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Using the IPv6 Flow Label for Performance Measurement with Alternate Marking Method in Segment Routing
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Abstract

[RFC6294] makes a survey of Proposed Use Cases for the IPv6 Flow Label. The IPv6 protocol includes a flow label in every packet header, but this field is not used in practice. This document describes how the alternate marking method can be used as the passive performance measurement method in a IPv6 domain.

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].

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 November 23, 2017.

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1. Introduction

The IPv6 Header Format defined in RFC2460 introduces the availability of an 20-bit flow label in the base IPv6 Header.

The general feeling is to consider flow-label a non-permutable field, unpredictable and ill defined. It has been useless 20 bits in IPv6 header (and it is not expected to change).

[RFC6436] and [RFC6437] open the door for IPv6 Flow Label to be used in controlled environment, e.g. for IPv6 tunneled packets or SRv6 policies. For example [RFC6438] describes the use of the IPv6 Flow Label field for load distribution purpose, especially across Equal Cost Multi-Path (ECMP) and/or Link Aggregation Group (LAG) paths.

But, a specific goal presented in [RFC6437] is to enable and encourage the use of the flow label. In fact it is important to underline two aspects from this specification:

- It encourages non-zero flow label values to be used and clearly defines how to set a non-zero value.
- It retains the rule that the flow label must not be changed en route but allows routers to set the label on behalf of hosts that do not do so.

Based on these considerations, it is allowed to use the flow label field in a managed domain, assuming when a packet leaves the domain, the original flow label value has to be restored.

[I-D.ietf-ippm-alt-mark] describes passive performance measurement method, which can be used to measure packet loss, latency and jitter on live traffic. Because 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 tunneled packets or SRv6 policies.

2. IPv6 Flow Labels and Alternate Marking

The application of the Alternate Marking method in a managed and controlled domain is realized with two fundamental assumptions:

- The original flow-label reconstructed when leaving SP controlled domain.
- The usage of IPv6 tunnels (IPv6inIPv6, IPSec, IPv6 UDP, etc..) or SRv6 policies.

2.1. IPv6 Tunnel

The ingress router is the "source" of the IPv6 tunnel and impose the OUTER IPv6 header, so Ingress router can control the Flow-label of OUTER IPv6 header. The Egress router removes OUTER IPv6 header, restoring ORIGINAL payload (IPv6, IPv4, L2 traffic, MBH, etc...).

2.2. SRv6 Policy

When IPv6 SRv6 Encapsulation is used, the outer SRv6 header uses 2 bits (Mark Field) from 20 bit flow-label field. Outer SRv6 header

will be removed when exiting the SP domain and the original Flow-label is restored at egress.

When IPv6 SRv6 EH insertion is used, there is the insertion of IPv6 Extension Headers (however in RFC2460bis it was ruled against insertion of EHs, making SRv6 header insert future uncertain). In this case the original flow-label can be carried as Opaque data TLV in SRv6 headers, and by egress device used for original header construction.

3. Alternate Marking Method Operation

The Figure 1 displays format of the Mark field (2 bits from 20 bit IPv6 flow-label field).

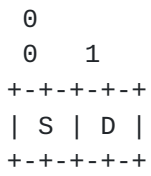

Figure 1: Mark field format

where:

- S - Single mark method;
- D - Double mark method.

3.1. Single Mark Measurement

As explained in the [I-D.ietf-ippm-alt-mark], marking can be applied to delineate blocks of packets based either on equal number of packets in a block or based on equal time interval. The latter method offers better control as it allows better account for capabilities of downstream nodes to report statistics related to batches of packets and, at the same time, time resolution that affects defect detection interval.

If the Single Mark measurement used, then the D flag MUST be set to zero on transmit and ignored by monitoring point.

The S flag is used to create alternate flows to measure the packet loss by switching value of the S flag. Delay metrics MAY be calculated with the alternate flow using any of the following methods:

- o First/Last Batch Packet Delay calculation: timestamps are collected based on order of arrival so this method is sensitive to packet loss and re-ordering.

- o Average Packet Delay calculation: an average delay is calculated by considering the average arrival time of the packets within a single block. This method only provides single metric for the duration of the block and it doesn't give information about the delay distribution.

3.2. Double Mark Measurement

Double Mark method allows more detailed measurement of delays for the monitored flow but it requires more nodal and network resources. If the Double Mark method used, then the S flag MUST be used to create the alternate flow. The D flag MUST be used to mark single packets to measure delay jitter.

The first marking (S flag alternation) is needed for packet loss and also for average delay measurement. The second marking (D flag is put to one) creates a new set of marked packets that are fully identified and dedicated for delay. This method is useful to have not only the average delay but also to know more about the statistic distribution of delay values.

4. Security Considerations

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5. Acknowledgements

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6. IANA Considerations

7. References

7.1. Normative References

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7.2. Informative References

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