        Performance Measurement (PM) with Alternate Marking Method in Service
                    Function Chaining (SFC) Domain
                      draft-mirsky-sfc-pmamm-01

   Abstract

      This document describes how the alternate marking method be used as
      the passive performance measurement method in a Service Function
      Chaining (SFC) domain.

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1.  Introduction

   [RFC7665] introduced architecture of a Service Function Chain (SFC)
   in the network and defined its components as classifier, Service
   Function Forwarder (SFF), and Service Function (SF).
   [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 (AMM).

   This document defines how the alternate marking method can be used to
   measure packet loss and delay metrics of a service flow over e2e or
   any segment of the SFC.

2.  Conventions used in this document

2.1.  Terminology

   MM: Marking Method

   OAM: Operations, Administration and Maintenance

   SFC: Service Function Chain

   SF: Service Function

   SFF: Service Function Forwarder

   SFP: Service Function Path

   NSH: Network Service Header

## 2.2. 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.

## 3. Mark Field in NSH Base Header

   [I-D.ietf-sfc-nsh] defines format of the Network Service Header
   (NSH).

```
   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
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  |Ver|O|R|    TTL    |   Length  | M |R|R|MD Type|    Proto      |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
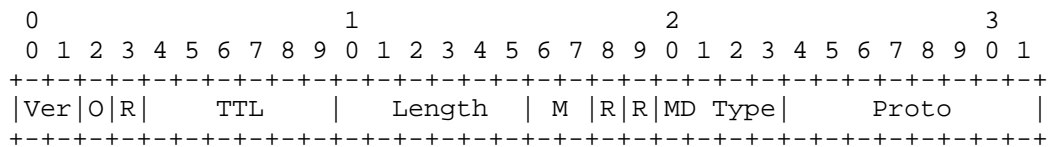
                       Figure 1: NSH Base format

   This document defines two bit long field, referred as Mark field (M
   in Figure 1, as part of NSH Base and designated for the alternate
   marking performance measurement method [I-D.ietf-ippm-alt-mark].  The
   Mark field MUST NOT be used in defining forwarding and/or quality of
   service treatment of a SFC packet.  The Mark field MUST be used only
   for the performance measurement of data traffic in SFC layer.
   Because setting of the field to any value does not affect forwarding
   and/or quality of service treatment of a packet, the alternate
   marking method in SFC layer can be viewed as true example of passive
   performance measurement method.

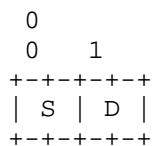   The Figure 2 displays format of the Mark field.

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

                       Figure 2: Mark field format

where:

o  S- Single mark method;

o  D - Double mark method.

4.  Theory of Operation

The marking method can be successfully used in the SFC.  Without
limiting any generality consider SFC presented in Figure 3.  Any
combination of markings, Loss and/or Delay, can be applied to a
service flow by any component of the SFC at either ingress or egress
point to perform node, link, segment or end-to-end measurement to
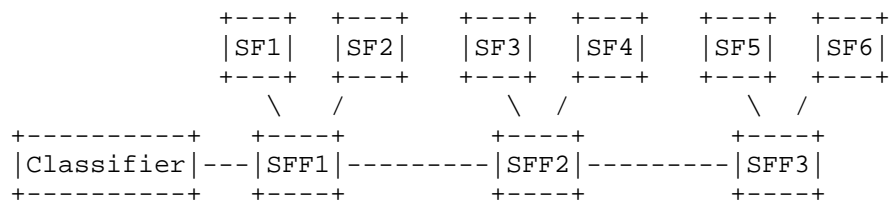detect performance degradation defect and localize it efficiently.

```
              +---+  +---+    +---+  +---+    +---+  +---+
              |SF1|  |SF2|    |SF3|  |SF4|    |SF5|  |SF6|
              +---+  +---+    +---+  +---+    +---+  +---+
                \    /          \    /          \    /
   +----------+   +----+        +----+          +----+
   |Classifier|---|SFF1|--------|SFF2|----------|SFF3|
   +----------+   +----+        +----+          +----+
```

Figure 3: SFC network

Using the marking method a component of the SFC creates distinct sub-
flows in the particular service traffic over SFC.  Each sub-flow
consists of consecutive blocks that are unambiguously recognizable by
a monitoring point at any component of the SFC and can be measured to
calculate packet loss and/or packet delay metrics.

4.1.  Single Mark Enabled 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 every N-th packet or at certain

time intervals.  Delay metrics MAY be calculated with the alternate
flow using any of the following methods:

o  First/Last Packet Delay calculation: whenever the marking, i.e.
   value of S flag, changes a component of the SFC can store the
   timestamp of the first/last packet of the block.  The timestamp
   can be compared with the timestamp of the packet that arrived in
   the same order through a monitoring point at downstream component
   of the SFC to compute packet delay.  Because timestamps collected
   based on order of arrival this method is sensitive to packet loss
   and re-ordering of packets

o  Average Packet Delay calculation: an average delay is calculated
   by considering the average arrival time of the packets within a
   single block.  A component of the SFC may 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.  Then difference between averages
   calculated at two monitoring points is the average packet delay on
   that segment.  This method is robust to out of order packets and
   also to packet loss (only a small error is introduced).  This
   method only provides single metric for the duration of the block
   and it doesn't give the minimum and maximum delay values.  This
   limitation could be overcome by reducing the duration of the block
   by means of an highly optimized implementation of the method.

4.2.  Double Mark Enabled Measurement

Double Mark method allows measurement of minimum and maximum 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, i.e. mark larger batches of
packets.  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 over the SFC, so that a component can store the timestamps
of these packets; these timestamps can be compared with the
timestamps of the same packets on another component of the SFC to
compute packet delay values for each packet.  The number of
measurements can be easily increased by changing the frequency of the
second marking.  But the frequency of the second marking must be not
too high in order to avoid out of order issues.  This method is
useful to have not only the average delay but also the minimum and
maximum delay values and, in wider terms, to know more about the
statistic distribution of delay values.

5.  IANA Considerations

5.1.  Mark Field in NSH Base Header

   This document requests IANA to allocate Mark field as two bits-long
   field from NSH Base Header Reserved Bits [I-D.ietf-sfc-nsh].

   This document requests IANA to register values of the Mark field of
   NSH as the following:

   +--------------+---------+--------------------------+--------------+
   | Bit Position | Marking | Description              | Reference    |
   +--------------+---------+--------------------------+--------------+
   |      0       |    S    | Single Mark Measurement  | This document |
   |      1       |    D    | Double Mark Measurement  | This document |
   +--------------+---------+--------------------------+--------------+

                     Table 1: Mark field of SFC NSH

6.  Security Considerations

   This document lists the OAM requirement for SFC domain and does not
   raise any security concerns or issues in addition to ones common to
   networking and SFC.

7.  Acknowledgement

   TBD

8.  References

8.1.  Normative References

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             <http://www.rfc-editor.org/info/rfc2119>.

   [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC
             2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174,
             May 2017, <http://www.rfc-editor.org/info/rfc8174>.

8.2.  Informative References

   [I-D.ietf-ippm-alt-mark]
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   [RFC7665] Halpern, J., Ed. and C. Pignataro, Ed., "Service Function
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