



PMIPv6 Heartbeat

This chapter describes the Proxy Mobile IPv6 (PMIPv6) feature.

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Feature Description

The Proxy Mobile IPv6 (PMIPv6) feature is a network-based mobility management protocol that provides mobility without requiring the participation of the mobile node in any PMIPv6 mobility related signaling. The core functional entities Mobile Access Gateway (MAG) and the Local Mobility Anchor (LMA), set up tunnels dynamically to manage mobility for a mobile node.

The PMIPv6 Heartbeat or Path management mechanism through Heartbeat messages between the MAG and LMA is important to know the reachability of the peers, to detect failures, quickly inform peers in the event of a recovery from node failures, and allow a peer to take appropriate action.

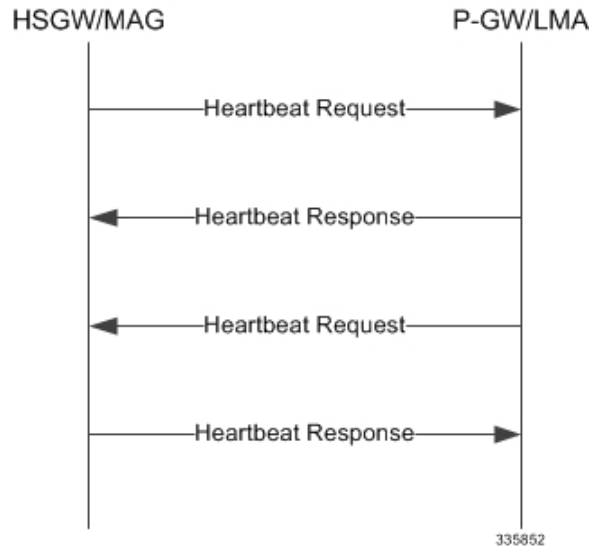
The PMIP Heartbeat feature support on HSGW/MAG and P-GW/LMA is based on RFC 5847.

How it Works

PMIPv6 Heartbeat Mechanism

The MAG and the LMA exchange Heartbeat messages at regular intervals to detect the current status of reachability between the two of them. The MAG initiates the heartbeat exchange to test if the LMA is reachable by sending a Heartbeat Request message to the LMA. Each Heartbeat Request contains a sequence number that is incremented monotonically. Heartbeat Request messages are sent to LMA only if the MAG has at least one PMIPv6 session with a corresponding LMA. Similarly, the LMA also initiates a heartbeat exchange with the MAG by sending a Heartbeat Request message to check if the MAG is reachable.

Figure 1: MAG and LMA exchange Heartbeat messages



Refer to the **heartbeat** CLI command in the LMA Service mode or MAG Service mode respectively to enable this heartbeat and configure the heartbeat variables.

The heartbeat messages are used only for checking reachability between the MAG and the LMA. They do not carry information that is useful for eavesdroppers on the path. Therefore, confidentiality protection is not required.

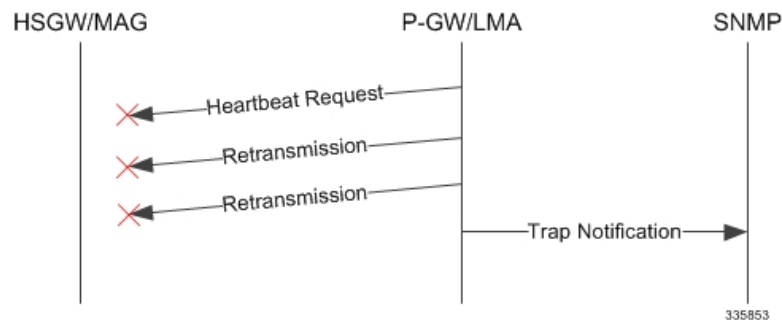
Failure Detection

The sequence number sent in the Heartbeat Request message is matched when the Heartbeat response is received at the MAG/LMA. Before sending the next Heartbeat Request, the missing heartbeat counter is incremented if it has not received a Heartbeat Response for the previous request.

When the missing heartbeat counter exceeds the configurable parameter **max-heartbeat-retransmission**, the MAG/LMA concludes that the peer is not reachable. The heartbeat request to the peer will be stopped and a notification trap is triggered to indicate the failure.

If a heartbeat response message is received, then the missing heartbeat counter is reset.

Figure 2: Failure Detection



The **starPMIPPathFailure** trap is cleared and the periodic heartbeat starts when the heartbeat request is received or when a new session is established from the corresponding peer.

**Important**

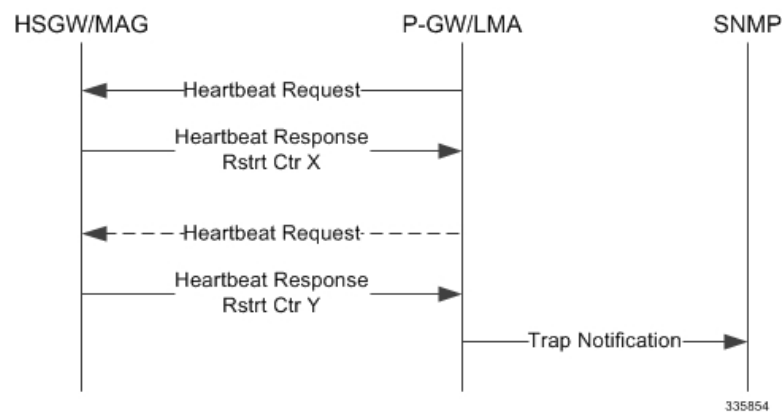
The failure detection at MAG will be the same as the one described in the Failure Detection figure for LMA.

Restart Detection

MAG/LMA generates restart counter when the service is started. This counter is generated based on the service start timestamp. The restart counter is stored as part of the config and it is incremented whenever the service is restarted. The counter is not incremented if the sessions are recovered properly after a crash. MAG/LMA includes the restart counter mobility option in a heartbeat response message to indicate the current value of the restart counter. MAG/LMA also stores the restart counter values of all the peers with which it currently has PMIPv6 sessions.

After receiving the Heartbeat Response message, MAG/LMA compares the Restart Counter value with the previously received value. If the value is different, then it assumes that the peer had crashed and recovered. If the restart counter value changes or if there was no previously stored values, then the new value is stored for the corresponding peer.

Figure 3: Restart Detection



The second heartbeat request in the Restart Detection figure is shown as a dashed arrow because the restart detection can happen even when an unsolicited heartbeat response is received with a change in restart counter.

The **starPMIPPathFailure** trap is cleared when the Heartbeat request is received or when a new session is established with the corresponding peer.

**Important**

The restart detection at MAG will be the same as the one described in Restart Detection figure for LMA.

Standards Compliance

The PMIPv6 Heartbeat functionality complies with the following standards:

- RFC 5847 (June 2010): Heartbeat Mechanism for Proxy Mobile IPv6
- 3GPP TS 29.275 Proxy Mobile IPv6 (PMIPv6) based Mobility and Tunnelling protocols Stage 3

Configuring PMIPv6 Heartbeat

The configuration examples in this section can be used to control the heartbeat messages interval and retransmission timeout and max retransmission.

Configuring PMIPv6 MAG Heartbeat

The following command configures the PMIPv6 heartbeat message interval and retransmission timeout and max retransmission for the MAG/HSGW Service.

```
configure
  context context_name
    mag-service hsgw_svc_name
      heartbeat { interval seconds | retransmission { max number
| timeout seconds } }
      default heartbeat { interval | retransmission { max |
timeout } }
      no heartbeat
    end
```

Notes:

- **interval:** The interval in seconds at which heartbeat messages are sent from 30-3600 seconds. Default: 60 seconds.
- **retransmission max:** The maximum number of heartbeat retransmissions allowed from 0-15. Default: 3.
- **retransmission timeout:** The timeout in seconds for heartbeat retransmissions from 1-20 seconds. Default: 3 seconds.

Configuring PMIPv6 LMA Heartbeat

The following command configures the PMIPv6 heartbeat message interval, retransmission timeout, and max retransmission for the LMA/P-GW Service.

```
configure
  context context_name
    lma-service pgw_lma_name
      heartbeat { interval seconds | retransmission { max number
| timeout seconds } }
      default heartbeat { interval | retransmission { max |
timeout } }
      no heartbeat
    end
```

Notes:

- **interval:** The interval in seconds at which heartbeat messages are sent.
seconds must be an integer from 30 to 2600. Default: 60
- **retransmission max:** The maximum number of heartbeat retransmissions allowed.

number must be an integer from 0 to 15.

Default: 3

- **retransmission timeout:** The timeout in seconds for heartbeat retransmissions.

seconds must be an integer from 1 to 20.

Default: 3

Verifying the PMIPv6 Heartbeat Configuration

The following show commands can be used to verify the configured heartbeat configuration.

show mag-service name <mag-service>

```
Heartbeat support: Enabled
Heartbeat Interval: 60
Heartbeat Retransmission Timeout: 5
Heartbeat Max Retransmissions: 5
```

show lma-service name <lma-service>

```
Heartbeat support: Enabled
Heartbeat Interval: 60
Heartbeat Retransmission Timeout: 5
Heartbeat Max Retransmissions: 5
```

Monitoring and Troubleshooting the PMIPv6 Heartbeat

This section includes show commands in support of the PMIPv6 Heartbeat, traps that are triggered by the MAGMGR/HAMGR after path failure and Heartbeat bulk statistics.

- [PMIPv6 Heartbeat Show Commands, on page 5](#)
- [PMIPv6 Heartbeat Traps on failure detection, on page 6](#)
- [PMIPv6 Heartbeat Bulk Statistics, on page 7](#)

PMIPv6 Heartbeat messages can be monitored using monitor protocol. HAMGR and MAGMGR log messages can be enabled to troubleshoot and debug PMIPv6 Heartbeat scenarios.

SNMP traps are generated on failure detection and restart detection. The traps can be enabled to know path failure or node restart

Heartbeat message statistics and path failure statistics on MAG and LMA can be used to troubleshoot and debug PMIPv6 Heartbeat scenarios.

PMIPv6 Heartbeat Show Commands

This section provides information regarding show commands and/or their outputs in support of the PMIPv6 Heartbeat.

show mag-service statistics

This show command displays heartbeat output similar to the following for heartbeat statistics.

```

Path Management Messages:
Heartbeat Request:
Total TX: 0                               Total RX: 0
Initial TX: 0                             Initial RX: 0
Retrans TX: 0
Heartbeat Response:
Total TX: 0                               Total RX: 0
Bind Error: 0
Heartbeat Messages Discarded:
Total: 0
Decode error: 0                          Invalid Buffer Length: 0
Heartbeat Rsp From Unknown Peer: 0       Heartbeat Rsp Seq. Num Mismatch: 0
Reasons for path failure:
Restart counter change: 0
No Heartbeat Response received: 0
Total path failures detected: 0

```

show lma-service statistics

This show command displays heartbeat output similar to the following for heartbeat statistics.

```

Path Management Messages:
Heartbeat Request:
Total TX: 0                               Total RX: 0
Initial TX: 0                             Initial RX: 0
Retrans TX: 0
Heartbeat Response:
Total TX: 0                               Total RX: 0
Bind Error: 0
Heartbeat Messages Discarded:
Total: 0
Decode error: 0                          Invalid Buffer Length: 0
Heartbeat Rsp From Unknown Peer: 0       Heartbeat Rsp Seq. Num Mismatch: 0
Reasons for path failure:
Restart counter change: 0
No Heartbeat Response received: 0
Total path failures detected: 0

```

PMIPv6 Heartbeat Traps on failure detection

PMIPv6 Path Failure Trap

The trap name is **starPMIPPathFailure**.

The following trap notifications are triggered by the MAGMGR/HAMGR when path failure or node restart is detected.

- Context Name
- Service Name
- Self Address
- Peer Address
- Peer old restart counter
- Peer new restart counter
- Failure reason

PMIPv6 Path Failure Clear Trap

The trap name is **starPMIPPathFailureClear**.

The following trap notifications are generated by MAGMGR/HAMGR to clear the Path Failure Trap when a node is responding for heartbeat messages.

- Context Name
- Service Name
- Self Address
- Peer Address

PMIPv6 Heartbeat Bulk Statistics

The following Schema bulk statistics have been introduced for the PMIPv6 Heartbeat feature:

MAG schema

The following bulkstats have been added for PMIPv6 heartbeat statistics:

- lma-fallback-attempted
- lma-fallback-success
- lma-fallback-failure
- lma-fallback-demux-update-fail
- lma-fallback-alt-pgw-not-found
- lma-fallback-pgw-rejects
- lma-fallback-pgw-timeouts
- mag-txhbreqinitial
- mag-txhbreqretrans
- mag-txhbrsptotal
- mag-rxhbreqtotal
- mag-rxhbrsptotal
- mag-rxhbrspbinderror
- mag-rxhbdiscardtotal
- mag-rxhbdecodeerror
- mag-rxhbinvalidbufflen
- mag-rxhbrspunknownpeer
- mag-rxhbrspseqnummismatch
- mag-rxhbrsprstctrmissing
- mag-pathfailurestotal
- mag-pathfailrstctrchange
- mag-pathfailnohbrsprcvd

For descriptions of these variables, see "MAG Schema Statistics" in the *Statistics and Counters Reference*.

LMA Schema

The following bulkstats have been added for PMIPv6 heartbeat statistics:

- lma-txhbreqinitial
- lma-txhbreqretrans

- lma-txhbrsptotal
- lma-rxhbreqtotal
- lma-rxhbrsptotal
- lma-rxhbrspbinderror
- lma-rxhbdiscardtotal
- lma-rxhbdecodeerror
- lma-rxhbinvalidbufflen
- lma-rxhbrspunknownpeer
- lma-rxhbrspseqnummismatch
- lma-rxhbrsprstctrmissing
- lma-pathfailuretotal
- lma-pathfailrstctrchange
- lma-pathfailnohbrsprevd

For descriptions of these variables, see "LMA Schema Statistics" in the *Statistics and Counters Reference*.