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DHCPv6 Prefix Delegation for NEMO
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Abstract

One aspect of network mobility support is the assignment of a prefix or prefixes to a Mobile Router (MR) for use on the links in the Mobile Network. DHCPv6 prefix delegation can be used for this configuration task.

1. Introduction

One aspect of network mobility support is the assignment of a prefix or prefixes to a Mobile Router for use on the links in the Mobile Network. DHCPv6 prefix delegation [[RFC3633](#)] (DHCPv6PD) can be used for this configuration task.

2. 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](#) [[RFC2119](#)].

The following terms used in this document are defined in the IPv6 Addressing Architecture document [[RFC3513](#)]:

- link-local unicast address
- link-local scope multicast address

The following terms used in this document are defined in the mobile IPv6 specification [[RFC3775](#)]:

- home agent (HA)
- home link

The following terms used in this document are defined in the Mobile Network terminology document [[I-D.ietf-nemo-terminology](#)]:

- Mobile Router (MR)
- Mobile Network
- mobile host (MH)

The following terms used in this document are defined in the DHCPv6 [[RFC3315](#)] and DHCPv6 prefix delegation [[RFC3633](#)] specifications:

- delegating router (DR)
- requesting router (RR)
- DHCPv6 relay agent

3. Application of DHCPv6 prefix delegation to mobile networks for delegation of home prefixes

The NEMO Basic protocol [[RFC3963](#)] extends the mobile IPv6 protocol [[RFC3775](#)] to enable network mobility. In this extension, a MR uses the mobile IPv6 protocol to establish and maintain a session with its HA, and uses bidirectional tunneling between the MR and HA to provide a path through which hosts attached to links in the Mobile Network can maintain connectivity with nodes not in the Mobile Network.

The requirements for NEMO [[I-D.ietf-nemo-requirements](#)] include the

ability of the MR to receive delegated prefixes that can then be assigned to links in the Mobile Network. DHCPv6PD can be used to meet this requirement for prefix delegation.

To use DHCPv6PD for Mobile Networks, the HA assumes the role of either the DR or a DHCPv6 relay agent and the MR assumes the role of the RR. Throughout the remainder of this document, the HA will be assumed to be acting as a DHCPv6PD DR or relay agent and the MR will be assumed to be acting as a RR.

If the HA is acts as relay agent, some other device acts as the DR. For example, the server providing DHCPv6 service in the home network might also provide NEMO DHCPv6PD service. Or, a home network with several HAs might configure one of those HAs as a DHCPv6PD server while the other HAs act as relay agents.

The HA and MR exchange DHCPv6PD protocol messages through the tunnel connecting them. The tunnel acts as the link labeled "DSL to subscriber premises" in figure 1 of the DHCPv6PD specification.

The DHCPv6PD server is provisioned with prefixes to be assigned using any of the prefix assignment mechanisms described in the DHCPv6PD specifications. Other updates to the HA data structures required as a side effect of prefix delegation are specified by the particular network mobility protocol. For example, in the case of Basic Network Mobility Support [[RFC3963](#)], the HA would add an entry in its binding cache registering the delegated prefix to the MR to which the prefix was delegated.

3.1. When the MR uses DHCPv6

The MR initiates a DHCPv6 message exchange for prefix delegation whenever it establishes an MRHA tunnel to its HA. If the MR does not have any active delegated prefixes (with unexpired leases), the MR initiates a DHCPv6 message exchange with a DHCPv6 Solicit message as described in [section 17 of RFC 3315](#) and [section 12 of RFC 3633](#). If the MR has one or more active delegated prefixes, the MR initiates a DHCPv6 message exchange with a DHCPv6 Confirm message as described in [section 18.1.2 of RFC 3315](#) and [section 12 of RFC 3633](#).

3.2. Use of MRHA tunnel for DHCPv6 messages

The DHCPv6 specification requires the use of link-local unicast and link-local scope multicast addresses in DHCPv6 messages (except in certain cases as defined in [section 22.12](#) of the DHCPv6 specification). [Section 10.4.2](#) of the mobile IPv6 specification describes forwarding of intercepted packets, and the third paragraph of that section begins:

However, packets addressed to the mobile node's link-local address MUST NOT be tunneled to the mobile node.

The DHCPv6 messages exchanged between the HA and the MR originate only with the HA and the MR, and therefore are not "intercepted packets" and may be sent between the HA and the MR through the tunnel.

Even though the MRHA tunnel is a point to point connection, the MR SHOULD use multicast DHCPv6 messages as described in [RFC 3315](#) over that tunnel.

[3.3.](#) Exchanging DHCPv6 messages when MR is at home

When the MR is on its home link, the HA uses the home link to exchange DHCPv6PD messages with the MR. It is the responsibility of the implementation to determine when the MR is on its home link and to avoid use of any existing tunnel.

[3.4.](#) Minimizing DHCPv6PD messages

DHCPv6PD in a Mobile Network can be combined with the Rapid Commit option [[RFC3315](#)] to provide DHCPv6 prefix delegation with a two message exchange between the mobile node and the DHCPv6 PD server.

[3.5.](#) DHCPv6PD and DHAAD

The MR acting as RR needs a direct link to the DR (or relay) function. When the MR is away from Home, that link is the MRHA tunnel. If a MR needs to obtain a prefix by means of DHCPv6PD, it has to locate a HA that is capable of serving either as a DHCPv6PD relay agent or server. Since the use of DHCPv6PD is optional and comes as an addition to existing protocols [[RFC 3775](#)] and [[RFC 3963](#)], it can not be expected that all HAs are DHCPv6PD capable.

This specification extends Dynamic Home Agent Address Discovery and the Home Agent Information Option in order to enable the detection by a MR of all HAs that are DHCPv6PD capable. A new 'D' bit is introduced to let Home Agents advertise that they are willing to participate to DHCP. Note that there is no need for the MR acting as RR to know whether a HA is actually a DR or simply acting as a relay.

[3.5.1.](#) Modified Dynamic Home Agent Address Discovery Request

A new flag (D) (Support for DHCPv6PD) is introduced in the DHAAD Request message, defined in [[RFC3775](#)] and [[RFC 3963](#)]. The Mobile Router sets this flag to indicate that it wants to discover Home Agents participating to DHCPv6 Prefix Delegation.

A the MR which sets the 'D' flag MUST also set the 'R' flag, to declare that it is a Mobile Router and asks for a HA that supports Mobile Routers, as defined in [[RFC 3963](#)].

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DHCPv6PD Support Flag (D)

A one-bit flag that when set indicates that the Mobile Router wants to discover Home Agents participating to DHCPv6 Prefix Delegation.

For a description of the other fields in the message, see [[RFC3775](#)] and [[RFC 3963](#)].

3.5.2. Modified Dynamic Home Agent Address Discovery Reply

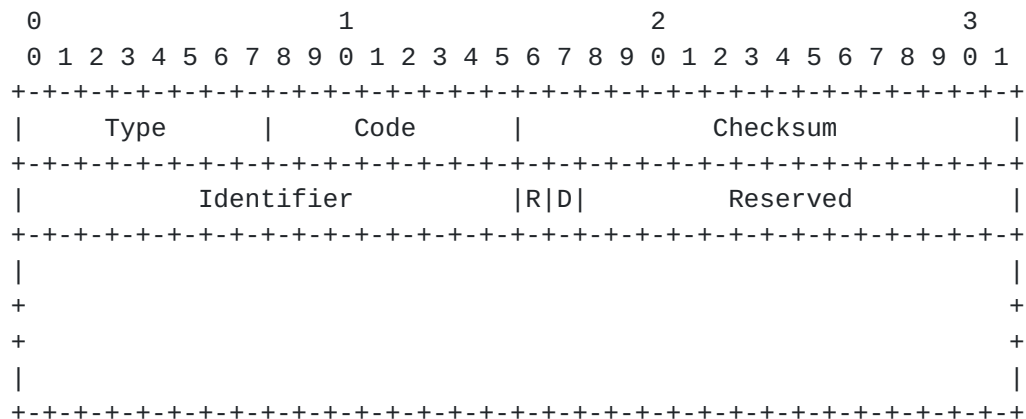
A new flag (D) (Support for DHCPv6PD) is introduced in the DHAAD Reply message, defined in [[RFC3775](#)] and [[RFC 3963](#)]. If a Home Agent receives a Dynamic Home Agent Discovery request message with the DHCPv6PD Support Flag set, it MUST reply with a list of Home Agents participating to DHCPv6PD.

The DHCPv6PD Support Flag MUST be set if there is at least one Home Agent participating to DHCPv6PD. In that case, the reply will list only those HAs that participate to DHCPv6PD, whether they act as servers (DRs) or relays.

A HA that supports DHCPv6PD MUST support Mobile Routers as well, so if the 'D' bit is set, then the 'R' bit should be set as well. So there is no need in an implementation to support the case where some HAs would support Mobile Routers while others would be participating to DHCPv6 Prefix Delegation but none could do both.

If none of the Home Agents support DHCPv6PD, the Home Agent MAY reply with a list of Home Agents that only support NEMO basic Mobile Routers or Mobile IPv6 Mobile Nodes. In this case, the DHCPv6PD Support Flag MUST be set to 0.

The modified message format is as follows.



DHCPv6PD Support Flag (D)

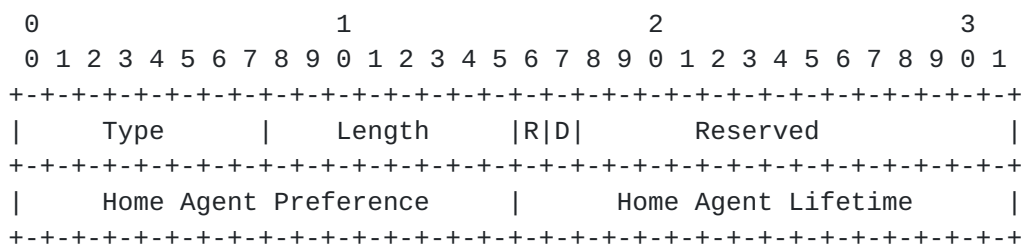
A one-bit flag that when set indicates that the Home Agents listed in this message participate to DHCPv6 Prefix Delegation.

For a description of the other fields in the message, see [\[RFC3775\]](#) and [\[RFC 3963\]](#).

3.5.3. Modified Home Agent Information Option

A new flag (D) (Support for DHCPv6PD) is introduced in the Home Agent Information Option defined in [\[RFC3775\]](#) and [\[RFC 3963\]](#).

If a Home Agent participates to DHCPv6PD, it SHOULD set the flag. If the HA sets the 'D' flag, then it MUST also set the 'R' flag, Indicating that it supports Mobile Routers, as defined in [\[RFC 3963\]](#).



DHCPv6PD Support Flag (D)

A one-bit flag that when set indicates that the Home Agents participates to DHCPv6 Prefix Delegation.

For a description of the other fields in the message, see [\[RFC3775\]](#) and [\[RFC 3963\]](#).

3.6. Location of DHCPv6PD Delegating Router function

Support of DHCPv6PD for a Mobile Network is optional.

The use of a DHCPv6 relay agent is not defined for DHCPv6PD in the DHCPv6PD specification [[RFC3633](#)]. If the DHCPv6PD DR function is implemented in the HA for the MR, no relay agent function is required.

It may be desirable to use a single DR to manage RRs in a network with multiple HAs. In this scenario, the HAs will act as DHCP relay agents, forwarding messages between the RRs and the DR.

Use of the DHCPv6 relay agent function with DHCPv6PD requires that there be some mechanism through which routing information for the delegated prefixes can be added to the appropriate routing infrastructure. If the HA is acting as a DHCPv6 relay agent, the HA SHOULD add a route to the delegated prefix and advertise that route after receiving a binding update for the prefix from the RR [[RFC3963](#)].

In particular, if the MR uses NEMO explicit mode, then it must add the delegated prefix to prefix list in the Binding Update messages. If the binding cache is cleared before the prefix valid lifetime, the MR might bind that prefix again using explicit mode, till the lifetime expires.

In implicit mode, the HA must save the delegated prefix with the binding cache entry of the Mobile Router. When the BCE is cleared, the HA loses the information about the delegated prefix. Because the MR will use DHCPv6 when it reestablishes its tunnel to the HA (see [Section 3.1](#)), the HA will be able to add the delegated prefix back to the BCE.

At the time this draft was written, one way in which a DR can explicitly notify a relay agent about delegated prefixes, is to use the "DHCP Relay Agent Assignment Notification Option" [[I-D.ietf-dhc-dhcpv6-agentopt-delegate](#)].

Another alternative, if the RR is part of the same administrative domain as the home network to which it is attached through the HA, and the RR can be trusted, the RR can use a routing protocol like OSPF to advertise any delegated prefixes.

NEMO explicit mode is recommended to take advantage of the function already defined for NEMO.

3.7. Other DHCPv6 functions

The DHCPv6 messages exchanged between the MR and the HA may also be used for other DHCPv6 functions in addition to DHCPv6PD. For example, the HA may assign global addresses to the MR and may pass other configuration information such as a list of available DNS recursive resolvers to the MR using the same DHCPv6 messages as used for DHCPv6PD.

The HA may act as a DHCPv6 relay agent for MHs while it acts as a DR for MRs.

4. Changes in this draft

4.1. Revision -01

Removed [section 3.2](#), "Delegating Access Prefixes".

Modified sections [3](#) and [3.6](#) (was [section 3.1.3](#)), "Location of DHCPv6PD Delegating Router function," to allow for DHCPv6PD through a relay agent and to allow for a single DR on a home network to perform PD for RRs through more than one HA.

Added [section 3.1](#) describing when the MR should use DHCPv6 PD.

Added [section 3.4](#) describing use of Rapid Commit to minimize DHCPv6PD messages and

Added [section 3.5](#) recommending that DHCPv6PD and DHAAD be kept independent and describing flags indicating availability of PD service from HA.

Added [section 3.7](#) describing the use of DHCPv6 for other configuration in parallel with PD.

5. Security Considerations

This document describes the use of DHCPv6 for prefix delegation in Mobile Networks. It does not introduce any additional security considerations beyond those described in the "Security Considerations" section of the DHCPv6 base specification [[RFC3315](#)] and the "Security Considerations" of the DHCPv6 Prefix Delegation specification [[RFC3633](#)].

Following the DHCPv6 Prefix Delegation specification, HAs and MRs SHOULD use DHCPv6 authentication as described in section

"Authentication of DHCP messages" of the DHCPv6 specification [[RFC3315](#)], to guard against attacks mounted through prefix delegation.

6. IANA Considerations

This document describes the use of DHCPv6 for prefix delegation in Mobile Networks. It does not introduce any additional IANA considerations.

7. Normative References

- [RFC3633] Troan, O. and R. Droms, "IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6", [RFC 3633](#), December 2003.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC3513] Hinden, R. and S. Deering, "Internet Protocol Version 6 (IPv6) Addressing Architecture", [RFC 3513](#), April 2003.
- [RFC3775] Johnson, D., Perkins, C., and J. Arkko, "Mobility Support in IPv6", [RFC 3775](#), June 2004.
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- [RFC3315] Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C., and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", [RFC 3315](#), July 2003.
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- [RFC3963] Devarapalli, V., Wakikawa, R., Petrescu, A., and P. Thubert, "Network Mobility (NEMO) Basic Support Protocol", [RFC 3963](#), January 2005.
- [I-D.ietf-dhc-dhcpv6-agentopt-delegate] Droms, R., "DHCPv6 Relay Agent Assignment Notification (RAAN) Option", [draft-ietf-dhc-dhcpv6-agentopt-delegate-02](#)

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