Configuring 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 on Cisco ASR 9000 Series Aggregation Services Routers.

For a complete description of the PMIPv6 LMA configuration commands listed in this module, refer to the Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Command Reference publication. To locate documentation of other commands that appear in this chapter, use the command reference master index, or search online.

Feature History for Configuring Proxy Mobile IPv6 Local Mobility Anchor on the Cisco ASR 9000 Series Router

<table>
<thead>
<tr>
<th>Release</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release 5.2.2</td>
<td>This feature was introduced.</td>
</tr>
<tr>
<td>Release 5.3.1</td>
<td>Smart Licensing feature was added.</td>
</tr>
</tbody>
</table>

- Information About Proxy Mobile IPv6 Support for LMA Functionality, on page 2
- How to Configure Proxy Mobile IPv6 LMA, on page 3
- VRF Aware LMA, on page 11
- Additional References, on page 19
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 Gateway

A 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, the MAG is the first-hop router in the localized mobility management infrastructure.

A MAG performs the following functions:

- Obtains an IP address from a Local Mobility Anchor (LMA) and assigns it to an MN
- Tunnels traffic from an 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 and RFC 5213) along with the capabilities required for supporting the PMIPv6 protocol.

The LMA retains and shares the IP address of an MN when the MN roams across MAGs.

Smart Licensing for PMIPv6 LMA

Smart Licensing method of licensing is available for PMIPv6 LMA on the Cisco ASR 9000 Series Aggregation Services Routers. The licensing mode is soft-enforced mode. The licensing string available is A9K-SESSION-128K with maximum supported scale of 128K LMA bindings.

For more information about Smart Licensing, see Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide.

Mobile Node

A mobile node (MN) is an IP host whose mobility is managed by the network. An 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. An 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.

How to Configure Proxy Mobile IPv6 LMA

This section contains the following tasks:

Configuring a Proxy Mobile IPv6 LMA Domain

This task enables you to configure Proxy Mobile IPv6 LMA domain:

SUMMARY STEPS

1. configure
2. ipv6 mobile pmipv6-domain  domain-name
3. auth-option spi  hex-value  key  ascii  string
4. nai  [user]@realm
5. network  network-identifier
6. service  {  ipv4  |  ipv6  |  dual  }
7. (Optional)  customer  customer-name
8. commit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>configure</td>
<td>Configures a PMIPv6 domain and enters PMIPv6 domain configuration mode.</td>
</tr>
<tr>
<td>Step 2</td>
<td>ipv6 mobile pmipv6-domain  domain-name</td>
<td>Configures the authentication option to all MAGs in the domain that includes an SPI value specified in hexadecimal format and a shared secret key which is specified as an ASCII string.</td>
</tr>
<tr>
<td>Example:</td>
<td>RP/0/RSP0/CPU0:router(config)# ipv6 mobile pmipv6-domain cisco.com</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>auth-option spi  hex-value  key  ascii  string</td>
<td>Configures a network access identifier (NAI) of the mobile node (MN) within the PMIPv6 domain and enters PMIPv6 domain MN configuration mode. The NAI must be of form username@realm or just @realm</td>
</tr>
<tr>
<td>Example:</td>
<td>RP/0/RSP0/CPU0:router(config-pmipv6-domain)# auth-option spi 67 key ascii key1</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>nai  [user]@realm</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>RP/0/RSP0/CPU0:router(config-pmipv6-domain)# nai <a href="mailto:example@cisco.com">example@cisco.com</a></td>
<td></td>
</tr>
</tbody>
</table>
Purpose
Command or Action

**Step 5**

network network-identifier

*Example:*

RP/0/RSP0/CPU0:router(config-pmipv6-domain-nai)#

- network network2

**Purpose**

Corresponds to a network configured under LMA comprising of an IPv4 and IPv6 address/prefix pool. The Mobile Node (MN) is assigned HoA or HNP from this network.

Associates a network with the LMA under which an IPv4 or IPv6 pool can be enabled.

**Step 6**

service { ipv4 | ipv6 | dual }

*Example:*

RP/0/RSP0/CPU0:router(config-pmipv6-domain-nai)#

- service dual

**Purpose**

Configures the service provided to the MN within the PMIPv6 domain.

**Step 7**

(Optional) customer customer-name

*Example:*

RP/0/RSP0/CPU0:router(config-pmipv6-domain-nai)#

- customer CUST1

**(Optional) Configures the name of the customer to which this NAI belongs. The customer is configured during LMA Mobile Local Loop service configuration as described in Configuring VRF Aware LMA, on page 13.**

**Step 8**

commit

*Example: Configuring a Proxy Mobile IPv6 LMA Domain*

This example shows sample configuration of PMIPv6 LMA domain:

```
ipv6 mobile pmipv6-domain cisco.com
!
auth-option spi 67 key ascii key1
nai example@cisco
 network network2
!
 nai example@ctc
 network network3
 service dual
 customer CUST1
!
```

**Configuring Proxy Mobile IPv6 LMA with Peer MAG**

This task lists detailed configuration steps for configuring Proxy Mobile IPv6 LMA with dynamic MAG learning:

**SUMMARY STEPS**

1. configure
2. ipv6 mobile pmipv6-lma lma-identifier domain domain-name
3. address { ipv4 | ipv6 } address
4. hnp maximum number
5. bce maximum number
6. **bce lifetime**  seconds
7. **bce delete-wait-time** milliseconds
8. **replay-protection timestamp window** seconds
9. **default profile**  profile-name
10. **bri delay**  \{ min | max \} milliseconds
11. **bri retries**  count
12. **aaa accounting**  \[ interim interim-interval \]
13. **mag**  mag-identifier  domain-name
14. Execute one of these:
   - **ipv4 address**  address
   - **ipv6 address**  address
15. **auth-option spi**  hex-value  key ascii value
16. **encap**  \{ gre-ipv4 | gre-ipv6 \}
17. **tunnel interface**  interface-type node-id
18. **commit**

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> configure</td>
<td>Enables the LMA service on the router, configures the PMIP domain for the LMA, and enters LMA configuration mode.</td>
</tr>
<tr>
<td><strong>Step 2</strong> ipv6 mobile pmipv6-lma lma-identifier domain  domain-name</td>
<td>Configures an IPv4 or IPv6 address for the LMA.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>RP/0/RSP0/CPU0:router(config)# ipv6 mobile pmipv6-lma lma1 domain cisco.com</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> address  { ipv4</td>
<td>ipv6 }  address</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>RP/0/RSP0/CPU0:router(config-pmipv6-lma)# address  ipv6 2001:DB8::1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> hnp maximum  number</td>
<td>Configures the maximum number of binding cache entries (BCEs) or bindings that the LMA can support.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>RP/0/RSP0/CPU0:router(config-pmipv6-lma)# hnp maximum 2</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> bce maximum  number</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce maximum 2500</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td><strong>bce lifetime</strong> <em>seconds</em>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce lifetime 2500</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td><strong>bce delete-wait-time</strong> <em>milliseconds</em>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce delete-wait-time 100</td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td><strong>replay-protection timestamp window</strong> <em>seconds</em>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;RP/0/RSP0/CPU0:router(config-pmipv6-lma)# replay-protection timestamp window 18</td>
</tr>
<tr>
<td><strong>Step 9</strong></td>
<td><strong>default profile</strong> <em>profile-name</em>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;RP/0/RSP0/CPU0:router(config-pmipv6-lma)# default profile profile1</td>
</tr>
<tr>
<td><strong>Step 10</strong></td>
<td><strong>bri delay</strong> { <em>min</em></td>
</tr>
<tr>
<td><strong>Step 11</strong></td>
<td><strong>bri retries</strong> <em>count</em>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bri retries 5</td>
</tr>
<tr>
<td><strong>Step 12</strong></td>
<td><strong>aaa accounting</strong></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>There are two types of accounting sessions, one for Mobile Nodes and one for tunnels. Interim-Update records are enabled only for tunnel accounting and not for Mobile Node accounting.</td>
<td></td>
</tr>
</tbody>
</table>

**Step 13**

**mag** mag-identifier domain-name  
**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma)# mag mag1 dn1
```

**Purpose:** Configures the MAG for the LMA and enters LMA-MAG configuration mode.

**Step 14**

Execute one of these:

- ipv4 address address  
- ipv6 address address  

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mag)# ipv4 address 192.168.0.4  
or  
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mag)# ipv6 address 2004:DC5::2
```

**Purpose:** Configures an IPv4 address for the LMA in case the transport between the MAG and the LMA is IPv4. Configures an IPv6 address for the LMA in case the transport between the MAG and the LMA is IPv6.

**Step 15**

auth-option spi hex-value key ascii value  
**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mag)# auth-option spi 87E key ascii key2
```

**Purpose:** Configures authentication for the LMA within the MAG.

**Step 16**

encap {gre-ipv4 | gre-ipv6 }  
**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mag)# encap gre-ipv6
```

**Purpose:** Configures a tunnel encapsulation mode type between the MAG and the LMA.

**Step 17**

**tunnel interface** interface-type node-id  
**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mag)# tunnel interface tunnel-ip 097
```

**Purpose:** Configures a static GRE tunnel to peering MAG. This step is required since GRE tunnel cannot be created dynamically.

**Step 18**

commit

Example: Configuring Proxy Mobile IPv6 LMA with Peer MAG

This example shows sample configuration of Proxy Mobile IPv6 LMA with Peer MAG:

```
ipv6 mobile pmipv6-lma lma1 domain cisco.com  
address ipv6 2001:DB8::1  
hnp maximum 2  
bce maximum 2500
```
bce lifetime 2500
bce delete-wait-time 100
replay-protection timestamp window 18
default profile profile1
aaa accounting interim 2
!
mg mag1 dn1
ipv4 address 192.168.0.4
auth-option spi 87E key ascii key2
encap gre-ipv6
tunnel interface tunnel-ip 097
!
!

Configuring Proxy Mobile IPv6 LMA with Dynamic MAG Learning

This task lists detailed configuration steps for configuring Proxy Mobile IPv6 LMA with dynamic MAG learning:

**SUMMARY STEPS**

1. configure
2. ipv6 mobile pmipv6-lma lma-identifier domain domain-name
3. address { ipv4 | ipv6 } address
4. hnp maximum number
5. heartbeat interval interval-value retries retries-value timeout timeout-value
6. bce maximum number
7. bce lifetime seconds
8. bce delete-wait-time milliseconds
9. replay-protection timestamp window seconds
10. default profile profile-name
11. bri delay { min | max } milliseconds
12. bri retries count
13. dynamic mag learning
14. aaa accounting [ interim interim-interval ]
15. network network-name
16. pool { mobile-node | mobile-network } { ipv4 | ipv6 } start-address address pool-prefix prefix [ network-prefix prefix ]
17. commit

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
</tr>
<tr>
<td><strong>Step 1</strong> configure</td>
</tr>
<tr>
<td>Enables the LMA service on the router, configures the PMIPv6 domain for the LMA, and enters LMA configuration mode.</td>
</tr>
<tr>
<td><strong>Step 2</strong> ipv6 mobile pmipv6-lma lma-identifier domain domain-name</td>
</tr>
</tbody>
</table>

Example:

RP/0/RSP0/CPU0:router(config) # ipv6 mobile
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pmipv6-lma lma1 domain cisco.com</strong></td>
<td></td>
</tr>
</tbody>
</table>

| **Step 3** | Configures an IPv4 or IPv6 address for the LMA. |
| **address { ipv4 | ipv6 } address** | Example: |
| `RP/0/RSP0/CPU0:router(config-pmipv6-lma)# address ipv6 2001:DB8::1` | 

| **Step 4** | Configures the maximum number of home network prefixes (HNP) that a mobile node can possess. |
| **hnp maximum number** | Example: |
| `RP/0/RSP0/CPU0:router(config-pmipv6-lma)# hnp maximum 2` | 

| **Step 5** | Configures global LMA heartbeat options. `interval-value` specifies the interval between two heartbeat messages in seconds. `retries-value` specifies the number of retries (in the absence of reply from the peer) before the path to the peer is declared as down. `timeout-value` specifies the timeout value to wait for a response from the peer after which the request is declared as timed out. |
| **heartbeat interval interval-value retries retries-value timeout timeout-value** | Example: |
| `RP/0/RSP0/CPU0:router(config-pmipv6-lma)# heartbeat interval 100 retries 5 timeout 10` | 

| **Step 6** | Configures the maximum number of binding cache entries (BCEs) or bindings that the LMA can support. |
| **bce maximum number** | Example: |
| `RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce maximum 2500` | 

| **Step 7** | Configures the permitted lifetime of a binding in seconds. The granted lifetime is minimum of this configured value and the value received from the MAG in the PBU packet. |
| **bce lifetime seconds** | Example: |
| `RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce lifetime 2500` | 

| **Step 8** | Configures the time in milliseconds that LMA must wait before it deletes a BCE of a MN, upon receiving a PBU message from a MAG with a lifetime value of 0. |
| **bce delete-wait-time milliseconds** | Example: |
| `RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce delete-wait-time 100` | 

<p>| <strong>Step 9</strong> | Configures the time window between the LMA’s running clock and the timestamp value received in the PBU from the MAG that the LMA can tolerate for the binding request to be accepted. If the calculated window is larger than this |</p>
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>replay-protection timestamp window 18</td>
<td>configured value, then the PBU is rejected with status code 156.</td>
</tr>
</tbody>
</table>

**Step 10**

**default profile** `profile-name`

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma)# default profile profile1
```

Enables the default profile for the MN.

**Step 11**

**bri delay** `{ min | max }` `milliseconds`

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bri delay min 500
RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bri delay max 2500
```

Configures the minimum and maximum time in milliseconds for which an LMA should wait before transmitting the Binding Revocation Indication (BRI) message to a MAG.

**Step 12**

**bri retries** `count`

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bri retries 5
```

Configures the maximum number of times an LMA should retransmit a BRI message until a Binding Revocation Acknowledgment (BRA) is received from the MAG.

**Step 13**

**dynamic mag learning**

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma)# dynamic mag learning
```

Enables an LMA to accept Proxy Mobile IPv6 (PMIPv6) signaling messages from any Mobile Access Gateway (MAG) that is not locally configured.

**Step 14**

**aaa accounting** [{ interim } `interim-interval`]

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma)# aaa accounting interim 2
```

Enables LMA accounting. If `interim interim-interval` option is specified, Interim-Update records are sent to the RADIUS security server at the configured `interim-interval` specified in minutes. Otherwise, only Start and Stop records are sent to the RADIUS security server.

There are two types of accounting sessions, one for Mobile Nodes and one for tunnels. Interim-Update records are enabled only for tunnel accounting and not for Mobile Node accounting.

**Step 15**

**network** `network-name`

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma)# network network1
```

Configures the network that comprises of one or more pools from which the LMA assigns IP addresses to the Mobile Nodes.
### Configure IPv4 or IPv6 address pool from which LMA assigns IP addresses to mobile nodes

**Step 16**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>pool { mobile-node</td>
<td>mobile-network } { ipv4</td>
</tr>
</tbody>
</table>

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-network)#
pool mobile-node ipv4 start-address 192.168.0.2 pool-prefix 8
```

**Step 17**

```
commit
```

### Example: Configuring Proxy Mobile IPv6 LMA with Dynamic MAG Learning

This example shows sample configuration of Proxy Mobile IPv6 LMA with dynamic MAG learning:

```
ipv6 mobile pmipv6-lma lma1 domain cisco.com
  address ipv6 2001:DB8::1
  hnp maximum 2
  heartbeat interval 100 retries 5 timeout 10
  bce maximum 2500
  bce lifetime 2500
  bce delete-wait-time 100
  replay-protection timestamp window 18
  default profile profile1
  dynamic mag learning
  aaa accounting interim 2
  network network1
    pool mobile-node ipv4 start-address 192.168.0.2 pool-prefix 8
    pool mobile-node ipv6 start-address 2002:10::1 pool-prefix 62
```

### VRF Aware LMA

This section contains the following topics:

#### VRF Aware LMA Solution

Local Mobility Anchor (LMA) supports VRF awareness on Cisco ASR 9000 Series Aggregation Services Routers. 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)/Mobile Access Gateway (MAG) devices in separate peering or transport VRFs
- AAA accounting for Mobile Nodes and tunnels
### Topology

The following figure is a sample topology of Mobile Local Loop service hosted on Multiprotocol Label Switching (MPLS) multi-VRF Customer Edge (CE) routers:

The following figure is a sample topology of Mobile Local Loop service hosted on MPLS Provider Edge (PE) routers:

In these diagrams:

- Mobile Local Loop (MLL) service allows enterprises Org A and Org B to securely link their remote small branch offices over mobile networks of Mobile Operator 1 and 2 without the need for dedicated leased lines or IP Security (IPSec) VPN cloud. The topologies are examples of MLL service deployment. The service uses Proxy Mobile IPv6 (PMIPv6) based overlay transport.

- At the branch office, CPE/MAG devices such as Cisco ISR series routers are equipped with Cisco HWIC (High-Speed WAN Interface Card) 3G/4G service modules. These devices are used for IP connectivity and setting up overlay transport for service access.

- MLL service provider hosts the LMA function of PMIPv6 and the MLL service on Cisco ASR 9000 series routers which could either be MPLS Provider Edge (PE) routers or MPLS Multi-VRF Customer Edge (CE) routers. LMA can peer with multiple mobile operators (such as Mobile Operators 1 and 2) to enable service access to CPE/MAG devices that can have connectivity to the mobile operators.
If accounting is enabled, LMA sends accounting records to AAA server with service usage counters.

**Configuring VRF Aware LMA**

Perform the following steps to configure VRF aware Proxy Mobile IPv6 LMA:

**SUMMARY STEPS**

1. configure
2. ipv6 mobile pmipv6-lma lma-identifier domain domain-name
3. hnp maximum number
4. heartbeat interval interval-value retries retries-value timeout timeout-value
5. bce maximum number
6. bce lifetime seconds
7. bce delete-wait-time milliseconds
8. replay-protection timestamp window seconds
9. bri delay \{ min | max \} milliseconds
10. bri retries count
11. dynamic mag learning
12. aaa accounting \[ interim interim-interval \]
13. dscp control-plane dscp-value \[ force \]
14. mobility-service mobile-local-loop
15. customer customer-name vrf vrf-name
16. auth-option spi hex-value key ascii value
17. heartbeat interval interval-value retries retries-value timeout timeout-value
18. bce lifetime seconds
19. network \{ unauthorized | authorized network-name \}
20. pool \{ mobile-node | mobile-network \} \{ ipv4 | ipv6 \} start-address address pool-prefix prefix \[ network-prefix prefix]\]
21. transport \[ vrf vrf-name \]
22. address \{ ipv4 | ipv6 \} address
23. commit

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>configure</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>ipv6 mobile pmipv6-lma lma-identifier domain domain-name</td>
</tr>
</tbody>
</table>

**Example:**

RP/0/RSP0/CPU0:router(config)# ipv6 mobile pmipv6-lma lma1 domain cisco.com

Enables the LMA service on the router, configures the PMIPv6 domain for the LMA, and enters LMA configuration mode.
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 3</strong> hnp maximum <em>number</em></td>
<td>Configures the maximum number of home network prefixes (HNP) that a mobile node can posses.</td>
</tr>
<tr>
<td><strong>Example:</strong> RP/0/RSP0/CPU0:router(config-pmipv6-lma)# hnp maximum 2</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> heartbeat interval <em>interval-value</em> retries <em>retries-value</em> timeout <em>timeout-value</em></td>
<td>Configures global LMA heartbeat options. <em>interval-value</em> specifies the interval between two heartbeat messages in seconds. <em>retries-value</em> specifies the number of retries (in the absence of reply from the peer) before the path to the peer is declared as down. <em>timeout-value</em> specifies the timeout value to wait for a response from the peer after which the request is declared as timed out.</td>
</tr>
<tr>
<td><strong>Example:</strong> RP/0/RSP0/CPU0:router(config-pmipv6-lma)# heartbeat interval 100 retries 5 timeout 10</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> bce maximum <em>number</em></td>
<td>Configures the maximum number of binding cache entries (BCEs) or bindings that the LMA can support.</td>
</tr>
<tr>
<td><strong>Example:</strong> RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce maximum 2500</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> bce lifetime <em>seconds</em></td>
<td>Configures the permitted lifetime of a binding in seconds. The granted lifetime is minimum of this configured value and the value received from the MAG in the PBU packet.</td>
</tr>
<tr>
<td><strong>Example:</strong> RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce lifetime 2500</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> bce delete-wait-time <em>milliseconds</em></td>
<td>Configures the time in milliseconds that LMA must wait before it deletes a BCE of a MN, upon receiving a PBU message from a MAG with a lifetime value of 0.</td>
</tr>
<tr>
<td><strong>Example:</strong> RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bce delete-wait-time 100</td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong> replay-protection timestamp window <em>seconds</em></td>
<td>Configures the time window between the LMA’s running clock and the timestamp value received in the PBU from the MAG that the LMA can tolerate for the binding request to be accepted. If the calculated window is larger than this configured value, then the PBU is rejected with status code 156.</td>
</tr>
<tr>
<td><strong>Example:</strong> RP/0/RSP0/CPU0:router(config-pmipv6-lma)# replay-protection timestamp window 18</td>
<td></td>
</tr>
<tr>
<td><strong>Step 9</strong> bri delay { min</td>
<td>max } <em>milliseconds</em></td>
</tr>
<tr>
<td><strong>Example:</strong> RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bri delay min 500 RP/0/RSP0/CPU0:router(config-pmipv6-lma)# bri delay max 2500</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| **Step 10** | **bri retries count**  
  **Example:**  
  RP/0/RSP/0/CPU0:router(config-pmipv6-lma)# bri retries 5 | Configures the maximum number of times an LMA should retransmit a BRI message until a Binding Revocation Acknowledgment (BRA) is received from the MAG. |
| **Step 11** | **dynamic mag learning**  
  **Example:**  
  RP/0/RSP/0/CPU0:router(config-pmipv6-lma)# dynamic mag learning | Enables an LMA to accept Proxy Mobile IPv6 (PMIPv6) signaling messages from any Mobile Access Gateway (MAG) that is not locally configured. |
| **Step 12** | **aaa accounting [ interim interim-interval ]**  
  **Example:**  
  RP/0/RSP/0/CPU0:router(config-pmipv6-lma)# aaa accounting interim 2 | Enables LMA accounting. If the **interim** **interim-interval** option is specified, Interim-Update records are sent to the RADIUS security server at the configured **interim-interval** specified in minutes. Otherwise, only Start and Stop records are sent to the RADIUS security server.  
  There are two types of accounting sessions, one for Mobile Nodes and one for tunnels. Interim-Update records are enabled only for tunnel accounting and not for Mobile Node accounting. For information about AAA/RADIUS configuration for accounting, see the **Authentication, Authorization, and Accounting Commands** chapter in Cisco ASR 9000 Series Aggregation Services Router System Security Command Reference. |
| **Step 13** | **dscp control-plane dscp-value [ force ]**  
  **Example:**  
  RP/0/RSP/0/CPU0:router(config-pmipv6-lma)# dscp control-plane 45 | Configures the value of Differentiated Services Code Point (DSCP) in the outgoing PMIPv6 control plane messages. The outgoing packets include locally generated packets such as Proxy Binding Revocation Indications (PBRIs), Proxy Binding Revocation Acknowledgments (PBRAs), Heartbeat Requests, and packets sent in response to packets received from MAG such as Proxy Binding Acknowledgments (PBAs), PBRIs, PBRAs, and Heartbeat Responses.  
  If **dscp-value** is not specified, then the DSCP received in a request is used in the outgoing response packet. DSCP is not set in the other outgoing packets.  
  If **dscp-value** is specified without the **force** option:  
  - The configured DSCP value is set in locally generated packets.  
  - If the received packet does not have DSCP marking, the configured value is set in the outgoing packet. |
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>• If the received packet has DSCP marking that matches the configured value, then the DSCP received is set in the outgoing response packet.</td>
<td></td>
</tr>
<tr>
<td>• If the received packet has DSCP marking that does not match the configured value, then the DSCP received is used in the outgoing response packet.</td>
<td></td>
</tr>
<tr>
<td>If <code>dscp-value</code> is specified with the <code>force</code> option, then the configured DSCP value is set in all outgoing packets.</td>
<td></td>
</tr>
</tbody>
</table>

**Step 14** mobility-service mobile-local-loop

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma)#
mobility-service mobile-local-loop
```

Configures Mobile Loop Local (MLL) service on the LMA and enters the service configuration mode.

**Step 15** customer `customer-name` vrf `vrf-name`

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mll)#
customer CUST1 vrf VRF1
```

Configures the name and the VRF of a customer. The command enters the customer configuration mode where other parameters of the customer are configured. Use the `no` form of this command to remove an existing customer. There can be many customers, however no two customers can be configured with the same VRF.

**Step 16** auth-option spi `hex-value` key ascii `value`

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mll-cust)#
auth-option spi 87E key ascii KEY1
```

Configures customer-specific authentication for the LMA within the MLL. The authentication option includes an SPI value specified in hexadecimal format and a shared secret key which is specified as an ASCII string. This configuration overrides the global auth-option configuration in the PMIPv6 LMA Domain.

**Step 17** heartbeat interval `interval-value` retries `retries-value` timeout `timeout-value`

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mll-cust)#
heartbeat interval 30 retries 10 timeout 10
```

Configures customer-specific heartbeat options. `interval-value` specifies the interval between two heartbeat messages in seconds. `retries-value` specifies the number of retries (in the absence of reply from the peer) before the path to the peer is declared as down. `timeout-value` specifies the timeout value to wait for a response from the peer after which the request is declared as timed out. This configuration overrides the global LMA heartbeat configuration.

**Step 18** bce lifetime `seconds`

**Example:**

```
RP/0/RSP0/CPU0:router(config-pmipv6-lma-mll-cust)#
bce lifetime 1500
```

Configures customer-specific permitted lifetime of binding cache entries (BCEs) in seconds. This configuration overrides the global LMA BCE configuration.

**Step 19** network `{ unauthorized | authorized `network-name` }

**Example:**

```
```

Configures customer-specific network.
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>Use the <strong>unauthorized</strong> keyword to configure an unauthorized network. In this case, no network pools are configured for address assignment. The address/prefix of the Logical Mobile Node (LMN) on the MAG and the network prefixes on the Mobile Network interfaces are accepted as received in the Proxy Binding Update (PBU). Use the <strong>authorized</strong> keyword to configure a named network. In this case, the address/prefix of the LMN and Mobile Network prefixes are validated against the configured network pool. The uniqueness of the named network is ensured. Use the <strong>no</strong> form of this command to remove an existing network.</td>
</tr>
<tr>
<td><strong>Step 20</strong></td>
<td><strong>pool</strong> { <strong>mobile-node</strong></td>
</tr>
<tr>
<td><strong>Step 21</strong></td>
<td><strong>transport</strong> [ <strong>vrf</strong> vrf-name ]</td>
</tr>
<tr>
<td><strong>Step 22</strong></td>
<td><strong>address</strong> { <strong>ipv4</strong></td>
</tr>
<tr>
<td><strong>Step 23</strong></td>
<td><strong>commit</strong></td>
</tr>
</tbody>
</table>

**Example: Configuring VRF Aware LMA in a MLL**

This example shows sample configuration of VRF aware LMA in a MLL:
/* Domain Configuration */

ipv6 mobile pmipv6-domain D1
lma LMA
!
  nai @CUST1
  lma LMA
  network CUST1
  service dual
  customer CUST1
!
  nai @CUST2
  lma LMA
  network CUST2
  service dual
  customer CUST2
!
!

/* AAA/RADIUS configuration for accounting */

radius-server host 10.10.10.2 auth-port 1645 acct-port 1646
  key 7 094F471A1A0A
!
  aaa accounting mobile default group radius

/* LMA Configuration */

ipv6 mobile pmipv6-lma LMA domain D1
  aaa accounting interim 2
  bce maximum 128000
  dscp control-plane 45
  dynamic mag learning
  mobility-service mobile-local-loop
  customer CUST1 vrf VRF1
    bce lifetime 300
    network unauthorized
    heartbeat interval 30 retries 10 timeout 10
    auth-option spi 100 key ascii xyz123
    transport vrf CUSTSP
      address ipv4 15.15.15.2
      address ipv6 2002:15::2
!
  customer CUST2 vrf VRF2
    network authorized CUST2
    pool mobile-node ipv4 start-address 10.10.10.1 pool-prefix 24
    pool mobile-node ipv6 start-address 2002:10:1::1 pool-prefix 48
    pool mobile-network ipv4 start-address 20.20.20.1 pool-prefix 24 network-prefix 28
    pool mobile-network ipv6 start-address 2002:20:0:1::1 pool-prefix 40 network-prefix 64
!
    transport vrf CUSTSP
      address ipv4 16.16.16.2
      address ipv6 2002:16::2
!
!

# Additional References

The following sections provide references related to PMIPv6 LMA

## Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
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<tbody>
<tr>
<td>PMIPv6 LMA commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples</td>
<td>Proxy Mobile IPv6 Local Mobility Anchor Commands IP Addresses and Services Command Reference for Cisco ASR 9000 Series Routers</td>
</tr>
</tbody>
</table>

## Standards and RFCs

<table>
<thead>
<tr>
<th>Standard/RFC</th>
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<tbody>
<tr>
<td>—</td>
<td>No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.</td>
</tr>
</tbody>
</table>

## MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
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<tbody>
<tr>
<td>-</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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</tbody>
</table>

## Technical Assistance

<table>
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<th>Description</th>
<th>Link</th>
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<tbody>
<tr>
<td>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
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</tbody>
</table>