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 1
- Prerequisites for Proxy Mobile IPv6 LMA, on page 1
- Information About Proxy Mobile IPv6 Support for LMA Functionality, on page 2
- How to Configure Proxy Mobile IPv6 LMA, on page 4
- Configuration Examples for Proxy Mobile IPv6 Support for LMA Functionality, on page 21
- Where to Go Next, on page 23
- Additional References, on page 23
- Feature Information for Proxy Mobile IPv6 Local Mobility Anchor , on page 24

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 1: 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.