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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 the Segment Routing case is discussed.

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 a 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 is often referred as Alternate Marking Method.

[I-D.song-opsawg-ifit-framework] introduces the telemetry architecture that can be considered as reference.

This document defines how the Alternate Marking Method ([RFC8321]) can be used to measure packet loss and delay metrics in IPv6.

The format of the IPv6 addresses is defined in [RFC4291] while [RFC8200] defines the IPv6 Header, including a 20-bit Flow Label and

the IPv6 Extension Headers. The Segment Routing Header (SRH) is defined in [RFC8754].

[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 TLV that can be encoded in the Option Headers (both Hop-by-Hop or Destination) for the purpose of the Alternate Marking Method application in an IPv6 domain. The case of SRH ([RFC8754]) is also discussed.

2. IPv6 application of the Alternate Marking

The Alternate Marking Method requires a marking field. As mentioned, several alternatives have been analysed in [I-D.fioccola-v6ops-ipv6-alt-mark] such as IPv6 Extension Headers, IPv6 Address and Flow Label.

The preferred choice would be the use of a new TLV to be encoded in the Option (Hop-by-Hop or Destination) Header.

This approach is compliant with [RFC8200] that clearly states the use of existing EH rather than defining new ones especially with hop by hop behaviour.

In order to optimize implementation and scaling of the Alternate Marking Method, a way to identify flows is required. The Flow Monitoring Identification field (FlowMonID), as introduced in the next section, goes in this direction and it is used to identify a monitored flow.

The Flow Monitoring Identification (FlowMonID) is required for some general reasons:

First, it helps to reduce the per node configuration. Otherwise, each node needs to configure an access-control list (ACL) for each of the monitored flows. Moreover, using a flow identifier allows a flexible granularity for the flow definition.

Second, it simplifies the counters handling. Hardware processing of flow tuples (and ACL matching) is challenging and often incurs into performance issues, especially in tunnel interfaces.

Third, it eases the data export encapsulation and correlation for the collectors.

Note that the FlowMonID is different from the Flow Label field of the IPv6 Header ([RFC8200]). Flow Label is used for application service,

like load-balancing/equal cost multi-path (LB/ECMP) and QoS. Instead, FlowMonID is only used to identify the monitored flow. The reuse of flow label field for identifying monitored flows is not considered since it may change the application intent and forwarding behaviour. Furthermore the flow label may be changed en route and this may also violate the measurement task. Those reasons make the definition of the FlowMonID necessary for IPv6. Flow Label and FlowMonID within the same packet have different scope, identify different flows, and associate different uses.

3. Definition of the AltMark TLV

The desired choice is to define a new TLV for the Option Extension Headers, carrying the data fields dedicated to the alternate marking method.

3.1. Data Fields Format

The following figure shows the data fields format for enhanced alternate marking TLV. This AltMark data is expected to be encapsulated in the IPv6 Option (Hop-by-Hop or Destination).

```
 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
                                +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                                |      Type     |     Length    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              FlowMonID                |L|D|     Reserved      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

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. [RFC8200] defines how to encode the three high-order bits of the Option Type field. The two high-order bits specify the action that must be taken if the processing IPv6 node does not recognize the Option Type; for AltMark these two bits MUST be set to 00 (skip over this Option and continue processing the header). The third-highest-order bit specifies whether or not the Option Data can change en route to the packet's final destination; for AltMark the value of this bit MUST be set to 0 (Option Data does not change en route).

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

- o 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.

- o L: Loss flag for Single-Marking as defined in [RFC8321];

- o D: Delay flag for Double-Marking as defined in [RFC8321];

- o Reserved: is reserved for future use. These bits MUST be set to zero on transmission and ignored on receipt.

4. AltMark: EH Option or SRH TLV

Using a new EH Option assumes that all routers in the domain support this type of headers even if an unrecognized EH Option may be just ignored without impacting the traffic. So, 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 both end to end and hop by hop measurements, and the alternate marking methodology in [RFC8321] allows, by definition, both performance measurements.

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

SRv6 leverages the Segment Routing header which consists of a new 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. But the usage of SRH TLV is still under discussion within the community and so it is not the preferred solution.

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 that is an identity in the SR path.

Destination Option + SRH => every node that is an identity in the SR path.

Note that the SRH TLV and Destination Option + SRH could be considered equivalent. Anyway, in general, HBH and Destination Options are the most suitable ways to implement Alternate Marking.

New Hop-by-Hop Options are not recommended because nodes may be configured to ignore the Options Header, drop or assign packets containing an Options Header to a slow processing path ([RFC7045] and [RFC8200]). For this reason, there has to be a clear justification to standardize a new Hop-by-Hop Option. Indeed, in case of the AltMark data fields described in this document, the new Hop-by-Hop Option is needed for OAM and an intermediate node can read it or not but, this does not affect the packet behavior. The source node is the only one that writes the Hop-by-Hop Option to mark alternately the flow, so, the performance measurement can be done for those nodes configured to read this Option, while the others are simply not considered for the metrics. Moreover, in case of SRv6, the use of SRH TLV for every node along the SR path could also be a good choice to implement hop by hop measurements.

In addition to the previous alternatives, for legacy network it is possible to mention a non-conventional application of the 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. On the other hand, using the SRH TLV or Destination Option for hop by hop action would cause worse performance than Hop-by-Hop. The only motivation for the hop by hop usage of Destination Options can be for compatibility reasons but in general it 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

This document aims to apply a method to perform measurements that does not directly affect Internet security nor applications that run on the Internet. However, implementation of this method must be mindful of security and privacy concerns, as explained in [RFC8321].

7. IANA Considerations

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

This draft requests the following IPv6 Option Type assignments from the Destination Options and Hop-by-Hop Options sub-registry of Internet Protocol Version 6 (IPv6) Parameters (https://www.iana.org/assignments/ipv6-parameters/).

Hex Value	Binary Value act chg rest	Description	Reference
TBD	00 0 tbd	AltMark	[This draft]

8. Acknowledgements

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9. References

9.1. Normative References

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