DHCPv6 Prefix Length Hint Issues
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Abstract

   DHCPv6 Prefix Delegation [RFC3633] allows a requesting router to
   include a prefix-length hint value in the IA_PD option to indicate a
   preference for the size of the prefix to be delegated, but is unclear
   about how the requesting router and delegating router should act in
   different situations involving the prefix-length hint. This document
   provides a summary of the existing problems with the prefix-length
   hint and guidance on what the requesting router and delegating router
   could do in different situations.

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1. Introduction

    DHCPv6 Prefix Delegation [RFC3633] allows a requesting router to
    include a prefix-length hint value in the message sent to the
    delegating router, to indicate a preference for the size of the
    prefix to be delegated. A prefix-length hint is communicated by a
    requesting router to the delegating router by including an IA_PD
    Prefix Option(OPTION_IAPREFIX), encapsulated in an IA_PD option, with
    the "IPv6 prefix" field set to zero and the "prefix-length" field set
    to a non-zero value. The delegating routers are free to ignore the
    prefix-length hint values depending on server policy. However, some
    requesting routers may not be able to function (or only in a degraded
    state) when they're provided with a prefix which length is different
    from what they requested. E.g. If the requesting router is asking
    for a /56 and the delegating router returns a /64, the functionality
    of the requesting router might be limited because it might not be
    able to split the prefix for all its interfaces. For other hints,
    such as requesting for a explicit address or lifetime, this might be
    less critical as it just help a client that wishes to continue using
    what it used last time, or a client that wants to Renew its lease for
    a certain period of time. The prefix-length hint directly impacts
    the operational capability of the requesting router, thus should be
    given more consideration.

    [RFC3633] is unclear about how the requesting router and delegating
    router should act in different situations involving the prefix-length
    hint. From the requesting router perspective, it should be able to

use the prefix-length hint to signal to the delegating router its
real time need and it should be able to handle the prefixes which
lengths are different from the prefix-length hint. This document
provides guidance on what a requesting router should do in different
situations to help it operate properly. From the delegating router
perspective, the delegating router is free to ignore the prefix-
length hints depending on server policy, but in cases where the
delegating router has a policy for considering the hint, this
document provides guidance on how the prefix-length hint should be
handled by the delegating router in different situations.

2. Requirements Language

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. Problem Description and Proposed Solutions

3.1. Creation of Solicit Message

Problem:

The Solicit message allows a requesting router to ask delegating
routers for prefixes and other configuration parameters. The
requesting router might want a different prefix length due to
configuration changes or it might just want the same prefix again
after reboot. The delegating router could decide whether to provide
the requesting router with the preferred prefix depending on server
policy, but the requesting router should be able to signal to the
delegating router its real time need.

The delegating routers usually has a record of the prefix it gave to
the requesting router during previous interactions. The best way to
assure a completely new delegated prefix is to send a new IAID in the
IA_PD. However, this would require the requesting router device to
have persistant storage, since rebooting the device would cause the
requesting router to use the original IAID in the IA_PD.

Solution:

When the requesting router prefers a prefix of specific length from
the delegating router, the requesting router SHOULD send a Solicit
message using the same IAID in the IAPD, include the preferred
prefix-length value in the "prefix-length" field of the
OPTION_IAPREFIX option, and set the "IPv6 prefix" field to zero.
This is an indiction to the delegating router that the requesting
router prefers a prefix of the specified length, regardless of what

it had gotten before.

When the requesting router wants the same prefix back from the
delegating router, it SHOULD send a Solicit message using the same
IAID in the IAPD, include the previously delegated prefix value in
the "IPv6 prefix" field of the OPTION_IAPREFIX option, and the length
of the prefix in the "prefix-length" field. This is an indication to
the delegating router that the requesting router wants the same
prefix back.

3.2. Receipt of Solicit message

Problem:

[RFC3633] allows a requesting router to include a prefix-length hint
in the Solicit message, to signal its preference to the delegating
router. It is unclear about how the prefix-length hint should be
handled by the delegating router. The requesting router might want a
different prefix length due to configuration changes or it might just
want the same prefix again after reboot. The delegating router
should interpret these cases differently.

Many delegating routers are configured to provide only prefixes of
specific lengths to the requesting router. E.g. If the requesting
router requested for a /54, and the delegating router could only
provide /30, /48, and /56. How should these delegating routers
decide which prefix to give to the requesting router based on the
prefix-length hint?

Solution:

Upon the receipt of Solicit message, if the requesting router
included only a prefix-length hint in the message, the delegating
router SHOULD first check its prefix pool for a prefix with length
matching the prefix-length hint value, regardless of the prefix
record from previous interactions with the requesting router. If the
delegating router does not have a prefix with length matching the
prefix-length hint value, then the delegating router SHOULD provide
the prefix with the shortest length possible which is closest to the
prefix-length hint value.

If the requesting router included a specific prefix value and the
corresponding prefix-length value in the Solicit message, the
delegating router SHOULD first try to check its prefix pool for a
prefix matching the requested prefix value. If the requested prefix
is not available in the delegating router's prefix pool, then the
delegating router SHOULD try to provide a prefix matching the prefix-
length value, or the prefix with the shortest length possible which

   is closest to the prefix-length value.

3.3. Receipt of Advertise Message

   Problem:

   The delegating router might not be able to honor the prefix-length
   hint due to server policy or lack of resources in its prefix pool.
   If the prefix length provided by the delegating router in the
   Advertise message is different from what the requesting router
   requested in the Solicit message, the question would be whether the
   requesting router should use the provided prefix length or continue
   to ask for its preferred prefix length. There are certain situations
   where the requesting router could not operate properly if it used a
   prefix which length is different from what it requested in the
   prefix-length hint. However, if the requesting router ignores the
   Advertise messages, and continues to solicit for the preferred prefix
   length, the requesting router might be stuck in the DHCP process.
   Another question is whether the requesting router should ignore other
   configuration parameters such as available addresses.

   Solution:

   If the requesting router could use the prefixes provided by the
   delegating routers despite being different from the prefix-length
   hint, the requesting router SHOULD choose the shortest prefix length
   which is closest to the prefix-length hint.

   If the requesting router cannot use the prefixes provided by the
   delegating routers, it MUST ignore the Advertise messages and
   continue to send Solicit messages until it gets the preferred prefix.
   To avoid traffic congestion, the requesting router MUST send Solicit
   messages at defined intervals, as specified in [RFC7083].

   If the requesting router also Solicited for other stateful
   configuration options such as IA_NAs, the requesting router SHOULD
   accept the stateful configuration options and continue to request for
   the desired IA_PD prefix in subsequent DHCPv6 messages as specified
   in [RFC7550].

3.4. Creation of Renew/Rebind Message

   Problem:

   Delegating routers might not be able to provide a prefix with length
   equal or shorter than the prefix-length hint. If the requesting
   router decided to use the prefix provided by the delegating router
   despite being longer than the prefix-length hint, but would still

prefer the prefix-length hint it originally requested in the Solicit
message, there should be some way for the requesting router to
express this preference during Renew/Rebind. E.g. If the requesting
router requested for a /60 but got a /64, the requesting router
should be able to signal to the delegating router during Renew/Rebind
that it would still prefer a /60. This is to see whether the
delegating router has the prefix preferred by the requesting router
available in its prefix pool during Renew/Rebind. [RFC3633] is not
completely clear on whether the requesting router is allowed to
include a prefix-length hint in the Renew/Rebind message.

Solution:

During Renew/Rebind, if the requesting router prefers a prefix length
different from the prefix it is currently using, then the requesting
router SHOULD send the Renew/Rebind message with the same IA_PD, and
include two OPTION_IAPREFIX options, one containing the currently
delegated prefix and the other containing the prefix-length hint.
This is to extend the lifetime of the prefix the requesting router is
currently using and also get the prefix the requesting router
prefers, and go through a graceful switch over.

If the delegating router is unable to provide the requesting router
with the newly requested prefix, but is able to extend lifetime of
the old prefix, the requesting router SHOULD continue using the old
prefix.

3.5. Receipt of Renew/Rebind Message

Problem:

The prefix preferred by the requesting router might become available
in the delegating router's prefix pool during Renew/Rebind, but was
unavailable during Solicit. This might be due to delegating router
configuration change or because some other requesting router stopped
using the prefix.

The question is whether the delegating router should remember the
prefix-length hint the requesting router originally included in the
Solicit message and check during Renew/Rebind to see if it has the
prefix length the requesting router preferred. This would require
the delegating router to keep extra information about the requesting
router. There is also the possibility that the requesting router's
preference for the prefix length might have changed during this time
interval, so the prefix-length hint remembered by the delegating
router might not be what the requesting router prefers during Renew/
Rebind.

Instead of having the delegating router remember the prefix-length
hint of the requesting router, another option is for the requesting
router to include the prefix-length hint in the Renew/Rebind message.
The current specification is unclear about what the delegating router
should do if the requesting router also included in the Renew/Rebind
message a prefix-length hint value, and whether the delegating router
could provide a different prefix to the requesting router during
Renew/Rebind.

Solution:

Upon the receipt of Renew/Rebind, if the requesting router included
in the IA_PD both OPTION_IAPREFIX option with the delegated prefix
value and an OPTION_IAPREFIX option with a prefix-length hint value,
the delegating router SHOULD check to see whether it could extend the
lifetime of the original delegated prefix and whether it has any
available prefix matching the prefix-length hint, or as close a
possible to the prefix-length hint, within the delegating router's
limit.

If the delegating router assigned the prefix included in IA_PD to the
requesting router, the delegating router SHOULD do one of the
following, depending on its policy:

1. Extend lifetime of the original delegated prefix.

2. Extend lifetime of the original delegated prefix and assign a new
prefix of the requested length.

3. Mark the original delegated prefix as invalid by giving it 0
lifetimes, and assign a new prefix of requested length. This avoids
the complexity of handling multiple delegated prefixes, but may break
all the existing connections of the requesting router.

4. Assign the original delegated prefix with 0 preferred-lifetime, a
short non-zero valid-lifetime, and assign a new prefix of requested
length. This allows the requesting router to finish up existing
connections with the original prefix, and use the new prefix to
establish new connections.

5. Do not include the original delegated prefix in the Reply
message, and assign a new prefix of requested length. The original
prefix would be valid until it's lifetime expires. This avoids
sudden renumbering on the requesting router.

If the delegating router does not know the requesting router's
bindings(e.g. a different delegating router receiving the message
during Rebind), then the delegating router SHOULD ignore the original

delegated prefix, and try to assign a new prefix of requested length.

It's unnecessary for the delegating router to remember the prefix-length hint the requesting router requested during Solicit. It is possible that the requesting router's preference for the prefix length might have changed during this time interval, so the prefix-length hint in the Renew message is reflecting what the requesting router prefers at the time.

4. Security Considerations

This document introduces no new security considerations over those already discussed in section 15 of RFC3633, as this document provides guidance on how the requesting routers and delegating routers interact with regard to the prefix-length hint mechanism introduced in RFC3633.

5. IANA Considerations

This document does not include an IANA request.

6. Contributors List

Many thanks to Qi Sun, Bernie Volz, Ole Troan, Sunil Gandhewar, Marcin Siodelski.

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