MBONED Working Group
Internet-Draft
Updates: 4291 (if approved)
Intended status: Standards Track
Expires: August 9, 2012

M. Boucadair, Ed.
France Telecom
J. Qin
ZTE
Y. Lee
Comcast
S. Venaas
Cisco Systems
X. Li
CERNET Center/Tsinghua University
M. Xu
Tsinghua University

February 06, 2012

IPv4-Embedded IPv6 Multicast Address Format
draft-ietf-mboned-64-multicast-address-format-00

Abstract

This document specifies an extension to the IPv6 multicast addressing architecture to be used in the context of IPv4-IPv6 interconnection. In particular, this document defines an address format for IPv4-embedded IPv6 multicast addresses. This address format can be used for IPv4-IPv6 translation or encapsulation schemes.

This document updates RFC4291.

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].

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference

material or to cite them other than as "work in progress."

This Internet-Draft will expire on August 9, 2012.

Copyright Notice

Table of Contents

1. Introduction

This document specifies an extension to the IPv6 multicast addressing architecture to be used in the context of IPv4-IPv6 interconnection. In particular, this document defines an address format for IPv4-embedded IPv6 multicast addresses. This address format can be used for IPv4-IPv6 translation or encapsulation schemes.

This document updates [RFC4291].

This specification can be used in conjunction with other extensions such as building unicast prefix-based multicast IPv6 address [RFC3306] or embedding the rendezvous point [RFC3956].

This document is a companion document to [RFC6052] which focuses exclusively on IPv4-embedded IPv6 unicast addresses.

Details about design choices are documented in Appendix A.

2. Terminology

This document makes use of the following terms:

- IPv4-embedded IPv6 multicast address: denotes a multicast IPv6 address which includes in 32 bits an IPv4 address. Two types of IPv6 addresses are defined that carry an IPv4 address in the low-order 32 bits of the address. The format to build such addresses is defined in Section 3 for ASM mode and Section 4 for SSM mode.

- Multicast Prefix64 (or MPREFIX64 for short) refers to an IPv6 multicast prefix to be used to construct IPv4-embedded IPv6 multicast addresses.

- ASM_MPREFIX64: denotes a multicast Prefix64 used in ASM mode. It follows the format described in Section 3.

- SSM_MPREFIX64: denotes a multicast Prefix64 used in SSM mode. It follows the format described in Section 4.

3. IPv4-Embedded IPv6 Multicast Address Format: ASM Mode

To meet the requirements listed in Appendix A.2, the following address format is defined to enclose an IPv4 multicast address when ASM mode is used:

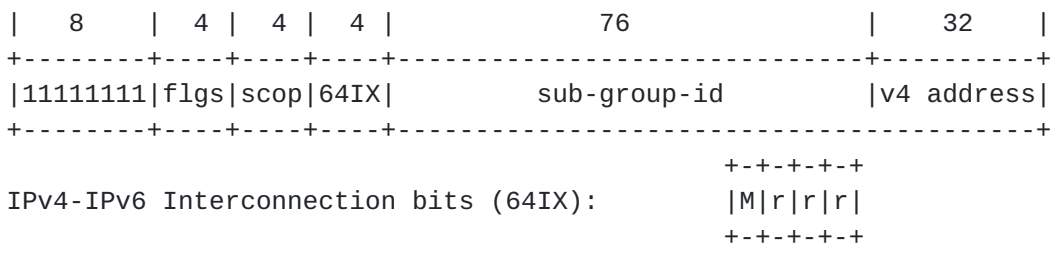


Figure 1: IPv4-Embedded IPv6 Multicast Address Format: ASM Mode

The description of the fields is as follows:

- "flgs" and "scop" fields are defined in [RFC4291].
- 64IX field (IPv4-IPv6 interconnection bits): The first bit is the M-bit. When "M-bit" is set to 1, it indicates that a multicast IPv4 address is embedded in the low-order 32 bits of the multicast IPv6 address. All the remaining bits are reserved and MUST be set to 0.
- sub-group-id: This field is configurable according to local policies of the entity managing the IPv4-IPv6 Interconnection Function. This field must follow the recommendations specified in [RFC3306] if unicast-based prefix is used or the recommendations specified in [RFC3956] if embedded-RP is used. The default value is all zeros.
- The low-order 32 bits MUST include an IPv4 multicast address when the M-bit is set to 1. The enclosed IPv4 multicast address SHOULD NOT be in 232/8 range.

4. IPv4-Embedded IPv6 Multicast Address Format: SSM Mode

As mentioned above, any IPv4-embedded IPv6 address used in SSM mode MUST be part of ff3x::/32 [RFC4607]. Figure 2 describes the format of the IPv6 multicast address to be used to enclose an IPv4 multicast address.

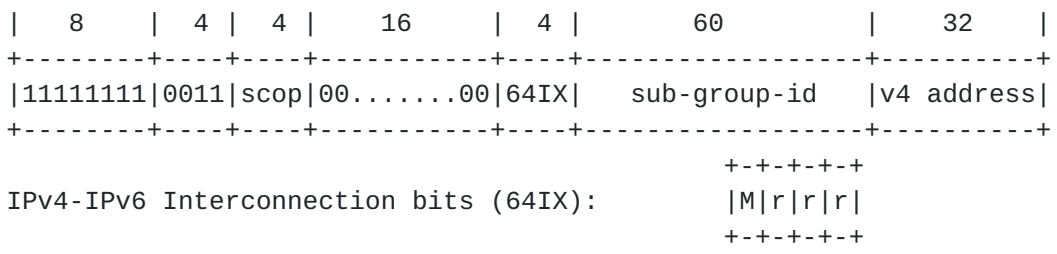


Figure 2: IPv4-Embedded IPv6 Multicast Address Format: SSM Mode

The description of the fields is as follows:

- Flags must be set to 0011.
- "scop" is defined in [RFC4291].
- 64IX field (IPv4-IPv6 interconnection bits): Same meaning as Section 3.
- sub-group-id: The default value is all zeros.
- The low-order 32 bits MUST include an IPv4 multicast address when the M-bit is set to 1. The embedded IPv4 address SHOULD be in the 232/8 range [RFC4607]. 232.0.0.1-232.0.0.255 range is being reserved to IANA.

5. Textual Representation

The embedded IPv4 address in an IPv6 multicast address is included in the last 32 bits; therefore dotted decimal notation can be used.

6. Multicast PREFIX64

For the delivery of the IPv4-IPv6 multicast interconnection services, a dedicated multicast prefix denoted as MPREFIX64 should be provisioned to any function requiring to build an IPv4-embedded IPv6 multicast address based on an IPv4 multicast address. MPREFIX64 can be of ASM or SSM type. When both modes are used, two prefixes are required to be provisioned.

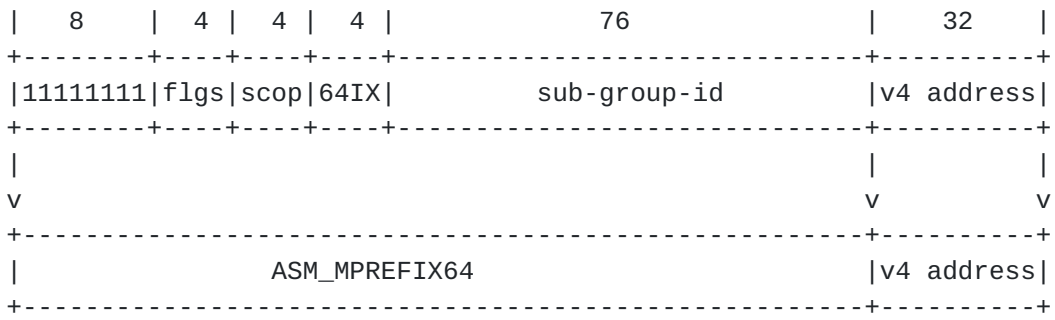
The structure of the MPREFIX64 follows the guidelines specified in Section 3 for the ASM mode and Section 4 when SSM mode is used.

The RECOMMENDED MPREFIX64 length is /96 (as shown in Figure 3).

The format of the MPREFIX64 should follow what is specified in [RFC3306] and [RFC3956] if corresponding mechanisms are used.

Note: the format specified in Section 3 uses some reserved bits defined in [RFC3306] and [RFC3956]: the first bit of the reserved bits have now a meaning, while the remaining bits MUST be set to 0.

ASM Mode:



SSM Mode:

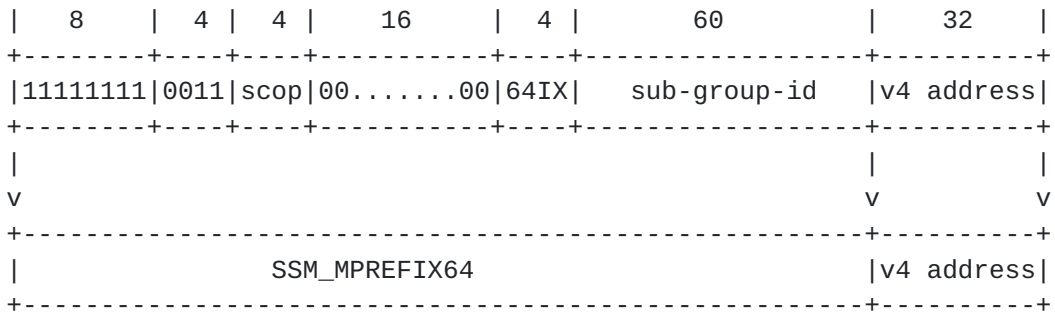


Figure 3: MPREFIX64

7. Source IPv4 Address in the IPv6 Realm

An IPv4 source is represented in the IPv6 realm with its IPv4-converted IPv6 address [RFC6052].

8. Examples

Figure 4 provides an example of ASM IPv4-Embedded IPv6 Address while Figure 4 provides an example of SSM IPv4-Embedded IPv6 Address.

MPREFIX64	IPv4 address	IPv4-embedded IPv6 address
ffxx:8000:abc::/96	224.1.2.3	ffxx:8000:abc::224.1.2.3

Figure 4: Example of ASM IPv4-embedded IPv6 address

MPREFIX64	IPv4 address	IPv4-embedded IPv6 address
ff3x:0:8000::/96	232.1.2.3	ffxx:0:8000::232.1.2.3

Figure 5: Example of SSM IPv4-embedded IPv6 address

9. IANA Considerations

Authors of this document request to reserve:

- ff3x:0:8000/33 SSM block to embed an IPv4 multicast address in the last 32 bits.
- ffxx:8000/17 ASM block to embed an IPv4 multicast address in the last 32 bits.

10. Security Considerations

This document defined an address format to embed an IPv4 multicast address in an IPv6 multicast address. The same security considerations as those discussed in [RFC6052] are to be taken into consideration.

11. Acknowledgements

Many thanks to R. Bonica, B. Sarikaya, P. Savola and T. Tsou for their comments and review.

12. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3306] Haberman, B. and D. Thaler, "Unicast-Prefix-based IPv6 Multicast Addresses", RFC 3306, August 2002.

[RFC3956] Savola, P. and B. Haberman, "Embedding the Rendezvous Point (RP) Address in an IPv6 Multicast Address", RFC 3956, November 2004.

[RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, February 2006.

[RFC4607] Holbrook, H. and B. Cain, "Source-Specific Multicast for IP", RFC 4607, August 2006.

[RFC6052] Bao, C., Huitema, C., Bagnulo, M., Boucadair, M., and X. Li, "IPv6 Addressing of IPv4/IPv6 Translators", RFC 6052, October 2010.

Appendix A. Design Choices

A.1. Location of the IPv4 Address

There is no strong argument to allow for flexible options to encode the IPv4 address inside the multicast IPv6 address. The option retained by the authors is to encode the multicast IPv4 address in the low-order 32 bits of the IPv6 address.

This choice is also motivated by the need to be compliant with [RFC3306] and [RFC3956].

A.2. Location of the M-bit

Figure 6 is a reminder of the IPv6 multicast address format as defined in [RFC4291]:

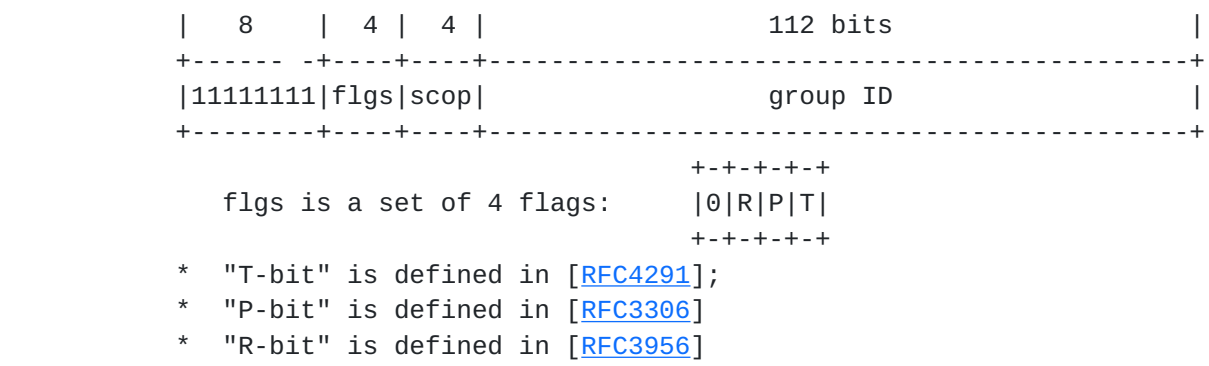


Figure 6: IPv6 Multicast address format as defined in RFC4291

It was tempting to use the remaining flag to indicate whether an IPv6 address embeds an IPv4 address or not. This choice has been abandoned by the authors for various reasons:

- ff3x::/32 is defined as SSM. Defining a new flag would require standards and implementations to also treat ffbx::/32 as SSM.
- Prefixes starting with ff7x are defined as embedded-RP, but not prefixes starting with fffx. Below is provided an excerpt from [RFC3956]:

  " ...the encoding and the protocol mode used when the two high-order bits in "flgs" are set to 11 ("fff0::/12") is intentionally unspecified until such time that the highest-order bit is defined. Without further IETF specification, implementations SHOULD NOT treat the fff0::/12 range as Embedded-RP."

  as such defining a new flag would require implementations to also treat ff7x::/12 as embedded-RP prefix.
- This is the last remaining flag and at this stage we are not sure whether there is other usage scenarios of the flag.

As a conclusion, the remaining flag is not used to indicate an IPv6 multicast address embeds an IPv4 multicast address. However the following constraints should be met:

(1) Belong to ff3x::/32 and be compatible with unicast-based prefix [RFC3306] for SSM. Note that [RFC3306] suggests to set "plen" to 0 and "network-prefix" to 0.
(2) Be compatible with embedded-RP [RFC3956] and unicast-based prefix [RFC3306] for ASM;
(3) Avoid ff3x::4000:0001-ff3x::7fff:ffff which is reserved for IANA.

Meeting (1) and (2) with the same location of the M-bit is not feasible without modifying embedded-RP and unicast-based prefix specifications; this option is avoided.

As a consequence, two multicast blocks are proposed to be used when

embedding IPv4 address: one block for ASM (Section 3) and another one for the SSM (Section 4).

A.3. Encapsulation vs. Translation

IPv4-IPv6 encapsulator and translator may be embedded in the same device or even implemented with the same software module. In order to help the function whether an encapsulated IPv6 multicast packets or translated IPv6 ones are to be transferred. It was tempting to define an S-bit for that purpose but this choice has been abandoned in favor of the recommendation to use distinct MPREFIX64 for each scheme.

As such, there is no need to reserve a bit in the IPv6 multicast address to separate between the translation and the encapsulation schemes.

Authors' Addresses

Mohamed Boucadair (editor)
France Telecom
Rennes, 35000
France

Email: mohamed.boucadair@orange.com

Jacni Qin
ZTE
Shanghai
China

Email: jacniq@gmail.com

Yiu L. Lee
Comcast
U.S.A

Email: yiu_lee@cable.comcast.com

Stig Venaas
Cisco Systems
Tasman Drive
San Jose, CA 95134
USA

Email: stig@cisco.com

Xing Li
CERNET Center/Tsinghua University
Room 225, Main Building, Tsinghua University
Beijing, 100084
P.R. China

Phone: +86 10-62785983
Email: xing@cernet.edu.cn

Mingwei Xu
Tsinghua University
Department of Computer Science, Tsinghua University
Beijing, 100084
P.R.China

Phone: +86-10-6278-5822
Email: xmw@cernet.edu.cn