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**Updates to the IPv6 Multicast Addressing Architecture**  
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Abstract

This document updates the IPv6 multicast addressing architecture by defining the 17-20 reserved bits as generic flag bits. The document provides also some clarifications related to the use of these flag bits.

This document updates [RFC 3956](#), [RFC 3306](#) and [RFC 4291](#).

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](#)].

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## [1.](#) Introduction

This document updates the IPv6 multicast addressing architecture [[RFC4291](#)] by defining the 17-20 reserved bits as generic flag bits ([Section 2](#)). The document provides also some clarifications related to the use of these flag bits ([Section 3](#)).

This document updates [[RFC3956](#)], [[RFC3306](#)], and [[RFC4291](#)]. These updates are logical consequences of the recommendation on the flag bits ([Section 3](#)).

Textual representation of IPv6 addresses included in the RFC updates follows the recommendation in [[RFC5952](#)].

## [2.](#) Addressing Architecture Update

Bits 17-20 of a multicast address are defined in [[RFC3956](#)] and [[RFC3306](#)] as reserved bits. This document defines these bits as generic flag bits so that they apply to any multicast address. Figure 1 and Figure 2 show the updated structure of the addressing architecture. The first diagram shows the update of the base IPv6 addressing architecture, and the second shows the update of so-called Embedded-RP.



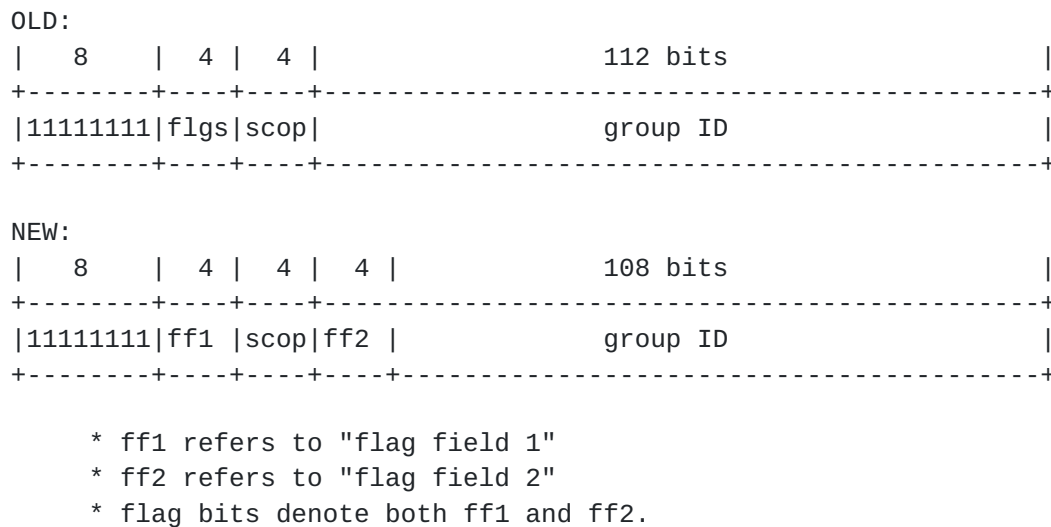


Figure 1: Updated IPv6 Multicast Addressing Architecture

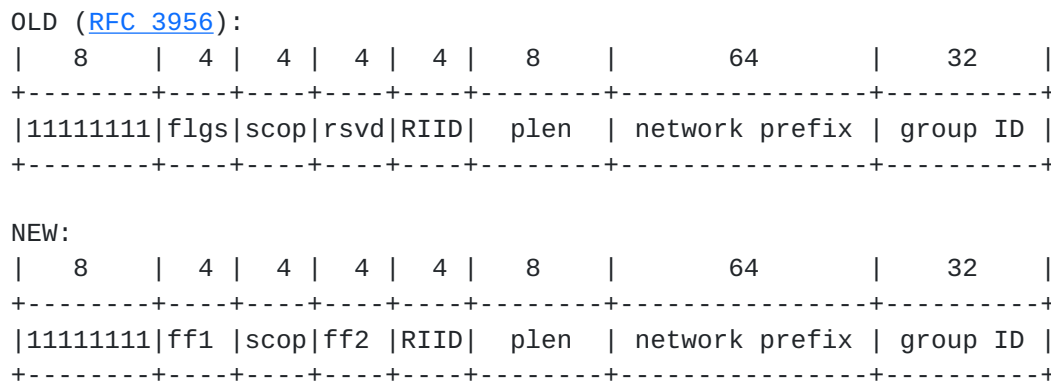


Figure 2: Embedded-RP with Updated IPv6 Multicast Address Arch.

Further specification documents may define a meaning for these flag bits. Defining the bits 17-20 as flags for all IPv6 multicast addresses allows addresses to be treated in a more uniform and generic way, and allows for these bits to be defined in the future for different purposes, irrespective of the specific type of multicast address.

### 3. Flag Bits: A Recommendation

Some implementations and specification documents do not treat the flag bits as separate bits but tend to use their combined value as a 4-bit integer. This practice is a hurdle for assigning a meaning to the remaining flag bits. Below are listed some examples for illustration purposes:



- o the reading of [\[RFC3306\]](#) may lead to conclude that ff3x::/32 is the only allowed SSM IPv6 prefix block.
- o [\[RFC3956\]](#) states only ff70::/12 applies to Embedded-RP. Particularly, implementations should not treat the fff0::/12 range as Embedded-RP.

To avoid such confusion and to unambiguously associate a meaning with the remaining flags, the following requirement is made

Implementations MUST treat flag bits as separate bits.

#### [4.](#) RFC Updates

##### [4.1.](#) [RFC 3306](#)

This document changes [Section 4 of \[RFC3306\]](#) as follows:

OLD:

```

| 8 | 4 | 4 | 8 | 8 | 64 | 32 |
+---+---+---+---+---+---+---+
|11111111|flgs|scop|reserved| plen | network prefix | group ID |
+---+---+---+---+---+---+---+

```

```

                                +-+-+-+-+
flgs is a set of 4 flags:      |0|0|P|T|
                                +-+-+-+-+

```

- o P = 0 indicates a multicast address that is not assigned based on the network prefix. This indicates a multicast address as defined in [\[ADDRARCH\]](#).
- o P = 1 indicates a multicast address that is assigned based on the network prefix.
- o If P = 1, T MUST be set to 1, otherwise the setting of the T bit is defined in [Section 2.7](#) of [\[ADDRARCH\]](#).

The reserved field MUST be zero.

NEW:



8	4	4	4	4	8	64	32
+-----+-----+-----+-----+-----+-----+-----+-----+							
11111111	ff1	scop	ff2	rsvd	plen	network prefix	group ID
+-----+-----+-----+-----+-----+-----+-----+-----+							

ff1 (flag field 1) is a set of 4 flags:

```

+-+--+--+
|X|Y|P|T|
+-+--+--+

```

X and Y may each be set to 0 or 1.

- o P = 0 indicates a multicast address that is not assigned based on the network prefix. This indicates a multicast address as defined in [\[RFC4291\]](#).
- o P = 1 indicates a multicast address that is assigned based on the network prefix.
- o If P = 1, T MUST be set to 1, otherwise the setting of the T bit is defined in [Section 2.7 of \[RFC4291\]](#).

ff2 (flag field 2) is a set of 4 flags:

```

+-+--+--+
|r|r|r|r|
+-+--+--+

```

where "rrrr" are for future assignment as additional flag bits.

Flag bits denote both ff1 and ff2.

This document changes [Section 6 of \[RFC3306\]](#) as follows:

OLD:

These settings create an SSM range of FF3x::/32 (where 'x' is any valid scope value). The source address field in the IPv6 header identifies the owner of the multicast address.

NEW:

If the flag bits in ff1 are set to 0011, these settings create an SSM range of ff3x::/32 (where 'x' is any valid scope value). The source address field in the IPv6 header identifies the owner of the multicast address. ff3x::/32 is not the only allowed SSM prefix range. For example if the most significant flag bit in ff1 is set, then we would get the SSM range ffbx::/32.





#### 4.2. [RFC 3956](#)

This document changes [Section 2 of \[RFC3956\]](#) as follows:

OLD:

As described in [\[RFC3306\]](#), the multicast address format is as follows:

```

|  8  |  4 |  4 |  8  |  8  |      64      |  32  |
+-----+-----+-----+-----+-----+-----+
|11111111|flgs|scop|reserved|plen| network prefix | group ID |
+-----+-----+-----+-----+-----+-----+

```

Where flgs are "0011". (The first two bits are as yet undefined, sent as zero and ignored on receipt.)

NEW:

The multicast address format is as follows:

```

|  8  |  4 |  4 |  4 |  4 |  8  |      64      |  32  |
+-----+-----+-----+-----+-----+-----+
|11111111|ff1 |scop|ff2 |rsvd|plen| network prefix | group ID |
+-----+-----+-----+-----+-----+-----+

```

ff1 (flag field 1) is a set of four flags:

```

+-+--+--+
|X|R|P|T|
+-+--+--+

```

X may be set to 0 or 1.

ff2 (flag field 2) is a set of 4 flags:

```

+-+--+--+
|r|r|r|r|
+-+--+--+

```

where "rrrr" are for future assignment as additional flag bits.

Flag bits denote both ff1 and ff2.

This document changes [Section 3 of \[RFC3956\]](#) as follows:

OLD:



```

|  8  |  4 |  4 |  4 |  4 |  8  |          64          |  32  |
+-----+-----+-----+-----+-----+-----+-----+-----+
|11111111|flgs|scop|rsvd|RIID|plen| network prefix | group ID |
+-----+-----+-----+-----+-----+-----+-----+-----+
                                     +-+--+--+
flgs is a set of four flags:      |0|R|P|T|
                                     +-+--+--+

```

When the highest-order bit is 0, R = 1 indicates a multicast address that embeds the address on the RP. Then P MUST be set to 1, and consequently T MUST be set to 1, as specified in [\[RFC3306\]](#). In effect, this implies the prefix FF70::/12. In this case, the last 4 bits of the previously reserved field are interpreted as embedding the RP interface ID, as specified in this memo.

The behavior is unspecified if P or T is not set to 1, as then the prefix would not be FF70::/12. Likewise, 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.

NEW:

```

|  8  |  4 |  4 |  4 |  4 |  8  |          64          |  32  |
+-----+-----+-----+-----+-----+-----+-----+-----+
|11111111|ff1 |scop|ff2 |RIID|plen| network prefix | group ID |
+-----+-----+-----+-----+-----+-----+-----+-----+
                                     +-+--+--+
ff1 is a set of four flags:      |X|R|P|T|
                                     +-+--+--+

X may be set to 0 or 1.

```

R = 1 indicates a multicast address that embeds the address of the RP. P MUST be set to 1, and consequently T MUST be set to 1, according to [\[RFC3306\]](#), as this is a special case of unicast-prefix based addresses. This implies that for instance prefixes ff70::/12 and fff0::/12 are embedded RP prefixes. The behavior is unspecified if P or T is not set to 1. When the R-bit is set, the last 4 bits of the field that were reserved in [\[RFC3306\]](#) are interpreted as embedding the RP interface ID, as specified in this memo.

This document changes [Section 4 of \[RFC3956\]](#) as follows:

OLD:



It MUST be a multicast address with "flgs" set to 0111, that is, to be of the prefix FF70::/12,

NEW:

It MUST be a multicast address with R-bit set to 1.

It MUST have P-bit and T-bit both set to 1 when using the embedding in this document as it is a prefix-based address.

This document changes [Section 7.1 of \[RFC3956\]](#) as follows:

OLD:

To avoid loops and inconsistencies, for addresses in the range FF70::/12, the Embedded-RP mapping MUST be considered the longest possible match and higher priority than any other mechanism.

NEW:

To avoid loops and inconsistencies, for addresses with R-bit set to 1, the Embedded-RP mapping MUST be considered the longest possible match and higher priority than any other mechanism.

## **5. IANA Considerations**

This document does not require any action from IANA.

## **6. Security Considerations**

Security considerations discussed in [\[RFC3956\]](#), [\[RFC3306\]](#) and [\[RFC4291\]](#) MUST be taken into account.

## **7. Acknowledgements**

Special thanks to B. Haberman for the discussions prior to the publication of this document.

Many thanks to J. Korhonen and T. Jinmei their comments.

## **8. Normative References**

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- [RFC5952] Kawamura, S. and M. Kawashima, "A Recommendation for IPv6 Address Text Representation", [RFC 5952](#), August 2010.

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