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**Performance Measurement (PM) with Alternate Marking Method in Service
Function Chaining (SFC) Domain
draft-mirsky-sfc-pmamm-08**

Abstract

   This document describes how the alternate marking method can be used
   as the efficient performance measurement method taking advantage of
   the actual data flows in a Service Function Chaining (SFC) domain.

Status of This Memo

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1. Introduction

   [RFC7665] introduced the architecture of a Service Function Chain
   (SFC) in the network and defined its components as classifier,
   Service Function Forwarder (SFF), and Service Function (SF).
   [RFC8321] describes the hybrid 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 to 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

[RFC8300] defines the 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|M|    TTL    |   Length  |U|U|U|U|MD Type|     Proto     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
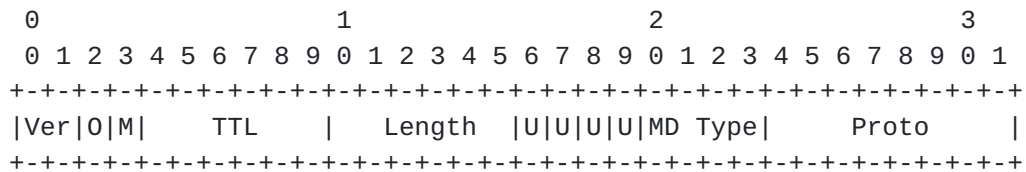
Figure 1: NSH Base format

This document defines the one-bit long field, referred to as Mark
field (M in Figure 1, as part of NSH Base and designated for the
alternate marking performance measurement method [RFC8321]. The Mark
field MUST be set to 0 at initialization of NSH and ignored on the
receipt when the method is not in use. The Mark field MUST NOT be
used in defining forwarding and/or quality of service treatment of an
SFC packet. The Mark field MUST be used only for the performance
measurement of data traffic in the SFC layer. Though the setting of
the field to any value likely not affect forwarding and/or quality of
service treatment of a packet, the alternate marking method in SFC
layer is characterized as an example of a hybrid performance
measurement method according to [RFC7799].

4. Theory of Operation

The marking method can be successfully used in the SFC. Without
limiting any generality consider SFC presented in Figure 2. 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|
    +----------+    +----+         +----+         +----+
```
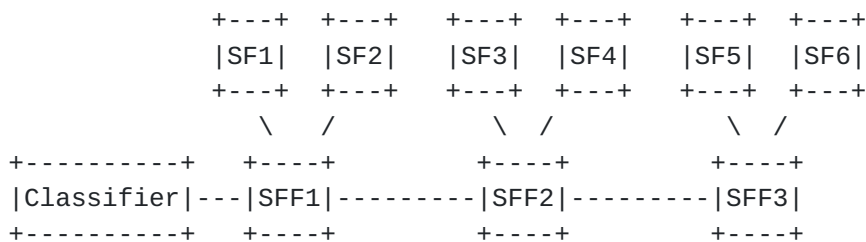
Figure 2: SFC network

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 [RFC8321], marking can be applied to delineate
blocks of packets based either on the equal number of packets in a
block or based on the same time interval. The latter method offers
better control as it allows a 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.

The Loss flag is used to create distinctive flows to measure the
packet loss by switching the value of the Loss flag every N-th packet
or at specified 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.,
   the value of Loss 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 a
   downstream component of the SFC to compute packet delay. Because
   timestamps collected based on the 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 the 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 a single metric for the duration of the
block, and it doesn't give the minimum and maximum delay values.
Highly optimized implementation of the method can reduce the
duration of the block and thus overcome the limitation.

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 Loss flag MUST
be used to create the alternate flow, i.e., mark more substantia
batches of packets. The Delay flag MUST be used to denote single
packets to measure delay jitter.

The first marking (Loss flag alternation) is needed for packet loss
and also for average delay measurement. The second marking (Delay
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 element 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 rate of the second marking must be not too
high to avoid out of order issues. This method supports the
calculation of not only the average delay but also the minimum and
maximum delay values and, in broader terms, to know more about the
statistic distribution of delay values.

4.3. Multiplexed Mark Enabled Measurement

There is also a scheme that provides the benefits of Double Mark
method, but uses only one bit like Single Mark. This methodology is
described in [I-D.mizrahi-ippm-compact-alternate-marking]. The
concept is that in the middle of each block of packets with a certain
value of the L flag, a single packet has the L flag inverted. So, by
examining the stream, the packets with the inverted bit can be easily
identified and employed for delay measurement. This Alternate
Marking variation is advantageous because it requires only one bit
from each packet, and such bits are always in short supply.

4.4. Residence Time Measurement with the Alternate Marking Method

   Residence time is the variable part of the propagation delay that a
   packet experiences while traversing a network, e.g., SFC. Residence
   Time over an SFC is the sum of the nodal residence times, i.e.,
   periods that the packet spent in each of SFFs that compose the SFC.
   The nodal residence time in SFC itself is the sum of sub-nodal
   residence times that the packet spent in each of SFs that are part of
   the given SFC and are mapped to the SFF. The residence time and
   deviation of the residence time metrics may include any combination
   of minimum, maximum, values over measurement period, as well as mean,
   median, percentile. These metrics may be used to evaluate the
   performance of the SFC and its elements before and during its
   operation.

   Use of the specially marked packets simplifies residence time
   measurement and correlation of the measured metrics over the SFC end-
   to-end. For example, the alternate marking method may be used as
   described in Section 4.2 to identify packets in the data flow to be
   used to measure the residence time. The nodal and sub-nodal
   residence time metrics can be locally calculated and then collected
   using either in-band or out-band OAM mechanisms.

5. IANA Considerations

5.1. Mark Field in NSH Base Header

   This document requests IANA to allocate the one-bit field from NSH
   Base Header Bits [RFC8300] as the Mark field of NSH as the following:

```
              +--------------+-------------+---------------+
              | Bit Position | Description | Reference     |
              +--------------+-------------+---------------+
              |     TBA      | Mark field  | 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. Acknowledgment

TBD

8. References

8.1. Normative References

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