MPLS Data Plane Encapsulation for In-situ OAM Data

draft-gandhi-mpls-ioam-08

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Abbreviations

Abbreviations	Meaning
AD	Ancillary Data
BOS	Bottom of Stack
E2E	Edge To Edge
HBH	Hop By Hop
IOAM	In-Situ OAM
ISD	In-Stack Data
IS-NAI-Opcode	In-Stack Network Action Indicator Opcode
MNA	MPLS Network Action
NAI	Network Action Indicator
NAI-OP	Network Action Indicator Opcode
NASI	Network Action Sub-Stack Indicator
PHI	Post-Stack Hop By Hop Post-Stack Network Action Presence Indicator
PNI	Post-Stack Network Action Presence Indicator
PSD	Post-Stack Data
bSPL	Base Special Purpose Label
MSD	Maximum Stack Depth

Agenda

- Requirements and Scope
- Summary
- Next Steps

Requirements and Scope

Requirements:

- Transport In-situ OAM (IOAM) data fields with MPLS Encapsulation

Scope:

- Using IOAM data fields defined in:
  - *RFC 9197*
  - *draft-ietf-ippm-ioam-direct-export*
- Edge-To-Edge (E2E) IOAM
- Hop-By-Hop (HBH) IOAM
- MPLS Network Action (MNA) Encoding
  - *draft-ietf-mpls-mna-fwk*
  - *draft-jags-mpls-mna-hdr*
  - *draft-song-mpls-extension-header*

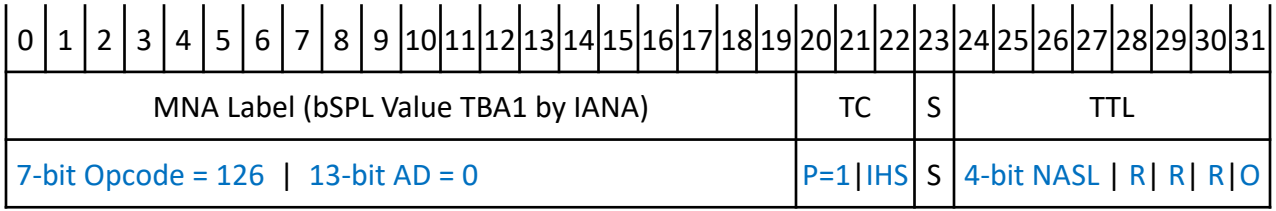
History of the draft

- October 2018 - Published draft-gandhi-**spring**-ioam-sr-mpls-00
- October 2019 - Published draft-gandhi-**mpls**-ioam-sr-00
- January 2021 - Completed **MPLS-RT** Expert review
  - Suggested to use G-ACh Type for IOAM
  - Concerned with multiple eSPLs for different use-cases + impact on MSD
  - Renamed to draft-gandhi-mpls-ioam to scope all MPLS data plane
- July 2022 - Using MNA Encoding
- October 2022 - Using Post-Stack Extension Header encoding, align with latest MNA solution draft

MPLS Extensions

IOAM Post-Stack Network Action Indicators

- MNA (NASI) Label is a new bSPL value to be allocated by IANA as part of [draft-ietf-mpls-mna-fwk]
- TTL field of the next LSE to carry MNA encoding flags
  - P Flag - PNI for Post-Stack Network Action Presence Indicator
  - IHS Scope - Edge-To-Edge (00b), Hop-By-Hop (01b) or Select Node (10b) Processing Scope Indicator



- Note: MNA encoding to be updated once MPLS WG adopts on a solution

IOAM and Scope Indicators

- Post-Stack Network Action Presence Indicator (**P Flag**) is set to “1” when IOAM data fields are present after BOS, for E2E, HBH and Select IOAM.
- In case of E2E IOAM:
  - E2E IOAM Option-Type(s) in the data packets are processed on edge nodes only.
  - IHS scope is set to I2E (value 0x0).
  - The intermediate nodes ignore the E2E IOAM Option-Type(s) carried by the data packets.
- In case of HBH IOAM:
  - HBH IOAM Option-Type(s) in the data packets are processed on the intermediate and edge nodes.
  - IHS scope is set to HBH (value 0x1).
- In case of SELECT IOAM:
  - HBH IOAM Option-Type(s) in the data packets are processed on Select nodes.
  - IHS scope is set to SELECT (value 0x2).

Post-Stack Network Action MPLS Extension Header for IOAM

- IANA to allocate NH Type for IOAM for Common Post-Stack MNA Header
- Each EH contains only one IOAM Option-Type
- IOAM EH carries 8-Bit NEXT-HEADER, 8-Bit Length of the IOAM Data fields (not including first 4-bytes) in 4-byte unit, 7-bit IOAM Option-Type [RFC9197] [draft-ietf-ippm-ioam-direct-export] and 8-bit BLOCK-NUMBER
- BLOCK-NUMBER is used to:
  - Aggregate IOAM data collected in data plane, e.g., compute measurement metrics for each block of a flow
  - Correlate IOAM data from different nodes

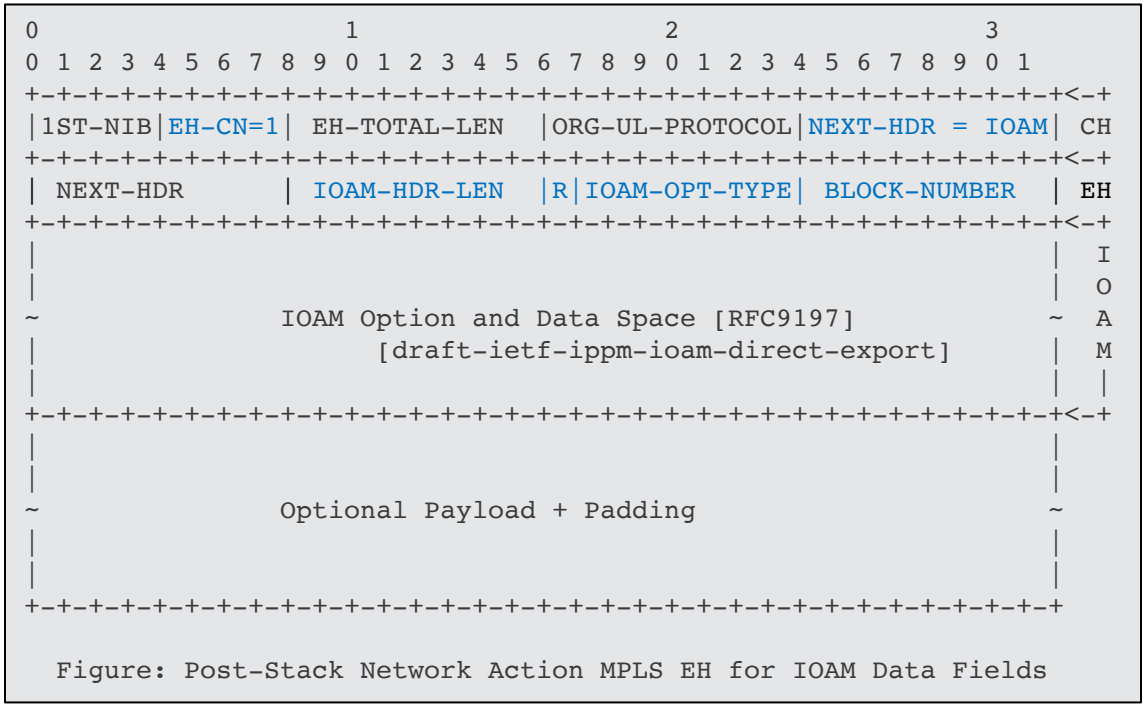


Figure: Post-Stack Network Action MPLS EH for IOAM Data Fields

- https://www.iana.org/assignments/protocol- numbers/protocol-numbers.xhtml

Post-Stack Network Action MPLS Extension Header for Multiple IOAM Options

- Each EH contains only one IOAM Option-Type
- Different EHs are added to carry different IOAM Option-Types, each EH with NH Type IOAM
- When using both HBH and E2E IOAM Option-Types, the HBH IOAM Option-Type MUST be placed before the E2E IOAM Option-Type to be able to easily process HBH IOAM in hardware on the intermediate nodes
- Use-case: Trace hop-by-hop interface Identifier and end-to-end latency.

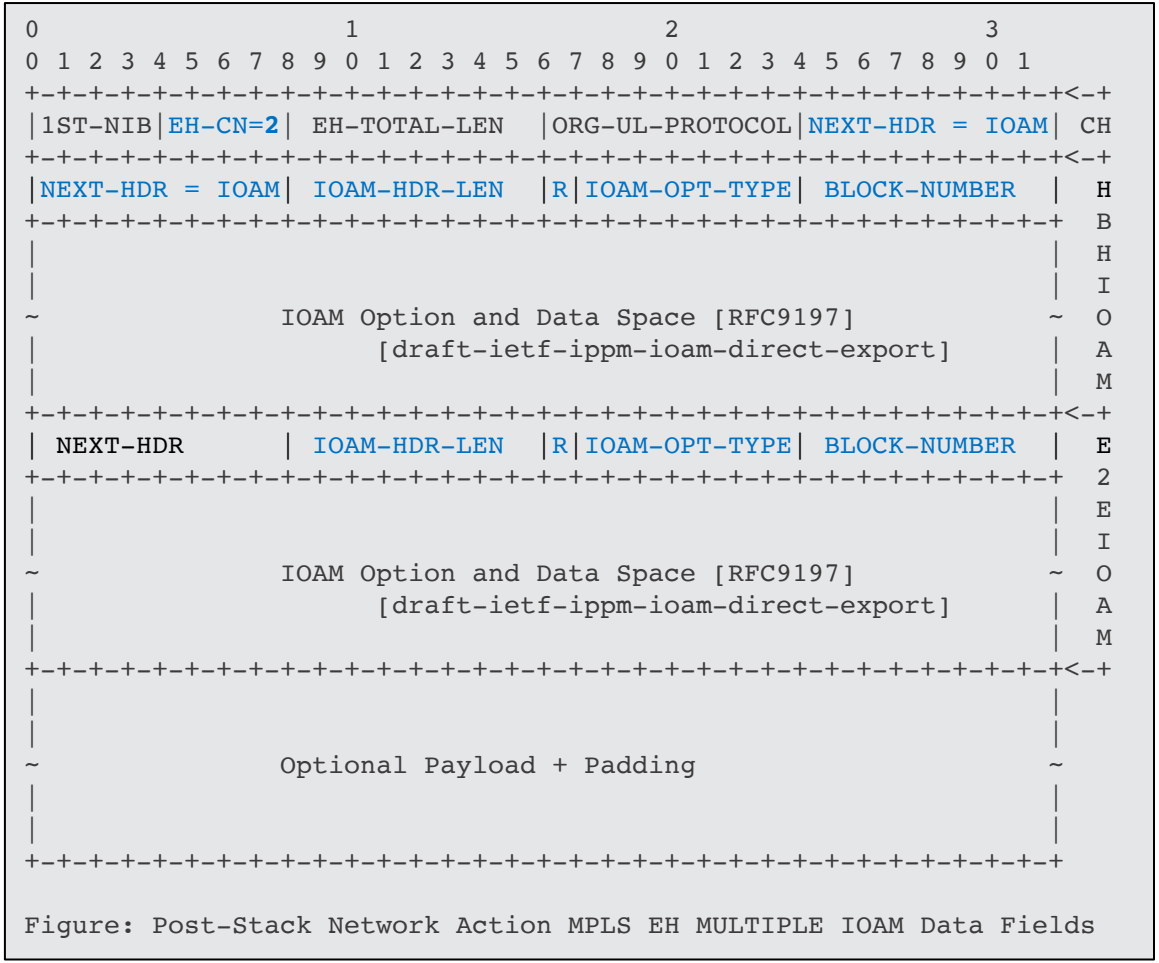


Figure: Post-Stack Network Action MPLS EH MULTIPLE IOAM Data Fields

MPLS Encapsulation with IOAM Data Fields

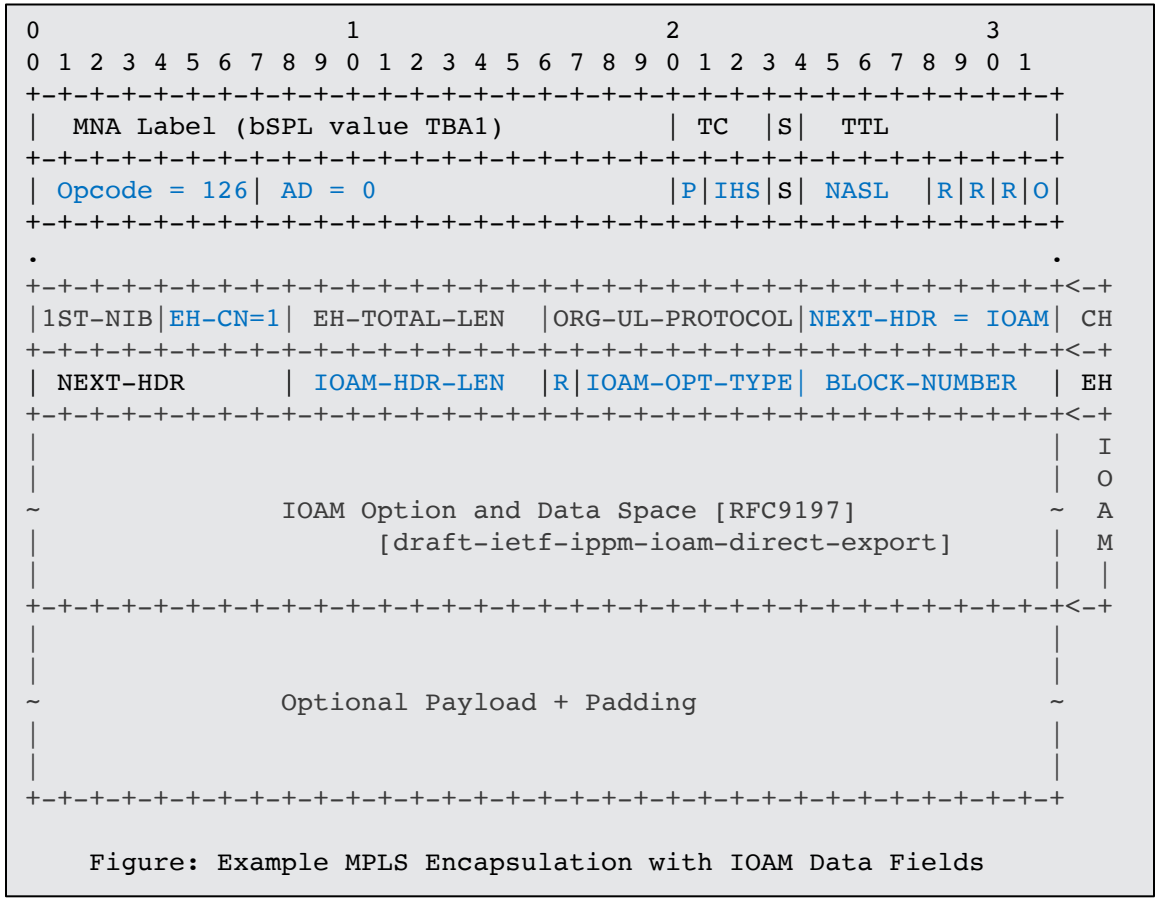


Figure: Example MPLS Encapsulation with IOAM Data Fields

E2E IOAM Procedure

1. E2E IOAM includes IOAM processing on encapsulating and decapsulating nodes.
   - E2E Option-Type (value 3) [RFC9197] as well as Direct Export (DEX) Option-Type (value TBD) [draft-ietf-ippm-ioam-direct-export] can be carried in the IOAM data field.
2. The encapsulating node inserts (1) the MNA bSPL Label (value TBA1) with the P flag set to "1", and (2) IHS scope set to I2E (value 0) and, (3) one or more IOAM data fields in MPLS Extension Header with NH Type set to IOAM (value TBA2).
   - The decapsulating node MUST support MPLS IOAM network action.
3. The intermediate nodes skip the IOAM data fields processing as IHS scope is I2E.
4. The penultimate node does not remove the MNA Sub-stack from the MPLS header so that the MNA Sub-stack is received at the decapsulating node.
5. The decapsulating node processes IOAM data field(s) in the packet.
   - The decapsulating node MAY "punt the timestamped copy" of the data packet including the IOAM data field(s) to slow-path.
6. The decapsulating node MUST remove the IOAM data field(s) from the packet.
   - The decapsulating node forwards the data packet downstream.

HBH IOAM Procedure

1. HBH IOAM includes IOAM processing on encapsulating, intermediate and decapsulating nodes.
   - Pre-allocated (value 0), Incremental (value 1), and Proof of Transit (value 2) [RFC9197], as well as Direct Export (DEX) Option-Type (value TBD) [draft-ietf-ippm-ioam-direct-export] can be carried in the IOAM data field(s).
2. The encapsulating node inserts (1) the MNA bSPL Label (value TBA1) with the P flag set to "1", and (2) IHS scope set to HBH (value 0x1) and, (3) one or more IOAM data fields in MPLS Extension Header with NH Type set to IOAM (value TBA2).
3. The intermediate nodes process the HBH IOAM data field(s) and forward the data packet downstream including updated IOAM data field(s) upon detecting IHS scope to HBH.
   - The intermediate nodes MAY "punt the timestamped copy" of the data packet including the IOAM data field(s) to slow-path.
   - The intermediate node that does not support the Network Action for IOAM, skips the IOAM processing.
4. On penultimate node, follow the same procedure as E2E IOAM case.
5. On decapsulating node, follow the same procedure as E2E IOAM case.

Next Steps

- Welcome your comments and suggestions
- Requesting MPLS WG adoption

Thank you