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Bulk Binding Update Support for Proxy Mobile IPv6

Abstract

For extending the lifetime of a mobility session, the Proxy Mobile IPv6 specification requires the mobile access gateway to send a Proxy Binding Update message to the local mobility anchor on a per-session basis. In the absence of signaling semantics for performing operations with group-specific scope, this results in a significant amount of signaling traffic on a periodic basis between a given mobile access gateway and a local mobility anchor. This document defines optimizations to the binding update and revocation operations in Proxy Mobile IPv6 for performing operations with group-specific scope with the use of a group identifier.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

The Proxy Mobile IPv6 base specification [RFC5213] requires the Mobile Node Identifier option to be present in the mobility signaling messages, such as in the Proxy Binding Update (PBU) and Proxy Binding Acknowledgement (PBA) messages. It essentially limits the operational scope of the binding update operation to a single mobility session. These signaling messages lack the capability to identify a group of mobility sessions, so the operations related to binding update and revocation can be performed on all the mobility sessions that are part of that group.

There is a need to have semantics for associating a group identity to a mobility session, so the scope of the operations related to binding update and revocation can be extended to all the mobility sessions identified by the group identifier. The group identifier therefore provides a considerably improved mechanism for protocol operations that would otherwise require multiple atomic transactions on a per-mobility-session basis. Following are some of the use cases where the group identifier can be used.

- o For extending the lifetime of a mobility session, the mobile access gateway (MAG) periodically sends a Proxy Binding Update message to the local mobility anchor (LMA) on a per-session basis. This process can be optimized by allowing the mobile access gateway to send a single Proxy Binding Update [RFC5213] message for a group of mobility sessions identified by a group identifier. Upon accepting the request, the local mobility anchor can update the lifetime of all the mobility sessions that are part of that group.
- o On detecting the failure of a specific service card, a local mobility anchor, or a mobile access gateway service hosted on blade architecture system, can potentially request the peer to revoke all the sessions identified by a common group identifier that are hosted on that service card. Potentially, a single Binding Revocation Indication [RFC5846] message carrying the group identifier can be used to revoke all the sessions hosted on that service card, which otherwise needs to be handled on a per-session basis.

This document defines a new mobility option, the Mobile Node Group Identifier option, and the extensions to procedures related to binding update and binding revocation for performing binding operations with group-specific scope.

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]. Additionally, this document uses the following terms:

Bulk Binding Update

A binding update operation that has group-specific scope. A binding operation is associated with a specific mobility session. However, a bulk binding update operation is associated with multiple mobility sessions. This operation is not relevant for new mobility session creation.

Bulk Binding Update Group

A group of mobility sessions that are part of the same logical group and therefore share a common group identifier. This group is the bulk binding update group. This bulk binding update group is maintained by both the mobile access gateway and the local mobility anchor, and the grouping logic is local to that node. A mobility session can therefore be identified by two bulk binding update group identifiers, one specific group created by the mobile access gateway and the other specific group created by the local mobility anchor. The bulk binding update group identifiers are exchanged as part of the initial mobility session creation. The mobility entities thereafter can perform operations related to binding update such as lifetime extension and revocation operations on an entire bulk binding update group identified by the group identifier.

3. Bulk Binding Update Overview

3.1. Motivation

In a typical Proxy Mobile IPv6 domain, a local mobility anchor serves multiple mobile access gateways, and the capacity of that node with respect to the number of mobility sessions that it can host is quite high, typically in the order of a few millions. As the number of

mobility sessions hosted by a local mobility anchor goes up, so does the amount of signaling traffic related to periodic binding update traffic.

The currently specified approach of the binding update procedure for extending the lifetimes of multiple mobility sessions (where the mobile access gateway is required to send a unique binding update message for each mobility session even when there is no change to the session state) is inefficient or sub-optimal. These periodic binding update messages consume a significant amount of network resources at both the peers, in terms of processing power and network bandwidth. There is an opportunity to optimize the signaling procedures by allowing the local mobility anchor and the mobile access gateway to perform bulk binding update operations. This document specifies extensions to Proxy Mobile IPv6 signaling for performing binding update and revocation operations on a group of mobility sessions. These extensions do not take away the existing functionality of performing binding operations on a single mobility session.

3.2. General Operation

The bulk binding update mechanism specified in this document allows the mobile access gateway and the local mobility anchor to perform binding update and revocation operations on a group of mobility sessions. As part of the initial signaling during mobility session establishment, the local mobility anchor and the mobile access gateway exchange the respective bulk binding update group identifiers for that mobility session. Subsequently, both the peers can perform bulk operations on those groups by presenting the bulk binding update group identifier in the signaling messages.

When sending a Proxy Binding Update message after detecting a new mobile node on its access link, a mobile access gateway can request the local mobility anchor to assign a bulk binding update group identifier for the mobile node's mobility session. This is indicated by setting the (B) flag in the Proxy Binding Update to a value of (1). The mobile access gateway will also assign a bulk binding update group identifier (or it may assign a default bulk binding update group - ALL-SESSIONS) and include that in the Mobile Node Group Identifier option.

Upon accepting the request, the local mobility anchor will group the mobility session to a specific bulk binding update group (or it may assign it to the default bulk binding update group - ALL-SESSIONS) and return this bulk binding update group identifier in a Proxy Binding Acknowledgement message. It will also set the (B) flag in

the Proxy Binding Acknowledgement message to a value of (1). The bulk binding update group identifier is carried in the Mobile Node Group Identifier option, described in Section 4.3.

Once the bulk binding update group identifiers are exchanged, the local mobility anchor and the mobile access gateway can perform binding operations on those entire groups, by including the bulk binding update group identifier in the signaling messages. For example, the mobile access gateway can extend the lifetime of all the mobility sessions that are part of a group by sending a single Proxy Binding Update message with that bulk binding update group identifier. Similarly, the local mobility anchor can revoke all the mobility sessions that are part of a group by including that group identifier in the Proxy Binding Revocation message. When initiating bulk binding update operations on a group of mobility sessions, the group identifier that is carried in the Mobile Node Group Identifier option is always the identifier of the local group, and not the identifier of the group on the peer.

Figure 1 explains the operational sequence of the bulk binding update and revocation operations on a group of mobile nodes (MN1, MN2, and MN3).

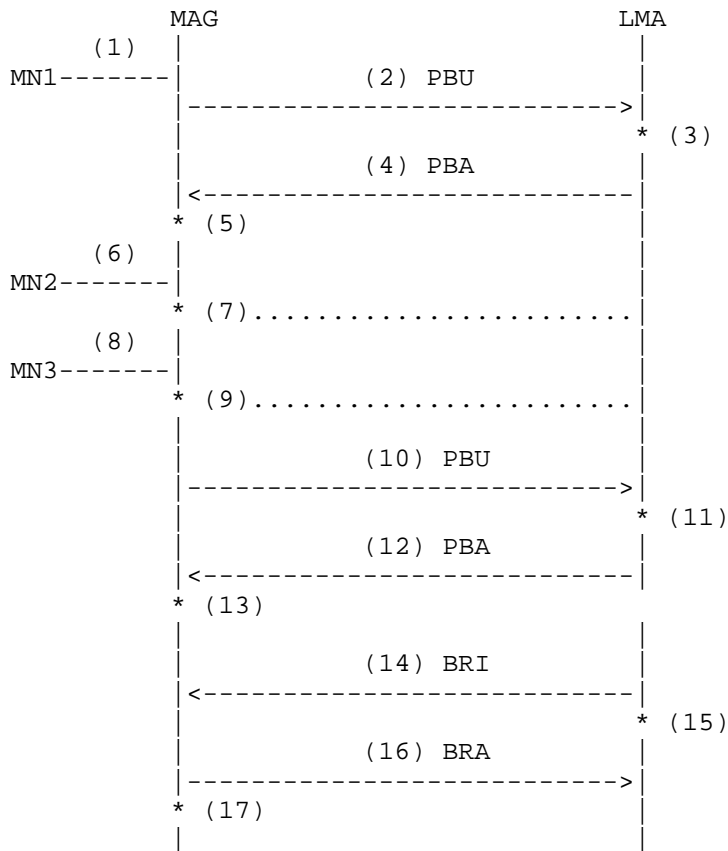


Figure 1: Exchange of Group Identifier

- o (1) to (2): The MAG detects the mobile node’s (MN1) attachment to the access link. The MAG groups the mobile node to a specific bulk binding update group, (M1). The MAG notifies this group identifier to the LMA by including it in the Mobile Node Group Identifier option of the PBU message.
- o (3): Upon accepting the PBU, the LMA creates a mobility session and groups the mobility session to a specific bulk binding update group, (L1). The LMA updates the mobile node’s Binding Cache entry to include the bulk binding update group identifier, (L1), and the bulk binding update group identifier presented by the MAG, (M1). The LMA also notifies the MAG about the bulk binding update group identifier (L1), by including it in the PBA.

- o (4) to (5): Upon receiving the PBA, the MAG updates the Binding Update List entry for that mobility session to include the bulk binding update group identifiers (L1) and (M1). At this point, both the LMA and MAG are aware of the mobile node's bulk binding update group identifiers assigned by the peers.
 - o (6) to (9): The above steps (1 through 5) are repeated here for MN2 and MN3; details are omitted. At the end of step (9), the MAG completes the signaling with the LMA. The MAG assigns the mobile nodes MN2 and MN3 to bulk binding update groups (M1) and (M2) respectively, while the LMA assigns them both to the same bulk binding update group, (L1).
 - o At this point, LMA has assigned MN1, MN2, and MN3 to the bulk binding update group (L1), while the MAG has assigned MN1 and MN2 to group (M1) and MN3 to group (M2). Both peers can now perform binding operations on a group of mobility sessions identified by the respective bulk binding update group identifier.
 - o (10) to (13): The MAG sends a Proxy Binding Update message for extending the lifetime of all the mobility sessions that are part of the bulk binding update group (M1). It includes the bulk binding update group identifier (M1) in the PBU. Upon accepting the PBU, the LMA extends the lifetime of both MN1 and MN2, which are part of the group (M1).
 - o (14) to (17): The LMA decides to revoke all the sessions that are part of bulk binding update group (L1). The LMA sends a Binding Revocation Indication (BRI) message with the bulk binding update group identifier (L1). Upon accepting the BRI message, the MAG revokes all the MN1, MN2, and MN3 mobility sessions, which are part of that bulk binding update group (L1), and sends a Binding Revocation Acknowledgement (BRA) [RFC5846] message.
4. Message Formats

This section identifies the extensions to Proxy Mobile IPv6 signaling messages that are required for supporting this specification.

4.1. Extensions to Proxy Binding Update Message

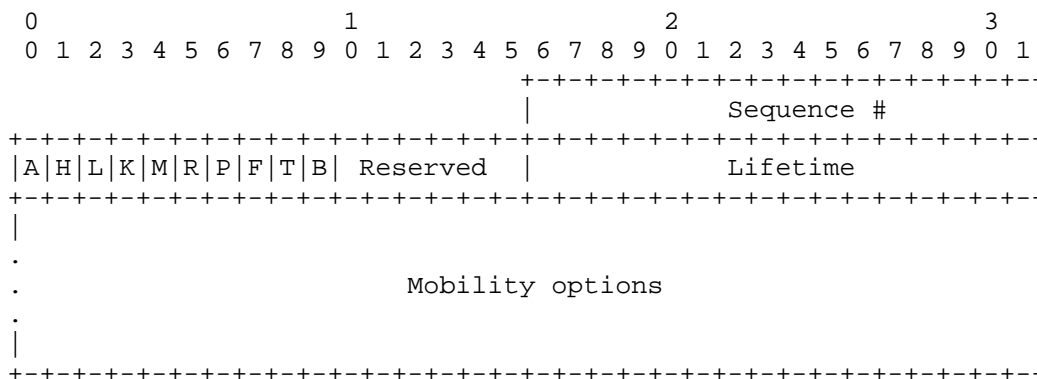


Figure 2: Extensions to Proxy Binding Update Message

A new flag, the Bulk-Binding-Update flag (B), is defined in the Proxy Binding Update message specified in [RFC5213]. The bit value of Bulk-Binding-Update flag (B) in the flags field of the message will be 0x0040.

If the Bulk-Binding-Update flag (B) is set to a value of (1), it informs the local mobility anchor to enable bulk binding update support for the mobility session associated with this message. If the (B) flag is set to a value of (0), the local mobility anchor MUST exclude the mobility session associated with this message from any bulk-binding-related operations and any binding update, or binding revocation operations with bulk-specific scope will not be relevant to that mobility session.

This flag is relevant only for Proxy Mobile IPv6 and therefore MUST be set to the value of (0) when the (P) flag is set to a value of (0).

All other fields in the Proxy Binding Update message and the mobility options that can be carried in the message conform to the appropriate specifications.

4.2. Extensions to Proxy Binding Acknowledgement Message

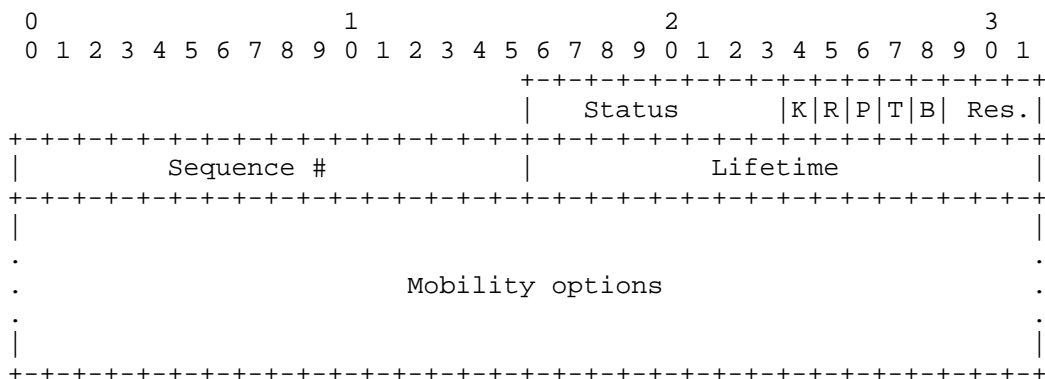


Figure 3: Extensions to Proxy Binding Acknowledgement Message

A new flag, the Bulk-Binding-Update flag (B), is defined in the Proxy Binding Acknowledgement message specified in [RFC5213]. The bit value of Bulk-Binding-Update flag (B) in the flags field of the message is 0x08.

If the Bulk-Binding-Update flag (B) is set to a value of (1), it serves as an indication to the mobile access gateway that the local mobility anchor has enabled bulk binding update support for the mobility session associated with this message. The value of the flag MUST be set to the value of (0) if the value of the (B) flag in the Proxy Binding Update message that it received from the mobile access gateway was set to a value of (0).

This flag is relevant only for Proxy Mobile IPv6 and therefore MUST be set to a value of (0) when the (P) flag is set to a value of (0).

All other fields in the Proxy Binding Acknowledgement message and the mobility options that can be carried in the message conform to the appropriate specifications.

4.3. Mobile Node Group Identifier Option

A new option, the Mobile Node Group Identifier option, is defined for use in Proxy Mobile IPv6 signaling messages exchanged between a local mobility anchor and a mobile access gateway. This option is used for carrying the mobile node's group identifier. There can be multiple instances of this option in a given signaling message; however, each of the instances SHOULD have a different sub-type value. This option is a generic option, and this specification uses only the sub-type value of (1).

The type value for this option is 50.

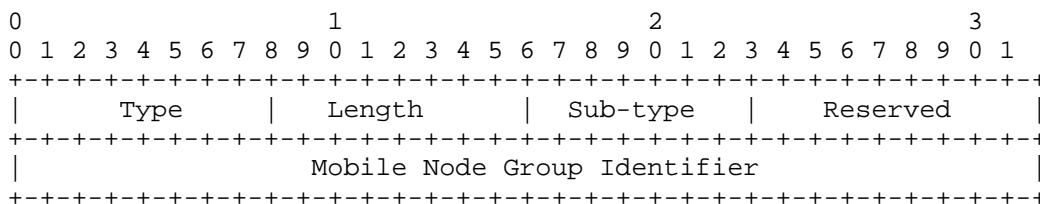


Figure 4: Mobile Node Group Identifier Option

Type
<50>

Length
This is an 8-bit unsigned integer indicating the length in octets of this option, excluding the type and length fields. The value for this field MUST be set to a value of (6).

Sub-type
This 8-bit field identifies the specific mobile node's group type. This number space will be managed by the IANA. The sub-type value of (1) is reserved for the Bulk Binding Update Group.

Reserved
This 8-bit field is unused for now. The value MUST be initialized to (0) by the sender and MUST be ignored by the receiver.

Mobile Node Group Identifier
This 32-bit field contains the mobile node's group identifier. The value of (0) is reserved and SHOULD NOT be used. The value of (1) ALL-SESSIONS is the default group of all mobility sessions established between a given local mobility anchor and a mobile access gateway.

4.4. Status Codes

This document defines the following new status code values for use in the Proxy Binding Acknowledgement message. These values have been allocated from the same number space as defined in Section 6.1.8 of [RFC6275].

INVALID_MOBILE_NODE_GROUP_IDENTIFIER: 175

Invalid group identifier value in the request

5. Protocol Considerations

5.1. MAG Considerations

The following are the considerations relevant to the mobile access gateway when supporting this specification.

5.1.1. Extensions to Binding Update List Entry Data Structure

The conceptual Binding Update List entry data structure maintained by the mobile access gateway, described in Section 6.1 of [RFC5213], is extended to include the following REQUIRED additional fields:

- o MAG-Bulk-Binding-Update-Group-Id
This is the bulk binding update group identifier assigned by this mobile access gateway for this mobility session. It is a 32-bit unsigned integer. This identifier is not globally unique within a Proxy Mobile IPv6 domain; the same group identifier value may be used by other nodes.
- o LMA-Bulk-Binding-Update-Group-Id
This is the bulk binding update group identifier assigned by the local mobility anchor for this mobility session. It is a 32-bit unsigned integer. This identifier is received in the Mobile Node Group Identifier option of the Proxy Binding Acknowledgement message. This identifier is not globally unique within a Proxy Mobile IPv6 domain; the same group identifier value may be used by other nodes.

5.1.2. Requesting Bulk Binding Update Support for a Mobility Session

The following are the considerations for the mobile access gateway for requesting bulk binding update support for a mobility session.

- o When sending a Proxy Binding Update message to the local mobility anchor, the mobile access gateway can choose to request that the local mobility anchor enable bulk binding update support for the mobility session associated with that Proxy Binding Update request. When making such request, the Bulk-Binding-Update flag (B) in the request MUST be set to a value of (1) and the Mobile Node Group Identifier option MUST be present. The decision to request bulk binding update support for a mobile node is a matter of local policy at the mobile access gateway and is controlled by the configuration variable RequestBulkBindingUpdateSupportForMobilitySession.

- o The mobile access gateway MUST assign a bulk binding update group identifier for the mobility session. Considerations on how the mobile access gateway assigns a group identifier to a mobility session is outside the scope of this document. This group identifier can be unique to the service card on which the mobility session is hosted or based on other grouping considerations. When no such group assignment is done, the mobile access gateway SHOULD assign the default group identifier value of (ALL-SESSIONS). This assigned group identifier value MUST be present in the Mobile Node Group Identifier option, and the sub-type value in the option MUST be set to the value of (1) (Bulk Binding Update Group).
- o If the received Proxy Binding Acknowledgement message has the status code value set to (0) (Proxy Binding Update accepted) and the Bulk-Binding-Update flag (B) set to a value of (0), in response to a Proxy Binding Update request with the Bulk-Binding-Update flag (B) set to a value of (1), it is an indication that the local mobility anchor has denied the request for enabling bulk binding update support for that mobility session and that the mobility session is not associated with any bulk binding update group. The mobile access gateway SHOULD set the bulk binding update group identifier values LMA-Bulk-Binding-Update-Group-Id and MAG-Bulk-Binding-Update-Group-Id to (0) in the Binding Update List entry for that mobility session. Furthermore, the mobility session should be excluded from any bulk binding update operations.
- o If the received Proxy Binding Acknowledgement message has the status code value set to (0) (Proxy Binding Update accepted) and the Bulk-Binding-Update flag (B) in the reply is set to a value of (1), it is an indication that the local mobility anchor has accepted the request to allow bulk binding update support for that mobility session. Furthermore, the Mobile Node Group Identifier option in the reply, with the sub-type value of (1) (Bulk Binding Update Group), contains the bulk binding update group identifier for that mobility session assigned by the local mobility anchor. The mobile access gateway MUST update the LMA-Bulk-Binding-Update-Group-Id and MAG-Bulk-Binding-Update-Group-Id parameters in the Binding Update List entry for that mobility session. However, if the received Proxy Binding Acknowledgement message has the Bulk-Binding-Update flag (B) set to a value of (1), but the Mobile Node Group Identifier option is not present, the message MUST be considered malformed and ignored.
- o If, at any point in time, the mobile access gateway chooses to request the local mobility anchor to disable bulk binding update support for a mobility session, it MUST send a Proxy Binding Update message with the (B) flag set to a value of (0), and the

Mobile Node Group Identifier option MUST NOT be present. This message is sent as a normal binding update request for lifetime extension. Requirements from Section 6.9.1 of [RFC5213] apply. Furthermore, the mobile access gateway MUST update the Binding Update List entry by setting the bulk binding update group identifier values LMA-Bulk-Binding-Update-Group-Id and MAG-Bulk-Binding-Update-Group-Id to (0), and the mobility session MUST be excluded from any bulk binding update operations.

5.1.3. Supporting Bulk Binding Updates

The following section identifies the considerations for a mobile access gateway performing binding update and revocation operations with group-specific scope.

- o For extending the lifetime of all mobility sessions that share the same bulk binding update group identifier, the mobile access gateway can choose to send a bulk binding update request. To make such a request, it can send a Proxy Binding Update message to the local mobility anchor, including the Mobile Node Group Identifier option with the sub-type value of (1) (Bulk Binding Update Group) and with the Bulk-Binding-Update flag (B) set to a value of (0). The identifier value in the option MUST be set to the bulk binding update group identifier of the group for which bulk binding update operation is being requested. The message MUST NOT include any individual session identifiers such as the Mobile Node Identifier option [RFC4283], the Home Network Prefix option [RFC5213], the IPv4 Home Address Request option [RFC5844], or the GRE Key option [RFC5845]. All the considerations from Section 5.3.3 of [RFC5213] MUST be followed when sending the bulk binding update request, with the exception related to the use of Mobile Node Group Identifier option in place of the individual session identifiers (Mobile Node Identifier option, Home Network Prefix option, GRE Key option, and IPv4 Home Address Request option).
- o When requesting binding revocation for all the sessions that share the same bulk binding update group identifier, the mobile access gateway can choose to send a bulk revocation request. To make such a request, it can send a Binding Revocation Indication message [RFC5846] to the local mobility anchor, including the Mobile Node Group Identifier option with the sub-type value of (1) (Bulk Binding Update Group). The identifier value in the option MUST be set to the bulk binding update group identifier of the group for which bulk binding update operation is being requested. The message MUST NOT include any individual session identifiers such as the Mobile Node Identifier option [RFC4283], the Home Network Prefix option [RFC5213], the IPv4 Home Address Request option [RFC5844], or the GRE Key option [RFC5845]. All the

considerations from Section 9.2 of [RFC5846] MUST be followed when sending the bulk binding update request, with the exception related to the use of Mobile Node Group Identifier option in place of the individual session identifiers (Mobile Node Identifier option, Home Network Prefix option, GRE Key option, IPv4 Home Address Request option).

- o Any time the mobile access gateway receives a Binding Revocation Indication message [RFC5846], with a Mobile Node Group Identifier option present in the request and with the sub-type value of (1) (Bulk Binding Update Group), this message serves as a bulk revocation request, with the request scope for revoking of all the mobility sessions that are part of that bulk binding update group specific to that local mobility anchor and identified by the group identifier in the Mobile Node Group Identifier option.
- o All the considerations from [RFC5846] apply when processing a binding revocation request, except making the scope of the operation apply to a set of mobility sessions identified by the bulk binding update group identifier present in the request.
- o If the received Binding Revocation Indication message includes the Mobile Node Identifier option [RFC4283], the Home Network Prefix option [RFC5213], the IPv4 Home Address Request option [RFC5844], or the GRE Key option [RFC5845], the mobile access gateway MUST consider this as an invalid message; it MUST reject the Binding Revocation Indication message and send a Binding Revocation Acknowledgement message with the Status field set to a value of 128 (Binding Does NOT Exist).

5.2. LMA Considerations

The following are the considerations relevant to a local mobility anchor when supporting this specification.

5.2.1. Extensions to Binding Cache Entry Data Structure

The conceptual Binding Cache entry data structure maintained by the local mobility anchor, described in Section 5.1 of [RFC5213], is extended to include the following REQUIRED additional fields.

- o MAG-Bulk-Binding-Update-Group-Id

This is the bulk binding update group identifier assigned by the mobile access gateway for this mobility session. It is a 32-bit unsigned integer. This identifier is received in the Mobile Node Group Identifier option of the Proxy Binding Update message. This

identifier is not globally unique within a Proxy Mobile IPv6 domain; the same group identifier value may be used by other nodes.

- o LMA-Bulk-Binding-Update-Group-Id

This is the bulk binding update group identifier assigned by this local mobility anchor for this mobility session. It is a 32-bit unsigned integer. This identifier is not globally unique within a Proxy Mobile IPv6 domain; the same group identifier value may be used by other nodes.

5.2.2. Enabling Bulk Binding Update Support for a Mobility Session

The local mobility anchor will process a received Proxy Binding Update message as specified in [RFC5213]. However, if the (B) flag in the received Proxy Binding Update message is set to a value of (1) and if it includes a Mobile Node Group Identifier option with the sub-type value of (1) (Bulk Binding Update Group), the following processing takes place:

- o If the (B) flag in the received Proxy Binding Update message is set to a value of (1) and if the Mobile Node Group Identifier option is present in the request, the message serves as a request to the local mobility anchor to enable bulk binding update support for that mobility session.
- o Upon successful processing and acceptance of the Proxy Binding Update, the local mobility anchor can choose to enable bulk binding update support for this mobility session. The decision whether to enable bulk binding update support for that mobility session is a matter of local policy and is controlled by the configuration variable `AcceptBulkBindingUpdateReqForMobilitySession`.
- o For enabling the bulk binding update support for the mobility session, the local mobility anchor MUST associate the mobility session to a specific bulk binding update group locally. The specific details on how the local mobility anchor associates the given mobility session to a specific bulk binding update group is outside the scope of this document. The local mobility anchor can choose to assign a default bulk binding update group identifier value of (ALL-SESSIONS), indicating that all the mobility sessions from that mobile access gateway are part of that group. The local mobility anchor SHOULD update the bulk binding update group identifier values in the Binding Cache entry, LMA-Bulk-Binding-Update-Group-Id and MAG-Bulk-Binding-Update-Group-Id, to the respective values.

- o If the bulk binding update support is enabled for the mobile node's mobility session, the local mobility anchor MUST send the assigned bulk binding update group identifier as part of the Mobile Node Group Identifier option, with the sub-type value of (1) (Bulk Binding Update Group) in the Proxy Binding Acknowledgement message that it sends to the mobile access gateway. The (B) flag in the Proxy Binding Acknowledgement message MUST be set to value of (1).
- o If the bulk binding update support is not enabled for the mobility session, the local mobility anchor MUST NOT include the Mobile Node Group Identifier option with the sub-type value of (1) (Bulk Binding Update Group), in the Proxy Binding Acknowledgement message that it sends to the mobile access gateway. Furthermore, the (B) flag in the Proxy Binding Acknowledgement message MUST be set to value of (0). It is to be noted that the Mobile Node Group Identifier option is a generic option and new sub-types may be defined by future specifications.
- o If the received Proxy Binding Update message is not a bulk binding update request, (i.e., the (B) flag is set to a value of (0) and the Mobile Node Group Identifier option with the sub-type value of (1) (Bulk Binding Update Group) is not present), but is a request for extending the lifetime of an existing mobility session, for which the bulk binding update support is already enabled, then the local mobility anchor MUST process the request as specified in [RFC5213]. However, the value of (0) in the (B) flag in the message serves as a request for the local mobility anchor to disable bulk binding update support for that mobility session. Upon accepting the request, the local mobility anchor SHOULD set the parameters, LMA-Bulk-Binding-Update-Group-Id and MAG-Bulk-Binding-Update-Group-Id in the Binding Cache entry to a value of (0) and the mobility session MUST be excluded from any bulk binding update operations.
- o Any time the local mobility anchor detects that the mobile node has roamed and changed its point of attachment to a new mobile access gateway, it SHOULD also update the bulk binding update group identifier of the mobility session. Additionally, it should also update the existing group identifiers associated with that session. As part of sending the Proxy Binding Acknowledgement to the new mobile access gateway, it MUST include the updated group identifier in the Mobile Node Group Identifier option, with a sub-type value of (1). However, if the received Proxy Binding Update from the new mobile access gateway did not have the (B) flag set to a value of (1), then it MUST NOT include the mobility

session in any of bulk binding update group and MUST NOT include the Mobile Node Group Identifier option with the sub-type value of (1).

- o Any time a mobile node's mobility session is de-registered by the mobile access gateway, or the session is revoked for administrative or any other reasons, the mobility session MUST also be removed from the bulk binding update group.

5.2.3. Supporting Bulk Binding Updates

The following section identifies the considerations for a local mobility anchor for performing bulk binding update and revocation operations with group-specific scope.

- o Any time the local mobility anchor receives a Proxy Binding Update message with the (B) flag in the request set to a value of (0) and a Mobile Node Group Identifier option present in the request with sub-type value of (1) (Bulk Binding Update Group), the local mobility anchor MUST consider the request a bulk binding update request, with the request scope including all the mobility sessions that are part of that bulk binding update group, specific to that mobile access gateway, and identified by the group identifier in Mobile Node Group Identifier option. However, if the received request also includes any individual session identifiers such as the Mobile Node Identifier option [RFC4283], the Home Network Prefix option [RFC5213], the IPv4 Home Address Request option [RFC5844], or the GRE Key option [RFC5845], the local mobility anchor MUST consider this as an invalid message; it MUST reject the Proxy Binding Update message and send a Proxy Binding Acknowledgement message with the Status field set to INVALID_MOBILE_NODE_GROUP_IDENTIFIER (Invalid group identifier value in the request).
- o The local mobility anchor MUST consider the message as a request for extending the lifetime of all the mobility sessions that are associated with the group identifier in the Mobile Node Group Identifier option. However, if the Mobile Node Group Identifier option with the sub-type value of (1) (Bulk Binding Update Group) has an unknown group identifier, then the local mobility anchor MUST reject the Proxy Binding Update message and send a Proxy Binding Acknowledgement message with the Status field set to INVALID_MOBILE_NODE_GROUP_IDENTIFIER (Invalid group identifier value in the request).
- o Upon accepting the bulk binding update request, the local mobility anchor SHOULD extend the lifetime for all the mobility sessions that are part of the bulk binding update group identified by the

group identifier in the Mobile Node Group Identifier in the message. Considerations from [RFC5213] MUST be applied for extending the lifetime of a mobile node's session. It MUST also send a Proxy Binding Acknowledgement message with the Status field value set to 0 (Proxy Binding Update accepted). The lifetime field in the message MUST be set to the allocated lifetime for all the mobility sessions. The message MUST also include the Mobile Node Group Identifier option, with the sub-type value of (1) (Bulk Binding Update Group) and with the identifier value copied from the Mobile Node Group Identifier option present in the received Proxy Binding Update message.

- o If the local mobility anchor rejects the bulk binding update request for any administrative reason, then it MUST NOT update the lifetime in the Binding Cache entries of any of the mobile nodes identified by the group identifier. The local mobility anchor SHOULD send a Proxy Binding Acknowledgement indicating the reason for the rejection in the status code.
- o Any time the local mobility anchor receives a Binding Revocation Indication Message [RFC5846] with a Mobile Node Group Identifier option present in the request and with the sub-type value of (1) (Bulk Binding Update Group), the local mobility anchor MUST consider the request as a bulk revocation request, with the request scope including all the mobility sessions that are part of the bulk binding update group specific to that mobile access gateway and identified by the group identifier in Mobile Node Group Identifier option. However, if the received request also includes the Mobile Node Identifier option [RFC4283], the Home Network Prefix option [RFC5213], the IPv4 Home Address Request option [RFC5844], or the GRE Key option [RFC5845], the local mobility anchor MUST consider this as an invalid message; it MUST reject the Binding Revocation Indication message and send a BRA message with the Status field set to a value of 128 (Binding Does NOT Exist). All the considerations from [RFC5846] apply when processing a binding revocation request, except making the scope of the operation apply to a set of mobility sessions identified by the group identifier present in the request.
- o Upon accepting the Binding Revocation Indication request and completing the operation, the local mobility anchor MUST send a Binding Revocation Acknowledgement message with the Status field set to a value of 0 (success). The message MUST include the Mobile Node Group Identifier option, with the identifier value copied from the Mobile Node Group Identifier option present in the received Binding Revocation Indication message.

6. Protocol Configuration Variables

6.1. Local Mobility Anchor - Configuration Variables

This specification adds a new configuration variable for the local mobility anchor. The configured value for this variable is expected to survive server reboots and service restarts.

AcceptBulkBindingUpdateReqForMobilitySession

This flag indicates whether or not the local mobility anchor will accept the request from the mobile access gateway to enable bulk binding update support for the mobility session. The default value for this flag is set to (1), indicating that it will accept the request from the mobile access gateway. If the value of the flag is set to (0), the local mobility anchor will deny the request.

6.2. Mobile Access Gateway - Configuration Variables

This specification adds a new configuration variable for the mobile access gateway. The configured value for this variable is expected to survive server reboots and service restarts.

RequestBulkBindingUpdateSupportForMobilitySession

This flag indicates whether or not the mobile access gateway will request the local mobility anchor to enable bulk binding update support for the mobility session. The default value for this flag is set to (1), indicating that the mobile access gateway will set the bulk binding update flag (B) in the Proxy Binding Update request to a value of (1). If the flag is set to a value of (0), the mobile access gateway will set the bulk binding update flag (B) in the Proxy Binding Update to a value of (0).

7. IANA Considerations

Per this document, IANA has done the following:

- o Action-1: This specification defines a new flag (B) to the Proxy Binding Update message, specified in [RFC5213]. This flag is described in Section 4.1. The value of the flag (B) has been allocated from the "Binding Update Flags" registry.
- o Action-2: This specification defines a new flag (B) to the Proxy Binding Acknowledgement message, specified in [RFC5213]. This flag is described in Section 4.2. The value of the flag (B) has been allocated from the "Binding Acknowledgement Flags" registry.

- o Action-3: This specification defines a new Mobility Header option, the Mobile Node Group Identifier option. This option is described in Section 4.3. The Type value for this option has been assigned in the same number space as allocated for the other mobility options [RFC6275].
- o Action-4: The Sub-type field of the Mobile Node Group Identifier option introduces a new number space. This number space is now managed by IANA, under the Registry, "Mobile Node Group Identifier Type Registry". This specification reserves the sub-type value of (1) (Bulk Binding Update Group). Approval of new sub-type values are to be made through IANA Expert Review. The value range of this field is 0 through 255, but the values 0 and 255 are marked as reserved. The remaining values 2-254 are available for allocation.
- o Action-5: This document also defines a new status value `INVALID_MOBILE_NODE_GROUP_IDENTIFIER` (Invalid group identifier value in the request: 175) for use in the Proxy Binding Acknowledgement message, as described in Section 4.4. This value has been assigned from the same number space as allocated for other status codes [RFC6275].

8. Security Considerations

The Mobile Node Group Identifier option defined in this specification is for use in Proxy Binding Update and Proxy Binding Acknowledgement messages. This option is carried like any other mobility header option, and it does not require any other special security considerations.

The bulk binding update and the bulk revocation operations specified in this document perform operations on a group of mobility sessions. If proper authorization checks are not in place, a malicious node may be able to hijack a mobile node's mobility session or may carry out a denial-of-service attack. To prevent this attack, this specification requires the local mobility anchor to allow only authorized mobile access gateways to perform bulk operations.

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10. References

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