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DHCPv6 Prefix-Length Hint Issues

Abstract

DHCPv6 Prefix Delegation allows a client 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 it is unclear about how the client and server 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 client and server could do in different situations.

Status of This Memo

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1. Introduction

DHCPv6 Prefix Delegation [RFC3633] allows a client to include a prefix-length hint value in the message sent to the server to indicate a preference for the size of the prefix to be delegated. A prefix-length hint is communicated by a client to the server by including an IA_PD Prefix Option (IAPREFIX option), 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 servers are free to ignore the prefix-length hint values depending on server policy. However, some clients may not be able to function (or only in a degraded state) when they're provided with a prefix whose length is different from what they requested. For example, if the client is asking for a /56 and the server returns a /64, the functionality of the client might be limited because it might not be able to split the prefix for all its interfaces. For other hints, such as requesting for an explicit address, this might be less critical, as it just helps a client that wishes to continue using what it used last time. The prefix-length hint directly impacts the operational capability of the client; thus, it should be given more consideration.

[RFC3633] is unclear about how the client and server should act in different situations involving the prefix-length hint. From the client perspective, it should be able to use the prefix-length hint to signal to the server its real-time need and should be able to handle prefixes with lengths different from the prefix-length hint. This document provides guidance on what a client should do in different situations to help it operate properly. From the server perspective, the server is free to ignore the prefix-length hints depending on server policy; however, in cases where the server has a

policy for considering the hint, this document provides guidance on how the prefix-length hint should be handled by the server in different situations.

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Problem Description and Proposed Solutions

3.1. Creation of Solicit Message

Problem:

The Solicit message allows a client to ask servers for prefixes and other configuration parameters. The client might want a different prefix length due to configuration changes, or it might just want the same prefix again after reboot. The client might also prefer a prefix of a specific length in case the requested prefix is not available. The server could decide whether to provide the client with the preferred prefix depending on server policy, but the client should be able to signal to the server its real-time need.

The server usually has a record of the prefix it gave to the client during its most recent interaction. The best way to assure a completely new delegated prefix is to send a new IAID (Identity Association Identifier) in the IA_PD (Identity Association for Prefix Delegation). However, this would require the client device to have persistent storage, because rebooting the device would cause the client to use the original IAID in the IA_PD.

Solution:

When the client prefers a prefix of a specific length from the server, the client MUST send a Solicit message using the same IAID in the IA_PD, include the preferred prefix-length value in the "prefix-length" field of the IAPREFIX option, and set the "IPv6 prefix" field to zero. This is an indication to the server that the client prefers a prefix of the specified length, regardless of what it received before.

When the client wants the same prefix back from the server, it MUST send a Solicit message using the same IAID in the IA_PD, include the previously delegated prefix value in the "IPv6 prefix" field of the

IAPREFIX option, and include the length of the prefix in the "prefix-length" field. This is an indication to the server that the client wants the same prefix back.

When the client wants the same prefix back from the server and would prefer to accept a prefix of a specified length in case the requested prefix is not available, the client MUST send a Solicit message using the same IAID in the IA_PD, include the previously delegated prefix in one IAPREFIX option, and include the prefix-length hint in another IAPREFIX option. There is no requirement regarding the order of the two IAPREFIX options.

3.2. Receipt of Solicit Message

Problem:

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

Many servers are configured to provide only prefixes of specific lengths to the client, for example, if the client requested for a /54 but the server could only provide /30, /48, and /56. How should these servers decide which prefix to give to the client based on the prefix-length hint?

Solution:

Upon the receipt of Solicit message, if the client included only a prefix-length hint in the message, the server SHOULD first check its prefix pool for a prefix with a length matching the prefix-length hint value, regardless of the prefix record from previous interactions with the client. If the server does not have a prefix with a length matching the prefix-length hint value, then the server SHOULD provide the prefix whose length is shorter and closest to the prefix-length hint value.

If the client included a specific prefix value in the Solicit message, the server SHOULD check its prefix pool for a prefix matching the requested prefix value. If the requested prefix is not available in the server's prefix pool, and the client also included a prefix-length hint in the same IA_PD option, then the server SHOULD check its prefix pool for a prefix with a length matching the prefix-length hint value. If the server does not have a prefix with a length matching the prefix-length hint value, the server SHOULD

provide the prefix whose length is shorter and closest to the prefix-length hint value.

If the server will not assign any prefixes to any IA_PDs in a subsequent Request from the client, the server MUST send an Advertise message to the client as described in Section 11.2 of [RFC3633].

3.3. Receipt of Advertise Message

Problem:

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

Solution:

If the client could use the prefixes included in the Advertise messages despite being different from the prefix-length hint, the client SHOULD choose the shortest prefix length that is closest to the prefix-length hint. The client SHOULD continue requesting the preferred prefix in the subsequent DHCPv6 messages as defined in Section 3.4 of this document.

If the client sent a Solicit with only IA_PDs and cannot use the prefixes included in the Advertise messages, it MUST ignore the Advertise messages and continue to send Solicit messages until it gets the preferred prefix. To avoid traffic congestion, the client MUST send Solicit messages at defined intervals, as specified in [RFC7083].

If the client also solicited for other stateful configuration options such as IA_NAs and the client cannot use the prefixes included in the Advertise messages, the client SHOULD accept the other stateful configuration options and continue to request the desired IA_PD prefix in subsequent DHCPv6 messages as specified in [RFC7550].

3.4. Creation of Renew/Rebind Message

Problem:

Servers might not be able to provide a prefix with the length equal to or shorter than the prefix-length hint. If the client decided to use the prefix provided by the server despite it being longer than the prefix-length hint but would still prefer the prefix-length hint originally requested in the Solicit message, there should be some way for the client to express this preference during Renew/Rebind. For example, if the client requested for a /60 but got a /64, the client should be able to signal to the server during Renew/Rebind that it would still prefer a /60. This is to see whether the server has the prefix preferred by the client available in its prefix pool during Renew/Rebind. [RFC3633] is not completely clear on whether the client is allowed to include a prefix-length hint in the Renew/Rebind message.

Solution:

During Renew/Rebind, if the client prefers a prefix length that is different from the prefix it is currently using, then the client SHOULD send the Renew/Rebind message with the same IA_PD, and include two 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 client is currently using, get the prefix the client prefers, and go through a graceful switch over.

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

3.5. Receipt of Renew/Rebind Message

Problem:

The prefix preferred by the client might become available in the server's prefix pool during Renew/Rebind, even though it was unavailable during Solicit. This might be due to a server configuration change or because some other client stopped using the prefix.

The question is whether the server should remember the prefix-length hint the client originally included in the Solicit message and check it during Renew/Rebind to see if it has the prefix length the client preferred. This would require the server to keep extra information about the client. There is also the possibility that the client's preference for the prefix length might have changed during this time

interval, so the prefix-length hint remembered by the server might not be what the client prefers during Renew/Rebind.

Instead of having the server remember the prefix-length hint of the client, another option is for the client to include the prefix-length hint in the Renew/Rebind message. [RFC3633] is unclear about what the server should do if the client also included a prefix-length hint value in the Renew/Rebind message and whether the server could provide a different prefix to the client during Renew/Rebind.

Solution:

Upon the receipt of a Renew/Rebind message, if the client included in the IA_PD both an IAPREFIX option with the delegated prefix value and an IAPREFIX option with a prefix-length hint value, the server SHOULD check whether it could extend the lifetime of the original delegated prefix and whether it has any available prefix matching the prefix-length hint (or determine the closest possible to the prefix-length hint) within its limit.

If the server assigned the prefix included in IA_PD to the client, the server SHOULD do one of the following, depending on its policy:

1. Extend the lifetime of the original delegated prefix.
2. Extend the 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 the requested length. This avoids the complexity of handling multiple delegated prefixes but may break all the existing connections of the client.
4. Assign the original delegated prefix with 0 preferred-lifetime, a specific non-zero valid-lifetime depending on actual requirement, and assign a new prefix of the requested length. This allows the client 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 the requested length. The original prefix would be valid until its lifetime expires. This avoids sudden renumbering on the client.

If the server does not know the client's bindings (e.g., a different server receiving the message during Rebind), then the server SHOULD ignore the original delegated prefix and try to assign a new prefix of the requested length.

It's unnecessary for the server to remember the prefix-length hint the client requested during Solicit. It is possible that the client'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 client prefers at the time.

3.6. General Recommendation

The recommendation to address the issues discussed in this document is for a client that wants (at least) to have a delegated prefix of a specific prefix length to always include an IAPREFIX option with just the prefix-length hint in addition to any IAPREFIX options it has included for each IA_PD in any Solicit, Request, Renew, and Rebind messages it sends. While a server is free to ignore the hint, servers that do not choose to ignore the hint should attempt to assign a prefix of the hint length (or assign the next closest length that does not exceed the hint) if one is available. Whether a server favors the hint or avoiding a renumbering event is a matter of server policy.

4. Security Considerations

This document provides guidance on how the clients and servers interact with regard to the DHCPv6 prefix-length hint. Security considerations in DHCP are described in Section 23 of [RFC3315]. Security considerations regarding DHCPv6 prefix delegation are described in Section 15 of [RFC3633].

5. IANA Considerations

This document does not require any IANA actions.

6. Normative References

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