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PMIPv6-based Distributed Mobility Management
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Abstract

Proxy Mobile IPv6 (PMIPv6) is the network-based mobility management protocol where access network supports the mobility of a mobile node on behalf of the MN. In PMIPv6, the location information of the MN should be registered to Localized Mobility Anchor and communication must be established via the LMA. Therefore, the performance can be degraded due to traffic concentration and congestion possibility. One method to overcome the above problems is to exploit the distributed mobility management (DMM) mechanism to distribute the LMA function to all access routers within the PMIPv6 domain. This document presents a fully distributed mobility management mechanism in PMIPv6-based network. In this mechanism, there is no need for the location management function to register the location of the MN.

Status of this Memo

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1. Introduction

Centralized mobility management protocols such as MIPv6 [1] and PMIPv6 [2] have several problems such as single-node failure, congestion possibility, scalability issues and non-optimal routes [3]. One method to resolve such problems is to use the distributed mobility management (DMM) mechanism to distribute mobile agent function to access routers [4]. Especially, in PMIPv6-based DMM, when an MN moves one network to another, a new access router that the MN moves and connects should know (1) whether the MN firstly enters the PMIPv6 domain and (2) the address information of the LMA for the MN when the access router knows that the MN moves from another network.

This document presents a fully distributed mobility management mechanism which does not need the control function for managing MN-LMA address binding information.

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 RFC 2119 [5].

2.2 Terminology

TBD.

3. Protocol Operation

Figure 1 shows the message exchange procedure between network entities to provide fully distributed mobility management in PMIPv6 environment presented in this document. A network prefix "PREF" is allocated to the PMIPv6 domain. However, a different sub-network prefix belonging to the same network prefix "PREF" is allocated to a different mobility access gateway (MAG) in PMIPv6 domain.
For example, a sub-network prefix "PREF1" belonging to "PREF" is allocated to MAG1 and a different sub-network prefix "PREF2" belonging to the same "PREF" is allocated to MAG2. Even though a different sub-network prefix is allocated to a different MAG, all MAGs advertise the same network prefix "PREF" through the interfaces providing PMIPv6 service.

```
         MN                    MAG1                 MAG2      MAG3       CN
          |                      |                   |         |         |
          |*** L2 attachment ***>|                   |         |         |
          |<----- RA(PREF) ------|                   |         |         |
          |---DHCP request msg-->|                   |         |         |
          |<--DHCP reponse msg---|                   |         |         |
          |    (MN's address)    |                   |         |         |
    (Configure IPv6 address)     |                   |         |         |
          |<-------------------- exchange IP traffic ------------------->|
    (Move from MAG1 to MAG2)     |                   |         |         |
          |************ L2 attachment **************>|         |         |
          |<-------------- RA(PREF) -----------------|         |         |
          |--------------- IP packet --------------->|         |         |
          |                      |       (packet buffering)    |         |
          |                      |<----DPBU msg------|         |         |
          |     (create BCE and est. tunnel)         |         |         |
          |                      |-----DPBA msg----->|         |         |
          |                      | (create BUL and est. tunnel)|         |
          |                      |<====IP packet=====|         |         |
          |                      |--------------- IP packet ------------>|
     (Move from MAG2 to MAG3)    |                   |         |         |
          |                      |         (packet buffering)  |         |
          |                      |<----DPBRU msg-----|         |         |
          |                      |----DPBRA msg----->|         |         |
          |****************** L2 attachment ******************>|         |
          |<------------------- RA (PREF) ---------------------|         |
          |------------------- IP pkt ------------------------>|         |
          |                      |                    (pkt bufferring)   |
          |                      |<-- exchange DPBU/DPBA msg ->|         |
          |                      |<========= IP packet ========|         |
          |                      |-------------- IP packet ------------->|

                      (a) MN to CN packet transmission scenario
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```
      MN                    MAG1                 MAG2      MAG3       CN
       |                      |                   |         |         |
       |*** L2 attachment ***>|                   |         |         |
       |<----- RA(PREF) ------|                   |         |         |
       |---DHCP request msg-->|                   |         |         |
       |<--DHCP reponse msg---|                   |         |         |
       |    (MN's address)    |                   |         |         |
 (Configure IPv6 address)     |                   |         |         |
       |<-------------------- exchange IP traffic ------------------->|
 (Move from MAG1 to MAG2)     |                   |         |         |
       |                      |<----------- IP packet ----------------|
       |              (packet buffering)          |         |         |
       |************ L2 attachment **************>|         |         |
       |<-------------- RA(PREF) -----------------|         |         |
       |                      |<----DPBU msg------|         |         |
       |     (create BCE and est. tunnel)         |         |         |
       |                      |-----DPBA msg----->|         |         |
       |                      | (create BUL and est. tunnel)|         |
       |                      |=====IP packet====>|         |         |
       |<---------------- IP packet ---------------|         |         |
  (Move from MAG2 to MAG3)    |                   |         |         |
       |                      |         (packet buffering)  |         |
       |                      |<----DPBRU msg-----|         |         |
       |                      |<= Buffered IP pkt=|         |         |
       |              (packet bufffering)         |         |         |
       |                      |<--- FLUSH msg ----|         |         |
       |                      |----DPBRA msg----->|         |         |
       |****************** L2 attachment ******************>|         |
       |<-------------------- RA (PREF) ---------------------|         |
       |                      |<-- exchange DPBU/DPBA msg ->|         |
       |                      |==== buffered IP packet ====>|         |
       |                      |====== IP packet ===========>|         |
       |<------------------ IP packet -----------------------|         |
```

(b) CN to MN packet transmission scenario

Figure 1: Message exchange scenario

When an MN firstly enters the PMIPv6 domain and connects to a MAG (say, MAG1), MAG1 transmits to the MN a Router Advertisement (RA) message by setting "M (Managed address configuration)" flag in order to configure an address to the MN by using the stateful address configuration method [6]. The network prefix "PREF" is set to the prefix option information field in the RA message. The MN having received the RA message transmits the dynamic host configuration protocol (DHCP) request message to the MAG1 [7]. The MAG1 considers that the MN firstly connects to the PMIPv6 domain and transmits the DHCP response message containing an address belonging to the "PREF1" to the MN. The MN sets the address contained in the

DHCP response message to its interface. After that, the MN can communicate to a CN within the Internet.

When the MN moves MAG1 to MAG2 while communicating with a CN, the MAG1 begins to perform the LMA function for the MN and stores packets sent from the CN into the buffer. The MAG1 stores the MM's information into its Binding Cache Entry (BCE). When the MN connects to MAG2, the MAG2 transmits the RA message containing network prefix set to "PREF" to the MN. The MN having received the RA message considers that it connects to the same network by using the "PREF" network prefix in prefix information option of RA message. It continues to use the address configured previously and transmits IP packets as usual. MAG2 checks the first packet transmitted by the MN. If the first packet contains the DHCP request packet, then MAG2 considers that the MN firstly connects to the PMIPv6 domain. Otherwise, MAG2 considers that the MN moves from another MAG area and creates the Binding Update List (BUL) for the MN. And then, MAG2 transmits the Distributed Proxy Binding Update (DPBU) message. The source address of the packet containing the DPBU message is set to the address of the MAG2 (say, Proxy-CoA2) and the destination address is set to the address of the MN. Here, MAG2 can know the address of the MN by using the source address of the IP packet sent by the MN. Moreover, MAG2 stores packets sent by the MN. DPBU message is transmitted to the MAG1 through the Internet topologically correct routing path. MAG1 having received the DPBU message stores the Proxy-CoA2 address to its BCE for the MN, establishes the tunnel with MAG2, and transmits the Distributed Proxy Binding Acknowledgement (DPBA) message to MAG2. The source and destination addresses of the packet containing the DPBA message are set to the address of MAG1 (say, Proxy-CoA1) and Proxy-CoA2, respectively. The DPBA message contains the address of the MN in its option field. MAG2 receiving the PBA message stores the Proxy-CoA1 address to its BUL and establishes the tunnel with MAG1. And then, MAG1 transmits the packets stored in the buffer to MAG2, and MAG2 would the received packets to the MN. After that, the MN continues to communicate with the CN.

Packets sent from MAG1 to MAG2 might be lost if the MN moves from MAG2 to another MAG (MAG3 for example in this draft). It is because MAG1 cannot know the fact that the MN moves and connects to MAG3. In order to avoid the packet loss, When MAG2 knows to disconnect to the MN, MAG2 transmits the Distributed Proxy Binding Release Update (DPBRU) message to MAG1. Moreover, MAG2 transmits packets for the MN to MAG1 again. When MAG1 receives the DPBRU message, MAG1 transmits FLUSH message to the MAG2 and stores packets sent from the CN in its buffer. MAG2 having received the FLUSH message considers that the message is the final packet sent from the MAG1 and retransmits the FLUSH message. And then, MAG2 removes the entry related the MN in the BUL. MAG1 having received the FLUSH message having sent from MAG2 considers that themessage is the final packet sent from MAG2. MAG1 transmits the Distributed Proxy Binding Release Acknowledgement (DPBRA) message to MAG2. When MAG1 receives the DPBU message from MAG3, MAG1 transmits the DPBA message to MAG3, update its BCE related to the MN, transmits the stored packets sent from MAG2, and then transmits packets sent from the CN.

4. Security Considerations

TBD

5. IANA Considerations

TBD

6. References

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