IPv6 Group
Internet-Draft
Expires: August 6, 2004

R. Droms
P. Thubert
Cisco
February 6, 2004

DHCPv6 Prefix Delegation for NEMO
draft-droms-nemo-dhcpv6-pd-01.txt

Status of this Memo

Copyright Notice

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 [4] (DHCPv6PD) can be used for this configuration task, whether from the Home Network or locally from an Access Network.

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 [1].

The following terms used in this document are defined in the IPv6 Addressing Architecture document [3]:

link-local unicast address

link-local scope multicast address

The following terms used in this document are defined in the mobile IPv6 specification [5]:

home agent (HA)

home link

The following terms used in this document are defined in the mobile network terminology document [8]:

mobile router (MR)

mobile network

mobile host (MH)

The following terms used in this document are defined in the DHCPv6 [2] and DHCPv6 prefix delegation [4] specifications:

delegating router (DR)

requesting router (RR)

DHCPv6 relay agent

3. Application of DHCPv6 prefix delegation to mobile networks

The network mobility requirements document [7] defines a solution for

mobile IPv6 networks based on the mobile IPv6 protocol [5]. In this solution, a MR uses the mobile IPv6 protocol to establish a 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 in basic network mobility support [7] 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.

3.1 Delegating Home prefixes

To use DHCPv6PD for mobile networks, the HA assumes the role of the DR 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 and the MR will be assumed to be acting as a RR.

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 HA (acting as the DR) 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 [6], the HA would add an entry in its binding cache registering the delegated prefix to the MR to which the prefix was delegated.

3.1.1 Use of HA-MR 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.

3.1.2 Exchanging DHCPv6 messages when HA and MR are on the same link

When the MR is on its home link, the HA uses the home link to exchange DHCPv6PD messages with the MR, even if there is a tunnel across the home link between the MR and the HA. 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.

3.1.3 Location of DHCPv6PD Delegating Router function

The DHCPv6PD DR function MUST be implemented in the HA for the MR. The use of a DHCPv6 relay agent is not defined for DHCPv6PD.

3.1.4 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.

3.2 Delegating Access Prefixes

A Mobile Router may also obtain a temporary delegated prefix from its Access Router (acting as a DHCPv6PD DR) while the MR is roaming within the AR space.

This is used for instance if the MR opens a network for anonymous visitors to roam in. In that model, the delegated network is advertised in the clear, as opposed to the MR's own Mobile Network

Prefixes, which can stay private, over secured media.

As a result, the CareOf Addresses of the visitors in a nested structure are all aggregated by a larger prefix owned, subdelegated, and advertised to the infrastructure by the Access Router itself.

It is possible to protect the privacy of both parties between a VMN that implements RFC 3041 [13] and a visited MR that advertises only the delegated prefixes in the clear.

In the case of a nested structure, it is expected that the AR and the MR maintain a tunnel and that the connectivity between the two is maintained somehow; this can be achieved by:

Performing a routing protocol such as a MANET within the nested topology.

performing some L3 bridging technique between AR and MRs.

placing a Nemo Home Agent at the AR so that the MR registers the mobility of the delegated prefix while it is roaming inside or outside the nested structure below the AR.

It may be beneficial for the Mobile Router to use its address within its delegated prefix as CareOf to register to its Home Agent. As a result, the MR gets some advantages similar to those obtained with HMIP.

In particular, if the Access Router is a Home Agent for the aggregation of delegated prefixes, and if that Home Agent supports the Reverse Routing Header (see [9]), then there are only 2 tunnels, the MRAR encapsulating the MRHA tunnel whatever the nested depth of the MR.

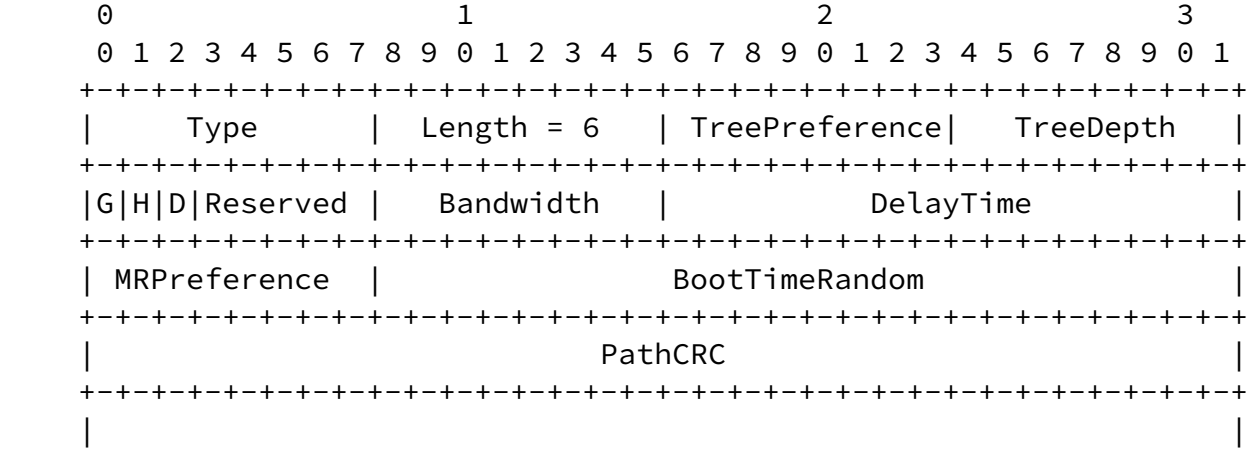
3.2.1 New Tree Information Option Format

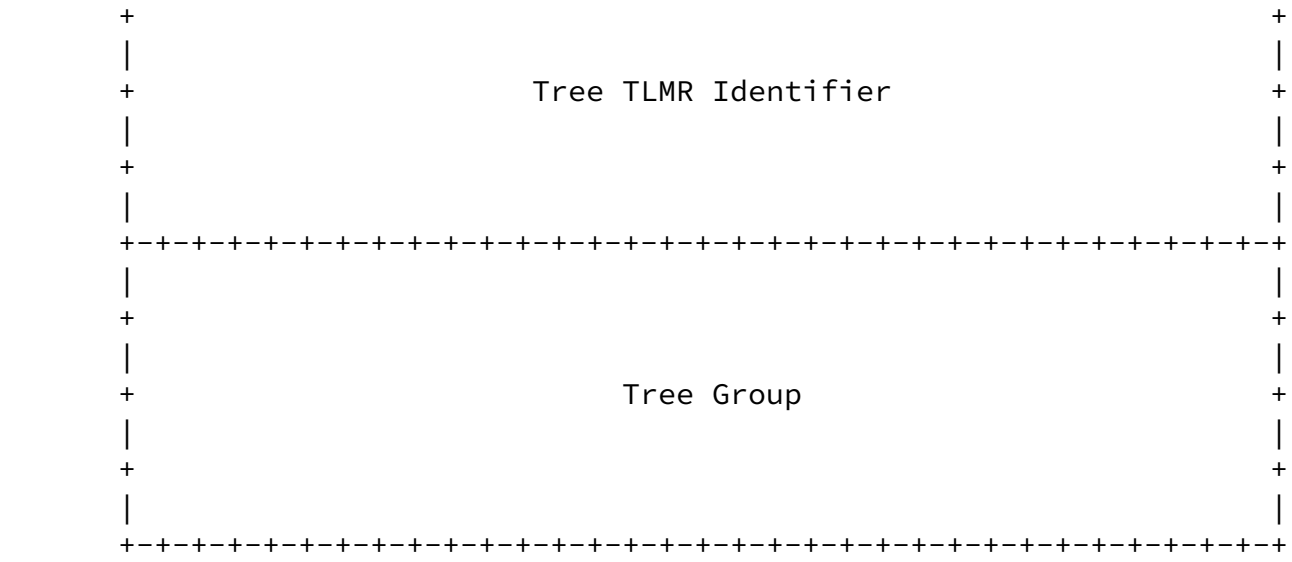
This draft modifies the Tree Information option, as described in [9], adding a new bit to indicate that the TLMR supports DHCP-PD.

The new bit are set by the TLMR are propagated transparently by the

MRs. Mobile Routers SHOULD add that option to the Router Advertisement messages sent over the ingress interfaces.

The Tree Information option has the following format:





Type

8-bit unsigned integer set to 10 by the TLMR.

Length

8-bit unsigned integer set to 6 by the TLMR. The length of the option (including the type and length fields) in units of 8 octets.

TreePreference

8-bit unsigned integer set by the TLMR to its configured preference. Range from 0 = lowest to 255 = highest.

TreeDepth

8-bit unsigned integer set to 0 by the TLMR and incremented by 1

by each MR down the tree.

Grounded (G)

1-bit flag. Set by the TLMR to indicate that it is either attached to a fixed network or at home.

Home Agent (H)

1-bit flag. Set by the TLMR to indicate that it is also functioning as a Home Agent, for re-homing purposes.

Home (D)

1-bit flag. Set by the TLMR to indicate that it is also functioning as a DHCPv6PD-DR.

Reserved

6-bit unsigned integer, set to 0 by the TLMR.

Bandwidth

8-bit unsigned integer set by the TLMR and decremented by MRs with lower egress bandwidth. This is a power of 2 so that the available egress bandwidth in bps is between 2^Bandwidth and 2^(Bandwidth+1). 0 means 'unspecified' and can not be modified down the tree.

DelayTime

16-bit unsigned integer set by the TLMR. Tree time constant in milliseconds.

MRPreference

8-bit signed integer. Set by each MR to its configured preference. Range from 0 = lowest to 255 = highest.

BootTimeRandom

24-bit unsigned integer set by each MR to a random value that the MR generates at boot time.

PathCRC

32-bit unsigned integer CRC, updated by each MR. This is the result of a CRC-32c computation on a bit string obtained by

appending the received value and the MR CareOf Address. TLMRs use a 'previous value' of zeroes to initially set the pathCRC.

Tree TLMR Identifier

IPv6 global address, set by the TLMR. Identifier of the tree.

Tree Group

IPv6 global address, set by the TLMR. Identifier of the tree group. A MR may use the Tree Group in its tree selection algorithm.

The AR MUST include this option in its Router Advertisements, placing itself as TLMR.

A MR receiving this option from its Attachment Router MUST update the TreeDepth, MRPreference, BootTimeRandom and PathCRC fields, and MUST propagate it on its ingress interface(s), as described in [9].

The alignment requirement of the Tree Information option is 8n.

4. 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 [2] and the "Security Considerations" of the DHCPv6 Prefix Delegation specification [4].

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 [2], to guard against attacks mounted through prefix delegation.

5. IANA Considerations

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

6. Terms of Use

Cisco has a pending patent which relates to the subject matter of this Internet Draft. If a standard relating to this subject matter is adopted by IETF and any claims of any issued Cisco patents are necessary for practicing this standard, any party will be able to

obtain a license from Cisco to use any such patent claims under openly specified, reasonable, non-discriminatory terms to implement and fully comply with the standard.

Normative References

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

[2] Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C. and M. Carney, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)", RFC 3315, July 2003.

[3] Hinden, R. and S. Deering, "Internet Protocol Version 6 (IPv6) Addressing Architecture", RFC 3513, April 2003.

[4] Troan, O. and R. Droms, "IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6", RFC 3633, December 2003.

[5] Johnson, D., Perkins, C. and J. Arkko, "Mobility Support in IPv6", draft-ietf-mobileip-ipv6-24 (work in progress), July 2003.

[6] Devarapalli, V., "Nemo Basic Support Protocol", draft-ietf-nemo-basic-support-02 (work in progress), December 2003.

[7] Ernst, T., "Network Mobility Support Goals and Requirements", draft-ietf-nemo-requirements-01 (work in progress), May 2003.

[8] Ernst, T. and H. Lach, "Network Mobility Support Terminology", draft-ietf-nemo-terminology-00 (work in progress), May 2003.

[9] Thubert, P. and M. Molteni, "IPv6 Reverse Routing Header and its application to Mobile Networks", draft-thubert-nemo-reverse-routing-header-02 (work in progress), June 2003.

[10] Soliman, H., Castelluccia, C., Malki, K. and L. Bellier, "Hierarchical Mobile IPv6 mobility management (HMIPv6)", draft-ietf-mobileip-hmipv6-08 (work in progress), July 2003.

[11] Johnson, D., "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR)", draft-ietf-manet-dsr-09 (work in progress), April 2003.

[12] Perkins, C., Royer, E. and S. Das, "Ad Hoc On Demand Distance

Vector (AODV) Routing", draft-ietf-manet-aodv-13 (work in progress), February 2003.

[13] Narten, T. and R. Draves, "Privacy Extensions for Stateless Address Autoconfiguration in IPv6", RFC 3041, January 2001.

Authors' Addresses

Ralph Droms
Cisco
1414 Massachusetts Avenue
Boxborough, MA 01719
USA

Phone: +1 978.936.1674
EMail: rdroms@cisco.com

Pascal Thubert
Cisco
Village d'Entreprises Green Side
400, Avenue Roumanille
Biot - Sophia Antipolis 06410
FRANCE

EMail: pthubert@cisco.com

Appendix A. Changes since version 00

The section on access prefix delegation was added. That section provides a mechanism that is very close to HMIP but purely based on standard DHCP-PD. It is limited to Nemo applications, but it provides additional features, including the privacy of the mobile access router.

Intellectual Property Statement

Full Copyright Statement

Acknowledgment

Funding for the RFC Editor function is currently provided by the Internet Society.