DMM WG   D. Patki
Internet-Draft   S. Gundavelli
Intended status: Standards Track   Cisco
Expires: September 12, 2017   J. Lee
                                              Sangmyung University
                                                              Q. Fu
                                                        China Mobile
                                                            L. Bertz
                                                              Sprint
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LMA Controlled MAG Session Parameters
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Abstract

   This specification defines a new extension, LMA-Controlled-MAG-
   Session-Params to Proxy Mobile IPv6. This option can be used by the
   local mobility anchor in Proxy Mobile IPv6 signaling for notifying
   the mobile access gateway to conform to various parameters contained
   in this extension.

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1. Introduction

   A large Proxy Mobile IPv6 (PMIPv6) deployment, such as residential
   deployment, can have tens of thousands of mobile access gateways
   (MAG) spread across geographical locations. While it can be
   operationally challenging to manage such a large number of MAGs, it
   can also be very difficult to ensure configuration consistency across
   all the MAGs if they are not centrally managed. Configuring
   aggressive values of parameters such as re-registration timeout and
   heartbeat interval can potentially create considerable signaling load
   on the local mobility anchor (LMA). This document provides a new
   option to enable the LMA to control various parameters on the MAG
   such as the re-registration frequency [RFC5213] and heartbeat
   frequency [RFC5847]. With this option, the configuration of these
   tunable parameters done centrally on the LMA enables Service
   Providers to have better control on the behavior of the MAGs with
   deterministic signaling load on the LMA.

2. Conventions and Terminology

2.1. Conventions

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in [RFC2119].

2.2. Terminology

   All the terms used in this document are to be interpreted as defined
   in [RFC5213], [RFC5847] and [RFC7563].

3. Protocol Extension

   The LMA Controlled MAG Parameters (LCMP) option is a mobility header
   option used to exchange information related to the parameters that a
   LMA enforces on a MAG. The option can be included in Proxy Binding
   Acknowledge (PBA) message only, and there MUST NOT be more than a
   single instance of this mobility option in the PBA message. This
   mobility option MUST contain one or more LCMP sub-options. The sub-
   options are defined in Section 3.1. The alignment of this option
   MUST be 4n [RFC2460].

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |    Length     |            Reserved           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                ... LCMP Sub-option(s) ...                     ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
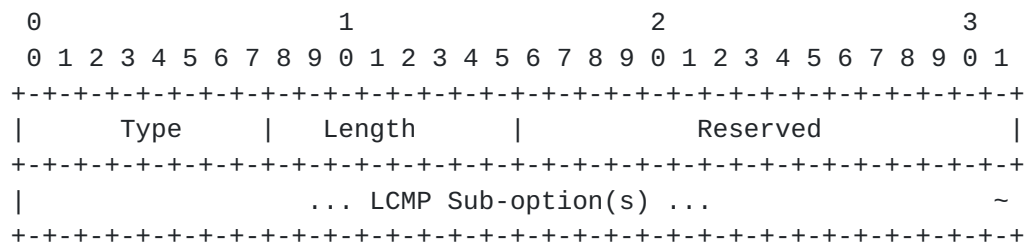
           Figure 1: LMA Controlled MAG Parameters Option

   Type

      MUST be set to the value of IANA-1, indicating that it is a LMA-
      Controlled-MAG-Parameters option.

   Length

      8-bit unsigned integer indicating the length in octets of the
      option, excluding the Type and Length fields.

Reserved

   MUST be set to zero when sending and ignored when received.

LCMP Sub-option(s)

   LCMP Sub-options are described in the below sections. The sub-
   options can be present in any order. Inclusion of any specifc
   sub-option is optional, but at least one sub-option MUST be
   present.

3.1. Format of the LCMP Sub-Options

The LCMP sub-options are used for carrying information elements
related to various parameters that need to be configured on the MAG.
These sub-options can be included in the LCMP option defined in
Section 3. The alignment of the sub-option MUST be 4n. The format
of this sub-option is as follows.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   LCMP Type   | LCMP Length   |      Sub-Option Data      ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
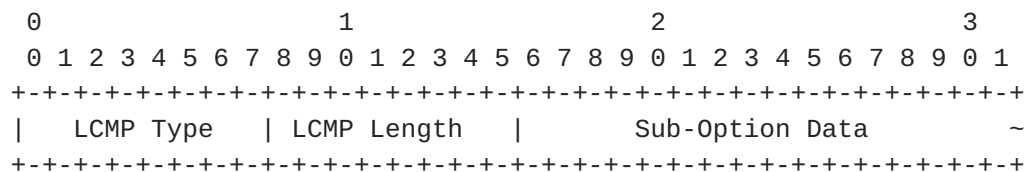
           Figure 2: LMA Controlled MAG Parameters Sub-Option

Type

   8-bit unsigned integer indicating the type of the LCMP sub-option.
   This specification defines the following types:

   0 - Reserved

   1 - Binding Re-registration Control Sub-Option

   2 - Heartbeat Control Sub-Option

Length

   8-bit unsigned integer indicating the number of octets needed to
   encode the Option Data, excluding the LCMP Type and LCMP Length
   fields of the sub-option.

3.1.1. **Binding Re-registration Control Sub-Option**

   The Binding Re-registration Control Sub-Option is a mobility sub-
   option carried in the LCMP mobility option defined in Section 3.1.
   This sub-option carries re-registration related timer values. There
   MUST be no more than a single instance of this sub-option in LCMP
   option. The format of this sub-option is defined below.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| LCMP Type = 1 |  LCMP Length  |  Re-registration-Start-Time   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Initial-Retransmission-Time  | Maximum-Retransmission-Time   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
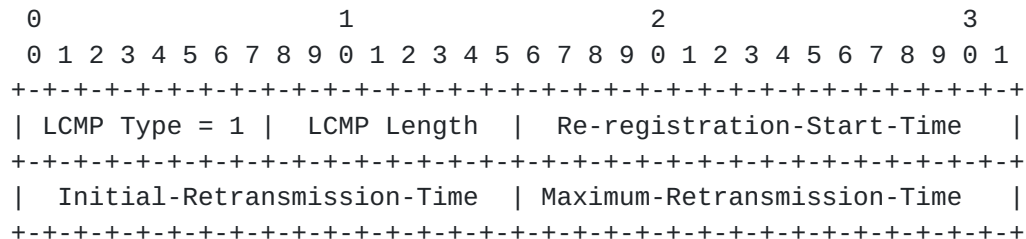
            Figure 3: Binding Re-registration Control Sub-Option

   LCMP Type

      1 for Binding Re-registration Control Sub-Option

   LCMP Length

      6

   Re-registration-Start-Time

      16-bit unsigned integer indicating the number of time units before
      the expiry of the PMIPv6 binding lifetime when the registration
      refresh process needs to be activated. One time unit is 4
      seconds.

   Initial-Retransmission-Time

      16-bit unsigned integer indicating minimum delay in seconds before
      the first Proxy Binding Update (PBU) retransmission of the
      exponential back-off process.

   Maximum-Retransmission-Time

      16-bit unsigned integer indicating maximum delay in seconds before
      the last PBU retransmission message of the exponential back-off
      process.

3.1.2. Heartbeat Control Sub-Option

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| LCMP Type = 2 |  LCMP Length  |         HB-Interval           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    HB-Retransmission-Delay    |    HB-Max-Retransmissions      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
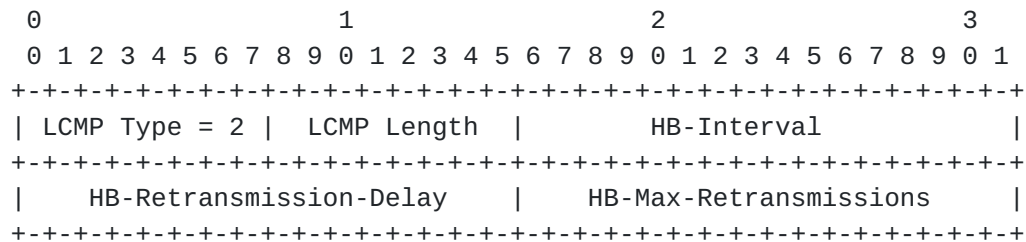
                 Figure 4: Heartbeat Control Sub-Option

LCMP Type

   2 for Heartbeat Control Sub-Option

LCMP Length

   6

HB-Interval

   16-bit unsigned integer indicating heartbeat interval, i.e. time
   delay in seconds after a successful heartbeat exchange (heartbeat
   request followed by response) when the next heartbeat exchange can
   be triggered.

HB-Retransmission-Delay

   16-bit unsigned integer indicating minimum time delay in seconds
   before a heartbeat message is retransmitted.

HB-Max-Retransmissions

   16-bit unsigned integer indicating maximum number of heartbeat
   retransmissions.

4. Protocol Configuration Variables

4.1. Local Mobility Anchor - Configuration Variables

The LMA MUST allow the following variables to be configured by the
system management. The configured values for these protocol
variables MUST survive server reboots and service restarts.

EnableLCMPSubOptReregControl

This flag indicates the operational state of the Binding Re-
registration Control sub-option support. The default value for
this flag is set to (0), indicating that support for the Binding
Re-registration Control sub-option is disabled.

EnableLCMPSubOptHeartbeatControl

This flag indicates the operational state of the Heartbeat Control
sub-option support. The default value for this flag is set to
(0), indicating that support for the Heartbeat Control sub-option
is disabled.

The following variables MAY be defined at various granularities such
as per binding, per peering MAG, per cluster of MAGs or any other
custom grouping. Regardless of the granularity of this
configuration, the LMA MUST be able to determine the value of these
variables on an individual binding basis by way of configuration
hierarchy.

LCMPReregistrationStartTime

This variable is used to set the minimum time interval in number
of seconds before the expiry of the PMIPv6 binding lifetime when
the registration refresh process SHOULD be activated. The default
value is 10 units, where each unit is 4 seconds.

LCMPInitialRetransmissionTime

This variable is used to set the minimum delay in seconds before
the first PBU retransmission of the exponential back-off process.
This variable is same as INITIAL_BINDACK_TIMEOUT mentioned in
Section 6.9.4 of [RFC5213]. The default value is 1 second.

LCMPMaximumRetransmissionTime

This variable is used to set the maximum delay in seconds before
the last PBU retransmission message of the exponential back-off
process. This variable is same as MAX_BINDACK_TIMEOUT mentioned
in Section 6.9.4 of [RFC5213]. The default value is 32 seconds.

LCMPHeartbeatInterval

This variable is used to set the time delay in seconds after a
successful heartbeat exchange (heartbeat request followed by
response) when the next heartbeat exchange can be triggered. The
default value is 60 seconds. It SHOULD NOT be set to less than 30
seconds or more than 3600 seconds. The value of this variable MAY

be derived from the variable HEARTBEAT_INTERVAL defined in
Section 5 of [RFC5847] if configured on the LMA.

LCMPHeartbeatRetransmissionDelay

This variable is used to set the minimum time delay in seconds
before a heartbeat message is retransmitted. The value of this
variable SHOULD be less than LCMPHeartbeatInterval. The default
value is 5 seconds.

LCMPHeartbeatMaxRetransmissions

This variable is used to set the maximum number of heartbeat
retransmissions. The default value for this variable is 3. The
value of this variable MAY be derived from the variable
MISSING_HEARTBEATS_ALLOWED defined in Section 5 of [RFC5847] if
configured on the LMA.

5. Protocol Considerations

The following considerations apply to the LMA and the MAG.

The conceptual Binding Cache Entry data structure maintained by the
LMA, described in Section 5.1 of [RFC5213] and the conceptual Binding
Update List entry data structure maintained by the MAG, described in
Section 6.1 of [RFC5213], MUST be extended to store the LCMP option
related information elements associated with the current session.
Specifically the following parameters MUST be defined:

o LCMPReregistrationStartTime

o LCMPInitialRetransmissionTime

o LCMPMaximumRetransmissionTime

o LCMPHeartbeatInterval

o LCMPHeartbeatRetransmissionDelay

o LCMPHeartbeatMaxRetransmissions

5.1. Local Mobility Anchor Considerations

On receiving a PBU message [RFC5213] from a MAG, the LMA MUST check
if the variable EnableLCMPSubOptReregControl is configured and set to
(1). If yes, and if all of LCMPReregistrationStartTime,
LCMPInitialRetransmissionTime and LCMPMaximumRetransmissionTime are
set to NON_ZERO values, then it MUST include Binding Re-registration

Control Sub-Option in the LCMP mobility option which is in turn
included in the PBA message. If the variable
EnableLCMPSubOptReregControl is configured and set to (1) and if any
of LCMPReregistrationStartTime, LCMPInitialRetransmissionTime and
LCMPMaximumRetransmissionTime is set to ZERO value, then the LMA MUST
report a configuration error and reject the binding request by
sending a PBA message with status code '128-Reason Unspecified'
[RFC5213].

The LMA MUST also check if variable EnableLCMPSubOptHeartbeatControl
is configured and set to (1). If yes, and if all of
LCMPHeartbeatInterval, LCMPHeartbeatRetransmissionDelay and
LCMPHeartbeatMaxRetransmissions are set to NON_ZERO values, then it
MUST include Heartbeat Control Sub-Option in the LCMP mobility option
which is in turn included in the PBA message. If the variable
EnableLCMPSubOptHeartbeatControl is set to (1) and if any of
LCMPHeartbeatInterval, LCMPHeartbeatRetransmissionDelay and
LCMPHeartbeatMaxRetransmissions is set to ZERO value, then the LMA
MUST report a configuration error and reject the binding request by
sending a PBA message with status code '128-Reason Unspecified'
[RFC5213].

5.2. Mobile Access Gateway Considerations

If the PBA message [RFC5213] received from the LMA contains the LCMP
mobility option and the Binding Re-registration Control Sub-Option,
then the MAG MUST overwrite the binding re-registration related timer
parameters configured locally on the MAG with the parameters received
in Binding Re-registration Control Sub-Option. If any of the
parameters in the Binding Re-registration Control Sub-Option is ZERO,
then the PBA message MUST be ignored and an error message SHOULD be
logged.

Similarly, if the LCMP mobility option contains the Heartbeat Control
Sub-Option, then the MAG MUST overwrite the heartbeat related timer
parameters configured locally on the MAG with the parameters received
in the Heartbeat Control Sub-Option. If any of the parameters in the
Heartbeat Control Sub-Option except HB-Retransmission-Delay is ZERO,
then the PBA message MUST be ignored and error message SHOULD be
logged.

6. IANA Considerations

This document requires the following IANA actions in the "Mobile IPv6
Parameters" registry.

o Action 1: This specification defines a new mobility header option,
   "LMA Controlled MAG Parameters". This mobility option is

described in Section 3. The type value (IANA-1) for this option
needs to be assigned from the same numbering space as allocated
for the other mobility options, as defined in [RFC6275].

o Action 2: This specification defines a new mobility sub-option
   format, the LCMP Parameters sub-option. The format of this
   mobility sub-option is described in Section 3.1. This sub-option
   can be carried in the LCMP Parameters option. The type value for
   this sub-option needs to be managed by IANA, under the registry
   "LMA Controlled MAG Parameters Sub-Option Type Values". This
   specification reserves the following type values. Approval of new
   LCMP Parameters sub-option type values are to be made through IANA
   Expert Review.

```
+---+-------------------------------------------------------+
| 0 | Reserved                                              |
+---+-------------------------------------------------------+
| 1 | Binding Re-registration Control Sub-Option            |
+---+-------------------------------------------------------+
| 2 | Heartbeat Control Sub-Option                          |
+---+-------------------------------------------------------+
```

7. Security Considerations

The LCMP Parameters option defined in this specification is for use
in PBA message. This option is carried like any other mobility
header option as specified in [RFC6275] and does not require any
special security considerations.

8. Acknowledgements

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comments and discussions on this document. The authors would also
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Authors' Addresses

   Dhananjay Patki
   Cisco
   Cessna Business Park SEZ, Kadubeesanahalli
   Bangalore, Karnataka 560087
   India

   Email: dhpatki@cisco.com

   Sri Gundavelli
   Cisco
   170 West Tasman Drive
   San Jose, CA 95134
   USA

   Email: sgundave@cisco.com

Jong-Hyouk Lee
Sangmyung University
31, Sangmyeongdae-gil, Dongnam-gu
Cheonan 330-720
Republic of Korea

Email: jonghyouk@smu.ac.kr

Qiao Fu
China Mobile
Xuanwumenxi Ave. No.32
Beijing
P.R. China

Email: fuqiao1@outlook.com

Lyle T Bertz
Sprint
Kansas
USA

Email: Lyle.T.Bertz@sprint.com