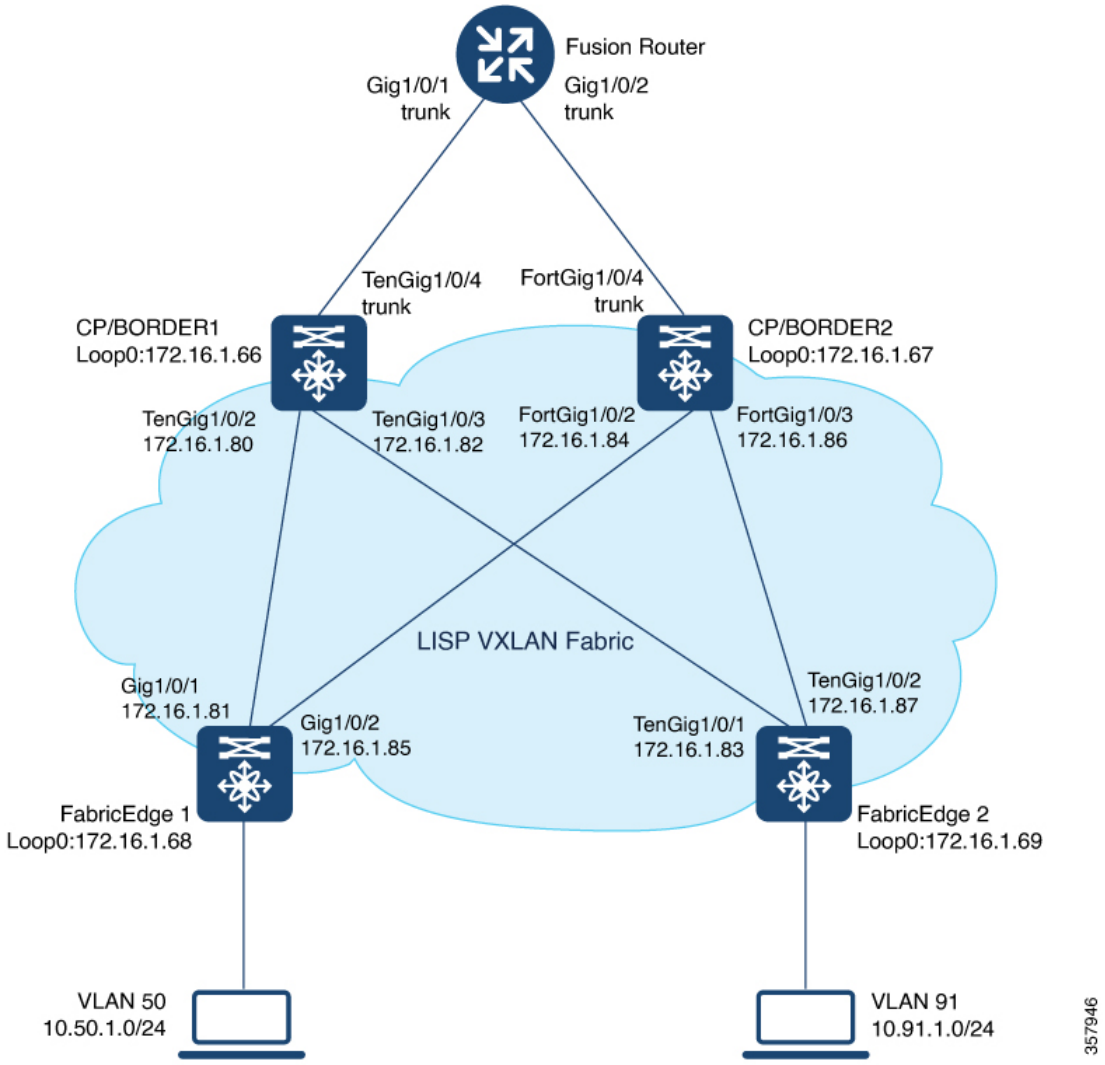
```
  service ipv4
   eid-table default
   map-cache 10.91.1.0/24 map-request
   exit-service-ipv4
  !
  instance-id 4099
  remote-rloc-probe on-route-change
  service ipv4
   eid-table vrf VN3
   database-mapping 0.0.0.0/0 locator-set default_etr_locator default-etr local
   route-import database bgp 600 route-map MATCH_DC_ROUTE locator-set eid_locator
   exit-service-ipv4
  !
  service ipv6
   eid-table vrf VN3
   database-mapping ::/0 locator-set default_etr_locator default-etr local
   route-import database bgp 600 route-map MATCH_DC_ROUTE_V6 locator-set eid_locator
   exit-service-ipv6
  !
  exit-instance-id
 !
 ipv4 locator reachability minimum-mask-length 32
 ipv4 source-locator Loopback0
 exit-router-lisp
!


router bgp 600
 bgp router-id interface Loopback0
 bgp log-neighbor-changes
 bgp graceful-restart
 !
 address-family ipv4
  bgp redistribute-internal
  bgp aggregate-timer 0
  network 10.20.2.0 mask 255.255.255.252
  network 10.91.1.1 mask 255.255.255.255
  aggregate-address 10.91.1.0 255.255.255.0 summary-only
  redistribute lisp metric 10 route-map LISP_TO_BGP
  neighbor 10.20.2.2 remote-as 300
  neighbor 10.20.2.2 update-source Vlan111
  neighbor 10.20.2.2 activate
  neighbor 10.20.2.2 send-community both
 exit-address-family
 !
 address-family ipv4 vrf VN3
  bgp aggregate-timer 0
  network 10.20.1.0 mask 255.255.255.252
  network 10.50.1.1 mask 255.255.255.255
  aggregate-address 10.50.1.0 255.255.255.0 summary-only
  redistribute lisp metric 10 route-map LISP_TO_BGP
  neighbor 10.20.1.2 remote-as 300
  neighbor 10.20.1.2 update-source Vlan222
  neighbor 10.20.1.2 activate
  neighbor 10.20.1.2 send-community both
  neighbor 10.20.1.2 weight 65535
 exit-address-family
 !
 address-family ipv6 vrf VN3
  redistribute lisp metric 10 route-map LISP_TO_BGP
  bgp aggregate-timer 0
  network 2001:DB8:20::/126
  network 2001:DB8:2050::1/128
  aggregate-address 2001:DB8:2050::/64 summary-only
```

```
  neighbor 2001:DB8:20::2 remote-as 300
  neighbor 2001:DB8:20::2 update-source Vlan222
  neighbor 2001:DB8:20::2 activate
  neighbor 2001:DB8:20::2 send-community both
  neighbor 2001:DB8:20::2 weight 65535
 exit-address-family
!

ip prefix-list DENY_0.0.0.0 seq 10 permit 0.0.0.0/0
!
ip prefix-list L3HANDOFF_PREFIXES seq 63755909 permit 10.20.2.0/30
ip prefix-list L3HANDOFF_PREFIXES seq 828011002 permit 10.20.1.0/30
!
ipv6 prefix-list DENY_IPV6_0 seq 10 permit ::/0
!
ipv6 prefix-list L3HANDOFF_PREFIXES seq 568642686 permit 2001:DB8:20::/126
!
route-map MATCH_DC_ROUTE deny 5
 description Deny IPV4 default route
 match ip address prefix-list DENY_0.0.0.0
!
route-map MATCH_DC_ROUTE deny 17
 description Deny L3Handoff Prefixes
 match ip address prefix-list L3HANDOFF_PREFIXES
!
route-map MATCH_DC_ROUTE permit 20
 description Permit DC routes
 match tag 300
!
route-map MATCH_DC_ROUTE_V6 deny 5
 description Deny IPV6 default route
 match ipv6 address prefix-list DENY_IPV6_0
!
route-map MATCH_DC_ROUTE_V6 deny 17
 description Deny L3Handoff IPV6 Prefixes
 match ipv6 address prefix-list L3HANDOFF_PREFIXES
!
route-map MATCH_DC_ROUTE_V6 permit 20
 description Permit DC routes
 match tag 300
!

route-map LISP_TO_BGP permit 10
 description AS-number tag
 set as-path tag
```

Configuration Example for Colocated Border Node

Here is a sample configuration for a colocated control plane node and external border node (BNCP) without Layer 3 handoff.

Figure 2: LISP VXLAN Fabric with Colocated Border and Control Plane Nodes



Ensure that there is IP reachability between all fabric nodes in the underlay.

BNCP

```
vrf definition VN3
 rd 1:4099
 !
 address-family ipv4
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family
 !
 address-family ipv6
  route-target export 1:4099
  route-target import 1:4099
 exit-address-family
!
```

```
interface Loopback50
 description Loopback Border
 vrf forwarding VN3
 ip address 10.50.1.1 255.255.255.255
 ipv6 address 2001:DB8:2050::1/128
 ipv6 enable
 ipv6 dhcp relay trust
!
!
interface Loopback91
 description Loopback Border
 ip address 10.91.1.1 255.255.255.255
!

router lisp
 locator-table default
 locator-set default_etr_locator
  IPv4-interface Loopback0 priority 10 weight 10
  exit-locator-set
 !
 locator-set rloc_site1
  IPv4-interface Loopback0 priority 10 weight 10
  auto-discover-rlocs
  exit-locator-set
 !
 locator default-set rloc_set1
 service ipv4
  encapsulation vxlan
  map-cache publications
  import publication publisher 172.16.1.66
  import publication publisher 172.16.1.67
  itr map-resolver 172.16.1.66
  itr map-resolver 172.16.1.67
  etr map-server 172.16.1.66 key auth-key
  etr map-server 172.16.1.66 proxy-reply
  etr map-server 172.16.1.67 key some-key
  etr map-server 172.16.1.67 proxy-reply
  etr
  sgt
  route-export publications
  distance publications 250
  proxy-etr
  proxy-itr 172.16.1.66
  map-server
  map-resolver
  exit-service-ipv4
 !
 service ipv6
  encapsulation vxlan
  map-cache publications
  import publication publisher 172.16.1.66
  import publication publisher 172.16.1.67
  itr map-resolver 172.16.1.66
  itr map-resolver 172.16.1.67
  etr map-server 172.16.1.66 key auth-key
  etr map-server 172.16.1.66 proxy-reply
  etr map-server 172.16.1.67 key some-key
  etr map-server 172.16.1.67 proxy-reply
  etr
  sgt
  route-export publications
  distance publications 250
  proxy-etr
  proxy-itr 172.16.1.66
  map-server
```

```
 map-resolver
 exit-service-ipv6
!

instance-id 4097
 remote-rloc-probe on-route-change
 service ipv4
  eid-table default
  map-cache 10.91.1.0/24 map-request
  exit-service-ipv4
 !
 exit-instance-id
!

instance-id 4099
 remote-rloc-probe on-route-change
 service ipv4
  eid-table vrf VN3
  database-mapping 0.0.0.0/0 locator-set default_etr_locator default-etr local
  exit-service-ipv4
 !
 service ipv6
  eid-table vrf VN3
  database-mapping ::/0 locator-set default_etr_locator default-etr local
  exit-service-ipv6
 !
 exit-instance-id
!
site site_uci
 description map-server uci_map_server
 authentication-key some-key
 eid-record instance-id 4097 0.0.0.0/0 accept-more-specifics     //To import routes from
external network
 eid-record instance-id 4097 10.91.1.0/24 accept-more-specifics  //Fabric prefix
 eid-record instance-id 4099 0.0.0.0/0 accept-more-specifics     //To import routes from
external network
 eid-record instance-id 4099 10.50.1.0/24 accept-more-specifics  //Fabric prefix
 eid-record instance-id 4099 ::/0 accept-more-specifics          //To import routes from
external network
 eid-record instance-id 4099 2001:DB8:2050::/64 accept-more-specifics
 eid-record instance-id 8194 any-mac
 eid-record instance-id 8197 any-mac
 allow-locator-default-etr instance-id 4097 ipv4
 allow-locator-default-etr instance-id 4099 ipv4
 allow-locator-default-etr instance-id 4099 ipv6
 exit-site
!
ipv4 locator reachability minimum-mask-length 32
ipv4 source-locator Loopback0
!

router bgp 700
 bgp router-id interface Loopback0
 bgp log-neighbor-changes
 bgp graceful-restart
 !
 address-family ipv4
  bgp redistribute-internal
  bgp aggregate-timer 0
  network 10.91.1.1 mask 255.255.255.255
 exit-address-family
 !
 address-family ipv4 vrf VN3
  bgp aggregate-timer 0
  network 10.50.1.1 mask 255.255.255.255
```

```
 exit-address-family
 !
 address-family ipv6 vrf VN3
  bgp aggregate-timer 0
  network 2001:DB8:2050::1/128
 exit-address-family
!
!
```

Verify Colocated Border and Control Plane Node

This section provides sample outputs for the **show** commands on the fabric edge nodes in the topology shown Figure 2: LISP VXLAN Fabric with Colocated Border and Control Plane Nodes.

In the topology, 172.16.1.68 and 172.16.1.69 are Fabric Edge Nodes; 172.16.1.67 is a colocated border and control plane node; 172.16.1.66 is another colocated border and control plane node.

The **show lisp session** command displays a summary of the the LISP sessions on the colocated control plane and border node device.

Note that the 4342 port on 172.16.1.66 and 172.16.1.67 is the control plane LISP server.

As you can see in the output below, each colocated control plane and border node shows two LISP sessions on the same device.

The LISP session entries for 172.16.1.66:4342 and 172.16.1.67:4342 indicate the LISP session from the border node to the control plane on the respective device. The LISP session entries 172.16.1.66:52946 and 172.16.1.67:13864 indicate the sessions from the control plane to the border on the respective device.

```
BNCP# show lisp session

Sessions for VRF default, total: 10, established: 6
Peer                            State      Up/Down        In/Out    Users
172.16.1.69:27785                 Up         1d04h           9/27     8
172.16.1.66:4342                  Up         1d04h         172/27     7
172.16.1.66:52946                 Up         1d04h          27/172    7
172.16.1.68:33554                 Up         1d02h          11/17     8
172.16.1.67:4342                  Up         1d03h          39/17     8
172.16.1.67:13864                 Up         1d03h          14/35     7
BNCP#
```

View the LISP session with the edge node:

```
BNCP# show lisp session 172.16.1.69

Peer address:     172.16.1.69:27785
Local address:    172.16.1.66:4342
Session Type:     Passive
Session State:    Up (1d04h)
Messages in/out:  9/27
Bytes in/out:     276/1666
Fatal errors:     0
Rcvd unsupported: 0
Rcvd invalid VRF: 0
Rcvd override:    0
Rcvd malformed:   0
Sent deferred:    0
SSO redundancy:   unsynchronized
Auth Type:        None

Accepting Users:  1
```

```
Users:            8
  Type                      ID                                      In/Out    State
  Capability Exchange       N/A                                      1/1      waiting
  MS Reliable Registration  lisp 0 IID 4097 AFI IPv4                  1/0      idle
    WLC subscription received
  MS Reliable Registration  lisp 0 IID 4097 AFI IPv6                  1/0      idle
    WLC subscription received
  MS Reliable Registration  lisp 0 IID 4099 AFI IPv4                  1/0      idle
    WLC subscription received
  MS Reliable Registration  lisp 0 IID 4099 AFI IPv6                  1/0      idle
    WLC subscription received
  MS Reliable Registration  lisp 0 IID 8194 AFI MAC                   1/0      idle
    WLC subscription received
  MS Reliable Registration  lisp 0 IID 8197 AFI MAC                   1/0      idle
    WLC subscription received
  MS Reliable Registration  lisp 0 IID 16777214 AFI IPv4              2/13     waiting
    WLC subscription received
BNCP#
```

View a summary of the LISP service IPv4 instances on the colocated border and control plane node:

```
BNCP# show lisp service ipv4 summary
Router-lisp ID:   0
Instance count:   5
Key: DB - Local EID Database entry count (@ - RLOC check pending
                                          * - RLOC consistency problem),
     DB no route - Local EID DB entries with no matching RIB route,
     Cache - Remote EID mapping cache size, IID - Instance ID,
     Role - Configured Role

                      Interface    DB  DB no  Cache Incom Cache
EID VRF name             (.IID)  size  route   size plete  Idle Role
default               LISP0.4097     0      0      1  0.0%  0.0% ETR-PITR-PETR
VN3                   LISP0.4099     1      1      0    0%    0% ETR-PITR-PETR

Number of eid-tables:                                  2
Total number of database entries:                      1 (inactive 0)
Maximum database entries:                         214528
EID-tables with inconsistent locators:                 0
Total number of map-cache entries:                     1
Maximum map-cache entries:                        214528
EID-tables with incomplete map-cache entries:          0
EID-tables pending map-cache update to FIB:            0
BNCP1#
```

View the LISP EID statistics related to packet encapsulations, de-encapsulations, map requests, map replies, map registers, and other LISP-related packets on the colocated border and control plane node::

```
BNCP# show lisp service ipv4 statistics
LISP EID Statistics for all EID instances - last cleared: never
Control Packets:
  Map-Requests in/out:                              170/2
    Map-Requests in (5 sec/1 min/5 min):            0/5/22
    Encapsulated Map-Requests in/out:               51/0
    RLOC-probe Map-Requests in/out:                 119/2
    SMR-based Map-Requests in/out:                  0/0
    Extranet SMR cross-IID Map-Requests in:         0
    Map-Requests expired on-queue/no-reply          0/0
    Map-Resolver Map-Requests forwarded:            0
    Map-Server Map-Requests forwarded:              0
```

```
  Map-Reply records in/out:                         0/0
    Authoritative records in/out:                   0/0
    Non-authoritative records in/out:               0/0
    Negative records in/out:                        0/0
    RLOC-probe records in/out:                      0/0
    Map-Server Proxy-Reply records out:             0
  WLC Map-Subscribe records in/out:                 11/5
    Map-Subscribe failures in/out:                  0/0
  WLC Map-Unsubscribe records in/out:               0/0
    Map-Unsubscribe failures in/out:                0/0
  Map-Register records in/out:                      16/14
    Map-Registers in (5 sec/1 min/5 min):           0/0/0
    Map-Server AF disabled:                         0
    Not valid site eid prefix:                      7
    Authentication failures:                        0
    Disallowed locators:                            0
    Miscellaneous:                                  0
  WLC Map-Register records in/out:                  0/0
    WLC AP Map-Register in/out:                     0/0
    WLC Client Map-Register in/out:                 0/0
    WLC Map-Register failures in/out:               0/0
  Map-Notify records in/out:                        22/35
    Authentication failures:                        0
  WLC Map-Notify records in/out:                    0/0
    WLC AP Map-Notify in/out:                       0/0
    WLC Client Map-Notify in/out:                   0/0
    WLC Map-Notify failures in/out:                 0/0
  Publish-Subscribe in/out:
    Subscription Request records in/out:            6/6
      IID subscription requests in/out:             6/6
      Pub-refresh subscription requests in/out:     0/0
      Policy subscription requests in/out:          0/0
    Subscription Request failures in/out:           0/0
    Subscription Status records in/out:             11/10
      End of Publication records in/out:            11/10
      Subscription rejected records in/out:         0/0
      Subscription removed records in/out:          0/0
    Subscription Status failures in/out:            0/0
    Solicit Subscription records in/out:            12/15
    Solicit Subscription failures in/out:           0/0
    Publication records in/out:                     7/6
    Publication failures in/out:                    0/0
Errors:
  Mapping record TTL alerts:                        0
  Map-Request invalid source rloc drops:            0
  Map-Register invalid source rloc drops:           0
  DDT Requests failed:                              0
  DDT ITR Map-Requests dropped:                     0 (nonce-collision: 0, bad-xTR-nonce:
0)
Cache Related:
  Cache entries created/deleted:                    1/0
  NSF CEF replay entry count                        0
  Number of rejected EID-prefixes due to limit:     0
Forwarding:
  Number of data signals processed:                 0 (+ dropped 0)
  Number of reachability reports:                   0 (+ dropped 0)
  Number of SMR signals dropped:                    0
LISP RLOC Statistics - last cleared: never
Control Packets:
  RTR Map-Requests forwarded:                       0
  RTR Map-Notifies forwarded:                       0
  DDT-Map-Requests in/out:                          0/0
  DDT-Map-Referrals in/out:                         0/0
Errors:
```

```
  Map-Request format errors:                        0
  Map-Reply format errors:                          0
  Map-Referral format errors:                       0
LISP Miscellaneous Statistics - last cleared: never
Errors:
  Invalid IP version drops:                         0
  Invalid IP header drops:                          0
  Invalid IP proto field drops:                     0
  Invalid packet size drops:                        0
  Invalid LISP control port drops:                  0
  Invalid LISP checksum drops:                      0
  Unsupported LISP packet type drops:               0
  Unknown packet drops:                             0
BNCP#
```

View the detailed information on the remote IPv4 EID-prefix forwarding. Remote EID-prefixes are the destination prefixes.

```
BNCP# show lisp service ipv4 forwarding eid remote detail
Prefix                Fwd action  Locator status bits   encap_iid
10.91.1.0/24          signal      0x00000000            N/A
  packets/bytes       2/1152
  path list 7FAE553FE0D8, 4 locks, per-destination, flags 0x49 [shble, rif, hwcn]
    ifnums:
      LISP0.4097(75)
    1 path
      path 7FAE574157A8, share 1/1, type attached prefix, for IPv4
        attached to LISP0.4097, glean for LISP0.4097
    1 output chain
      chain[0]: glean for LISP0.4097
BNCP#
```

View the LISP IPv4 service instance forwarding state.

```
BNCP# show lisp service ipv4 forwarding state
LISP forwarding state for EID table IPv4:Default
  Instance ID                 4097
  EID VRF                     Default (0x0)
    IPv4
      Configured roles        ETR|PITR|PETR
      EID table               IPv4:Default
      ALT table               <null>
      Locator status bits     Disabled
      Nonce                   SGT
      TTL Propagation         Enabled
      Table Suppression       Disabled
      SGT Policy Fwd          Disabled
    IPv6
      Configured role         DISABLED
      EID table               <null>
      ALT table               <null>
      Locator status bits     Disabled
      Nonce                   N/A
      TTL Propagation         Enabled
      Table Suppression       Disabled
      SGT Policy Fwd          Disabled
    L2
      Configured role         DISABLED
      L2 Domain ID            0
      IPv4 Unnum I/F          N/A
      IPv6 Unnum I/F          N/A
    RLOC transport VRF        Default (0x0)
      IPv4 RLOC table         IPv4:Default
```

```
      IPv6 RLOC table          IPv6:Default
      IPv4 path MTU discovery  min  576 max 65535
      IPv6 path MTU discovery  min 1280 max 65535
      IPv4 RLOC fltr handle    0x0
      IPv6 RLOC fltr handle    0x0
    LISP router ID             0
    LISP virtual interface     LISP0.4097
    User                       LISP
BNCP#
```

```
BNCP# show lisp service ipv4 forwarding statistics
IPv4 LISP Forwarding Statistics
 Map requests              0
 Map requests resolve DGT  0
 Unexpected map requests   0
 Map cache deletes         0
BNCP#
```

View the dynamic interfaces that are created after LISP configuration on the colocated control plane and border node:

```
BNCP# show ip interface brief | i LISP
Interface              IP-Address      OK? Method Status                Protocol
LISP0                  unassigned      YES unset  up                    up
LISP0.4097             172.16.1.66     YES unset  up                    up
LISP0.4099             10.50.1.1       YES unset  up                    up
BNCP#
```