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IPv6 Application of the Alternate Marking Method
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Abstract

This document describes how the Alternate Marking Method can be used as the passive performance measurement tool in an IPv6 domain and reports implementation considerations. It proposes how to define a new Extension Header Option to encode alternate marking technique and also considers the Segment Routing Header TLV alternative.

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

[RFC8321] and [I-D.ietf-ippm-multipoint-alt-mark] describe passive performance measurement method, which can be used to measure packet loss, latency and jitter on live traffic. Since this method is based on marking consecutive batches of packets, the method often referred as Alternate Marking Method.

This document defines how the alternate marking method can be used to measure packet loss and delay metrics of IPv6. Consequently, the SRv6 (Segment Routing over IPv6 data plane) application is also discussed. Both Extension Header (EH) Option and Segment Routing Header (SRH) TLV are considered here.

The format of the IPv6 addresses is defined in [RFC4291]. [RFC8200] introduces the IPv6 Header Format, including the Extension Headers in the base IPv6 Header and the availability of a 20-bit flow label. In this respect, [I-D.fioccola-v6ops-ipv6-alt-mark] reported a summary on the possible implementation options for the application of the alternate marking method in an IPv6 domain. This document, starting from the outcome of [I-D.fioccola-v6ops-ipv6-alt-mark], introduces a new Option/TLV that can be encoded as EH Option or as SRH TLV.

[I-D.zhou-ippm-enhanced-alternate-marking] defines the data fields for the alternate marking in order to generalize its application. More information can be considered within the alternate marking field to facilitate the efficiency and ease the deployment.

[I-D.song-opsawg-ifit-framework] introduces the telemetry architecture and [I-D.song-ippm-postcard-based-telemetry] defines the Postcard-Based Telemetry with Packet Marking (PBT-M). PBT-M marks the user packets (set one bit) or configure the flow filter to invoke the data collection. At each PBT-aware node, if the mark is detected, a postcard is generated and sent to a collector.

2. IPv6 application of the Alternate Marking

The application of the alternate marking requires a marking field. As mentioned, several alternatives have been analysed in [I-D.fioccola-v6ops-ipv6-alt-mark] (Extension Header, IPv6 Address, Flow Label). Anyway the best choice would be the use of an Extension Header(EH) Option or TLV.

A new Option/TLV can be defined for this scope. This approach follows [RFC8200] that strongly recommended against creating new EHs especially with hop by hop behaviour.

The document aims to be general for IPv6 data plane. A possibility can be to use a Destination or a Hop-By-Hop(HBH) Extension Header(EH). The assumption is that an EH with an alternate marking measurement option can be defined. The router processing can be easily optimized to handle this use case. For SRv6, SRH TLV (as described in [I-D.ietf-6man-segment-routing-header]) can be a good choice to encode the Data fields.

The main objective is to ensure enough space to implement and optimize the deployment of the Alternate Marking method and the introduction of a monitored flow identification field (FlowMonID), as described in the next Section goes in this direction. FlowMonID is also introduced in [I-D.zhou-ippm-enhanced-alternate-marking].

Note that FlowMonID is different from the Flow Label field of the IPv6 Header ([RFC8200]). Flow Label is used for application service, like LB/ECMP and QoS. Instead, FlowMonID is only used to identify the monitored flow. The reuse of flow label field for monitored flow identification is not considered since it may change the application intent and forwarding behaviour, so that the measurement does not align with the original traffic. Furthermore the flow label may be changed en route and this may also violate the measurement task. That is to explain the reason why we need to introduce FlowMonID for

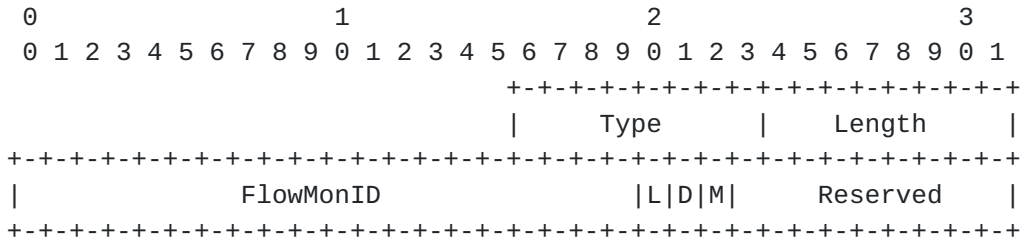
IPv6. Flow Label and FlowMonID within the same packet have different scope, identify different flows, different usage.

3. Definition of the AltMark Option/TLV

The desired choice is to define a new Extension Header Option/TLV. [I-D.zhou-ippm-enhanced-alternate-marking] generalizes the data fields for the alternate marking method and inspired the layout.

3.1. Data Fields Format

The following figure shows the data fields format for enhanced alternate marking EH Option/TLV. This AltMark data is expected to be encapsulated to specific encapsulation, e.g. the IPv6 Option or SRH TLV.



where:

- Type/Option Type: 8 bit identifier of the type of Option/TLV that needs to be allocated. Unrecognised Types MUST be ignored on receipt.

- Length/Opt Data Len: The length of the length Data Fields of this Option/TLV in bytes.

- FlowMonID: 20 bits unsigned integer. The FlowMon identifier field is to uniquely identify a monitored flow within the measurement domain. The field is set at the ingress node. The FlowMonID can be uniformly assigned by the central controller or algorithmically generated by the ingress node. The latter approach cannot guarantee the uniqueness of FlowMonID but it may be preferred for local or private network, where the conflict probability is small due to the large FlowMonID space.

- L: Loss flag as defined in [RFC8321];

- D: Delay flag as defined in [RFC8321];

- M: Marking bit as defined in PBT-M [I-D.song-ippm-postcard-based-telemetry];

- Reserved: is reserved for further use. These bits MUST be set to zero.

4. AltMark: EH Option or SRH TLV

Using a new EH Option assumes that all routers in the domain support this type of headers, but, beyond backward compatibility, the new AltMark Option Layout seems the best way to implement the Alternate Marking method.

It is important to highlight that the Option Layout can be used both as Destination Option and as Hop-By-Hop Option depending on the Use Cases. In general, it is needed to perform end-to-end or hop-by-hop measurements, and the alternate marking methodology in [RFC8321] allows, by definition, both end-to-end and hop-by-hop performance measurements.

So, Hop-By-Hop Options Header or Destination Options Header can be used based on the chosen type of performance measurement.

SRv6 is a subset of IPv6 and it is one type of routing header. Like any other use case of IPv6, HBH and Destination options are useable when SRv6 header is present. Because SRv6 is a routing header, destination options before the routing header are processed by each destination in the route list.

SRH TLV can also be used to encode the AltMark Data Fields for SRv6. Furthermore the intermediated nodes that are not in the SID list may consider the SRH as a green field, therefore they cannot support and bypass or support and dig into the SRH TLV.

In summary, it is possible to list the alternative options:

Destination Option => measurement only by node in Destination Address.

Hop-By-Hop Option => every router on the path with feature enabled.

SRH TLV => every node along the SR path.

Destination Option + SRH => every node along the SR path.

Note that the SRH TLV and Destination Option + SRH can be considered equivalent; so in this case it may be preferred the use of SRH TLV.

In addition to the previous alternatives, for legacy network it is possible to mention a non-conventional application of SRH TLV and

Destination Option for the hop-by-hop usage. [RFC8200] defines that the nodes along a path examine and process the Hop-by-Hop Options header only if HBH processing is explicitly configured. But, on the other hand, using SRH TLV or Destination Option for hop-by-hop action would cause worse performance than Hop-By-Hop. The only motivation for hiding the hop-by-hop options inside of destination options can be for compatibility reasons. Anyway this is not recommended.

5. Alternate Marking Method Operation

[RFC8321] and [I-D.ietf-ippm-multipoint-alt-mark] describe in detail the methodology.

6. Security Considerations

tbc

7. IANA Considerations

The option type should be assigned in IANA's "Destination Options and Hop-by-Hop Options" registry. Also, the TLV type should be assigned from Segment Routing Header TLVs Registry.

8. Acknowledgements

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9. References

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