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Update Notifications for Proxy Mobile IPv6
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Abstract

This document specifies protocol enhancements for allowing the local mobility anchor in a Proxy Mobile IPv6 domain to asynchronously notify the mobile access gateway about changes related to a mobility session. These update notifications are exchanged using a Mobility Header message type specifically designed for this purpose.

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1. Introduction

In some situations, there is a need for the local mobility anchor to send asynchronous notification messages to the mobile access gateway in the course of a mobility session. In this context, 'Asynchronous messages' is used to mean messages that are not synchronous with the Proxy Binding Update and Proxy Binding Acknowledgement messages of the base Proxy Mobile IPv6 specification [RFC5213]. The base Proxy Mobile IPv6 specification does not have a provision for this.

Proxy Mobile IPv6 [RFC5213] describes the protocol operations to maintain reachability and session persistence for a Mobile Node (MN) without the explicit participation from the mobile node in signaling operations at the Internet Protocol (IP) layer. In order to facilitate such network-based mobility, the Proxy Mobile IPv6 protocol defines a mobile access gateway (MAG), which acts as a proxy for the mobile node in Mobile IPv6 [RFC6275], and the local mobility anchor (LMA) which acts similar to a Home Agent. The setup of the mobility session is initiated by the mobile access gateway by sending a Proxy Binding Update message and acknowledged by the local mobility anchor in the Proxy Binding Acknowledgement message. Once the mobility session is set up for a given lifetime, the local mobility anchor has no mechanism to inform the mobile access gateway about changes to the mobility session or any parameters related to the mobility session.

One such scenario where such a mechanism is needed is when the local mobility anchor wants to inform the mobile access gateway that it needs to re-register mobility session for a mobile node. It is possible to achieve a similar effect by using a short lifetime for the mobility sessions but in several networks this results in an unacceptable, and mostly unnecessary, increase in the signaling load and overhead. More suitable is to enable a demand-based signaling from the local mobility anchor to one or more mobile access gateways. Another example is when there is change in QoS policy [I-D.ietf-netext-pmip6-qos], or a IPv4 Traffic Offload Policy [RFC6909], for a mobility session, the local mobility anchor wants to request the mobile access gateway to perform re-registration of the mobility session and so it can obtain the updated policy. While it is possible to use an existing mobility header type to enable LMA-initiated signaling to a MAG, for instance the Proxy Mobile IPv6 Heartbeat message [RFC5847], or the Binding Revocation message [RFC5846], the existing messages do not provide the required semantics and cannot be used.

This document defines a new mobility header message for allowing the local mobility anchor to send notification messages to the mobile access gateway and a corresponding mobility header message for the

mobile access gateway to acknowledge the notification message. The purpose of the notification message is two-fold: (1) enable the local mobility anchor to notify the mobile access gateway about the updated session parameters, (2) enable the local mobility anchor to request the mobile access gateway to re-negotiate the session parameters.

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 [RFC2119].

2.2. Terminology

All the mobility related terms used in this document are to be interpreted as defined in the base Proxy Mobile IPv6 specifications [RFC5213] and [RFC5844].

3. Notification Message - Usage Examples

Usecase-1: Consider a use case where the local mobility anchor wants the mobile access to re-register a specific mobility session.

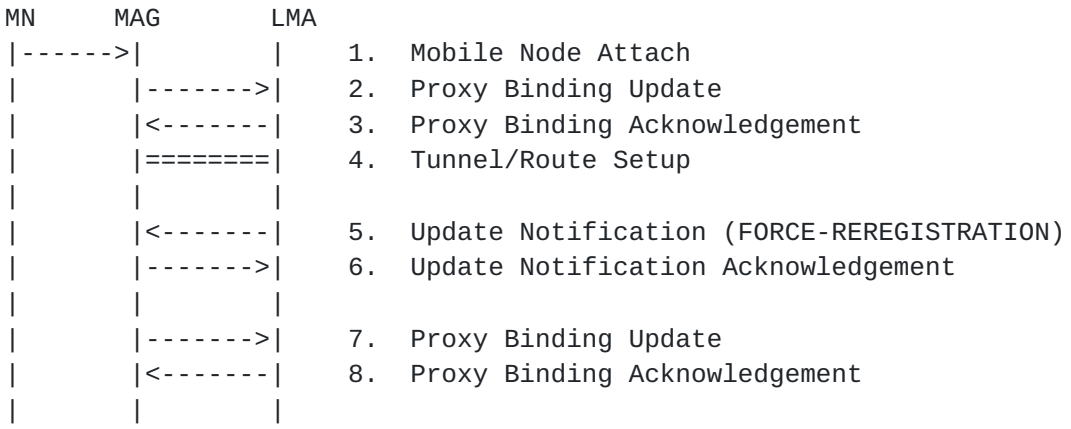


Figure 1: Update Notification - Force ReRegistration

Usecase-2: Consider a use case where the local mobility anchor wants to notify the updated session parameters to the mobile access gateway, for example, an updated QoS profile, or and updated IPv4 Offload Policy.

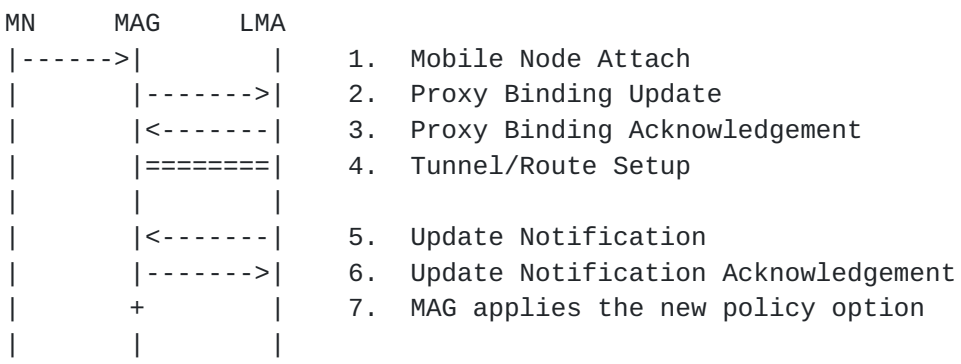


Figure 2: Update Notification - Notifying Session Parameters

4. Message Formats

4.1. Update Notification(UPN)

The Update Notification is a mobility header message that has an MH Type value of <IANA-1>. It is used by the local mobility anchor to notify the mobile access gateway that some parameters related to the mobility session have changed.

The format of the Update Notification message is as follows:

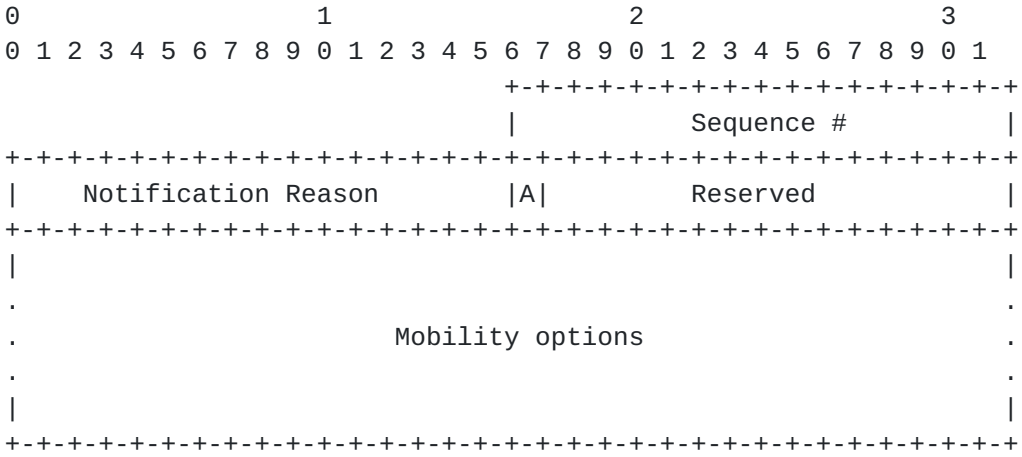


Figure 3: Update Notification Message

Sequence Number
A 16-bit unsigned integer used by the local mobility anchor to identify the Update Notification Acknowledgement message. This sequence number MUST be initialized to a random number and increased monotonically for subsequent messages.

Notification Reason
This 16-bit unsigned integer indicates the Notification reason code. This code corresponding to the reason that caused the local mobility anchor to send the Update Notification to the mobile access gateway. This field does not contain any structure and MUST be treated as an enumeration. The following Notification Reason values are currently defined:
0 - Reserved
1 - FORCE-REREGISTRATION
2 - UPDATE-SESSION-PARAMETERS

Acknowledgement Requested Flag (A-Flag)
When this flag is set to a value of (1), it is an indication that the local mobility anchor is requesting the mobile access gateway to send a Update Notification Acknowledgement message.

Reserved
This field is unused for now. The value MUST be initialized to 0 by the sender and MUST be ignored by the receiver.

Mobility Options
A variable-length field of such length that the complete Mobility Header is an integer multiple of 8 octets long. This field contains zero or more TLV-encoded mobility options. Any of the mobility header options can be included here. The receiver MUST ignore and skip any options that it does not understand. These mobility options are used by the mobile access gateway to identify the specific binding for which the Update Notification message is sent.

4.2. Update Notification Acknowledgement(UPA)

The Update Notification Acknowledgement is a mobility header message that has an MH Type value of <IANA-2>. The mobile access gateway sends this message in order to acknowledge that it has received an Update Notification message with the A-flag set and to indicate the status after processing the message.

The format of the Update Notification Acknowledgement message is as follows:

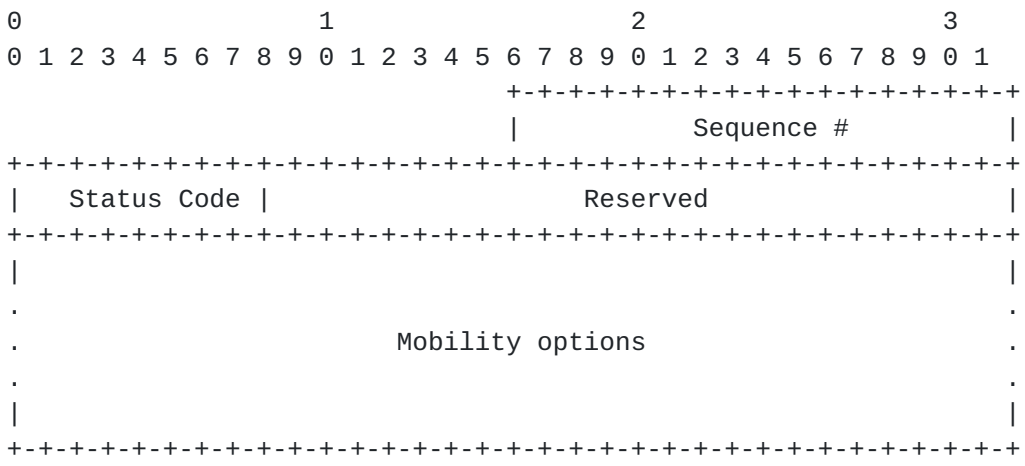


Figure 4: Update Notification Acknowledgement Message

Sequence Number
A 16-bit unsigned integer copied from the Update Notification message. This is used for matching the Update Notification Acknowledgement message to the Update Notification message.

Status Code
This 8-bit unsigned integer indicates the status code. Specifies the result of the processing of the update notification message. The status codes between 0 and 127 signify successful processing of the Update Notification message and codes between 128 and 255 signify that an error occurred during processing of the update \ notification message. The following Status Code values are currently defined:
0 - Success
129 - FAILED-TO-UPDATE-SESSION-PARAMETERS

Reserved
This field is unused for now. The value MUST be initialized to 0 by the sender and MUST be ignored by the receiver.

Mobility Options
A variable-length field of such length that the complete Mobility Header is an integer multiple of 8 octets long. This field contains zero or more TLV-encoded mobility options. Any of the mobility header options can be included here. The receiver MUST ignore and skip any options that it does not understand. These mobility options are used by the mobile access gateway to identify the specific binding for which the Update Notification Acknowledgement message is sent.

5. LMA Considerations

- The local mobility anchor sends the Update Notification message in response to a condition that is specified in the Notification Reason field. The Notification Reason field in the Update Notification message MUST be set to a specific value that identifies the reason for which the Update Notification message is being sent. The Notification Reason based on the chosen value, may require a specific Action that the mobile access gateway needs to perform (Ex: Requiring Re-registration of a mobility session).
- The Update Notification message MAY contain a modified session parameters in the form of a mobility options (e.g.,: IPv4 Traffic Offload option, or a QoS option), so the mobile access gateway can apply them on the identified mobility session.
- For requesting an Acknowledgement message *and an indication about the result of processing the message* from the mobile access gateway for the Update Notification message, the A-flag in the Update Notification message MUST be set to a value of (1), otherwise it MUST be set to a value of (0).
- The Sequence Number field of the message MUST be initialized to a random number and increased monotonically for subsequent messages.
- The Update Notification message may include the Mobile Node Identifier option, which identifies the mobility session for which Update Notification message is being sent.
- Considerations from Section 5.1 MUST be applied when sending the Update Notification message.

5.1. Constructing the Update Notification Message

The local mobility anchor when sending the Update Notification message to the mobile access gateway has to construct the message as specified below:

- When using IPv4 transport, the source address in the IPv4 header MUST be set to local mobility anchor's IPv4 address (IPv4-LMAA) and the destination address in the IPv4 header MUST be set to IPv4-Proxy-CoA of the mobile access gateway. The Mobility Header (without the IPv6 header) containing the Update Notification message is encapsulated in UDP header with the destination port of 5436 [RFC5844]. If IPsec ESP is used to protect signaling, the packet is processed using transport mode ESP.
- The format of the Update Notification message sent over IPv4 and protected using ESP is shown below:

```
IPv4 header (src=IPv4-LMAA, dst=IPv4-Proxy-CoA)
  ESP header (in transport mode)
    UDP header (sport=5436, dport=5436)
```

```
        Mobility Header (Update Notification)
          (One or more Mobile Header Options)
```

- When using IPv6 transport, the source address in the IPv6 header MUST be set to local mobility anchor's IPv6 address (LMAA). The destination address in the IPv6 header MUST be set to Proxy-CoA of the mobile access gateway. The Mobility Header is part of the IPv6 headers.
- The format of the Update Notification message sent over IPv6 and protected using ESP is shown below:

```
 IPv6 header (src=Proxy-CoA, dst=LMAA)
   Mobility Header (Update Notification)
   ESP header (in transport mode)
     (One or more Mobile Header Options)
```

5.2. Receiving the Update Notification Acknowledgement Message

- If the local mobility anchor does not receive an Update Notification Acknowledgement message from the mobile access gateway for the Update Notification message with the A-flag set, then the local mobility anchor SHOULD retransmit the message. When retransmitting an Update Notification message, the sequence number value MUST be reused from the original message that is being re-transmitted. The retransmissions MUST use an exponential back-off process in which the timeout period is doubled upon each retransmission.
- When receiving a Update Notification Acknowledgement message, the local mobility anchor MUST verify the Mobility Header as described in Section 9.2. of [RFC6275]. If the packet is dropped due to failing of any of the Mobility Header test checks, the local mobility anchor MUST follow the processing rules as in Section 9.2 of [RFC6275].
- Upon receiving the Update Notification Acknowledgement message, the local mobility anchor MUST verify that the received message is protected by the security association that is being used to protect the other signaling messages between those two peers. For example, if the Proxy Binding Update and Proxy Binding Acknowledgement messages are protected using IPsec Security Association, then the Update Notification Acknowledgement message MUST have the IPsec protection with the same IPsec Security Association.
- If the local mobility anchor receives an Update Notification Acknowledgement message with a failure Status and the value of larger than 128, then it SHOULD log an error.

- If the sequence number in the received Update Notification Acknowledgement message does not match any of the Update Notification messages that the local mobility anchor sent, then the message MUST be discarded and the message should be logged.
- If the local mobility anchor receives an Update Notification Acknowledgement message from the mobile access gateway for the Update Notification message, which did not have the A-flag set, the local mobility anchor SHOULD process the received message in the same way as a requested acknowledgement.

6. MAG Considerations

6.1. Receiving the Update Notification Message

- When receiving a Update Notification message, the mobile access gateway MUST verify the Mobility Header as described in Section 9.2. of [RFC6275]. If the packet is dropped due to failing of any of the Mobility Header test checks, the mobile access gateway MUST follow the processing rules as in Section 9.2 of [RFC6275].
- If the mobile access gateway does not support the Update Notification message and does not recognize the MH type <IANA-1>, then it sends a Binding Error message with the Status field set to 2 as described in [RFC6275].
- Upon receiving the Update Notification message, the mobile access gateway MUST verify that the received packet is protected by the security association that is being used to protect the other signaling messages between those two peers. For example, if the Proxy Binding Update and Proxy Binding Acknowledgement messages are protected using IPsec Security Association, then the Update Notification message MUST have the IPsec protection with the same IPsec Security Association.
- Upon accepting the Update Notification message, the mobile access gateway MUST process the message and perform the actions based on the Notification Reason. If the (A) flag in the message is set to a value of (1), the mobile access gateway SHOULD first send an Update Notification Acknowledgement message and set the status code field according to the result of processing the Update Notification message. For example, if the Notification Reason is set to a value of (1) "FORCE-REREGISTRATION", then the mobile access gateway SHOULD send a Proxy Binding Update message to the local mobility anchor and obtain the updated session parameters for that mobility session. If the Notification Reason is set to a value of (2) "UPDATE-SESSION-PARAMETERS", then the mobile access gateway SHOULD apply the session parameters that are obtained from the Update Notification message in the form of mobility options. For other Notification Reasons that are not reserved by this document, the processing required on the mobile access gateway is

out of the scope for this document and will be specified for each Notification reason in the respective document.

- Considerations from Section 6.2 MUST be applied when sending the Update Notification Acknowledgement message.

6.2. Constructing the Update Notification Acknowledgement Message

The mobile access gateway when sending the Update Notification Acknowledgement message to the local mobility anchor has to construct the message as specified below:

- The Sequence Number MUST be the same as the sequence Number from the received Update Notification message.
- The status field of the Update Notification message MUST be set to a value that reflects the status of the processing of the Update Notification request. The value of 0 (success), indicates that the handling of the Update Notification message was successful.
- The Update Notification Acknowledgement message MUST contain the Mobile Node Identifier option, copied from the Update Notification message. Furthermore, the mobile access gateway MAY include other mobility header options.
- The source address in the IP header of the Update Notification Acknowledgement message MUST be set to the destination IP address of the received Update Notification message.
- The destination address in the IP header MUST be set to the source address of the received Update Notification message.
- If IPsec ESP is used to protect signaling, the packet is processed using transport mode ESP.
- The format of the Update Notification Acknowledgement message sent over IPv4 and protected using ESP is shown below:

```
IPv4 header (src=IPv4-Proxy-CoA, dst=IPv4-LMAA)
  ESP header (in transport mode)
    UDP header (sport=5436, dport=5436)
      Mobility Header (Update Notification Acknowledgement)
        (One or more Mobile Header Options)
```

- The format of the Update Notification Acknowledgement message sent over IPv6 and protected using ESP is shown below:

```
IPv6 header (src=LMAA, dst=Proxy-CoA )
  Mobility Header (Update Notification Acknowledgement)
  ESP header (in transport mode)
    (One or more Mobile Header Options)
```

7. Security Considerations

The Update Notification protocol described in this specification is for use between local mobility anchor and mobile access gateway. This specification defines two new mobility header messages, Update Notification and the Update Notification Acknowledgement messages. These mobility header messages are to be protected using the same security mechanism that is used for protecting the Proxy Mobile IPv6 signaling messages exchanged between a given local mobility anchor and mobile access gateway.

If IPsec is used, the IPsec security association that is used for protecting the Proxy Binding Update and Proxy Binding Acknowledgement, also needs to be used for protecting Update Notification and the Update Notification Acknowledgement messages. The traffic selectors associated with the Security Policy Database (SPD) entry protecting Proxy Binding Update and Proxy Binding Acknowledgement messages have to be extended to include the mobility header type values, <IANA-1> and <IANA-2>, allocated for Update Notification and Update Notification Acknowledgement messages.

8. Acknowledgements

The authors would like to thank Basavaraj Patil, Rajeev Koodli, Lionel Morand, and other members of the NETEXT working group for all the comments and discussions on the draft.

9. IANA Considerations

This document requires the following IANA actions.

- Action-1: This specification defines a new Mobility Header Type message, Update Notification. This mobility header message is described in Section 4.1. The type value <IANA-1> for this message needs to be allocated from the Mobility Header Types registry at http://www.iana.org/assignments/mobility-parameters. RFC Editor: Please replace <IANA-1> in Section 4.1 and Section 7 with the assigned value, and update this section accordingly.
- Action-2: This specification defines a new Mobility Header Type message, Update Notification Acknowledgement. This mobility header message is described in Section 4.2. The type value <IANA-2> for this message needs to be allocated from the Mobility Header Types registry at http://www.iana.org/assignments/mobility-parameters. RFC Editor: Please replace <IANA-2> in Section 4.2 and Section 7 with the assigned value, and update this section accordingly.

- Action-3: This specification defines a new registry for Notification Reasons. Its called, "Update Notification Reasons Registry". The notification Reason is a field in the Update Notification message Section 4.1. The number space for the Notification Reason field needs to be managed by IANA, under the Registry, Update Notification Reason Registry. This specification reserves the following type values. The allocation policy for this field is First Come, First Served.

0	Reserved
1	FORCE-REREGISTRATION
2	UPDATE-SESSION-PARAMETERS

- Action-4: This specification defines a new registry for Status. Its called, "Update Notification Acknowledgement Status Registry". The status is a field in the Update Notification Acknowledgement message Section 4.2. The number space for the status field needs to be managed by IANA, under the Registry, Update Notification Status Registry. This specification reserves the following type values. The allocation policy for this field is First Come, First Served. The status codes between 0 and 127 signify successful processing of the Update Notification message and codes between 128 and 255 signify that an error occurred during processing of the Update Notification message.

0	Success
129	FAILED-TO-UPDATE-SESSION-PARAMETERS

10. References

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