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Enhanced Alternate Marking Method
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Abstract

This document extends the IPv6 Alternate Marking Option to provide enhanced capabilities and allow advanced functionalities. With this extension, it can be possible to perform thicker packet loss measurements and more dense delay measurements with no limitation for the number of concurrent flows under monitoring.

Status of This Memo

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

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This Internet-Draft will expire on September 1, 2022.

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1. Introduction

The Alternate Marking [RFC8321] and Multipoint Alternate Marking [RFC8889] define the Alternate Marking technique that is a hybrid performance measurement method, per [RFC7799] classification of measurement methods. This method is based on marking consecutive batches of packets and it can be used to measure packet loss, latency, and jitter on live traffic.

The IPv6 AltMark Option [I-D.ietf-6man-ipv6-alt-mark] applies the Alternate Marking Method to IPv6, and defines an Extension Header Option to encode the Alternate Marking Method for both the Hop-by-Hop Options Header and the Destination Options Header. Similarly, SRv6 AltMark [I-D.fz-spring-srv6-alt-mark] defines how Alternate Marking data is carried as a TLV in the Segment Routing Header.

While the IPv6 AltMark Option implements the basic alternate marking methodology, this document defines extended data fields for the AltMark Option and provides enhanced capabilities to overcome some challenges and enable future proof applications.

It is worth mentioning that the enhanced capabilities are intended for further use and are optional.

Some possible enhanced applications MAY be:

1. thicker packet loss measurements: the single marking method of the base AltMark Option can be extended with additional marking bits in order to get shortest marking periods under the same timing conditions.

2. more dense delay measurements: than double marking method of the base AltMark Option can be extended with additional marking bits in order to identify down to each packet as delay sample.

3. increase the number of concurrent flows under monitoring: if the 20-bit FlowMonID is set independently and pseudo randomly, there is a 50% chance of collision for 1206 flows. The size of FlowMonIDcan can be extended to raise the entropy and therefore to increase the number of concurrent flows that can be monitored.

1.1. Requirements Language

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.

2. Data Fields Format

The Data Fields format is represented in Figure 1. A 4-bit NH(NextHeader) field is allocated from the Reserved field of IPv6 AltMark Option [I-D.ietf-6man-ipv6-alt-mark]. It is worth highlighting that remaining bits of the former Reserved field continue to be reserved.

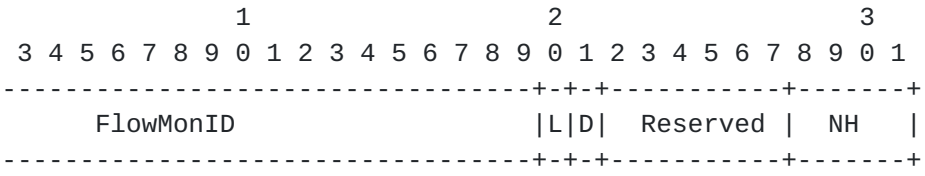

Figure 1: Data fields indicator for enhanced capabilities

The NH (NextHeader) field is used to indicate the extended data fields which are used for enhanced capabilities:

NextHeader value of 0x00 is reserved for backward compatibility. It means that there is no extended data field attached.

NextHeader values of 0x01-0x08 are reserved for private use or for experimentation.

NextHeader value of 0x09 indicates the extended data fields. The format is showed in Figure 2.

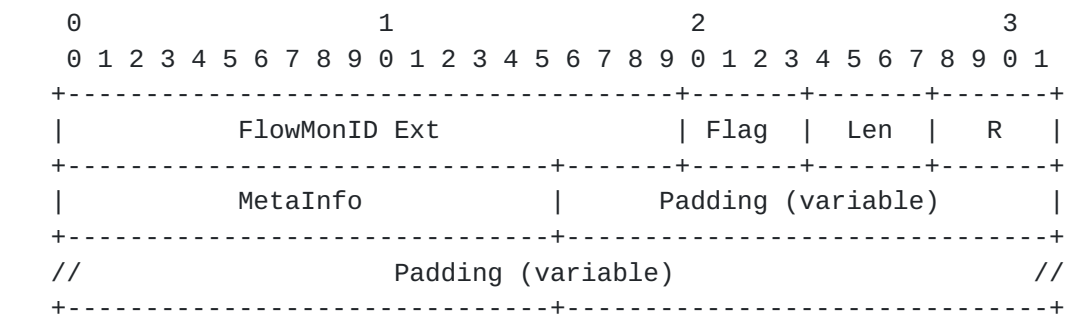

Figure 2: Data fields extension for enhanced alternate marking

where:

- FlowMonID Ext - 20 bits unsigned integer. This is used to extend the FlowMonID in order to reduce the conflict when random allocation is applied. The disambiguation of the FlowMonID field is discussed in IPv6 AltMark Option [I-D.ietf-6man-ipv6-alt-mark].

- Flag - A 4-bit flag to indicate the special purpose usage (see below).

- Len - Length. It indicates the length of the enhanced alternate marking extension in bytes.

- R - Reserved for further use. These bits MUST be set to zero on transmission and ignored on receipt.

- MetaInfo - A 16-bit Bitmap to indicate more meta data attached for the enhanced function (see below).

- Padding - These bits MUST be set to zero when not being used.

The Flag is defined in Figure 3 as:

- bit 0 - Measurement mode, M bit. If M=0, it indicates that it is for hop-by-hop monitoring. If M=1, it indicates that it is for end-to-end monitoring.

- bit 2 - Flow direction identification, F bit. This flag is used in the case backward direction flow monitoring is requested to be set up automatically. If F=1, it indicates that the flow direction is forward. If F=0, it indicates that the flow direction is backward.

- others (shown as R) - Reserved. These bits MUST be set to zero and ignored on receipt.

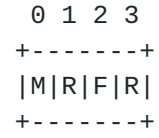

Figure 3: Flag data field

The MetaInfo is defined in the following Figure 4 as a bit map:

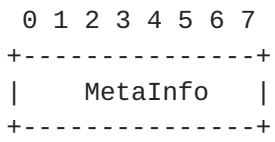

Figure 4: MetaInfo data field

- bit 0: it indicates a 6 bytes Timestamp that is attached as Padding after the MetaInfo. Timestamp(s) stands for the number of seconds in the timestamp. It will overwrite the Padding after MetaInfo. Timestamp(ns) stands for the number of sub-seconds in the timestamp with the unit of nano second. This Timestamp is filled by the encapsulation node, and is taken all the way to the decapsulation node. So that all the intermediate nodes could compare it with its local time, and measure the one way delay.

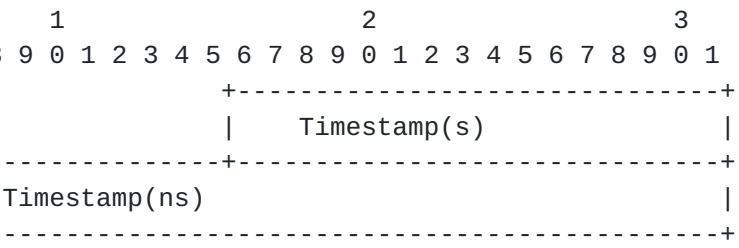

Figure 5: Timestamp data field

- bit 1: it indicates the control information with the following data format that is attached as Padding after the MetaInfo:

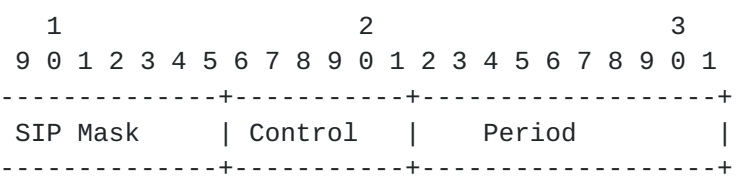

Figure 6: Control words for backward direction flow monitoring

This is used to set up the backward direction flow monitoring. Where:

* DIP Mask: it is the length of the destination IP prefix.

* SIP Mask: it is the length of the source IP prefix.

* Control: it indicates more match fields to set up the backward direction flow monitoring.

* Period: it indicates the alternate marking period with the unit of second.

o bit 2: it indicates a 4 bytes Sequence number with the following data format that is attached as Padding after the MetaInfo. The unique Sequence could be used to detect the out-of-order packets, in addition to the normal loss measurement. More over, the Sequence can be used together with the latency measurement, so as to get the per packet timestamp.

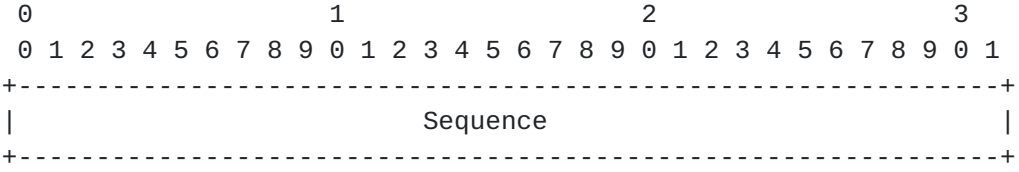

Figure 7: Sequence number data field

It is worth noting that the meta data information forming the Padding and specified above in Figure 5, Figure 6 and Figure 7 must be ordered according to the order of the MetaInfo bits.

3. Security Considerations

IPv6 AltMark Option [I-D.ietf-6man-ipv6-alt-mark] analyzes different security concerns and related solutions. These aspects are valid and applicable also to this document. In particular the fundamental security requirement is that Alternate Marking MUST only be applied in a specific limited domain, as also mentioned in [RFC8799].

4. IANA Considerations

This document has no request to IANA.

5. References

5.1. Normative References

[I-D.fz-spring-srv6-alt-mark]
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[I-D.ietf-6man-ipv6-alt-mark]
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5.2. Informative References

[RFC8321] Fioccola, G., Ed., Capello, A., Cociglio, M., Castaldelli, L., Chen, M., Zheng, L., Mirsky, G., and T. Mizrahi, "Alternate-Marking Method for Passive and Hybrid Performance Monitoring", RFC 8321, DOI 10.17487/RFC8321, January 2018, <https://www.rfc-editor.org/info/rfc8321>.

[RFC8799] Carpenter, B. and B. Liu, "Limited Domains and Internet Protocols", RFC 8799, DOI 10.17487/RFC8799, July 2020, <https://www.rfc-editor.org/info/rfc8799>.

[RFC8889] Fioccola, G., Ed., Cociglio, M., Sapio, A., and R. Sisto, "Multipoint Alternate-Marking Method for Passive and Hybrid Performance Monitoring", RFC 8889, DOI 10.17487/RFC8889, August 2020, <https://www.rfc-editor.org/info/rfc8889>.

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