Integrating the Alternate-Marking Method into In Situ Operations, Administration, and Maintenance (IOAM)

draft-he-ippm-integrating-am-into-ioam-00

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Motivation and Objective

Motivation

- According to RFC7799, the Alternate-Marking method and In situ Operations, Administration, and Maintenance (IOAM） can all be classified as Hybrid Type I.
- The Alternate-Marking Method ([RFC9341], [RFC9343]) has been widely employed in operator’s networks to implement performance measurements such as packet loss, delay, and jitter. However, IOAM [RFC9197] and IOAM Direct Export (DEX) [RFC9326] have some problems in doing performance measurements such as packet loss . We would wish to complement IOAM by integrating the Alternate-Marking Method into IOAM.

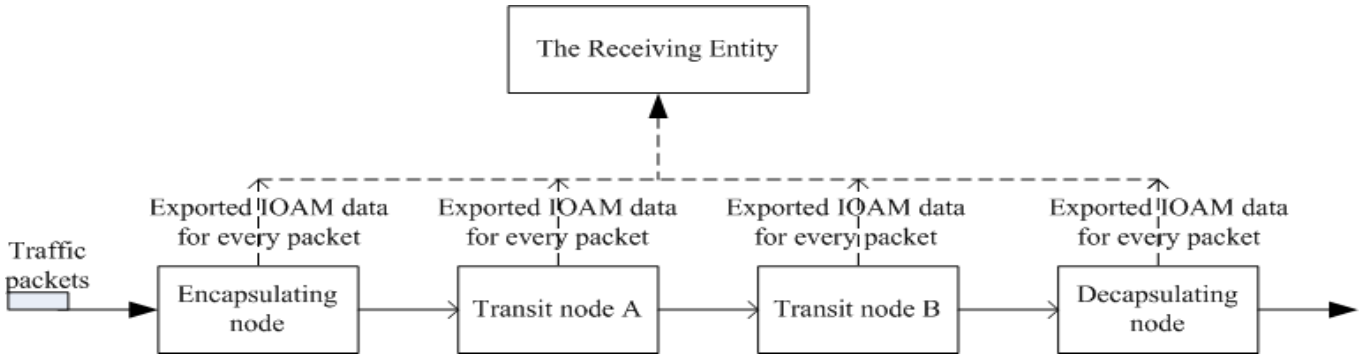
Objective

- Our proposed solution does not intend to substitute for the existing standards (say, RFC9343), but augments IOAM's capabilities in performance measurement aspects.

Problems and challenges

Although IOAM DEX Option-Type can complement IOAM Trace Option-Type for monitoring packet loss and drop location, some issues have to be considered as follows:

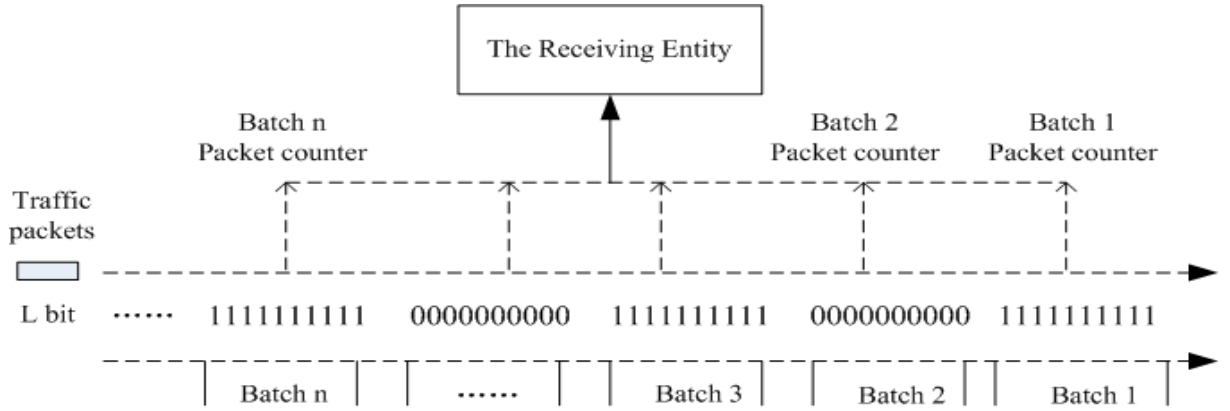
- Issue 1: In theory, if an IOAM encapsulating node incorporates the DEX Option-Type into all the traffic of interest it forwards, the fidelity of packet loss measurement can be ensured. If the too small subset of traffic or too low traffic sampling on an encapsulating node is implemented, loss measurement results can not reflect the actual packet drop, due to the fact that the transmitting packet interval does not cover packet drop caused by instantaneous congestion such as microbursts.
- Issue 2: Because the IOAM data of the same user packet is generated by every node along the path, the receiving entity needs more processing overhead to correlate these data for packet loss computation. The more user packets measured, the more processing overhead is required.
- Issue 3: While using the Alternate-Marking Method, traffic flows are split into consecutive blocks: each block represents a measurable entity unambiguously recognizable by all network devices along the path. In contrast, based on IOAM DEX Option-Type, it is the responsibility of the receiving entity to determine the measurement period of performance metrics. It is not beneficial to uniform measurement methodology.



Integrate the Alternate-Marking Method into IOAM

By integrating the Alternate-Marking method into IOAM, the benefits obtained include:

- ✓ an IOAM encapsulating node could color all the traffic of interest it forwards, not a subset of the packets, thus the fidelity of performance measurement such as packet loss can be ensured.
- ✓ in Hop-by Hop mode for loss measurement, every node along the path only exports a packet carrying counter value of each measurement block including a batch of packets; In End-to End mode for loss measurement, only the IOAM encapsulating node and the IOAM decapsulating node export a packet carrying counter value of each measurement block. It mitigates the network and the receiving entity greatly. Furthermore, compared with IOAM DEX Option-Type, the receiving entity needs much less processing overhead to correlate these counters for packet loss computation.
- ✓ While implementing performance measurement and IOAM trace monitoring concurrently, an IOAM encapsulating node may incorporate the DEX Option-Type into all the traffic of interest it forwards; Meanwhile, an IOAM encapsulating node only needs to select a very small subset of the packets that are forwarded for IOAM trace monitoring (e.g., 1/10000 of all the traffic of interest), so the amount of exported data is significantly reduced to mitigate the network and the receiving entity.
- ✓ While using the Alternate-Marking method, traffic flows are split into consecutive blocks, thus the measurement period is completely determined by network devices. The receiving entity does not need to concern about determination of measurement period, but only compute the result of each measurement period. It is beneficial to uniform measurement methodology.



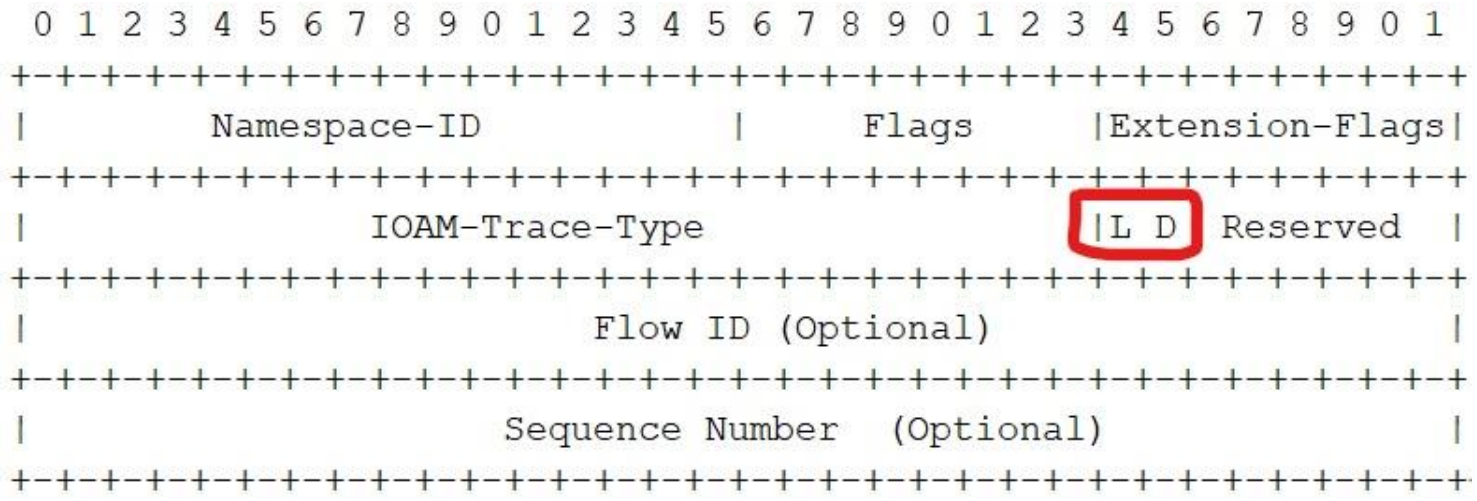
The Extended DEX Option-Type Format

The format of the extended DEX Option-Type is depicted in Figure 1. All fields are same as DEX Option-Type Format defined in RFC9326 except the Reserved field. The extended DEX Option-Type format uses the most significant 2 bits of the Reserved field.

- L: 1-bit Loss flag for Packet Loss Measurement
- D: 1-bit Delay flag for Single Packet Delay Measurement
- Reserved: 6-bit field, reserved for future use.

IANA Consideration:

- IOAM Option-Type: IOAM Extended DEX Option Type (TBD-type, suggested code point 5)



Next Steps

- Any comments or any suggestions?
- Possible implementation and verification