Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: February 22, 2013

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August 21, 2012

Prefix Assignment in DHCPv6
draft-ietf-dhc-host-gen-id-03

Abstract

This document introduces a generic prefix announcement mechanism using DHCPv6. In this new address configuration procedure, the prefix is propagated from a DHCPv6 server to hosts through DHCPv6 message exchanging while the interface identifiers are independently generated by the hosts. It enables both integral address assignment and self-generated addresses in one single mechanism, DHCPv6. It also enables stateless address configuration without RA attendance.

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 February 22, 2013.

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1. Introduction

A host IPv6 address is combined by a prefix and an interface identifier. Currently, there are two mechanisms to configure a host IPv6 address. [RFC3315] describes the operation of address assignment by a DHCPv6 server. The operation assumes that the server is responsible for the assignment of an integral address which includes both prefix and interface identifier parts as described in [RFC4291]. In the Stateless Address Autoconfiguration (SLACC, [RFC4862]) model, the interface Identifier is generated by the host itself while the prefix is configured through Router Advertisement message defined in [RFC4861].

However, in a DHCPv6-managed network, assigning 128-bit address is insufficient. Some hosts may want to use self-generated address, which are combined by prefixes obtained from network configuration and interface identifiers generated by hosts. The examples include CGA [RFC3972], modified EUI-64 interface identifier [EUI-64], temporary addresses for privacy [RFC4941] and etc.

In these scenarios, the address configuration precedure has to be splitted in two motheds: integral address assignment through DHCPv6 and prefix announcement by RA advertisement. Some ISPs desire to manage address configuration using one set of protocol, rather than mixture of DHCPv6 and Neighbor Discovery.

There are also some network environments in that perfix annoucement through RAs may not be the best choice. For example, hosts may connect through tunnels, either layer 2 tunnels or layer 3 tunnels.

While a RA is only able to announce prefix on a single link, DHCPv6 configuration can be used to manage multiple links by setup DHCPv6 relay.

Up to now, there is no mechanism for the prefix announcement/ assignment in DHCPv6. [RFC3633] defines Prefix Delegation options providing a mechanism for automated delegation of IPv6 prefixes using the DHCPv6. This mechanism is intended for delegating a long-lived prefix from a delegating router to a requesting router. This mechanism "is not bound to the assignment of IP addresses or other configuration information to hosts" [RFC3633]. It delegates prefixes to a routable device for itself use only. It does not support the host-generated interface identifiers model, in which prefix(es) need to be advertised or assigned to hosts.

This document introduces a generic prefix announcement mechanism using DHCPv6. In this new address configuration procedure, the prefix is propagated from a DHCPv6 server to hosts through DHCPv6

message exchanging while the interface identifiers are independently generated by the hosts. It is alternative of RA prefix assignment/ announcement. It enables both integral address assignment and self-generated addresses in one single mechanism, DHCPv6. Note, in many scenarios, neighbor discovery is still needed for routing and reachability. In other scenarios, this mechanism enables stateless address configuration while RA absents.

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].

The terminology in this document is based on the definitions in [RFC3315], in addition to the ones specified in this section

derivative prefix: A prefix is derived from another prefix. For example, a /64 prefix is derived from a /48 prefix, that is, the /64 prefix has the same leftmost 48 bits with the /48 prefix.

authorized prefix: A specific router is given a specific set of subnet prefixes to advertise; other routers have an authorization to advertise other subnet prefixes. In [RFC3971],Certification Path Advertisement message is used to convey authorized prefixes.

3. Address Auto-configuration

Router Advertisements in [RFC4861] allow routers to inform hosts how to perform Address Auto-configuration. For example, routers can specify whether hosts should use DHCPv6 and/or stateless address configuration. In Router Advertisement message, M and O bits are used for indication of address auto-configuration mode.

Whatever address auto-configuration mode a host uses, the following two parts are necessary for the host to formulate it's IPv6 address:

- A prefix. In [RFC3971], Certification Path Solicitation and Certification Path Advertisement messages are designed for verifying routers being authorized to act as routers. Certification Path Advertisement message can also be used to verify that routers are authorized to advertise a certain set of subnet prefixes. In the stateless auto-configuration address mode, the prefixes in Router Advertisement message should be a subset of authorized prefixes, or derivative prefixes from authorized prefixes. In the stateful auto-configuration address mode, prefix assignment from a DHCPv6 server is not currently

support.

- o An interface identifier. Modified EUI-64 interface identifier [EUI-64] is a widely-used host generated interface identifier. It generates interface identifier from the host MAC address. The interface identifier of [RFC3972] is generated by computing a cryptographic hash of a public key of a host. The host is responsible for interface identifier generation.

In the ND-managed environment, RA is used to assign the prefix.

So far, there is no mechanism to support the scenario that prefixes are managed by a DHCPv6 server. This document targets to meet this gap. The DHCPv6 operation defined in this document enables the DHCPv6 server to assign a prefix, rather than a integral address, to the host, so that the host can obtain an IPv6 address by combining the prefix with its own generated interface identifier. It actually enables the auto address configuration through DHCPv6.

4. DHCPv6 Operation

Figure 1 shows the operation of separating prefix assignment and interface identifier generation in the DHCPv6.

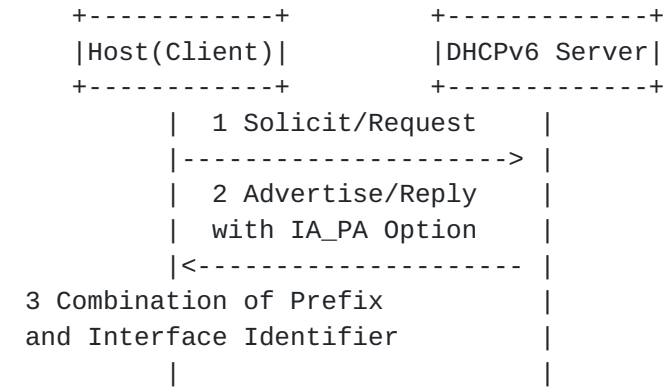


Figure 1: DHCPv6 Operation

1. A host uses a Solicit message to discover DHCPv6 servers that have been configured to assign prefixes for the host. Identity Association for Prefix Delegation Option (IA_PD) is defined in [RFC3633] for prefix delegation between a requesting router and delegating router. Referring to the definition, a new Identity Association for Prefix Assignment (IA-PA) option is defined in Section 5.1 to enable the prefix assignment from a DHCPv6 server to a host. A host MAY include a Option Request Option requesting IA_PA in a Solicit or a IA_PA Option in a Request message to request prefix assignment explicitly.

2. The DHCPv6 server assigns one or more prefixes to the host in Advertise messages or in the Reply messages responding to the prefix requests from the hosts. When the prefix assignment in advertise model, even if a host does not request, DHCPv6 server can push it initiatively. The assigned prefixes SHOULD be a subset of the authorized prefixes or derivative prefixes of the authorized prefixes. Identity Association for Prefix Assignment Option in Section 5.1 is used for conveying the assigned prefixes. If there is not a proper prefix available, a NoPrefixAvail (defined in [RFC3633])status-code is returned to the host and the procedure is terminated. When receiving multiple prefixes, the host may use pre-configured hints for prefix assignment preference. The hints are authorized prefixes advertised by an authorized router through Certification Path Advertisement defined in [RFC3971].
3. The host generates an interface identifier and formulates a combined IPv6 address by concatenating the assigned prefix and the self-generated interface identifier. There are many ways to generate interface identifier. [RFC3972] defines a method to generate the interface identifier by computing a cryptographic hash of a public key of the host. Modified EUI-64 interface identifier [EUI-64] is generated based on the host MAC address.

After the host generates an IPv6 address using the above procedure, the host may send a Request message to the DHCPv6 server in order to confirm the usage of the new address. The confirmation procedure may be completed together with the address registration procedure [I-D.ietf-dhc-addr-registration]. However, the confirmation procedure is out of scope.

When the host reaches T1 or T2 defined in Section 5.1, it SHOULD use the same message exchanges, as described in section 18, "DHCP Client-Initiated Configuration Exchange" of [RFC3315], to obtain or update prefix(es) from a DHCPv6 server.

A DHCPv6 server MAY initiatively send a reconfiguration message to the host, as described in section 19, "DHCP Server-Initiated Configuration Exchange" of [RFC3315], to cause prefix(es) information update.

5. DHCPv6 IA_PA Option

In this section, one new option is defined, Identity Association for Prefix Assignment Option . The format of this new DHCPv6 IA_PA Option has been deliberately designed to be the same with IA_PD option[RFC3633]. The IA_PD Prefix and IA Address sub-options from IA_PD option are also reused. However, the two options are different

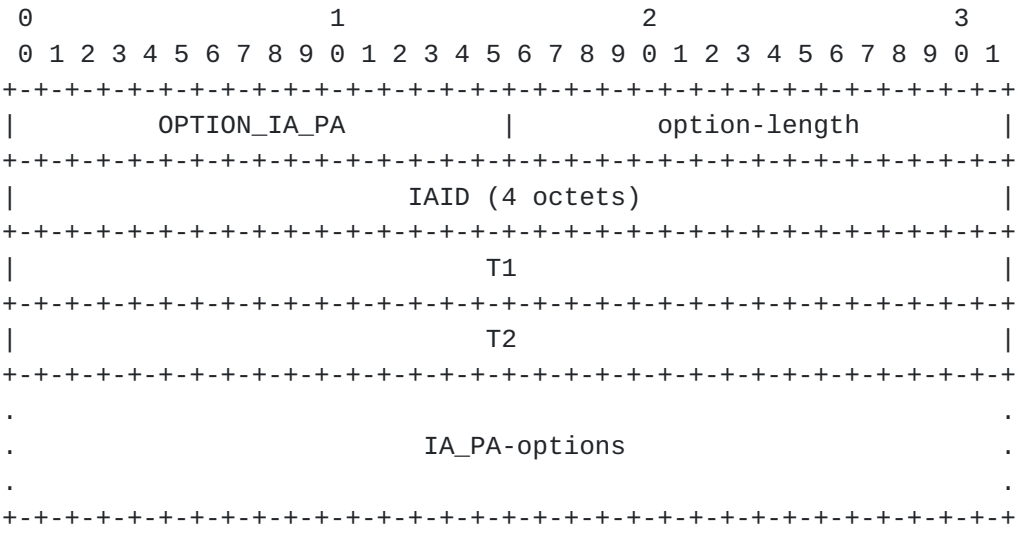
on the semantics and usage models.

The prefixed assigned through this DHCPv6 IA_PA option could be shared accross multiple hosts.

5.1. Identity Association for Prefix Assignment Option

The IA_PA option is used to carry a prefix assignment identity association, the parameters associated with the IA_PA and the prefixes associated with it.

The format of the IA_PA option is:



option-code: OPTION_IA_PA (TBA1)

option-length: 12 + length of IA_PA-options field.

IAID: The unique identifier for this IA_PA; the IAID must be unique among the identifiers for all of this host's IA_PAs.

T1: The time at which the host should contact the DHCPv6 server from which the prefixes in the IA_PA were obtained to extend the lifetimes of the prefixes assigned to the IA_PA; T1 is a time duration relative to the current time expressed in units of seconds.

T2: The time at which the host should contact any available DHCPv6 server to extend the lifetimes of the prefixes assigned to the IA_PA; T2 is a time duration relative to the current time expressed in units of seconds.

IA_PA-options: Options associated with this IA_PA.

The details of the fields are similar to the IA_PD option description in [RFC3633]. The difference is here a DHCPv6 server and a host involved, while a delegating router and requesting router involved in [RFC3633].

5.2. IA_PA Prefix Option

OPTION_IAPREFIX (26) "IA_PD Prefix Option" defined in Section 10 of [RFC3633] is reused.

Originally, the option is used for conveying prefix information between a delegating router and a requesting router. Here the IA_PD Prefix option is used to specify IPv6 address prefixes associated with an IA_PA in Section 5.1. The IA_PD Prefix option must be encapsulated in the IA_PA-options field of an IA_PA option.

6. Applicability

In point-to-point link model, DHCPv6 operation with host-generated interface identifier, described in this document, may be used. [RFC4968] provides different IPv6 link models that are suitable for 802.16 based networks and a point-to-point link model is recommended. Also, 3GPP and 3GPP2 have earlier adopted the point-to-point link model based on the recommendations in [RFC3314]. In this model, one

prefix can only be assigned to one interface of a host (mobile station) and different hosts (mobile stations) can't share a prefix. The unique prefix can be used to identify the host. It is not necessary for a DHCPv6 server to generate an interface identifier for the host. The host may generate its interface identifier as described in [RFC4941]. An interface identifier could even be generated via random number generation.

Modified EUI-64 interface identifier [EUI-64] is also typically generated by hosts. [RFC4941] has defined temporary addresses for privacy purposes. The temporary addresses is also generated by hosts using random algorithm. The DHCPv6 operations defined in this document also supports such address methods.

7. IANA consideration

This document defines a new DHCPv6 [RFC3315] option, which must be assigned Option Type values within the option numbering space for DHCPv6 messages:

The OPTION_IA_PA Option (TBA1), described in Section 5.1.

8. Security Considerations

Security considerations in DHCPv6 are described in [RFC3315].

To guard against attacks through prefix assignment, a host and a DHCPv6 server SHOULD use DHCPv6 authentication as described in Section 21, "Authentication of DHCP messages" of [RFC3315] or Secure DHCPv6 [I-D.ietf-dhc-secure-dhcpv6] .

9. Acknowledgements

The authors would like to thanks Suresh Krishnan, Ted Lemon, Bing Liu, Andre Kostur, Gaurav Halwasia, Bernie Volz and other members of DHC WG for their valuable comments.

10. References

10.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[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.

[RFC3633] Troan, O. and R. Droms, "IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6", RFC 3633, December 2003.

[RFC3971] Arkko, J., Kempf, J., Zill, B., and P. Nikander, "SEcure Neighbor Discovery (SEND)", RFC 3971, March 2005.

[RFC3972] Aura, T., "Cryptographically Generated Addresses (CGA)", RFC 3972, March 2005.

[RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, February 2006.

[RFC4861] Narten, T., Nordmark, E., Simpson, W., and H. Soliman, "Neighbor Discovery for IP version 6 (IPv6)", RFC 4861, September 2007.

[RFC4862] Thomson, S., Narten, T., and T. Jinmei, "IPv6 Stateless Address Autoconfiguration", RFC 4862, September 2007.

[RFC4941] Narten, T., Draves, R., and S. Krishnan, "Privacy Extensions for Stateless Address Autoconfiguration in IPv6", RFC 4941, September 2007.

10.2. Informative references

[RFC3314] Wasserman, M., "Recommendations for IPv6 in Third Generation Partnership Project (3GPP) Standards", RFC 3314, September 2002.

[RFC4968] Madanapalli, S., "Analysis of IPv6 Link Models for 802.16 Based Networks", RFC 4968, August 2007.

[I-D.ietf-dhc-secure-dhcpv6]
Jiang, S. and S. Shen, "Secure DHCPv6 Using CGAs", draft-ietf-dhc-secure-dhcpv6-06 (work in progress), March 2012.

[I-D.ietf-dhc-addr-registration]
Jiang, S. and G. Chen, "A Generic IPv6 Addresses Registration Solution Using DHCPv6", draft-ietf-dhc-addr-registration-00 (work in progress), May 2012.

[EUI-64] "Guidelines for 64-bit Global Identifier (EUI-64) Registration Authority", http://standards.ieee.org/regauth/oui/tutorials/EUI64.html", March 1997.

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