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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.

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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.

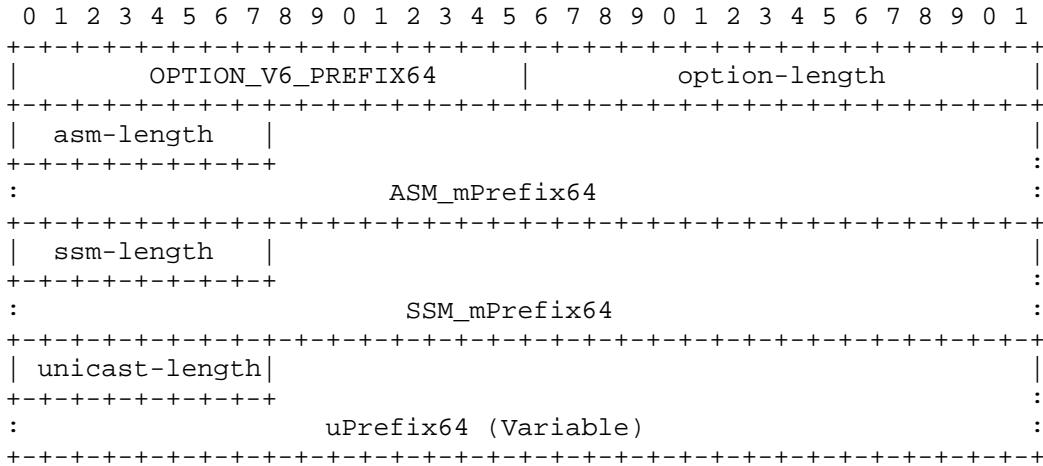


Figure 1: Option Format for OPTION_V6_PREFIX64

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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- [RFC8114] Boucadair, M., Qin, C., Jacquenet, C., Lee, Y., and Q. Wang, "Delivery of IPv4 Multicast Services to IPv4 Clients over an IPv6 Multicast Network", RFC 8114, DOI 10.17487/RFC8114, March 2017, <<http://www.rfc-editor.org/info/rfc8114>>.

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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