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Issues with multiple stateful DHCPv6 options
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Abstract

Dynamic Host Configuration Protocol for IPv6 (DHCPv6) was not written with the expectation that additional stateful DHCPv6 options would be developed. IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6 shoe-horned the new options for Prefix Delegation into DHCPv6. Implementation experience of the CPE model described in has shown multiple issues with the DHCPv6 protocol in supporting multiple stateful options.

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 November 8, 2012.

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1. Introduction

DHCPv6 [RFC3315] was not written with the expectation that additional stateful DHCPv6 options would be developed. DHCPv6 Prefix Delegation [RFC3633] shoe-horned the new options for Prefix Delegation into DHCPv6. Implementation experience of the CPE model described in [RFC6204] has shown multiple issues with the DHCPv6 protocol in supporting multiple stateful options.

This document describes a number of problems encountered with multiple IA option types into DHCP and recommended changes to the DHCPv6 protocol specifications.

The intention of this work is to modify the DHCP protocol specification to support multiple IA option types within a single DHCP session. This problem can also be solved by implementing a separate DHCP session (separate client state machine) per IA option type. This latter approach has a number of issues: additional DHCP protocol traffic, 'collisions' between stateless options also included with the IA options, divergence in that each IA option type specification specifies its 'own' version of the DHCP protocol.

The changes described in this document will be incorporated in a new revision of the DHCPv6 protocol specification [RFC3315].

2. Conventions

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 RFC 2119 [RFC2119].

3. Terminology

Stateful options	Options that require dynamic binding state per client on the server.
Identity association (IA):	A collection of stateful options assigned to a client. Each IA has an associated IAID. A client may have more than one IA assigned to it; for example, one for each of its interfaces. Each IA holds one type of IA option; for example, an identity association for temporary addresses (IA_TA) holds temporary addresses (see "identity association for temporary addresses"). Throughout this

document, "IA" is used to refer to an identity association without identifying the type of stateful option in the IA.

4. Handling of multiple IA options types

DHCPv6 was written with the assumption that the only stateful options where for assigning addresses. DHCPv6 PD describes how to extend the DHCPv6 protocol to handle prefix delegation, but RFC3633 did not consider how DHCP address assignment and prefix delegation could co-exist.

4.1. Advertisement message

RFC3315 specifies that a client must ignore an Advertise message if a server will not assign any addresses to a client. A client requesting both IA_NA and IA_PD, with a server that only offers one of them, is not supported in the current protocol specification.

Proposed solution: a client should accept Advertise messages, even when not all IA option types are being offered. A client should ignore an Advertise message when no bindings at all are being offered.

Replace Section 17.1.3: (existing errata)

> The client MUST ignore any Advertise message that includes a Status Code option containing the value NoAddrsAvail, with the exception that the client MAY display the associated status message(s) to the user.

With:

> The client MUST ignore any Advertise message that contains no bindings (if only IA_NA and/or IA_TA options were requested, this is a message that includes a Status Code option containing the value NoAddrsAvail), with the exception that the client MAY display the associated status message(s) to the user.

And, replace:

- The client MAY choose a less-preferred server if that server has a better set of advertised parameters, such as the available addresses advertised in IAs.

With:

- The client MAY choose a less-preferred server if that server has a better set of advertised parameters, such as the available options advertised in IAs.

It is important to note that the receipt of a Advertisement without any bindings does not imply that the client should restart the Solicit retransmissions timers. Doing so would lead to a Solicit/ Advertisement storm.

4.2. Placement of Status codes

In Reply messages IA specific status codes (NoAddrsAvail, NotOnlink, NoBinding) are encapsulated in the IA option. In Advertisement messages the Status Code option with the NoAddrsAvail code is in the "global" scope. That makes sense when the failure case is fatal. With the introduction of multiple IA option types, there might be a case where a server is not willing to offer addresses, but might be willing to offer other stateful option types.

While a Status Code option is implicitly bound to a specific type of IA, e.g. NoPrefixAvail is only applicable to IA_PD and NoAddrsAvail is only applicable to IA_NA/IA_TA, it may be problematic to make this assumption for all status codes. Ideally the Status Code option should be encapsulated in the IA option for all DHCP messages. This makes Advertisement messages equal to Reply messages.

Proposed solution: No change. For backwards compatibility, the NoAddrsAvail Status Code option when no addresses are available will be kept in the global scope for Advertise messages. Other IA option types MUST encapsulate the Status Code option within the IA option.

4.3. T1/T2 timers

The T1 and T2 timers determine when the client will contact the server to extend lifetimes of information received in an IA. How should a client handle the case where multiple IA options have different T1 and T2 timers?

In a multiple IA option types model, the T1/T2 timers are protocol timers, that should be independent of the IA options themselves. If we were to redo the DHCP protocol from scratch the T1/T2 timers should be carried in a separate DHCP option.

Proposed solution: The server SHOULD set the T1/T2 timers in all IA options in Reply and Advertise messages to the same value. To deal with the case where servers have not yet been updated to do that, clients MUST use the shortest (explicit or implicit) T1/T2 timer (larger than 0) in any IA options in the Reply. Longer T1/T2 timers

are ignored.

4.4. Confirm message

The Confirm message, as described in [RFC3315], is specific to address assignment. It lets a server without a binding to reply to the message, under the assumption that the server only needs knowledge about the prefix(es) on the link, to inform the client that the address is likely valid or not. This message is sent when e.g. the client has moved and needs to validate its addresses. Not all bindings can be validated by servers and the Confirm message provides for this by specifying that a server that is unable to determine the on-link status MUST NOT send a Reply.

Note: Confirm has a specific meaning and does not overload Renew/ Rebind. It also is lower processing cost as the server does NOT need to extend lease times or otherwise send back other configuration options.

Proposed solution: Allow and specify the Confirm message for other IA option types. A server SHOULD respond to a Confirm message only if it has definitive knowledge, based on the network configuration and not the specific client's bindings, that the client is still on-link or not on-link.

4.5. Release messages

A client can release any individual lease at any time. A client can get "back" a lease by using a Renew message. It MAY do this at any time, though must avoid creating a Renew storm. E.g. wait until T1.

4.6. Unanswered options

If a client requests multiple IA option types, but the server is willing to only offer a subset of them, the client could react in several ways. Reset the state machine and continue to send Solicit messages, create separate DHCP sessions for each IA option type and continue to Solicit for the missing options, or it could continue with the single session, and include the missing options on subsequent messages to the server.

Proposed solution: the client should keep a single session with the server. The client should continue with the IA options received, while continuing to request the other IA options in subsequent messages to the server. That means to continue to include the empty unanswered IAs in subsequent Renew and Rebind messages.

For the IAs that the server will not offer a binding, it must reply

using the same behaviour as for a Request message. That is not with the currently specified NoBinding status). This behaviour will not require the server to remember the IAs that it is not willing to serve. I.e. the change is to allow the client to include IAs in Renew/Rebind messages for which it has not received bindings (yet).

A client can only use the Renew (or Rebind) to request new IA options if it already has one or more bindings. A client MUST NOT use Renew (or Rebind) if it has no valid bindings it is renewing.

Replace Section 18.2.3:

> If the server cannot find a client entry for the IA the server returns the IA containing no addresses with a Status Code option set to NoBinding in the Reply message.

With:

> If the server cannot find a client entry for the IA but has one or more bindings for the client, the server SHOULD treat this like a Request message for the IA. If the server has no other bindings for the client, the server SHOULD return the IA containing no bindings with a Status Code option set to NoBinding in the Reply message.

4.7. Multiple provisioning domains

This document has assumed that all DHCP servers on a network are in a single provisioning domain and thus should be "equal" in the service that they offer.

One could envision a network where the DHCP servers are in multiple provisioning domains, and it may be desireable to have the DHCP client obtain different IA types from different provisioning domains. How a client detects the multiple provisioning domains and how it would interact with the multiple servers in these different domains is outside the scope of this document and an area for future work.

5. IANA Considerations

This specification does not require any IANA actions.

6. Security Considerations

There are no new security considerations pertaining to this document.

7. Acknowledgements

8. 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.

[RFC6204] Singh, H., Beebee, W., Donley, C., Stark, B., and O. Troan, "Basic Requirements for IPv6 Customer Edge Routers", RFC 6204, April 2011.

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