IP Mobility: PMIPv6 Configuration Guide, IOS XE Gibraltar 16.10.x

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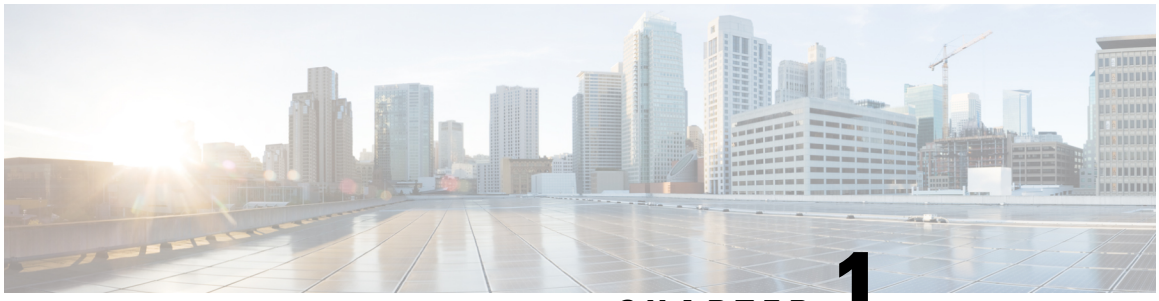


CHAPTER 1

Read Me First

Important Information about Cisco IOS XE 16

Effective Cisco IOS XE Release 3.7.0E (for Catalyst Switching) and Cisco IOS XE Release 3.17S (for Access and Edge Routing) the two releases evolve (merge) into a single version of converged release—the Cisco IOS XE 16—providing one release covering the extensive range of access and edge products in the Switching and Routing portfolio.

Feature Information

Use Cisco Feature Navigator to find information about feature support, platform support, and Cisco software image support. An account on Cisco.com is not required.

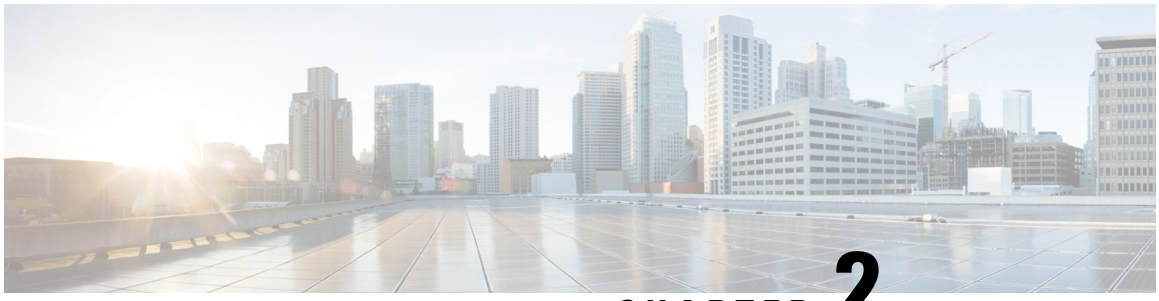
Related References

- Cisco IOS Command References, All Releases

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see What's New in Cisco Product Documentation.

To receive new and revised Cisco technical content directly to your desktop, you can subscribe to the What's New in Cisco Product Documentation RSS feed. RSS feeds are a free service.



CHAPTER 2

Proxy Mobile IPv6 Support for MAG Functionality

The Proxy Mobile IPv6 Support for MAG Functionality feature provides network-based IP Mobility management to a mobile node (MN) without requiring the participation of the mobile node in any IP Mobility-related signaling. The Mobile Access Gateway (MAG) tracks the movements of the MN to and from an access link and sends signals to the local mobility anchor of the MN.

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- Prerequisites for Proxy Mobile IPv6 Support for MAG Functionality, on page 3
- Information About Proxy Mobile IPv6 Support for MAG Functionality, on page 4
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- Feature Information for Proxy Mobile IPv6 Support for MAG Functionality, on page 21

Finding Feature Information

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

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

Prerequisites for Proxy Mobile IPv6 Support for MAG Functionality

The DHCP server must be configured.

Information About Proxy Mobile IPv6 Support for MAG Functionality

Proxy Mobile IPv6 Overview

Proxy Mobile IPv6 (PMIPv6) provides network-based IP Mobility management to a mobile node (MN), without requiring the participation of the MN in any IP mobility-related signaling. The mobility entities in the network track the movements of the MN, initiate the mobility signaling, and set up the required routing state.

The major functional entities of PMIPv6 are Mobile Access Gateways (MAGs), Local Mobility Anchors (LMAs), and MNs.

Mobile Access Gateways

Mobile Access Gateway (MAG) performs mobility-related signaling on behalf of the mobile nodes (MN) attached to its access links. MAG is the access router for the MN; that is, MAG is the first-hop router in the localized mobility management infrastructure.

MAG performs the following functions:

- Obtains an IP address from Local Mobility Anchor (LMA) and assigns it to MN.
- Retains the IP address of an MN when the MN roams across MAGs.
- Tunnels traffic from MN to LMA.

Local Mobility Anchor

Local Mobility Anchor (LMA) is the home agent for a mobile node (MN) in a Proxy Mobile IPv6 (PMIPv6) domain. It is the topological anchor point for MN home network prefixes and manages the binding state of an MN. An LMA has the functional capabilities of a home agent as defined in the Mobile IPv6 base specification (RFC 3775) along with the capabilities required for supporting the PMIPv6 protocol.

Note Use the **dynamic mag learning** command to enable LMA to accept Proxy Mobile IPv6 (PMIPv6) signaling messages from any Mobile Access Gateway (MAG) that is not configured locally.

Mobile Node

Mobile node (MN) is an IP host and the mobility of the MN is managed by a network. MN can be an IPv4-only node, an IPv6-only node, or a dual-stack node, which is a node with IPv4 and IPv6 protocol stacks. MN is not required to participate in any IP mobility-related signaling for achieving mobility for an IP address or a prefix that is obtained in the Proxy Mobile IPv6 (PMIPv6) domain.

AAA Server Attributes for Proxy Mobile IPv6

If an authentication, authorization, and accounting (AAA) server is available, a Mobile Access Gateway (MAG) obtains the profile information of the Proxy Mobile IPv6 (PMIPv6) domain and the mobile node (MN) from the server during the configuration and call-flow time, respectively.

The following are the AAA attributes required for configuring the PMIPv6 domain and the MN are:

- PMIPv6 domain-specific AAA attributes:
  - cisco-mpc-protocol-interface
  - lma-identifier
  - mag-identifier
  - mag-v4-address
  - mag-v6-address
  - pmip6-domain-identifier
  - pmip6-timestamp-window
  - pmip6-replay-protection
  - pmip6-spi-key
  - pmip6-spi-value
- MN-specific AAA attributes:
  - home-lma
  - home-lma-ipv6-address
  - mn-nai
  - home-lma-ipv4-address
  - mn-apn
  - Mobile-Node-Identifier
  - mn-network
  - mn-service
  - multihomed

How to Configure Proxy Mobile IPv6 Support for MAG Functionality

Configuring a Proxy Mobile IPv6 Domain by Using the Configuration from the AAA Server

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name* **load-aaa**
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **load-aaa** **Example:** `Device(config)# ipv6 mobile pmipv6-domain D1 load-aaa`	Creates a PMIPv6 domain and configures it by using the configuration from the AAA server.
Step 4	**end** **Example:** `Device(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Configuring the Minimum Configuration for a MAG to Function

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name*
4. **lma** *lma-id*
5. **ipv6-address** *ipv6-address*
6. **exit**
7. Repeat Steps 5 to 8 to configure the second LMA.
8. **nai** [*user*]*@realm*
9. **lma** *lma-id*
10. **service** {**dual** | **ipv4** | **ipv6**}
11. **exit**
12. Repeat Steps 10 to 11 to configure the second MN.
13. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-domain dn1`	Creates the Proxy Mobile IPv6 (PMIPv6) domain and enters PMIPv6 domain configuration mode.
Step 4	**lma** *lma-id* **Example:** `Device(config-ipv6-pmipv6-domain)# lma lma1`	Configures an Local Mobility Anchor (LMA) within the PMIPv6 domain and enters PMIPv6 domain LMA configuration mode.
Step 5	**ipv6-address** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-domain-lma)# ipv6-address 2001:DB8::1`	Configures an IPv6 address for the LMA within the PMIPv6 domain.
Step 6	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-lma)# exit`	Exits PMIPv6 domain LMA configuration mode and returns to PMIPv6 domain configuration mode.
Step 7	Repeat Steps 5 to 8 to configure the second LMA.	—
Step 8	**nai** [*user*]*@realm* **Example:** `Device(config-ipv6-pmipv6-domain)# nai user1@example.com`	Configures a network access identifier for the mobile node (MN) within the PMIPv6 domain and enters PMIPv6 domain mobile node configuration mode.
Step 9	**lma** *lma-id* **Example:** `Device(config-ipv6-pmipv6-domain-mn)# lma lma1`	Configures an LMA for the MN.
Step 10	**service** {**dual** | **ipv4** | **ipv6**} **Example:** `Device(config-ipv6-pmipv6-domain-mn)# service ipv4`	Configures the service provided to the MN within the PMIPv6 domain. The type of services provided to the MN are as follows: • **dual**—Specifies both IPv4 and IPv6 services for an MN.

	Command or Action	Purpose
		• **IPv4**—Specifies IPv4 service for an MN. • **IPv6**—Specifies IPv6 service for an MN.
Step 11	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-mn)# exit`	Exits PMIPv6 domain mobile node configuration mode and returns to PMIPv6 domain configuration mode.
Step 12	Repeat Steps 10 to 11 to configure the second MN.	—
Step 13	**end** **Example:** `Device(config-ipv6-pmipv6-domain)# end`	Exits PMIPv6 domain configuration mode and returns to privileged EXEC mode.

Configuring a Detailed Configuration for a MAG When an AAA Server Is Not Available

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name*
4. **service password-encryption**
5. **replay-protection timestamp** [**window** *seconds*]
6. **auth-option spi** {*spi-hex-value* | **decimal** *spi-decimal-value*} **key** {**ascii** *ascii-string* | **hex** *hex-string*}
7. **encap** {**gre-ipv4** | **ipv6-in-ipv6**}
8. **local-routing-mag**
9. **lma** *lma-id*
10. **ipv6-address** *ipv6-address*
11. **exit**
12. Repeat Steps 10 to 12 to configure each LMA.
13. **mag** *mag-id*
14. **ipv6-address** *ipv6-address*
15. **exit**
16. **mn-profile-load-aaa**
17. **nai** [*user*]*@realm*
18. **lma** *lma-id*
19. **int att** *interface-access-type* **l2-addr** *mac-address*
20. **gre-encap-key** [**down** | **up**] *key-value*
21. **service** {**dual** | **ipv4** | **ipv6**}
22. **apn** *apn-name*
23. **exit**

24. Repeat Steps 20 to 24 to configure each MN.
25. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-domain dn1`	Creates a Proxy Mobile IPv6 (PMIPv6) domain and enters PMIPv6 domain configuration mode.
Step 4	**service password-encryption** **Example:** `Device(config)# service password-encryption`	Converts unencrypted passwords to encrypted passwords automatically.
Step 5	**replay-protection timestamp** [**window** *seconds*] **Example:** `Device(config-ipv6-pmipv6-domain)# replay-protection timestamp window 200`	Configures the replay protection mechanism within the PMIPv6 domain.
Step 6	**auth-option spi** {*spi-hex-value* | **decimal** *spi-decimal-value*} **key** {**ascii** *ascii-string* | **hex** *hex-string*} **Example:** `Device(config-ipv6-pmipv6-domain)# auth-option spi 67 key ascii key1`	Configures authentication for the PMIPv6 domain.
Step 7	**encap** {**gre-ipv4** | **ipv6-in-ipv6**} **Example:** `Device(config-ipv6-pmipv6-domain)# encap gre-ipv4`	Configures the tunnel encapsulation mode type between the Mobile Access Gateway (MAG) and the Local Mobility Anchor (LMA).
Step 8	**local-routing-mag** **Example:** `Device(config-ipv6-pmipv6-domain)# local-routing-mag`	Enables local routing for the MAG.

	Command or Action	Purpose
Step 9	**lma** *lma-id* **Example:** `Device(config-ipv6-pmipv6-domain)# lma lma1`	Configures LMA within the PMIPv6 domain and enters PMIPv6 domain LMA configuration mode.
Step 10	**ipv6-address** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-domain-lma)# ipv6-address 2001:0DB8:2:3::1`	Configures an IPv6 address for the LMA within the PMIPv6 domain.
Step 11	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-lma)# exit`	Exits PMIPv6 domain LMA configuration mode and returns to PMIPv6 domain configuration mode.
Step 12	Repeat Steps 10 to 12 to configure each LMA.	—
Step 13	**mag** *mag-id* **Example:** `Device(config-ipv6-pmipv6-domain)# mag mag1`	Configures a MAG within the PMIPv6 domain and enters PMIPv6 domain MAG configuration mode.
Step 14	**ipv6-address** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-domain-mag)# ipv6-address 2001:0DB8:2:4::1`	Configures an IPv6 address for the MAG within the PMIPv6 domain.
Step 15	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-mag)# exit`	Exits PMIP domain MAG configuration mode and returns to PMIPv6 domain configuration mode.
Step 16	**mn-profile-load-aaa** **Example:** `Device(config-ipv6-pmipv6-domain)# mn-profile-load-aaa`	(Optional) Loads the profile configuration from AAA to the mobile node (MN) within the PMIPv6 domain. **Note** Steps 20 to 24 need not be entered if the MN is configured using the configuration from AAA. You can use the specific command to override the configuration for a specific mobile node (MN) parameter.
Step 17	**nai** [*user*]*@realm* **Example:** `Device(config-ipv6-pmipv6-domain)# nai user1@example.com`	Configures the network address identifier (NAI) for the MN within the PMIPv6 domain and enters PMIPv6 domain MN configuration mode.

	Command or Action	Purpose
Step 18	**lma** *lma-id* **Example:** `Device(config-ipv6-pmipv6-domain-mn)# lma lma1`	Configures the LMA for the MN.
Step 19	**int att** *interface-access-type* **l2-addr** *mac-address* **Example:** `Device(config-ipv6-pmipv6-domain-mn)# int att Gigabitethernet l2-addr 02c7.f800.0422`	Configures the access technology type, interface, and MAC address of the MN interface within the PMIPv6 domain.
Step 20	**gre-encap-key** [**down** | **up**] *key-value* **Example:** `Device(config-ipv6-pmipv6-domain-mn)# gre-encap-key down 45`	Configures a generic routing encapsulation (GRE) key for the MN within the PMIPv6 domain.
Step 21	**service** {**dual** | **ipv4** | **ipv6**} **Example:** `Device(config-ipv6-pmipv6-domain-mn)# service ipv4`	Configures the service provided to the MN within the PMIPv6 domain. The type of services provided to the MN are as follows: • **dual**—Specifies both IPv4 and IPv6 services for an MN. • **IPv4**—Specifies an IPv4 service for an MN. • **IPv6**—Specifies an IPv6 service for an MN.
Step 22	**apn** *apn-name* **Example:** `Device(config-ipv6-pmipv6-domain-mn)# apn apn1`	Specifies an access point name (APN) to the MN subscriber within the PMIPv6 domain.
Step 23	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-mn)# exit`	Exits PMIP domain MN configuration mode and returns to PMIPv6 domain configuration mode.
Step 24	Repeat Steps 20 to 24 to configure each MN.	—
Step 25	**end** **Example:** `Device(config-ipv6-pmipv6-domain)# end`	Exits PMIPv6 domain configuration mode and returns to privileged EXEC mode.

Configuring a Minimum Configuration for a MAG

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name*
4. **address ipv6** *ipv6-address*
5. **sessionmgr**
6. **generate grekey**
7. **interface** *type number*
8. **role** {**3gpp** | **lte** | **wimax** | **wlan**}
9. **apn** *apn-name*
10. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-mag mag1 domain dn1`	Enables the MAG service on a device, configures the PMIPv6 domain for the MAG, and enters MAG configuration mode.
Step 4	**address ipv6** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-mag)# address ipv6 2001:0DB8:2:4::1`	Configures an IPv6 address for the MAG.
Step 5	**sessionmgr** **Example:** `Device(config-ipv6-pmipv6-mag)# sessionmgr`	Enables the MAG to process the the notification it receives through the mobile client service abstraction (MCSA) from the Intelligent Services Gateway (ISG).
Step 6	**generate grekey** **Example:**	Enables dynamic generation of upstream generic routing encapsulation keys for mobile nodes in an LMA.

	Command or Action	Purpose
	`Device(config-ipv6-pmipv6-mag)# generate grekey`	
Step 7	**interface** *type number* **Example:** `Device(config-ipv6-pmipv6-mag)# interface gigabitethernet 0/0/0`	Enables an interface for the MAG.
Step 8	**role** {**3gpp** | **lte** | **wimax** | **wlan**} **Example:** `Device(config-ipv6-pmipv6-mag)# role lte`	Configures a role for the MAG. The keywords are as follows: • **3gpp**—Specifies the role as the 3rd Generation Partnership Project (3GPP). • **lte**—Specifies the role as Long Term Evaluation (LTE). • **wimax**—Specifies the role as wimax. • **wlan**—Specifies the role as wireless LAN (WLAN).
Step 9	**apn** *apn-name* **Example:** `Device(config-ipv6-pmipv6-mag)# apn apn2`	Specifies an access point name (APN) to the subscriber of the MAG. **Note** Specifying an APN is mandatory if the role of the MAG is 3GPP.
Step 10	**end** **Example:** `Device(config-ipv6-pmipv6-mag)# end`	Exits MAG configuration mode and returns to privileged EXEC mode.

Configuring a Detailed Configuration for a MAG

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vrf definition** *vrf-name*
4. **exit**
5. **ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name*
6. **role** {**3gpp** | **wlan**}
7. **apn** *apn-name*
8. **local-routing-mag**
9. **discover-mn-detach poll interval** *seconds* **timeout** *seconds* **retries** *retry-count*
10. **address ipv4** *ipv4-address*
11. **address ipv6** *ipv6-address*

12. **sessionmgr**
13. **interface** *type number*
14. **binding maximum** *number*
15. **binding lifetime** *seconds*
16. **binding refresh-time** *seconds*
17. **binding init-retx-time** *milliseconds*
18. **binding max-retx-time** *milliseconds*
19. **replay-protection timestamp** [**window** *seconds*]
20. **bri delay min** *milliseconds*
21. **bri delay max** *milliseconds*
22. **bri retry** *number*
23. **lma** *lma-id domain-name*
24. **auth-option spi** {*spi-hex-value* | **decimal** *spi-decimal-value*} **key** {**ascii** | **hex**} *hex-string*
25. **ipv4-address** *ipv4-address*
26. **vrfid** *vrf-name*
27. **encap** {**gre-ipv4** | **ipv6-in-ipv6**}
28. **end**
29. **show ipv6 mobile pmipv6 mag** *mag-id* **globals**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**vrf definition** *vrf-name* **Example:** `Device(config)# vrf definition vrf1`	Configures a virtual routing and forwarding (VRF) routing table instance and enters VRF configuration mode.
Step 4	**exit** **Example:** `Device(config-vrf) exit`	Exits VRF configuration mode and returns to global configuration mode.
Step 5	**ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-mag mag1 domain dn1`	Enables the MAG service on a device, configures the PMIPv6 domain for the MAG, and enters MAG configuration mode.

	Command or Action	Purpose
Step 6	**role** {**3gpp** | **wlan**} **Example:** `Device(config-ipv6-pmipv6-mag)# role 3gpp`	Configures a role for the MAG. The keywords are as follows: • **3gpp**—Specifies the role as 3GPP. • **lte**—Specifies the role as LTE. • **wimax**—Specifies the role as wimax. • **wlan**—Specifies the role as wireless LAN (WLAN).
Step 7	**apn** *apn-name* **Example:** `Device(config-ipv6-pmipv6-mag)# apn apn2`	Specifies an access point name (APN) to the subscriber of the MAG.
Step 8	**local-routing-mag** **Example:** `Device(config-ipv6-pmipv6-mag)# local-routing-mag`	Enables local routing for the MAG.
Step 9	**discover-mn-detach poll interval** *seconds* **timeout** *seconds* **retries** *retry-count* **Example:** `Device(config-ipv6-pmipv6-mag)# discover-mn-detach poll interval 11 timeout 3 retries 4`	Enables periodic verification of the MN attachment with the MAG-enabled interface.
Step 10	**address ipv4** *ipv4-address* **Example:** `Device(config-ipv6-pmipv6-mag)# address ipv4 10.1.3.1`	Configures an IPv4 address for the MAG.
Step 11	**address ipv6** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-mag)# address ipv6 2001:0DB8:2:4::1`	Configures an IPv6 address for the MAG.
Step 12	**sessionmgr** **Example:** `Device(config-ipv6-pmipv6-mag)# sessionmgr`	Configures an IPv6 address for the MAG.
Step 13	**interface** *type number* **Example:**	Enables an interface for the MAG.

	Command or Action	Purpose
	`Device(config-ipv6-pmipv6-mag)# interface gigabitethernet 0/0/0`	
Step 14	**binding maximum** *number* **Example:** `Device(config-ipv6-pmipv6-mag)# binding maximum 200`	Specifies the maximum number of Proxy Binding Update (PBU) entries allowed for the MAG.
Step 15	**binding lifetime** *seconds* **Example:** `Device(config-ipv6-pmipv6-mag)# binding lifetime 5000`	Specifies the maximum lifetime permitted for the PBU entry.
Step 16	**binding refresh-time** *seconds* **Example:** `Device(config-ipv6-pmipv6-mag)# binding refresh-time 2000`	Specifies the PBU entry refresh time.
Step 17	**binding init-retx-time** *milliseconds* **Example:** `Device(config-ipv6-pmipv6-mag)# binding init-retx-time 110`	Specifies the initial timeout interval between the PBU and Proxy Binding Acknowledgment (PBA) until a PBA is received.
Step 18	**binding max-retx-time** *milliseconds* **Example:** `Device(config-ipv6-pmipv6-mag)# binding max-retx-time 4000`	Specifies the maximum timeout interval between the PBU and the PBA until a PBA is received.
Step 19	**replay-protection timestamp** [**window** *seconds*] **Example:** `Device(config-ipv6-pmipv6-mag)# replay-protection timestamp window 200`	Configures the replay protection mechanism within the PMIPv6 domain.
Step 20	**bri delay min** *milliseconds* **Example:** `Device(config-ipv6-pmipv6-mag)# bri delay min 500`	Specifies the minimum time for which an LMA should wait before transmitting the Binding Revocation Indication (BRI) message.
Step 21	**bri delay max** *milliseconds* **Example:** `Device(config-ipv6-pmipv6-mag)# bri delay max 4500`	Specifies the maximum time for which an LMA should wait for the Binding Revocation Acknowledgment (BRA) message before retransmitting the BRI message.

	Command or Action	Purpose
Step 22	**bri retry** *number* **Example:** `Device(config-ipv6-pmipv6-mag)# bri retry 6`	Specifies the maximum number of times an LMA should retransmit a BRI message, until a BRA is received.
Step 23	**lma** *lma-id domain-name* **Example:** `Device(config-ipv6-pmipv6-mag)# lma lma3 dn1`	Configures the LMA for the MAG and enters MAG-LMA configuration mode.
Step 24	**auth-option spi** {*spi-hex-value* | **decimal** *spi-decimal-value*} **key** {**ascii** | **hex**} *hex-string* **Example:** `Device(config-ipv6-pmipv6mag-lma)# auth-option spi decimal 258 key hex BDF`	Configures authentication for the LMA within the MAG.
Step 25	**ipv4-address** *ipv4-address* **Example:** `Device(config-ipv6-pmipv6mag-lma)# ipv4-address 172.16.0.1`	Configures an IPv4 address for the LMA within the MAG. **Note** You can repeat this command to configure multiple IP addresses.
Step 26	**vrfid** *vrf-name* **Example:** `Device(config-ipv6-pmipv6mag-lma)# vrfid vrf1`	Specifies a VRF for an LMA peer.
Step 27	**encap** {**gre-ipv4** | **ipv6-in-ipv6**} **Example:** `Device(config-ipv6-pmipv6mag-lma)# encap gre-ipv4`	Configures a tunnel encapsulation mode type between the MAG and the LMA.
Step 28	**end** **Example:** `Device(config-ipv6-pmipv6mag-lma)# end`	Exits MAG-LMA configuration mode and returns to privileged EXEC mode.
Step 29	**show ipv6 mobile pmipv6 mag** *mag-id* **globals** **Example:** `Device# show ipv6 mobile pmipv6 mag mag1 globals`	(Optional) Displays MAG global configuration details.

Example

The following example shows the MAG global configuration:

```
Router# show ipv6 mobile pmipv6 mag mag1 globals

--------------------------------------------------
Domain  : D1
Mag Identifier  : M1
        MN's detach discover            : disabled
        Local routing                   : disabled
        Mag is enabled on interface     : GigabitEthernet0/0/0
        Mag is enabled on interface     : GigabitEthernet0/1/0
        Max Bindings                    : 3
        AuthOption                      : disabled
        RegistrationLifeTime            : 3600 (sec)
        BRI InitDelayTime               : 1000 (msec)
        BRI MaxDelayTime                : 40000 (msec)
        BRI MaxRetries                  : 6
        BRI EncapType                   : IPV6_IN_IPV6
        Fixed Link address is           : enabled
        Fixed Link address              : aaaa.aaaa.aaaa
        Fixed Link Local address is     : enabled
        Fixed Link local address        : 0xFE800000 0x0 0x0 0x2
        RefreshTime                     : 300 (sec)
        Refresh RetxInit time           : 20000 (msec)
        Refresh RetxMax time            : 50000 (msec)
        Timestamp option                : enabled
        Validity Window                 : 7

Peer :  LMA1
        Max Bindings                    : 3
        AuthOption                      : disabled
        RegistrationLifeTime            : 3600 (sec)
        BRI InitDelayTime               : 1000 (msec)
        BRI MaxDelayTime                : 40000 (msec)
        BRI MaxRetries                  : 6
        BRI EncapType                   : IPV6_IN_IPV6
        Fixed Link address is           : enabled
        Fixed Link address              : aaaa.aaaa.aaaa
        Fixed Link Local address is     : enabled
        Fixed Link local address        : 0xFE800000 0x0 0x0 0x2
        RefreshTime                     : 300 (sec)
        Refresh RetxInit time           : 20000 (msec)
        Refresh RetxMax time            : 50000 (msec)
        Timestamp option                : enabled
        Validity Window                 : 7
Peer :  LMA2
        Max Bindings                    : 3
        AuthOption                      : disabled
```

Troubleshooting Tips

You can use the following commands to troubleshoot the MAG configuration:

- **debug ipv6 mobile mag event**
- **debug ipv6 mobile mag info**
- **show ipv6 mobile pmipv6 mag bindings**
- **show ipv6 mobile pmipv6 mag globals**

Configuration Examples for Proxy Mobile IPv6 Support for MAG Functionality

Example: Configuring a Proxy Mobile IPv6 Domain by Using the Configuration from the AAA Server

The following example shows how to configure the PMIPv6 domain by using the AAA server configuration:

```
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D1 load-aaa
```

The following example shows how to configure the PMIPv6 domain by using the configuration from the AAA server and how to override the configuration for specific PMIPv6 domain parameters:

```
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D11 load-aaa
Device(config)# ipv6 mobile pmipv6-domain D11
Device(config-ipv6-pmipv6-domain)# gre-ipv4
Device(config-ipv6-pmipv6-domain)# auth-option spi 67 key ascii key1
```

Example: Configuring a Proxy Mobile IPv6 Domain When the Configuration from an AAA Server Is Not Available

The following example shows how to configure the PMIPv6 domain when an AAA server configuration is not available:

```
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D2
Device(config-ipv6-pmipv6-domain)# replay-protection timestamp window 200
Device(config-ipv6-pmipv6-domain)# auth-option spi 100 key ascii hi
Device(config-ipv6-pmipv6-domain)# encap ipv6-in-ipv6
!
Device(config-ipv6-pmipv6-domain)# lma lma1
Device(config-ipv6-pmipv6-domain-lma)# ipv4-address 10.1.1.1
Device(config-ipv6-pmipv6-domain-lma)# ipv6-address 2001:0DB8:2:3::1
Device(config-ipv6-pmipv6-domain-lma)# exit
!
Device(config-ipv6-pmipv6-domain)# mag mag1
Device(config-ipv6-pmipv6-domain-mag)# ipv4-address 10.1.3.1
Device(config-ipv6-pmipv6-domain-mag)# ipv6-address 2001:0DB8:2:5::1
Device(config-ipv6-pmipv6-domain-mag)# exit
!
Device(config-ipv6-pmipv6-domain)# nai example1@example.com
Device(config-ipv6-pmipv6-domain-mn)# lma lma1
Device(config-ipv6-pmipv6-domain-mn)# int att gigabitethernet l2-addr 02c7.f800.0422
Device(config-ipv6-pmipv6-domain-mn)# gre-encap-key up 1234
Device(config-ipv6-pmipv6-domain-mn)# gre-encap-key down 5678
Device(config-ipv6-pmipv6-domain-mn)# service ipv4
Device(config-ipv6-pmipv6-domain-mn)# end
```

Example: Configuring a Mobile Access Gateway

The following example shows the minimum configuration required to enable MAG:

```
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D2
Device(config-ipv6-pmipv6-domain)# lma lma1
Device(config-ipv6-pmipv6-domain-lma)# ipv4-address 10.1.1.1
Device(config-ipv6-pmipv6-domain-lma)# ipv6-address 2001:0DB8:2:3::1
Device(config-ipv6-pmipv6-domain-lma)# exit
Device(config-ipv6-pmipv6-domain)# lma lma2
Device(config-ipv6-pmipv6-domain-lma)# ipv4-address 10.2.1.1
Device(config-ipv6-pmipv6-domain-lma)# ipv6-address 2001:0DB8:2:4::1
Device(config-ipv6-pmipv6-domain-lma)# exit
Device(config-ipv6-pmipv6-domain)# nai example1@example.com
Device(config-ipv6-pmipv6-domain-mn)# lma lma1
Device(config-ipv6-pmipv6-domain-mn)# exit
Device(config-ipv6-pmipv6-domain)# nai example2@example.com
Device(config-ipv6-pmipv6-domain-mn)# lma lma2
Device(config-ipv6-pmipv6-domain-mn)# exit
Device(config)# ipv6 mobile pmipv6-mag mag1 domain D2
Device(config-ipv6-pmipv6-mag)# address ipv6 2001:DB8:0:0:E000::F
Device(config-ipv6-pmipv6-mag)# address ipv4 10.2.1.1
Device(ipv6-mag-config)# interface gigabitethernet 0/0/0
Device(ipv6-mag-config)# role 3gpp
Device(ipv6-mag-config)# apn a
Device(ipv6-mag-config)# exit
```

Where to Go Next

The MAG entity works with the LMA provided by the ASR 5000 devices. To configure the LMA in the Cisco ASR 5000, see the “PDN Gateway Configuration” module in the Cisco ASR 5000 Series Packet Data Network Gateway Administration Guide.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Command List, All Releases*
IP mobility commands	*Cisco IOS IP Mobility Command Reference*

Standards and RFCs

Standard/RFC	Title
RFC 3775	*Mobility Support in IPv6*
RFC 5213	*Proxy Mobile IPv6*

Standard/RFC	Title
RFC 5844	*IPv4 Support for Proxy Mobile IPv6*
RFC 5845	*Generic Routing Encapsulation (GRE) Key Option for Proxy Mobile IPv6*
RFC 5846	*Binding Revocation for IPv6 Mobility*

MIBs

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

Technical Assistance

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

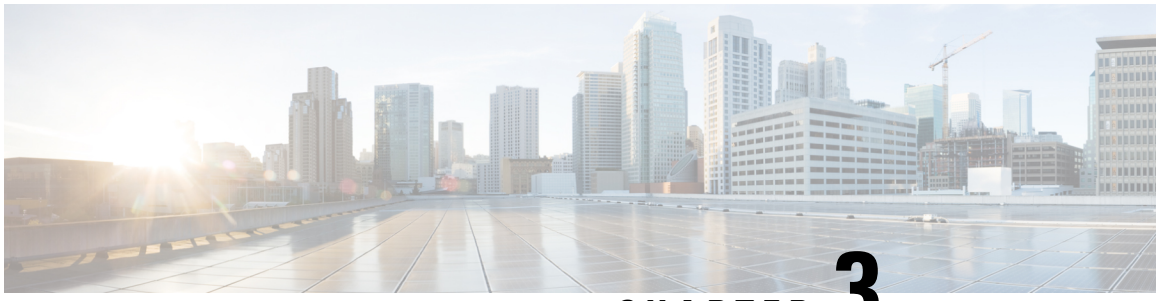
Feature Information for Proxy Mobile IPv6 Support for MAG Functionality

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

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

Table 1: Feature Information for Proxy Mobile IPv6 MAG Functionality Support

Feature Name	Releases	Feature Information
Proxy Mobile IPv6 MAG Functionality Support	Cisco IOS XE Release 3.4S	The Proxy Mobile IPv6 Support for MAG Functionality feature provides network-based IP Mobility management to a mobile node without requiring the participation of the mobile node in any IP mobility-related signaling. The Mobile Access Gateway tracks the movements of the mobile node to and from the access link, and sends signals to the local mobility anchor of the mobile node. In Cisco IOS XE Release 3.4S, this feature was introduced on the Cisco ASR Series Aggregation Services 1000 routers. The following commands were introduced: **address**, **apn**, **auth-option**, **binding**, **bri**, **clear ipv6 mobile pmipv6 mag**, **debug ipv6 mobile mag**, **debug ipv6 mobile packets**, **discover-mn-detach**, **encap**, **fixed-link-layer-address**, **fixed-link-local-address**, **gre-encap-key**, **int att**, **interface**, **ipv4-address**, **ipv6 mobile pmipv6-domain**, **ipv6 mobile pmipv6-mag**, **ipv6-address**, **lma**, **local-routing-mag**, **mag**, **mn-profile-load-aaa**, **multi-homed**, **nai**, **replay-protection**, **role**, **service**, **show ipv6 mobile pmipv6 mag binding**, **show ipv6 mobile pmipv6 mag globals**, **show ipv6 mobile pmipv6 mag stats**.
IPv6 Client Support on Proxy Mobile IPv6 Mobile Access Gateway	Cisco IOS XE Release 3.5S	Prior to the introduction of the IPv6 Client Support on Proxy Mobile IPv6 Mobile Access Gateway feature, only IPv4 service could be provided to an MN within the PMIP domain. The IPv6 client support on Proxy Mobile IPv6 MAG feature is an enhancement to provide IPv4, IPv6, and dual service to the MN within the PMIP domain. The following command was modified: **service**.



CHAPTER 3

Proxy Mobile IPv6 Local Mobility Anchor

Local Mobility Anchor (LMA) acts as the home agent for a mobile node (MN) in a Proxy Mobile IPv6 domain, which is the network where the mobility management of an MN is handled using the Proxy Mobile IPv6 (PMIPv6) protocol. LMA is the topological anchor point for the MN's home network prefix(es) and is the entity that manages the MN's binding state. This module explains how to configure LMA.

- Finding Feature Information, on page 23
- Prerequisites for Proxy Mobile IPv6 LMA, on page 23
- Information About Proxy Mobile IPv6 Support for LMA Functionality, on page 24
- How to Configure Proxy Mobile IPv6 LMA, on page 26
- Configuration Examples for Proxy Mobile IPv6 Support for LMA Functionality, on page 43
- Where to Go Next, on page 45
- Additional References, on page 45
- Feature Information for Proxy Mobile IPv6 Local Mobility Anchor , on page 46

Finding Feature Information

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

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

Prerequisites for Proxy Mobile IPv6 LMA

You must configure the IPv4 and IPv6 address pool for LMA to assign IPv4 or IPv6 addresses.

Information About Proxy Mobile IPv6 Support for LMA Functionality

Proxy Mobile IPv6 Overview

Proxy Mobile IPv6 (PMIPv6) provides network-based IP Mobility management to a mobile node (MN), without requiring the participation of the MN in any IP mobility-related signaling. The mobility entities in the network track the movements of the MN, initiate the mobility signaling, and set up the required routing state.

The major functional entities of PMIPv6 are Mobile Access Gateways (MAGs), Local Mobility Anchors (LMAs), and MNs.

Mobile Access Gateways

Mobile Access Gateway (MAG) performs mobility-related signaling on behalf of the mobile nodes (MN) attached to its access links. MAG is the access router for the MN; that is, MAG is the first-hop router in the localized mobility management infrastructure.

MAG performs the following functions:

- Obtains an IP address from Local Mobility Anchor (LMA) and assigns it to MN.
- Retains the IP address of an MN when the MN roams across MAGs.
- Tunnels traffic from MN to LMA.

Local Mobility Anchor

Local Mobility Anchor (LMA) is the home agent for a mobile node (MN) in a Proxy Mobile IPv6 (PMIPv6) domain. It is the topological anchor point for MN home network prefixes and manages the binding state of an MN. An LMA has the functional capabilities of a home agent as defined in the Mobile IPv6 base specification (RFC 3775) along with the capabilities required for supporting the PMIPv6 protocol.

Note Use the **dynamic mag learning** command to enable LMA to accept Proxy Mobile IPv6 (PMIPv6) signaling messages from any Mobile Access Gateway (MAG) that is not configured locally.

Mobile Node

Mobile node (MN) is an IP host and the mobility of the MN is managed by a network. MN can be an IPv4-only node, an IPv6-only node, or a dual-stack node, which is a node with IPv4 and IPv6 protocol stacks. MN is not required to participate in any IP mobility-related signaling for achieving mobility for an IP address or a prefix that is obtained in the Proxy Mobile IPv6 (PMIPv6) domain.

VRF-Aware LMA

The VRF Aware LMA feature is an enhancement that enables VRF awareness support on Local Mobility Anchor (LMA). This feature includes the following capabilities:

- Awareness of multiple customers belonging to different VRFs.
- Peer with multiple mobile operators for transport towards the Customer Premises Equipment (CPE) or Mobile Access Gateway (MAG) devices in separate peering or transport VRFs.

AAA Server Attributes for Proxy Mobile IPv6

If an authentication, authorization, and accounting (AAA) server is available, a Mobile Access Gateway (MAG) obtains the profile information of the Proxy Mobile IPv6 (PMIPv6) domain and the mobile node (MN) from the server during the configuration and call-flow time, respectively.

The following are the AAA attributes required for configuring the PMIPv6 domain and the MN are:

- PMIPv6 domain-specific AAA attributes:
  - cisco-mpc-protocol-interface
  - lma-identifier
  - mag-identifier
  - mag-v4-address
  - mag-v6-address
  - pmip6-domain-identifier
  - pmip6-timestamp-window
  - pmip6-replay-protection
  - pmip6-spi-key
  - pmip6-spi-value
- MN-specific AAA attributes:
  - home-lma
  - home-lma-ipv6-address
  - mn-nai
  - home-lma-ipv4-address
  - mn-apn
  - Mobile-Node-Identifier
  - mn-network
  - mn-service
  - multihomed

How to Configure Proxy Mobile IPv6 LMA

Configuring a Proxy Mobile IPv6 Domain by Using the Configuration from the AAA Server

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name* **load-aaa**
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **load-aaa** **Example:** `Device(config)# ipv6 mobile pmipv6-domain D1 load-aaa`	Creates a PMIPv6 domain and configures it by using the configuration from the AAA server.
Step 4	**end** **Example:** `Device(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Configuring a Minimum Configuration for a Domain When an AAA Server Is Not Available

SUMMARY STEPS

1. **enable**
2. **configure terminal**

3. **ipv6 mobile pmipv6-domain** *domain-name*
4. **mag** *mag-id*
5. **ipv4-address** *ipv4-address*
6. **ipv6-address** *ipv6-address*
7. **exit**
8. Repeat Steps 4 to 7 to configure the second MAG.
9. **nai** [*user*]*@realm*
10. **network** *network-name*
11. **service** {**dual** | **ipv4** | **ipv6**}
12. **exit**
13. Repeat Steps 8 to 12 to configure the second MN.
14. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-domain dn1`	Creates the PMIP domain and enters PMIP domain configuration mode.
Step 4	**mag** *mag-id* **Example:** `Device(config-ipv6-pmipv6-domain)# mag mag1`	Configures a MAG within the PMIP domain and enters PMIP domain MAG configuration mode.
Step 5	**ipv4-address** *ipv4-address* **Example:** `Device(config-ipv6-pmipv6-domain-mag)# ipv4-address 192.0.2.254`	Configures an IPv4 address for the MAG within the PMIP domain.
Step 6	**ipv6-address** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-domain-mag)# ipv6-address 2001:DB8::1`	Configures an IPv6 address for the MAG within the PMIP domain.

	Command or Action	Purpose
Step 7	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-mag)# exit`	Exits PMIP domain MAG configuration mode and returns to PMIP domain configuration mode.
Step 8	Repeat Steps 4 to 7 to configure the second MAG.	—
Step 9	**nai** [*user*]*@realm* **Example:** `Device(config-ipv6-pmipv6-domain)# nai example1@example.com`	Configures a network access identifier (NAI) for the MN within the PMIP domain and enters PMIP domain MN configuration mode.
Step 10	**network** *network-name* **Example:** `Device(config-ipv6-pmipv6-domain-mn)# network network1`	Associates a network name with the LMA under which an IPv4 or IPv6 pool can be enabled.
Step 11	**service** {**dual** | **ipv4** | **ipv6**} **Example:** `Device(config-ipv6-pmipv6-domain-mn)# service ipv4`	Configures the service provided to the MN within the PMIP domain.
Step 12	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-mn)# exit`	Exits PMIP domain MN configuration mode and returns to PMIP domain configuration mode.
Step 13	Repeat Steps 8 to 12 to configure the second MN.	—
Step 14	**end** **Example:** `Device(config-ipv6-pmipv6-domain)# end`	Exits PMIP domain configuration mode and returns to privileged EXEC mode.

Configuring a Detailed Configuration for a Domain When the AAA Server Is Not Available

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name*
4. **fixed-link-local-address** *ipv6-address*
5. **fixed-link-layer-address** *hardware-address*

6. **replay-protection timestamp** [**window** *seconds*]
7. **auth-option spi** {*spi-hex-value* | **decimal** *spi-decimal-value*} **key** {**ascii** *ascii-string* | **hex** *hex-string*}
8. **encap** {**gre-ipv4** | **ipv6-in-ipv6**}
9. **local-routing-mag**
10. **mag** *mag-id*
11. **ipv4-address** *ipv4-address*
12. **ipv6-address** *ipv6-address*
13. **exit**
14. Repeat Steps 10 to 13 to configure each MAG.
15. **mag** *mag-id*
16. **ipv4-address** *ipv4-address*
17. **ipv6-address** *ipv6-address*
18. **exit**
19. **mn-profile-load-aaa**
20. **nai** [*user*]*@realm*
21. **lma** *lma-id*
22. **service** {**dual** | **ipv4** | **ipv6**}
23. **network** *network-name*
24. Repeat Steps 22 and 23 to configure each MN.
25. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-domain dn1`	Creates a PMIP domain and enters PMIPv6 domain configuration mode.
Step 4	**fixed-link-local-address** *ipv6-address* **Example:** `Router(config-ipv6-pmipv6-domain)# fixed-link-local-address FE80::CE00:BFF:FEFC:0`	Configures a fixed link-local address for the MAG-enabled interface toward the MN.
Step 5	**fixed-link-layer-address** *hardware-address* **Example:**	Configures a fixed link layer address (Layer 2 address) for the MAG-enabled interface toward the MN.

	Command or Action	Purpose
	`Router(config-ipv6-pmipv6-domain)# fixed-link-layer-address aaaa.bbbb.cccc`	
Step 6	**replay-protection timestamp** [**window** *seconds*] **Example:** `Device(config-ipv6-pmipv6-domain)# replay-protection timestamp window 200`	Configures the replay protection mechanism within the PMIP domain.
Step 7	**auth-option spi** {*spi-hex-value* | **decimal** *spi-decimal-value*} **key** {**ascii** *ascii-string* | **hex** *hex-string*} **Example:** `Device(config-ipv6-pmipv6-domain)# auth-option spi 67 key ascii key1`	Configures authentication for the PMIP domain.
Step 8	**encap** {**gre-ipv4** | **ipv6-in-ipv6**} **Example:** `Device(config-ipv6-pmipv6-domain)# encap gre-ipv4`	Configures the tunnel encapsulation mode type between the MAG and the LMA.
Step 9	**local-routing-mag** **Example:** `Device(config-ipv6-pmipv6-domain)# local-routing-mag`	Enables local routing for the MAG.
Step 10	**mag** *mag-id* **Example:** `Device(config-ipv6-pmipv6-domain)# mag mag1`	Configures MAG within the PMIP domain and enters PMIP domain MAG configuration mode.
Step 11	**ipv4-address** *ipv4-address* **Example:** `Device(config-ipv6-pmipv6-domain-mag)# ipv4-address 192.0.2.254`	Configures an IPv4 address for the MAG.
Step 12	**ipv6-address** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-domain-mag)# ipv6-address 2001:0DB8:2:3::1`	Configures an IPv6 address for the MAG.
Step 13	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-mag)# exit`	Exits PMIP domain MAG configuration mode and returns to PMIP domain configuration mode.

	Command or Action	Purpose
Step 14	Repeat Steps 10 to 13 to configure each MAG.	—
Step 15	**mag** *mag-id* **Example:** `Device(config-ipv6-pmipv6-domain)# mag mag1`	Configures a MAG within the PMIP domain and enters PMIP domain MAG configuration mode.
Step 16	**ipv4-address** *ipv4-address* **Example:** `Device(config-ipv6-pmipv6-domain-mag)# ipv4-address 192.0.2.254`	Configures an IPv4 address for the MAG.
Step 17	**ipv6-address** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-domain-mag)# ipv6-address 2001:0DB8:2:4::2`	Configures an IPv6 address for the MAG.
Step 18	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-mag)# exit`	Exits PMIP domain MAG configuration mode and returns to PMIP domain configuration mode.
Step 19	**mn-profile-load-aaa** **Example:** `Device(config-ipv6-pmipv6-domain)# mn-profile-load-aaa`	(Optional) Loads the profile configuration from the AAA server to the MN within the PMIP domain. **Note** Steps 20 to 24 need not be executed if the MN is configured using the configuration from the AAA server. You can use the specific command to override the configuration for the specific MN parameter.
Step 20	**nai** [*user*]*@realm* **Example:** `Device(config-ipv6-pmipv6-domain)# nai example1@example.com`	Configures the NAI for the MN within the PMIP domain and enters PMIP domain MN configuration mode.
Step 21	**lma** *lma-id* **Example:** `Device(config-ipv6-pmipv6-domain-mn)# lma lma1`	Configures the LMA for the MN.
Step 22	**service** {**dual** | **ipv4** | **ipv6**} **Example:** `Device(config-ipv6-pmipv6-domain-mn)# service ipv4`	Configures the service provided to the MN within the PMIP domain.

	Command or Action	Purpose
Step 23	**network** *network-name* **Example:** `Device(config-ipv6-pmipv6-domain-mn)# network network1`	Associates a network name with the LMA under which an IPv4 or IPv6 pool can be enabled.
Step 24	Repeat Steps 22 and 23 to configure each MN.	—
Step 25	**end** **Example:** `Device(config-ipv6-pmipv6-domain-mn)# end`	Exits PMIP domain MN configuration mode and returns to privileged EXEC mode.

Configuring a Minimum Configuration for an LMA

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip local pool** *pool-name low-ip-address high-ip-address*
4. **ipv6 local pool** *pool-name prefix/prefix-length assigned-length*
5. **ipv6 unicast-routing**
6. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
7. **address ipv6** *ipv6-address*
8. **network** *network1*
9. **pool ipv4** *pool-name* **pfxlen** *number*
10. **pool ipv6** *pool-name* **pfxlen** *number*
11. **exit**
12. **default profile** *profile-name*
13. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 3	**ip local pool** *pool-name low-ip-address high-ip-address* **Example:** `Device(config)# ip local pool v4pool 172.16.23.1 172.16.23.10`	Creates a local pool of IPv4 addresses.
Step 4	**ipv6 local pool** *pool-name prefix/prefix-length assigned-length* **Example:** `Device(config)# ipv6 local pool v6pool 2001:0DB8::/29 64`	Creates a local pool of IPv6 addresses.
Step 5	**ipv6 unicast-routing** **Example:** `Device(config)# ipv6 unicast-routing`	Enables IPv6 routing.
Step 6	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables the LMA service on the router, configures the PMIP domain for the LMA, and enters LMA configuration mode.
Step 7	**address ipv6** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-lma)# address ipv6 2001:DB8::1`	Configures an IPv6 address for the LMA.
Step 8	**network** *network1* **Example:** `Device(config-ipv6-pmipv6-lma)# network network1`	Associates a network, on which an IPv4 or IPv6 pool is configured, with the LMA, and enters LMA-network configuration mode.
Step 9	**pool ipv4** *pool-name* **pfxlen** *number* **Example:** `Device(config-ipv6-pmipv6lma-network)# pool ipv4 v4pool pfxlen 24`	Specifies the name of the IPv4 address pool from which a home address is allocated to an MN subscriber.
Step 10	**pool ipv6** *pool-name* **pfxlen** *number* **Example:** `Device(config-ipv6-pmipv6lma-network)# pool ipv6 v6pool pfxlen 24`	Specifies the name of the IPv6 address pool from which a home address is allocated to the MN subscriber.

	Command or Action	Purpose
Step 11	**exit** **Example:** `Device(config-ipv6-pmipv6lma-network)# exit`	Exits the LMA-network configuration mode and enters LMA configuration mode.
Step 12	**default profile** *profile-name* **Example:** `Device(config-ipv6-pmipv6-lma)# default profile profile1`	Enables the default profile for the MN.
Step 13	**end** **Example:** `Device(config-ipv6-pmipv6-lma)# end`	Exits LMA configuration mode and enters privileged EXEC mode.

Configuring a Detailed Configuration for an LMA

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip local pool** *pool-name low-ip-address high-ip-address*
4. **ipv6 local pool** *pool-name prefix/prefix-length assigned-length*
5. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
6. **enable aaa accounting**
7. **network** *network-name*
8. **pool ipv4** *pool-name* **pfxlen** *number*
9. **pool ipv6** *pool-name* **pfxlen** *number*
10. **exit**
11. **default profile** *profile1*
12. **address ipv4** *ipv4-address*
13. **address ipv6** *ipv6-address*
14. **bce maximum** *number*
15. **bce lifetime** *seconds*
16. **bce refresh-time** *seconds*
17. **bce delete-wait-time** *seconds*
18. **replay-protection timestamp** [**window** *seconds*]
19. **bri delay min** *milliseconds*
20. **bri delay max** *milliseconds*
21. **bri retries** *number*
22. **mag** *mag-id domain-name*
23. **auth-option spi** {*spi-hex-value* | **decimal** *spi-decimal-value*} **key** {**ascii** | **hex**} *hex-string*
24. **ipv4-address** *ipv4-address*

25. **ipv6-address** *ipv6-address*
26. **encap** {**gre-ipv4** | **ipv6-in-ipv6**}
27. **end**
28. **show ipv6 mobile pmipv6 lma lma1 globals**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip local pool** *pool-name low-ip-address high-ip-address* **Example:** `Device(config)# ip local pool v4pool 172.16.23.1 172.16.23.10`	Creates a local pool of IPv4 addresses.
Step 4	**ipv6 local pool** *pool-name prefix/prefix-length assigned-length* **Example:** `Device(config)# ipv6 local pool v6pool 2001:0DB8::/29 64`	Creates a local pool of IPv6 addresses.
Step 5	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables the LMA service on a device, configures the PMIP domain for the LMA, and enters LMA configuration mode.
Step 6	**enable aaa accounting** **Example:** `Device(config-ipv6-pmipv6-lma)# enable aaa accounting`	Enables AAA accounting for MN sessions.
Step 7	**network** *network-name* **Example:** `Device(config-ipv6-pmipv6-lma)# network network1`	Configures a network name with the LMA under which an IPv4 or IPv6 pool is to be enabled and enters LMA-network configuration mode.

	Command or Action	Purpose
Step 8	**pool ipv4** *pool-name* **pfxlen** *number* **Example:** `Device(config-ipv6-pmipv6lma-network)# pool ipv4 v4pool pfxlen 24`	Specifies the name of the IPv4 address pool from which a home address is allocated to an MN subscriber.
Step 9	**pool ipv6** *pool-name* **pfxlen** *number* **Example:** `Device(config-ipv6-pmipv6lma-network)# pool ipv6 v6pool pfxlen 24`	Specifies the name of the IPv6 address pool from which a home address is allocated to an MN subscriber.
Step 10	**exit** **Example:** `Device(config-ipv6-pmipv6lma-network)# exit`	Exits LMA-network configuration mode and enters LMA configuration mode.
Step 11	**default profile** *profile1* **Example:** `Device(config-ipv6-pmipv6-lma)# default profile profile1`	Enables the default profile for the MN.
Step 12	**address ipv4** *ipv4-address* **Example:** `Device(config-ipv6-pmipv6-lma)# address ipv4 192.0.2.1`	Configures an IPv4 address for the LMA.
Step 13	**address ipv6** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-lma)# address ipv6 2001:DB8::1`	Configures an IPv6 address for the LMA.
Step 14	**bce maximum** *number* **Example:** `Device(config-ipv6-pmipv6-lma)# bce maximum 200`	Specifies the maximum number of Binding Cache Entries (BCE) that is allowed for the LMA on the MN.
Step 15	**bce lifetime** *seconds* **Example:** `Device(config-ipv6-pmipv6-lma)# bce lifetime 5000`	Specifies the maximum lifetime of a BCE on a MN.
Step 16	**bce refresh-time** *seconds* **Example:**	Specifies the time to refresh the BCE of an MN.

	Command or Action	Purpose
	`Device(config-ipv6-pmipv6-lma)# bce refresh-time 2000`	
Step 17	**bce delete-wait-time** *seconds* **Example:** `Device(config-ipv6-pmipv6-lma)# bce delete-wait-time 2000`	Specify the minimum amount of time in seconds the LMA must wait before it deletes a BCE on receiving the notification from the MAG.
Step 18	**replay-protection timestamp** [**window** *seconds*] **Example:** `Device(config-ipv6-pmipv6-lma)# replay-protection timestamp window 200`	Configures the replay protection mechanism within the PMIP domain.
Step 19	**bri delay min** *milliseconds* **Example:** `Device(config-ipv6-pmipv6-lma)# bri delay min 500`	Specifies the minimum time for which an LMA should wait before transmitting the Binding Revocation Indication (BRI) message.
Step 20	**bri delay max** *milliseconds* **Example:** `Device(config-ipv6-pmipv6-lma)# bri delay max 4500`	Specifies the maximum time for which an LMA should wait for the Binding Revocation Acknowledgment (BRA) message before retransmitting the BRI message.
Step 21	**bri retries** *number* **Example:** `Device(config-ipv6-pmipv6-lma)# bri retries 6`	Specifies the maximum number of times an LMA should retransmit a BRI message until a BRA is received.
Step 22	**mag** *mag-id domain-name* **Example:** `Device(config-ipv6-pmipv6-lma)# mag mag3 dn1`	Configures the MAG for the LMA and enters LMA-MAG configuration mode.
Step 23	**auth-option spi** {*spi-hex-value* | **decimal** *spi-decimal-value*} **key** {**ascii** | **hex**} *hex-string* **Example:** `Device(config-ipv6-pmipv6lma-mag)# auth-option spi decimal 258 key hex FFFFF`	Configures authentication for the LMA within the MAG.
Step 24	**ipv4-address** *ipv4-address* **Example:** `Device(config-ipv6-pmipv6mag-lma)# ipv4-address 192.0.2.254`	Configures an IPv4 address for the LMA within the MAG. **Note** Repeat the **ipv4-address** *ipv4-address* to configure as many IPv4 addresses as required.

	Command or Action	Purpose
Step 25	**ipv6-address** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6mag-lma)# ipv6-address 2001:0DB8:2:5::1`	Configures an IPv6 address for the LMA within the MAG. **Note** Repeat the **ipv6-address** *ipv6-address* to configure as many IPv6 addresses as required.
Step 26	**encap** {**gre-ipv4** | **ipv6-in-ipv6**} **Example:** `Device(config-ipv6-pmipv6mag-lma)# encap gre-ipv4`	Configures a tunnel encapsulation mode type between the MAG and the LMA.
Step 27	**end** **Example:** `Device(config-ipv6-pmipv6mag-lma)# end`	Exits LMA-MAG configuration mode and returns to privileged EXEC mode.
Step 28	**show ipv6 mobile pmipv6 lma lma1 globals** **Example:** `Device# show ipv6 mobile pmipv6 lma lma1 globals`	(Optional) Displays LMA global configuration details.

Example

The following is sample output from the **show ipv6 mobile lma globals** command:

```
Device# show ipv6 mobile pmipv6 lma lma1 globals

--------------------------------------------------
Domain  : D1

LMA Identifier                          :lma1
        AAA Accounting                  : Disabled
        Default MN Profile              : profile1
        Network                         : network1
        IPv4 Pool Name                  : v4
        Prefix Length                   : 24
        IPv6 Pool Name                  : v6pool
        Prefix Length                   : 48
        Max. HNPs                       : 1
        Max Bindings                    : 128000
        AuthOption                      : disabled
        RegistrationLifeTime            : 3600 (sec)
        DeleteTime                      : 10000 (msec)
        CreateTime                      : 1500 (msec)
        BRI InitDelayTime               : 1000 (msec)
        BRI MaxDelayTime                : 2000 (msec)
        BRI MaxRetries                  : 1
        BRI EncapType                   : IPV6_IN_IPV6
        Fixed Link address is           : enabled
        Fixed Link address              : aaaa.aaaa.aaaa
        Fixed Link Local address is     : enabled
        Fixed Link local address        : 0xFE800000 0x0 0x0 0x2
        RefreshTime                     : 300 (sec)
        Refresh RetxInit time           : 1000 (msec)
```

```
        Refresh RetxMax time            : 32000 (msec)
        Timestamp option                : enabled
        Validity Window                 : 10

Peer :  mag1
        Max. HNPs                       : 1
        Max Bindings                    : 128000
        AuthOption                      : disabled
        RegistrationLifeTime            : 3600 (sec)
        DeleteTime                      : 10000 (msec)
        CreateTime                      : 1500 (msec)
        BRI InitDelayTime               : 1000 (msec)
        BRI MaxDelayTime                : 2000 (msec)
        BRI MaxRetries                  : 1
        BRI EncapType                   : IPV6_IN_IPV6
        Fixed Link address is           : enabled
        Fixed Link address              : aaaa.aaaa.aaaa
        Fixed Link Local address is     : enabled
        Fixed Link local address        : 0xFE800000 0x0 0x0 0x2
        RefreshTime                     : 300 (sec)
        Refresh RetxInit time           : 1000 (msec)
        Refresh RetxMax time            : 32000 (msec)
        Timestamp option                : enabled
        Validity Window                 : 10

Peer :  mag0
        Max. HNPs                       : 1
        Max Bindings                    : 128000
        AuthOption                      : disabled
        RegistrationLifeTime            : 3600 (sec)
        DeleteTime                      : 10000 (msec)
        CreateTime                      : 1500 (msec)
        BRI InitDelayTime               : 1000 (msec)
        BRI MaxDelayTime                : 2000 (msec)
        BRI MaxRetries                  : 1
        BRI EncapType                   : GRE in IPV4
        Fixed Link address is           : enabled
        Fixed Link address              : aaaa.aaaa.aaaa
        Fixed Link Local address is     : enabled
        Fixed Link local address        : 0xFE800000 0x0 0x0 0x2
        RefreshTime                     : 300 (sec)
        Refresh RetxInit time           : 1000 (msec)
        Refresh RetxMax time            : 32000 (msec)
        Timestamp option                : enabled
        Validity Window                 : 10
```

Troubleshooting Tips

You can use the following commands to troubleshoot the LMA configuration:

- **debug ipv6 mobile lma event**
- **debug ipv6 mobile lma info**
- **show ipv6 pmipv6 lma bindings info**
- **show ipv6 pmipv6 lma globals**
- **show ipv6 pmipv6 lma tunnel**

Configuring VRF-Aware LMA

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-lma** *lma-identifier* **domain** *domain-name*
4. **hnp maximum** *number*
5. **heartbeat interval** *interval-values* **retries** *retries-values*
6. **bce maximum** *number*
7. **bce lifetime** *seconds*
8. **bce delete-wait-time** *milliseconds*
9. **replay-protection timestamp window** *seconds*
10. **bri delay min** *milliseconds*
11. **bri retries** *count*
12. **dynamic mag learning**
13. **dscp control-plane** *dscp-value*
14. **mobility-service mobile-local-loop**
15. **customer** *customer-name* **vrf** *vrf-name*
16. **auth-option spi** *hex-value* **key ascii** *hex-value*
17. **heartbeat interval** *interval-value* **retries** *retries-value*
18. **network unauthorized**
19. **transport** [**vrf** *vrf-name*]
20. **address ipv6** *ipv6-address*
21. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-lma** *lma-identifier* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables the Local Mobility Anchor (LMA) service on the device, configures the PMIPv6 domain for the LMA, and enters LMA configuration mode.

	Command or Action	Purpose
Step 4	**hnp maximum** *number* **Example:** `Device (config-pmipv6-lma)# hnp maximum 2`	Configures the maximum number of home network prefixes (HNP) that a mobile node can possess.
Step 5	**heartbeat interval** *interval-values* **retries** *retries-values* **Example:** `Device (config-pmipv6-lma)# heartbeat interval 300 retries 3`	Configures heartbeat detection between MAG and LMA.
Step 6	**bce maximum** *number* **Example:** `Device (config-pmipv6-lma)# bce maximum 2500`	Configures the maximum number of binding cache entries (BCEs) or bindings that the LMA can support.
Step 7	**bce lifetime** *seconds* **Example:** `Device (config-pmipv6-lma)# bce lifetime 2500`	Specifies the maximum lifetime of a BCE on a mobile node.
Step 8	**bce delete-wait-time** *milliseconds* **Example:** `Device (config-pmipv6-lma)# bce delete-wait-time 2000`	Configures the minimum amount of time in seconds the LMA must wait before it deletes a BCE on receiving the notification from the MAG.
Step 9	**replay-protection timestamp window** *seconds* **Example:** `Device (config-pmipv6-lma)# replay-protection timestamp window 200`	Configures the replay protection mechanism within the PMIP domain.
Step 10	**bri delay min** *milliseconds* **Example:** `Device (config-pmipv6-lma)# bri delay min 500`	Configures the minimum time for which an LMA should wait before transmitting the Binding Revocation Indication (BRI) message.
Step 11	**bri retries** *count* **Example:** `Device(config-pmipv6-lma)# bri retries 6`	Configures the maximum number of times an LMA should retransmit a BRI message until a Binding Revocation Acknowledgment (BRA) is received.
Step 12	**dynamic mag learning** **Example:** `Device(config-pmipv6-lma)# dynamic mag learning`	Enables the LMA to accept PMIPv6 signaling messages from any MAG that is not locally configured.

	Command or Action	Purpose
Step 13	**dscp control-plane** *dscp-value* **Example:** `Device(config-pmipv6-lma)# dscp control-plane 50`	Configures the value of Differentiated Services Code Point (DSCP) in the outgoing PMIPv6 control plane messages.
Step 14	**mobility-service mobile-local-loop** **Example:** `Device (config-pmipv6-lma)# mobility-service mobile-local-loop`	Configures Mobile Loop Local (MLL) service on the LMA and enters the PMIPv6 LMA MLL configuration mode.
Step 15	**customer** *customer-name* **vrf** *vrf-name* **Example:** `Device (config-pmipv6-lma-mll)# customer cust1 vrf vrf1`	Configures the name and the VRF of a customer and enters the PMIPv6 LMA MLL Customer configuration mode. **Note** You should have already configured the VRF by the name *vrf1* in the device.
Step 16	**auth-option spi** *hex-value* **key ascii** *hex-value* **Example:** `Device (config-pmipv6-lma-mll-cust)# auth-option spi 87E key ascii key1`	Configures customer-specific authentication for the LMA within the MLL.
Step 17	**heartbeat interval** *interval-value* **retries** *retries-value* **Example:** `Device (config-pmipv6-lma-mll-cust)# heartbeat interval 300 retries 10`	Configures the heartbeat detection.
Step 18	**network unauthorized** **Example:** `Device (config-pmipv6-lma-mll-cust)# network unauthorized`	Configures customer-specific unauthorized network.
Step 19	**transport** [**vrf** *vrf-name*] **Example:** `Device (config-pmipv6-lma-mll-cust)# transport vrf transport_vrf`	Configures customer-specific transport options in an LMA within a MLL and enters PMIPv6 LMA MLL Customer Transport configuration mode. **Note** If the transport is in global VRF, then the **vrf** and *vrf-name* keyword-argument pair can be omitted in this command.
Step 20	**address ipv6** *ipv6-address* **Example:** `Device (config-pmipv6-lma-mll-cust-tpt)# address ipv6 2001:DB8::1`	Configures customer-specific LMA IP address. There can only be two instances of addresses, one for IPv4 and one for IPv6.
Step 21	**end** **Example:**	Exits the PMIPv6 LMA MLL Customer Transport configuration mode and returns to privileged EXEC mode.

	Command or Action	Purpose
	`Device (config-pmipv6-lma-mll-cust-tpt)# end`	

Configuration Examples for Proxy Mobile IPv6 Support for LMA Functionality

Example: Configuring a Proxy Mobile IPv6 Domain by Using the Configuration from the AAA Server

The following example shows how to configure the PMIPv6 domain by using the AAA server configuration:

```
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D1 load-aaa
```

The following example shows how to configure the PMIPv6 domain by using the configuration from the AAA server and how to override the configuration for specific PMIPv6 domain parameters:

```
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D11 load-aaa
Device(config)# ipv6 mobile pmipv6-domain D11
Device(config-ipv6-pmipv6-domain)# gre-ipv4
Device(config-ipv6-pmipv6-domain)# auth-option spi 67 key ascii key1
```

Example: Configuring a Minimum Configuration for a Domain When the Configuration from the AAA Server Is Not Available

The following example shows how to configure a minimum configuration for a domain when the AAA server configuration is not available:

```
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D2
Device(config-ipv6-pmipv6-domain)# replay-protection timestamp window 200
Device(config-ipv6-pmipv6-domain)# auth-option spi 100 key ascii hi
Device(config-ipv6-pmipv6-domain)# encap ipv6-in-ipv6
!
Device(config-ipv6-pmipv6-domain)# lma lma1
Device(config-ipv6-pmipv6-domain-lma)# ipv4-address 10.1.1.1
Device(config-ipv6-pmipv6-domain-lma)# ipv6-address 2001:0DB8:2:3::1
Device(config-ipv6-pmipv6-domain-lma)# exit
!
Device(config-ipv6-pmipv6-domain)# mag mag1
Device(config-ipv6-pmipv6-domain-mag)# ipv4-address 10.1.3.1
Device(config-ipv6-pmipv6-domain-mag)# ipv6-address 2001:0DB8:2:5::1
Device(config-ipv6-pmipv6-domain-mag)# exit
!
Device(config-ipv6-pmipv6-domain)# nai example@example.com
Device(config-ipv6-pmipv6-domain-mn)# lma lma1
Device(config-ipv6-pmipv6-domain-mn)# int att GigabitETHERNET l2-addr 02c7.f800.0422
Device(config-ipv6-pmipv6-domain-mn)# gre-encap-key up 1234
```

```
Device(config-ipv6-pmipv6-domain-mn)# gre-encap-key down 5678
Device(config-ipv6-pmipv6-domain-mn)# service ipv4
Device(config-ipv6-pmipv6-domain-mn)# network-name example1
Device(config-ipv6-pmipv6-domain-mn)# end
```

Example: Configuring an LMA

The following example shows the minimum configuration required to enable LMA:

```
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D2
!
Device(config-ipv6-pmipv6-domain)# lma lma1
Device(config-ipv6-pmipv6-domain-lma)# ipv4-address 10.1.1.1
Device(config-ipv6-pmipv6-domain-lma)# ipv6-address 2001:0DB8:2:3::1
Device(config-ipv6-pmipv6-domain-lma)# exit
!
Device(config-ipv6-pmipv6-domain)# lma lma2
Device(config-ipv6-pmipv6-domain-lma)# ipv4-address 10.2.1.1
Device(config-ipv6-pmipv6-domain-lma)# ipv6-address 2001:0DB8:2:4::1
Device(config-ipv6-pmipv6-domain-lma)# exit
!
Device(config-ipv6-pmipv6-domain)# nai example1@example.com
Device(config-ipv6-pmipv6-domain-mn)# network-name example1
Device(config-ipv6-pmipv6-domain-mn)# exit
!
Device(config-ipv6-pmipv6-domain)# nai example2@example.com
Device(config-ipv6-pmipv6-domain-mn)# network-name example1
Device(config-ipv6-pmipv6-domain-mn)# exit
!
Device(config)# ipv6 mobile pmipv6-lma lma1 domain D2
Device(config-ipv6-pmipv6-lma)# address ipv6 2001:DB8:0:0:E000::F
Device(config-ipv6-pmipv6-lma)# address ipv4 10.2.1.1
Device(config-ipv6-pmipv6-domain-mn)# network-name example1
Device(config-ipv6-pmipv6lma-network)# pool ipv4 v4pool pfxlen number
Device(config-ipv6-pmipv6lma-network)# pool ipv6 v6pool pfxlen number
Device(config-ipv6-pmipv6lma-network)# exit
Device(config-ipv6-pmipv6-lma)# default profile example2@example.com

Device(ipv6-mag-config)# exit
```

Example: Configuring VRF-Aware LMA

```
Device# configure
Device (config)# ipv6 mobile pmipv6-lma lma1 domain example.com
Device (config-pmipv6-lma)# hnp maximum 2
Device (config-pmipv6-lma)# heartbeat interval 300 retries 3
Device (config-pmipv6-lma)# bce maximum 2500
Device (config-pmipv6-lma)# bce lifetime 2500
Device (config-pmipv6-lma)# bce delete-wait-time 2000
Device (config-pmipv6-lma)# replay-protection timestamp window 200
Device (config-pmipv6-lma)# bri delay min 500
Device(config-pmipv6-lma)# bri retries 6
Device(config-pmipv6-lma)# dynamic mag learning
Device(config-pmipv6-lma)# dscp control-plane 50
Device (config-pmipv6-lma)# mobility-service mobile-local-loop
Device (config-pmipv6-lma-mll)# customer cust1 vrf vrf1
Device (config-pmipv6-lma-mll-cust)# auth-option spi 87E key ascii key1
```

```
Device (config-pmipv6-lma-mll-cust)# heartbeat interval 300 retries 10
Device (config-pmipv6-lma-mll-cust)# network unauthorized
Device (config-pmipv6-lma-mll-cust)# transport vrf transport_vrf
Device (config-pmipv6-lma-mll-cust-tpt)# address ipv6 2001:DB8::1
Device (config-pmipv6-lma-mll-cust-tpt)# end
```

Where to Go Next

The MAG entity works with the LMA provided by the ASR 5000 devices. To configure the LMA in the Cisco ASR 5000, see the "PDN Gateway Configuration" module in the Cisco ASR 5000 Series Packet Data Network Gateway Administration Guide.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Command List, All Releases*
IP mobility commands	*Cisco IOS IP Mobility Command Reference*

Standards and RFCs

Standard/RFC	Title
RFC 3775	*Mobility Support in IPv6*
RFC 5213	*Proxy Mobile IPv6*
RFC 5844	*IPv4 Support for Proxy Mobile IPv6*
RFC 5845	*Generic Routing Encapsulation (GRE) Key Option for Proxy Mobile IPv6*
RFC 5846	*Binding Revocation for IPv6 Mobility*

MIBs

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

Technical Assistance

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

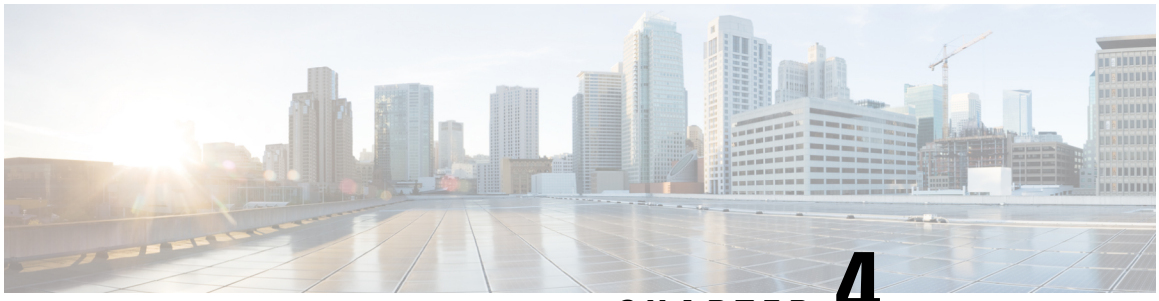
Feature Information for Proxy Mobile IPv6 Local Mobility Anchor

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

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

Table 2: Feature Information for Proxy Mobile IPv6 Local Mobility Anchor

Feature Name	Releases	Feature Information
Proxy Mobile IPv6 Local Mobility Anchor	15.5(2)T	Local Mobility Anchor (LMA) acts as the home agent for a mobile node (MN) in a Proxy Mobile IPv6 domain, which is the network where the mobility management of an MN is handled using the Proxy Mobile IPv6 (PMIPv6) protocol. LMA is the topological anchor point for the MN's home network prefix(es) and is the entity that manages the MN's binding state. This module explains how to configure LMA.



CHAPTER 4

PMIP Mobility - 3G Mobility Anchor

The 3G Mobility Anchor(3GMA) feature acts as an anchor point for 3G User Equipment (UE). 3GMA functions as the DHCP server for Gateway general packet radio service (GPRS) Support Node (GGSN)/Packet Data Serving Node (PDSN), and as a Local Mobility Anchor (LMA) towards Wi-Fi Mobile Access Gateway (MAG).

This module describes the 3G Mobility Anchor feature.

- Finding Feature Information, on page 47
- Prerequisites for 3G Mobility Anchor, on page 47
- Information about PMIP Mobility - 3G Mobility Anchor, on page 48
- How to Configure PMIP Mobility - 3G Mobility Anchor, on page 49
- Configuration Examples for PMIP Mobility - 3G Mobility Anchor, on page 51
- Additional References for PMIP Mobility - 3G Mobility Anchor, on page 52
- Feature Information for PMIP Mobility - 3G Mobility Anchor, on page 52

Finding Feature Information

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

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

Prerequisites for 3G Mobility Anchor

You must configure the IPv4 and IPv6 address pools for the Local Mobility Anchor (LMA) to assign IPv4 or IPv6 addresses.

Information about PMIP Mobility - 3G Mobility Anchor

3G Mobility Anchor Overview

Third-generation Mobility Anchor (3GMA) is the default gateway for Packet Data Serving Node (PDSN)/General Packet Radio Service (GPRS) Support Node (GGSN). A 3GMA node is placed on Gi interface of the PDSN/GGSN to serve as an anchor point for 3G User Equipments (UEs). Gi interface is the reference point between a GPRS network and an external packet data network. 3GMA node works as a DHCP server towards GGSN/PDSN, and as an LMA towards a WiFi MAG. 3GMA node assigns an IP address and responds to DHCP messages from GGSN/PDSN. UEs are configured with a specific Access Point Names (APNs); when a UE connects to this APN, PDSN/ GGSN is configured to operate in Proxy DHCP mode, instead of using local address pool. In 3GMA mode, the IP address assigned to the mobile is obtained from an external DHCP server (3GMA node). Local Mobility Anchor (LMA) functionality described in RFC 5213 can also be configured in 3GMA mode.

Local Mobility Anchor

Local Mobility Anchor (LMA) is the home agent for a mobile node (MN) in a Proxy Mobile IPv6 (PMIPv6) domain. It is the topological anchor point for MN home network prefixes and manages the binding state of an MN. An LMA has the functional capabilities of a home agent as defined in the Mobile IPv6 base specification (RFC 3775) along with the capabilities required for supporting the PMIPv6 protocol.

Note Use the **dynamic mag learning** command to enable LMA to accept Proxy Mobile IPv6 (PMIPv6) signaling messages from any Mobile Access Gateway (MAG) that is not configured locally.

Mobile Node

Mobile node (MN) is an IP host and the mobility of the MN is managed by a network. MN can be an IPv4-only node, an IPv6-only node, or a dual-stack node, which is a node with IPv4 and IPv6 protocol stacks. MN is not required to participate in any IP mobility-related signaling for achieving mobility for an IP address or a prefix that is obtained in the Proxy Mobile IPv6 (PMIPv6) domain.

Radio Access Technology Type

A radio access type (RAT) refers to the method of allocating radio resources in a wireless network for communication in the uplink (user to network) and downlink (network to user). RAT indicates the type of radio technology used to access a Core Network (CN), which is the central part of a telecommunication network that provides various services to customers who are connected by the access network. RAT is implemented by the radio access network (RAN) that resides between a device such as a mobile phone, a computer, or any remotely controlled machine, and provides connection with its CN. Mobile phones and other wireless connected devices are known as user equipment (UE). Examples of RAT types include Worldwide Interoperability for Microwave Access (WiMAX), Wireless Local Area Network (WLAN), and 3GPP

How to Configure PMIP Mobility - 3G Mobility Anchor

Configuring LMA in 3GMA Mode

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip local pool** *pool-name low-ip-address high-ip-address*
4. **ipv6 local pool** *pool-name prefix/prefix-length assigned-length*
5. **ipv6 unicast-routing**
6. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
7. **address ipv6** *ipv6-address*
8. **network** *network1*
9. **pool ipv4** *pool-name* **pfxlen** *number*
10. **pool ipv6** *pool-name* **pfxlen** *number*
11. **exit**
12. **default profile** *profile-name*
13. **role 3gma**
14. **interface** *interface-type*
15. **rat** *rat-type* **priority** *priority-number*
16. **end**
17. **show ipv6 mobile pmipv6 lma binding**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip local pool** *pool-name low-ip-address high-ip-address* **Example:** `Device(config)# ip local pool v4pool 209.165.201.1 209.165.201.10`	Creates a local pool of IPv4 addresses.

	Command or Action	Purpose
Step 4	**ipv6 local pool** *pool-name prefix/prefix-length assigned-length* **Example:** `Device(config)# ipv6 local pool v6pool 2001:0DB8::/32 64`	Creates a local pool of IPv6 addresses.
Step 5	**ipv6 unicast-routing** **Example:** `Device(config)# ipv6 unicast-routing`	Enables IPv6 routing.
Step 6	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables the Local Mobility Anchor (LMA) service on the device, configures the Proxy Mobile IPv6 (PMIPv6) domain for the LMA, and enters LMA configuration mode.
Step 7	**address ipv6** *ipv6-address* **Example:** `Device(config-ipv6-pmipv6-lma)# address ipv6 2001:DB8::1`	Configures an IPv6 address for the LMA.
Step 8	**network** *network1* **Example:** `Device(config-ipv6-pmipv6-lma)# network network1`	Associates a network, on which an IPv4 or IPv6 pool is configured, with the LMA, and enters LMA-network configuration mode.
Step 9	**pool ipv4** *pool-name* **pfxlen** *number* **Example:** `Device(config-ipv6-pmipv6lma-network)# pool ipv4 v4pool pfxlen 24`	Specifies the name of the IPv4 address pool from which a home address is allocated to an mobile node (MN) subscriber.
Step 10	**pool ipv6** *pool-name* **pfxlen** *number* **Example:** `Device(config-ipv6-pmipv6lma-network)# pool ipv6 v6pool pfxlen 24`	Specifies the name of the IPv6 address pool from which a home address is allocated to the MN subscriber.
Step 11	**exit** **Example:** `Device(config-ipv6-pmipv6lma-network)# exit`	Exits the LMA-network configuration mode and enters LMA configuration mode.
Step 12	**default profile** *profile-name* **Example:**	Enables the default profile for the MN.

	Command or Action	Purpose
	`Device(config-ipv6-pmipv6-lma)# default profile profile1`	
Step 13	**role 3gma** **Example:** `Device(config-ipv6-pmipv6-lma)# role 3gma`	Enables 3GMA and enters 3GMA mode. **Note** Specifying at least one interface is mandatory. The **role 3gma** command does not work if no interface is specified.
Step 14	**interface** *interface-type* **Example:** `Device(config-ipv6-pmipv6lma-role)# interface Ethernet 1`	Configures 3GMA interface on LMA.
Step 15	**rat** *rat-type* **priority** *priority-number* **Example:** `Device (config-ipv6-pmipv6lma-role)# rat wlan priority 2`	Sets the priority for Radio Access Type (RAT).
Step 16	**end** **Example:** `Device (config-ipv6-pmipv6lma-role)# end`	Exits 3GMA role configuration mode and enters privileged EXEC mode.
Step 17	**show ipv6 mobile pmipv6 lma binding** **Example:** `Device# show ipv6 mobile pmipv6 lma binding`	Displays the list of the LMA bindings established over the Proxy Mobile IPv6 (PMIPv6) signaling plane.

Configuration Examples for PMIP Mobility - 3G Mobility Anchor

Example: Configuring LMA in 3GMA Mode

The following example shows how to configure LMA in 3GMA mode:

```
Device> enable
Device# configure terminal
Device(config)# ip local pool v4pool 209.165.201.1 209.165.201.10
Device(config)# ipv6 local pool v6pool 2001:0DB8::/32 64
Device(config)# ipv6 unicast-routing
Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1
Device(config-ipv6-pmipv6-lma)# address ipv6 2001:DB8::1
Device(config-ipv6-pmipv6-lma)# network network1
Device(config-ipv6-pmipv6lma-network)# pool ipv4 v4pool pfxlen 24
Device(config-ipv6-pmipv6lma-network)# pool ipv6 v6pool pfxlen 24
Device(config-ipv6-pmipv6lma-network)# exit
```

```
Device(config-ipv6-pmipv6-lma)# default profile profile1
Device(config-ipv6-pmipv6-lma)# role 3gma
Device(config-ipv6-pmipv6lma-role)# interface Ethernet 1
Device (config-ipv6-pmipv6lma-role)# rat wlan priority 2
Device (config-ipv6-pmipv6lma-role)# end
Device# show ipv6 mobile pmipv6 lma binding
```

Additional References for PMIP Mobility - 3G Mobility Anchor

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
IP mobility commands	Cisco IOS IP Mobility Command Reference

Standards and RFCs

Standard/RFC	Title
RFC 3775	*Mobility Support in IPv6*
RFC 5213	*Proxy Mobile IPv6*
RFC 5844	*IPv4 Support for Proxy Mobile IPv6*
RFC 5845	*Generic Routing Encapsulation (GRE) Key Option for Proxy Mobile IPv6*
RFC 5846	*Binding Revocation for IPv6 Mobility*

Technical Assistance

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

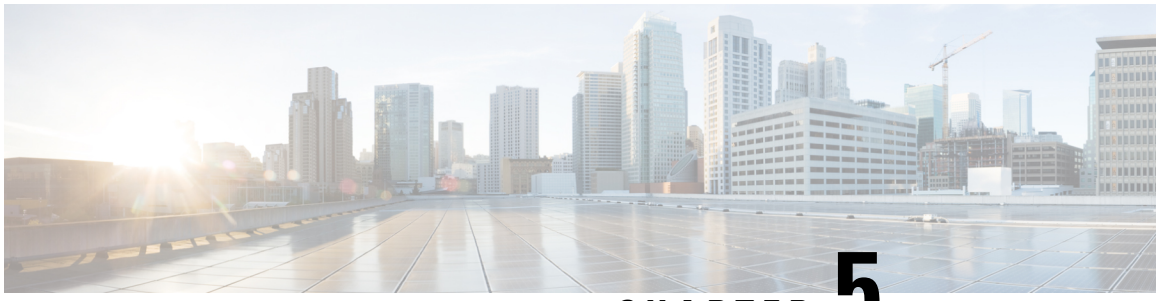
Feature Information for PMIP Mobility - 3G Mobility Anchor

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

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

Table 3: Feature Information for PMIP Mobility - 3G Mobility Anchor

Feature Name	Releases	Feature Information
PMIP Mobility - 3G Mobility Anchor	Cisco IOS XE Release 3.9S	The 3G Mobility Anchor(3GMA) feature acts as an anchor point for 3G User Equipment (UE). 3GMA functions as the DHCP server for Gateway general packet radio service (GPRS) Support Node (GGSN)/Packet Data Serving Node (PDSN), and as a Local Mobility Anchor (LMA) towards Wi-Fi Mobile Access Gateway (MAG). The following commands were introduced or modified: **rat**, **role 3gma**, **interface (proxy mobile IPv6)**, and **show ipv6 mobile pmipv6 lma binding**



CHAPTER 5

PMIP: Multipath Support on MAG and LMA

The PMIP: Multipath Support on MAG and LMA feature enables Mobile Access Gateway (MAG) to register multiple transport end-points with Local Mobility Anchor (LMA), allowing MAG and LMA to establish multiple tunnels and apply path selection on a flow basis.

- Finding Feature Information, on page 55
- Prerequisites for PMIP: Multipath Support for MAG and LMA, on page 55
- Information About PMIP: Multipath Support for MAG and LMA, on page 56
- How to Configure PMIP: Multipath Support for MAG and LMA, on page 58
- Configuration Examples for PMIPv6 Multipath Support for MAG and LMA, on page 80
- Additional References, on page 84
- Feature Information for PMIP: Multipath Support on MAG and LMA, on page 85

Finding Feature Information

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

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

Prerequisites for PMIP: Multipath Support for MAG and LMA

- Configure UDP in tunnel encapsulation mode on Mobile Access Gateway (MAG) and Local Mobility Anchor (LMA).
- Configure multipath and run the IP SLA responder.

Information About PMIP: Multipath Support for MAG and LMA

Local Mobility Anchor

Local Mobility Anchor (LMA) is the home agent for a mobile node (MN) in a Proxy Mobile IPv6 (PMIPv6) domain. It is the topological anchor point for MN home network prefixes and manages the binding state of an MN. An LMA has the functional capabilities of a home agent as defined in the Mobile IPv6 base specification (RFC 3775) along with the capabilities required for supporting the PMIPv6 protocol.

Note Use the **dynamic mag learning** command to enable LMA to accept Proxy Mobile IPv6 (PMIPv6) signaling messages from any Mobile Access Gateway (MAG) that is not configured locally.

Mobile Access Gateways

Mobile Access Gateway (MAG) performs mobility-related signaling on behalf of the mobile nodes (MN) attached to its access links. MAG is the access router for the MN; that is, MAG is the first-hop router in the localized mobility management infrastructure.

MAG performs the following functions:

- Obtains an IP address from Local Mobility Anchor (LMA) and assigns it to MN.
- Retains the IP address of an MN when the MN roams across MAGs.
- Tunnels traffic from MN to LMA.

Mobile Node

Mobile node (MN) is an IP host and the mobility of the MN is managed by a network. MN can be an IPv4-only node, an IPv6-only node, or a dual-stack node, which is a node with IPv4 and IPv6 protocol stacks. MN is not required to participate in any IP mobility-related signaling for achieving mobility for an IP address or a prefix that is obtained in the Proxy Mobile IPv6 (PMIPv6) domain.

Multipath Support

At any given time, many network paths exists between Local Mobility Anchor (LMA) and Mobile Access Gateway (MAG). The PMIP: Multipath Support on MAG and LMA feature enables MAG to select any one of the paths on priority basis or select all the existing network paths simultaneously to create tunnels to reach LMA. All paths have the same priority when multiple paths are selected.

Mobile Map

Mobile map configuration facilitates application-based routing. More than one mobile map can be configured under the Proxy Mobile IPv6 (PMIPv6) domain, however, at a given point of time, only one mobile map is

active at Mobile Access Gateway (MAG) and Local Mobility Anchor (LMA). The mobile map and its entries are configured or modified when no bindings are available.

Logical Mobile Node

Logical Mobile Node (LMN) is a logical entity that represents a mobile node (MN) that is hosted on one of the interfaces of Mobile Access Gateway (MAG) device. LMN has Network Access Indicator (NAI) similar to MN. One or more networks can be associated with each LMN through the interfaces designated as mobile network interfaces. LMN on mobile network receives an IP address from a DHCP server that runs on MAG, unlike a mobile node whose address is assigned by Local Mobility Anchor (LMA).

Multipath Management

The PMIPv6 Mutipath Management feature enables PMIPv6 to choose from multiple available links which have different access technologies. Available path is constantly monitored using PMIPv6 heartbeat which is a special type of PMIPv6 packet. Link preferences can be assigned to various types of traffic using mobile maps.

Hybrid-Access Service

Hybrid-access service is a multipath management solution, which provides mobility service under MAG. PMIPv6 hybrid-access service is an independent function that manages application profiles, captures and stores link performance statistics, and programs the PMIPv6 data plane based on the application requirements (HTTP, SSH, Telnet, and video).

Note PMIPv6 hybrid-access service has no interference with the core PMIPv6 functionality.

MAG to MAG Traffic Blocking on the PMIPv6 LMA

To prevent communication between PMIPv6 clients such as, mobile nodes (MNs), or entire mobile networks, that are connected to the same Local Mobility Anchor (LMA), the inter-MAG tunnel traffic is blocked by applying access control list (ACL) on the PMIPv6 tunnels. To enable the blockage of inter-MAG tunnel traffic, the prefixes of all the PMIPv6 addresses mentioned in the address pool configured on LMA, must be entered in the ACL.

IP SLA Optimization

IP SLA optimization helps solve MAG scaling limitations. In the case of PMIPv6 multipath scenario, if hybrid access is enabled then MAG and LMA start SLA probes to measure link performance. Programmatically created IP SLA probes uses dynamic route map entries to route these SLA packets. The current IP SLA implementation supports only 1024 dynamic route map entries on ASR1000 Series Aggregation Services Routers and this limits MAG scaling.

As a solution, IP SLA APIs have been enhanced to accept egress interface for UDP jitter probes. With this enhancement, PMIPv6 does not create dynamic route map entries to redirect IP SLA traffic over PMIPv6 tunnel instead it uses new enhanced APIs to configure egress interface for the dynamically created SLA probes.

Loopback as a Roaming Interface

Loopback as roaming interface solves customer IP address space limitation issues. In case of PMIPv6 multipath VRF scenario, MAG supports different service providers. This leads to duplicate IP address on roaming interface (each service provider can use the same IP). The current implementation does not support this scenarios because LMA expects unique roaming interface IP. This limits the usage of IP address space for different customers.

Loopback IP as a tunnel source solves this problem. The roaming interface is the loopback interface which is associated with a physical egress interface. Loopback interface should be unique across MAGs, however, physical interface IPs can be duplicated.

How to Configure PMIP: Multipath Support for MAG and LMA

Configuring PMIP: Multipath Support for MAG and LMA

Configuring UDP Encapsulation for a PMIPv6 Domain

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name*
4. **encap udptunnel**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-domain dn1`	Creates a PMIPv6 domain and enters PMIPv6 domain configuration mode.

	Command or Action	Purpose
Step 4	**encap udptunnel** **Example:** `Device(config-ipv6-pmipv6-domain)# encap udptunnel`	Configures the tunnel encapsulation mode type between Mobile Access Gateway (MAG) and Local Mobility Anchor (LMA).
Step 5	**end** **Example:** `Device(onfig-ipv6-pmipv6-domain)# end`	Exits PMIPv6 domain configuration mode and returns to privileged EXEC mode.

Configuring Roaming Interface

Note Perform this task when configuring multipath for MAG.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name*
4. **address** *dynamic*
5. **roaming interface** *type number*
6. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-mag mag1 domain dn1`	Enables MAG service on a device, configures the PMIPv6 domain for MAG, and enters MAG configuration mode.
Step 4	**address** *dynamic* **Example:** `Device(config-ipv6-pmipv6-mag)# address dynamic`	Configures dynamic address for MAG and enters MAG dynamic address configuration mode.

	Command or Action	Purpose
Step 5	**roaming interface** *type number* **Example:** `Device(config-ipv6-pmipv6-mag-addr-dyn)# roaming interface Ethernet 0/0`	Specifies an interface as a roaming interface on MAG.
Step 6	**exit** **Example:** `Device(config-ipv6-pmipv6-mag-addr-dyn)# exit`	Exits MAG dynamic address configuration mode and returns to privileged EXEC mode.

Configuring Multipath under LMA and MAG Configurations

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
4. **multipath**
5. **exit**
6. **ipv6 mobile pmipv6-mag mag1 domain dn1**
7. **multipath**
8. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables LMA service on the device, configures the PMIPv6 domain for Local Mobility Anchor (LMA), and enters LMA configuration mode.
Step 4	**multipath** **Example:** `Device(config-ipv6-pmipv6-lma)# multipath`	Enables multipath support on LMA.
Step 5	**exit** **Example:**	Exits LMA configuration mode and enters global configuration mode.

	Command or Action	Purpose
	`Device(config-ipv6-pmipv6-lma)# exit`	
Step 6	**ipv6 mobile pmipv6-mag mag1 domain dn1** **Example:** `Device(config)# ipv6 mobile pmipv6-mag mag1 domain dn1`	Enables MAG service on a device, configures the PMIPv6 domain for MAG, and enters MAG configuration mode.
Step 7	**multipath** **Example:** `Device(config-ipv6-pmipv6-mag)# multipath`	Enables multipath support on MAG.
Step 8	**exit** **Example:** `Device(config-ipv6-pmipv6-mag)# exit`	Exits MAG configuration mode and returns to global configuration mode.

Configuring Mobile Map Support on LMA

Configuring Access Lists in LMA

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list extended** *access-list-name*
4. **permit** *protocol* **any any**
5. **exit**
6. **ip access-list extended** *access-list-name*
7. **permit** *protocol* **any any**
8. **exit**
9. **ip access-list extended** *access-list-name*
10. **permit** *protocol* **any any**
11. **exit**
12. **ip access-list extended** *access-list-name*
13. **permit ip any** *destination-address destination-wildcard*
14. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip access-list extended** *access-list-name* **Example:** `Device(config)# ip access-list extended tcp`	Configures an extended named ACL specific to TCP.
Step 4	**permit** *protocol* **any any** **Example:** `Device(config-ext-nacl)# permit tcp any any`	Sets conditions in named IP lists that permit packets.
Step 5	**exit** **Example:** `Device(config-ext-nacl)# exit`	Exits extended-ACL configuration mode and returns to global configuration mode.
Step 6	**ip access-list extended** *access-list-name* **Example:** `Device(config)# ip access-list extended icmp`	Configures an extended named ACL specific to Internet Control Message Protocol (ICMP).
Step 7	**permit** *protocol* **any any** **Example:** `Device(config-ext-nacl)# permit icmp any any`	Sets conditions in named IP lists that permit packets.
Step 8	**exit** **Example:** `Device(config-ext-nacl)# exit`	Exits extended-ACL configuration mode and returns to global configuration mode.
Step 9	**ip access-list extended** *access-list-name* **Example:** `Device(config)# ip access-list extended udp`	Configures an extended named ACL specific to UDP.
Step 10	**permit** *protocol* **any any** **Example:** `Device(config-ext-nacl)# permit udp any any`	Sets conditions in named IP lists that permit packets.
Step 11	**exit** **Example:**	Exits extended-ACL configuration mode and returns to global configuration mode.

	Command or Action	Purpose
	`Device(config-ext-nacl)# exit`	
Step 12	**ip access-list extended** *access-list-name* **Example:** `Device(config)# ip access-list extended LB010ACL`	Configures an extended named ACL.
Step 13	**permit ip any** *destination-address destination-wildcard* **Example:** `Device(config-ext-nacl)# permit ip any 10.255.224.0 0.0.0.255`	Sets conditions in named IP lists that permit packets.
Step 14	**end** **Example:** `Device(config-ext-nacl)# end`	Exits extended-ACL configuration mode and returns to privileged EXEC mode.

Configuring Mobile Maps under the PMIPv6 domain

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name* **terminal**
4. **mobile-map** *map-name sequence-number*
5. **match access-list** *acl-list-name*
6. **set link-type** *link-name1*`[` *link-name2*`]` `[`*link-name2*`]` **null**
7. **exit**
8. **mobile-map** *map-name sequence-number*
9. **match access-list** *acl-list-name*
10. **set link-type** *link-name1* **null**
11. **end**

DETAILED STEPS

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

	Command or Action	Purpose
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **terminal** **Example:** `Device(config)# ipv6 mobile pmipv6-domain dn1`	Creates a PMIP domain and enters PMIPv6 domain configuration mode.
Step 4	**mobile-map** *map-name sequence-number* **Example:** `Device(config-ipv6-pmipv6-domain)# mobile-map mobilemap1 10`	Configures a mobile map for the PMIPv6 domain and enters mobile-map configuration mode.
Step 5	**match access-list** *acl-list-name* **Example:** `Device(config-ipv6-pmipv6-domain-mobile-map)# match access-list LB010ACL`	Specifies an access list (ACL) name.
Step 6	**set link-type** *link-name1*`[` *link-name2*`]` `[`*link-name2*`]` **null** **Example:** `Device(config-ipv6-pmipv6-domain-mobile-map)# set link-type lte_intf 3g_intf wifi_intf null`	Specifies the link type for a match clause.
Step 7	**exit** **Example:** `Device(config-ipv6-pmipv6-domain-mobile-map)# exit`	Exits mobile-map configuration mode and enters global configuration mode.
Step 8	**mobile-map** *map-name sequence-number* **Example:** `Device(config-ipv6-pmipv6-domain)# mobile-map mobilemap1 20`	Configures a mobile map for a PMIPv6 domain and enters mobile-map configuration mode.
Step 9	**match access-list** *acl-list-name* **Example:** `Device(config-ipv6-pmipv6-domain-mobile-map)# match access-list icmp`	Specifies an access-list (ACL) name.
Step 10	**set link-type** *link-name1* **null** **Example:** `Device(config-ipv6-pmipv6-domain-mobile-map)# set link-type 3g_intf_lte_intf null`	Specifies the link type for a match clause.

	Command or Action	Purpose
Step 11	**end** **Example:** `Device(config-ipv6-pmipv6-domain-mobile-map)# end`	Exits mobile-map configuration mode and returns to privileged EXEC mode.

Configuring a Mobile Map under LMA Configuration and Applying it on an Interface

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
4. **mobile-map** *map-name*
5. **interface** *type number*
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables LMA service on the device, configures the PMIP domain for LMA, and enters LMA configuration mode.
Step 4	**mobile-map** *map-name* **Example:** `Device(config-ipv6-pmipv6-lma)# mobile-map mobilemap1`	Configures a mobile map for the PMIPv6 domain and enters mobile-map configuration mode. **Note** If you modify one or more access-list entries, for the modified access list to be applied, you must unconfigure the mobile map from LMA configuration and reconfigure it.
Step 5	**interface** *type number* **Example:**	Enables an interface for the mobile map.

	Command or Action	Purpose
	`Device(config-ipv6-pmipv6-lma)# interface gigabitethernet 0/0/0`	
Step 6	**end** **Example:** `Device(config-ipv6-pmipv6-lma)# end`	Exits mobile-map configuration mode and returns to privileged EXEC mode.

Configuring the MTU to be Applied on the PMIPv6 Tunnel

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
4. **tunnel mtu** *mtu-size*
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables LMA service on the device, configures the PMIP domain for LMA, and enters LMA configuration mode.
Step 4	**tunnel mtu** *mtu-size* **Example:** `Device(config-ipv6-pmipv6-lma)# tunnel mtu 1360`	Configures a maximum transmission unit (MTU) on a PMIPv6 tunnel.
Step 5	**end** **Example:** `Device(config-ipv6-pmipv6-lma)# end`	Exits LMA configuration mode and returns to privileged EXEC mode.

Applying an ACL on the PMIPv6 Tunnel

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list extended** *access-list-name*
4. **deny** *protocol* **host** *addr* **any**
5. **permit** *protocol* **any any**
6. **exit**
7. **ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name*
8. **tunnel acl** *acl-list-name*
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip access-list extended** *access-list-name* **Example:** `Device(config)# ip access-list extended acl1`	Defines an IP access list by name and enters the extended ACL configuration mode.
Step 4	**deny** *protocol* **host** *addr* **any** **Example:** `Device(config-ext-nacl)# deny ip host 10.2.2.2 any`	Sets conditions in a named IP access list that will deny packets.
Step 5	**permit** *protocol* **any any** **Example:** `Device(config-ext-nacl)# permit ip any any`	Sets conditions to allow a packet to pass a named IP access list.
Step 6	**exit** **Example:** `Device(config-ext-nacl)# exit`	Exits the extended ACL configuration mode and returns to the global configuration mode.
Step 7	**ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma mag1 domain dn1`	Enables MAG service on the device, configures the PMIP domain for LMA, and enters MAG configuration mode.

	Command or Action	Purpose
Step 8	**tunnel acl** *acl-list-name* **Example:** `Device(config-ipv6-pmipv6-lma)# tunnel acl acl1`	Specifies an ACL to be applied on the PMIPv6 tunnel in an LMA.
Step 9	**end** **Example:** `Device(config-ipv6-pmipv6-lma)# end`	Exits LMA configuration mode and returns to privileged EXEC mode.

Configuring Multiple Mobile Network IPv4 or IPv6 Address Pools for a Network Under LMA Configuration

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
4. **network** *name*
5. Do one of the following:
   - **mobile-network pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
   - **mobile-network v6pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
6. Do one of the following:
   - **mobile-network pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
   - **mobile-network v6pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables LMA service on the device, configures the PMIP domain for LMA, and enters LMA configuration mode.

	Command or Action	Purpose
Step 4	**network** *name* **Example:** `Device(config-ipv6-pmipv6-lma)# network name`	Specifies mobile address pools, from which a mobile network prefix is allocated to a logical mobile node (LMN) and enters LMA-network configuration mode.

Step 5	Do one of the following:
	• **mobile-network pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
	• **mobile-network v6pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
	Example:
	`Device(config)# mobile-network pool 10.20.2.1 pool-prefix 24 network-prefix 30`
	Example:
	`Device(config)# mobile-network pool 2001:DB8::1 pool-prefix 48  pool-prefix 48 network-prefix 30`
		Associates a network, to which an IPv4 or IPv6 pool can be configured, with LMA.

Step 6	Do one of the following:
	• **mobile-network pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
	• **mobile-network v6pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
	Example:
	`Device(config)# mobile-network pool 10.20.2.2 pool-prefix 24 network-prefix 30`
	Example:
	`Device(config)# mobile-network pool 2001:DB8::2 pool-prefix 64 pool-prefix 48 network-prefix 30`
		Associates a network, to which an IPv4 or IPv6 pool can be configured, with LMA.

Step 7	**end** **Example:** `Device(config-ipv6-pmipv6lma-network)# end`	Exits LMA-network configuration mode and returns to privileged EXEC mode.

Configuring Heartbeat under LMA Configuration

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
4. **heartbeat** [**interval** *interval* **retries** *retries* [**label** *label*] **natreboot**]]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1`	Enables LMA service on the device, configures the PMIP domain for LMA, and enters LMA configuration mode.
Step 4	**heartbeat** [**interval** *interval* **retries** *retries* [**label** *label*] **natreboot**]] **Example:** `Device(config-ipv6-pmipv6-lma)# heartbeat interval 300 retries 2 label label1 natreboot`	Configures heartbeat detection between MAG and LMA.
Step 5	**end** **Example:** `Device(config-ipv6-pmipv6-lma)# end`	Exits LMA configuration mode and returns to privileged EXEC mode.

Configuring Multipath Management

Configuring Multipath Management on LMA

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name*
4. **mobile-map** *map-name sequence-number*
5. **match access-list** *access list name*
6. **set link-type** *link-type*
7. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
8. **address ipv4** *ipv4-address*
9. **heartbeat** [**interval** *interval* **retries** *retries*]
10. **bce maximum** *number*

11. **default profile** *profile-name*
12. **dynamic mag learning**
13. **multipath**
14. **mobile-map** *map-name sequence-number*
15. **tunnel mtu** *mtu-size*
16. **interface** *interface-type*
17. **network** *network-name*
18. Do one of the following:
    - **pool ipv4** *pool-name* **pfxlen** *number*
    - **mobile-network v4pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
19. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-domain D1`	Creates the PMIP domain and enters PMIP domain configuration mode.
Step 4	**mobile-map** *map-name sequence-number* **Example:** `Device (config-ipv6-pmipv6-domain)# mobile-map MAP1 12`	Configures a mobile map for the PMIPv6 domain and enters mobile-map configuration mode. • The range is from 1 to 255.
Step 5	**match access-list** *access list name* **Example:** `Device (config-ipv6-pmipv6-domain-mobile-map)# match access-list voice`	Specifies the access list that identifies an application.
Step 6	**set link-type** *link-type* **Example:** `Device (config-ipv6-pmipv6-domain-mobile-map)# set link-type lte_intf 3g_intf`	Sets link preferences for the application.
Step 7	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device (config-ipv6-pmipv6-domain-mobile-map)# ipv6 mobile pmipv6-lma LMA1 domain D1`	Enables LMA service on the device, configures the PMIP domain for LMA, and enters LMA configuration mode.

	Command or Action	Purpose
Step 8	**address ipv4** *ipv4-address* **Example:** `Device (config-ipv6-pmipv6-lma)# address ipv4 9.9.9.1`	Configures an IPv4 address for LMA.
Step 9	**heartbeat** [**interval** *interval* **retries** *retries*] **Example:** `Device (config-ipv6-pmipv6-lma)# heartbeat interval 15 retries 1`	Configures heartbeat.
Step 10	**bce maximum** *number* **Example:** `Device (config-ipv6-pmipv6-lma)# bce maximum 128000`	Configures the maximum number of binding cache entries (BCEs) or bindings that LMA can support. **Note** Bindings represent a mobile node session.
Step 11	**default profile** *profile-name* **Example:** `Device (config-ipv6-pmipv6-lma)# default profile regularmn`	Configures the default profile for mobile nodes.
Step 12	**dynamic mag learning** **Example:** `Device (config-ipv6-pmipv6-lma)# dynamic mag learning`	Enables LMA to accept PMIPv6 signaling messages from any MAG that is not configured locally.
Step 13	**multipath** **Example:** `Device (config-ipv6-pmipv6-lma)# multipath`	Enables multipath support on LMA.
Step 14	**mobile-map** *map-name sequence-number* **Example:** `Device (config-ipv6-pmipv6-lma)# mobile-map MAP1`	Configures a mobile map for the PMIPv6 domain and enters mobile-map configuration mode.
Step 15	**tunnel mtu** *mtu-size* **Example:** `Device (config-ipv6-pmipv6-lma)# tunnel mtu 1360`	Configures a maximum transmission unit (MTU) on a PMIPv6 tunnel.
Step 16	**interface** *interface-type* **Example:** `Device (config-ipv6-pmipv6-lma)# interface Ethernet 0/2`	Configures an egress interface for LMA.
Step 17	**network** *network-name* **Example:** `Device (config-ipv6-pmipv6-lma)# network net1`	Specifies mobile address pools, from which a mobile network prefix is allocated to a Logical Mobile Node (LMN) and enters LMA-network configuration mode.

	Command or Action	Purpose

Step 18	Do one of the following:
	• **pool ipv4** *pool-name* **pfxlen** *number*
	• **mobile-network v4pool** *address* **pool-prefix** *pool-prefix* **network-prefix** *network-prefix*
	Example:
	`Device (config-ipv6-pmipv6lma-network)# pool ipv4 v4pool pfxlen 24`
	Example:
	`Device (config-ipv6-pmipv6lma-network)# mobile-network pool 10.0.0.1 pool-prefix 24 network-prefix 30`
		Specifies an IPv4 address pool from which a home address is allocated to the MN subscriber and configures IPv4 pool for mobile networks or mobile nodes.

Step 19	**end** **Example:** `Device (config-ipv6-pmipv6lma-network)# end`	Exits LMA configuration mode and returns to privileged EXEC mode.

Configuring Multipath Management on MAG

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-domain** *domain-name*
4. **mobile-map** *map-name sequence-number*
5. **match access-list** *access-list name*
6. **traffic-profile** *profile-name*
7. **ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name*
8. **address dynamic**
9. **roaming interface** *type number* **priority** *interface priority* **egress-att** *interface-attribute user assigned labels*
10. **exit**
11. **heartbeat** [**interval** *interval* **retries** *retries*]
12. **bce maximum** *number*
13. **multipath**
14. **mobile-map** *map-name sequence-number*
15. **tunnel mtu** *mtu-size*
16. **interface** *interface-type*
17. **lma** *lma-id domain-name*
18. **mobility-service hybrid-access**
19. **profile-definition** *profile-name*
20. **jitter** *value*
21. **rtt** *value*
22. **packet-loss** *value*
23. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-domain D1`	Creates the PMIP domain and enters PMIP domain configuration mode.
Step 4	**mobile-map** *map-name sequence-number* **Example:** `Device (config-ipv6-pmipv6-domain)# mobile-map MAP1 12`	Configures a mobile map for the PMIPv6 domain and enters mobile-map configuration mode. • The range is from 1 to 255.
Step 5	**match access-list** *access-list name* **Example:** `Device (config-ipv6-pmipv6-domain-mobile-map)# match access-list voice`	Specifies an ACL that identifies an application such as HTTP, SSH, Telnet, and video.
Step 6	**traffic-profile** *profile-name* **Example:** `Device (config-ipv6-pmipv6-domain-mobile-map)# traffic-profile haccess-voice`	Specifies a hybrid access profile where the performance requirements have been defined.
Step 7	**ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name* **Example:** `Device (config-ipv6-pmipv6-domain-mobile-map)# ipv6 mobile pmipv6-mag MAG1 domain D1`	Enables MAG service on the device, configures the PMIP domain for MAG, and enters MAG configuration mode.
Step 8	**address dynamic** **Example:** `Device (config-ipv6-pmipv6-mag)# address dynamic`	Configures dynamic address for MAG and enters MAG dynamic address configuration mode.
Step 9	**roaming interface** *type number* **priority** *interface priority* **egress-att** *interface-attribute user assigned labels* **Example:** `Device (config-ipv6-pmipv6-mag-addr-dyn)# roaming interface Ethernet1/0 priority 1 egress-att LTE label lte_intf` **Example:**	Specifies a roaming interface and priority on MAG.

	Command or Action	Purpose
	`Device (config-ipv6-pmipv6-mag-addr-dyn)# roaming interface Ethernet1/1 priority 2 egress-att 3G label 3g_intf`	
Step 10	**exit** **Example:** `Device (config-ipv6-pmipv6-mag-addr-dyn)# exit`	Enters MAG dynamic address configuration mode and returns to privileged EXEC mode.
Step 11	**heartbeat** [**interval** *interval* **retries** *retries*] **Example:** `Device (config-ipv6-pmipv6-mag)# heartbeat interval 15 retries 1`	Configures heartbeat.
Step 12	**bce maximum** *number* **Example:** `Device (config-ipv6-pmipv6-mag)# bce maximum 128000`	Configures the maximum number of binding cache entries (BCEs) or bindings that MAG can support.
Step 13	**multipath** **Example:** `Device (config-ipv6-pmipv6-mag)# multipath`	Enables multipath support on MAG.
Step 14	**mobile-map** *map-name sequence-number* **Example:** `Device (config-ipv6-pmipv6-mag)# mobile-map MAP1`	Configures a mobile map for the PMIPv6 domain and enters mobile-map configuration mode.
Step 15	**tunnel mtu** *mtu-size* **Example:** `Device (config-ipv6-pmipv6-mag)# tunnel mtu 1360`	Configures a maximum transmission unit (MTU) on a PMIPv6 tunnel.
Step 16	**interface** *interface-type* **Example:** `Device (config-ipv6-pmipv6-mag)# interface Ethernet 0/2`	Configures an egress interface for MAG.
Step 17	**lma** *lma-id domain-name* **Example:** `Device(config-ipv6-pmipv6- mag)# lma LMA1 D1`	Enables LMA service on the device, configures the PMIP domain for LMA, and enters LMA configuration mode.
Step 18	**mobility-service hybrid-access** **Example:** `Device (config-ipv6-pmipv6-mag)# mobility-service hybrid-access`	Configures hybrid-access service.
Step 19	**profile-definition** *profile-name* **Example:**	Defines a traffic profile.

	Command or Action	Purpose
	`Device (config-ipv6-pmipv6-mag-haccess-svc)# profile-definition haccess-voice`	
Step 20	**jitter** *value* **Example:** `Device (config-ipv6-pmipv6-mag-haccess-profile-def-svc)# jitter 50`	Configures the jitter value, in milliseconds.
Step 21	**rtt** *value* **Example:** `Device (config-ipv6-pmipv6-mag-haccess-profile-def-svc)# rtt 100`	Configures the Round Trip Time (RTT) value, in milliseconds.
Step 22	**packet-loss** *value* **Example:** `Device (config-ipv6-pmipv6-mag-haccess-profile-def-svc)# packet-loss 2`	Configures the packet loss value, in percentage.
Step 23	**end** **Example:** `Device (config-ipv6-pmipv6-mag-haccess-profile-def-svc)# end`	Exits MAG configuration mode and returns to privileged EXEC mode.

Configuring Hybrid-Access Unequal Load Balance on LMA

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name*
4. **mobility-service hybrid-access**
5. **bandwidth-ratio**
6. **label** *link type***bandwidth-ratio priority** *1 - 15*
7. **mag** *mag name*
8. **exit**
9. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:**	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
	`Device> enable`	
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-lma** *lma-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-mag mag1 domain dn1`	Enables LMA service on a device, configures the PMIPv6 domain for LMA, and enters LMA configuration mode.
Step 4	**mobility-service hybrid-access** **Example:** `Device(config-ipv6-pmipv6-lma)# mobility-service hybrid-acces`	Configures hybrid-access service
Step 5	**bandwidth-ratio** **Example:** `Device(config-ipv6-pmipv6-lma-haccess-svc)# bandwidth-ratio`	Enables bandwidth ratio mode
Step 6	**label** *link type***bandwidth-ratio priority** *1 - 15* **Example:** `Device(config-ipv6-pmipv6-lma-haccess-bw-ratio-svc)#label LTE bandwidth-ratio 4`	Configures global link specific bandwidth ratio
Step 7	**mag** *mag name* **Example:** `Device(config-ipv6-pmipv6-lma-haccess-bw-ratio-svc)#mag M1`	Configures a MAG within the bandwidth ratio and enbles hybrid access bandwidth ratio mode.
Step 8	**exit** **Example:** `Device(config-ipv6-pmipv6-lma-haccess_mag-bw-ratio-svc)#exit`	Exits MAG specific bandwidth ratio configuration mode and returns to hybrid access bandwidth ratio configuration mode.
Step 9	**exit** **Example:** `Device(config-ipv6-pmipv6-lma-haccess-bw-ratio-svc)#exit`	Exits hybrid access bandwidth ratio configuration mode.

Configuring Hybrid-Access Unequal Load Balance on MAG

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name*
4. **mobility-service hybrid-access**
5. **bandwidth-ratio**
6. **label** *link type* **bandwidth-ratio** *type number*
7. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-mag mag1 domain dn1`	Enables MAG service on a device, configures the PMIPv6 domain for MAG, and enters MAG configuration mode.
Step 4	**mobility-service hybrid-access** **Example:** `Device(config-ipv6-pmipv6-mag)# mobility-service hybrid-acces`	Configures hybrid-access service
Step 5	**bandwidth-ratio** **Example:** `Device(config-ipv6-pmipv6-mag-haccess-svc)# bandwidth-ratio`	Enables bandwidth ratio mode
Step 6	**label** *link type* **bandwidth-ratio** *type number* **Example:** `Device(config-ipv6-pmipv6-mag-haccess-bw-ratio-svc)# label LTE bandwidth-ratio 4`	Configures link specific bandwidth ratio
Step 7	**exit** **Example:** `Device(config-ipv6-pmipv6-mag-haccess-bw-ratio-svc)#exit`	Exits hybrid access bandwidth ratio configuration mode

Configuring Loopback as a Roaming Interface

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name*
4. **heartbeat** [**interval** *interval* **retries** *retries* **timeout** *timeout*]
5. **address** *dynamic*
6. **roaming interface** *type number* **egress-interface** *type number* **priority** *interface priority* **egress-att** *interface-attribute user assigned labels*
7. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mobile pmipv6-mag** *mag-id* **domain** *domain-name* **Example:** `Device(config)# ipv6 mobile pmipv6-mag mag1 domain dn1`	Enables MAG service on a device, configures the PMIPv6 domain for MAG, and enters MAG configuration mode.
Step 4	**heartbeat** [**interval** *interval* **retries** *retries* **timeout** *timeout*] **Example:** `Device (config-ipv6-pmipv6-mag)# heartbeat interval 15 retries 1 timeout 6`	Configures heartbeat.
Step 5	**address** *dynamic* **Example:** `Device(config-ipv6-pmipv6-mag)# address dynamic`	Configures dynamic address for MAG and enters MAG dynamic address configuration mode.
Step 6	**roaming interface** *type number* **egress-interface** *type number* **priority** *interface priority* **egress-att** *interface-attribute user assigned labels* **Example:** `Device (config-ipv6-pmipv6-mag-addr-dyn)# roaming interface loopback0 egress-interface Dialer1 priority 90 egress-att ETHERNET label DSL` **Example:**	Specifies a roaming interface and priority on MAG.

	Command or Action	Purpose
	`Device (config-ipv6-pmipv6-mag-addr-dyn)# roaming interface loopback1 egress-interface GigabitEthernet8 priority 91 egress-att ETHERNET label LTE`	
Step 7	**exit** **Example:** `Device(config-ipv6-pmipv6-mag-addr-dyn)# exit`	Exits MAG dynamic address configuration mode and returns to privileged EXEC mode.

Configuration Examples for PMIPv6 Multipath Support for MAG and LMA

Example: Configuring Multipath on LMA

Example: Configuring UDP Encapsulation under PMIPv6 Domain

```
Device> enable
Device# configuration terminal
Device(config) ipv6 mobile pmipv6-domain D1
Device(config-ipv6-pmipv6-domain)# encap udptunnel
Device(config-ipv6-pmipv6-domain)# end
```

Example: Configuring Roaming Interface

Note This example is applicable when configuring multipath for MAG.

```
Device> enable
Device# configuration terminal
Device(config) ipv6 mobile pmipv6-ma mag1 domain D1
Device(config-ipv6-pmipv6-mag) address dynamic
Device(config-ipv6-pmipv6-mag-addr-dyn)# roaming interface Ethernet 0/0
Device(config-ipv6-pmipv6-mag-addr-dyn)# end
```

Example: Configuring PMIP: Multipath Support on LMA

```
Device> enable
Device# configuration terminal
Device(config) ipv6 mobile pmipv6-lma LMA1 domain D1
Device(config-ipv6-pmipv6-lma)# multipath
Device(config-ipv6-pmipv6-lma)# end
```

Example: Configuring Mobile Map on an LMA

Example: Configuring Access List on an LMA

```
Device> enable
Device# configuration terminal
Device(config)# ip access-list extended tcp
Device(config-ext-nacl)# permit tcp any any
Device(config-ext-nacl)# exit
Device(config)# ip access-list extended icmp
Device(config-ext-nacl)# permit icmp any any
Device(config-ext-nacl)# exit
Device(config)# ip access-list extended udp
Device(config-ext-nacl)# permit udp any any
Device(config-ext-nacl)# exit
Device(config)# ip access-list extended LB010ACL
Device(config-ext-nacl)# permit ip any 10.255.224.0 0.0.0.255
Device(config-ext-nacl)# end
```

Example: Applying an ACL on the PMIPv6 Tunnel

```
Device> enable
Device# configure terminal
Device(config)# ip access-list extended acl1
Device(config-ext-nacl)# deny ip host 10.2.2.2 any
Device(config)# permit ip any any
Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1
Device(config-ipv6-pmipv6-lma)# tunnel acl acl1
Device(config-ipv6-pmipv6-lma)# end
```

Example: Configuring mobile maps under the PMIPv6 domain

```
Device> enable
Device# configure terminal
Device(config)#  ipv6 mobile pmipv6-domain dn1
Device(config-ipv6-pmipv6-domain)# mobile-map mobilemap1 10
Device(config-ipv6-pmipv6-domain-mobile-map)# match access-list LB010ACL
Device(config-ipv6-pmipv6-domain-mobile-map)# set link-type lte_intf_3g_intf null
Device(config-ipv6-pmipv6-domain-mobile-map)# exit
Device(config-ipv6-pmipv6-domain)# mobile-map mobilemap1 20
Device(config-ipv6-pmipv6-domain-mobile-map)# match access-list icmp
Device(config-ipv6-pmipv6-domain-mobile-map)# set link-type lte_intf 3g_intf wifi_intf null
Device(config-ipv6-pmipv6-domain-mobile-map)# end
```

Example: Configuring a Mobile Map Under LMA Configuration and Applying it on an Interface

```
Device> enable
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1
Device(config-ipv6-pmipv6-domain)# mobile-map mobilemap1 10
Device(config-ipv6-pmipv6-domain-mobile-map)# interface gigabitethernet 0/0/0
Device(config-ipv6-pmipv6-domain-mobile-map)# end
```

Example: Configuring the MTU to be Applied on the PMIPv6 Tunnel

```
Device> enable
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1
Device(config-ipv6-pmipv6-lma)# tunnel mtu 1360
Device(config-ipv6-pmipv6-lma)# end
```

Example: Configuring Multiple Mobile Network Pools for a Network Under LMA Configuration

```
Device> enable
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1
Device(config-ipv6-pmipv6-lma)# network name
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 10.20.2.1 pool-prefix 24
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 10.20.3.1 pool-prefix 24
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# end
```

Example: Configuring Heartbeat under LMA Configuration

```
Device> enable
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-lma lma1 domain dn1
Device(config-ipv6-pmipv6-lma)# heartbeat interval 300 retries 2 label label1 natreboot
Device(config-ipv6-pmipv6-lma)# end
```

Example: Configuring Multipath Management

Example: Configuring Multipath Management on LMA

```
Device> enable
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D1
Device(config-ipv6-pmipv6-domain)# mobile-map MAP1 12
Device(config-ipv6-pmipv6-domain-mobile-map)# match access-list voice
Device(config-ipv6-pmipv6-domain-mobile-map)# set link-type lte_intf 3g_intf
Device(config-ipv6-pmipv6-domain-mobile-map)# ipv6 mobile pmipv6-lma LMA1 domain D1
Device(config-ipv6-pmipv6-lma)# address ipv4 9.9.9.1
Device(config-ipv6-pmipv6-lma)# heartbeat interval 15 retries 1
Device(config-ipv6-pmipv6-lma)# bce maximum 128000
Device(config-ipv6-pmipv6-lma)# default profile RegularMn
Device(config-ipv6-pmipv6-lma)# dynamic mag learning
Device(config-ipv6-pmipv6-lma)# multipath
Device(config-ipv6-pmipv6-lma)# mobile-map MAP1
Device(config-ipv6-pmipv6-lma)# tunnel mtu 1360
Device(config-ipv6-pmipv6-lma)# interface Ethernet0/2
```

```
Device(config-ipv6-pmipv6-lma)# network net1
Device(config-ipv6-pmipv6lma-network)# pool ipv4 v4pool pfxlen 24
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 20.20.2.1 pool-prefix 24
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 20.20.1.1 pool-prefix 24
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 30.30.2.1 pool-prefix 24
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# network net2
Device(config-ipv6-pmipv6lma-network)# pool ipv4 rv4pool pfxlen 16
Device(config-ipv6-pmipv6lma-network)# network net3
Device(config-ipv6-pmipv6lma-network)# pool ipv4 netpool2 pfxlen 24
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 31.31.1.1 pool-prefix 24
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 20.20.4.1 pool-prefix 24
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 20.20.3.1 pool-prefix 24
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# mobile-network pool 30.30.5.1 pool-prefix 23
network-prefix 30
Device(config-ipv6-pmipv6lma-network)# end
```

Example: Configuring Multipath Management on MAG

```
Device> enable
Device# configure terminal
Device(config)# ipv6 mobile pmipv6-domain D1
Device(config-ipv6-pmipv6-domain)# mobile-map MAP1 12
Device(config-ipv6-pmipv6-domain-mobile-map)# match access-list voice
Device(config-ipv6-pmipv6-domain-mobile-map)# traffic-profile haccess-voice
Device(config-ipv6-pmipv6-domain-mobile-map)# ipv6 mobile pmipv6-mag MAG1 domain D1
Device(config-ipv6-pmipv6-mag)# address dynamic
Device(config-ipv6-pmipv6-mag-addr-dyn)# roaming interface Ethernet1/0 priority 1 egress-att
 LTE label lte_intf
Device(config-ipv6-pmipv6-mag-addr-dyn)# roaming interface Ethernet1/1 priority 2 egress-att
 3G label 3g_intf
Device(config-ipv6-pmipv6-mag-addr-dyn)# exit
Device(config-ipv6-pmipv6-mag)# heartbeat interval 15 retries 1
Device(config-ipv6-pmipv6- mag)# bce maximum 128000
Device(config-ipv6-pmipv6- mag)# multipath
Device(config-ipv6-pmipv6- mag)# mobile-map MAP1
Device(config-ipv6-pmipv6- mag)# tunnel mtu 1360
Device(config-ipv6-pmipv6- mag)# interface Ethernet0/2
Device(config-ipv6-pmipv6- mag)# lma LMA1 D1
Device(config-ipv6-pmipv6-mag)# mobility-service hybrid-access
Device(config-ipv6-pmipv6-mag-haccess-svc)# profile-definition haccess-voice
Device(config-ipv6-pmipv6-mag-haccess-profile-def-svc)# jitter 50
Device(config-ipv6-pmipv6-mag-haccess-profile-def-svc)# rtt 100
Device(config-ipv6-pmipv6-mag-haccess-profile-def-svc)# packet-loss 2
Device(config-ipv6-pmipv6-mag-haccess-profile-def-svc)# end
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Command List, All Releases*
IP mobility commands	*Cisco IOS IP Mobility Command Reference*

Standards and RFCs

Standard/RFC	Title
RFC 3775	*Mobility Support in IPv6*
RFC 5213	*Proxy Mobile IPv6*
RFC 5844	*IPv4 Support for Proxy Mobile IPv6*
RFC 5845	*Generic Routing Encapsulation (GRE) Key Option for Proxy Mobile IPv6*
RFC 5846	*Binding Revocation for IPv6 Mobility*

MIBs

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

Technical Assistance

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

Feature Information for PMIP: Multipath Support on MAG and LMA

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

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

Table 4: Feature Information for PMIP: Multipath Support on MAG and LMA

Feature Name	Releases	Feature Information
PMIP: Multipath Support on MAG and LMA		The PMIP: Multipath Support on MAG and LMA feature enables Mobility Access Gateway (MAG) to register multiple transport end-points with Local Mobility Anchor (LMA), allowing MAG and LMA to establish multiple tunnels and apply path selection on a flow basis. The following commands were introduced or modified: **encap (proxy mobile IPv6)**, **heartbeat**, **interface (proxy mobile IPv6)** , **match access-list (PMIPv6)**, **mobile-map (PMIPv6 domain)**, **mobile-map (LMA)**, **mobile-network PMIPv6)**, **multipath**, **set link-type**, **tunnel mtu**, .
PMIPv6 Multipath Management		The PMIPv6 Mutipath Management feature enables PMIPv6 to choose from multiple available links which have different access technologies. The following commands were introduced or modified: **address dynamic**, **bce maximum**, **default profile**, **dynamic mag learning**, **heartbeat**, **jitter**, **match access-list**, **mobile-map**, **mobility-service hybrid-access**, **packet loss**, **profile-definition**, **rtt**, **set link-type**, **traffic-profile**.

Feature Name	Releases	Feature Information
PMIPv6: IP SLA optimization and Loopback as a roaming interface	Cisco IOS XE Fuji 16.9.1	IP SLA optimization helps solve MAG scaling limitations. Loopback as roaming interface solves customer IP address space limitation issues. The following commands were added or modified: **roaming interface** *type number* **egress-interface** *type number* **priority** *interface priority* **egress-att** *interface-attribute user assigned labels*.
PMIPv6 Unequal Load Balance	Cisco IOS XE Gibraltar 16.10.x	The PMIPv6 Unequal Load Balance feature helps to achieve Hybrid-Access Unequal Load Balance support on MAG and LMA.