Packet-Triggered IOAM Reporting

draft-li-ippm-ioam-packet-triggered-reporting-00

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IETF 125, Mar 19th,2026

Background & Motivation

IOAM Telemetry: Records operational data within user packets as they traverse a network path.

Alternate Marking: Packet loss measurement relies on periodic color changes to delineate precise intervals.

The Timer Challenge: Relying on timer synchronization across decapsulating and transit nodes is highly complex and error-prone.

The Goal: We need an efficient, in-band trigger to replace heavy egress timer dependencies.

Solution: The Cycle Identifier

2-Bit Cycle ID

Identifies the measurement interval. Increments sequentially through values 0, 1, 2, and 3 modulo 4.

Packet-Triggered

Decapsulating nodes monitor Cycle ID transitions in arriving packets to instantly trigger statistics reporting.

No Egress Timers

Completely eliminates the need for strict, synchronized interval timers on transit and decapsulating network nodes.

Cycle ID Field Format （Draft version 00）

The 32-bit field is carried within the **IOAM Option-Type header**:

Field	**Length**	**Description & Valid Values**
Cycle ID	2 bits	Identifies the measurement interval. Valid values are 00, 01, 10, and 11 (0 to 3).
K (Keepalive)	1 bit	Keepalive indicator. 0 indicates a user data packet. 1 indicates a keepalive packet.
Reserved	29 bits	Reserved for future use. MUST be set to zero on transmission and ignored on reception.

We have received comments from Justin(comply with RFC9197, a Namespace-ID field shoud be included), so the format will be updated in the next version

Encapsulation & Decapsulation

Encapsulating Node

- Assigns the current Cycle ID value to all outgoing packets in a flow.
- Increments the Cycle ID modulo 4 exactly at local interval boundaries.
- Maintains per-cycle, per-flow statistics counters (packets & bytes).

Decapsulating Node

- Maintains state for the *last received* Cycle ID.
- On mismatch (transition detected), it triggers the statistics report.
- Updates local counters based on the new Cycle ID without relying on an internal clock.

The Keepalive Mechanism

- **The Problem:** What happens if there is no user traffic during an interval? The state machine stalls, and reports are delayed indefinitely.
- **The Solution:** If no data was sent during the ending interval, the Encapsulating node generates a **Keepalive packet**.
- The packet has the K flag set to 1.
- The Decapsulating node processes the transition to trigger the report, but ignores the packet for loss statistics.

Reporting Schedule (2-Cycle Delay)

- To mitigate jitter impact, Nodes report statistics with a strict two-interval delay.

- This ensures all delayed or out-of-order packets from a given interval have been processed before generating the report.

- report_cycle_id = (current_cycle_id + 2) mod 4

Summary & Next Step

- Simplifies the IOAM measurement interval synchronization.
- The keepalive (K-Flag) bit solves the intermittent traffic problem.

We actively welcome review and comments from the IPPM working group.