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Prefix Management for Mobile IPv6 Fast Handover on Point-to-Point Links
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Abstract

Mobile IPv6 Fast Handovers specification currently does not explicitly define prefix management over point-to-point links when a mobile node uses a prefix to formulate a new care-of-address. In this document a mechanism is developed for a previous access router to request unique prefixes from a new access router, and in turn, the previous access router advertises the prefixes to the mobile node for a new care-of-address configuration. Extensions to Mobile IPv6 Fast Handovers specification are also specified in this document.

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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1. Introduction

Mobile IPv6 Fast Handovers (FMIPv6) [RFC5568] aims at reducing the handover latency by reducing the time to configure a new care-of address (NCoA) for a mobile node(MN). In FMIPv6, the MN formulates a prospective NCoA when it is still present on a link of a previous access router (PAR).

[RFC4968] provides different IPv6 link models that are suitable for IEEE802.16 based networks and provides analysis of various considerations for each link model and the applicability of each link model under different deployment scenarios. [RFC5121] specifies the addressing and operation of IPv6 over the IPv6 specific part of the packet convergence sublayer of IEEE Std 802.16e [802.16e], and point-to-point link model is recommended. Also, 3GPP and 3GPP2 have adopted the point-to-point link model based on the recommendations in [RFC3314].

In this document, we first explain the problems associated with FMIPv6 on point-to-point links followed by a detailed description of prefix management for FMIPv6 operation on point-to-point links.

In Section 3 we describe why the point-to-point link address formation procedures are needed in FMIPv6, in Section 4 we define a procedure that a new access router (NAR) can use to dynamically assign unique prefixes in point-to-point links and in Section 5 we define necessary messages/options for the operation in Section 4.

2. Terminology

The terminology in this document is based on the definitions in [RFC5568], in addition to the ones specified in this section.

point-to-point link model: In this model, a set of layer 2 transport connections between a MN and an access router (AR) are treated as a single link. Each link is allocated a separate, unique prefix or a set of unique prefixes by the AR. Please refer to [RFC4968] for details.

shared link model: In this model, one or more prefixes are shared by mobile nodes for constructing their global IPv6 addresses. Please refer to [RFC4968] for details.

dedicated prefix: In point-to-point link model, a unique prefix used by a MN for formulating a NCoA while the MN is still on a PAR's link.

3. Problem Statement

The following are operations relating to prefix management as per [RFC5568]:

- Movement detection. The protocol enables a MN to quickly detect that it has moved to a new subnet by providing the new access point and the associated subnet prefix information when the MN is still connected to its current subnet. For instance, the MN may discover available access points using link-layer specific mechanisms (i.e., a "scan" in WLAN) and then request subnet information corresponding to one or more of those discovered access points. The MN sends a Router Solicitation for Proxy Advertisement (RtSolPr) to its access router to resolve one or more Access Point Identifiers (AP-ID)to subnet-specific information. In response, the access router sends a Proxy Router Advertisement (PrRtAdv) message containing one or more [AP-ID, AR-Info] tuples, which the MN can use in readily detecting movement: when attachment to an access point with AP-ID takes place, the MN knows the corresponding new router's coordinates including its prefix, IP address, and L2 address. In this document, there is no changes to the movement detection procedure specified in [RFC5568].

- NCoA configuration. AR-Info contains the access router's L2 and IP addresses, and the prefix valid on the interface to which the Access Point (identified by AP-ID) is attached. With the prefix provided in the PrRtAdv message, the MN formulates a prospective NCoA.

In the shared link mode, the PAR only needs to figure out what IPv6 prefix is advertised by the NAR. In most cases, there would only be a small set of adjacent NARs and the PAR would be able to obtain this information easily. In the point-to-point link mode, the NAR has access to a pool of IPv6 prefixes and these prefixes are assigned dynamically to each mobile node's point-to-point link. Therefore it becomes difficult for the PAR to figure out which IPv6 prefix is going to be assigned to a particular mobile node when point-to-point link mode is used.

For the mobile node to configure an NCoA, the PAR sends a Proxy Router Advertisement to the mobile node. This requires that for

point-to-point links, the PAR must first contact the NAR to for the dedicated prefix and then advertise the prefix to the mobile node. This is an extension to [RFC5568] to support point-to-point links.

4. Prefix Management on Point-to-Point Links

Upon the indication of handover from the PAR to the NAR, the PAR uses Handover Initiate (HI)/ Handover Acknowledge (HAck) message exchange to get a dedicated prefix from the NAR. The PAR then sends this prefix in the PrRtAdv message to the MN as described in [RFC5568]. In the PrRtAdv message, A-bit and L-bit must be turned on. The MN thus uses this prefix for movement detection and NCoA configuration as per [RFC5568].

4.1. Predictive mode

New FMIPv6 message exchange is introduced for the PAR to ask for MN's dedicated prefix as shown in Figure 1. The MN sends an RtSolPr message to the PAR to resolve one or more Access Point Identifiers to subnet-specific information. The PAR in turn requests dedicated prefixes from the NAR through modified HI/HAck message exchange described in Section 5. With the information provided in the PrRtAdv message, the MN formulates a prospective NCoA and sends an FBU message to the PAR. The following operation is exactly the same as these specified in [RFC5568].

Lifetime in Dedicated Prefix Option Section 5.3 is used to prevent prefix depletion because of erroneous movement in which the mobile node receives a dedicated prefix prior to a handover that it is moving to a new access point but it either moves to a different one or it aborts movement altogether. Not until timeout of the prefix does the NAR release it.

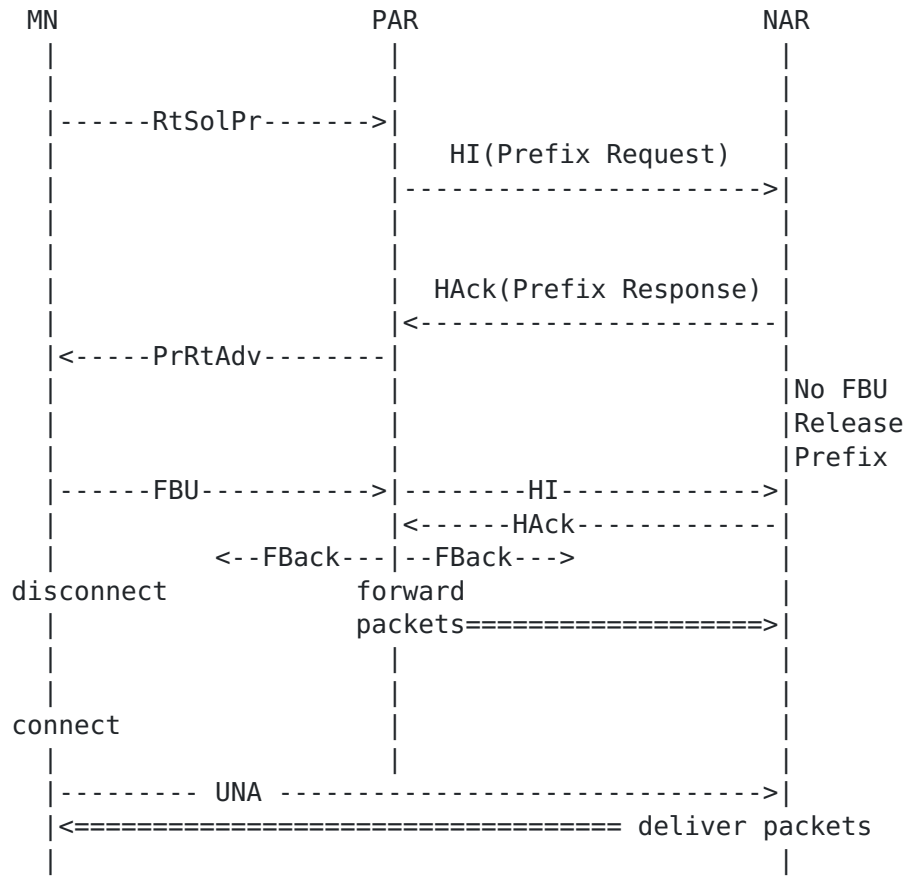

Figure 1: Prefix Signaling

In some wireless networks, the handover control may reside in the network even though the decision to undergo handover may be mutually agreed between the MN and the network. In such a case, the PAR can send an unsolicited PrRtAdv containing the link-layer address, IP address, and dedicated prefix of the mobile node when the network decides that a handover is imminent. In this network-initiated handover scenario, there isn't explicit RtSolPr to trigger PAR to request a prefix and implementation specific trigger must be used by PAR to send HI message for prefix request.

4.2. Reactive Mode

In the reactive mode, there are two cases.

- In the first case, the MN receives the PrRtAdv message while still attached to the PAR. The MN is then able to formulate NCoA before attaching to the NAR. The MN and the NAR operate as per the procedures defined in [RFC5568].

- In the second case, the MN does not receive a PrRtAdv before attaching to the NAR. The MN can configure its IP address using stateless or stateful address configuration. In the former case, the NAR should send un-solicited RA to expedite MN's address configuration. Once NCoA formulation is finished, the MN operates according to [RFC5568].

In both cases, the MN formulates NCoA from the dedicated prefix. Since the MN has already handed over to the NAR, this prefix is retained.

5. HI and Hack Extensions

5.1. HI Extension

The Handover Initiate (HI),defined in [RFC5568], is a Mobility Header message sent by one Access Router to another to initiate the process of a MN's handover.

In [RFC5568], the PAR uses a Code value of 0 when it processes an FBU with PCoA as source IP address, while uses a Code value of 1 when it processes an FBU whose source IP address is not PCoA. A Code value is used for the dedicated prefix request. Dedicated Prefix Option defined in Section 5.3 may be included as a hint for a requested preference. The NAR may allocate a dedicated prefix based on the prefix preference in the option. If the option is not included, the NAR allocates a prefix according to it's discretion.

5.2. HAck Extension

Handover Acknowledgment message defined in [RFC5568] is a Mobility Header message that must be sent as a reply to the Handover Initiate message. In this document, HAck is extended as follows to respond to a dedicated prefix request:

- One new Code value is defined. Here, a Code value is used for dedicated prefix response.
- Dedicated Prefix Option defined in Section 5.3 must be included for prefix delegation.

5.3. Dedicated Prefix Option

This option is of the form shown in Figure 2.

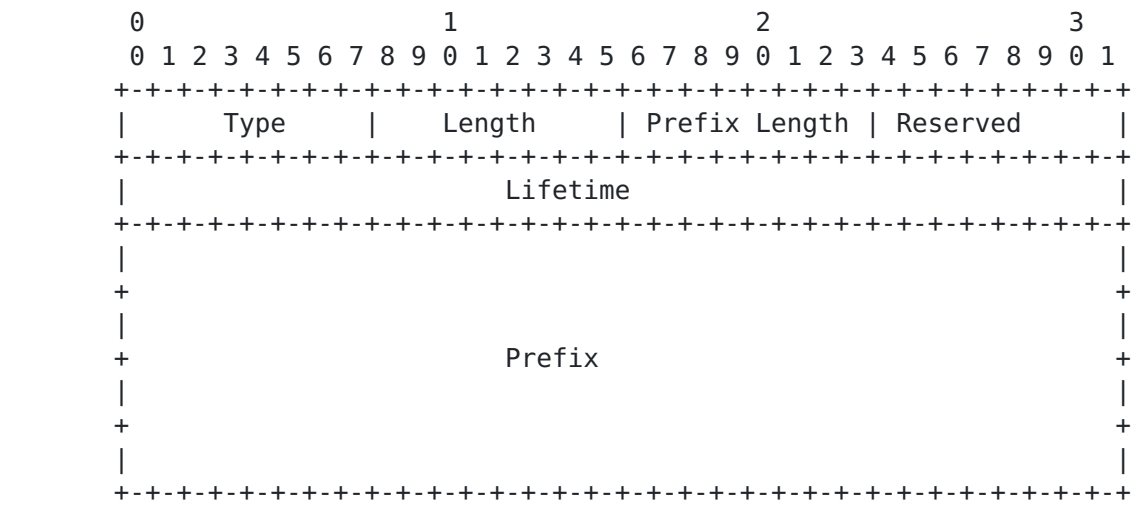

Figure 2: Dedicated Prefix Option

Type The type of the option

Length The length of the option in units of 8 octets.

Reserved
  must be set to zero by the sender and ignored by the receiver.

Prefix Length
  8-bit unsigned integer. The number of leading bits in the Prefix that are valid. The value ranges from 0 to 128.

Lifetime 32-bit unsigned integer. The length of time in seconds (relative to the time the packet is sent). A value of all one bits (0xffffffff) represents infinity.

Prefix An IP address or a prefix of an IP address. A MN uses it to formulate a NCoA.

6. Security Considerations

Prefix management for FMIPv6 operation on point-to-point links uses two messages (HI/Hack) for prefix request and response. These messages are secured using FMIPv6 security mechanisms and hence do

not introduce any new security threats and the security provided by FMIPv6 applies completely.

7. IANA considerations

None.

8. Acknowledgements

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9. References

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