PIM Message Type Space Extension and Reserved Bits

Abstract

   The PIM version 2 messages share a common message header format. The
   common header definition contains eight reserved bits. This document
   specifies how these bits may be used by individual message types and
   extends the PIM type space.

   This document updates RFCs 7761 and 3973 by defining the use of the
   Reserved field in the PIM common header. This document further
   updates RFCs 7761 and 3973, along with RFCs 5015, 5059, 6754, and
   8364, by specifying the use of the bits for each PIM message.

   This document obsoletes RFC 8736.

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
   https://www.rfc-editor.org/info/rfc9436.

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1. Introduction

   The PIM version 2 messages share a common message header format
   defined in the PIM Sparse Mode specification [RFC7761]. The common
   header definition contains eight reserved bits. While all message
   types use this common header, there is no document formally
   specifying that these bits are to be used per message type.

   This document updates the definition of the Reserved field and refers
   to it as the "Flag Bits field". It specifies that the flag bits are
   to be separately used on a per-message-type basis. It updates the
   "PIM Message Types" registry to indicate the per-message-type usage.

   This document updates [RFC7761] and [RFC3973] by defining the use of
   the Reserved field in the PIM common header. This document further
   updates [RFC7761] and [RFC3973], along with [RFC5015], [RFC5059],
   [RFC6754], and [RFC8364], by specifying the use of the bits for each
   PIM message.

   The originally defined PIM message types were in the range from 0 to
   15. Message type 15 had been reserved by [RFC6166] for type space
   extension. In Section 5, this document specifies the use of the Flag
   Bits field for message types 13, 14, and 15 in order to extend the
   PIM type space. The type space extension in [RFC6166] was made
   obsolete by [RFC8736]. This document obsoletes [RFC8736].

2. Conventions Used in This Document

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and
   "OPTIONAL" in this document are to be interpreted as described in
   BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all
   capitals, as shown here.

3. PIM Header Common Format

   The common PIM header is defined in Section 4.9 of [RFC7761]. This
   document updates the definition of the Reserved field and refers to
   it as the "Flag Bits field". The updated common header format is as
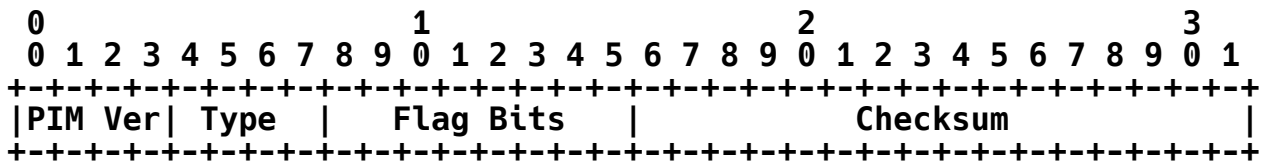   below.

```
 0                   1                   2                   3
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|PIM Ver| Type  |   Flag Bits   |            Checksum           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Updated Common Header

The Flag Bits field is defined in Section 4. All other fields remain
unchanged.

4. Flag Bit Definitions

Unless otherwise specified, all the flag bits for each PIM type are
Unassigned [RFC8126]. They MUST be set to zero on transmission, and
they MUST be ignored upon receipt. The specification of a new PIM
type MUST indicate whether the bits should be treated differently.

When defining flag bits, it is helpful to have a well-defined way of
referring to a particular bit. The most significant of the flag
bits, the bit immediately following the Type field, is referred to as
bit 7. The least significant, the bit right in front of the Checksum
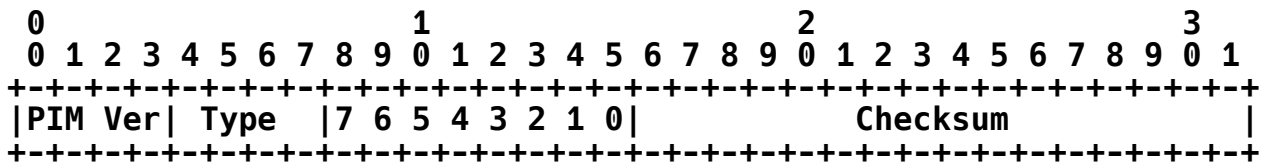field, is referred to as bit 0. This is shown in the diagram below.

```
 0                   1                   2                   3
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|PIM Ver| Type  |7 6 5 4 3 2 1 0|            Checksum           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2: Flag Bits

4.1. Flag Bits for Type 4 (Bootstrap)

PIM message type 4 (Bootstrap) [RFC5059] defines flag bit 7 as No-
Forward. The usage of the bit is defined in that document. The
remaining flag bits are unassigned.

4.2. Flag Bits for Type 10 (DF Election)

PIM message type 10 (DF Election) [RFC5015] specifies that the four
most significant flag bits (bits 4-7) are to be used as a subtype.
The usage of those bits is defined in that document. The remaining
flag bits are unassigned.

4.3. Flag Bits for Type 12 (PIM Flooding Mechanism)

PIM message type 12 (PIM Flooding Mechanism) [RFC8364] defines flag
bit 7 as No-Forward. The usage of the bit is defined in that
document. The remaining flag bits are unassigned.

4.4. Flag Bits for Types 13, 14, and 15 (Type Space Extension)

These types and the corresponding flag bits are defined in Section 5.

5. PIM Type Space Extension

This document extends types 13, 14, and 15 such that each becomes 16
new types, resulting in 48 types available for future PIM extensions.
This extension is achieved by defining a Subtype field (see Figure 3)
using the four most significant flag bits (bits 4-7). The notation
type.subtype is used to reference the new extended types. The
remaining four flag bits (bits 0-3, abbreviated as FB below) are to
be defined by each extended type.

Each of the extended types is represented by the eight bits resulting
from the concatenation of the Type and Subtype fields. No
relationship is expected or implied between extended type messages
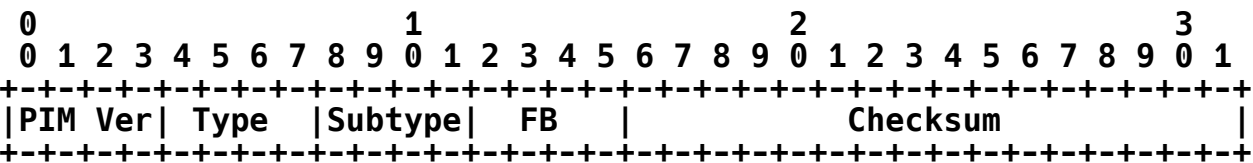with a common Type field.

```
 0                   1                   2                   3
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|PIM Ver| Type  |Subtype| FB    |            Checksum           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 3: Subtypes

6. Security Considerations

This document clarifies the use of the flag bits in the common PIM
header, and it extends the PIM type space. As such, there is no
impact on security or changes to the considerations in [RFC7761] and
[RFC3973].

7. IANA Considerations

This document updates the "PIM Message Types" registry to indicate
which flag bits are defined for use by each of the PIM message types
and changes their registration status to Unassigned except where the
bits have already been specified, as shown in Table 1. The
registration policy remains IETF Review [RFC8126]. Assignments to
this registry MUST define any non-default usage (see Section 4) of
the flag bits in addition to the type.

Extended type 15.15 is Reserved [RFC8126] for future extensions.

Because this document obsoletes [RFC8736], IANA has changed the
references to [RFC8736] in the registry to point to this document
instead.

The updated "PIM Message Types" registry is shown below.

Type	Name	Flag Bits	Reference
======	======	===========	===========
0	Hello	0-7: Unassigned	[RFC3973] [RFC7761]
1	Register	0-7: Unassigned	[RFC7761]

Type	Name	Flag Bits	Reference
2	Register Stop	0-7: Unassigned	[RFC7761]
3	Join/Prune	0-7: Unassigned	[RFC3973] [RFC7761]
4	Bootstrap	0-6: Unassigned	[RFC5059] [RFC7761]
		7: No-Forward	[RFC5059]
5	Assert	0-7: Unassigned	[RFC3973] [RFC7761]
6	Graft	0-7: Unassigned	[RFC3973]
7	Graft-Ack	0-7: Unassigned	[RFC3973]
8	Candidate RP Advertisement	0-7: Unassigned	[RFC7761]
9	State Refresh	0-7: Unassigned	[RFC3973]
10	DF Election	0-3: Unassigned	[RFC5015]
		4-7: Subtype	[RFC5015]
11	ECMP Redirect	0-7: Unassigned	[RFC6754]
12	PIM Flooding Mechanism	0-6: Unassigned	[RFC8364]
		7: No-Forward	[RFC8364]
13.0-15.14	Unassigned	0-3: Unassigned	
15.15	Reserved	0-3: Reserved	RFC 9436

Table 1: Updated PIM Message Types Registry

The unassigned types above, as explained in Section 5, use the extended type notation of type.subtype. Each extended type only has 4 flag bits available. New extended message types should be assigned consecutively, starting with 13.0, then 13.1, etc.

8. References

8.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
           Requirement Levels", BCP 14, RFC 2119,
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[RFC7761] Fenner, B., Handley, M., Holbrook, H., Kouvelas, I.,
           Parekh, R., Zhang, Z., and L. Zheng, "Protocol Independent
           Multicast - Sparse Mode (PIM-SM): Protocol Specification

(Revised)", STD 83, RFC 7761, DOI 10.17487/RFC7761, March 2016, <https://www.rfc-editor.org/info/rfc7761>.

[RFC8126] Cotton, M., Leiba, B., and T. Narten, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 8126, DOI 10.17487/RFC8126, June 2017, <https://www.rfc-editor.org/info/rfc8126>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

8.2. Informative References

[RFC3973] Adams, A., Nicholas, J., and W. Siadak, "Protocol Independent Multicast - Dense Mode (PIM-DM): Protocol Specification (Revised)", RFC 3973, DOI 10.17487/RFC3973, January 2005, <https://www.rfc-editor.org/info/rfc3973>.

[RFC5015] Handley, M., Kouvelas, I., Speakman, T., and L. Vicisano, "Bidirectional Protocol Independent Multicast (BIDIR-PIM)", RFC 5015, DOI 10.17487/RFC5015, October 2007, <https://www.rfc-editor.org/info/rfc5015>.

[RFC5059] Bhaskar, N., Gall, A., Lingard, J., and S. Venaas, "Bootstrap Router (BSR) Mechanism for Protocol Independent Multicast (PIM)", RFC 5059, DOI 10.17487/RFC5059, January 2008, <https://www.rfc-editor.org/info/rfc5059>.

[RFC6166] Venaas, S., "A Registry for PIM Message Types", RFC 6166, DOI 10.17487/RFC6166, April 2011, <https://www.rfc-editor.org/info/rfc6166>.

[RFC6754] Cai, Y., Wei, L., Ou, H., Arya, V., and S. Jethwani, "Protocol Independent Multicast Equal-Cost Multipath (ECMP) Redirect", RFC 6754, DOI 10.17487/RFC6754, October 2012, <https://www.rfc-editor.org/info/rfc6754>.

[RFC8364] Wijnands, IJ., Venaas, S., Brig, M., and A. Jonasson, "PIM Flooding Mechanism (PFM) and Source Discovery (SD)", RFC 8364, DOI 10.17487/RFC8364, March 2018, <https://www.rfc-editor.org/info/rfc8364>.

[RFC8736] Venaas, S. and A. Retana, "PIM Message Type Space Extension and Reserved Bits", RFC 8736, DOI 10.17487/RFC8736, February 2020, <https://www.rfc-editor.org/info/rfc8736>.

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