          DHCPv6 Option for IPv4-Embedded Multicast and Unicast IPv6 Prefixes

Abstract

   This document defines a Dynamic Host Configuration Protocol version 6
   (DHCPv6) Option for multicast IPv4 service continuity solutions,
   which is used to carry the IPv6 prefixes to be used to build unicast
   and multicast IPv4-embedded IPv6 addresses.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 7841.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc8115.

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1. Introduction

   Several solutions (e.g., [RFC8114]) are proposed for the delivery of
   multicast services in the context of transition to IPv6. Even if
   these solutions may have different applicable use cases, they all use
   specific IPv6 addresses that embed IPv4 addresses, for both multicast
   group and source addresses.

   This document defines a DHCPv6 option [RFC3315] that carries the IPv6
   prefixes to be used for constructing these IPv4-embedded IPv6
   addresses.

   In particular, this option can be used in the context of Dual-Stack
   Lite (DS-Lite) [RFC6333], Stateless Address plus Port (A+P)
   [RFC6346], and other IPv4-IPv6 transition techniques.

1.1. 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 RFC 2119 [RFC2119].

2. Terminology

   This document makes use of the following terms:

   IPv4-embedded IPv6 address: an IPv6 address that embeds a 32-bit-
      encoded IPv4 address [RFC6052]. An IPv4-embedded IPv6 address can
      be a unicast or a multicast address.

   Prefix64: an IPv6 prefix used for synthesizing IPv4-embedded IPv6
      addresses. A Prefix64 can be unicast or multicast.

         Note: "64" is used as an abbreviation for IPv6-IPv4
         interconnection.

   ASM_mPrefix64: a multicast Prefix64 that belongs to the Any-Source
      Multicast (ASM) range.

   SSM_mPrefix64: a multicast Prefix64 which belongs to the Source-
      Specific Multicast (SSM) [RFC4607] range.

   uPrefix64: a unicast Prefix64 for building the IPv4-embedded IPv6
      addresses of multicast sources in SSM mode.

3. OPTION_V6_PREFIX64 DHCPv6 Option

   OPTION_V6_PREFIX64 (Figure 1) conveys the IPv6 prefix(es) to be used
   (e.g., by an mB4 [RFC8114]) to synthesize IPv4-embedded IPv6
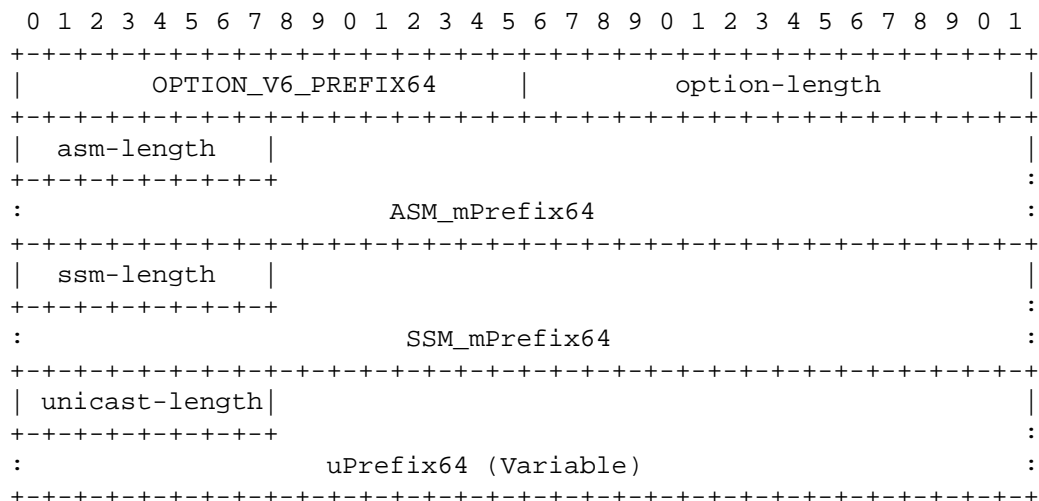   addresses.

```
    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_V6_PREFIX64    |           option-length        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |  asm-length   |                                               |
   +-+-+-+-+-+-+-+-+-+                                             :
   :                         ASM_mPrefix64                         :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |  ssm-length   |                                               |
   +-+-+-+-+-+-+-+-+-+                                             :
   :                         SSM_mPrefix64                         :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | unicast-length|                                               |
   +-+-+-+-+-+-+-+-+-+                                             :
   :                     uPrefix64 (Variable)                      :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

            Figure 1: Option Format for OPTION_V6_PREFIX64

   The fields of the option shown in Figure 1 are as follows:

   option-code: OPTION_V6_PREFIX64 (see Section 6).

   option-length: length of the option, in octets.

asm-length: the prefix length for the ASM IPv4-embedded prefix, as
   an 8-bit unsigned integer. This field represents the number of
   valid leading bits in the prefix. This field MUST be set to 96.

ASM_mPrefix64: this field identifies the IPv6 multicast prefix to be
   used to synthesize the IPv4-embedded IPv6 addresses of the
   multicast groups in the ASM mode. The conveyed multicast IPv6
   prefix MUST belong to the ASM range.

ssm-length: the prefix length for the SSM IPv4-embedded prefix, as
   an 8-bit unsigned integer. This field represents the number of
   valid leading bits in the prefix. This field MUST be set to 96.

SSM_mPrefix64: this field identifies the IPv6 multicast prefix to be
   used to synthesize the IPv4-embedded IPv6 addresses of the
   multicast groups in SSM mode. The conveyed multicast IPv6 prefix
   MUST belong to the SSM range.

unicast-length: the prefix length for the IPv6 unicast prefix to be
   used to synthesize the IPv4-embedded IPv6 addresses of the
   multicast sources, as an 8-bit unsigned integer. As specified in
   [RFC6052], the unicast-length MUST be one of 32, 40, 48, 56, 64,
   or 96. This field represents the number of valid leading bits in
   the prefix.

uPrefix64: this field identifies the IPv6 unicast prefix to be used
   in SSM mode for constructing the IPv4-embedded IPv6 addresses
   representing the IPv4 multicast sources in the IPv6 domain.
   uPrefix64 may also be used to extract the IPv4 address from the
   received multicast data flows. It is a variable-size field with
   the length of the field defined by the unicast-length field and is
   rounded up to the nearest octet boundary. In this case, any
   additional padding bits must be zeroed. The address mapping MUST
   follow the guidelines documented in [RFC6052].

Multiple instances of OPTION_V6_PREFIX64 may be returned to a DHCPv6
client. Configuration recommendations for DHCP servers are listed in
Appendix A.

Note that it was tempting to define three distinct DHCPv6 options,
but that approach was not adopted because it has a side effect: the
specification of a DHCPv6 option that could be used to discover
unicast Prefix64s in environments where multicast is not enabled.
Such a side effect conflicts with the recommendation to support the
Well-Known DNS Name heuristic discovery-based method for unicast-only
environments (Section 6 of [RFC7051]).

4. DHCPv6 Client Behavior

   To retrieve the IPv6 prefixes that will be used to synthesize unicast
   and multicast IPv4-embedded IPv6 addresses, the DHCPv6 client MUST
   include the OPTION_V6_PREFIX64 code in its OPTION_ORO. If the DHCPv6
   client receives more than one OPTION_V6_PREFIX64 option from the
   DHCPv6 server:

   o If each enclosed IPv6 multicast prefix has a distinct scope
      [RFC7346], the client MUST select the appropriate IPv6 multicast
      prefix whose scope matches the IPv4 multicast address used to
      synthesize an IPv4-embedded IPv6 multicast address.

   o If at least two of the received options convey IPv6 multicast
      prefixes that have the same scope, the said options MUST be
      discarded.

   If asm-length, ssm-length and unicast-length fields are all set to 0,
   the DHCPv6 client MUST behave as if OPTION_V6_PREFIX64 had not been
   received in the response received from the DHCPv6 server.

   If the asm-length field is non-null, the IPv6 prefix identified by
   ASM_mPrefix64 is used to synthesize IPv4-embedded IPv6 multicast
   addresses in the ASM range. This is achieved by concatenating the
   ASM_mPrefix64 and the IPv4 multicast address; the IPv4 multicast
   address is inserted in the last 32 bits of the IPv4-embedded IPv6
   multicast address.

   If the ssm-length field is non-null, the IPv6 prefix identified by
   SSM_mPrefix64 is used to synthesize IPv4-embedded IPv6 multicast
   addresses in the SSM range. This is achieved by concatenating the
   SSM_mPrefix64 and the IPv4 multicast address; the IPv4 multicast
   address is inserted in the last 32 bits of the IPv4-embedded IPv6
   multicast address.

   If the unicast-length field is non-null, the IPv6 prefix identified
   by uPrefix64 is used to synthesize IPv4-embedded IPv6 unicast
   addresses as specified in [RFC6052].

5. Security Considerations

   The security considerations documented in [RFC3315] and [RFC6052] are
   to be considered.

6. IANA Considerations

   IANA has assigned the following option code in the "Dynamic Host
   Configuration Protocol for IPv6 (DHCPv6)" registry
   <http://www.iana.org/assignments/dhcpv6-parameters>:

      Option Name   Value
      ------------------   -----
      OPTION_V6_PREFIX64   113

7. References

7.1. Normative References

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Appendix A. Configuration Recommendations for DHCP Servers

   This appendix details a set of non-normative configuration
   recommendations:

   o DHCP servers supporting OPTION_V6_PREFIX64 must be configured with
      ASM_mPrefix64 or SSM_mPrefix64, and may be configured with both.

   o uPrefix64 must also be configured when SSM_mPrefix64 is provided.

   o uPrefix64 may be configured when ASM_mPrefix64 is provided.

      Note that uPrefix64 is not mandatory for the ASM case if, for
      example, a local address mapping algorithm is supported or the
      Well-Known Prefix (64:ff9b::/96) is used.

   o Both ASM_mPrefix64 and SSM_mPrefix64 may be configured and
      therefore be returned to a requesting DHCP client in the same
      OPTION_V6_PREFIX64. In particular, if both SSM and ASM modes are
      supported, ASM_mPrefix64 and SSM_mPrefix64 prefixes must be
      configured. For SSM deployments, both SSM_mPrefix64 and uPrefix64
      must be configured.

   o When a multicast Prefix64 (ASM_mPrefix64 or SSM_mPrefix64) is
      configured, the length of the prefix must be /96.

   o When distinct IPv6 multicast address scopes [RFC7346] are required
      to preserve the scope when translating IPv4 multicast addresses
      (Section 8 of [RFC2365]), each scope is configured as a separate
      OPTION_V6_PREFIX64. How DHCP servers are configured to separate
      multicast Prefix64 per scope is implementation specific and not
      covered by this document.

   o When scope preservation is not required, only one instance of
      OPTION_V6_PREFIX64 is configured.

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