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Prefix Delegation Support for Proxy Mobile IPv6
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Abstract

This specification defines extensions to Proxy Mobile IPv6 protocol for allowing a mobile router in a Proxy Mobile IPv6 domain to obtain delegated IP prefixes for its attached mobile networks. The mobility entities in the network will provide network-based mobility management support for those delegated IP prefixes just as how IP mobility support is provided for the mobile node's home address. Even as the mobile router performs a handoff and changes its network point of attachment, mobility support is ensured for all the delegated IP prefixes and for all the IP nodes in the mobile network that use IP address configuration from those delegated IP prefixes.

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on December 20, 2013.

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1. Introduction

Proxy Mobile IPv6 [RFC5213] enables network-based mobility management support for an IP host without requiring its participation in any IP mobility signaling. The mobility elements in the network allow an IP host to obtain an IPv4 address and/or a set of IPv6 addresses and be able to obtain IP mobility support for those IP address(es) within the Proxy Mobile IPv6 domain. In this context, the mobility management support that is enabled is for an individual IP host, which is the mobile node. The IPv4 home address, or the IPv6 home network prefixes are logically bound to the link shared between the mobile access gateway and the mobile node and only the mobile node can use those IP address(es) by configuring them on the interface attached to that link. Currently, there is no mobility support for the mobile networks attached to a mobile router in a Proxy Mobile IPv6 domain.

This specification defines extensions to the Proxy Mobile IPv6 protocol for allowing mobility support to the mobile networks attached to a mobile router. The mobile router can request the mobility entities in the Proxy Mobile IPv6 domain for one or more delegated IP prefixes using DHCP Prefix Delegation extensions [RFC3633], or through other mechanisms outside the scope of this document. The mobility entities in the network will provide network-based mobility management support for those delegated prefixes just as how mobility is supported for an home address. The delegated prefixes are hosted in the mobile network attached to the mobile router. IP mobility is ensured for all the IP nodes in the mobile network, even as the mobile router performs a handoff by changing its point of network attachment within the Proxy Mobile IPv6 domain. The local mobility anchor in the Proxy Mobile IPv6 domain will not track the individual IP sessions for all the IP nodes in the mobile network, it only tracks a single mobile router session that is hosting the mobile network and associates the delegated IP prefixes with that session.

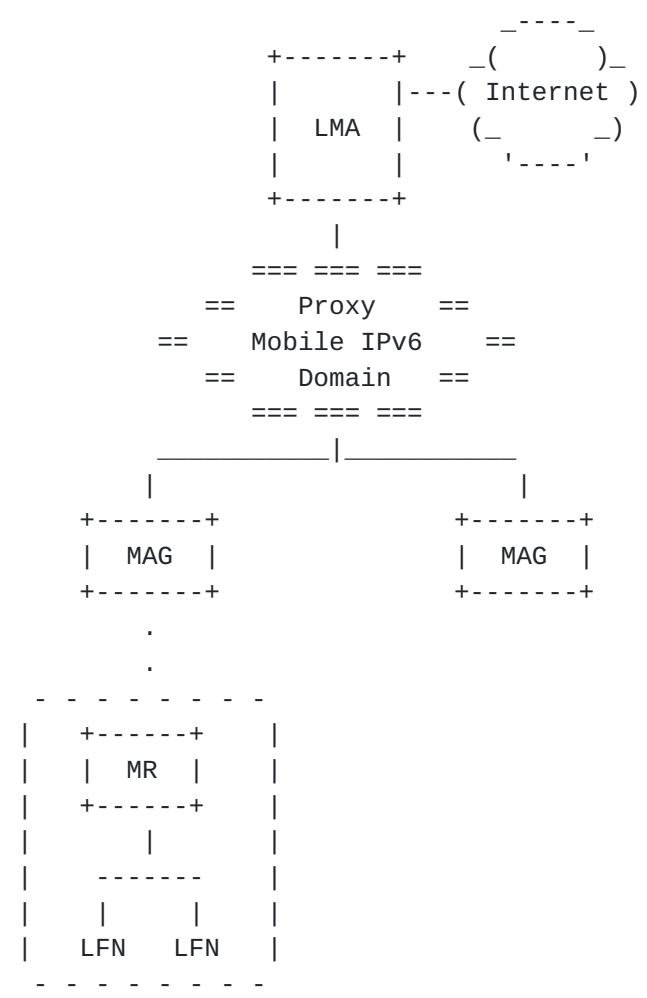


Figure 1: Mobile Router in Proxy Mobile IPv6 Domain

Within the context of this document, the definition of a mobile router extends that of a mobile node definition from [RFC5213], by adding routing capability for routing IP packets between its egress interface (interface used for attachment to the mobile access gateway) and any of its ingress interfaces (interface used for attachment to the mobile network). The network of nodes part of the mobile network are referred to as locally fixed nodes (LFN) and they all move with the mobile router as a single cluster. As the mobile router moves, the LFNs are not aware of the mobility of the MR to a new MAG. Figure 1 illustrates a mobile router in a Proxy Mobile IPv6 domain.

The rest of the document identifies the protocol extensions and the operational details of the local mobility anchor and mobile access gateway for supporting this specification.

2. Convention and Terminology

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

All the mobility related terms used in this document are to be interpreted as defined in Proxy Mobile IPv6 specifications [RFC5213] and [RFC5844]. All the DHCP related terms are to be interpreted as defined in DHCPv6-PD for NEMO [RFC6276], DHCPv6-PD [RFC3633] and Subnet Allocation Option for DHCPv4 [RFC6656]. This document also provides a context-specific explanation to the following terms used in this document.

Mobile Router (MR)

The term mobile router is used to refer to an IP router whose mobility is managed by the network while being attached to a Proxy Mobile IPv6 domain. The mobile router is a mobile node as defined in [RFC5213], but with additional capabilities for supporting an attached mobile network. The mobility entities in the Proxy Mobile IPv6 domain provide mobility for the IPv4/IPv6 address(es) assigned to the mobile node's egress link and also mobility support to the network prefixes hosted in the network attached to the mobile router.

Mobile Network

It is an IP network attached to a mobile router. There can be many IP nodes in this IP network. The mobile router is a gateway for these IP nodes for reaching other IP networks or the Internet. The mobile router and the attached IP networks move as a single cluster.

Delegated Mobile Network Prefix (DMNP)

The Delegated Mobile Network Prefix is an IPv4/IPv6 prefix delegated to a mobile router and is hosted in the mobile network. The IP nodes in the mobile network will be able to obtain IP address configuration from the delegated mobile network prefix and will have IP mobility support for that address configuration. The DMNP is topologically anchored on the local mobility anchor and the mobility elements in the Proxy Mobile IPv6 domain provide IP mobility support for the prefix, by forwarding the mobile network traffic to the mobile router.

Locally Fixed Node (LFN)

A Locally Fixed Node is an IP node in the mobile network. As the mobile router performs a handoff and changes its network point of attachement, the locally fixed node moves along with the mobile router.

3. Solution Overview

This section provides an overview of the operation of this specification, as well as lists the stated assumptions. This specification references three different deployment scenarios and explains the protocol operation.

3.1. Stated Assumptions

- The mobile router is a mobile node as defined in [RFC5213], but with additional capabilities for routing IP packets between its egress interface (interface used for attachment to the mobile access gateway) and any of its ingress interfaces (interface used for attachment to the mobile network).

- The specification assumes that a mobile router is an IPv4 and/or IPv6 router without any capability for mobility management.

- The mobile router can obtain the delegated IP prefix(es) for its attached mobile networks using DHCPv6, or using mechanisms outside of this document (Example: Static Configuration, or access technology specific mechanisms). This document makes no assumption on the support of any one specific approach. However, it explains the protocol operation using DHCPv6-based prefix delegation as specified in [RFC3633] and with the use of Prefix Exclude Option for DHCPv6-PD as described in [RFC6603]. It defines an interworking between the mobility entities and the DHCPv6 functional elements in a non-normative way.

- The mobile router obtains the IP address configuration for its egress roaming interface as specified in [RFC5213] and [RFC5844]. The mobile router along with its mobile networks will be able to perform handoff and change its point of attachment in the network and will be able to retain IP mobility support.

3.2. Deployment Models

This section explains the protocol operation for supporting prefix delegation support in Proxy Mobile IPv6 for the following three deployment_models. The high-level message call flows between the mobile router, mobile access gateway and the local mobility anchor are presented.

3.2.1. Delegating Router Co-located with Mobile Access Gateway

- The delegating router (DR) function, as specified in [RFC3633], is co-located with the mobile access gateway.

- The requesting router (RR) function, as specified in [RFC3633], is enabled on the mobile router.

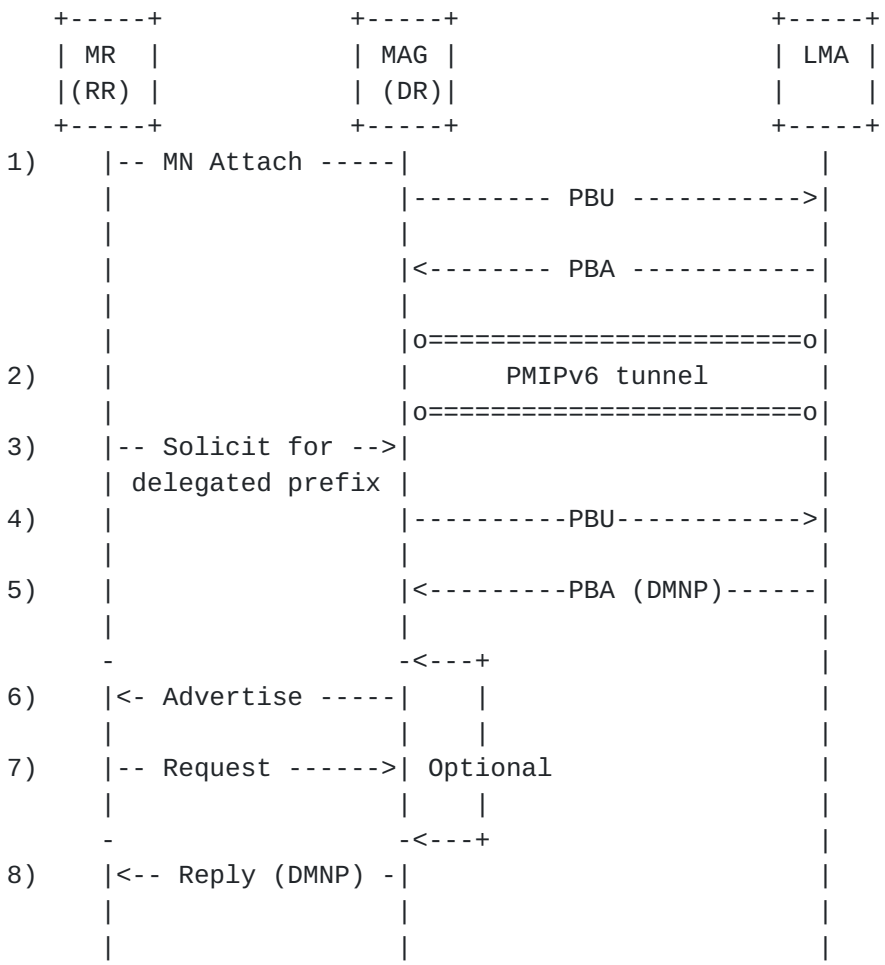


Figure 2: Delegating Router Co-located with Mobile Access Gateway

3.2.2. Delegating Router Co-located with Local Mobility Anchor

- The delegating router (DR) function, as specified in [RFC3633], is co-located with the local mobility anchor.

- A DHCPv6 Relay Agent (DRA) function, as specified in [RFC3315], is co-located on the mobile access gateway.

- The requesting router (RR) function, as specified in [RFC3633], is enabled on the mobile router.

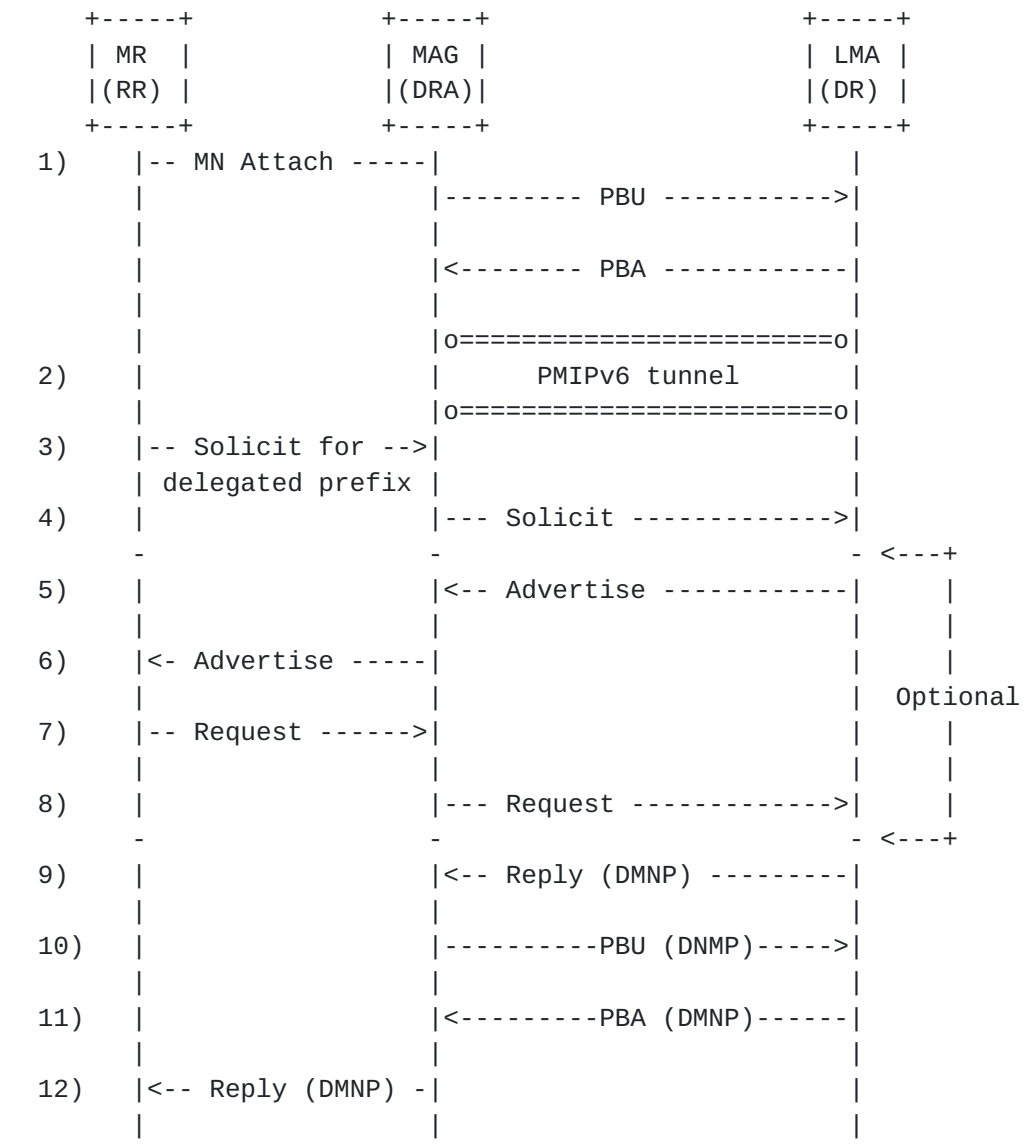


Figure 3: Delegating Router Co-located with Local Mobility Anchor

3.2.3. Static Configuration of Delegated Mobile Network Prefixes

- The delegated mobile network prefixes of the mobile router are statically configured in the mobile node's policy profile [RFC5213].

- The delegated mobile network prefixes are statically configured in the mobile network attached to the mobile router. The mobile router is the default-router for the mobile networks.

- The mobile access gateway obtains statically configured mobile network prefixes from the policy profile and registers them with the local mobility anchor using the extensions specified in this

document. There is no explicit trigger from the mobile router from registering, or de-registering those prefixes. As long as there is a mobility session for the mobile router's home address, the local mobility anchor enables mobility support for the mobile network prefixes.

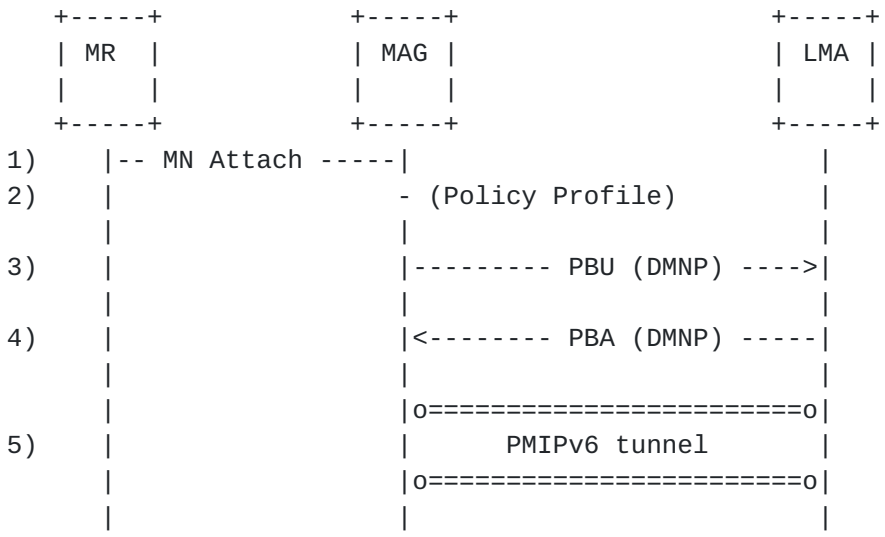


Figure 4: Static Configuration of Delegated Mobile Network Prefixes

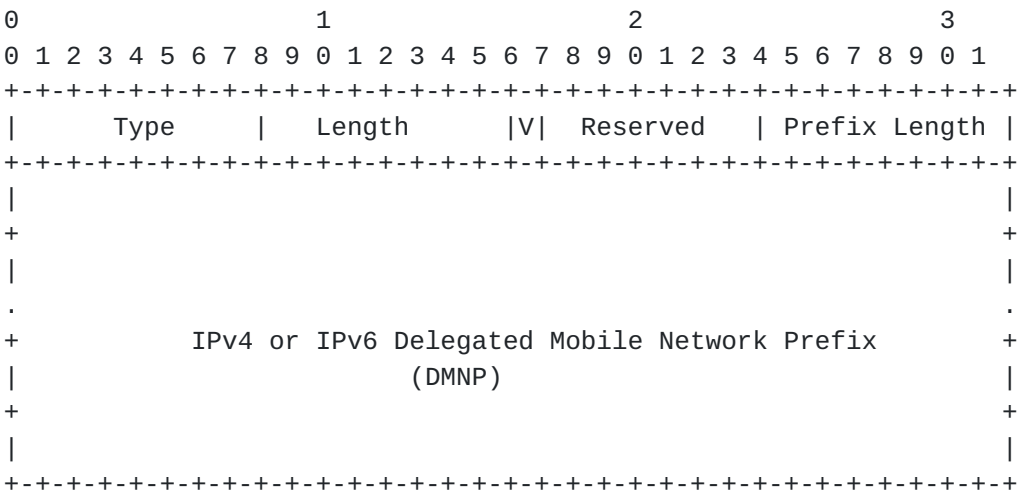
4. Message formats

This section defines extensions to Proxy Mobile IPv6 [RFC5213] protocol messages.

4.1. Delegated Mobile Network Prefix Option

A new mobility header option, Delegated Mobile Network Prefix option is defined for use with Proxy Binding Update and Proxy Binding Acknowledgment messages exchanged between a local mobility anchor and a mobile access gateway. This option is used for exchanging the mobile router's IPv4/IPv6 delegated mobile network prefix. There can be multiple instances of the Delegated Mobile Network Prefix option present in a message.

The Delegated Mobile Network Prefix option has an alignment requirement of 8n+2. Its format is as follows:



Type

<IANA-1>: To be assigned by IANA.

Length

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

IPv4 Prefix (V)

If the IPv4 Prefix (V) flag is set to a value of (1), then it indicates that the prefix that is included in the DMNP field is an IPv4 prefix. If the IPv4 Prefix (V) flag is set to a value of

(0), then it indicates that the prefix that is included in the DMNP field is an IPv6 prefix.

Reserved

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

Prefix Length

8-bit unsigned integer indicating the prefix length of the prefix contained in the option.

Delegated Mobile Network Prefix

Contains a mobile router's 4-byte IPv4 or a 16-byte IPv6 Delegated Mobile Network Prefix.

4.2. 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].

NOT_AUTHORIZED_FOR_DELEGATED_MNP: <IANA-2>

Not Authorized for delegated mobile network prefix

REQUESTED_DMNP_IN_USE: <IANA-3>

Requested delegated mobile network prefix is in use

5. Operational Details

5.1. MAG Considerations

5.1.1. Extension to Binding Update List Entry Data Structure

In order to support this specification, the conceptual Binding Update List Entry (BULE) data structure [RFC5213] needs to be extended to include delegated mobile network prefix (DMNP) list. Each entry in the list is used for storing an IPv4/IPv6 mobile network prefix delegated to the mobile router.

5.1.2. Signaling Considerations

- The mobile node's policy profile defined in [RFC5213] is extended to include a parameter which indicates Delegated Prefix support. During the mobile router's initial attachment procedure, the mobile access gateway obtains the mobile router's policy profile, as per the procedures defined in [RFC5213]. If the policy profile indicates that the mobile router is authorized for Delegated Prefix support, then the following considerations apply.

- For requesting the local mobility anchor to allocate delegated mobile network prefix(es) for the mobile router, the mobile access gateway MUST include one or more Delegated Mobile Network Prefix (DMNP) options in the Proxy Binding Update message.

  * There MUST be exactly one instance of the Delegated Mobile Network Prefix option with ALL_ZERO value and with the (V) flag set to a value of (0). This serves as a request to the local mobility anchor to allocate a set of delegated IPv6 mobile network prefixes.

  * There MUST be exactly one instance of the Delegated Mobile Network Prefix option with ALL_ZERO value and with the (V) flag set to a value of (1). This serves as a request to the local mobility anchor to allocate a set of delegated IPv4 mobile network prefixes.

  * There MUST be exactly one instance of the Delegated Mobile Network Prefix option with NON_ZERO prefix value for each of the mobile network prefixes that the mobile access gateway is requesting the local mobility anchor to allocate. The prefix value in the option is the prefix that is either statically configured for that mobile router in the mobile node's policy profile, or obtained via interactions with the DHCP PD functions. This serves as a request to the local mobility anchor to allocate the requested IPv4/IPv6 prefix.

- If the received Proxy Binding Acknowledgement message has the status field value set to NOT_AUTHORIZED_FOR_DELEGATED_MNP (Not Authorized for delegated mobile network prefix), the mobile access gateway MUST NOT enable mobility support for any of the prefixes in the mobile network and prefix delegation support has to be disabled.

- If the received Proxy Binding Acknowledgement message has the status field value set to REQUESTED_DMNP_IN_USE (Requested delegated mobile network prefix is in use), the mobile access gateway MUST NOT enable mobility support for the requested prefixes. The mobile access gateway MAY choose to send Proxy Binding Acknowledgement message requesting the local mobility anchor to perform the prefix assignment.

- If the received Proxy Binding Acknowledgement message has the status field value set to 0 (Proxy Binding Update accepted), the mobile access gateway has to apply the following considerations.

  * The delegated mobile network prefix (DMNP) list in the mobile router's Binding Update List entry has to be updated with the allocated prefix(es). However, if the received message was in response to a de-registration request with a lifetime value of (0), then the delegated mobile network prefix list has to be removed along with the Binding Update List entry.

  * The mobile access gateway has to set up a policy-based route for forwarding the IP packets received from the mobile network (with the source IP address from any of the delegated IPv4/IPv6 mobile network prefixes) through the bidirectional tunnel set up for that mobile router. However, if the received message was in response to a de-registration request with a lifetime value of (0), then the created forwarding state has to be removed.

5.1.2.1. DHCP - MAG Interactions

This section describes the interactions between the DHCP and PMIPv6 logical entities running on the mobile access gateway. This section is applicable only for deployments that use DHCPv6-based prefix delegation. As described next, these interactions vary slightly depending on the considered deployment model at the mobile access gateway (described in Section 3.2).

The mobile router, acting as a "Requesting Router" as described in [RFC3633], sends a SOLICIT message including one or more IA_PD option(s) to the Delegating Router/DHCPv6 Relay Agent collocated on the mobile access gateway. This message provides the needed trigger

for the mobile access gateway for requesting the local mobility anchor to enable delegated mobile network prefix support for that mobility session.

- Delegating router co-located with mobile access gateway

  - The mobile access gateway applies the considerations in Section 5.1.2 for requesting the local mobility anchor to enable delegated prefix support. For example, if the mobile router is soliciting an IPv4 prefix, the mobile access gateway includes in the Proxy Binding Update signaling a Delegated Mobile Network Prefix option with ALL_ZERO value and with the (V) flag set to a value of (1).

  - The mobile access gateway, upon successfully completing the Proxy Binding Update signaling with the local mobility anchor (following the considerations described in Section 5.1.2), adds the delegated mobile network prefixes to the binding update list. Then, the mobile access gateway provides the obtained prefixes to the DHCPv6 Delegating Router for prefix assignment. The way in which the mobile access gateway provides the DHCPv6 Delegating Router with this information is beyond the scope of this document.

    + In case the Proxy Binding Update signaling with the local mobility anchor is not completed successfully, for example because the local mobility anchor is not authorized for delegated mobile network prefix or the requested prefix is in use, the DHCPv6 Delegating Router will send a Reply message to the Requesting Router containing the IA_PD with the lifetimes of the prefixes in the IA_PD set to zero.

  - The standard DHCPv6 considerations will be applied with respect to the interactions between the Delegating Router and the Requesting Router. The Delegating Router is provided with the delegated prefix(es), which can then be then advertised in the mobile network, and therefore used by the locally fixed nodes to auto configure IP addresses allowing to gain access to the Internet.

  - Any time, the Requesting Router releases the delegated prefixes, the Delegating Router removes the assigned prefixes. To do so, the mobile access gateway will send an Updated Proxy Binding Update following the considerations described in Section 5.1.2 for deregistering those prefixes. The way in which the DHCPv6 Delegating Router triggers the mobile access gateway in order to deregister the prefixes is beyond the scope of this document.

  * In case the mobile router performs a handover and attaches to a different mobile access gateway, the following cases are possible:

    + The new mobile access gateway does not support the delegation of mobile network prefixes described in this specification. In this case, forwarding of the previously delegated mobile network prefixes is no longer performed.

    + The new mobile access gateway supports the delegation of mobile network prefixes described in this specification. There are two possible cases upon the reception of the SOLICIT message by the Delegating Router. If the MAG already knows the delegated mobile network prefixes, it conveys them in a DMNP option included in the Proxy Binding Update sent to the local mobility anchor, which then authorizes them based on: a) the content of the associated binding cache entry (if exists), b) the user profile (if the allocation is static), or, c) checking that the delegated mobile network prefixes are not already allocated. On the other hand, if the mobile access gateway is not aware of the delegated mobile network prefixes, it will include 0.0.0.0 / ::0 in a DMNP option included in the Proxy Binding Update sent to the LMA, which will provide the right prefixes back in the Proxy Binding Acknowledgemente based on a) the content of the associated binding cache entry (if exits), b) the profile (if static allocation is used), or c) dynamic assignment.

o Delegating router co-located with local mobility anchor

  * A DHCPv6 Relay Agent function running on the mobile access gateway will forward the DHCP messages to the local mobility anchor which has the co-located Delegating Router function. The Requesting Router and the Delegating Router complete the DHCP messages related to prefix delegation.

  * During the DHCPv6 exchange, the standard DHCPv6 considerations apply with respect to the interactions between the Delegating Router, DHCPv6 Relay Agent and the Requesting Router.

  * The mobile access gateway learns from the co-located DHCPv6 Relay Agent the prefixes allocated by the Delegating Router. The way in which the mobile access gateway learns obtains this information from the DHCPv6 Relay Agent is beyond the scope of this document.

* The mobile access gateway will apply the considerations in Section 5.1.2 for requesting the local mobility anchor to enable delegated prefix support. The mobile access gateway will include exactly one instance of the Delegated Mobile Network Prefix option with NON_ZERO prefix value for each of the mobile network prefixes that the mobile access gateway is requesting the local mobility anchor to allocate. The prefix value(s) in the option will be the prefix(es) obtained via DHCP prefix delegation.

* The mobile access gateway, upon successfully completing the Proxy Binding Update signaling with the local mobility anchor, will provide the obtained prefixes to the DHCPv6 Relay Agent for prefix assignment. The Delegating Router is provided with the delegated prefix(es) completing the standard DHCPv6 signaling. These prefixes can then be then advertised in the mobile network, and therefore used by the locally fixed nodes to auto configure IP addresses allowing to gain access to the Internet.

  + In case the Proxy Binding Update signalling with the local mobility anchor is not completed successfully, for example because the local mobility anchor is not authorized for delegated mobile network prefix, the requeted prefix is in use, or the delegated prefix(es) do not match the ones allocated by DHCP prefix delegation, the DHCPv6 Relay Agent MAY send a Reply message to the Requesting Router containing the IA_PD with the lifetimes of the prefixes in the IA_PD set to zero.

* In case the mobile router performs a handover and attaches to a different mobile access gateway, the following cases are possible:

  + The new mobile access gateway does not support the delegation of mobile network prefixes described in this specification. In this case, forwarding of the previously delegated mobile network prefixes is no longer performed.

  + The new mobile access gateway supports the delegation of mobile network prefixes described in this specification. There are two possible cases upon the reception of the SOLICIT message by the DHCPv6 Relay Agent. If the MAG already knows the delegated mobile network prefixes, it conveys them in a DMNP option included in the Proxy Binding Update sent to the local mobility anchor, which then authorizes them based on: a) the content of the associated binding cache entry (if exists), b) the user profile (if the

allocation is static), or, c) checking that the delegated mobile network prefixes are not already allocated. On the other hand, if the mobile access gateway is not aware of the delegated mobile network prefixes, it will include 0.0.0.0 / ::0 in a DMNP option included in the Proxy Binding Update sent to the LMA, which will provide the right prefixes back in the Proxy Binding Acknowledgemente based on a) the content of the associated binding cache entry (if exits), b) the profile (if static allocation is used), or c) dynamic assignment.

5.1.3. Packet Forwarding

- On receiving an IP packet from a mobile router, the mobile access gateway before tunneling the packet to the local mobility anchor MUST ensure that there is an established binding for the mobile router and the source IP address of the packet is a prefix delegated to that mobile router. If the source address of the received IP packet is not part of the delegated mobile network prefix, then the mobile access gateway MUST NOT tunnel the packet to the local mobility anchor.

- On receiving an IP packet from the bi-directional tunnel established with the local mobility anchor, the mobile access gateway MUST first decapsulate the packet (removing the outer header) and then use the destination address of the (inner) packet to forward it on the interface through which the mobile router is reachable.

- The above forwarding considerations are not applicable to the IP traffic sent/received to/from the mobile router's home address (IPv4 HOA/HNP). For the mobile router's home address traffic, forwarding considerations from [RFC5213] and [RFC5844] continue to apply.

5.2. LMA Considerations

5.2.1. Extensions to Binding Cache Entry Data Structure

In order to support this specification, the conceptual Binding Cache Entry (BCE) data structure [RFC5213] needs to be extended to include the delegated mobile network prefix (DMNP) list. Each entry in the list represents a delegated mobile network prefix.

5.2.2. Signaling Considerations

- If the Proxy Binding Update message does not include any Delegated Mobile Network Prefix option(s) (Section 4.1), then the local mobility anchor MUST NOT enable Delegated Prefix support for the mobility session, and the Proxy Binding Acknowledgment message that is sent in response MUST NOT contain any Delegated Mobile Network Prefix option(s).

- If the Proxy Binding Update message includes one or more Delegated Mobile Network Prefix options, but either the local mobility anchor is not configured to support Delegated Prefix support, then the local mobility anchor will ignore the option(s) and process the rest of the option as specified in [RFC5213]. This would have no effect on the operation of the rest of the protocol. The Proxy Binding Acknowledgement message that is sent in response will not include any Delegated Mobile Network Prefix option(s).

- If the Proxy Binding Update message has the Delegated Mobile Network Prefix option(s) and if the local mobility anchor is configured for Delegated Prefix support, then the local mobility anchor MUST enable Delegated Mobile Network Prefix option for that mobility session. The Proxy Binding Acknowledgement message that is sent in response MUST include the Delegated Mobile Network Prefix option(s). The following considerations apply.

  * If there is at least one instance of the Delegated Mobile Network Prefix option with a ALL_ZERO [RFC5213] prefix value, then this serves as a request for the local mobility anchor to perform the assignment of one or more delegated mobile network prefixes.

    + A Delegated Mobile Network option with ALL_ZERO value and with the (V) flag set to a value of (0), is a request for the local mobility anchor to allocate one or more IPv6 prefixes.

    + A Delegated Mobile Network option with ALL_ZERO value and with the (V) flag set to a value of (1), is a request for the local mobility anchor to allocate one or more IPv4 prefixes.

    + Inclusion of multiple instances of Delegated Mobile Network options with ALL_ZERO value, one with the (V) flag set to a value of (1), and another instance with the (V) flag set to a value of (0) is a request to allocate both IPv4 and IPv6 prefixes.

  * If there are no instances of the Delegated Mobile Network Prefix option present in the request with ALL_ZERO value, but has a specific prefix value, then this serves as a request for the local mobility anchor to perform the allocation of the requested prefix(es).

    + If any one of the requested prefixes are assigned to some other mobility node, or not from an authorized pool that the local mobility can allocate for that mobility session, then the Proxy Binding Update MUST be rejected by sending a Proxy Binding Acknowledgement message with Status field set to REQUESTED_DMNP_IN_USE (Requested delegated mobile network prefix is in use).

- Upon accepting the Proxy Binding Update, the local mobility anchor MUST send a Proxy Binding Acknowledgement message with the Status field set to 0 (Proxy Binding Update accepted).

  * The message MUST include one instance of the Delegated Mobile Network Prefix option for each of the allocated IPv4/IPv6 delegated mobile network prefixes.

  * The delegated mobile network prefix (DMNP) list in the mobile router's Binding Cache entry has to be updated with the allocated prefix(es). However, if the request is a de-registration request with a lifetime value of (0), the delegated mobile network prefix list has to be removed along with the Binding Cache entry.

  * A route (or a platform-specific equivalent function that sets up the forwarding) for each of the allocated prefixes over the tunnel has to be added. However, if the request is a de-registration request, with a lifetime value of (0), all the IPv4/IPv6 delegated prefix routes created for that session have to be removed.

5.2.3. Packet Forwarding

- The local mobility anchor MUST advertise a connected route into the Routing Infrastructure for the IP prefixes delegated to all of the mobile routers that it is serving. This step essentially enables the local mobility anchor to be a routing anchor for those IP prefixes and be able to intercept IP packets sent to those mobile networks.

- On receiving a packet from a correspondent node with the destination address matching any of the mobile router's delegated mobile network prefixes, the local mobility anchor MUST forward

the packet through the bi-directional tunnel set up with the mobile access gateway where the mobile router is attached.

- On receiving an IP packet from the bi-directional tunnel established with the mobile access gateway, the local mobility anchor MUST first decapsulate the packet (removing the outer header) and then use the destination address of the (inner) packet for forwarding decision. The local mobility anchor MUST ensure that there is an established binding for the mobile router and the source IP address of the packet is a prefix delegated to a mobile router reachable over that bi-directional tunnel.

- The above forwarding considerations are not applicable to the IP traffic sent/received to/from the mobile router's home address (IPv4 HOA/HNP). For the mobile router's home address traffic, forwarding considerations from [RFC5213] and [RFC5844] continue to apply.

5.3. Security Policy Database (SPD) Example Entries

The use of DHCPv6, as described in this document, requires message integrity protection and source authentication. The IPsec security mechanism used by Proxy Mobile IPv6 [RFC5213] for securing the signaling messages between the mobile access gateway and the local mobility anchor can be used for securing the DHCP signaling between the mobile access gateway and the local mobility anchor.

The Security Policy Database (SPD) and Security Association Database (SAD) entries necessary to protect the DHCP signaling is specified below. The format of these entries is based on [RFC4877] conventions. The SPD and SAD entries are only example configurations. A particular implementation of mobile access gateway and local mobility anchor implementation can configure different SPD and SAD entries as long as they provide the required security for protecting DHCP signaling messages.

For the examples described in this document, a mobile access gateway with address "mag_address_1", and a local mobility anchor with address "lma_address_1" are assumed.

```
mobile access gateway SPD-S:
  - IF local_address = mag_address_1 &
       remote_address = lma_address_1 & proto = UDP &
       local_port = any & remote_port = DHCP
    Then use SA1 (OUT) and SA2 (IN)
```

```
mobile access gateway SAD:
  - SA1(OUT, spi_a, lma_address_1, ESP, TRANSPORT):
        local_address = mag_address_1 &
        remote_address = lma_address_1 &
        proto = UDP & remote_port = DHCP
  - SA2(IN, spi_b, mag_address_1, ESP, TRANSPORT):
        local_address = lma_address_1 &
        remote_address = mag_address_1 &
        proto = UDP & local_port = DHCP

local mobility anchor SPD-S:
  - IF local_address = lma_address_1 &
       remote_address = mag_address_1 & proto = UDP &
       local_port = DHCP & remote_port = any
    Then use SA2 (OUT) and SA1 (IN)

local mobility anchor SAD:
  - SA2(OUT, spi_b, mag_address_1, ESP, TRANSPORT):
        local_address = lma_address_1 &
        remote_address = mag_address_1 &
        proto = UDP & local_port = DHCP
  - SA1(IN, spi_a, lma_address_1, ESP, TRANSPORT):
        local_address = mag_address_1 &
        remote_address = lma_address_1 &
        proto = UDP & remote_port = DHCP
```

6. Security Considerations

The Delegated Mobile Network Prefix 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 as specified in [RFC5213]. Therefore, it inherits from [RFC5213] its security guidelines and does not require any additional security considerations.

The use of DHCPv6 in this specification is as defined in DHCPv6 base specification [RFC3315] and DHCPv6 Prefix Delegation specifications [RFC3633]. The security considerations specified in those specifications apply to this specification.

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 the DHCPv6 signaling between the mobile access gateway and the local mobility anchor. Considerations specified in Section 5.3 identify the extensions to security policy entries [RFC4301]

7. IANA Considerations

This document requires the following IANA actions.

- Action-1: This specification defines a new Mobility Header option, Delegated Mobile Network Prefix option. This mobility option 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 with the assigned value, and update this section accordingly.

- Action-2: This document also defines two new status code values for use in the Proxy Binding Acknowledgement message, as described in Section 4.2. These status codes are, NOT_AUTHORIZED_FOR_DELEGATED_MNP (Not Authorized for delegated mobile network prefix) with a status code value of <IANA-2>, and REQUESTED_DMNP_IN_USE (Requested delegated mobile network prefix is in use) with a status code value of <IANA-3>. These values have to be assigned from the same number space as allocated for other status codes [RFC6275] and update this section accordingly.

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