



Cisco Nexus 7000 Series NX-OS LISP Configuration Guide

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Preface

This preface describes the audience, organization, and conventions of the Book Title. It also provides information on how to obtain related documentation.

This chapter includes the following topics:

Audience

This publication is for experienced network administrators who configure and maintain Cisco NX-OS on Cisco Nexus 7000 Series Platform switches.

Document Conventions



Note

- As part of our constant endeavor to remodel our documents to meet our customers' requirements, we have modified the manner in which we document configuration tasks. As a result of this, you may find a deviation in the style used to describe these tasks, with the newly included sections of the document following the new format.
- The Guidelines and Limitations section contains general guidelines and limitations that are applicable to all the features, and the feature-specific guidelines and limitations that are applicable only to the corresponding feature.

Command descriptions use the following conventions:

Convention	Description
bold	Bold text indicates the commands and keywords that you enter literally as shown.
<i>Italic</i>	Italic text indicates arguments for which the user supplies the values.
[x]	Square brackets enclose an optional element (keyword or argument).
[x y]	Square brackets enclosing keywords or arguments separated by a vertical bar indicate an optional choice.
{x y}	Braces enclosing keywords or arguments separated by a vertical bar indicate a required choice.
[x {y z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.
variable	Indicates a variable for which you supply values, in context where italics cannot be used.

Convention	Description
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.

Examples use the following conventions:

Convention	Description
<code>screen font</code>	Terminal sessions and information the switch displays are in screen font.
boldface screen font	Information you must enter is in boldface screen font.
<i>italic screen font</i>	Arguments for which you supply values are in italic screen font.
<>	Nonprinting characters, such as passwords, are in angle brackets.
[]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

This document uses the following conventions:



Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.



Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Related Documentation

Documentation for Cisco Nexus 7000 Series Switches is available at:

- Configuration Guides
<http://www.cisco.com/c/en/us/support/switches/nexus-7000-series-switches/products-installation-and-configuration-guides-list.html>
- Command Reference Guides
<http://www.cisco.com/c/en/us/support/switches/nexus-7000-series-switches/products-command-reference-list.html>
- Release Notes
<http://www.cisco.com/c/en/us/support/switches/nexus-7000-series-switches/products-release-notes-list.html>
- Install and Upgrade Guides
<http://www.cisco.com/c/en/us/support/switches/nexus-7000-series-switches/products-installation-guides-list.html>

- Licensing Guide

<http://www.cisco.com/c/en/us/support/switches/nexus-7000-series-switches/products-licensing-information-listing.html>

Documentation for Cisco Nexus 7000 Series Switches and Cisco Nexus 2000 Series Fabric Extenders is available at the following URL:

<http://www.cisco.com/c/en/us/support/switches/nexus-2000-series-fabric-extenders/products-installation-and-configuration-guides-list.html>

Documentation Feedback

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Cisco Bug Search Tool

[Cisco Bug Search Tool](#) (BST) is a web-based tool that acts as a gateway to the Cisco bug tracking system that maintains a comprehensive list of defects and vulnerabilities in Cisco products and software. BST provides you with detailed defect information about your products and software.



CHAPTER 1

New and Changed Information

- [New and Changed Information](#), on page 1

New and Changed Information

Your software release might not support all the features in this document. For the latest caveats and feature information, see the Bug Search Tool at <https://tools.cisco.com/bugsearch/> and the release notes for your software release.

Table 1: New and Changed Information

Feature	Description	Changed in Release	Where Documented
LISP ESM Multihop Mobility	This feature was introduced.	6.2(8)	Configuring LISP ESM Multihop Mobility , on page 33
Dynamic-EID Route Import	This feature was introduced.	6.2(8)	Configuring LISP ESM Multihop Mobility , on page 33
LISP Instance ID Support	This feature was introduced.	6.2(2)	
LISP Delegate Database Tree	This feature was introduced.	6.2(2)	Configuring LISP Delegate Database Tree (DDT) , on page 97
LISP Multicast	This feature was introduced.	6.2(2) Note The LISP Multicast feature is not supported on the F3 series module.	Configuring LISP Multicast , on page 101



CHAPTER 2

Configuring Locator ID Separation Protocol

This chapter describes how to configure the basic Cisco NX-OS Locator/ID Separation Protocol (LISP) functionality on all LISP-related devices, including the Ingress Tunnel Router (ITR), Egress Tunnel Router, Proxy ITR (PITR), Proxy ETR (PETR), Map Resolver (MR), Map Server (MS), and LISP-ALT device.

This chapter contains the following sections:

- [Licensing Requirements, on page 3](#)
- [Information About Locator/ID Separation Protocol, on page 3](#)
- [Information About LISP, on page 4](#)
- [LISP Devices Overview, on page 5](#)
- [LISP Guidelines and Limitations, on page 6](#)
- [Default Settings for LISP, on page 6](#)
- [Configuring Locator/ID Separation Protocol, on page 7](#)
- [Additional References, on page 16](#)
- [Feature History for LISP, on page 17](#)

Licensing Requirements

For a complete explanation of Cisco NX-OS licensing recommendations and how to obtain and apply licenses, see the [Cisco NX-OS Licensing Guide](#).

Information About Locator/ID Separation Protocol

The Locator/ID Separation Protocol (LISP) network architecture and protocol implements a new semantic for IP addressing by creating two new namespaces: Endpoint Identifiers (EIDs), which are assigned to end hosts, and Routing Locators (RLOCs), which are assigned to devices (primarily routers) that make up the global routing system. Splitting EID and RLOC functions improves routing system scalability, multihoming efficiency, and ingress traffic engineering. LISP end site support is configured on devices such as Cisco routers.

Information About LISP

In the current Internet routing and addressing architecture, the IP address is used as a single namespace that simultaneously expresses two functions about a device: its identity and how it is attached to the network. One very visible and detrimental result of this single namespace is demonstrated by the rapid growth of the Internet's default-free zone (DFZ) as a consequence of multi-homing, traffic engineering (TE), nonaggregatable address allocations, and business events such as mergers and acquisitions.

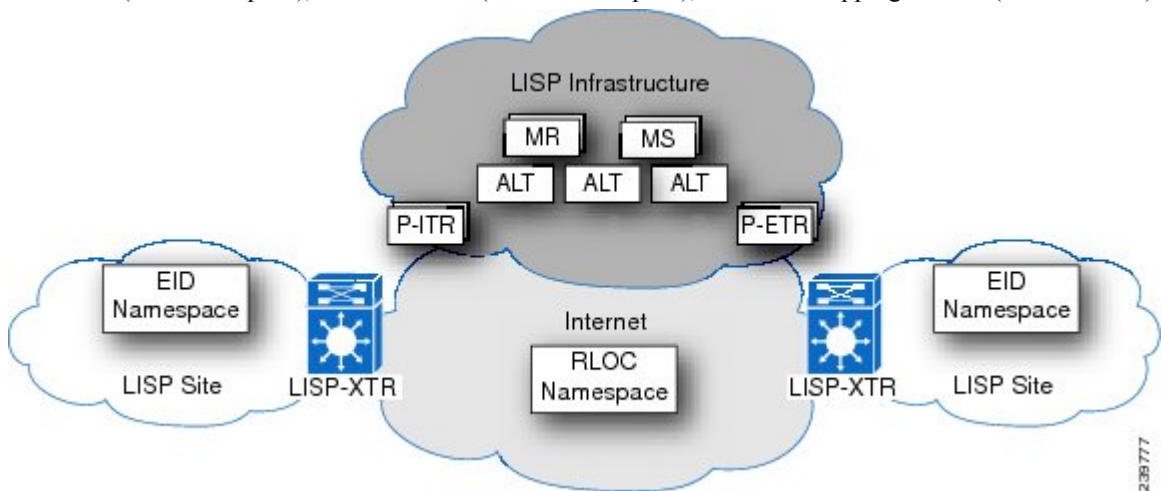
LISP changes current IP address semantics by creating two new namespaces: Endpoint Identifiers (EIDs) that are assigned to end-hosts and Routing Locators (RLOCs) that are assigned to devices (primarily routers) that make up the global routing system. These two namespaces provide the following advantages:

- Improved routing system scalability by using topologically aggregated RLOCs
- Provider independence for devices numbered out of the EID space
- Multihoming of endsites with improved traffic engineering
- IPv6 transition functionality

LISP is deployed primarily in network edge devices. It requires no changes to host stacks, Domain Name Service (DNS), or local network infrastructure, and little to no major changes to existing network infrastructures.

Figure 1: Cisco NX-OS LISP Deployment Environment

This figure shows a LISP deployment environment. Three essential environments exist in a LISP environment: LISP sites (EID namespace), non-LISP sites (RLOC namespace), and LISP Mapping Service (infrastructure).



The LISP EID namespace represents customer end sites as they are defined today. The only difference is that the IP addresses used within these LISP sites are not advertised within the non-LISP, Internet (RLOC namespace). End customer LISP functionality is deployed exclusively on CE routers that function within LISP as Ingress Tunnel Router (ITR) and Egress Tunnel Router (ETR) devices.



Note The ITR and ETR are abbreviated as xTR in the figure.

To fully implement LISP with support for Mapping Services and Internet interworking, you might need to deploy additional LISP infrastructure components such as Map Server (MS), Map Resolver (MR), Proxy Ingress Tunnel Router (PITR), Proxy Egress Tunnel Router (PETR), and Alternative Topology (ALT).

LISP Devices Overview

The following devices are found in a full LISP deployment:

LISP Site Devices

The LISP site devices are as follows:

Ingress Tunnel Router (ITR)—This device is deployed as a LISP site edge device. It receives packets from site-facing interfaces (internal hosts) and either LISP encapsulates packets to remote LISP sites or the ITR natively forwards packets to non-LISP sites.

Egress Tunnel Router (ETR)—This device is deployed as a LISP site edge device. It receives packets from core-facing interfaces (the Internet) and either decapsulates LISP packets or delivers them to local EIDs at the site.



Note Customer Edge (CE) devices can implement both ITR and ETR functions. This type of CE device is referred to as an xTR. The LISP specification does not require a device to perform both ITR and ETR functions, however.

For both devices, the EID namespace is used inside the sites for end-site addresses for hosts and routers. The EIDs go in DNS records. The EID namespace is not globally routed in the underlying Internet. The RLOC namespace is used in the (Internet) core. RLOCs are used as infrastructure addresses for LISP routers and ISP routers and are globally routed in the underlying infrastructure. Hosts do not know about RLOCs, and RLOCs do not know about hosts.

LISP Infrastructure

The LISP infrastructure devices are as follows:

Map Server (MS)—This device is deployed as a LISP Infrastructure component. It must be configured to permit a LISP site to register to it by specifying for each LISP site the EID prefixes for which registering ETRs are authoritative. An authentication key must match the key that is configured on the ETR. An MS receives Map-Register control packets from ETRs. When the MS is configured with a service interface to the LISP ALT, it injects aggregates for the EID prefixes for registered ETRs into the ALT. The MS also receives Map-Request control packets from the ALT, which it then encapsulates to the registered ETR that is authoritative for the EID prefix being queried.

Map Resolver (MR)—This device is deployed as a LISP Infrastructure device. It receives Map-Requests encapsulated to it from ITRs. When configured with a service interface to the LISP ALT, the MR forwards Map Requests to the ALT. The MR also sends Negative Map-Replies to ITRs in response to queries for non-LISP addresses.

Alternative Topology (ALT)—This is a logical topology and is deployed as part of the LISP Infrastructure to provide scalable EID prefix aggregation. Because the ALT is deployed as a dual-stack (IPv4 and IPv6)

Border Gateway Protocol (BGP) over Generic Routing Encapsulation (GRE) tunnels, you can use ALT-only devices with basic router hardware or other off-the-shelf devices that can support BGP and GRE.

LISP Internetworking Devices

The LISP internetworking devices are as follows:

Proxy ITR (PITR)—This device is a LISP infrastructure device that provides connectivity between non-LISP sites and LISP sites. A PITR advertises coarse-aggregate prefixes for the LISP EID namespace into the Internet, which attracts non-LISP traffic destined to LISP sites. The PITR then encapsulates and forwards this traffic to LISP sites. This process not only facilitates LISP/non-LISP internetworking but also allows LISP sites to see LISP ingress traffic engineering benefits from non-LISP traffic.

Proxy ETR (PETR)—This device is a LISP infrastructure device that allows IPv6 LISP sites without native IPv6 RLOC connectivity to reach LISP sites that only have IPv6 RLOC connectivity. In addition, the PETR can also be used to allow LISP sites with Unicast Reverse Path Forwarding (URPF) restrictions to reach non-LISP sites.

LISP Guidelines and Limitations

LISP has the following configuration guidelines and limitations:

- LISP requires the Cisco Nexus 7000 Series 32-Port, 10 Gigabit Ethernet (M1) module (N7K-M132XP-12 or N7K-M132XP-12L), with Electronic Programmable Logic Device (EPLD) version 186.008 or later.
- Use an Overlay Transport Virtualization (OTV) or another LAN extension mechanism to filter the HSRP hello messages across the data centers to create an active-active HSRP setup and provide egress path optimization for the data center hosts.
- Make sure that the HSRP group and the HSRP Virtual IP address in all data centers in the extended LAN are the same. Keeping the HSRP group number consistent across locations guarantees that the same MAC address is always used for the virtual first-hop gateway.
- LISP VM mobility across subnets requires that the same MAC address is configured across all HSRP groups that allow dynamic EIDs to roam. You must enable the Proxy Address Resolution Protocol (ARP) for the interfaces that have VM mobility enabled across subnets.
- LISP is not supported for F2 Series modules.
- From Release 8.2(1), LISP is supported on F3 and M3 line cards.

Default Settings for LISP

This table lists the default settings for LISP parameters.

Table 2: LISP Default Settings

Parameters	Default
feature lisp command	Disabled

Configuring Locator/ID Separation Protocol

Enabling the LISP Feature

You can enable the LISP feature on the Cisco NX-OS device.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	feature lisp Example: switch(config)# feature lisp	Enables the LISP feature set if it is not already configured.

Configuring LISP ITR/ETR (xTR) Functionality

Configuring LISP ITR/ETR (xTR)

You can enable and configure a LISP xTR with a LISP Map-Server and Map-Resolver for mapping services for both IPv4 and IPv6 address families.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	{ip ipv6} lisp itr Example: switch(config)# ip lisp itr Example: switch(config)# ipv6 lisp itr	Enables LISP ITR functionality.
Step 3	{ip ipv6} lisp etr Example: switch(config)# ip lisp etr	Enables LISP ETR functionality.

	Command or Action	Purpose
	Example: <pre>switch(config)# ipv6 lisp etr</pre>	
Step 4	(Optional) {ip ipv6} lisp itr-etr Example: <pre>switch(config)# ip lisp itr-etr</pre> Example: <pre>switch(config)# ipv6 lisp itr-etr</pre>	Enables both the LISP ITR and the LISP ETR functionality. When both ITR and ETR functionality is being enabled on the same device, the configuration can be simplified by using this command instead of the {ip ipv6} lisp itr and {ip ipv6} lisp etr commands separately.
Step 5	{ip ipv6} lisp itr map-resolver <i>map-resolver-address</i> Example: <pre>switch(config)# ip lisp itr map-resolver 10.10.10.1</pre> Example: <pre>switch(config)# ipv6 lisp itr map-resolver 10.10.10.1</pre>	Configures the locator address of the Map-Resolver to which this router sends Map-Request messages for IPv4 or IPv6 EIDs. Note The locator address of the Map-Resolver can be an IPv4 or IPv6 address. See the <i>Cisco Nexus 7000 Series NX-OS LISP Command Reference</i> for more details.
Step 6	{ip ipv6} database-mapping <i>EID-prefix/prefixlength locator priority priority weight weight</i> Example: <pre>switch(config)# ip lisp database-mapping 10.10.10.0/24 172.16.1.1 priority 1 weight 100</pre> Example: <pre>switch(config)# ipv6 lisp database-mapping 2001:db8:bb::/48 172.16.1.1 priority 1 weight 100</pre>	Configures an EID-to-RLOC mapping relationship and associated traffic policy for all IPv4 or IPv6 EID prefix(es) for this LISP site. Note If the site has multiple locators associated with the same EID-prefix block, enter multiple ip lisp database-mapping commands to configure all of the locators for a given EID-prefix block. If the site is assigned multiple EID-prefix blocks, enter the ip lisp database-mapping command for each EID-prefix block assigned to the site and for each locator by which the EID-prefix block is reachable. If the site has multiple ETRs, you must configure all ETRs with the ip lisp database-mapping and ipv6 lisp database-mapping commands ensuring the options used are consistent.
Step 7	{ip ipv6} lisp etr map-server <i>map-server-address key key-type authentication-key</i> Example:	Configures the locator address of the LISP Map-Server to which this router, acting as an IPv4 or IPv6 LISP ETR, registers.

	Command or Action	Purpose
	<pre>switch(config)# ip lisp etr map-server 172.16.1.2 key 0 123456789</pre> <p>Example:</p> <pre>switch(config)# ipv6 lisp etr map-server 172.16.1.2 key 0 123456789</pre>	<p>Note The Map-Server must be configured with EID prefixes that match the EID-prefixes configured on this ETR, and a key matching the one configured on this ETR.</p> <p>The locator address of the Map-Server may be an IPv4 or IPv6 address. See the <i>Cisco Nexus 7000 Series NX-OS LISP Command Reference</i> for more details.</p>
Step 8	<p>exit</p> <p>Example:</p> <pre>switch(config)# exit switch#</pre>	Exits global configuration mode.
Step 9	<p>(Optional) show {ip ipv6} lisp</p> <p>Example:</p> <pre>switch# show ip lisp</pre> <p>Example:</p> <pre>switch# show ipv6 lisp</pre>	Displays all configured IPv4 or IPv6 LISP configuration parameters.

What to do next

Complete the optional LISP xTR parameters as needed.

Configuring Optional LISP ITR/ETR (xTR) Functionality

You can configure optional capability for the LISP xTR.

Procedure

	Command or Action	Purpose
Step 1	<p>configure terminal</p> <p>Example:</p> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	<p>(Optional) {ip ipv6} lisp etr accept-map-request-mapping [verify]</p> <p>Example:</p> <pre>switch(config)# ip lisp etr accept-map-request verify</pre> <p>Example:</p> <pre>switch(config)# ipv6 lisp etr accept-map-request verify</pre>	<p>Configures the LISP ETR to cache IPv4 or IPv6 mapping data contained in a Map-Request message received from the Map-Server on behalf of a LISP ITR.</p> <p>The verify keyword allows the mapping data to be cached but not used for forwarding packets until the ETR can send its own Map-Request to one of the locators from the mapping data</p>

	Command or Action	Purpose
		record and receive a Map-Reply with the same data in response. By default, the router does not cache mapping data contained in a Map-Request message.
Step 3	(Optional) { ip ipv6 } lisp ip lisp etr map-cache-ttl <i>time-to-live</i> Example: <pre>switch(config)# ip lisp etr map-cache-ttl 720</pre> Example: <pre>switch(config)# ipv6 lisp etr map-cache-ttl 720</pre>	Configures the time-to-live (TTL) value, in minutes, inserted into LISP Map-Reply messages sent by this ETR.
Step 4	(Optional) { ip ipv6 } lisp map-cache-limit <i>cache-limit</i> [reserve-list <i>list</i>] Example: <pre>switch(config)# ip lisp map-cache-limit 2000</pre> Example: <pre>switch(config)# ipv6 lisp map-cache-limit 2000</pre>	Configures the maximum number of LISP map-cache entries allowed to be stored. By default, the LISP map-cache limit is 1000 entries.
Step 5	(Optional) { ip ipv6 } lisp map-request-source <i>source-address</i> Example: <pre>switch(config)# ip lisp map-request-source 172.16.1.1</pre> Example: <pre>switch(config)# ipv6 lisp map-request-source 2001:db8:0a::1</pre>	Configures the address to be used as the source address for LISP Map-Request messages. By default, one of the locator addresses configured with the ip lisp database-mapping or ipv6 lisp database-mapping command is used as the default source address for LISP Map-Request messages.
Step 6	(Optional) { ip ipv6 } lisp path-mtu-discovery { min <i>lower-bound</i> max <i>upper-bound</i> } Example: <pre>switch(config)# ip lisp path-mtu-discovery min 1200</pre> Example: <pre>switch(config)# ipv6 lisp path-mtu-discovery min 1200</pre>	Configures the minimum and maximum MTU settings for the LISP router for path-mtu-discovery. By default, path-mtu-discovery is enabled by the LISP router. Caution Disabling the use of path-mtu-discovery is not recommended.
Step 7	(Optional) [no] lisp loc-reach-algorithm { tcp-count echo-nonce rloc-probing }	Enables or disables the use of a LISP locator reachability algorithm. Locator reachability algorithms are address-family independent. By

	Command or Action	Purpose
	Example: <pre>switch(config)# lisp loc-reach-algorithm rloc-probing</pre>	default, all locator reachability algorithms are disabled.
Step 8	exit Example: <pre>switch(config)# exit switch#</pre>	Exits global configuration mode.
Step 9	(Optional) show {ip ipv6} lisp Example: <pre>switch# show ip lisp</pre> Example: <pre>switch# show ipv6 lisp</pre>	Displays all configured IPv4 or IPv6 LISP configuration parameters.

Related Topics

[Configuring LISP ITR/ETR \(xTR\)](#), on page 7

Configuring LISP-ALT Functionality

You can enable and configure LISP-ALT (ALT) functionality for both IPv4 and IPv6 address families.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	{ip ipv6} lisp alt-vrf vrf-name Example: <pre>switch(config)# ip lisp alt-vrf lisp</pre> Example: <pre>switch(config)# ipv6 lisp alt-vrf lisp</pre>	Configures LISP to use the LISP-ALT VRF vrf-name.
Step 3	exit Example: <pre>switch(config)# exit switch#</pre>	Exits global configuration mode.
Step 4	(Optional) show {ip ipv6} lisp Example: <pre>switch# show ip lisp</pre>	Displays all configured IPv4 or IPv6 LISP configuration parameters.

	Command or Action	Purpose
	Example: switch# show ipv6 lisp	

Configuring Required LISP Map-Resolver Functionality

You can enable and configure LISP Map-Resolver (MR) functionality for both IPv4 and IPv6 address families.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	{ip ipv6} lisp map-resolver Example: switch(config)# ip lisp map-resolver Example: switch(config)# ipv6 lisp map-resolver	Enables LISP Map-Resolver functionality on the device.
Step 3	exit Example: switch(config)# exit switch#	Exits global configuration mode.
Step 4	(Optional) show {ip ipv6} lisp Example: switch# show ip lisp Example: switch# show ipv6 lisp	Displays all configured IPv4 or IPv6 LISP configuration parameters.

Related Topics

[Configuring LISP-ALT Functionality](#), on page 11

Configuring LISP Map-Server Functionality

Configuring Required LISP Map-Server Functionality

You can enable and configure LISP Map-Server (MS) functionality for both IPv4 and IPv6 address families.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	{ip ipv6} lisp map-server Example: switch(config)# ip lisp map-server Example: switch(config)# ipv6 lisp map-server	Enables LISP Map-Server functionality on the device.
Step 3	lisp site site-name Example: switch(config)# lisp site Customer1 switch(config-lisp-site)#	Creates the site name and enters LISP site configuration mode.
Step 4	description description Example: switch(config-lisp-site)# description LISP Site Customer1	Enters a description for the LISP site being configured.
Step 5	authentication-key key-type password Example: switch(config-lisp-site)# authentication-key 0 123456789	Enters the authentication key type and password for the LISP site being configured. Note The password must match the one configured on the ETR in order for the ETR to successfully register.
Step 6	eid-prefix EID-prefix [route-tag tag] Example: switch(config-lisp-site)# eid-prefix 192.168.1.0/24 route-tag 12345 Example: switch(config-lisp-site)# eid-prefix 2001:db8:aa::/48 route-tag 12345	Enters the EID-prefix for which the LISP site being configured is authoritative and optionally adds a route-tag.
Step 7	end Example: switch(config-lisp-site)# end switch#	Exits LISP site configuration mode.
Step 8	(Optional) show {ip ipv6} lisp Example:	Displays all configured IPv4 or IPv6 LISP configuration parameters.

	Command or Action	Purpose
	<pre>switch# show ip lisp</pre> <p>Example:</p> <pre>switch# show ipv6 lisp</pre>	

What to do next

Complete the optional LISP Map-Server configuration items as needed.

Related Topics

[Configuring LISP-ALT Functionality](#), on page 11

Configuring Optional LISP Map-Server Functionality

You can configure optional LISP Map-Server functionality.

Procedure

	Command or Action	Purpose
Step 1	<p>configure terminal</p> <p>Example:</p> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	<p>lisp site <i>site-name</i></p> <p>Example:</p> <pre>switch(config)# lisp site Customer1 switch(config-lisp-site)#</pre>	Enters LISP site configuration mode for the indicated site. If the site does not exist, it will be created.
Step 3	<p>(Optional) allowed-locators <i>rloc1</i> [<i>rloc2</i> [...]]</p> <p>Example:</p> <pre>switch(config-lisp-site)# allowed-locators 172.16.8.1 2001:db8:aa::1</pre>	<p>Enters the locators that are to be allowed to be included in the Map-Register message for the LISP site being configured.</p> <p>Note When the allowed-locators command is configured, all locators listed on the Map-Server within the LISP site configuration must also appear in the Map-Register message sent by the ETR for the Map-Register message to be accepted.</p>
Step 4	<p>end</p> <p>Example:</p> <pre>switch(config-lisp-site)# end switch#</pre>	Exits LISP site configuration mode.

	Command or Action	Purpose
Step 5	(Optional) show {ip ipv6} lisp Example: switch# show ip lisp Example: switch# show ipv6 lisp	Displays all configured IPv4 or IPv6 LISP configuration parameters.

Related Topics

[Configuring LISP-ALT Functionality](#), on page 11

[Configuring Required LISP Map-Server Functionality](#), on page 12

Configuring Required LISP Proxy-ITR Functionality

You can enable and configure LISP Proxy-ITR functionality for both IPv4 and IPv6 address families.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	{ip ipv6} proxy-itr locator [<i>other-address-family-locator</i>] Example: switch(config)# ip lisp proxy-itr 172.16.8.1 Example: switch(config)# ipv6 lisp proxy-itr 2001:db8:aa::1	Configures LISP Proxy-ITR functionality on the device. The <i>locator</i> address is used as a source address for encapsulating data packets or Map-Request messages. Optionally, you can provide an address for the other address family (for example, IPv6 for the ip proxy-itr command).
Step 3	exit Example: switch(config)# exit switch#	Exits global configuration mode.
Step 4	(Optional) show {ip ipv6} lisp Example: switch# show ip lisp Example: switch# show ipv6 lisp	Displays all configured IPv4 or IPv6 LISP configuration parameters.

Related Topics

[Configuring LISP-ALT Functionality](#), on page 11

Configuring Required LISP Proxy-ETR Functionality

You can enable and configure LISP Proxy-ETR functionality for both IPv4 and IPv6 address families.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	{ip ipv6} proxy-etr Example: <pre>switch(config)# ip lisp proxy-etr</pre> Example: <pre>switch(config)# ipv6 lisp proxy-etr</pre>	Configures LISP Proxy-ETR functionality.
Step 3	exit Example: <pre>switch(config)# exit switch#</pre>	Exits global configuration mode.
Step 4	(Optional) show {ip ipv6} lisp Example: <pre>switch# show ip lisp</pre> Example: <pre>switch# show ipv6 lisp</pre>	Displays all configured IPv4 or IPv6 LISP configuration parameters.

Related Topics

[Configuring LISP-ALT Functionality](#), on page 11

Additional References

This section includes additional information related to implementing LISP.

Related Documents

Related Topic	Document Title
Cisco NX-OS licensing	<i>Cisco NX-OS Licensing Guide</i>

Standards

Standard	Title
No new or modified standards are supported by this release.	

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco NX-OS software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
draft-ietf-lisp-07	Locator/ID Separation Protocol (LISP) http://tools.ietf.org/html/draft-ietf-lisp-07
draft-ietf-lisp-alt-04	LISP Alternative Topology (LISP+ALT) http://tools.ietf.org/html/draft-ietf-lisp-alt-04
draft-ietf-lisp-interworking-01	Interworking LISP with IPv4 and IPv6 http://tools.ietf.org/html/draft-ietf-lisp-interworking-01
draft-ietf-lisp-lig-00	LISP Internet Groper (LIG) http://tools.ietf.org/html/draft-ietf-lisp-lig-00
draft-ietf-lisp-ms-05	LISP Map Server http://tools.ietf.org/html/draft-ietf-lisp-ms-05

Feature History for LISP

Table 3: Feature History for LISP

Feature Name	Releases	Feature Information
LISP-ALT functionality	5.2(3)	This functionality is no longer required to configure other LISP features.

Feature Name	Releases	Feature Information
Locator/ID Separation Protocol (LISP)	5.2(1)	This feature is introduced.



CHAPTER 3

LISP VM Mobility

This chapter contains the following sections:

- [Information About LISP VM Mobility, on page 19](#)
- [Licensing Requirements for LISP, on page 21](#)
- [LISP Guidelines and Limitations, on page 21](#)
- [Default Settings for LISP, on page 21](#)
- [Configuring LISP VM Mobility, on page 22](#)
- [Additional References, on page 29](#)
- [Feature History for LISP, on page 31](#)

Information About LISP VM Mobility

Locator/ID Separation Protocol (LISP) Virtual Machine (VM) mobility enables IP end points to change locations while keeping their assigned IP addresses. Because LISP separates the location information (RLOCs) from the identity information (EID), devices can change locations dynamically. RLOCs remain associated with the topology and are reachable by traditional routing. EIDs can change locations dynamically and are reachable through different RLOCs, depending on where an EID attaches to the network.

The LISP Tunnel Router (xTR) dynamically detects VM moves based on data plane events. LISP VM Mobility compares the source IP address of the host traffic received at the LISP router against a range of prefixes that are allowed to roam. The IP prefixes of roaming devices within the range of allowed prefixes are referred to as the dynamic EIDs. When a new xTR detects a move, it updates the mappings between EIDs and RLOCs. Traffic is redirected to the new locations without causing any disruption to the underlying routing. When deployed at the first-hop router, LISP VM Mobility provides adaptable and comprehensive first-hop router functionality to service the IP gateway needs of the roaming devices that relocate.

LISP VM Mobility allows any IP addressable device to move and keep the same IP address in the following two scenarios:

VM Mobility with LAN extensions

The device moves to a new location on a subnet that has been extended with Overlay Transport Virtualization (OTV) or another LAN extension mechanism.

VM Mobility across subnets

The device moves off of a subnet to a new subnet.

Dynamic EIDs

A device that moves to another subnet or extended subnet is a roaming device. The IP address of this roaming device is within the dynamic-EID prefix. A LISP xTR configured with LISP VM mobility and dynamic EIDs is a LISP-VM router. The LISP-VM router dynamically determines when a dynamic EID moves on or off one of the directly connected subnets on the LISP-VM router. The IP addresses of the LISP-VM router are the locators (RLOCs) used to encapsulate traffic to and from the dynamic EID. When a dynamic EID roams, the new LISP-VM router needs to detect the newly moved-in VM and process the following updates:

- Update the Map Server (MS) with the new locators for the EID.
- Update the Ingress Tunnel Routers (ITRs) or Proxy ITRs (PITRs) that have cached the EID.

To detect VM moves, LISP-VM router compares the source address in a received packet with the range of prefixes configured as dynamic EIDs for the interface that the data packet is received on. Once the LISP-VM router detects a move and registers the dynamic EID to the MS, the new LISP-VM router also needs to update the map caches on the other LISP domain ITRs and PITRs.

VM-Mobility with LAN Extensions

LISP VM Mobility supports virtual machine (VM) movement in a network that uses LAN extension mechanisms such as OTV. The LISP-VM router detects the mobile EIDs (VMs) dynamically and updates the LISP mapping system with the new EID-RLOC mapping. LISP can coexist with LAN extensions such as OTV to provide dynamic move detection and updates that are transparent to the host and provide a direct data path to the new location of the mobile VM. The VM move requires no routing reconvergence or DNS updates.

The LISP-VM router detects new VM move events if it receives a data packet from a source that matches the dynamic EID configured for that interface. Once the LISP-VM router detects a dynamic EID, the LISP-VM router triggers an update to the map server with the database mapping details from the dynamic-EID map configuration.

The LISP-VM router continues to register the dynamic EID as long as the source continues to be active. The dynamic-EID registration times out based on server inactivity. See [Configuring VM Mobility with VLAN Extensions](#), on page 22.

Related Topics

[Configuring VM Mobility with VLAN Extensions](#), on page 22

VM Mobility Across Subnets

In a network without LAN extension mechanisms, the LISP VM router can detect the dynamic-EIDs (VMs) across subnets with automated move detection and map-cache updates that provide a direct data path to the new location of the mobile VM. Off-subnet connections (connections between the moved VM and other devices that are not on the local subnets) are maintained across the move and require no routing re-convergence or DNS updates.

The LISP-VM router detects a VM move if it receives any data packet that is not from one of its configured subnets and that is within the range of prefixes configured as dynamic EIDs for the receiving interface. The LISP-VM router registers the new dynamic-EID-RLOC mapping to the configured map servers associated with the dynamic EID. See [Configuring VM Mobility Across Subnets](#), on page 25.

Related Topics

[Configuring VM Mobility Across Subnets](#), on page 25

Licensing Requirements for LISP

The following table shows the LISP licensing requirements:

Product	License Requirement
Cisco NX-OS	This feature requires the LAN_ENTERPRISE_SERVICES_PKG license. For a complete explanation of the Cisco NX-OS licensing scheme, see the <i>Cisco NX-OS Licensing Guide</i> .

LISP Guidelines and Limitations

LISP has the following configuration guidelines and limitations:

- LISP requires the Cisco Nexus 7000 Series 32-Port, 10 Gigabit Ethernet (M1) module (N7K-M132XP-12 or N7K-M132XP-12L), with Electronic Programmable Logic Device (EPLD) version 186.008 or later.
- Use an Overlay Transport Virtualization (OTV) or another LAN extension mechanism to filter the HSRP hello messages across the data centers to create an active-active HSRP setup and provide egress path optimization for the data center hosts.
- Make sure that the HSRP group and the HSRP Virtual IP address in all data centers in the extended LAN are the same. Keeping the HSRP group number consistent across locations guarantees that the same MAC address is always used for the virtual first-hop gateway.
- LISP VM mobility across subnets requires that the same MAC address is configured across all HSRP groups that allow dynamic EIDs to roam. You must enable the Proxy Address Resolution Protocol (ARP) for the interfaces that have VM mobility enabled across subnets.
- LISP is not supported for F2 Series modules.
- From Release 8.2(1), LISP is supported on F3 and M3 line cards.

Default Settings for LISP

This table lists the default settings for LISP parameters.

Table 4: LISP Default Settings

Parameters	Default
<code>feature lisp</code> command	Disabled

Configuring LISP VM Mobility

Configuring VM Mobility with VLAN Extensions

You can enable and configure the dynamic-EID roaming functionality for a given EID prefix on a Cisco Nexus 7000 Series device. By default, LISP considers that the mobility event is across the subnet, unless it is configured with the **lisp extended-subnet-mode** command.

Before you begin

- You must enable the LISP feature.
- Ensure that you are in the correct virtual device context (VDC).
- Configure a dynamic-EID map to associate with this VLAN interface.
- Ensure that you have enabled the VLAN interfaces feature.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	lisp dynamic-eid <i>dynamic-eid-map-name</i> Example: <pre>switch(config)# lisp dynamic-eid Roamer-1 switch((config-lisp-dynamic-eid)#</pre>	Enters dynamic-EID map configuration mode.
Step 3	Required: database-mapping <i>EID-prefix</i> <i>prefix-length locator-ip</i> priority <i>priority</i> weight <i>weight</i> Example: <pre>switch(config)# lisp dynamic-eid Roamer-1 switch(config-lisp-dynamic-eid)# database-mapping 172.16.1.1/32 10.1.1.1 priority 1 weight 100</pre>	Configures a dynamic-EID range, the RLOC mapping relationship, and associated traffic policy for all IPv4 dynamic-EID-prefixes for this LISP site. Because this is configured under the dynamic-eid-map configuration mode, the LISP ETR registers a /32 host prefix to the mapping system when a dynamic-EID is detected in the configured range.

	Command or Action	Purpose
		<p>Note If you assign multiple dynamic-EID-prefix blocks to the site, database mapping is configured for each dynamic-EID prefix block and for each locator by which the EID-prefix block is reachable. Also, the subnet associated to the dynamic-eid prefixes must be more specific than the one used in the global database-mapping configuration and the one used for the switch virtual interfaces (SVIs) where the LISP map is applied.</p> <p>If the site has multiple locators associated with the same EID-prefix block, use the ip lisp database-mapping command to configure all of the locators for a given EID-prefix block. If a site is multihomed, you must consistently configure <i>all</i> ETRs that belong to the same LISP or data center site by using the ip lisp database-mapping command.</p>
Step 4	<p>Required: map-notify-group <i>mcast-group-id</i></p> <p>Example:</p> <pre>switch(config-dynamic-eid)# map-notify-group 239.1.1.2</pre>	<p>Configures a discovering LISP-VM router to send a Map-Notify message to other LISP-VM routers within the same data center site so that they can also determine the location of the dynamic EID.</p> <p>Note In LISP extended subnet mode, a dynamic-EID detection by one xTR needs to be notified to all of the xTRs that belong to the same LISP site. In this case, use the map-notify-group command under the dynamic-EID-map with a multicast group IP address. This address is used to send a map-notify message by the xTR to all other xTRs when a dynamic-EID is detected. The Time To Live (TTL) value for this notification message is set to 1. This multicast group IP address can be any user-defined address other than an address that is already in use in your network. The multicast message is delivered by leveraging the LAN extension connection established between separate data centers.</p>

	Command or Action	Purpose
Step 5	<p>(Optional) map-server <i>map-server-address</i> key <i>key-type-authentication-key</i></p> <p>Example:</p> <pre>switch(config)# lisp dynamic-eid Roamer-1 switch(config-lisp-dynamic-eid)# map-server 10.111.10.14 key 0 cisco switch(config-lisp-dynamic-eid)# map-server 10.111.10.14 proxy-reply</pre>	<p>Configures the IP address of the LISP MS to which this router registers dynamic-EID-RLOC mappings. When deploying a redundant MS pair, you can specify both IP addresses.</p> <p>Use this optional configuration step when you want to register Dynamic-EID-RLOC mapping to a specific MS other than one configured in the global LISP configuration. If you do not configure the MS, LISP uses the MS that is configured in the global configuration.</p>
Step 6	<p>exit</p> <p>Example:</p> <pre>switch(config-lisp-dynamic-eid)# exit</pre>	Exits the configuration mode.
Step 7	<p>interface <i>interface-name</i></p> <p>Example:</p> <pre>switch(config)# interface Ethernet 2/0</pre>	<p>Enters the interface configuration mode.</p> <p>The <i>interface-name</i> value is the name of the interface in which the dynamic EIDs are expected to roam in or out. Switch virtual interfaces (SVIs) are specifically used in this scenario.</p>
Step 8	<p>lisp mobility <i>dynamic-eid-map-name</i></p> <p>Example:</p> <pre>switch(config-if)# lisp mobility Roamer-1</pre>	<p>Configures the interface that you configured earlier in Step 7 to detect a dynamic EID when a roam event occurs.</p> <p>The <i>dynamic-eid-map-name</i> can be any case-sensitive, alphanumeric string up to 64 characters.</p> <p>Note The <i>interface-name</i> value is the dynamic EID map name that you configured in Step 2.</p>
Step 9	<p>Required: lisp extended-subnet-mode</p> <p>Example:</p> <pre>switch(config-if)# lisp extended-subnet-mode</pre>	Configures the interface that you configured in Step 7 to accept and detect dynamic-EID roaming on extended subnets.
Step 10	<p>exit</p> <p>Example:</p> <pre>switch(config-if)# exit</pre>	Exits the interface configuration mode.
Step 11	<p>show lisp dynamic-eid [summary]</p> <p>Example:</p> <pre>switch # show lisp dynamic-eid summary</pre>	(Optional) Displays the summary of the LISP dynamic EIDs that are detected.

	Command or Action	Purpose
Step 12	(Optional) copy running-config startup-config Example: <pre>switch(config-if-hsrp)# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

Related Topics

[VM-Mobility with LAN Extensions](#), on page 20

Configuring VM Mobility Across Subnets

You can configure LISP VM Mobility across subnets.

Before you begin

- You must enable the LISP feature.
- Ensure that you are in the correct VDC.
- Configure a dynamic-EID map to associate with this VLAN interface.
- Ensure that you have enabled the VLAN interfaces feature.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	{ip ipv6} lisp database-mapping <i>EID-prefix/prefixlength locator priority</i> <i>priority weight weight</i> Example: <pre>switch(config)# ip lisp database-mapping 172.16.0.0/16 172.16.1.1 priority 1 weight 100</pre> Example: <pre>switch(config)# ipv6 lisp database-mapping 2001:db8:bb::/48 172.16.1.1 priority 1 weight 100</pre>	Configures an EID-to-RLOC mapping relationship and associated traffic policy for all IPv4 or IPv6 EID prefix(es) for this LISP site. When deploying LISP for VM Mobility, the prefix specified here is added only to one specific datacenter location where the EIDs are deployed initially before they are moved to remote sites.
Step 3	lisp dynamic-eid <i>dynamic-eid-map-name</i> Example:	Enters dynamic-EID map configuration mode. Note The <i>dynamic-eid-map-name</i> value can be any user-defined name.

	Command or Action	Purpose
	<pre>switch(config)# lisp dynamic-eid Roamer-1 switch(config-lisp-dynamic-eid)#</pre>	
Step 4	<p>Required: database-mapping <i>EID-prefix</i> <i>prefix-length locator-ip</i> priority <i>priority</i> weight <i>weight</i></p> <p>Example:</p> <pre>switch(config)# lisp dynamic-eid Roamer-1 switch(config-lisp-dynamic-eid)# database-mapping 172.16.1.0/24 10.1.1.1 priority 1 weight 100</pre>	<p>Configures a dynamic-EID range, the RLOC mapping relationship, and associated traffic policy for all IPv4 dynamic-EID prefixes for this LISP site. Because this is configured under the dynamic-eid-map configuration mode, the LISP ETR registers a /32 host prefix to the mapping system when a dynamic-EID is detected in the configured range.</p> <p>Note If you assign multiple dynamic-EID-prefix blocks to the site, database mapping is configured for each dynamic-EID-prefix block and for each locator by which the EID-prefix block is reachable.</p> <p>If the site has multiple locators associated with the same EID-prefix block, use the database-mapping command to configure all of the locators for a given EID-prefix block. If a site is multihomed, you must consistently configure all ETRs that belong to the same LISP or data center site by using the database-mapping command. Only the RLOCs of the xTRs that belong to the same data center site must be specified, which you specified by using the database-mapping command. Do not specify the RLOCs for all the xTRs that belong to the same LISP site.</p>
Step 5	<p>Required: map-notify-group <i>multicast-group-ip</i></p> <p>Example:</p> <pre>switch(config)# lisp dynamic-eid Roamer-1 switch(config-lisp-dynamic-eid)# map-notify-group 239.1.1.254</pre>	<p>Configures a discovering LISP-VM router to send a Map-Notify message to other LISP-VM routers within the same data center site so that they can also determine the location of the dynamic EID.</p>

	Command or Action	Purpose
		<p>Note If the LISP dynamic-EID site is multihomed, a dynamic-EID detection by one ETR needs to notify the second ETR in the same site so that the traffic is handled or load balanced by both xTRs. In this case, use the map-notify-group command to configure the dynamic-EID-map with a multicast group IP address. This address is used to send a map-notify message from the ETR to all other ETRs that belong to the same LISP or data center site when a dynamic EID is detected. The Time To Live (TTL) value for this notification message is set to 1. This multicast group IP address can be any user-defined address other than an address that is already in use in your network.</p>
Step 6	<p>Required: map-server <i>map-server-address</i> key <i>key-type-authentication-key</i></p> <p>Example:</p> <pre>switch(config)# lisp dynamic-eid Roamer-1 switch(config-lisp-dynamic-eid)# map-server 10.1.1.1 key some-password switch(config-lisp-dynamic-eid)# map-server 10.1.1.1 proxy-reply</pre>	Configures the IP address of the LISP Map Server to which this router registers dynamic-EID-RLOC mappings.
Step 7	<p>exit</p> <p>Example:</p> <pre>switch(config-lisp-dynamic-eid)# exit</pre>	Exits configuration mode.
Step 8	<p>interface <i>interface-name</i></p> <p>Example:</p> <pre>switch(config)# interface Ethernet 2/0</pre>	<p>Enters interface configuration mode.</p> <p>The <i>interface-name</i> value is the name of the interface in which the dynamic EIDs are expected to roam in or out.</p>
Step 9	<p>lisp mobility <i>dynamic-eid-map-name</i></p> <p>Example:</p> <pre>switch(config-if)# lisp mobility Roamer-1</pre>	Configures the interface that you configured earlier in Step 7 to detect a dynamic EID when a roam event occurs.
Step 10	<p>ip proxy-arp</p> <p>Example:</p> <pre>switch(config-if)# ip proxy-arp</pre>	Configures the proxy-arp interface.

	Command or Action	Purpose
Step 11	exit Example: switch(config-if) exit	Exits the configuration mode.
Step 12	show lisp dynamic-eid [summary] Example: switch # show lisp dynamic-eid summary	(Optional) Displays the summary of the LISP dynamic EIDs that are detected.
Step 13	copy running-config startup-config Example: switch # copy running-config start-up-config	(Optional) Copies the running configuration to the startup configuration.

Related Topics

[VM Mobility Across Subnets](#), on page 20

Configuring HSRP for VM Mobility

You can configure the Hot Standby Router Protocol (HSRP) for LISP VM Mobility.

Before you begin

- You must enable the LISP feature.
- Ensure that you are in the correct VDC.
- Ensure that you have enabled the VLAN interfaces feature and the HSRP feature.
- In extended subnet mode, you must filter HSRP hellos between sites to allow a localized default gateway functionality.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	interface <i>vlan-id</i> Example: switch(config)# interface VLAN 10 switch(config-if)#	Configures a VLAN interface (SVI) and enters interface configuration mode.
Step 3	Required: ip <i>ip-address</i> Example:	Configures the IPv4 address. The address is in dotted decimal notation.

	Command or Action	Purpose
	<code>switch(config-if)# ip 10.3.3.5/24</code>	
Step 4	Required: hsrp id Example: <pre>switch(config-if)# hsrp 100 switch(config-if-hsrp)#</pre>	Configures HSRP for this VLAN interface and enters interface HSRP configuration mode. When using LISP-VM Mobility with LAN extensions, we recommend that the same HSRP IDs be used consistently across all sites where the VLANs are extended to guarantee that the same MAC address is used for the HSRP gateway in all sites. If different HSRP IDs are used, then you must manually set the mac-address as described in the following step.
Step 5	(Optional) mac-address virtual-mac-address Example: <pre>switch(config-if-hsrp)# mac-address 0000.0E1D.010C</pre>	Configures the HSRP virtual MAC address. This address must be identical across all subnets. This command is required when using LISP-VM mobility across subnets, but might not be required when using LISP VM-mobility in conjunction with LAN extensions and if the HSRP ID is kept constant across the different sites.
Step 6	(Optional) ip virtual-ip-address Example: <pre>switch(config-if-hsrp)# ip 10.3.3.1</pre>	Configures the HSRP virtual IP address. You must use this command for extended VLANs, and the address must be identical in all sites in the extended VLAN.
Step 7	(Optional) show lisp dynamic-eid [summary] Example: <pre>switch(config-if-hsrp)# show lisp dynamic-eid summary</pre>	Displays a summary of the dynamic EIDs detected.
Step 8	(Optional) copy running-config startup-config Example: <pre>switch(config-if-hsrp)# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

Additional References

This section includes additional information related to implementing LISP.

Related Documentation

Related Documentation	Title
http://www.cisco.com/en/US/products/ps9402/prod_command_reference_list.html	Cisco Nexus 7000 Series Switches Command References

Related Documentation	Title
http://www.cisco.com/US/products/ios/sw/7000/ios_commands/7000_cmds.html	Cisco Nexus 7000 Series NX-OS LISP Command Reference

RFCs

RFC	Title
draft-ietf-lisp-07	Locator/ID Separation Protocol (LISP) http://tools.ietf.org/html/draft-ietf-lisp-07
draft-ietf-lisp-alt-04	LISP Alternative Topology (LISP+ALT) http://tools.ietf.org/html/draft-ietf-lisp-alt-04
draft-ietf-lisp-interworking-01	Interworking LISP with IPv4 and IPv6 http://tools.ietf.org/html/draft-ietf-lisp-interworking-01
draft-ietf-lisp-lig-00	LISP Internet Groper (LIG) http://tools.ietf.org/html/draft-ietf-lisp-lig-00
draft-ietf-lisp-ms-05	LISP Map Server http://tools.ietf.org/html/draft-ietf-lisp-ms-05

Standards

Standard	Title
No new or modified standards are supported by this release.	

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco NX-OS software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Feature History for LISP

Table 5: Feature History for LISP

Feature Name	Releases	Feature Information
LISP-ALT functionality	5.2(3)	This functionality is no longer required to configure other LISP features.
Locator/ID Separation Protocol (LISP)	5.2(1)	This feature is introduced.



CHAPTER 4

Configuring LISP ESM Multihop Mobility

This chapter describes how to configure the Extended Subnet Mode (ESM) multihop mobility feature to separate the Locator/ID Separation Protocol (LISP) dynamic host detection function from the LISP encapsulation/decapsulation function within a LISP topology.

This chapter contains the following sections:

- [Finding Feature Information, on page 33](#)
- [Information About LISP ESM Multihop Mobility, on page 33](#)
- [Guidelines and Limitations for LISP ESM Multihop Mobility, on page 33](#)
- [Default Settings for LISP, on page 34](#)
- [Configuring LISP ESM Multihop Mobility, on page 34](#)
- [Configuration Examples for LISP ESM Multihop Mobility, on page 40](#)
- [Additional References, on page 44](#)
- [Feature Information for LISP ESM Multihop Mobility, on page 45](#)

Finding Feature Information

Your software release might not support all the features documented in this module. For the latest caveats and feature information, see the Bug Search Tool at <https://tools.cisco.com/bugsearch/> and the release notes for your software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the "New and Changed Information" chapter or the Feature History table in this chapter.

Information About LISP ESM Multihop Mobility

Guidelines and Limitations for LISP ESM Multihop Mobility

LISP ESM multihop mobility has the following guidelines and limitations:

- Locator/ID Separation Protocol (LISP) multihop mobility is supported only in Extended Subnet Mode (ESM) and it is recommended in combination with Overlay Transport Virtualization (OTV).
- ESM multihop mobility requires OTV First Hop Redundancy Protocol (FHRP) isolation to avoid hair-pinning of traffic across the OTV Data Center Interconnect (DCI) framework.

- ESM multihop mobility does not support Network Address Translated (NAT'd) endpoint identifiers (EIDs).
- To properly route traffic between extended VLANs when the source and destination hosts are detected by FHRs at different data centers, we recommend one of the following designs:
 - Establish a routing protocol adjacency between the first-hop routers (FHRs) in the different data centers over a dedicated extended VLAN; redistribute host routes from LISP into the routing protocol for discovered hosts at each data center FHR.
 - Separate each mobile VLAN in a VRF and configure the LISP FHR within the related virtual routing and forwarding (VRF) context. Set up an external site gateway xTR to act as router for all of the mobile VLANs (VRFs).

Default Settings for LISP

This table lists the default settings for LISP parameters.

Table 6: LISP Default Settings

Parameters	Default
feature lisp command	Disabled

Configuring LISP ESM Multihop Mobility

This section includes the following topics:

Configuring the First-Hop Device

Before you begin

- Ensure that LISP is enabled on the Cisco NX-OS device.
- Ensure that you are in the correct VDC.
- Ensure that you have enabled the VLAN interfaces feature.

Procedure

	Command or Action	Purpose
Step 1	switch# configure terminal	Enters global configuration mode.
Step 2	switch(config)# ip lisp etr	Configures a Cisco NX-OS device to act as an IPv4 Locator/ID Separation Protocol (LISP) Egress Tunnel Router (ETR),

	Command or Action	Purpose
Step 3	(Optional) switch(config)# vrf context <i>vrf-name</i>	Creates a new VRF and enters VRF configuration mode to configure the first-hop router (FHR) function within the specified VRF routing context instead of using the default VRF. The value of the <i>vrf-name</i> is any case-sensitive, alphanumeric string of up to 32 characters. Note This approach implements a mobility design where each mobile VLAN is a member of a distinct VRF and an external site gateway xTR acts as router for all of the mobile VLANs (VRFs).
Step 4	switch(config)# lisp dynamic-eid <i>dynamic-EID-policy-name</i>	Configures a LISP Virtual Machine (VM) Mobility (dynamic-EID roaming) policy and enters the LISP dynamic-EID configuration mode.
Step 5	switch(config-lisp-dynamic-eid)# database-mapping <i>dynamic-EID-prefix</i> <i>locator</i> priority <i>priority</i> weight <i>weight</i>	Configures a IPv4 or IPv6 dynamic-endpoint identifier to Routing Locator (EID-to-RLOC) mapping relationship and its associated traffic policy. Note If you configured the vrf context command, the IP prefix specified for the <i>dynamic-EID-prefix locator</i> argument must belong to a local interface that is member of the same VRF.
Step 6	(Optional) switch(config-lisp-dynamic-eid)# instance-id <i>iid</i>	Configures an association between the dynamic EID policy and a LISP Instance ID. The <i>iid</i> must match the instance ID configured on the gateway xTR. The range is from 1 to 16777215. The default value is 0.
Step 7	switch(config-lisp-dynamic-eid)# eid-notify <i>ip-address</i> key <i>password</i>	Enables sending of dynamic endpoint identifier (EID) presence notifications to a gateway xTR with the specified IP address along with the authentication key used with the gateway xTR.
Step 8	switch(config-lisp-dynamic-eid)# map-notify-group <i>ipv4-group-address</i>	Configures a discovering LISP-Virtual Machine (VM) switch to send a Map-Notify message to other LISP-VM switches within the same data center site so that they can also determine the location of the dynamic-EID.

	Command or Action	Purpose
Step 9	Repeat the preceding steps for each first-hop device to be configured.	—
Step 10	switch(config-lisp-dynamic-eid)# exit	Exits the LISP dynamic-EID configuration mode and returns to global configuration mode.
Step 11	switch (config)# interface vlan <i>vlan-id</i>	Creates or modifies a VLAN and enters interface configuration mode.
Step 12	(Optional) switch(config)# vrf member <i>vrf-name</i>	This step is required if you configured the vrf context command. Adds the interface being configured to a VRF when the FHR is configured within a VRF context.
Step 13	switch(config-if)# lisp mobility <i>dynamic-EID-policy-name</i>	Configures an interface on an Ingress Tunnel Router (ITR) to participate in Locator/ID Separation Protocol (LISP) virtual machine (VM)-mobility (dynamic-EID roaming) for the referenced dynamic-EID policy.
Step 14	switch(config-if)# lisp-extended subnet-mode	Configures an interface to create a dynamic-endpoint identifier (EID) state for hosts attached on their own subnet in order to track the movement of EIDs from one part of the subnet to another part of the same subnet.
Step 15	switch(config-if)# ip router ospf <i>instance-tag area area-id</i>	Species the Open Shortest Path First (OSPF) instance and area for an interface
Step 16	switch(config-if)# ip ospf passive-interface	Suppresses Open Shortest Path First (OSPF) routing updates on an interface to avoid establishing adjacency over the LAN extension.
Step 17	switch(config-if)# hsrp <i>group-number</i>	Enters Hot Standby Router Protocol (HSRP) configuration mode and creates an HSRP group.
Step 18	switch(config-if-hsrp)# ip address <i>ip-address</i>	Creates a virtual IP address for the HSRP group. The IP address must be in the same subnet as the interface IP address.
Step 19	Repeat the preceding steps for each interface to be configured for multihop mobility.	—
Step 20	switch(config-if-hsrp)# end	Returns to privileged EXEC mode.

Configuring the Site Gateway xTR

Before you begin

- Ensure that LISP is enabled on the Cisco NX-OS device.
- Ensure that you are in the correct VDC.

Procedure

	Command or Action	Purpose
Step 1	switch# configure terminal	Enters global configuration mode.
Step 2	(Optional) switch# lisp instance-id iid	Configures an association between a VRF or the default VRF and a LISP instance ID. The value of the instance ID configured on the FHR, Site Gateway xTR, MSMR, and remote xTR must match. This command modifies the value of the instance ID (iid) from the default (0) to the specified value. The range of the iid argument is from 1 to 16777215.
Step 3	switch(config)# ip lisp itr-etr	Configures a Cisco NX-OS device to act as both an IPv4 LISP Ingress Tunnel Router (ITR) and Egress Tunnel Router (ETR), also known as an xTR.
Step 4	switch(config)# ip lisp database-mapping EID-prefix { locator dynamic } priority priority weight weight	Configures an IPv4 endpoint identifier to Routing Locator (EID-to-RLLOC) mapping relationship and its associated traffic policy.
Step 5	Repeat the preceding step for each locator.	switch(config)# ip lisp database-mapping 192.168.0.0/16 10.0.1.2 priority 1 weight 5 switch(config)# ip lisp database-mapping 192.168.0.0/16 10.0.2.2 priority 1 weight 5
Step 6	switch(config)# ip lisp itr map-resolver map-resolver-address	Configures a Cisco NX-OS device to act as an IPv4 Locator/ID Separation Protocol (LISP) Map-Resolver (MR).
Step 7	switch(config)# ip lisp etr map-server map-server-address {[key key-type authentication-key] proxy-reply }	Configures the IPv4 or IPv6 locator address of the Locator/ID Separation Protocol (LISP) Map-Server to be used by the egress tunnel router (ETR) when registering for IPv4 EIDs.
Step 8	switch(config)# lisp dynamic-eid dynamic-EID-policy-name	Configures a LISP Virtual Machine (VM) Mobility (dynamic-EID roaming) policy and enters the LISP dynamic-EID configuration mode.

	Command or Action	Purpose
Step 9	switch(config-lisp-dynamic-eid)# database-mapping <i>dynamic-EID-prefix</i> <i>locator priority priority weight weight</i>	Configures a IPv4 or IPv6 dynamic-endpoint identifier to Routing Locator (EID-to-RLOC) mapping relationship and its associated traffic policy.
Step 10	switch(config-lisp-dynamic-eid)# eid-notify authentication-key { 0 <i>unencrypted-password</i> 6 <i>encrypted-password</i> <i>password</i> }	Specifies an authentication key to validate the endpoint identifier (EID)-notify messages received from a device.
Step 11	Repeat the preceding three steps to enable sending EID presence notifications to each additional site gateway.	Exits LISP locator-set configuration mode and returns to LISP configuration mode.
Step 12	switch(config-lisp-dynamic-eid)# end	Returns to privileged EXEC mode.

Configuring xTR

Before you begin

- Ensure that LISP is enabled on the Cisco NX-OS device.
- Ensure that you are in the correct VDC.

Procedure

	Command or Action	Purpose
Step 1	switch# configure terminal	Enters global configuration mode.
Step 2	(Optional) switch# lisp instance-id <i>iid</i>	Configures an association between a VRF or the default VRF and a LISP instance ID. The value of the instance ID configured on the FHR, Site Gateway xTR, MSMR, and remote xTR must match. This command modifies the value of the instance ID (<i>iid</i>) from the default (0) to the specified value. The range of the <i>iid</i> argument is from 1 to 16777215.
Step 3	switch(config)# ip lisp itr-etr	Configures a Cisco NX-OS device to act as both an IPv4 LISP Ingress Tunnel Router (ITR) and Egress Tunnel Router (ETR), also known as an xTR.
Step 4	switch(config)# ip lisp database-mapping <i>EID-prefix</i> { <i>locator</i> dynamic } priority <i>priority weight weight</i>	Configures an IPv4 endpoint identifier to Routing Locator (EID-to-RLOC) mapping relationship and its associated traffic policy.

	Command or Action	Purpose
Step 5	switch(config)# ip lisp database-mapping <i>EID-prefix</i> { <i>locator</i> dynamic } priority <i>priority</i> weight <i>weight</i>	Configures an IPv4 endpoint identifier to Routing Locator (EID-to-RLOC) mapping relationship and its associated traffic policy.
Step 6	switch(config)# ip lisp itr map-resolver <i>map-resolver-address</i>	Configures a Cisco NX-OS device to act as an IPv4 Locator/ID Separation Protocol (LISP) Map-Resolver (MR).
Step 7	switch(config)# ip lisp etr map-server <i>map-server-address</i> {[key <i>key-type</i> <i>authentication-key</i>] proxy-reply }	Configures the IPv4 or IPv6 locator address of the Locator/ID Separation Protocol (LISP) Map-Server to be used by the egress tunnel router (ETR) when registering for IPv4 EIDs.
Step 8	switch(config)# exit	Exits global configuration mode and returns to privileged EXEC mode.

Configuring the Map Server

Before you begin

- Ensure that LISP is enabled on the Cisco NX-OS device.
- Ensure that you are in the correct VDC.

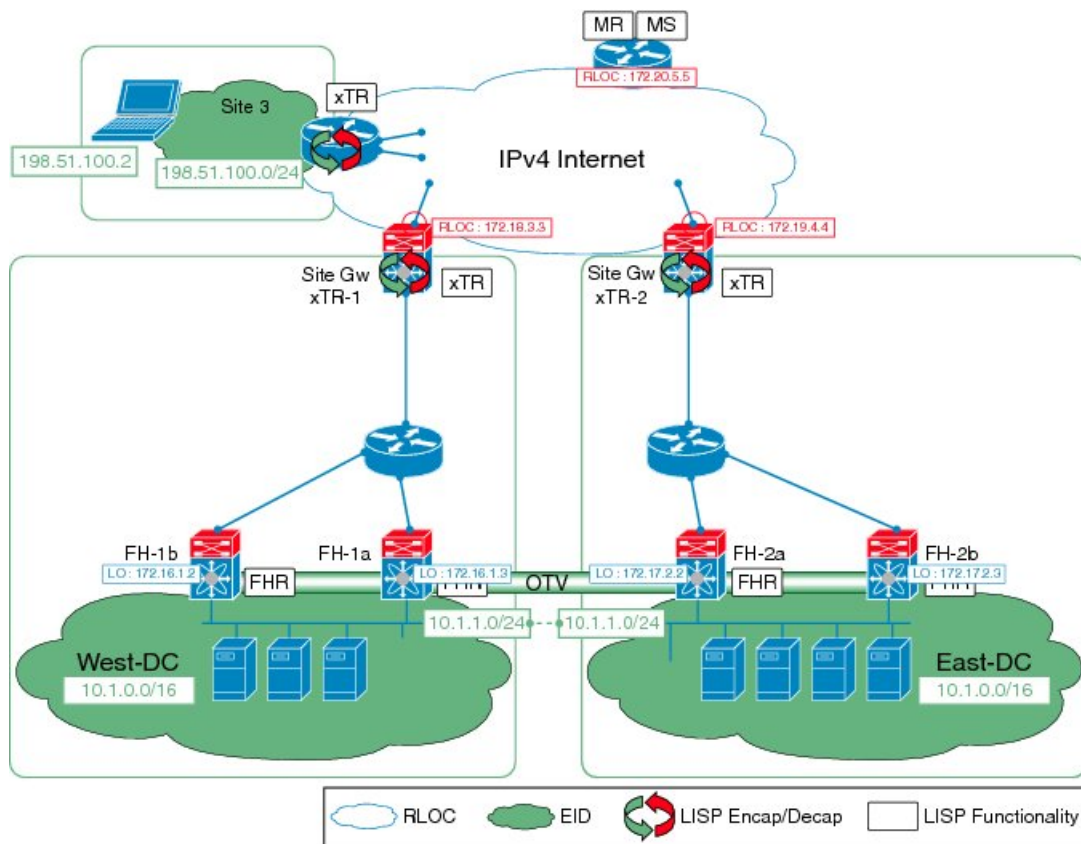
Procedure

	Command or Action	Purpose
Step 1	switch# configure terminal	Enters global configuration mode.
Step 2	switch(config)# ip lisp itr map-resolver <i>map-resolver-address</i>	Configures a Cisco NX-OS device to act as an IPv4 Locator/ID Separation Protocol (LISP) Map-Resolver (MR).
Step 3	switch(config)# ip lisp etr map-server <i>map-server-address</i> {[key <i>key-type</i> <i>authentication-key</i>] proxy-reply }	Configures the IPv4 or IPv6 locator address of the Locator/ID Separation Protocol (LISP) Map-Server to be used by the egress tunnel router (ETR) when registering for IPv4 EIDs.
Step 4	switch(config)# lisp site <i>site-name</i>	Configures a Locator/ID Separation Protocol (LISP) site and enter site configuration mode on a LISP Map-Server.
Step 5	switch(config-lisp-site)# eid-prefix [instance-id <i>iid</i>] { <i>EID-prefix</i> [route-tag <i>tag</i>] } [accept-more-specifics]	Configures a list of endpoint identifier (EID)-prefixes that are allowed in a Map-Register message sent by an egress tunnel router (ETR) when registering to the Map Server.

	Command or Action	Purpose
Step 6	switch(config-lisp-site)# authentication-key <i>key-type password</i>	Configures the password used to create the SHA-1 HMAC hash for authenticating the Map-Register message sent by an egress tunnel router (ETR) when registering to the Map-Server.
Step 7	Repeat the preceding three steps to configure each additional LISP site.	—
Step 8	switch(config-lisp-site)# end	Returns to privileged EXEC mode.

Configuration Examples for LISP ESM Multihop Mobility

Figure 2: LISP ESM Multihop Topology

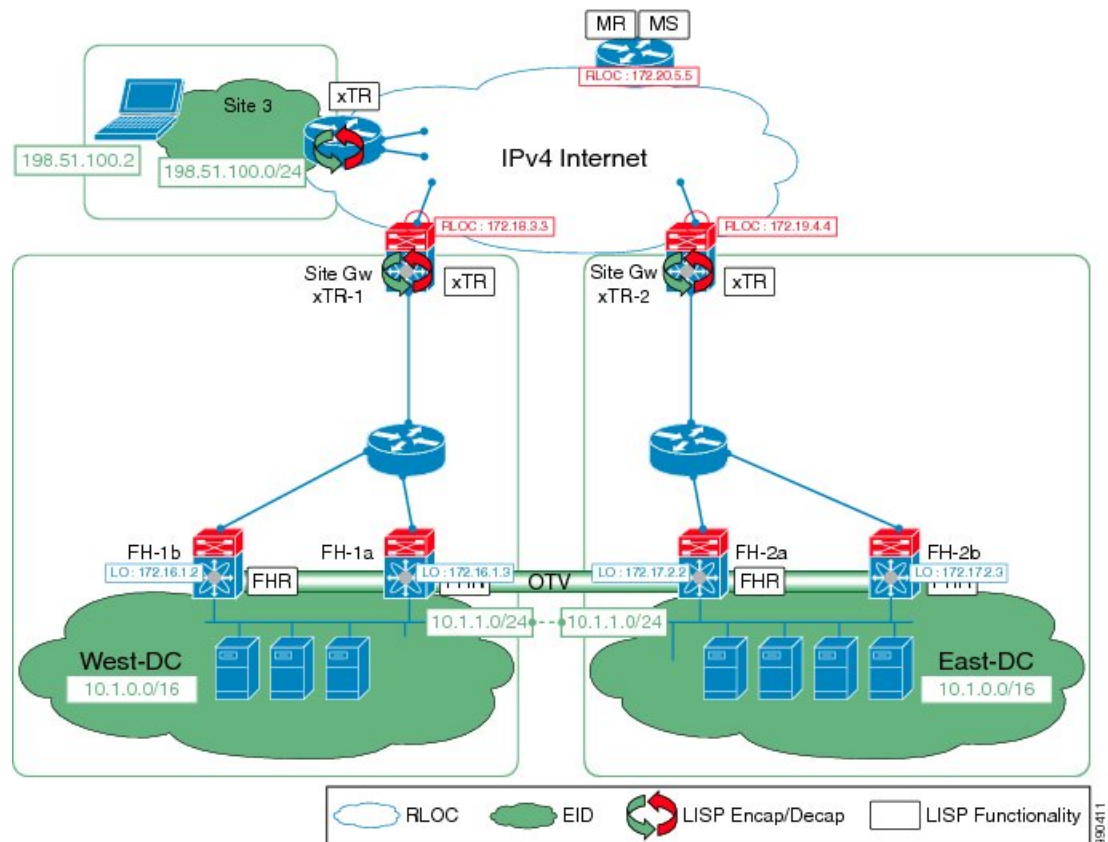


This section includes the following examples for configuring the topology in the preceding figure:

-

Example: First-Hop Router Configuration

Figure 3: Sample Topology



The following example shows how to configure the first hop "FH-1a" in the sample topology:

```

ip lisp etr
lisp dynamic-eid VLAN-11
  database-mapping 10.1.1.0/24 172.16.1.2 pr 10 w 50
  database-mapping 10.1.1.0/24 172.16.1.3 pr 10 w 50
  eid-notify 172.16.0.1 key 3 75095fe9112836e3
  map-notify-group 225.1.1.1
lisp dynamic-eid VLAN-12
  database-mapping 10.1.2.0/24 172.16.1.2 pr 10 w 50
  database-mapping 10.1.2.0/24 172.16.1.3 pr 10 w 50
  eid-notify 172.16.0.1 key 3 75095fe9112836e3
  map-notify-group 225.1.1.2

interface Vlan11
  lisp mobility VLAN-11
  lisp extended-subnet-mode
  ip address 10.1.1.3/24
  ip ospf passive-interface
  ip router ospf 100 area 0.0.0.1
  hsrp 1
  ip 10.1.1.1

interface Vlan12
  lisp mobility VLAN-12
  lisp extended-subnet-mode
  
```

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Example: First-Hop Router Configuration

```
ip address 10.1.2.3/24
ip ospf passive-interface
ip router ospf 100 area 0.0.0.1
hsrp 2
 ip 10.1.2.1
```

The following example shows how to configure the first hop "FH-2a" in the sample topology:

```
ip lisp etr
lisp dynamic-eid VLAN-11
 database-mapping 10.1.1.0/24 172.17.2.2 pr 10 w 50
 database-mapping 10.1.1.0/24 172.17.2.3 pr 10 w 50
 eid-notify 172.17.0.1 key 3 6d018260cf71b07c
 map-notify-group 225.1.1.1
lisp dynamic-eid VLAN-12
 database-mapping 10.1.2.0/24 172.17.2.2 pr 10 w 50
 database-mapping 10.1.2.0/24 172.17.2.3 pr 10 w 50
 eid-notify 172.17.0.1 key 3 6d018260cf71b07c
 map-notify-group 225.1.1.2

interface Vlan11
 lisp mobility VLAN-11
 lisp extended-subnet-mode
 ip address 10.1.1.4/24
 ip ospf passive-interface
 ip router ospf 100 area 0.0.0.2
 hsrp 1
 ip 10.1.1.1

interface Vlan12
 lisp mobility VLAN-12
 lisp extended-subnet-mode
 ip address 10.1.2.4/24
 ip ospf passive-interface
 ip router ospf 100 area 0.0.0.2
 hsrp 2
 ip 10.1.2.1
```

The following additional configuration ensures that the FHRs can route traffic from other attached subnets to servers that belong to the mobile subnet site1 and are discovered in the opposite data center. For this purpose the FHRs are configured to establish an adjacency over a dedicated extended VLAN using a dedicated routing protocol instance and to redistribute host routes from LISP.

For FH-1a:

```
ip prefix-list DiscoveredServers seq 5 permit 10.1.0.0/22 ge 32

route-map LISP2EIGRP permit 10
 match ip address prefix-list DiscoveredServers

interface Vlan100
 no shutdown
 ip address 10.255.0.1/30
 ip router eigrp 100

router eigrp 100
 autonomous-system 100
 redistribute lisp route-map LISP2EIGRP
```

For FHA-2a:

```
ip prefix-list DiscoveredServers seq 5 permit 10.1.0.0/22 ge 32

route-map LISP2EIGRP permit 10
 match ip address prefix-list DiscoveredServers
```

```

interface Vlan100
  no shutdown
  ip address 10.255.0.2/30
  ip router eigrp 100

router eigrp 100
  autonomous-system 100
  redistribute lisp route-map LISP2EIGRP

```

Example: Site Gateway xTR Configuration

The following example shows how to configure the site gateway "Site GW xTR-1" in the sample topology:

```

ip lisp itr-etr
ip lisp database-mapping 10.1.0.0/16 172.18.3.3 priority 10 weight 50
ip lisp itr map-resolver 172.20.5.5
ip lisp etr map-server 172.20.5.5 key 3 0b50279df3929e28
lisp dynamic-eid VLAN11
database-mapping 10.1.1.0/24 172.18.3.3 priority 10 weight 50
  eid-notify authentication-key 3 75095fe9112836e3
  lisp dynamic-eid VLAN12
database-mapping 10.1.2.0/24 172.18.3.3 priority 10 weight 50
  eid-notify authentication-key 3 75095fe9112836e3

interface Ethernet3/1
  description Inside DC West
  ip address 172.16.0.1/30
  ip router ospf 1 area 0.0.0.1

```

The following example configuration is for the site gateway "Site GW xTR-2" in the sample topology:

```

ip lisp itr-etr
ip lisp database-mapping 10.2.2.0/24 172.19.4.4 priority 10 weight 50
ip lisp itr map-resolver 172.20.5.5
ip lisp etr map-server 172.20.5.5 key 3 0b50279df3929e28
lisp dynamic-eid VLAN11
database-mapping 10.1.1.0/24 172.19.4.4 priority 10 weight 50
  eid-notify authentication-key 3 6d018260cf71b07c
  lisp dynamic-eid VLAN12
database-mapping 10.1.2.0/24 172.19.4.4 priority 10 weight 50
  eid-notify authentication-key 3 6d018260cf71b07c

interface Ethernet3/1
  description Inside DC East
  ip address 172.17.0.1/30
  ip router ospf 1 area 0.0.0.2

```

Example: xTR Configuration

The following example shows how to configure the xTR (at Site 3):

```

ip lisp itr-etr
ip lisp database-mapping 198.51.100.0/24 172.21.1.5 priority 10 weight 50
ip lisp itr map-resolver 172.20.5.5
ip lisp etr map-server 172.20.5.5 key 3 0b50279df3929e28

```

Example: MSMR Configuration

The following example shows how to configure the map server map resolver (MSMR) device in the sample topology:

```
ip lisp map-resolver
ip lisp map-server
lisp site roaming1
  eid-prefix 10.1.0.0/16 accept-more-specifics
  authentication-key 3 0b50279df3929e28
lisp site site2
  eid-prefix 10.2.2.0/24
  authentication-key 3 0b50279df3929e28
lisp site site3
  eid-prefix 198.51.100.0/24
  authentication-key 3 0b50279df3929e28
```

Example: Multi-Hop Mobility Interworking with Routing Protocols Configuration

The following example shows how to dynamically redistribute LISP host routes for discovered servers into OSPF at the first-hop router (FHR):

```
ip prefix-list lisp-pflist seq 10 permit 10.1.1.0/24 ge 32
route-map lisp-rmap permit 10
match ip address prefix-list lisp-pflist
router ospf 100
redistribute lisp route-map lisp-rmap
```

The following example shows how to automatically convert host routes from a routing protocol into LISP dynamic EID entries at a Site Gateway xTR (in lieu of an EID notification coming from a FHR):

```
ip lisp itr-etr
ip lisp database-mapping 10.1.0.0/16 172.18.3.3 priority 10 weight 50
ip lisp itr map-resolver 172.20.5.5
ip lisp etr map-server 172.20.5.5 key 3 0b50279df3929e28
lisp dynamic-eid site1
  database-mapping 10.1.1.0/24 172.18.3.3 priority 10 weight 50
  register-route-notifications
```

Additional References

This section includes additional information related to implementing LISP.

Feature Information for LISP ESM Multihop Mobility

Feature Name	Release	Feature Information
LISP ESM multihop mobility	6.2(8)	<p>This feature was introduced.</p> <p>The LISP Extended Subnet Mode (ESM) Multihop Mobility feature separates the Locator/ID Separation Protocol (LISP) dynamic host detection function from the LISP encapsulation and decapsulation function within a LISP topology.</p>
Dynamic-EID Route Import	6.2(8)	<p>This feature was introduced.</p> <p>This feature provides the ability for a Site Gateway xTR to perform server presence detection upon receiving host routes updates.</p>



CHAPTER 5

LISP Instance-ID Support

This chapter includes the following sections:

- [Information about LISP Instance-ID Support, on page 47](#)
- [How to Configure LISP Instance-ID Support, on page 55](#)
- [Configuration Examples for LISP Instance-ID Support, on page 86](#)

Information about LISP Instance-ID Support

Overview of LISP Instance ID

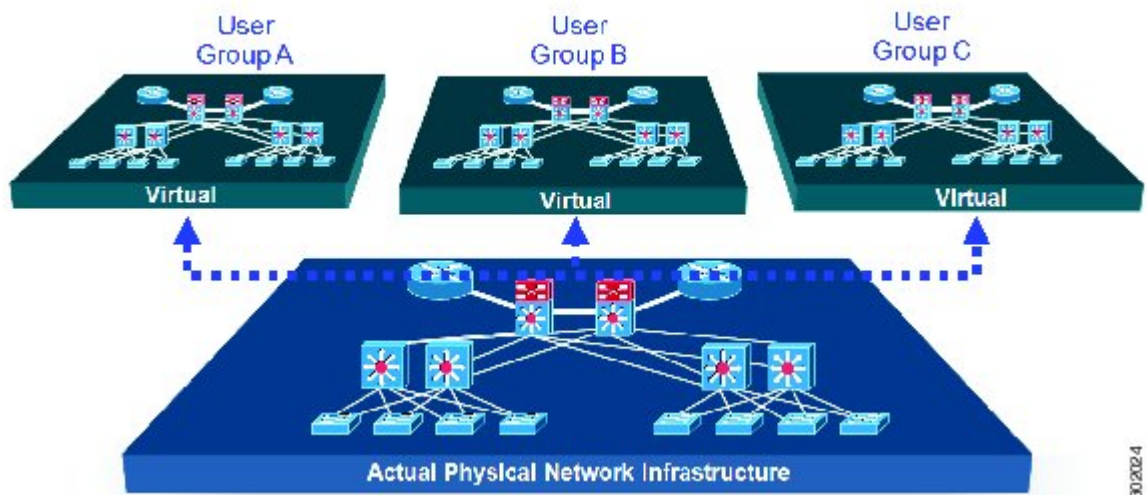
The LISP Instance ID provides a means of maintaining unique address spaces (or "address space segmentation") in the control and data plane. Instance IDs are numerical tags defined in the LISP canonical address format (LCAF). The Instance ID has been added to LISP to support virtualization.

When multiple organizations inside of a LISP site are using private addresses as Endpoint ID (EID) prefixes, their address spaces must remain segregated due to possible address duplication. An Instance ID in the address encoding can be used to create multiple segmented VPNs inside of a LISP site where you want to keep using EID-prefix-based subnets. The LISP Instance ID is currently supported in LISP ingress tunnel routers and egress tunnel routers (ITRs and ETRs, collectively known as xTRs), map server (MS) and map resolver (MR).

This chapter explains how to configure LISP xTRs with LISP MS and MR to implement virtualization. The content considers different site topologies and includes guidance to both shared and parallel LISP model configurations. It includes conceptual background and practical guidance, and provides multiple configuration examples.

The purpose of network virtualization, as illustrated the following figure, is to create multiple, logically separated topologies across one common physical infrastructure.

Figure 4: LISP Deployment Environment



When you plan the deployment of a LISP virtualized network environment, you must plan for virtualization at both the device level and the path level.

For path level virtualization: LISP binds virtual routing and forwarding (VRFs) to instance IDs (IIDs). These IIDs are included in the LISP header to provide data plane (traffic flow) separation.

For device level virtualization: Both the EID and the RLOC namespaces can be virtualized. The EID can be virtualized by binding a LISP instance ID to an EID VRF; the RLOC by tying locator addresses and associated mapping services to the specific VRF within which they are reachable.

Prerequisites for LISP Instance-ID Support

- Allow the use of instance-id 0's within a virtual routing and forwarding (VRF) instance.

Guidelines and Limitations for LISP Instance-ID Support

The LISP Instance-ID Support feature has the following configuration guidelines and restrictions:

- If you enable LISP, nondisruptive upgrade (ISSU) and nondisruptive downgrade (ISSD) paths are not supported. Disable LISP prior to any upgrade. This restriction applies only to releases before 6.2(2), not to 6.2(2) or subsequent LISP releases.

Device Level Virtualization

Virtualization at the device level uses virtual routing and forwarding (VRF) to create multiple instances of Layer 3 routing tables, as shown in the figure below. VRFs provide segmentation across IP addresses, allowing for overlapped address space and traffic separation. Separate routing, quality of service (QoS), security, and management policies can be applied to each VRF instance. An interior gateway protocol (IGP) or exterior gateway protocol (EGP) routing process is typically enabled within a VRF, just as it would be in the global (default) routing table. LISP binds VRFs to instance IDs for similar purposes.

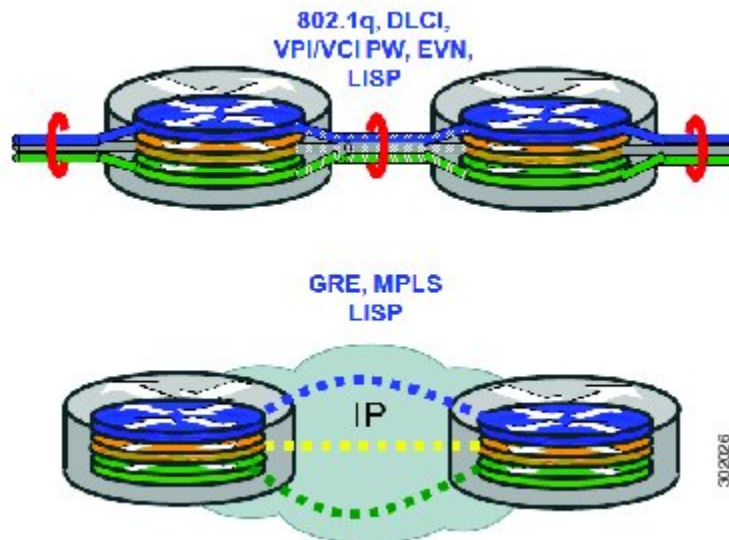
Figure 5: Device Level Virtualization



Path Level Virtualization

VRF table separation is maintained across network paths, as shown in the following figure. Single-hop path segmentation (hop by hop) is typically accomplished by using 802.1q VLANs, virtual path identifier/virtual circuit identifier password (VPI/VCI PW), or easy virtual network (EVN). You can also use the Locator ID Separation Protocol (LISP) in multihop mechanisms that include Multiprotocol Label Switching (MPLS) and generic routing encapsulation (GRE) tunnels. LISP binds VRF instances to instance IDs (IIDs), and then these IIDs are included in the LISP header to provide data plane (traffic flow) separation for single or multihop needs.

Figure 6: Path Level Virtualization



LISP Virtualization at the Device Level

LISP implements Locator ID separation and thereby creates two namespaces; endpoint ID (EID) and routing locator (RLOC). Either or both of these can be virtualized.

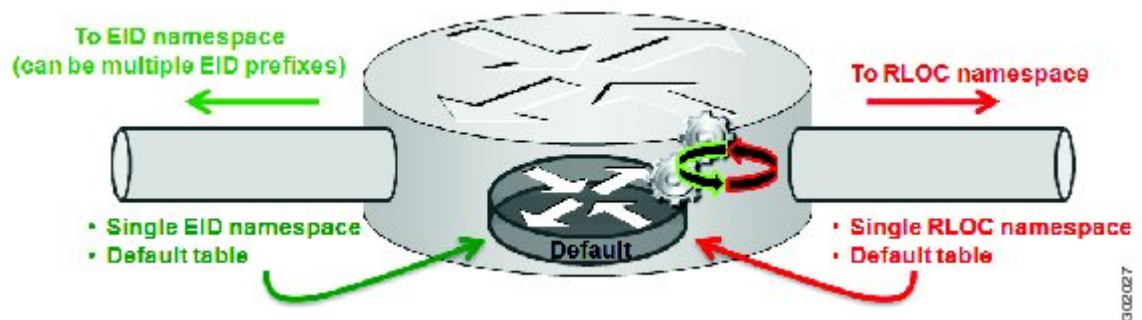
- EID virtualization—Enabled by binding a LISP instance ID to an EID virtual routing and forwarding (VRF). Instance IDs are numerical tags defined in the LISP canonical address format (LCAF) draft, and are used to maintain address space segmentation in both the control plane and data plane.
- Routing locator (RLOC) virtualization—Tying locator addresses and associated mapping services to the specific VRF within which they are reachable enables RLOC virtualization.

Because LISP can virtualize either or both of these namespaces, two models of operation are defined: the shared model and the parallel model. To understand how these models differ from the non-virtualized model of LISP, review information about the default (non-virtualized) model of LISP before reading about the shared model and the parallel model.

Default (Non-Virtualized) LISP Model

By default, LISP is not virtualized in the EID space or the RLOC space. That is, unless otherwise configured, both EID and RLOC addresses are resolved in the default (global) routing table. See the following figure.

Figure 7: Default (Nonvirtualized) LISP Model

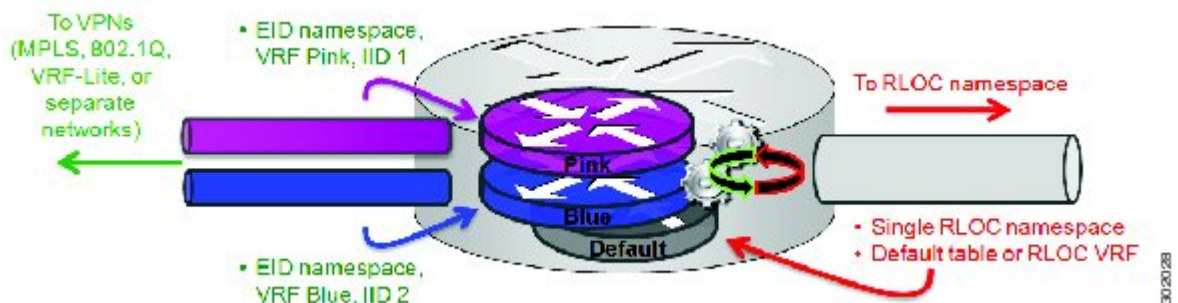


The mapping system must also be reachable through the default table. This default model can be thought of as a single instantiation of the parallel model of LISP virtualization where EID and RLOC addresses are within the same namespace.

LISP Shared Model Virtualization

A LISP shared model virtualized EID space is created when you bind VRFs associated with an EID space to Instance IDs. A common, shared locator space is used by all virtualized EIDs.

Figure 8: LISP Shared Model Virtualization resolves EIDs within VRFs tied to Instance IDs. The default (global) routing table is the shared space.

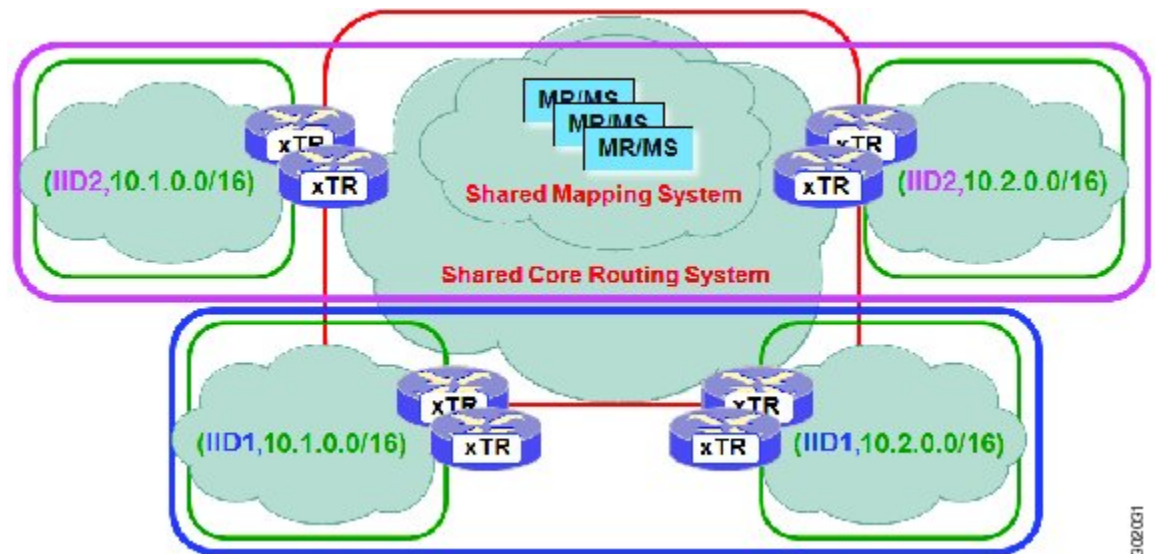


As shown in the figure, EID space is virtualized through its association with VRFs, and these VRFs are tied to LISP Instance IDs to segment the control plane and data plane in LISP. A common, shared locator space, the default (global) table, is used to resolve RLOC addresses for all virtualized EIDs. The mapping system must also be reachable through the common locator space.

LISP Shared Model Virtualization Architecture

You can deploy the LISP shared model virtualization in single or multitenancy configurations. In the shared model *single tenancy* case, ingress and egress tunnel routers (xTRs) are dedicated to a customer but share infrastructure with other customers. Each customer and all sites associated with an xTR use the same instance ID and are part of a VPN using their own EID namespace. LISP instance IDs segment the LISP data plane and control plane. See the following figure.

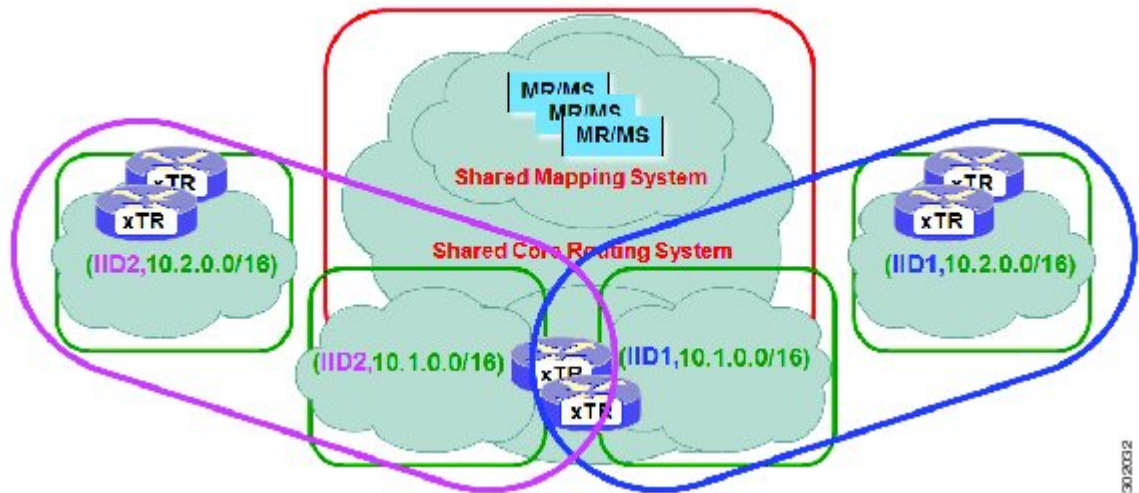
Figure 9: LISP shared model single tenancy use case. A customer uses its own xTR and shares a common core network and mapping system.



In the shared model *multitenancy* case, a set of xTRs is shared (virtualized) among multiple customers. These customers also share a common infrastructure with other single and multitenant customers. Each customer and all sites associated with it use the same instance ID and are part of a VPN using their own EID namespace. LISP instance IDs segment the LISP data plane and control plane. See the following figure.

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Figure 10: LISP shared model multitenancy use case. Customer's use shared xTRs and share a common core network and mapping system.



LISP Shared Model Virtualization Implementation Considerations and Caveats

When you use the LISP Shared Model, instance IDs must be unique to an EID VRF.

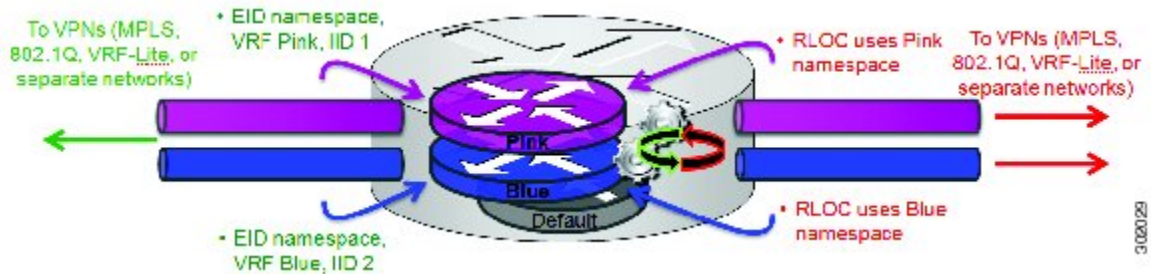
```
xTR-1# configure terminal
xTR-1(config)# vrf context alpha
xTR-1(config-vrf)# lisp instance-id 101
xTR-1(config-vrf)# exit
xTR-1(config)# vrf context beta
xTR-1(config-vrf)# lisp instance-id 101
Instance-ID 101 is already assigned to VRF context alpha
```

In the example, two EID VRFs are created: alpha and beta. In global configuration mode, a VRF named alpha is specified and associated with the instance ID 101. Next, a VRF named beta is specified and also associated with the instance ID 101. This configuration is not permissible because instance ID 101 is already associated with the VRF context named alpha. That is, you cannot connect the same instance ID to more than one EID VRF.

LISP Parallel Model Virtualization

The LISP parallel model virtualization ties the virtualized EID space associated with VRFs to RLOCs that are associated with the same or different VRFs (see the following figure).

Figure 11: LISP parallel model virtualization resolves an EID and associated RLOCs within the same or a different VRF. In this example, both EID and RLOC addresses are resolved in the same VRF, but multiple (parallel) segmentation is configured on the same device (BLUE and PINK).

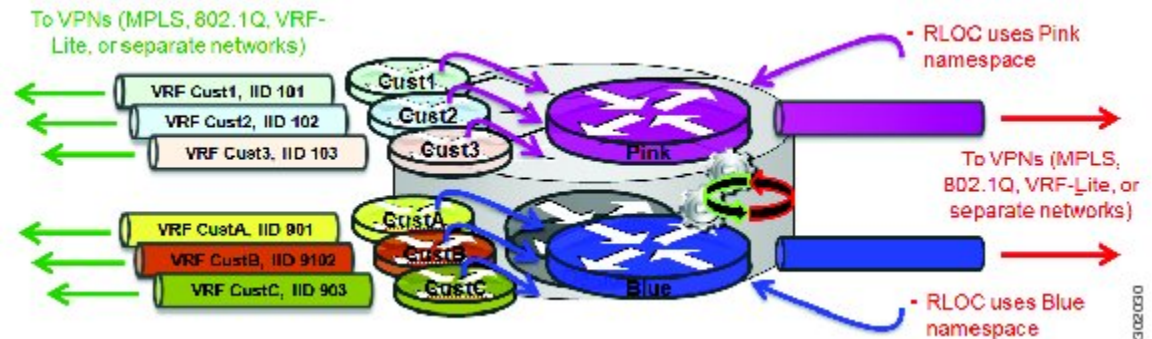


EID space is virtualized through its association with VRFs, and these VRFs are tied to LISP Instance IDs to segment the control plane and data plane in LISP. A common, “shared” locator space, the default (global) table is used to resolve RLOC addresses for all virtualized EIDs. The mapping system must also be reachable through the common locator space as well.

In the figure, virtualized EID space is associated with a VRF (and bound to an Instance ID) that is tied to locator space associated with the same VRF, in this case - Pink/Pink and Blue/Blue. However, this is not required; the EID VRF does not need to match the RLOC VRF. In any case, a mapping system must be reachable through the associated locator space. Multiple parallel instantiations can be defined.

A shared model and parallel model can be combined such that multiple EID VRFs share a common RLOC VRF, and multiple instantiations of this architecture are implemented on the same platform, as shown in the following figure.

Figure 12: LISP shared and parallel models may be combined for maximum flexibility.



LISP Parallel Model Virtualization Architecture

You can deploy LISP parallel model virtualization in single or multitenancy configurations. In the parallel model multitenancy case, a set of xTRs is shared (virtualized) among multiple customers, and each customer uses their own private (segmented) core infrastructure and mapping system. All sites associated with the customer use the same instance ID and are part of a VPN using their own EID namespace, as shown in the following figure.

Figure 13: LISP parallel model multitenancy case. Shared xTRs use virtualized core networks and mapping systems. LISP instance IDs segment the LISP data plane and control plane.



LISP Parallel Model Virtualization Implementation Considerations and Caveats

When you use LISP parallel model virtualization, each `vrf vrf-name` instantiation is considered by a separate process. Instance IDs must be unique only within a vrf instantiation.

```
xTR-1# configure terminal
xTR-1 (config) # vrf context alpha
xTR-1 (config-vrf) # address-family ipv4 unicast
xTR-1 (config-vrf-af-ipv4) # exit
xTR-1 (config) # vrf context beta
xTR-1 (config-vrf) # address-family ipv4 unicast
xTR-1 (config-vrf-af-ipv4) # exit
xTR-1 (config-vrf) # exit
xTR-1 (config) # vrf context gamma
xTR-1 (config-vrf) # address-family ipv4 unicast
xTR-1 (config-vrf-af-ipv4) # exit
xTR-1 (config-vrf) # exit
xTR-1 (config) # vrf context delta
xTR-1 (config-vrf) # address-family ipv4 unicast
xTR-1 (config-vrf-af-ipv4) # exit
xTR-1 (config-vrf) # exit
xTR-1 (config) # vrf context alpha
xTR-1 (config-vrf) # lisp instance-id 101
xTR-1 (config-vrf) # exit
xTR-1 (config) # vrf context gamma
xTR-1 (config-vrf) # lisp instance-id 101
xTR-1 (config-vrf) # exit
xTR-1 (config) # vrf context beta
xTR-1 (config-vrf) # lisp instance-id 201
The vrf beta table is not available for use as an EID table (in use by switch lisp 1 EID
instance 101 VRF)
```

In the above example, four VRFs are created: alpha, beta, gamma, and delta, as follows:

- The vrf instantiation device lisp 1 is created and associated with the VRF named alpha.
- The EID VRF named beta is specified and associated with instance ID 101.
- A new vrf instantiation, device lisp 3, is created and associated with the locator-table VRF named gamma.
- The EID table VRF named delta is specified and also associated with instance ID 101.

These two instance IDs are unrelated to each other; one is relevant only within device lisp 1, and the other is relevant only within device lisp 2.

In the example, note that under device lisp 2, the code requests a VRF instance named beta. Note that the device is unable to use this VRF instance because it (beta) is already associated with a vrf command within the device lisp 1 instantiation.

You can reuse an instance ID. The EID VRF into which it is decapsulated depends on the vrf instantiation with which it is associated. However, you cannot connect the same EID VRF to more than one VRF.

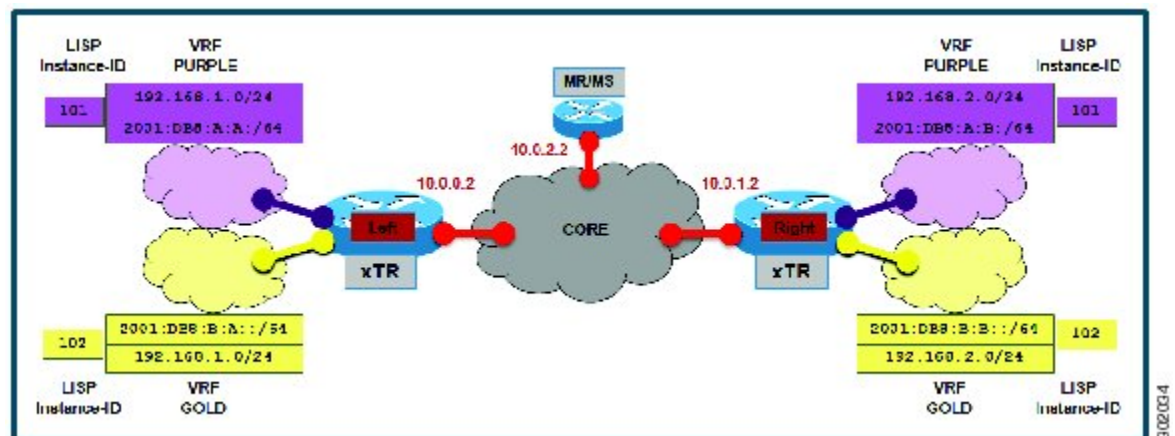
How to Configure LISP Instance-ID Support

Configuring Simple LISP Shared Model Virtualization

You can perform this task to enable and configure LISP ingress tunnel router/egress tunnel router (ITR/ETR) functionality (also known as xTR) with the LISP map server and map resolver, and thereby implement LISP shared model virtualization. This LISP shared model reference configuration is for a very simple two-site LISP topology, including xTRs and an map server/map resolver (MS/MR).

The following figure shows a basic LISP shared model virtualization solution. Two LISP sites are deployed, each containing two VRFs: PURPLE and GOLD. LISP is used to provide virtualized connectivity between these two sites across a common IPv4 core, while maintaining address separation between the two VRF instances.

Figure 14: Simple LISP Site with Virtualized IPv4 and IPv6 EIDs and a Shared IPv4 core



In this figure, each LISP site uses a single edge switch that is configured as both an ITR and ETR (xTR), with a single connection to its upstream provider. The RLOC is IPv4, and IPv4 and IPv6 EID prefixes are configured. Each LISP site registers to a map server/map resolver (MS/MR) switch that is located in the network core within the shared RLOC address space.



Note All IPv4 or IPv6 EID-sourced packets destined for both LISP and non-LISP sites are forwarded in one of two ways:

- LISP-encapsulated to a LISP site when traffic is LISP-to-LISP
- Natively forwarded when traffic is LISP-to-non-LISP

Packets are deemed to be a candidate for LISP encapsulation when they are sourced from a LISP EID and the destination matches one of the following entries:

- a current map-cache entry
- a default route with a legitimate next-hop
- a static route to Null0
- no route at all

In this configuration example, because the xTR has IPv4 RLOC connectivity, a default route to the upstream SP is used for all IPv4 packets to support LISP processing. Adding an IPv6 default route to Null0 ensures that all IPv6 packets are handled by LISP processing. (The use of the static route to Null0 is not strictly required, but is a LISP best practice.)

The components in the figure above are as follows:

LISP site

- The CPE functions as a LISP ITR and ETR (xTR).
- Both LISP xTRs have two VRFs: GOLD and PURPLE. Each VRF contains both IPv4 and IPv6 EID-prefixes. A LISP instance ID is used to maintain separation between two VRFs. In this example, the share key is configured "per-site" and not "per-VRF." (Another configuration could configure the shared key per-VPN.)
- Each LISP xTR has a single RLOC connection to a shared IPv4 core network.

Mapping system

- One map server/map resolver system is shown and is assumed available for the LISP xTR to register to. The MS/MR has an IPv4 RLOC address of 10.0.2.2 within the shared IPv4 core.
- The map server site configurations are virtualized using LISP instance IDs to maintain separation between the two VRFs.

Perform the following procedure (once through for each xTR in the LISP site) to enable and configure LISP ITR and ETR (xTR) functionality when using a LISP map server and map resolver for mapping services. The example configurations at the end of this task show the full configuration for two xTRs (xTR1 and xTR2).

Summary Steps

Before you begin, create the VRF instances by using the `vrf definition` command.

Before you begin

Create the VRFs using the `vrf definition` command.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal</pre>	Enters global configuration mode.
Step 2	vrf context <i>vrf-name</i> Example: <pre>switch(config)# vrf context vrf1</pre>	Enters VRF configuration submenu.
Step 3	ip lisp database-mapping <i>EID-prefix/prefix-length locator priority</i> <i>priority weight weight</i> Example: <pre>switch(config-vrf)# ip lisp database-mapping 192.168.1.0/24 10.0.0.2 priority 1 weight 100</pre>	Configures an IPv4 EID-to-RLOC mapping relationship and its associated traffic policy for this LISP site. Note In this example, a single IPv4 EID prefix, 192.168.1.0/24, is being associated with the single IPv4 RLOC 10.0.0.2.
Step 4	Repeat Step 3 until all EID-to-RLOC mappings for the LISP site are configured. Example: <pre>switch(config-vrf)# ipv6 lisp database-mapping 2001:db8:b:a::/64 10.0.0.2 priority 1 weight 100</pre>	Configures an IPv6 EID-to-RLOC mapping relationship and its associated traffic policy for this LISP site.
Step 5	ip lisp itr Example: <pre>switch(config-vrf)# ip lisp itr</pre>	Enables LISP ITR functionality for the IPv4 address family.
Step 6	ip lisp etr Example: <pre>switch(config-vrf)# ip lisp etr</pre>	Enables LISP ETR functionality for the IPv4 address family.
Step 7	ip lisp itr map-resolver <i>map-resolver-address</i> Example: <pre>switch(config-vrf)# ip lisp itr map-resolver 10.0.2.2</pre>	Configures a locator address for the LISP map resolver to which this switch will send map request messages for IPv4 EID-to-RLOC mapping resolutions. The locator address of the map resolver may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map resolver is reachable using its IPv4 locator address.

	Command or Action	Purpose
		<p>Note You can configure up to two map resolvers if multiple map resolvers are available.</p>
Step 8	<p>ip lisp etr map-server <i>map-server-address</i> key <i>key-type authentication-key</i></p> <p>Example:</p> <pre>switch(config-vrf)# ip lisp etr map-server 10.0.2.2 key 0 Left-key</pre>	<p>Configures a locator address for the LISP map server and an authentication key for which this switch, acting as an IPv4 LISP ETR, will use to register with the LISP mapping system.</p> <p>You must configure the map serve with EID prefixes and instance IDs matching those configured on this ETR and with an identical authentication key.</p> <p>Note The locator address of the map server may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map-server is reachable using its IPv4 locator addresses.</p>
Step 9	<p>ipv6 lisp itr</p> <p>Example:</p> <pre>switch(config-vrf)# ipv6 lisp itr</pre>	Enables LISP ITR functionality for the IPv6 address family.
Step 10	<p>ipv6 lisp etr</p> <p>Example:</p> <pre>switch(config-vrf)# ipv6 lisp etr</pre>	Enables LISP ETR functionality for the IPv6 address family.
Step 11	<p>ipv6 lisp itr map-resolver <i>map-resolver-address</i></p> <p>Example:</p> <pre>switch(config-vrf)# ipv6 lisp itr map-resolver 10.0.2.2</pre>	<p>Configures a locator address for the LISP map resolver to which this switch will send map request messages for IPv6 EID-to-RLOC mapping resolutions.</p> <p>The locator address of the map resolver may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map resolver is reachable using its IPv4 locator addresses.</p> <p>Note You can configure up to two map resolvers if multiple map resolvers are available.</p>
Step 12	<p>ipv6 lisp etr map-server <i>map-server-address</i> key <i>key-type authentication-key</i></p>	Configures a locator address for the LISP map-server and an authentication key that this

	Command or Action	Purpose
	<p>Example:</p> <pre>switch(config-vrf)# ipv6 lisp etr map-server 10.0.2.2 key 0 Left-key</pre>	<p>switch, acting as an IPv6 LISP ETR, will use to register to the LISP mapping system.</p> <p>The map server must be configured with EID prefixes and instance IDs matching those configured on this ETR and with an identical authentication key.</p> <p>Note The locator address of the map-server may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map-server is reachable using its IPv4 locator addresses.</p>
Step 13	<p>ip lisp locator-vrf default</p> <p>Example:</p> <pre>switch(config-vrf)# ip lisp locator-vrf BLUE</pre>	Configures a nondefault VRF table to be referenced by any IPv4 locators addresses.
Step 14	<p>ipv6 lisp locator-vrf default</p> <p>Example:</p> <pre>switch(config-vrf)# ipv6 lisp locator-vrf default</pre>	Configures a nondefault VRF table to be referenced by any IPv6 locator addresses.
Step 15	<p>exit</p> <p>Example:</p> <pre>switch(config-vrf)# exit</pre>	Exits VRF configuration mode and returns to global configuration mode.
Step 16	<p>ip lisp itr</p> <p>Example:</p> <pre>switch(config)# ip lisp itr</pre>	Enables LISP ITR functionality for the IPv4 address family.
Step 17	<p>ip lisp etr</p> <p>Example:</p> <pre>switch(config)# ip lisp etr</pre>	Enables LISP ETR functionality for the IPv4 address family.
Step 18	<p>ipv6 lisp itr</p> <p>Example:</p> <pre>switch(config)# ipv6 lisp itr</pre>	Enables LISP ITR functionality for the IPv6 address family.

	Command or Action	Purpose
Step 19	ipv6 lisp etr Example: <pre>switch(config)# ipv6 lisp etr</pre>	Enables LISP ETR functionality for the IPv6 address family.
Step 20	ip route <i>ipv4-prefix next-hop</i> Example: <pre>switch(config)# ip route 0.0.0.0 0.0.0.0 10.0.0.1</pre>	<p>Configures a default route to the upstream next hop for all IPv4 destinations.</p> <p>In this configuration example, because the xTR has IPv4 RLOC connectivity, a default route to the upstream SP is used for all IPv4 packets to support LISP processing.</p>
Step 21	ipv6 route <i>ipv6-prefix next-hop</i> Example: <pre>switch(config)# ipv6 route ::/0 Null0</pre>	<p>Configures a default route to the upstream next hop for all IPv6 destinations.</p> <p>In this configuration example, because the xTR has only IPv4 RLOC connectivity, adding an IPv6 default route to Null0 ensures that all IPv6 packets are handled by LISP processing. (Use of the static route to Null0 is not strictly required, but is recommended as a LISP best practice.) If the destination is another LISP site, packets are LISP-encapsulated (using IPv4 RLOCs) to the remote site. If the destination is non-LISP, all IPv6 EIDs are LISP-encapsulated to a PETR (assuming one is configured).</p>
Step 22	(Optional) show running-config lisp Example: <pre>switch(config)# show running-config lisp</pre>	Displays the LISP configuration on the switch.
Step 23	(Optional) show [ip ipv6] lisp Example: <pre>switch(config)# show ip lisp vrf TRANS</pre>	The show ip lisp and show ipv6 lisp commands quickly verify the operational status of LISP as configured on the switch, as applicable to the IPv4 and IPv6 address families, respectively.
Step 24	(Optional) show [ip ipv6] lisp map-cache [vrf <i>vrf-name</i>] Example: <pre>switch(config)# show ip lisp map-cache</pre>	The show ip lisp map-cache and show ipv6 lisp map-cache commands quickly verify the operational status of the map cache on a switch configured as an ITR or PITR, as applicable to the IPv4 and IPv6 address families, respectively.
Step 25	(Optional) show [ip ipv6] lisp database [vrf <i>vrf-name</i>]	The show ip lisp database and show ipv6 lisp database commands quickly verify the operational status of the database mapping on

	Command or Action	Purpose
	<p>Example:</p> <p>The following example shows IPv6 mapping database information for the VRF named GOLD.</p> <pre>switch(config)# show ipv6 lisp database vrf GOLD</pre>	a switch configured as an ETR, as applicable to the IPv4 and IPv6 address families, respectively.
Step 26	<p>(Optional) show lisp site [name <i>site-name</i>]</p> <p>Example:</p> <pre>switch(config)# show lisp site</pre>	Displays the operational status of LISP sites as configured on a map server. This command applies only to a switch configured as a map server.
Step 27	<p>clear [ip ipv6] lisp map-cache [vrf <i>vrf-name</i>]</p> <p>Example:</p> <p>The first command displays IPv4 mapping cache information for vrf1. The second clears the mapping cache for vrf1 and shows the information after clearing the cache.</p> <pre>switch(config)# show ip lisp map-cache vrf vrf1 switch(config)# clear ip lisp map-cache vrf vrf1</pre>	This command removes all IPv4 or IPv6 dynamic LISP map-cache entries stored by the switch, and displays the operational status of the LISP control plane. This command applies to a LISP switch that maintains a map cache (for example, if configured as an ITR or PITR).

Configuring a Private LISP Mapping System for LISP Shared Model Virtualization

You can perform this task to configure and enable standalone LISP map server/map resolver functionality for LISP shared model virtualization. In this procedure, you configure a switch as a standalone map server/map resolver (MR/MS) for a private LISP mapping system. Because the MR/MS is configured as a standalone switch, it has no need for LISP Alternate Logical Topology (ALT) connectivity. All relevant LISP sites must be configured to register with this map server so that this map server has full knowledge of all registered EID prefixes within the (assumed) private LISP system.

Procedure

	Command or Action	Purpose
Step 1	<p>configure terminal</p> <p>Example:</p> <pre>switch# configure terminal</pre>	Enters global configuration mode.

	Command or Action	Purpose
Step 2	<p>lisp site <i>site-name</i></p> <p>Example:</p> <pre>switch(config)# lisp site LEFT</pre>	<p>Specifies a LISP site named LEFT and enters LISP site configuration mode.</p> <p>Note A LISP site name is locally significant to the map server on which it is configured. It has no relevance anywhere else. This name is used solely as an administrative means of associating EID-prefix or prefixes with an authentication key and other site-related mechanisms.</p>
Step 3	<p>authentication-key [<i>key-type</i>] <i>authentication-key</i></p> <p>Example:</p> <pre>switch(config-lisp-site)# authentication-key 0 Left-key</pre>	<p>Configures the password used to create the SHA-2 HMAC hash for authenticating the map register messages sent by an ETR when registering to the map server.</p> <p>Note The LISP ETR must be configured with an identical authentication key as well as matching EID prefixes and instance IDs.</p>
Step 4	<p>eid-prefix <i>EID-prefix</i> instance-id <i>instance-id</i></p> <p>Example:</p> <pre>switch(config-lisp-site)# eid-prefix 192.168.1.0/24 instance-id 102</pre>	<p>Configures an EID prefix and instance ID that are allowed in a map register message sent by an ETR when registering to this map server. Repeat this step as necessary to configure additional EID prefixes under this LISP site.</p> <p>Note In this example, the IPv4 EID prefix 192.168.1.0/24 and instance ID 102 are associated together. To complete this task, an IPv6 EID prefix is required.</p>
Step 5	<p>(optional) eid-prefix <i>EID-prefix</i> instance-id <i>instance-id</i></p> <p>Example:</p> <pre>switch(config-lisp-site)# eid-prefix 2001:db8:a:b::/64 instance-id 102</pre>	<p>(optional) Configures an EID prefix and instance ID that are allowed in a map register message sent by an ETR when registering to this map server. This step is repeated here to configure an additional EID prefix under this LISP site.</p> <p>Note In this example, the IPv6 EID prefix 2001:db8:a:b::/64 and instance ID 102 are associated together.</p>
Step 6	<p>exit</p> <p>Example:</p> <pre>switch(config-lisp-site)# exit</pre>	<p>Exits LISP site configuration mode and returns to global configuration mode.</p>

	Command or Action	Purpose
Step 7	ip lisp map-resolver ipv6 lisp map-resolver Example: switch(config)# ip lisp map-resolver switch(config)# ipv6 lisp map-resolver	Enables LISP map resolver functionality for EIDs in the IPv4 address family and in the IPv6 family..
Step 8	ip lisp map-server ipv6 lisp map-server Example: switch(config)# ip lisp map-server switch(config)# ipv6 lisp map-server	Enables LISP map server functionality for EIDs in the IPv4 address family and in the IPv6 address family..
Step 9	(optional) show running-config lisp Example: switch(config)# show running-config lisp	Displays the LISP configuration on the switch.
Step 10	(optional) show [ip ipv6] lisp Example: switch(config)# show ip lisp vrf TRANS	The show ip lisp and show ipv6 lisp commands display the operational status of LISP as configured on the switch, as applicable to the IPv4 and IPv6 address families respectively.
Step 11	(optional) show [ip ipv6] lisp map-cache [vrf vrf-name] Example: switch(config)# show ip lisp map-cache	The show ip lisp map-cache and show ipv6 lisp map-cache commands display the operational status of the map cache on a switch configured as an ITR or Pitr, as applicable to the IPv4 and IPv6 address families respectively.
Step 12	(optional) show [ip ipv6] lisp database [vrf vrf-name] Example: The following example shows IPv6 mapping database information for the VRF named GOLD. switch(config)# show ipv6 lisp database vrf GOLD	The show ip lisp database and show ipv6 lisp database commands display the operational status of the database mapping on a switch configured as an ETR, as applicable to the IPv4 and IPv6 address families respectively.
Step 13	(optional) show lisp site [name site-name] Example: switch(config)# show lisp site	The show lisp site command displays the operational status of LISP sites, as configured on a map server. This command only applies to a switch configured as a map server.
Step 14	clear [ip ipv6] lisp map-cache [vrf vrf-name]	The clear ip lisp map-cache and clear ipv6 lisp map-cache commands remove all IPv4

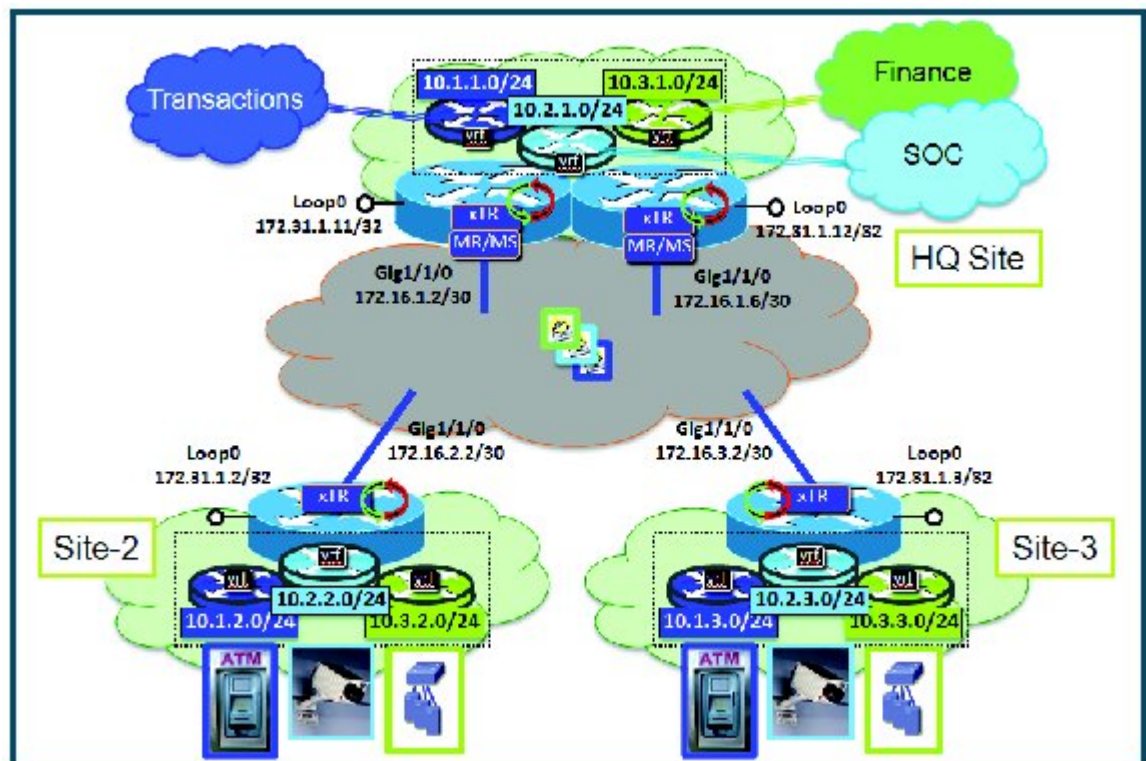
	Command or Action	Purpose
	<p>Example:</p> <p>The first command displays IPv4 mapping cache information for vrf1. The second command clears the mapping cache for vrf1 and displays the updated status.</p> <pre>switch(config)# show ip lisp map-cache vrf vrf1 switch(config)# clear ip lisp map-cache vrf vrf1</pre>	<p>or IPv6 dynamic LISP map-cache entries stored by the switch, respectively. They also show the operational status of the LISP control plane. This command applies to a LISP switch that maintains a map cache (for example, a switch configured as an ITR or PITR).</p>

Configuring Large-Scale LISP Shared Model Virtualization

To implement LISP shared model virtualization, you can configure LISP ITR/ETR (xTR) functionality with LISP map server and map resolver. This LISP shared model reference configuration is for a large-scale, multiple-site LISP topology, including xTRs and multiple MS/MRs.

This procedure is for an enterprise that is deploying the LISP Shared Model where EID space is virtualized over a shared, common core network. A subset of the entire network is shown in the following figure. Three sites are shown: a multihomed "Headquarters" (HQ) site, and two remote office sites. The HQ site switches are deployed as xTRs and also as map resolver/map servers. The remote sites switches act as xTRs, and use the MS/MRs at the HQ site for LISP control plane support.

Figure 15: Large Scale LISP Site with Virtualized IPv4 EIDs and a Shared IPv4 Core



The components in the figure are as follows:

- **LISP site:**

- Each customer premises equipment (CPE) switch functions as a LISP ITR and ETR (xTR), as well as a Map-Server/Map-Resolver (MS/MR).
- Both LISP xTRs have three VRFs: TRANS (for transactions), SOC (for security operations), and FIN (for financials). Each VRF contains only IPv4 EID-prefixes. No overlapping prefixes are used; segmentation between each VRF by LISP instance-ids makes this possible. Note that in this example, the separate authentication key is configured “per-vrf” and not “per-site”, which affects both the xTR and MS configurations.
- The HQ LISP Site is multihomed to the shared IPv4 core, but each xTR at the HQ site has a single RLOC.
- Each CPE also functions as an MS/MR to which the HQ and Remote LISP sites can register.
- The map server site configurations are virtualized using LISP instance IDs to maintain separation between the three VRFs.

- **LISP remote sites**

- Each remote site CPE switch functions as a LISP ITR and ETR (xTR).
- Each LISP xTRs has the same three VRFs as the HQ Site: TRANS, SOC, and FIN. Each VRF contains only IPv4 EID-prefixes.
- Each remote site LISP xTR has a single RLOC connection to a shared IPv4 core network.

Before you begin

Create the VRFs using the **vrf definition** command.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal</pre>	Enters global configuration mode.
Step 2	lisp site <i>site-name</i> Example:	Specifies a LISP site named TRANS and enters LISP site configuration mode.

	Command or Action	Purpose
	<pre>switch(config)# lisp site TRANS</pre>	<p>Note A LISP site name is significant to the local map server on which it is configured and has no relevance anywhere else. This site name serves solely as an administrative means of associating an EID-prefix or prefixes with an authentication key and other site-related mechanisms.</p>
Step 3	<p>authentication-key [<i>key-type</i>] <i>authentication-key</i></p> <p>Example:</p> <pre>switch(config-lisp-site)# authentication-key 0 Left-key</pre>	<p>Configures the password used to create the SHA-2 HMAC hash for authenticating the map register messages sent by an ETR when registering to the map server.</p> <p>Note The LISP ETR must be configured with an identical authentication key as well as matching EID prefixes and instance IDs.</p>
Step 4	<p>eid-prefix <i>EID-prefix / prefix-length</i> instance-id <i>instance-id</i> accept-more-specifics</p> <p>Example:</p> <pre>switch(config-lisp-site)# eid-prefix 10.1.0.0/16 instance-id 1 accept-more-specifics</pre>	<p>Configures an EID prefix and instance ID that are allowed in a map register message sent by an ETR when registering to this map server. Repeat this step as necessary to configure additional EID prefixes under this LISP site.</p> <ul style="list-style-type: none"> In the example, EID-prefix 10.1.0.0/16 and instance ID 1 are associated. The EID-prefix 10.1.0.0/16 is assumed to be an aggregate that covers all TRANS EID-prefixes at all LISP Sites. Use accept-more-specifics to allow each site to register its more-specific EID-prefix contained within that aggregate. If aggregation is not possible, simply enter all EID prefixes integrated within instance ID 1.
Step 5	<p>exit</p> <p>Example:</p> <pre>switch(config-lisp-site)# exit</pre>	<p>Exits LISP site configuration mode and returns to LISP configuration mode.</p>
Step 6	<p>Repeat Steps 3 through 5 for each LISP site to be configured.</p>	<p>Repeat steps 3 through 5 for the site SOC and FIN as shown in the configuration example at the end of this procedure.</p>
Step 7	<p>ip lisp map-resolver</p> <p>Example:</p>	<p>Enables LISP map resolver functionality for EIDs in the IPv4 address family.</p>

	Command or Action	Purpose
	<pre>switch(config)# ip lisp map-resolver</pre>	
Step 8	<p>ip lisp map-server</p> <p>Example:</p> <pre>switch(config)# ip lisp map-server</pre>	Enables LISP map server functionality for EIDs in the IPv4 address family.
Step 9	<p>vrf context <i>vrf-name</i></p> <p>Example:</p> <pre>switch(config)# vrf context vrf1</pre>	Enters VRF configuration submode.
Step 10	<p>database-mapping <i>EID-prefix/prefix-length locator priority priority weight weight</i></p> <p>Example:</p> <pre>switch(config-vrf)# database-mapping 10.1.1.0/24 172.16.1.2 priority 1 weight 100</pre>	<p>Configures an EID-to-RLOC mapping relationship and its associated traffic policy for this LISP site.</p> <ul style="list-style-type: none"> • The EID prefix 10.1.1.0/24 within instance ID 1 at this site is associated with the local IPv4 RLOC 172.16.1.2, as well as with the neighbor xTR RLOC 172.6.1.6. • Repeat Step 10 until all EID-to-RLOC mappings within this eid-table vrf and instance ID for the LISP site are configured.
Step 11	Repeat Step 10 until all EID-to-RLOC mappings within this EID table VRF and instance ID for the LISP site are configured.	
Step 12	<p>ip lisp etr map-server <i>map-server-address key key-type authentication-key</i></p> <p>Example:</p> <pre>switch(config-vrf)# ip lisp etr map-server 172.16.1.2 key 0 TRANS-key</pre>	<p>Configures a locator address for the LISP map server and an authentication key, which this switch, acting as an IPv4 LISP ETR, will use to register with the LISP mapping system.</p> <ul style="list-style-type: none"> • In this example, the map server and authentication-key are specified in the EID-table subcommand mode, so that the authentication key is associated only with this instance ID, within this VPN. <p>Note The map server must be configured with EID prefixes and instance-ids matching the one(s) configured on this ETR, as well as an identical authentication key.</p>

	Command or Action	Purpose
		<p>Note The locator address of the map server can be an IPv4 or IPv6 address. Because each xTR has only IPv4 RLOC connectivity, the map server is reachable using its IPv4 locator addresses.</p>
Step 13	<p>ip lisp itr map-resolver <i>map-resolver-address</i></p> <p>Example:</p> <pre>switch(config-vrf)# ip lisp itr map-resolver 172.16.1.2</pre>	<p>Configures a locator address for the LISP map resolver to which this switch will send map request messages for IPv4 EID-to-RLOC mapping resolutions.</p> <p>Note In this example, the map resolver is specified in switch lisp configuration mode and is inherited into all EID-table instances, since nothing is related to any single instance ID. In addition, redundant map resolvers are configured. Because the MR is co-located with the xTRs in this case, this xTR is pointing to itself for mapping resolution (and to its neighbor xTR/MS/MR at the same site).</p> <p>Note The locator address of the map resolver may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map resolver is reachable using its IPv4 locator address.</p> <p>Note You can configure up to two map resolvers if multiple map resolvers are available.</p>
Step 14	<p>Repeat Step 13 to configure another locator address for the LISP map resolver</p> <p>Example:</p> <pre>switch(config-vrf)# ip lisp itr map-resolver 172.16.1.6</pre>	<p>Configures a locator address for the LISP map resolver to which this switch will send map request messages for IPv4 EID-to-RLOC mapping resolutions.</p> <p>Note In this example, a redundant map resolver is configured. (Because the MR is co-located with the xTRs in this case, this command indicates that this xTR is pointing to itself for mapping resolution (and its neighbor xTR/MS/MR at the same site).</p>

	Command or Action	Purpose
		<p>Note The locator address of the map resolver may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map resolver is reachable using its IPv4 locator address.</p> <p>Note You can configure up to two map resolvers if multiple map resolvers are available.</p>
Step 15	<p>ip lisp itr</p> <p>Example:</p> <pre>switch(config-vrf)# ip lisp itr</pre>	Enables LISP ITR functionality for the IPv4 address family.
Step 16	<p>ip lisp etr</p> <p>Example:</p> <pre>switch(config-vrf)# ip lisp etr</pre>	Enables LISP ETR functionality for the IPv4 address family.
Step 17	<p>ip lisp locator-vrf default</p> <p>Example:</p> <pre>switch(config-vrf)# ip lisp locator-vrf BLUE</pre>	Configures a nondefault VRF table to be referenced by any IPv4 locators addresses.
Step 18	<p>ipv6 lisp locator-vrf default</p> <p>Example:</p> <pre>switch(config-vrf)# ipv6 lisp locator-vrf default</pre>	Configures a nondefault VRF table to be referenced by any IPv6 locator addresses.
Step 19	<p>exit</p> <p>Example:</p> <pre>switch(config-vrf)# exit</pre>	Exits VRF configuration mode and returns to global configuration mode.
Step 20	Repeat step 9 to 19 for all VRFs.	
Step 21	<p>ip route <i>ipv4-prefix next-hop</i></p> <p>Example:</p>	Configures a default route to the upstream next hop for all IPv4 destinations.

	Command or Action	Purpose
	<pre>switch(config)# ip route 0.0.0.0 0.0.0.0 172.16.1.1</pre>	<p>Note All IPv4 EID-sourced packets destined to both LISP and non-LISP sites are forwarded in one of two ways:</p> <ul style="list-style-type: none"> • LISP-encapsulated to a LISP site when traffic is LISP-to-LISP • natively forwarded when traffic is LISP-to-non-LISP <p>Note Packets are deemed to be a candidate for LISP encapsulation when they are sourced from a LISP EID and the destination is one of the following:</p> <ul style="list-style-type: none"> • a current map-cache entry • a default route with a legitimate next-hop • a static route to Null0 • no route at all <p>In this configuration example, because the xTR has IPv4 RLOC connectivity, a default route to the upstream SP is used for all IPv4 packets to support LISP processing.</p>
Step 22	<p>(Optional) show running-config lisp</p> <p>Example:</p> <pre>switch(config)# show running-config lisp</pre>	Displays the LISP configuration on the switch.
Step 23	<p>(Optional) show [ip ipv6] lisp</p> <p>Example:</p> <pre>switch(config)# show ip lisp vrf TRANS</pre>	The show ip lisp and show ipv6 lisp commands are useful for quickly verifying the operational status of LISP as configured on the switch, as applicable to the IPv4 and IPv6 address families respectively.
Step 24	<p>(Optional) show [ip ipv6] lisp map-cache [vrf vrf-name]</p> <p>Example:</p> <pre>switch(config)# show ip lisp map-cache</pre>	Displays the operational status of the map cache on a switch configured as an ITR or PITR, as applicable to the IPv4 and IPv6 address families.
Step 25	<p>(Optional) show [ip ipv6] lisp database [vrf vrf-name]</p> <p>Example:</p>	The show ip lisp database and show ipv6 lisp database commands are useful for quickly verifying the operational status of the database mapping on a switch configured as an ETR,

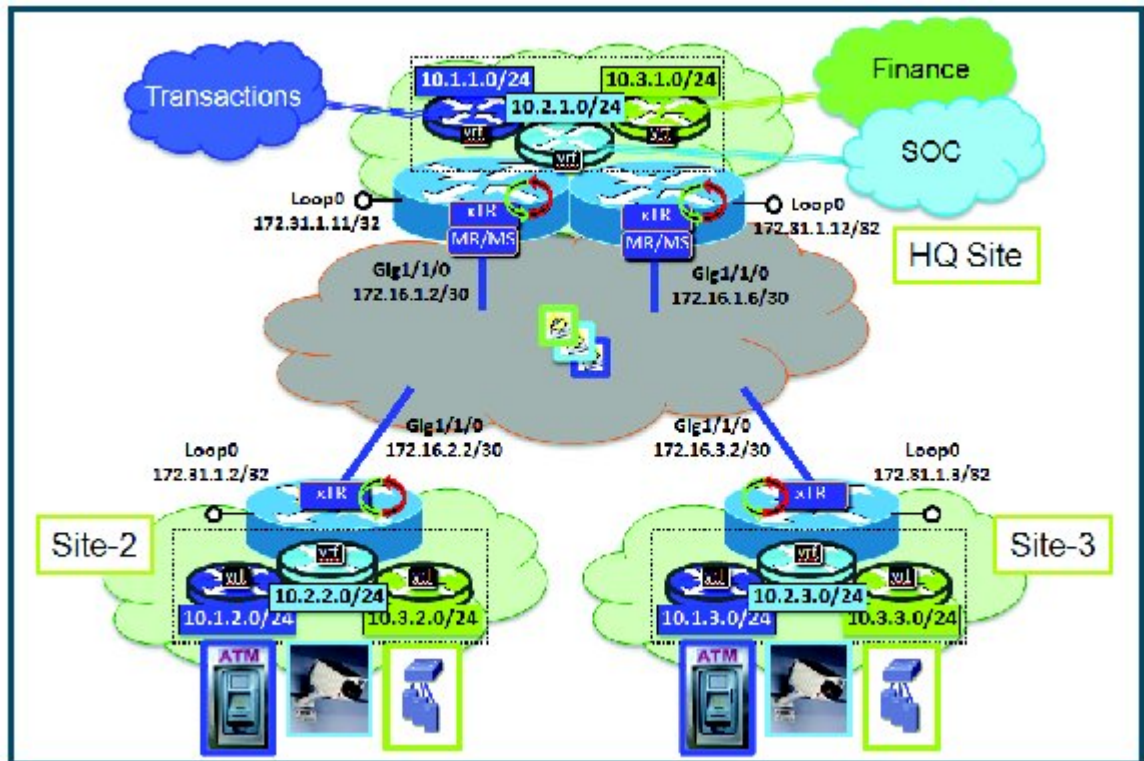
	Command or Action	Purpose
	<pre>switch(config)# show ipv6 lisp database vrf GOLD</pre>	<p>as applicable to the IPv4 and IPv6 address families.</p> <p>This example shows IPv6 mapping database information for a VRF named GOLD.</p>
Step 26	<p>(Optional) show lisp site [<i>name site-name</i>]</p> <p>Example:</p> <pre>switch(config)# show lisp site</pre>	<p>The show lisp site command verifies the operational status of LISP sites, as configured on a map server. This command only applies to a switch configured as a map server.</p>
Step 27	<p>(Optional) clear [<i>ip ipv6</i>] lisp map-cache [<i>vrf vrf-name</i>]</p> <p>Example:</p> <pre>switch(config)# show ip lisp map-cache vrf vrf1 switch(config)# clear ip lisp map-cache vrf vrf1</pre>	<p>The clear ip lisp map-cache and clear ipv6 lisp map-cache commands remove all IPv4 or IPv6 dynamic LISP map-cache entries stored by the switch. They verify the operational status of the LISP control plane. The command applies to a LISP switch that maintains a map cache (for example, a switch configured as an ITR or PITR).</p> <p>The first command in the example displays IPv4 mapping cache information for vrf1. The second command clears the mapping cache for vrf1 and displays the status information after clearing the cache.</p>

Configuring a Remote Site for Large-Scale LISP Shared Model Virtualization

You can perform this task to enable and configure LISP ITR/ETR (xTR) functionality at a remote site to implement LISP shared model virtualization as part of a large-scale, multiple-site LISP topology.

This configuration task is part of a more complex, larger scale LISP virtualization solution. The configuration applies to one of the remote sites shown in the figure below. The remote site switches only act as xTRs, and use the MS/MRs at the HQ site for LISP control plane support.

Figure 16: Large Scale LISP Site with Virtualized IPv4 EIDs and a Shared IPv4 Core



The components illustrated in the topology shown in the figure above are described below:

- **LISP remote sites:**

- Each customer premises equipment (CPE) switch at a remote site functions as a LISP ITR and ETR (xTR).
- Each LISP xTR has the same three VRFs as the HQ Site: the TRANS (for transactions), the SOC (for security operations), and the FIN (for financials). Each VRF contains only IPv4 EID-prefixes.
- Each remote site LISP xTR has a single RLOC connection to a shared IPv4 core network.

Before you begin

Create the VRFs using the **vrf definition** command and verify that the Configure a Large-Scale LISP Shared Model Virtualization task has been performed at one or more central (headquarters) sites.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: Switch# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 2	vrf context <i>vrf-name</i> Example: <pre>Switch(config)# vrf context vrf1</pre>	Enters VRF configuration submode.
Step 3	database-mapping <i>EID-prefix/prefix-length locator priority priority weight weight</i> Example: <pre>Switch(config-vrf)# database-mapping 10.1.1.0/24 172.16.1.2 priority 1 weight 100</pre>	Configures an EID-to-RLOC mapping relationship and its associated traffic policy for this LISP site. <ul style="list-style-type: none"> In this example, the EID prefix 10.1.1.0/24 within instance-id 1 at this site is associated with the local IPv4 RLOC 172.16.1.2, as well as with the neighbor xTR RLOC 172.6.1.6.
Step 4	ip lisp etr map-server <i>map-server-address key key-type authentication-key</i> Example: <pre>Switch(config-vrf)# ip lisp etr map-server 172.16.1.2 key 0 TRANS-key</pre>	Configures a locator address for the LISP map server and an authentication key for which this switch, acting as an IPv4 LISP ETR, will use to register with the LISP mapping system. <ul style="list-style-type: none"> In this example, the map server and authentication-key are specified here, within the eid-table subcommand mode, so that the authentication key is associated only with this instance ID, within this VPN. <p>Note The map server must be configured with EID prefixes and instance-ids matching the one(s) configured on this ETR, as well as an identical authentication key.</p> <p>Note The locator address of the map server may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map server is reachable using its IPv4 locator addresses.</p>
Step 5	Repeat Step 4 to configure another locator address for the same LISP map server. Example: <pre>Switch(config-vrf)# ip lisp etr map-server 172.16.1.6 key 0 TRANS-key</pre>	Configures a locator address for the LISP map server and an authentication key for which this switch, acting as an IPv4 LISP ETR, will use to register with the LISP mapping system. <ul style="list-style-type: none"> In this example, a redundant map server is configured. (Because the MS is co-located with the xTRs in this case, this command indicates that this xTR is

	Command or Action	Purpose
		pointing to itself for registration (and its neighbor xTR/MS/MR at the same site).
Step 6	<p>ip lisp itr map-resolver <i>map-resolver-address</i></p> <p>Example:</p> <pre>Switch(config-vrf)# ip lisp itr map-resolver 172.16.1.2</pre>	<p>Configures a locator address for the LISP map resolver to which this switch will send map request messages for IPv4 EID-to-RLOC mapping resolutions.</p> <ul style="list-style-type: none"> In this example, the map resolver is specified within switch lisp configuration mode and inherited into all eid-table instances since nothing is related to any single instance ID. In addition, redundant map resolvers are configured. (Because the MR is co-located with the xTRs in this case, this command indicates that this xTR is pointing to itself for mapping resolution (and its neighbor xTR/MS/MR at the same site). The locator address of the map resolver may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map resolver is reachable using its IPv4 locator address. <p>Note Up to two map resolvers may be configured if multiple map resolvers are available.</p>
Step 7	<p>Repeat Step 6 to configure another locator address for the LISP map resolver</p> <p>Example:</p> <pre>Switch(config-vrf)# ip lisp itr map-resolver 172.16.1.6</pre>	<p>Configures a locator address for the LISP map resolver to which this switch will send map request messages for IPv4 EID-to-RLOC mapping resolutions.</p> <p>Note In this example, a redundant map resolver is configured. (Because the MR is co-located with the xTRs in this case, this command indicates that this xTR is pointing to itself for mapping resolution (and its neighbor xTR/MS/MR at the same site).</p> <p>The locator address of the map resolver may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map resolver is reachable using its IPv4 locator address.</p>

	Command or Action	Purpose
		Note Up to two map resolvers may be configured if multiple map resolvers are available.
Step 8	ip lisp itr Example: Switch(config-vrf)# ip lisp itr	Enables LISP ITR functionality for the IPv4 address family.
Step 9	ip lisp etr Example: Switch(config-vrf)# ip lisp etr	Enables LISP ETR functionality for the IPv4 address family.
Step 10	ip lisp locator-vrf default Example: Switch(config-vrf)# ip lisp locator-vrf BLUE	Configures a non-default VRF table to be referenced by any IPv4 locator addresses.
Step 11	ipv6 lisp locator-vrf default Example: Switch(config-vrf)# ipv6 lisp locator-vrf default	Configures a non-default VRF table to be referenced by any IPv6 locator addresses.
Step 12	exit Example: Switch(config-vrf)# exit	Exits VRF configuration mode and returns to global configuration mode.
Step 13	Repeat Steps 2 to 12 for all VRFs.	
Step 14	ip route <i>ipv4-prefix next-hop</i> Example: Switch(config)# ip route 0.0.0.0 0.0.0.0 172.16.2.1	Configures a default route to the upstream next hop for all IPv4 destinations. <ul style="list-style-type: none"> • All IPv4 EID-sourced packets destined to both LISP and non-LISP sites are forwarded in one of two ways: <ul style="list-style-type: none"> • LISP-encapsulated to a LISP site when traffic is LISP-to-LISP • natively forwarded when traffic is LISP-to-non-LISP • Packets are deemed to be a candidate for LISP encapsulation when they are sourced from a LISP EID and the destination matches one of the following entries:

	Command or Action	Purpose
		<ul style="list-style-type: none"> • a current map-cache entry • a default route with a legitimate next-hop • a static route to Null0 • no route at all <p>In this configuration example, because the xTR has IPv4 RLOC connectivity, a default route to the upstream SP is used for all IPv4 packets to support LISP processing.</p>
Step 15	(Optional) show running-config lisp Example: <pre>Switch(config)# show running-config lisp</pre>	Verifies the LISP configuration on the switch.
Step 16	(Optional) show [ip ipv6] lisp Example: <pre>Switch(config)# show ip lisp vrf TRANS</pre>	The show ip lisp and show ipv6 lisp commands verify the operational status of LISP as configured on the switch, as applicable to the IPv4 and IPv6 address families, respectively.
Step 17	(Optional) show [ip ipv6] lisp map-cache [vrf vrf-name] Example: <pre>Switch(config)# show ip lisp map-cache</pre>	The show ip lisp map-cache and show ipv6 lisp map-cache commands verify the operational status of the map cache on a switch configured as an ITR or Pitr, as applicable to the IPv4 and IPv6 address families, respectively.
Step 18	(Optional) show [ip ipv6] lisp database [vrf vrf-name] Example: The following example shows IPv6 mapping database information for the VRF named GOLD. <pre>Switch(config)# show ipv6 lisp database vrf GOLD</pre>	The show ip lisp database and show ipv6 lisp database commands display the operational status of the database mapping on a switch configured as an ETR, as applicable to the IPv4 and IPv6 address families, respectively.
Step 19	(Optional) show lisp site [name site-name] Example: <pre>Switch(config)# show lisp site</pre>	The show lisp site command is useful for quickly verifying the operational status of LISP sites, as configured on a map server. This command only applies to a switch configured as a map server.
Step 20	clear [ip ipv6] lisp map-cache [vrf vrf-name]	The clear ip lisp map-cache and clear ipv6 lisp map-cache commands remove all IPv4 or IPv6 dynamic LISP map-cache entries

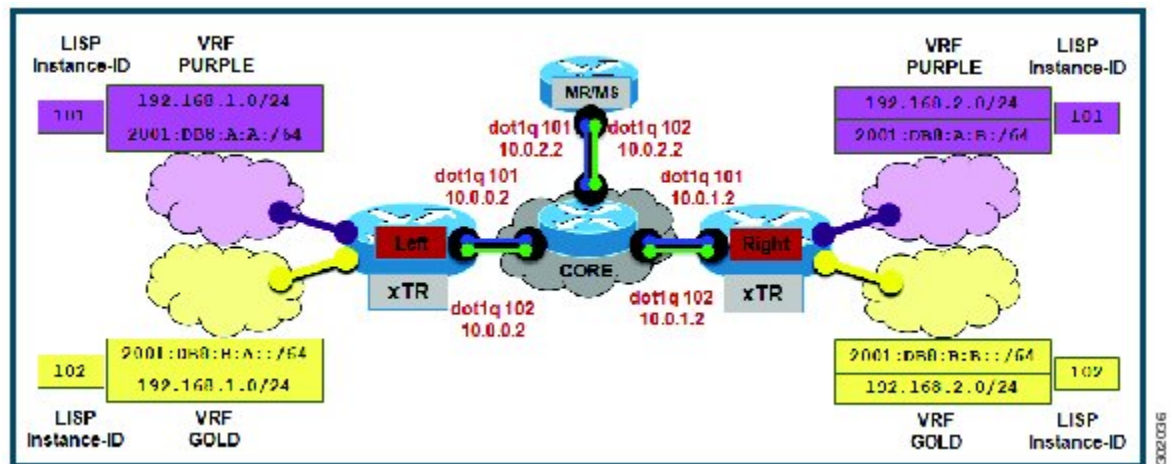
	Command or Action	Purpose
	<p>Example:</p> <p>The following commands display IPv4 mapping cache information for vrf1, and clear the mapping cache for vrf1. Clearing also displays the show information after it clears the cache.</p> <pre>Switch(config)# show ip lisp map-cache vrf vrf1 Switch(config)# clear ip lisp map-cache vrf vrf1</pre>	<p>stored by the switch. These verify the operational status of the LISP control plane. The command applies to a LISP switch that maintains a map cache (for example, if configured as an ITR or PITR).</p>

Configuring Simple LISP Parallel Model Virtualization

You can perform these tasks to enable and configure LISP ITR/ETR (xTR) functionality and LISP map resolver and map server for LISP parallel model virtualization.

The configuration in the following figure below is for two LISP sites that are connected in parallel mode. Each LISP site uses a single edge switch configured as both an ITR and ETR (xTR), with a single connection to its upstream provider. Note that the upstream connection is VLAN-segmented to maintain RLOC space separation within the core. Two VRFs are defined here: BLUE and GREEN. The IPv4 RLOC space is used in each of these parallel networks. Both IPv4 and IPv6 EID address space is used. The LISP site registers to one map server/map resolver (MS/MR), which is segmented to maintain the parallel model architecture of the core network.

Figure 17: Simple LISP Site with One IPv4 RLOC and One IPv4 EID



The components illustrated in the topology shown in the figure above are described below.

LISP site

- The customer premises equipment (CPE) functions as a LISP ITR and ETR (xTR).
- Both LISP xTRs have two VRFs: GOLD and PURPLE, with each VRF containing both IPv4 and IPv6 EID-prefixes, as shown in the figure above. Note the overlapping prefixes, used for illustration purposes.

A LISP instance ID is used to maintain separation between two VRFs. The share key is configured "per-VPN."

- Each LISP xTR has a single RLOC connection to a parallel IPv4 core network.

Perform the steps in this task (once through for each xTR in the LISP site) to enable and configure LISP ITR and ETR (xTR) functionality when using a LISP map-server and map-resolver for mapping services. The example configurations at the end of this task show the full configuration for two xTRs (Left-xTR and Right-xTR).

Before you begin

Create the VRFs using the **vrf context** command.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal	Enters global configuration mode.
Step 2	vrf context <i>vrf-name</i> Example: switch(config)# vrf context vrf1	Enters VRF configuration submode. • In this example, the RLOC VRF named vrf1 is configured.
Step 3	lisp instance-id <i>instance-id</i> Example: switch(config-vrf)# lisp instance-id 101	Configures an association between a VRF and a LISP instance ID.
Step 4	ip lisp database-mapping <i>EID-prefix/prefix-length locator priority</i> <i>priority weight weight</i> Example: switch(config-vrf)# ip lisp database-mapping 192.168.1.0/24 10.0.0.2 priority 1 weight 1	Configures an EID-to-RLOC mapping relationship and its associated traffic policy for this LISP site. Note In this example, a single IPv4 EID prefix, 192.168.1.0/24, within instance ID 1 at this site is associated with the local IPv4 RLOC 10.0.0.2.
Step 5	exit Example: switch(config-vrf)# exit	Exits VRF configuration submode and returns to global mode.
Step 6	ipv4 itr map-resolver <i>map-resolver-address</i> Example:	Configures a locator address for the LISP map resolver to which this switch will send map

	Command or Action	Purpose
	<pre>switch(config)# ip lisp itr map-resolver 10.0.2.2</pre>	<p>request messages for IPv4 EID-to-RLOC mapping resolutions.</p> <p>Note The locator address of the map resolver may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map resolver is reachable using its IPv4 locator address.</p> <p>Note Up to two map resolvers may be configured if multiple map resolvers are available.</p>
Step 7	<p>ip lisp etr map-server <i>map-server-address</i> key <i>key-type authentication-key</i></p> <p>Example:</p> <pre>switch(config)# ip lisp etr map-server 10.0.2.2 key 0 PURPLE-key</pre>	<p>Configures a locator address for the LISP map server and an authentication key for which this switch, acting as an IPv4 LISP ETR, will use to register with the LISP mapping system.</p> <p>Note The map server must be configured with EID prefixes and instance IDs matching those configured on this ETR and with an identical authentication key.</p> <p>Note The locator address of the map server may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map-server is reachable using its IPv4 locator addresses.</p>
Step 8	<p>ip lisp itr</p> <p>Example:</p> <pre>switch(config)# ip lisp itr</pre>	<p>Enables LISP ITR functionality for the IPv4 address family.</p>
Step 9	<p>ip lisp etr</p> <p>Example:</p> <pre>switch(config)# ip lisp etr</pre>	<p>Enables LISP ETR functionality for the IPv4 address family.</p>
Step 10	<p>ipv6 lisp itr map-resolver <i>map-resolver-address</i></p> <p>Example:</p>	<p>Configures a locator address for the LISP map resolver to which this switch will send map request messages for IPv6 EID-to-RLOC mapping resolutions.</p>

	Command or Action	Purpose
	<pre>switch(config)# ipv6 lisp itr map-resolver 10.0.2.2</pre>	<p>Note The locator address of the map resolver may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map-resolver is reachable using its IPv4 locator addresses.</p> <p>Note Up to two map resolvers may be configured if multiple map resolvers are available.</p>
Step 11	<p>ipv6 lisp etr map-server <i>map-server-address</i> key <i>key-type authentication-key</i></p> <p>Example:</p> <pre>switch(config)# ipv6 lisp etr map-server 10.0.2.2 key 0 PURPLE-key</pre>	<p>Configures a locator address for the LISP map-server and an authentication key that this switch, acting as an IPv6 LISP ETR, will use to register to the LISP mapping system.</p> <p>Note The map-server must be configured with EID prefixes and instance IDs matching those configured on this ETR and with an identical authentication key.</p> <p>Note The locator address of the map-server may be an IPv4 or IPv6 address. In this example, because each xTR has only IPv4 RLOC connectivity, the map-server is reachable using its IPv4 locator addresses.</p>
Step 12	<p>ipv6 itr</p> <p>Example:</p> <pre>switch(config)# ipv6 itr</pre>	Enables LISP ITR functionality for the IPv6 address family.
Step 13	<p>ipv6 etr</p> <p>Example:</p> <pre>switch(config)# ipv6 etr</pre>	Enables LISP ETR functionality for the IPv6 address family.
Step 14	<p>ip route vrf <i>rloc-vrf-name ipv4-prefix</i> <i>next-hop</i></p> <p>Example:</p> <pre>switch(config)# ip route vrf BLUE 0.0.0.0 0.0.0.0 10.0.0.1</pre>	<p>Configures a default route to the upstream next hop for all IPv4 destinations.</p> <p>All IPv4 EID-sourced packets destined to both LISP and non-LISP sites are forwarded in one of two ways:</p> <ul style="list-style-type: none"> • LISP-encapsulated to a LISP site when traffic is LISP-to-LISP

	Command or Action	Purpose
		<ul style="list-style-type: none"> • natively forwarded when traffic is LISP-to-non-LISP <p>Packets are deemed to be a candidate for LISP encapsulation when they are sourced from a LISP EID and the destination matches one of the following entries:</p> <ul style="list-style-type: none"> • a current map-cache entry • a default route with a legitimate next-hop • a static route to Null0 • no route at all <p>In this configuration example, because the xTR has IPv4 RLOC connectivity, a default route to the upstream SP is used for all IPv4 packets to support LISP processing.</p>
Step 15	<p>ipv6 route vrf <i>rloc-vrf-name ipv6-prefix next-hop</i></p> <p>Example:</p> <pre>switch(config)# ipv6 route vrf BLUE ::/0 Null0</pre>	<p>Configures a default route to the upstream next hop for all IPv6 destinations, reachable within the specified RLOC VRF.</p> <p>All IPv6 EID-sourced packets destined for both LISP and non-LISP sites require LISP support for forwarding in the following two ways:</p> <ul style="list-style-type: none"> • LISP-encapsulated to a LISP site when traffic is LISP-to-LISP • natively forwarded when traffic is LISP-to-non-LISP <p>Packets are deemed to be a candidate for LISP encapsulation when they are sourced from a LISP EID and the destination matches one of the following entries:</p> <ul style="list-style-type: none"> • a current map-cache entry • a default route with a legitimate next-hop • a static route to Null0 • no route at all <p>In this configuration example, because the xTR has only IPv4 RLOC connectivity, adding an IPv6 default route to Null0 ensures that all IPv6 packets are handled by LISP processing. If the destination is another LISP site, packets are LISP-encapsulated (using IPv4 RLOCs) to the remote site. If the destination is non-LISP, all IPv6 EIDs are LISP-encapsulated to a Proxy ETR (PETR) –assuming one is configured.</p>

	Command or Action	Purpose
		Note The use of the static route to Null0 is not required, but is considered a LISP best practice.
Step 16	(Optional) show running-config lisp Example: switch(config)# show running-config lisp	Shows the LISP configuration on the switch.
Step 17	(Optional) show [ip ipv6] lisp Example: switch(config)# show ip lisp vrf TRANS	The show ip lisp and show ipv6 lisp commands verify the operational status of LISP as configured on the switch, as applicable to the IPv4 and IPv6 address families, respectively.
Step 18	(Optional) show [ip ipv6] lisp map-cache [vrf vrf-name] Example: switch(config)# show ip lisp map-cache	The show ip lisp map-cache and show ipv6 lisp map-cache commands verify the operational status of the map cache on a switch configured as an ITR or Proxy ETR (PETR), as applicable to the IPv4 and IPv6 address families, respectively.
Step 19	(Optional) show [ip ipv6] lisp database [vrf vrf-name] Example: The following example shows IPv6 mapping database information for the VRF named GOLD. switch(config)# show ipv6 lisp database vrf GOLD	The show ip lisp database and show ipv6 lisp database commands verify the operational status of the database mapping on a switch configured as an ETR, as applicable to the IPv4 and IPv6 address families, respectively.
Step 20	(Optional) show lisp site [name site-name] Example: switch(config)# show lisp site	The show lisp site command verifies the operational status of LISP sites, as configured on a map server. This command only applies to a switch configured as a map server.
Step 21	clear [ip ipv6] lisp map-cache [vrf vrf-name] Example: switch(config)# show ip lisp map-cache vrf vrf1 switch(config)# clear ip lisp map-cache vrf vrf1	The clear ip lisp map-cache and clear ipv6 lisp map-cache commands remove all IPv4 or IPv6 dynamic LISP map-cache entries stored by the switch. This verifies the operational status of the LISP control plane. This command applies to a LISP switch that maintains a map cache (for example, if configured as an ITR or PITR).

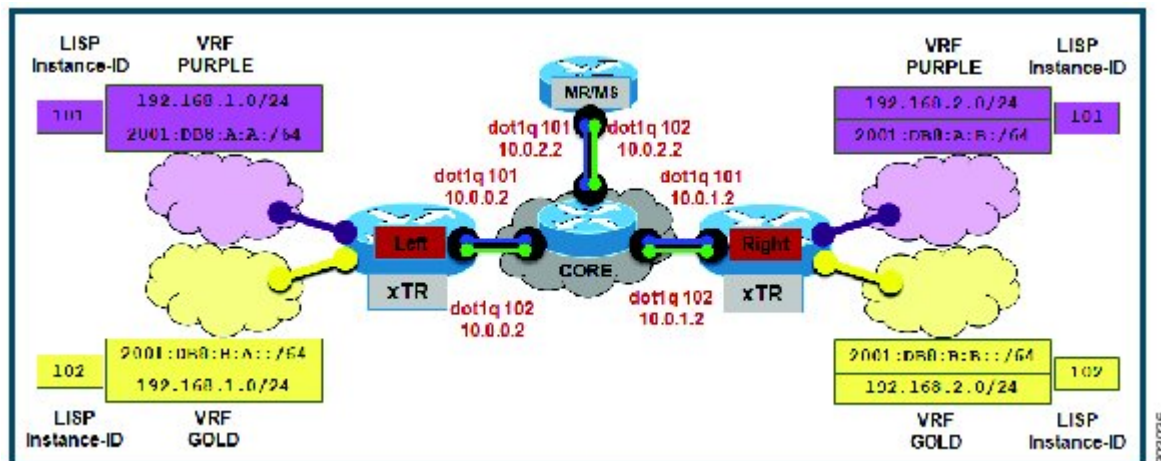
	Command or Action	Purpose
		The commands in the example display IPv4 mapping cache information for vrf1, and clear the mapping cache for vrf1 and show information after clearing the cache.

Configuring a Private LISP Mapping System for LISP Parallel Model Virtualization

Perform this task to configure and enable standalone LISP map server/map resolver functionality for LISP parallel model virtualization. In this task, a Cisco switch is configured as a standalone map resolver/map server (MR/MS) for a private LISP mapping system. Because the MR/MS is configured as a stand-alone switch, it has no need for LISP alternate logical topology (ALT) connectivity. All relevant LISP sites must be configured to register with this map server so that this map server has full knowledge of all registered EID prefixes within the (assumed) private LISP system.

- **Mapping system:**

Figure 18: Simple LISP Site with One IPv4 RLOC and One IPv4 EID



- One map resolver/map server (MS/MR) system is shown in the figure above and assumed available for the LISP xTR to register to within the proper parallel RLOC space. The MS/MR has an IPv4 RLOC address of 10.0.2.2, within each VLAN/VRF (Green and Blue) providing parallel model RLOC separation in the IPv4 core.
- The map server site configurations are virtualized using LISP instance IDs to maintain separation between the two VRFs, PURPLE and GOLD.

Repeat this task for all lisp instantiations and RLOC VRFs.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>Switch# configure terminal</pre>	Enters global configuration mode.
Step 2	lisp site <i>site-name</i> Example: <pre>Switch(config)# lisp site PURPLE</pre>	Specifies a LISP site named Purple and enters LISP site configuration mode. <ul style="list-style-type: none"> In this example, the LISP site named Purple is configured.
Step 3	authentication-key [<i>key-type</i>] authentication-key Example: <pre>Switch(config-lisp-site)# authentication-key 0 Purple-key</pre>	Configures the password used to create the SHA-2 HMAC hash for authenticating the map register messages sent by an ETR when registering to the map server. <p>Note The ETR must be configured with EID prefixes and instance IDs matching the one(s) configured on this map server, as well as an identical authentication key.</p>
Step 4	eid-prefix <i>EID-prefix</i> instance-id <i>instance-id</i> Example: <pre>Switch(config-lisp-site)# eid-prefix 192.168.1.0/24 instance-id 101</pre>	Configures an EID prefix and instance ID that are allowed in a map register message sent by an ETR when registering to this map server. Repeat this step as necessary to configure additional IPv4 EID prefixes under this LISP site. <ul style="list-style-type: none"> In this example, the IPv4 EID prefix 192.168.1.0/24 and instance ID 101 are associated together.
Step 5	eid-prefix <i>EID-prefix</i> instance-id <i>instance-id</i> Example: <pre>Switch(config-lisp-site)# eid-prefix 2001:db8:a:a::/64 instance-id 101</pre>	Configures an EID prefix and instance ID that are allowed in a map register message sent by an ETR when registering to this map server. Repeat this step as necessary to configure additional IPv6 EID prefixes under this LISP site. <ul style="list-style-type: none"> In this example, the IPv6 EID prefix 2001:db8:a:a::/64 and instance ID 101 are associated together.
Step 6	exit Example: <pre>Switch(config-lisp-site)# exit</pre>	Exits LISP site configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 7	ip lisp map-resolver Example: Switch(config)# ip lisp map-resolver	Enables LISP map resolver functionality for EIDs in the IPv4 address family.
Step 8	ip lisp map-server Example: Switch(config)# ip lisp map-server	Enables LISP map server functionality for EIDs in the IPv4 address family.
Step 9	ipv6 lisp map-resolver Example: Switch(config)# ipv6 lisp map-resolver	Enables LISP map resolver functionality for EIDs in the IPv6 address family.
Step 10	ipv6 lisp map-server Example: Switch(config)# ipv6 lisp map-server	Enables LISP map server functionality for EIDs in the IPv6 address family.
Step 11	ip route vrf rloc-vrf-name ipv4-prefix next-hop Example: Switch(config)# ip route vrf BLUE 0.0.0.0 0.0.0.0 10.0.2.1	Configures a default route to the upstream next hop for all IPv4 destinations, reachable within the specified RLOC VRF.
Step 12	show running-config lisp Example: Switch(config)# show running-config lisp	Verifies the LISP configuration on the switch.
Step 13	show [ip ipv6] lisp Example: Switch(config)# show ip lisp vrf TRANS	The show ip lisp and show ipv6 lisp commands are useful for quickly verifying the operational status of LISP as configured on the switch, as applicable to the IPv4 and IPv6 address families respectively.
Step 14	show [ip ipv6] lisp map-cache [vrf vrf-name] Example: Switch(config)# show ip lisp map-cache	The show ip lisp map-cache and show ipv6 lisp map-cache commands are useful for quickly verifying the operational status of the map cache on a switch configured as an ITR or PITR, as applicable to the IPv4 and IPv6 address families respectively.
Step 15	show [ip ipv6] lisp database [vrf vrf-name] Example:	The show ip lisp database and show ipv6 lisp database commands are useful for quickly verifying the operational status of the database

	Command or Action	Purpose
	<p>The following example shows IPv6 mapping database information for the VRF named GOLD.</p> <pre>Switch(config)# show ipv6 lisp database vrf GOLD</pre>	mapping on a switch configured as an ETR, as applicable to the IPv4 and IPv6 address families respectively.
Step 16	<p>show lisp site [<i>name site-name</i>]</p> <p>Example:</p> <pre>Switch(config)# show lisp site</pre>	The show lisp site command is useful for quickly verifying the operational status of LISP sites, as configured on a map server. This command only applies to a switch configured as a map server.
Step 17	<p>clear [<i>ip ipv6</i>] lisp map-cache [<i>vrf vrf-name</i>]</p> <p>Example:</p> <p>The following example displays IPv4 mapping cache information for vrf1, shows the command used to clear the mapping cache for vrf1, and displays the show information after clearing the cache.</p> <pre>Switch(config)# show ip lisp map-cache vrf vrf1 Switch(config)# clear ip lisp map-cache vrf vrf1</pre>	The clear ip lisp map-cache and clear ipv6 lisp map-cache commands remove all IPv4 or IPv6 dynamic LISP map-cache entries stored by the switch. This can be useful for trying to quickly verify the operational status of the LISP control plane. This command applies to a LISP switch that maintains a map cache (for example, if configured as an ITR or PITR).

Configuration Examples for LISP Instance-ID Support

Example: Configuring Simple LISP Shared Model Virtualization

These examples show the complete configuration for the LISP topology. On the xTRs, the VRFs and EID prefixes are assumed to be attached to VLANs configured on the switches.

This example shows how to configure the left xTR:

```
vrf context GOLD
  ipv6 lisp itr
  ip lisp itr
  ipv6 lisp etr
  ip lisp etr
  ipv6 lisp database-mapping 2001:db8:b:a::/64 10.0.0.2 priority 1 weight 100
  ip lisp database-mapping 192.168.1.0/24 10.0.0.2 priority 1 weight 100
  lisp instance-id 102
  ipv6 lisp locator-vrf default
  ip lisp locator-vrf default
  ipv6 lisp itr map-resolver 10.0.2.2
  ip lisp itr map-resolver 10.0.2.2
```



```
ipv6 lisp etr map-server 10.0.2.2 key Left-key
ip lisp etr map-server 10.0.2.2 key Left-key

interface Ethernet0/0
 ip address 10.0.0.2 255.255.255.0

interface Ethernet1/0.1
 encapsulation dot1q 101
 vrf forwarding PURPLE
 ip address 192.168.1.1 255.255.255.0
 ipv6 address 2001:DB8:A:A::1/64

interface Ethernet1/0.2
 encapsulation dot1q 102
 vrf forwarding GOLD
 ip address 192.168.1.1 255.255.255.0
 ipv6 address 2001:DB8:B:A::1/64

vrf context PURPLE
 ipv6 lisp itr
 ip lisp itr
 ipv6 lisp etr
 ip lisp etr
 ipv6 lisp database-mapping 2001:db8:a:a::/64 10.0.0.2 priority 1 weight 100
 ip lisp database-mapping 192.168.1.0/24 10.0.0.2 priority 1 weight 100
 lisp instance-id 101
 ipv6 lisp locator-vrf default
 ip lisp locator-vrf default
 ipv6 lisp itr map-resolver 10.0.2.2
 ip lisp itr map-resolver 10.0.2.2
 ipv6 lisp etr map-server 10.0.2.2 key Left-key
 ip lisp etr map-server 10.0.2.2 key Left-key
```

This example shows how to configure the right xTR:

```
vrf context GOLD
 ipv6 lisp itr
 ip lisp itr
 ipv6 lisp etr
 ip lisp etr
 ipv6 lisp database-mapping 2001:db8:b:b::/64 10.0.1.2 priority 1 weight 100
 ip lisp database-mapping 192.168.2.0/24 10.0.1.2 priority 1 weight 100
 lisp instance-id 102
 ipv6 lisp locator-vrf default
 ip lisp locator-vrf default
 ipv6 lisp itr map-resolver 10.0.2.2
 ip lisp itr map-resolver 10.0.2.2
 ipv6 lisp etr map-server 10.0.2.2 key Right-key
 ip lisp etr map-server 10.0.2.2 key Right-key

interface Ethernet0/0
 ip address 10.0.1.2 255.255.255.0

interface Ethernet1/0.1
 encapsulation dot1q 101
 vrf forwarding PURPLE
 ip address 192.168.2.1 255.255.255.0
 ipv6 address 2001:DB8:A:B::1/64
```

```

interface Ethernet1/0.2
 encapsulation dot1q 102
 vrf forwarding GOLD
 ip address 192.168.2.1 255.255.255.0
 ipv6 address 2001:DB8:B:B::1/64

vrf context PURPLE
 ipv6 lisp itr
 ip lisp itr
 ipv6 lisp etr
 ip lisp etr
 ipv6 lisp database-mapping 2001:db8:a:b::/64 10.0.1.2 priority 1 weight 100
 ip lisp database-mapping 192.168.2.0/24 10.0.1.2 priority 1 weight 100
 lisp instance-id 101
 ipv6 lisp locator-vrf default
 ip lisp locator-vrf default
 ipv6 lisp itr map-resolver 10.0.2.2
 ip lisp itr map-resolver 10.0.2.2
 ipv6 lisp etr map-server 10.0.2.2 key Right-key
 ip lisp etr map-server 10.0.2.2 key Right-key

```

Example: Configuring a Private LISP Mapping System for LISP Shared Model Virtualization

This example shows how to configure the LISP map server/map resolver.

```

hostname MSMR
!
interface Ethernet0/0
 ip address 10.0.2.2 255.255.255.0
!
router lisp
!
 site Left
 authentication-key Left-key
 eid-prefix instance-id 101 192.168.1.0/24
 eid-prefix instance-id 101 2001:DB8:A:A::/64
 eid-prefix instance-id 102 192.168.1.0/24
 eid-prefix instance-id 102 2001:DB8:B:A::/64
 exit

!
 site Right
 authentication-key Right-key
 eid-prefix instance-id 101 192.168.2.0/24
 eid-prefix instance-id 101 2001:DB8:A:B::/64
 eid-prefix instance-id 102 192.168.2.0/24
 eid-prefix instance-id 102 2001:DB8:B:B::/64
 exit

!
 ipv4 map-server
 ipv4 map-resolver
 ipv6 map-server
 ipv6 map-resolver
 exit

!
 ip route 0.0.0.0 0.0.0.0 10.0.2.1

```

Example: Configuring Large-Scale LISP Shared Model Virtualization

Example:

The examples show the complete configuration for the HQ-RTR-1 and HQ-RTR-2 (xTR/MS/MR located at the HQ site), and Site2-xTR LISP switches. Both HQ-RTR-1 and HQ-RTR-2 are provided to illustrate the proper method for configuring a LISP multihomed site.

This example shows how to configure HQ-RTR-1 with an xTR, a map server, and a map resolver.

```

feature lisp
interface loopback 0
  ip address 172.31.1.11/32
interface ethernet2/1
  ip address 172.16.1.6/30
interface Ethernet 2/2
  vrf member TRANS
  ip address 10.1.1.1/24
interface Ethernet 2/3
  vrf member SOC
  ip address 10.2.1.1/24
interface Ethernet 2/4
  vrf member FIN
  ip address 10.3.1.1/24
ip lisp itr
ip lisp etr
ip lisp map-resolver
ip lisp map-server
ip lisp database-mapping 172.31.1.11/32 172.16.1.2 priority 1 weight 50
ip lisp database-mapping 172.31.1.11/32 172.16.1.6 priority 1 weight 50
ip lisp itr map-resolver 172.16.1.2
ip lisp itr map-resolver 172.16.1.6
ip lisp etr map-server 172.16.1.2 key DEFAULT-key
ip lisp etr map-server 172.16.1.6 key DEFAULT-key
vrf context FIN
  ip lisp itr
  ip lisp etr
  ip lisp database-mapping 10.3.1.0/24 172.16.1.2 priority 1 weight 50
  ip lisp database-mapping 10.3.1.0/24 172.16.1.6 priority 1 weight 50
  lisp instance-id 3
  ip lisp itr map-resolver 172.16.1.2
  ip lisp itr map-resolver 172.16.1.6
  ip lisp etr map-server 172.16.1.2 key FIN-key
  ip lisp etr map-server 172.16.1.6 key FIN-key
  ip lisp locator-vrf default
vrf context SOC
  ip lisp itr
  ip lisp etr
  ip lisp database-mapping 10.2.1.0/24 172.16.1.2 priority 1 weight 50
  ip lisp database-mapping 10.2.1.0/24 172.16.1.6 priority 1 weight 50
  lisp instance-id 2
  ip lisp itr map-resolver 172.16.1.2
  ip lisp itr map-resolver 172.16.1.6
  ip lisp etr map-server 172.16.1.2 key SOC-key
  ip lisp etr map-server 172.16.1.6 key SOC-key
  ip lisp locator-vrf default
vrf context TRANS
  ip lisp itr
  ip lisp etr
  ip lisp database-mapping 10.1.1.0/24 172.16.1.2 priority 1 weight 50
  ip lisp database-mapping 10.1.1.0/24 172.16.1.6 priority 1 weight 50

```

Example: Configuring Large-Scale LISP Shared Model Virtualization

```

lisp instance-id 1
ip lisp itr map-resolver 172.16.1.2
ip lisp itr map-resolver 172.16.1.6
ip lisp etr map-server 172.16.1.2 key TRANS-key
ip lisp etr map-server 172.16.1.6 key TRANS-key
ip lisp locator-vrf default
lisp site DEFAULT
  eid-prefix 172.31.1.0/24 accept-more-specifics
  authentication-key DEFAULT-key
lisp site FIN
  eid-prefix 10.3.0.0/16 accept-more-specifics
  authentication-key FIN-key
lisp site SOC
  eid-prefix 10.2.0.0/16 instance-id 2 accept-more-specifics
  authentication-key SOC-key
lisp site TRANS
  eid-prefix 10.1.0.0/16 instance-id 1 accept-more-specifics
  authentication-key TRANS-key

```

This example shows how to configure HQ-RTR-2 with an xTR, a map server, and a map resolver.

```

feature lisp
interface loopback 0
  ip address 172.31.1.12/32
interface ethernet2/1
  ip address 172.16.1.6/30
interface Ethernet 2/2
  vrf member TRANS
  ip address 10.1.1.2/24
interface Ethernet 2/3
  vrf member SOC
  ip address 10.2.1.2/24
interface Ethernet 2/4
  vrf member FIN
  ip address 10.3.1.2/24

ip lisp itr
ip lisp etr
ip lisp map-resolver
ip lisp map-server
ip lisp database-mapping 172.31.1.12/32 172.16.1.2 priority 1 weight 50
ip lisp database-mapping 172.31.1.12/32 172.16.1.6 priority 1 weight 50
ip lisp itr map-resolver 172.16.1.2
ip lisp itr map-resolver 172.16.1.6
ip lisp etr map-server 172.16.1.2 key DEFAULT-key
ip lisp etr map-server 172.16.1.6 key DEFAULT-key
vrf context FIN
  ip lisp itr
  ip lisp etr
  ip lisp database-mapping 10.3.1.0/24 172.16.1.2 priority 1 weight 50
  ip lisp database-mapping 10.3.1.0/24 172.16.1.6 priority 1 weight 50
  lisp instance-id 3
  ip lisp itr map-resolver 172.16.1.2
  ip lisp itr map-resolver 172.16.1.6
  ip lisp etr map-server 172.16.1.2 key FIN-key
  ip lisp etr map-server 172.16.1.6 key FIN-key
  ip lisp locator-vrf default
vrf context SOC
  ip lisp itr
  ip lisp etr
  ip lisp database-mapping 10.2.1.0/24 172.16.1.2 priority 1 weight 50
  ip lisp database-mapping 10.2.1.0/24 172.16.1.6 priority 1 weight 50
  lisp instance-id 2

```

```

ip lisp itr map-resolver 172.16.1.2
ip lisp itr map-resolver 172.16.1.6
ip lisp etr map-server 172.16.1.2 key SOC-key
ip lisp etr map-server 172.16.1.6 key SOC-key
ip lisp locator-vrf default
vrf context TRANS
ip lisp itr
ip lisp etr
ip lisp database-mapping 10.1.1.0/24 172.16.1.2 priority 1 weight 50
ip lisp database-mapping 10.1.1.0/24 172.16.1.6 priority 1 weight 50
lisp instance-id 1
ip lisp itr map-resolver 172.16.1.2
ip lisp itr map-resolver 172.16.1.6
ip lisp etr map-server 172.16.1.2 key TRANS-key
ip lisp etr map-server 172.16.1.6 key TRANS-key
ip lisp locator-vrf default
lisp site DEFAULT
eid-prefix 172.31.1.0/24 accept-more-specifics
authentication-key DEFAULT-key
lisp site FIN
eid-prefix 10.3.0.0/16 accept-more-specifics
authentication-key FIN-key
lisp site SOC
eid-prefix 10.2.0.0/16 instance-id 2 accept-more-specifics
authentication-key SOC-key
lisp site TRANS
eid-prefix 10.1.0.0/16 instance-id 1 accept-more-specifics
authentication-key TRANS-key

```

Example: Configuring a Remote Site for Large-Scale LISP Shared Model Virtualization

This example shows the complete configuration for the remote site switch. Only one remote site configuration is shown.

This example shows how to configure Site 2 with an xTR, using the map server and a map resolver from the HQ site.

```

feature lisp
interface loopback 0
ip address 172.31.1.2/32
interface ethernet2/1
ip address 172.16.2.2/30
interface Ethernet 2/2
vrf member TRANS
ip address 10.1.2.1/24
interface Ethernet 2/3
vrf member SOC
ip address 10.2.2.1/24
interface Ethernet 2/4
vrf member FIN
ip address 10.3.2.1/24

ip lisp itr
ip lisp etr
ip lisp map-resolver
ip lisp map-server
ip lisp database-mapping 172.31.1.2/32 172.16.2.2 priority 1 weight 100

```

```

ip lisp itr map-resolver 172.16.1.2
ip lisp itr map-resolver 172.16.1.6
ip lisp etr map-server 172.16.1.2 key DEFAULT-key
ip lisp etr map-server 172.16.1.6 key DEFAULT-key
vrf context FIN
  ip lisp itr
  ip lisp etr
  ip lisp database-mapping 10.3.2.0/24 172.16.2.2 priority 1 weight 100
lisp instance-id 3
  ip lisp itr map-resolver 172.16.1.2
  ip lisp itr map-resolver 172.16.1.6
  ip lisp etr map-server 172.16.1.2 key FIN-key
  ip lisp etr map-server 172.16.1.6 key FIN-key
  ip lisp locator-vrf default
vrf context SOC
  ip lisp itr
  ip lisp etr
  ip lisp database-mapping 10.2.2.0/24 172.16.2.2 priority 1 weight 100
lisp instance-id 2
  ip lisp itr map-resolver 172.16.1.2
  ip lisp itr map-resolver 172.16.1.6
  ip lisp etr map-server 172.16.1.2 key SOC-key
  ip lisp etr map-server 172.16.1.6 key SOC-key
  ip lisp locator-vrf default
vrf context TRANS
  ip lisp itr
  ip lisp etr
  ip lisp database-mapping 10.1.2.0/24 172.16.2.2 priority 1 weight 100
lisp instance-id 1
  ip lisp itr map-resolver 172.16.1.2
  ip lisp itr map-resolver 172.16.1.6
  ip lisp etr map-server 172.16.1.2 key TRANS-key
  ip lisp etr map-server 172.16.1.6 key TRANS-key
  ip lisp locator-vrf default

```

Example: Configuring Simple LISP Parallel Model Virtualization

Example:

These examples show the complete configuration for the LISP topology. On the xTRs, the VRFs and EID prefixes are assumed to be attached to VLANs configured on the switches.

This example shows how to configure the left xTR:

```

hostname Left-xTR
!
ipv6 unicast-routing
!
vrf definition PURPLE
address-family ipv4
exit
address-family ipv6
exit
!
vrf definition GOLD
address-family ipv4
exit
address-family ipv6

```

```

exit
!
interface Ethernet0/0
ip address 10.0.0.2 255.255.255.0
!
interface Ethernet1/0.1
encapsulation dot1q 101
vrf forwarding PURPLE
ip address 192.168.1.1 255.255.255.0
ipv6 address 2001:DB8:A:A::1/64
!
interface Ethernet1/0.2
encapsulation dot1q 102
vrf forwarding GOLD
ip address 192.168.1.1 255.255.255.0
ipv6 address 2001:DB8:B:A::1/64
!
router lisp
eid-table vrf PURPLE instance-id 101
database-mapping 192.168.1.0/24 10.0.0.2 priority 1 weight 1
database-mapping 2001:DB8:A:A::/64 10.0.0.2 priority 1 weight 1
eid-table vrf GOLD instance-id 102
database-mapping 192.168.1.0/24 10.0.0.2 priority 1 weight 1
database-mapping 2001:DB8:B:A::/64 10.0.0.2 priority 1 weight 1
exit
!
ipv4 itr map-resolver 10.0.2.2
ipv4 itr
ipv4 etr map-server 10.0.2.2 key Left-key
ipv4 etr
ipv6 itr map-resolver 10.0.2.2
ipv6 itr
ipv6 etr map-server 10.0.2.2 key Left-key
ipv6 etr
exit
!
ip route 0.0.0.0 0.0.0.0 10.0.0.1
ipv6 route ::/0 Null0

```

This example shows how to configure the right xTR:

```

hostname Right-xTR
!
ipv6 unicast-routing
!
vrf definition PURPLE
address-family ipv4
exit
address-family ipv6
exit
!
vrf definition GOLD
address-family ipv4
exit
address-family ipv6
exit
!
interface Ethernet0/0
ip address 10.0.1.2 255.255.255.0
!
interface Ethernet1/0.1
encapsulation dot1q 101
vrf forwarding PURPLE

```

```

ip address 192.168.2.1 255.255.255.0
ipv6 address 2001:DB8:A:B::1/64
!
interface Ethernet1/0.2
encapsulation dot1q 102
vrf forwarding GOLD
ip address 192.168.2.1 255.255.255.0
ipv6 address 2001:DB8:B:B::1/64
!
router lisp
eid-table vrf PURPLE instance-id 101
database-mapping 192.168.2.0/24 10.0.1.2 priority 1 weight 1
database-mapping 2001:DB8:A:B::/64 10.0.1.2 priority 1 weight 1
eid-table vrf GOLD instance-id 102
database-mapping 192.168.2.0/24 10.0.1.2 priority 1 weight 1
database-mapping 2001:DB8:B:B::/64 10.0.1.2 priority 1 weight 1
exit
!
ipv4 itr map-resolver 10.0.2.2
ipv4 itr
ipv4 etr map-server 10.0.2.2 key Right-key
ipv4 etr
ipv6 itr map-resolver 10.0.2.2
ipv6 itr
ipv6 etr map-server 10.0.2.2 key Right-key
ipv6 etr
exit
!
ip route 0.0.0.0 0.0.0.0 10.0.1.1
ipv6 route ::/0 Null0

```

Example: Configuring a Private LISP Mapping System for LISP Parallel Model Virtualization

This example shows how to configure the map server/map resolver:

```

hostname MSMR
!
vrf definition BLUE
address-family ipv4
exit
!
vrf definition GREEN
address-family ipv4
exit
!
ipv6 unicast-routing
!
interface Ethernet0/0.101
encapsulation dot1Q 101
vrf forwarding BLUE
ip address 10.0.0.2 255.255.255.0
!
interface Ethernet0/0.102
encapsulation dot1Q 102
vrf forwarding GREEN
ip address 10.0.0.2 255.255.255.0

```



```

!
router lisp 1
locator-table vrf BLUE
site Purple
authentication-key PURPLE-key
eid-prefix instance-id 101 192.168.1.0/24
eid-prefix instance-id 101 192.168.2.0/24
eid-prefix instance-id 101 2001:DB8:A:A::/64
eid-prefix instance-id 101 2001:DB8:A:B::/64
!
ipv4 map-server
ipv4 map-resolver
ipv6 map-server
ipv6 map-resolver
!
router lisp 2
locator-table vrf GREEN
site Gold
authentication-key GOLD-key
eid-prefix instance-id 102 192.168.1.0/24
eid-prefix instance-id 102 192.168.2.0/24
eid-prefix instance-id 102 2001:DB8:B:A::/64
eid-prefix instance-id 102 2001:DB8:B:B::/64
!
ipv4 map-server
ipv4 map-resolver
ipv6 map-server
ipv6 map-resolver
!
ip route vrf GREEN 0.0.0.0 0.0.0.0 10.0.2.1
ip route vrf BLUE 0.0.0.0 0.0.0.0 10.0.2.1

```

Feature History for Configuring LISP Instance ID

This table lists the release history for this feature.

Table 7: Feature History for Configuring LISP Instance ID

Feature Name	Releases	Feature Information
Locator/ID Separation Protocol (LISP) Instance ID	6.2(2)	This feature is introduced.



CHAPTER 6

Configuring LISP Delegate Database Tree (DDT)

This chapter contains the following sections:

- [LISP Delegate Database Tree \(DDT\)](#), on page 97
- [Overview of DDT](#), on page 97
- [Restrictions for LISP Delegate Database Tree \(DDT\)](#), on page 97
- [Configuring LISP Delegate Database Tree \(DDT\)](#), on page 98
- [Configuration Examples for LISP Delegate Database Tree \(DDT\)](#), on page 99

LISP Delegate Database Tree (DDT)

Overview of DDT

LISP Delegated Database Tree (DDT) defines a large-scale distributed database of LISP Endpoint Identifier (EID) space using a DDT node. A DDT node is configured to be authoritative for some specified portion of an overall LISP EID space, as well as the set of more specific subprefixes that are delegated to other DDT nodes. It is also configured with the set of more-specific sub-prefixes that are further delegated to other DDT nodes. To delegate a sub-prefix, the “parent” DDT node is configured with the Routing Locators (RLOCs) of each child DDT node that is authoritative for the sub-prefix. Each RLOC either points to a map server (sometimes termed a “terminal DDT node”) to which an egress tunnel routers (ETRs) registers that sub-prefix or points to another.

Restrictions for LISP Delegate Database Tree (DDT)

The following restriction applies to the LISP Delegate Database Tree (DDT) feature:

- If LISP is enabled, nondisruptive upgrade (ISSU) and nondisruptive downgrade (ISSD) paths are not supported. Disable LISP prior to any upgrade. This restriction only applies to releases before 6.2(2) but not to this release or to future LISP releases.

Configuring LISP Delegate Database Tree (DDT)

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: Switch# configure terminal	Enters global configuration mode.
Step 2	lisp ddt Example: Switch(config)# lisp ddt	Configures a switch to perform LISP DDT functionality.
Step 3	lisp ddt root <i>root-locator</i> [public-key <i>number</i>] Example: Switch(config)# lisp ddt root 10.1.1.1	Configures an IPv4 or IPv6 locator for a DDT root node within the delegation hierarchy on a DDT-enabled map resolver. <ul style="list-style-type: none"> In this example, a DDT-enabled map resolver is configured to refer to the DDT root node locator: 2001:db8:1::1111.
Step 4	lisp ddt map-server-peer <i>map-server-locator</i> {<i>eid-prefix eid-prefix</i> <i>instance-id iid</i>} [<i>map-server</i>] <i>map-server-locator</i> Example: Switch(config)# lisp ddt map-server-peer 10.1.1.1 eid-prefix 2001:db8:eeee::/48	Configures a DDT-enabled map server, the locator and EID prefix (and/or instance ID) for a map server peer within the LISP DDT delegation hierarchy. <ul style="list-style-type: none"> In this example, a LISP DDT map server is configured as authoritative for the IPv6 EID prefix 2001:db8:eeee::/48 for its own locator 10.1.1.1
Step 5	lisp ddt authoritative-prefix {<i>eid-prefix eid-prefix</i> <i>instance-id iid</i>} Example: Switch(config)# lisp ddt authoritative-prefix eid-prefix 172.16.0.0/16	Configures a LISP DDT node to be authoritative for a specified EID prefix. <ul style="list-style-type: none"> In this example, the LISP DDT node is configured to be authoritative for the IPv4 EID-prefix 172.16.0.0/16
Step 6	exit Example: Switch(config)# exit	Exits global configuration mode and returns to privileged EXEC mode.
Step 7	show lisp ddt vrf <i>vrf-name</i> Example:	Displays the configured DDT root(s) and/or DDT delegation nodes on a switch enabled for

	Command or Action	Purpose
	Switch# show lisp ddt vrf vrf-1	LISP DDT. When vrf <i>vrf-name</i> is specified, information for VRF is displayed.
Step 8	show lisp ddt queue [<i>eid-address</i> instance-id <i>iid</i> { <i>eid-address</i> } vrf <i>vrf-name</i>] Example: Switch# show lisp ddt queue 10.1.1.1	Displays the map-resolver's map-request queue. If <i>eid-address</i> is specified, then only the queue element for an EID being map-requested is displayed
Step 9	show lisp ddt referral-cache [<i>eid-address</i> instance-id <i>iid</i> { <i>eid-address</i> } cache-entries { vrf <i>vrf-name</i> } vrf <i>vrf-name</i>] Example: Switch# show lisp ddt referral-cache 10.1.1.1	Displays the DDT referral cache stored in map-resolvers. When the <i>eid-address</i> variable is specified each cache entry that is less specific than the <i>eid-address</i> variable will be displayed.
Step 10	end Example: Switch# end	

Configuration Examples for LISP Delegate Database Tree (DDT)

Examples: LISP Delegate Database Tree (DDT)

The following is an example of parent and child DDT nodes, where the parent has all of 10.0.0.0/8 and delegates two sub-prefixes, 10.0.0.0/12 and 10.0.16.0/12 to two child DDT nodes. All of these prefixes are within the DDT sub-tree Key-ID=0, IID=223, and AFI=1 (IPv4).

```
Switch(config)# lisp ddt authoritative-prefix instance-id 223 10.0.0.0/8
Switch(config)# lisp ddt child 192.168.1.100 instance-id 223 eid-prefix 10.0.0.0/12
Switch(config)# lisp ddt child 192.168.1.200 instance-id 223 eid-prefix 10.16.0.0/12
```

The following example defines the delegation of the EID-prefix 10.0.0.0/12 to a DDT Map Server with RLOC 192.168.1.100 and delegation of the EID-prefix 10.16.0.0/12 to a DDT Map-Server with RLOC 192.168.1.200. The child DDT Map-Server for 10.16.0.0/12 is further configured to allow ETRs to register the sub-prefixes 10.18.0.0/16 and 10.17.0.0/16:

```
Switch(config)# lisp ddt authoritative-prefix instance-id 223 eid-prefix 10.16.0.0/12
Switch(config)# lisp site site-1
Switch(config)# eid-prefix 10.18.0.0/16 instance-id 223
Switch(config)# lisp site site-2
Switch(config)# eid-prefix 10.17.0.0/16 instance-id 223
```

Feature History for Delegate Database Tree

Table 8: Feature History for LISP Delegate Database Tree

Feature Name	Releases	Feature Information
Locator/ID Separation Protocol (LISP) Delegate Database Tree (DDT)	6.2(2)	This feature is introduced.



CHAPTER 7

Configuring LISP Multicast

This chapter contains the following sections:

- [LISP Multicast, on page 101](#)
- [Restrictions for LISP Multicast, on page 101](#)
- [Configuration Example for LISP Multicast, on page 104](#)

LISP Multicast

This chapter describes how to configure the Multicast functionality in Locator/ID Separation Protocol (LISP) architecture where the Multicast source and Multicast receivers can reside in separate LISP sites.

LISP introduced a mapping function from a site's Endpoint ID (EID) prefix to its associated Routing Locator (RLOC). Unicast packets require the mapping of both the source and destination address. Multicast only requires the source address to be mapped as the destination group address is not topology-dependent.

The implementation of Multicast LISP includes the following features:

- Building the multicast distribution tree across LISP sites.
- Forwarding multicast data packets from sources to receivers across LISP sites.
- Supporting different service models, including ASM (Any Source Multicast), and SSM (Source Specific Multicast).
- Supporting different combinations of LISP and non-LISP capable source and receiver sites.

When the Multicast LISP feature is enabled, a new tunnel interface type called GLT (Generic Lisp Tunnel) is created. The GLT is supported by Oracle Identity Manager APIs and only one GLT per Virtual Device Context (VDC) is created.



Attention The LISP Multicast feature is not supported on the F3 series module.

Restrictions for LISP Multicast

The following restrictions apply to the LISP Multicast feature:

- Only IPv4 Multicast LISP is supported over the Unicast core.

- Only Any Source Multicast (ASM) and Single Source Multicast (SSM) modes are supported.
- Only static Rendezvous Point (RP) is supported.

Configuring LISP Multicast

Perform this task to configure a device to support Locator/ID Separation Protocol (LISP) Multicast functionality.

In this task, a LISP site an edge router configured as an xTR (performs as both an ITR and an ETR) and includes a single IPv4 connection to an upstream provider. Both the RLOC and the EID are IPv4. Additionally, this LISP site registers to one map resolver/map server (MR/MS) device in the network core.

- **Mapping system:**

- One map resolver/map server (MR/MS) system is assumed to be available for the LISP xTR to configure. The MR/MS have IPv4 RLOC 11.0.0.2.
- Mapping services are assumed to be provided as part of this LISP solution via a private mapping system or as a public LISP mapping system. From the perspective of the configuration of these LISP site xTRs, there is no difference.

The steps in this task enable and configure LISP Multicast ITR and ETR (xTR) functionality when using a LISP map server and map resolver for mapping services.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 2	vrf context <i>name</i> Example: Device(config)# vrf context management	Creates a virtual routing and forwarding instance (VRF) and enters VRF configuration mode.
Step 3	ip pim rp-address <i>rp-address access-list</i> Example: Device(config-vrf)# ip pim rp-address 10.0.0.1 group-list 224.0.0.0/8	Configures the address of a Protocol Independent Multicast (PIM) rendezvous point (RP) for a particular group.
Step 4	ip pim ssm range <i>access-list</i> Example: Device(config-vrf)# ip pim ssm range 232.0.0.0/8	Defines the Source Specific Multicast (SSM) range of IP multicast addresses.

	Command or Action	Purpose
Step 5	ip lisp itr-etr Example: <pre>Device(config-vrf)# ip lisp itr-etr</pre>	Configures the Cisco NX-OS device to act as both an IPv4 LISP Ingress Tunnel Router (ITR) and Egress Tunnel Router (ETR).
Step 6	ip lisp database-mapping <i>EID-prefix/prefix-length locator priority priority weight weight</i> Example: <pre>Device(config-vrf)# ip lisp database-mapping 10.0.0.0/24 10.0.0.1 priority 1 weight 100</pre>	Configures an IPv4 endpoint identifier to Routing Locator (EID-to-RLOC) mapping relationship and its associated traffic policy.
Step 7	lisp instance-id id Example: <pre>Device(config-vrf)# lisp instance-id 1</pre>	Configures an instance ID to be associated with endpoint identifier (EID)-prefixes for a Locator/ID Separation Protocol (LISP) xTR .
Step 8	ip lisp locator-vrf default Example: <pre>Device(config-vrf)# ip lisp locator-vrf default</pre>	Configures a nondefault virtual routing and forwarding (VRF) table to be referenced by any IPv4 locators.
Step 9	ip lisp itr map-resolver map-resolver-address Example: <pre>Device(config-vrf)# ip lisp itr map-resolver 10.0.0.2</pre>	Configures the IPv4 locator address of the Locator/ID Separation Protocol (LISP) Map-Resolver to be used by the ingress tunnel router (ITR) ITR or Proxy ITR (PITR) when sending Map-Requests for IPv4 EID-to-RLOC mapping resolution. Note Up to two map resolvers may be configured if multiple map resolvers are available. (See the <i>LISP Command Reference</i> for more details.)
Step 10	ip lisp etr map-server map-server-address key key-type authentication-key Example: <pre>Device(config-vrf)# ip lisp etr map-server 10.0.0.2 key 3 5b0f2bd760fe4ce3</pre>	Configures the IPv4 locator address of the Locator/ID Separation Protocol (LISP) Map-Server to be used by the egress tunnel router (ETR) when registering for IPv4 EIDs. Note Up to two map servers may be configured if multiple map servers are available. (See the <i>LISP Command Reference</i> for more details.)

	Command or Action	Purpose
Step 11	ip lisp multicast Example: Device(config-vrf)# ip lisp multicast	Configures the device to support Locator/ID Separation Protocol (LISP) Multicast functionality.
Step 12	exit Example: Device(config-vrf)# exit	Exits vrf configuration mode.
Step 13	show ipmroute detail Example: Device# show ip mroute detail	(Optional) Displays information about the LISP multicast encapsulation for the IPv4 multicast routes.
Step 14	show ippimlisp encap Example: Router# show ip pim lisp encap	(Optional) Displays information about the LISP encapsulation indices stored by PIM.
Step 15	show forwardingdistributionmulticast route group-addr Example: Router# show forwarding distribution multicast route group 226.1.1.1	(Optional) Displays information about the multicast Forwarding Information Base (FIB) distribution routes.

Configuration Example for LISP Multicast

Example: Configuring LISP Multicast

The following example shows how to configure Locator/ID Separation Protocol (LISP) Multicast on either the Egress Tunnel Router (ETR) or the Ingress Tunnel Router (ITR):

```
vrf context vrf1
 ip pim rp-address 35.0.0.1 group-list 224.0.0.0/4
 ip pim ssm range 232.0.0.0/8
 ip lisp itr-etr <<< this router acts as a Lisp xTR gateway
 ip lisp database-mapping 20.0.0.0/24 11.0.0.1 priority 1 weight 100
 lisp instance-id 1
 ip lisp locator-vrf default
 ip lisp itr map-resolver 11.0.0.2
 ip lisp etr map-server 11.0.0.2 key 3 5b0f2bd760fe4ce3
 ip lisp multicast <<< this router supports Lisp Multicast
```

Feature History for LISP Multicast

Table 9: Feature History for LISP Multicast

Feature Name	Releases	Feature Information
Locator/ID Separation Protocol (LISP) Multicast	6.2(2) Note The LISP Multicast feature is not supported on the F3 series module.	This feature is introduced.



CHAPTER 8

Configuration Limits for LISP

This chapter contains the following sections:

- [Configuration Limits for LISP, on page 107](#)

Configuration Limits for LISP

The configuration limits are documented in the *Cisco Nexus 7000 Series NX-OS Verified Scalability Guide*.

