IPv6 Performance Measurement with Alternate Marking Method

draft-fioccola-v6ops-ipv6-alt-mark-00

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RFC 8321 at a glance

Alternate Marking methodology is an OAM PM technique and enables Packet Loss, Delay and Delay Variation measurements.

- Every marking interval (e.g. 5 minutes) the packet mark is changed between Red and Blue.

- When the Red packet counters are running the Blue counters are still and viceversa.

- Packet Loss calculation by comparing the counters for each block.

- Also Delay and Delay Variation can be measured.

Main Strengths of the methodology:

- It works on Real Production Traffic

- It works even in case of Out of Sequence.

- It works on not synchronized networks (strict sync is not needed!)

- It works without OAM packets to divide «precisely» traffic blocks.

OAM RFC 8321 Applications in IETF

There are three documents that defines how to use two bits long field to perform alternate marking method in BIER, SFC and NVO3:
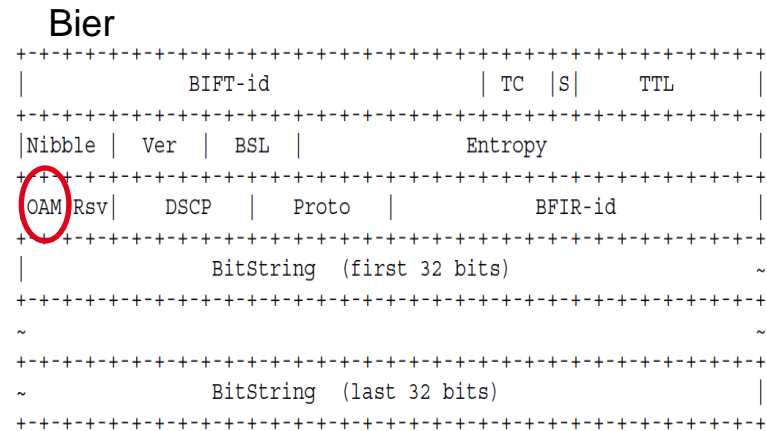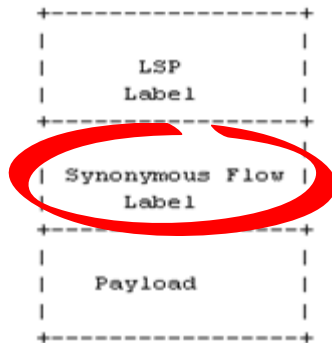
draft-ietf-bier-pmmm-oam

draft-mirsky-sfc-pmamm

draft-fmm-nvo3-pm-alt-mark

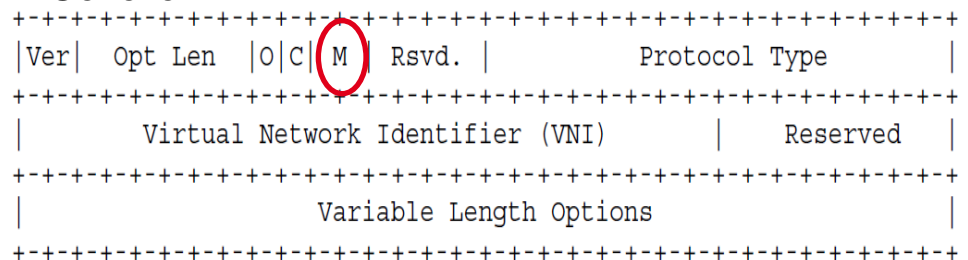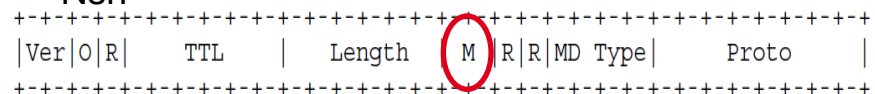Marking Method Application to MPLS RFC6374:

draft-ietf-mpls-rfc6374-sfl

Bier

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   BIFT-id            | TC |S|     TTL         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Nibble|  Ver  |  BSL  |              Entropy                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|OAM|Rsv|   DSCP  |  Proto  |            BFIR-id                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   BitString  (first 32 bits)                 ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                   BitString  (last 32 bits)                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

MPLS
Label
Stack
with SFL

```
+-------------------+
|                   |
|      LSP          |
|      Label        |
+-------------------+
|                   |
| Synonymous Flow   |
|      Label        |
+-------------------+
|                   |
|     Payload       |
|                   |
+-------------------+
```

Geneve

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Ver|  Opt Len  |O|C| M| Rsvd. |          Protocol Type        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Virtual Network Identifier (VNI)      |   Reserved   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Variable Length Options                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Nsh

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Ver|O|R|    TTL    |   Length   | M |R|R|MD Type|     Proto    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
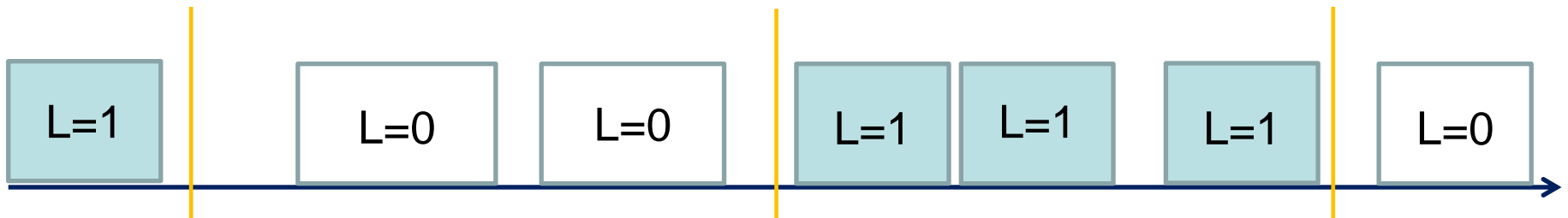
- There is also an alternate marking variation in QUIC:
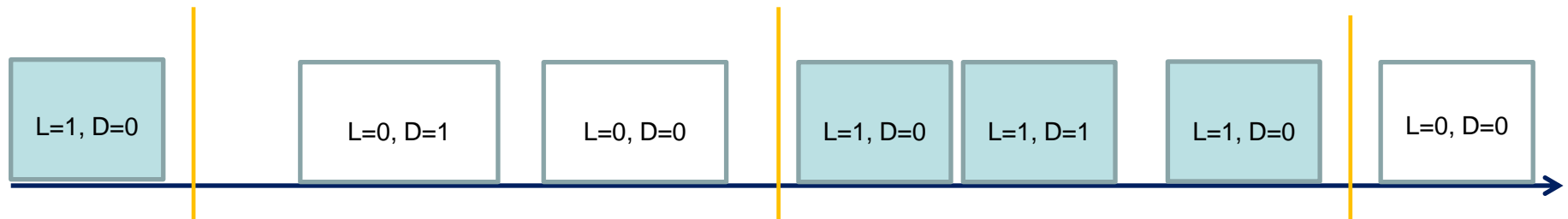
draft-trammell-quic-spin

Single Mark Method

- Batching packets based on time interval to measure packet loss by switching value of the L flag. D flag MUST be set to 0 on transmit and ignored on receipt.

- First/Last Packet Delay calculation:
  - capture timestamp of when L flag value flips. Method is sensitive to packet loss and packet re-ordering

- Average Packet Delay calculation:
  - collect timestamps for each packet received within a single block. Average of the timestamp is the sum of all the timestamps divided by the total number of packets received. Hence minimally impacted by a packet loss and no impact if packets get re-ordered.

- Average Delay Variation calculation is possible

| L=1 | | L=0 | L=0 | | L=1 | L=1 | L=1 | | L=0 |

Double Mark Method

- Use L flag to create batch of packets as in Single Mark method
- Use D flag to create new set of marked packets that are fully identified over the NVO3 network
- Collect and compare timestamps on D-marked packets to calculate more informative one-way packet delay metrics, such as minimum, maximum delay, median and percentiles values.
- Double mark method may be implemented by multiplexing fields or making certain assumptions about characteristic information that identifies the flow. See also draft-mizrahi-ippm-compact-alternate-marking

| L=1, D=0 | | L=0, D=1 | L=0, D=0 | L=1, D=0 | L=1, D=1 | L=1, D=0 | L=0, D=0 |

What about IPv6

Each of the layers is responsible for its own OAM.

This document reports a summary on the possible implementation options for the application of the alternate marking method in an IPv6 domain.

The IPv6 Header Format defined in RFC8200 introduces the availability of a 20-bit flow label, the format of IPv6 addresses and the Extension Headers in the base IPv6 Header.
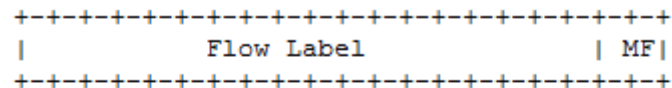
The application of the alternate marking requires a marking field.

The alternatives that can be taken into consideration for the choice of the marking field are the following:
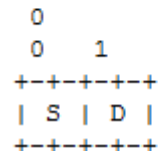
- Extension Header
- IPv6 Address
- Flow Label

Which Marking Field for IPv6?

- **IPv6 Extension Headers as Marking Field**: A new type of EH may be a proposal (e.g. RFC8250 gives a chance). A possibility can be to use a Hop-By-Hop(HBH) Extension Header(EH). But having a EH seems less backward compatible.

- **IPv6 Addresses as Marking Field**: Using the DA to encode this alternate marking processing means that it is easy to retrofit into existing devices and models. But using DA for marking seems expensive.

- **IPv6 Flow Label as Marking Field**: The flow-label as marking field is something that routers can do right now and this allows less bits on the wire. But RFC6438 describes flow-label based load balancing, ECMP or LAG.

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               Flow Label              | MF|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


Mark Field (MF) is:

 0
 0   1
+-+-+-+-+
| S | D |
+-+-+-+-+
```

Reviews and Feedbacks

We got some comments on V6OPS mailing list and the main points of discussion were:

- If we use 1 or 2 bits of the flow label for marking, does 18 or 19 bits of entropy give enough entropy for flow-label based ECMP? Could the flow label be overloaded?

- Would it be a better solution to put marking into an option for Hop-by-Hop or Destination Options extension?

- Adding a marking field to an existing proposed EH or defining a new EH?

- Might it be possible to use a marking field from an extensible encapsulation, such as GUE, to carry the passive measurement bits, as discussed in NVO3?

- Should the intended status of the draft be standard, informational or experimental?

Next Steps

- Find an agreed way to apply RFC 8321 for IPv6
- Add Multipoint Alternate Marking Use Case
   (see draft-fioccola-ippm-multipoint-alt-mark)
- Adopt by WG
- Welcome questions, comments
- Address comments

Thank you