

Dynamic Host Configuration (DHC)
Internet-Draft
Updates: [3633](#) (if approved)
Intended status: Standards Track
Expires: April 11, 2011

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Prefix Exclude Option for DHCPv6-based Prefix Delegation
draft-ietf-dhc-pd-exclude-00.txt

Abstract

This specification defines an optional mechanism to allow exclusion of one specific prefix from a delegated prefix set when using DHCPv6-based prefix delegation.

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Table of Contents

| | | |
|-----------------------|---|-------------------|
| 1. | Introduction | 3 |
| 2. | Requirements and Terminology | 3 |
| 3. | Prefix Delegation with Excluded Prefixes | 3 |
| 3.1. | Problem Background | 3 |
| 3.2. | Proposed Solution | 4 |
| 4. | Prefix Exclude Option | 4 |
| 5. | Delegating Router Solicitation | 6 |
| 5.1. | Requesting Router | 6 |
| 5.2. | Delegating Router | 6 |
| 6. | Requesting Router Initiated Prefix Delegation | 7 |
| 6.1. | Requesting Router | 7 |
| 6.2. | Delegating Router | 7 |
| 7. | Security Considerations | 7 |
| 8. | IANA Considerations | 8 |
| 9. | Acknowledgements | 8 |
| 10. | References | 8 |
| 10.1. | Normative References | 8 |
| 10.2. | Informative References | 8 |
| | Authors' Addresses | 8 |

1. Introduction

This specification defines an optional mechanism and the related DHCPv6 option to allow exclusion of one specific prefix from a delegated prefix set when using DHCPv6-based prefix delegation.

The prefix exclusion mechanism is targeted to deployments where DHCPv6-based prefix delegation is used but a single aggregatable route/prefix has to represent one customer, instead of using one prefix for the link between the delegating router and the requesting router and another prefix for the customer network. The mechanism defined in this specification allows a delegating router to use a prefix out of the delegated prefix set on the link through which it exchanges DHCPv6 messages with the requesting router.

2. Requirements 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](#)].

3. Prefix Delegation with Excluded Prefixes

3.1. Problem Background

DHCPv6 Prefix Delegation (DHCPv6-PD) [[RFC3633](#)] has an explicit limitation described in [Section 12.1 of \[RFC3633\]](#) that a prefix delegated to a requesting router cannot be used by the delegating router. This restriction implies that the delegating router will have two (non aggregatable) routes towards a customer, one for the link between the requesting router and the delegating router and one for the customer site behind the requesting router. This approach works well with the unnumbered router model (i.e. routers on the link have no globally scoped prefixes). Also the same approach applies to the case where the prefix assigned to the requesting router link through which it received DHCP messages does not in any way need to be associated to the delegated prefixes.

There are architectures and link models, where a host (e.g. a mobile router, also acting as a requesting router) always has a single (/64) prefix configured on its uplink interface and the delegating router is also requesting router's first hop router. Furthermore, it may be required that the prefix configured on the uplink interface has to be aggregatable with the delegated prefixes. This introduces a problem in how to use DHCPv6-PD together with stateless [[RFC4862](#)] or stateful [[RFC3315](#)] address autoconfiguration on a link, where the /64

advertised on the link is also part of the prefix delegated (e.g. /56) to the requesting router.

3.2. Proposed Solution

This specification defines a new DHCPv6 option, `OPTION_PD_EXCLUDE` (TBD1), that is used to exclude exactly one prefix from a delegated prefix. The `OPTION_PD_EXCLUDE` MUST only be included in the `OPTION_IAPREFIX` IAPrefix-options field. There can be at most one `OPTION_PD_EXCLUDE` option in one `OPTION_IAPREFIX` option. The `OPTION_PD_EXCLUDE` option allows prefix delegation where a requesting router is delegated a prefix (e.g. /56) and the delegating router uses one prefix (e.g. /64) on the link through which it exchanges DHCPv6 messages with the requesting router with a prefix out of the same delegated prefix set.

A requesting router SHOULD include an `OPTION_ORO` option with the `OPTION_PD_EXCLUDE` option code in a Solicit, Request, Renew, Rebind or Confirm message to inform the delegating router about the support for the prefix delegation functionality defined in this specification. A delegating router MAY include the `OPTION_PD_EXCLUDE` option code in an `OPTION_ORO` option in a Reconfigure message for indicating that the requesting router should request `OPTION_PD_EXCLUDE` from the delegating router.

The delegating router includes the prefix in the `OPTION_PD_EXCLUDE` option that is excluded from the delegated prefix set. The requesting router MUST NOT assign the excluded prefix to any of its downstream interfaces.

4. Prefix Exclude Option

```

0                               1                               2                               3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|          OPTION_PD_EXCLUDE          |          option-len          |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| prefix-len   | IPv6 subnet ID (1 to 16 octets)                      ~
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

Prefix Exclude Option

- o option-code: `OPTION_PD_EXCLUDE` (TBD1).
- o option-len: 1 + length of IPv6 subnet ID in octets. A valid option-len is between 2 and 17.

- o prefix-len: The length of the excluded prefix in bits. The prefix-len MUST be between 'OPTION_IAPREFIX prefix-length'+1 and 128.
- o IPv6 subnet ID: A variable length IPv6 subnet ID up to 128 bits. The subnet ID contains prefix-len minus 'OPTION_IAPREFIX prefix-length' bits extracted from the excluded prefix starting from the bit position 'OPTION_IAPREFIX prefix-length'. The extracted subnet ID MUST be left shifted to start from a full octet boundary, i.e. left shift of 'OPTION_IAPREFIX prefix-length' mod 7 bits. The subnet ID MUST be zero padded to the next full octet boundary.

The OPTION_PD_EXCLUDE option MUST only be included in the OPTION_IAPREFIX Iaprefix-options [[RFC3633](#)] field. The OPTION_PD_EXCLUDE option MUST be located before the possible Status Code option in the Iaprefix-options field.

Any prefix excluded from the delegated prefix MUST be contained in OPTION_PD_EXCLUDE options within the corresponding OPTION_IAPREFIX.

The prefix included in the OPTION_PD_EXCLUDE option share the same preferred-lifetime and valid-lifetime as the delegated prefix in the encapsulating OPTION_IAPREFIX option.

The prefix in the OPTION_PD_EXCLUDE option MUST be part of the delegated prefix in the OPTION_IAPREFIX. For example, the requesting router has earlier been assigned a 2001:db8:dead:beef::/64 prefix by the delegating router, and the delegated prefix in the OPTION_IAPREFIX is 2001:db8:dead:bee0::/59. In this case, 2001:db8:dead:beef::/64 is a valid prefix to be used in the OPTION_PD_EXCLUDE option. The OPTION_PD_EXCLUDE option would be encoded as follows:

```

0          1          2          3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|          OPTION_PD_EXCLUDE          |          2          |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|          64          |0|1|1|1|1|0|0|0|
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
                        ^          ^
                        |          |
                        |          +- 3 zero padded bits follow
                        |
                        +- using C syntax: (0xef & 0x1f) << 3

```


5. Delegating Router Solicitation

The requesting router locates and selects a delegating router in the same way as described in [Section 11 \[RFC3633\]](#). This specification only describes the additional steps required by the use of `OPTION_PD_EXCLUDE` option.

5.1. Requesting Router

If the requesting router implement the solution described in [Section 3.2](#) then the requesting router **MUST** include the `OPTION_PD_EXCLUDE` option code in the `OPTION_ORO` option in the Solicit message.

Once receiving Advertise message, the requesting router uses the prefix(es) received in `OPTION_PD_EXCLUDE` in addition to the advertised prefixes to choose the delegating router to respond to. If Advertise message did not include `OPTION_PD_EXCLUDE` option, then the requesting router **MUST** fall back to normal [\[RFC3633\]](#) behavior.

Editor's Note: is there actually deployment case when multiple delegating routers would respond?

5.2. Delegating Router

If the `OPTION_ORO` option in the Solicit message includes the `OPTION_PD_EXCLUDE` option code, then the delegating router knows that the requesting router supports the solution defined in this specification. If the Solicit message also contains an `IA_PD` option, the delegating router can delegate to the requesting router a prefix which includes the prefix already assigned to the requesting router's uplink interface. The delegating router includes the prefix originally or to be assigned to the requesting router in the `OPTION_PD_EXCLUDE` option within the `OPTION_IAPREFIX` `IAPrefix-option` in the Advertise message.

If the `OPTION_ORO` option in the Solicit message does not include the `OPTION_PD_EXCLUDE` option code, then the delegating router **MUST** fall back to normal [\[RFC3633\]](#) behavior.

If the `OPTION_ORO` option in the Solicit message includes the `OPTION_PD_EXCLUDE` option code but the delegating router does not support the solution described in this specification, then the delegating router acts as specified in [\[RFC3633\]](#). The requesting router **MUST** in this case also fall back to normal [\[RFC3633\]](#) behavior.

6. Requesting Router Initiated Prefix Delegation

The procedures described in the following sections are aligned with [Section 12 of \[RFC3633\]](#). In this specification we only describe the additional steps required by the use of `OPTION_PD_EXCLUDE` option.

6.1. Requesting Router

The requesting router behavior regarding the use of the `OPTION_PD_EXCLUDE` option is more or less identical to step described in [Section 5.1](#). The only difference really is different used DHCPv6 messages.

The requesting router uses a Release message to return the delegated prefix(es) to a delegating router. The prefix(es) to be released MUST be included in the `IA_PDs` along with the excluded prefix included in the `OPTION_PD_EXCLUDE` option. The requesting router MUST NOT use the `OPTION_PD_EXCLUDE` option to introduce additional excluded prefix in the Release message that it originally got a valid binding for.

The requesting router must create sink routes for the delegated prefixes minus the excluded prefixes. This may be done by creating sink routes for delegated prefixes and more specific routes for the excluded prefixes.

6.2. Delegating Router

The delegating router behavior regarding the use of the `OPTION_PD_EXCLUDE` option is more or less identical to step described in [Section 5.2](#). The only difference really is DHCPv6 messages used to carry the `OPTION_PD_EXCLUDE` option.

The delegating router may mark any prefix(es) in `IA_PD Prefix` options in a Release message from a requesting router as 'available' excluding the prefix included in the `OPTION_PD_EXCLUDE` options. If the Release message contains 'new' excluded prefix in any `OPTION_PD_EXCLUDE` option, the delegating router MUST send a Reply message with Status Code set to `NoBinding` for that `IA_PD` option.

7. Security Considerations

Security considerations in DHCPv6 are described in [Section 23 of \[RFC3315\]](#), and for DHCPv6 Prefix Delegation in [Section 12 of \[RFC3633\]](#).

8. IANA Considerations

A new DHCPv6 Option Code is reserved from DHCPv6 registry for DHCP Option Codes.

OPTION_PD_EXCLUDE is set to TBD1

9. Acknowledgements

Authors would like to thank Ralph Droms, Frank Brockners, Ted Lemon, Julien Laganier, Fredrik Garneij, Sri Gundavelli, Mikael Abrahamsson, Behcet Sarikaya, Jyrki Soini and Deng Hui for their valuable comments and discussions.

10. References

10.1. Normative References

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

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