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Update Notifications for Proxy Mobile IPv6

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 Notification messages are exchanged using a new Mobility Header message type specifically designed for this purpose.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc7077.

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1. Introduction

In some situations, there is a need for the local mobility anchor (LMA) to send asynchronous notification messages to the mobile access gateway (MAG) in the course of a mobility session. These situations include changes to mobility session parameters and policy parameters. 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 sending unsolicited Update Notification messages from the local mobility anchor to the mobile access gateway.

Proxy Mobile IPv6 [RFC5213] is a network-based mobility management protocol. It is designed to provide IP mobility management support to a mobile node without requiring the participation of the mobile node in any IP mobility-related signaling. The protocol defines two mobility management entities: the LMA and the MAG. These entities are responsible for managing IP mobility management support for a mobile node in a Proxy Mobile IPv6 domain. 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, currently there is no mechanism for the local mobility anchor to inform the mobile access gateway about changes to the mobility session or any parameters related to the mobility session. However, there are mechanisms in the Proxy Mobile IPv6 protocol that allow a local mobility anchor to send signaling messages to the mobile access gateway asynchronously, as defined in the Proxy Mobile IPv6 Heartbeat message [RFC5847] or in the Binding Revocation message [RFC5846], but these signaling messages are designed for a very specific purpose and are not sufficient for supporting a notification framework.

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 the 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. A more suitable scenario would be to enable demand-based signaling from the local mobility anchor to one or more mobile access gateways. Another example is when there is a change in a QoS policy [PMIPv6-QoS], an IP flow mobility policy [PMIPv6-FLOW-MOB], or an IPv4 traffic offload policy [RFC6909] for a mobility session. In this case, the local mobility anchor wants to request that the mobile access gateway perform re-registration of the

mobility session in order to update the policies associated with the mobility session of a mobile node.

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 twofold: (1) to enable the local mobility anchor to notify the mobile access gateway about the updated session parameters and (2) to enable the local mobility anchor to request that the mobile access gateway renegotiate 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

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

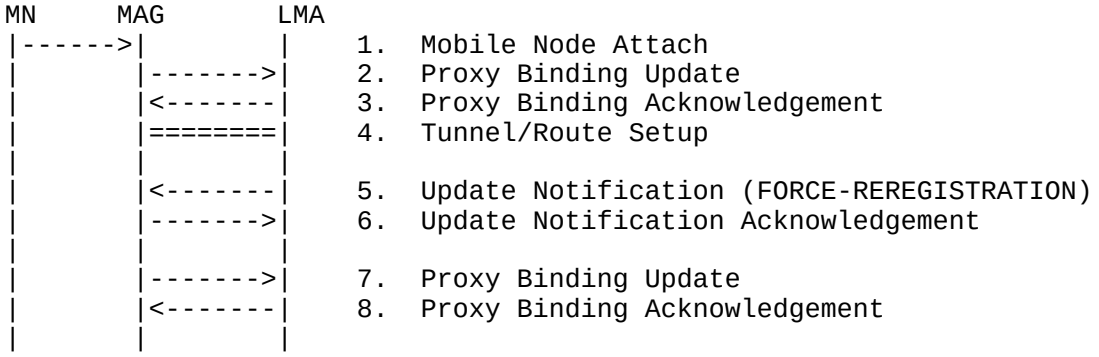

Figure 1: Update Notification: FORCE-REREGISTRATION

Use Case 2: Consider a use case where the local mobility anchor wants to notify the mobile access gateway of the updated session parameters, for example, an updated QoS profile or an updated IPv4 offload policy.

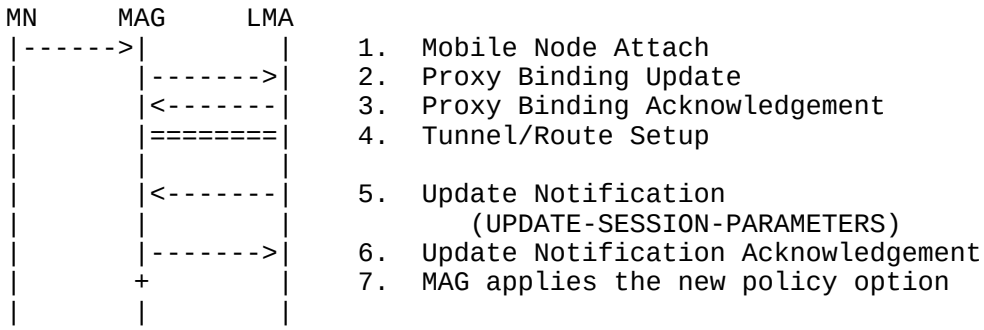

Figure 2: Update Notification: UPDATE-SESSION-PARAMETERS

4. Message Formats

4.1. Update Notification (UPN)

The Update Notification is a Mobility Header message that has an MH Type value of 19. 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:

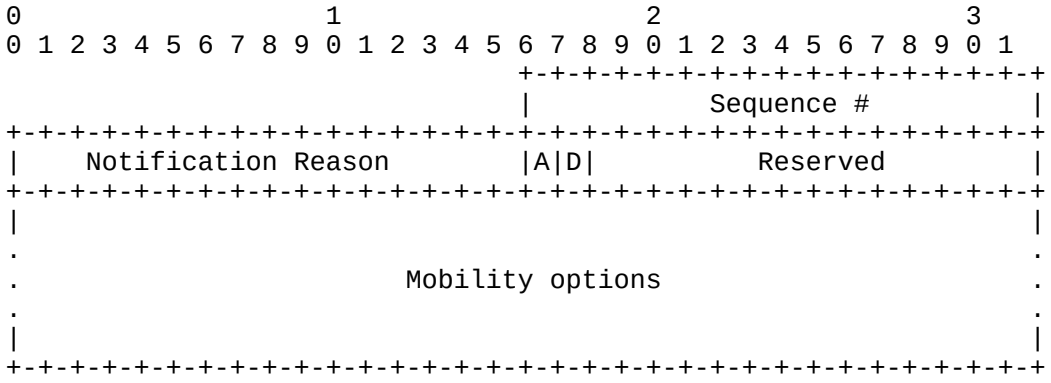

Figure 3: Update Notification Message

Sequence Number
This 16-bit unsigned integer is used by the local mobility anchor to match the received Update Notification Acknowledgement message with this Update Notification message. This Sequence Number could be a random number and can be managed under the same variable used in Proxy Mobile IPv6 signaling messages [RFC5213]. Implementations MUST ensure that there is no collision between the Sequence Numbers of all outstanding Update Notification messages at any time.

Notification Reason
This 16-bit unsigned integer indicates the Notification Reason code. This code corresponds to the reason that the local mobility anchor sent the Update Notification to the mobile access gateway. This field does not contain any structure and MUST be treated as an enumeration. The reason code can indicate a vendor-specific reason if the semantics of the Update Notification message are to be based on the attached vendor-specific options, not solely from the reason code. These attached options can be deployment specific and are not specified in this document. The following Notification Reason values are currently defined:

(0) - Reserved
This value is currently reserved and cannot be used.

(1) - FORCE-REREGISTRATION
Request to re-register the session by sending a Proxy Binding Update for the mobility session.

(2) - UPDATE-SESSION-PARAMETERS
Request to apply the updated session parameters obtained from the message on the mobility session.

(3) - VENDOR-SPECIFIC-REASON
This Notification Reason is for vendor-specific use. The processing rules are to be based on the Vendor-Specific Mobility option(s) [RFC5094] present in the message.

(4) - ANI-PARAMS-REQUESTED
Request to send currently known Access Network Identifier (ANI) [RFC6757] parameters for the mobility session.

(255) - Reserved
This value is currently reserved and cannot be used.

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 that the mobile access gateway send an Update Notification Acknowledgement message. When this flag is set to a value of (0), it is an indication that the local mobility anchor is not requesting any Update Notification Acknowledgement messages.

Retransmit Flag ((D) Flag)
When this flag is set to a value of (1), it is an indication that the message is a retransmitted message and has the same Sequence Number and other message contents as in the previously sent message. The (D) flag is set for retransmitted request messages, to aid the reliable detection of duplicate requests at the receiver of the request message. It is set when originating requests that have not yet been acknowledged, as an indication of a possible duplicate due to a retransmission. This flag MUST be cleared when sending a request for the first time for a given Sequence Number; otherwise, the sender MUST set this flag.

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
This variable-length field is of such length that the complete Mobility Header is an integer multiple of 8 octets long; the Pad1 and PadN options [RFC6275] can be used for padding. This field contains zero or more TLV-encoded mobility options. Any of the Mobility Header options, including Vendor-Specific Mobility options [RFC5094], 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 20. 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:

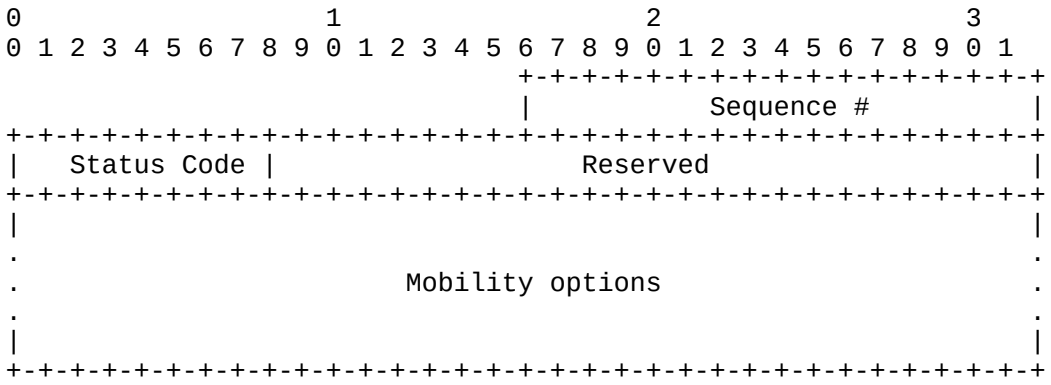

Figure 4: Update Notification Acknowledgement Message

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

Status Code
This 8-bit unsigned integer indicates the status code and specifies the result of the processing of the Update Notification message. 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
The mobile access gateway successfully processed the received Update Notification message.

(128) - FAILED-TO-UPDATE-SESSION-PARAMETERS
The mobile access gateway was not able to apply the session parameters sent by the local mobility anchor in the Update Notification message.

(129) - MISSING-VENDOR-SPECIFIC-OPTION
The received Update Notification message does not have the required Vendor-Specific Mobility option(s) needed for handling the 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
This variable-length field is of such length that the complete Mobility Header is an integer multiple of 8 octets long; the Pad1 and PadN options [RFC6275] can be used for padding. This field contains zero or more TLV-encoded mobility options. Any of the Mobility Header options, including Vendor-Specific Mobility options [RFC5094], 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 (for example, requiring re-registration of a mobility session).

- The Update Notification message MUST include either the Mobile Node Identifier option [RFC4283] or the Mobile Node Group Identifier option [RFC6602].

  * If the Mobile Node Identifier option is present, it indicates that the Update Notification message is sent for that specific mobility session.

  * If the Mobile Node Group Identifier option is present, it indicates that the Update Notification message is sent for the set of mobility sessions identified by the Group Identifier. The Group Identifier is negotiated as part of the initial Proxy Mobile IPv6 signaling. If the Group Identifier is not negotiated in the initial Proxy Mobile IPv6 signaling, a value of (1) for the Group Identifier can always be used. The Group Identifier value of (1) identifies all the mobility sessions established between that local mobility anchor and the mobile access gateway.

- The Update Notification message MAY contain a modified session parameter in the form of a mobility option (e.g., an IPv4 traffic offload option or a QoS option), so the mobile access gateway can apply them on the identified mobility session.

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:

- 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). However, if the Notification Reason is set to a value of (1) "FORCE-REREGISTRATION" or (4) "ANI-PARAMS-REQUESTED", then it is RECOMMENDED that the (A) flag be set to a value of (0). For certain general notifications that are informational in nature, the local mobility anchor may choose not to request acknowledgement for the Update Notification message.

- The Sequence Number field of the message MUST be initialized to a random number and increased monotonically for subsequent messages. Once the Sequence Number hits the maximum value, it should be wrapped around to 0. Furthermore, if the message is a retransmission of a previously sent message, then the Sequence Number value is not changed.

- When using IPv4 transport, the source address in the IPv4 header MUST be set to the local mobility anchor's IPv4 address (IPv4-LMAA), and the destination address in the IPv4 header MUST be set to the IPv4-Proxy-CoA (Care-of Address) of the mobile access gateway. The Mobility Header (without the IPv6 header) containing the Update Notification message is encapsulated in a UDP header with the destination port of 5436 [RFC5844]. If IPsec Encapsulating Security Payload (ESP) [RFC4303] 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 Mobility Header options)
```

- When using IPv6 transport, the source address in the IPv6 header MUST be set to the local mobility anchor's IPv6 address (LMAA). The destination address in the IPv6 header MUST be set to the 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=LMAA, dst=Proxy-CoA)
  Mobility Header (Update Notification)
  ESP header (in transport mode)
    (one or more Mobility 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 MUST retransmit the message. The related considerations are as follows:

  * When retransmitting an Update Notification message, the Sequence Number value and other message contents MUST be the same as in the original message. The (D) flag in the message MUST be set to a value of (1).

  * There MUST be a minimum delay of MIN_DELAY_BETWEEN_UPDATE_NOTIFICATION_REPLAY (Section 7), with a default value of 1000 milliseconds, between two retransmit messages.

  * The message MUST be retransmitted up to the number of times defined by the configuration variable MAX_UPDATE_NOTIFICATION_RETRANSMIT_COUNT (Section 7), with a default value of (1). If there is no Update Notification Acknowledgement message after the retransmission count reaches the value defined by the configuration variable MAX_UPDATE_NOTIFICATION_RETRANSMIT_COUNT, then the message MUST be discarded, and the event SHOULD be logged.

- If the local mobility anchor receives a Binding Error message with the Status field set to 2 as described in [RFC6275], this indicates that the mobile access gateway does not support the Update Notification message, and hence the local mobility anchor MUST NOT send any further Update Notification messages to that mobile access gateway unless an administrative action is taken.

- When receiving an 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 failure of any of the Mobility Header test checks, the local mobility anchor MUST follow the processing rules as described 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 an IPsec security association [RFC4301], then the Update Notification Acknowledgement message MUST have the IPsec protection with the currently established IPsec security association that is being used for protecting the other Proxy Mobile IPv6 signaling messages.

- If the local mobility anchor receives an Update Notification Acknowledgement message with a failure status and a value of 128 or greater, 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 an Update Notification message that did not have the (A) flag set, the local mobility anchor MUST process the received message in the same way as a response to an Update Notification message with the (A) flag set.

6. MAG Considerations

6.1. Receiving the Update Notification Message

- When receiving an 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 failure of any of the Mobility Header test checks, the mobile access gateway MUST follow the processing rules as described in Section 9.2 of [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 an IPsec security association, then the Update Notification message MUST have the IPsec protection with the currently established IPsec security association that is being used for protecting the other Proxy Mobile IPv6 signaling messages.

- If the received Update Notification message is a retransmission of a previously received message, as identified by the Sequence Number, then the mobile access gateway MUST NOT handle the message as a new request. The (D) flag is used as an indication of a retransmitted request, e.g., due to lost messages or the local mobility anchor not seeing the requested update actions. If the mobile access gateway has not seen the (potentially lost) initial request message, it MUST treat the received Update Notification message (with the (D) flag set) as an initial request and continue processing based on that. If the mobile access gateway detects that the request is a retransmission based on the (D) flag and the Sequence Number, then it SHOULD redo the requested update action, e.g., when the Acknowledgement Requested ((A)) flag is not set. The mobile access gateway MUST always respond to the retransmitted request if the (A) flag is set.

- 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 MUST send an Update Notification Acknowledgement message with the status code field set based on the result of processing the Update Notification message.

  * If the Notification Reason is set to a value of (1) "FORCE-REREGISTRATION", then the mobile access gateway MUST 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 MUST apply the session parameters that are obtained from the Update Notification message in the form of mobility options.

However, if the mobile access gateway is unable to apply the received session parameters, then the mobile access gateway MUST apply the following considerations:

+ If the received Update Notification message has the (A) flag in the message set to a value of (0), then the mobile access gateway MUST drop the received Update Notification message and log the error.

+ If the received Update Notification message has the (A) flag in the message set to a value of (1), then the mobile access gateway MUST send an Update Notification Acknowledgement message with a status code value of 128 (FAILED-TO-UPDATE-SESSION-PARAMETERS).

* If the Notification Reason is set to a value of (3) "VENDOR-SPECIFIC-REASON", then the mobile access gateway MUST apply the considerations related to handling of the Vendor-Specific Mobility option [RFC5094] that is carried in the Update Notification message. However, if there is no Vendor-Specific Mobility option present in the message, the mobile access gateway MUST apply the following considerations:

  + If the received Update Notification message has the (A) flag in the message set to a value of (0), then the mobile access gateway MUST drop the received Update Notification message and log the error.

  + If the received Update Notification message has the (A) flag in the message set to a value of (1), then the mobile access gateway MUST send an Update Notification Acknowledgement message with a status code value of 129 (MISSING-VENDOR-SPECIFIC-OPTION).

* If the Notification Reason is set to a value of (4) "ANI-PARAMS-REQUESTED", then the mobile access gateway MUST send a Proxy Binding Update message to the local mobility anchor with the Access Network Identifier option [RFC6757]. The Access Network Identifier option MUST reflect the current access network parameters for that mobility session as known to the mobile access gateway at the time of sending the Proxy Binding Update message.

* For other Notification Reason values not reserved by this document, the processing required on the mobile access gateway is out of scope for this document and will be specified for each Notification Reason defined by other documents.

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. A value of 0 (SUCCESS) indicates that the handling of the Update Notification message was successful.

- The Update Notification Acknowledgement message MUST contain either the Mobile Node Identifier option or the Mobile Node Group 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 of the Update Notification Acknowledgement message 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 Mobility Header options)
```

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

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

7. Protocol Configuration Variables

This specification defines the following configuration variables that control the Update Notification feature.

The mobility entities, the local mobility anchor, and the mobile access gateway have to allow these variables to be configured by the system management. The configured values for these protocol variables have to survive server reboots and service restarts.

MAX_UPDATE_NOTIFICATION_RETRANSMIT_COUNT

This variable specifies the maximum number of times a local mobility anchor can retransmit an Update Notification message before it receives an Update Notification Acknowledgement message. The default value for this parameter is 1. The suggested range of configured values for this variable is between 0 and 5.

MIN_DELAY_BETWEEN_UPDATE_NOTIFICATION_REPLAY

This variable specifies the minimum delay in seconds before an Update Notification message is retransmitted. The default value for this parameter is 1000 milliseconds. The suggested range of configured values for this variable is between 500 and 5000 milliseconds.

8. Security Considerations

The Update Notification protocol described in this specification is for use between a local mobility anchor and a mobile access gateway. This specification defines two new Mobility Header messages: Update Notification messages and 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 Update Notification Acknowledgement messages. A Proxy Mobile IPv6 implementation and the IPsec layer are typically able to communicate with each other through an implementation-specific interface, for example, to exchange configuration and notification information.

The traffic selectors associated with the Security Policy Database (SPD) entry for protecting Proxy Binding Update and Proxy Binding Acknowledgement messages (Section 4.2 of [RFC5213]) have to be

extended to include the Mobility Header Type values 19 and 20, which have been allocated for Update Notification and Update Notification Acknowledgement messages, respectively. Furthermore, any time there is rekeying of the IPsec security association between the mobile access gateway and the local mobility anchor, the newly established IPsec security association will be used for protecting the Update Notification and Update Notification Acknowledgement messages.

9. Acknowledgements

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10. IANA Considerations

IANA has taken the following actions.

- This specification defines a new Mobility Header Type message, Update Notification. This Mobility Header message is described in Section 4.1. The type value 19 for this message has been allocated from the "Mobility Header Types - for the MH Type field in the Mobility Header" registry at <http://www.iana.org/assignments/mobility-parameters>.

- 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 20 for this message has been allocated from the "Mobility Header Types - for the MH Type field in the Mobility Header" registry at <http://www.iana.org/assignments/mobility-parameters>.

- This specification defines a new registry for Notification Reasons. It is called the "Update Notification Reasons Registry". This registry has been created under the "Mobile IPv6 Parameters" registry at <http://www.iana.org/assignments/mobility-parameters>. 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 "Update Notification Reason Registry". This specification reserves the following type values. The allocation policy for this field is "Specification Required" [RFC5226].

Value	Description	Reference
0	Reserved	[RFC7077]
1	FORCE-REREGISTRATION	[RFC7077]
2	UPDATE-SESSION-PARAMETERS	[RFC7077]
3	VENDOR-SPECIFIC-REASON	[RFC7077]
4	ANI-PARAMS-REQUESTED	[RFC7077]
255	Reserved	[RFC7077]

o This specification defines a new registry for Status. It is called the "Update Notification Acknowledgement Status Registry". This registry has been created under the "Mobile IPv6 Parameters" registry at <http://www.iana.org/assignments/mobility-parameters>. 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 "Update Notification Acknowledgement Status Registry". This specification reserves the following type values. The allocation policy for this field is "Specification Required". 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.

Value	Description	Reference
0	SUCCESS	[RFC7077]
128	FAILED-TO-UPDATE-SESSION-PARAMETERS	[RFC7077]
129	MISSING-VENDOR-SPECIFIC-OPTION	[RFC7077]

11. References

11.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4283] Patel, A., Leung, K., Khalil, M., Akhtar, H., and K. Chowdhury, "Mobile Node Identifier Option for Mobile IPv6 (MIPv6)", RFC 4283, November 2005.

[RFC5094] Devarapalli, V., Patel, A., and K. Leung, "Mobile IPv6 Vendor Specific Option", RFC 5094, December 2007.

[RFC5213] Gundavelli, S., Leung, K., Devarapalli, V., Chowdhury, K., and B. Patil, "Proxy Mobile IPv6", RFC 5213, August 2008.

[RFC5844] Wakikawa, R. and S. Gundavelli, "IPv4 Support for Proxy Mobile IPv6", RFC 5844, May 2010.

[RFC6275] Perkins, C., Johnson, D., and J. Arkko, "Mobility Support in IPv6", RFC 6275, July 2011.

[RFC6602] Abinader, F., Gundavelli, S., Leung, K., Krishnan, S., and D. Premec, "Bulk Binding Update Support for Proxy Mobile IPv6", RFC 6602, May 2012.

11.2. Informative References

[PMIPv6-FLOW-MOB]
Bernardos, CJ., Ed., "Proxy Mobile IPv6 Extensions to Support Flow Mobility", Work in Progress, October 2013.

[PMIPv6-QoS]
Liebsch, M., Seite, P., Yokota, H., Korhonen, J., and S. Gundavelli, "Quality of Service Option for Proxy Mobile IPv6", Work in Progress, November 2013.

[RFC4301] Kent, S. and K. Seo, "Security Architecture for the Internet Protocol", RFC 4301, December 2005.

[RFC4303] Kent, S., "IP Encapsulating Security Payload (ESP)", RFC 4303, December 2005.

[RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, May 2008.

[RFC5846] Muhanna, A., Khalil, M., Gundavelli, S., Chowdhury, K., and P. Yegani, "Binding Revocation for IPv6 Mobility", RFC 5846, June 2010.

[RFC5847] Devarapalli, V., Koodli, R., Lim, H., Kant, N., Krishnan, S., and J. Laganier, "Heartbeat Mechanism for Proxy Mobile IPv6", RFC 5847, June 2010.

[RFC6757] Gundavelli, S., Korhonen, J., Grayson, M., Leung, K., and R. Pazhyannur, "Access Network Identifier (ANI) Option for Proxy Mobile IPv6", RFC 6757, October 2012.

[RFC6909] Gundavelli, S., Zhou, X., Korhonen, J., Feige, G., and R. Koodli, "IPv4 Traffic Offload Selector Option for Proxy Mobile IPv6", RFC 6909, April 2013.

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