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, page 1
- Prerequisites for PMIP: Multipath Support for MAG and LMA, page 1
- Information About PMIP: Multipath Support for MAG and LMA, page 2
- How to Configure PMIP: Multipath Support for MAG and LMA, page 4
- Configuration Examples for PMIPv6 Multipath Support for MAG and LMA, page 25
- Additional References, page 29
- Feature Information for PMIP: Multipath Support on MAG and LMA, page 30

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.

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.
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.
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.

	Command or Action	Purpose
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.

	Command or Action	Purpose
Step 5	**exit** **Example:** `Device(config-ipv6-pmipv6-lma)# exit`	Exits LMA configuration mode and enters global configuration mode.
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.
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**	Sets conditions in named IP lists that permit packets.

	Command or Action	Purpose
	Example: `Device(config-ext-nacl)# permit tcp any any`	
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:** `Device(config-ext-nacl)# exit`	Exits extended-ACL configuration mode and returns to global configuration mode.
Step 12	**ip access-list extended** *access-list-name* **Example:** `Device(config)# ip access-list extended LB010ACL`	Configures an extended named ACL.

	Command or Action	Purpose
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.

	Command or Action	Purpose
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:** `Device(config-ipv6-pmipv6-lma)# interface gigabitethernet 0/0/0`	Enables an interface for the mobile map.
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.

	Command or Action	Purpose
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.

	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 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.
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.
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.

	Command or Action	Purpose

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.

	Command or Action	Purpose
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.
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.

	Command or Action	Purpose
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.

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.

	Command or Action	Purpose
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:
	`Device (config-ipv6-pmipv6-mag-addr-dyn)# roaming interface Ethernet1/1 priority 2 egress-att 3G label 3g_intf`
		Specifies a roaming interface and priority on MAG.

Step 10	**exit** **Example:** `Device (config-ipv6-pmipv6-mag-addr-dyn)# exit`	Enters MAG dynamic address configuration mode and returns to privileged EXEC mode.

	Command or Action	Purpose
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:** `Device (config-ipv6-pmipv6-mag-haccess-svc)# profile-definition haccess-voice`	Defines a traffic profile.
Step 20	**jitter** *value* **Example:** `Device (config-ipv6-pmipv6-mag-haccess-profile-def-svc)# jitter 50`	Configures the jitter value, in milliseconds.

	Command or Action	Purpose
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.

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 1: 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**, .

Feature Name	Releases	Feature Information
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**.