IOAM Direct Exporting (DEX) Option Extensions for Incorporating the Alternate-Marking Method

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Motivation , Objective and Solution

Motivation and Objective

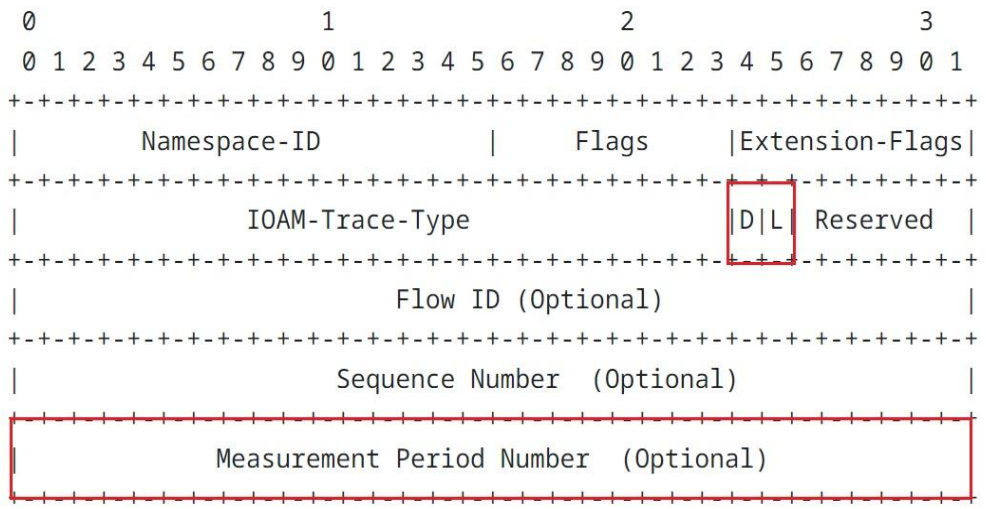
- Both the IOAM and Alternate-Marking method are the On-Path hybrid measurement methods， and it is necessary to unify the packet encapsulation format to reduce the complexity of the forwarding chip.
- IOAM Direct Export (DEX) Option [RFC9326] （postcard mode） have faced some problems in performance measurements such as packet loss , including more processing overhead and bandwidth, inaccurate measurement results and inconsistent measurement methodology, etc.
- This draft intends to augment IOAM's capabilities in performance measurement aspects by incorporating the Alternate-Marking method.

Solution

- Extend DEX Option by defining the most significant 2 bits of the Reserved field (D, L) and MPN field .
- Employ 32 bits for Flow ID, which may be devided into two sub-fields: NodeID (assigned globally by the unified planning) and FlowMonID （assigned locally）, so it can be deployed in distributed way in case of centralized controller unavaillable.
- Support the three IOAM operation modes: only IOAM trace monitoring; only performance measurement; hybrid.

Benefits

- Augment IOAM DEX Option's capabilities in performance measurement.
- Augment the Alternate-Marking method in IPv6 (RFC9343) by extending 32-bit Flow ID, SN and MPN field.
- Only unique packet header encapsulation format is required for both IOAM trace monitoring and performance measurement such as packet loss, latency and jitter, thus simplifing the complexity of forwarding chips （like EVPN integrating L2/3 MPLS VPN).



IANA Consideration

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

– Extension-Flags: Bit 4, used as MPN (TBA)

Motivation , Objective and Solution(cont.)

the collision probability (CP) of Flow ID when deployed in distributed way

- 32-bit Flow ID is used for every source node
- N edge nodes (source nodes) in a large-scale operator network, and each source node can generate a unique Flow ID for every measured flow independently and randomly.
- Each node randomly generates M different Flow IDs

32-bit Flow ID	N=100	N=100	N=200	N=200	N=200	N=200
	M=100	M=200	M=200	M=300	M=400	M=500
CP	0.0115	0.0453	0.1692	0.3410	0.5235	0.6860

- When using 20-bit FlowMonID (RFC9343) and generating 10000 concurrent flows, CP will drastically rises to approximately 100% .

Why extend 32-bit Flow ID, SN and MPN field for the Alternate-Marking Method ?

- Compared to 20-bit FlowMonID, CP is significantly reduced in distributed way. On the other hand, 32-bit Flow ID can be split into two sub-fields (NodeID assigned globally by the unified planning and FlowMonID assigned locally), with respective sufficient space.
- By employing MPN field, it is more simpler and accurate for an analyzer or collector to correlate loss measurement data (packet counter values) belonging to the same measurement period (or measurement block) from different nodes, especially in the case where milliseconds-level measurement block for real-time network performance monitoring is required, e.g., Precision Availability Metrics (PAM) described in RFC9544 (such as Violated Interval (VI)).
- By using SN and MPN fields together, multiple timestamps in different packets from different nodes belonging to the same measurement block can be identified in case of packet reordering, and they can also be used to identify which double-marked packet is lost. Compared to selecting a single double-marked packet for each batch, which may lead to an invalid delay result if this double-marked packet is lost, selecting multiple double-marked packets for each measurement batch provides a robust and accurate method for packet delay measurement .Furthermore, the average delay can also be obtained for every measurement period.

Next Steps

- Any comments or any suggestions are welcome
- Request for WG adoption call