

# MPLS Network Actions for Transporting IOAM Data Fields and Direct Exporting

*draft-gandhi-mpls-mna-ioam-dex-01*

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# Agenda

- Requirements and Scope
  - IOAM E2E/POT/Trace
  - IOAM Direct Export
- IOAM MPLS Network Actions
  - In-Stack Network Actions with PSNA Offset
  - Post-Stack Network Actions (PSNAs)
- Next Steps

# History of the draft

1. October 2018 - Published draft-gandhi-**spring**-ioam-sr-mpls
2. October 2019 - Renamed draft-gandhi-**mpls**-ioam-sr (using G-ACH for IOAM)
3. January 2021 - Completed MPLS-RT Expert review
4. July 2021 - Renamed draft-gandhi-mpls-**ioam** (using new SPL)
5. July 2022 - Updated using In-Stack MNA Solution (and G-ACH for IOAM)
6. October 2022 - Updated PS using Extension Header (draft-song-mpls-extension-header)
7. March 2023 - Updated using Post-Stack MNA encoding (draft-jags-mpls-ps-mna)
8. **June 2024 - Renamed draft-gandhi-mpls-**mna**-ioam-dex - aligned with latest MNA drafts**

# Requirements and Scope

## Requirements:

- ✓ Transport In Situ OAM (IOAM) Option-Types in MPLS Networks
- ✓ Transport In Situ OAM Direct Export (IOAM-DEX) Option-Type in MPLS Networks
- ✓ MNA use-case described in Section 2.2.1 in [draft-ietf-mpls-mna-usecases]

## Scope:

- IOAM Option-Types
  - RFC 9197: IOAM E2E/POT/Trace
  - RFC 9326: IOAM Direct Export
- MPLS Network Action (MNA) Solution
  - In-Stack Network Action: [draft-ietf-mpls-mna-hdr]
  - Post-Stack Network Action: [draft-jags-mpls-ps-mna-hdr]
  - Post-Stack Header: [draft-ietf-mpls-1stnibble]

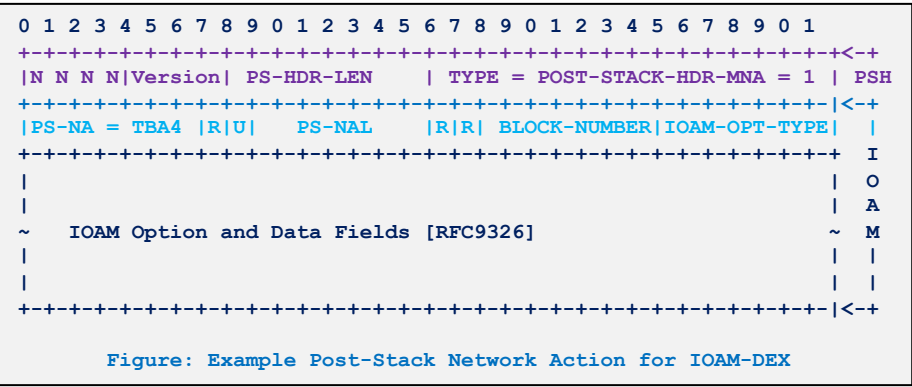
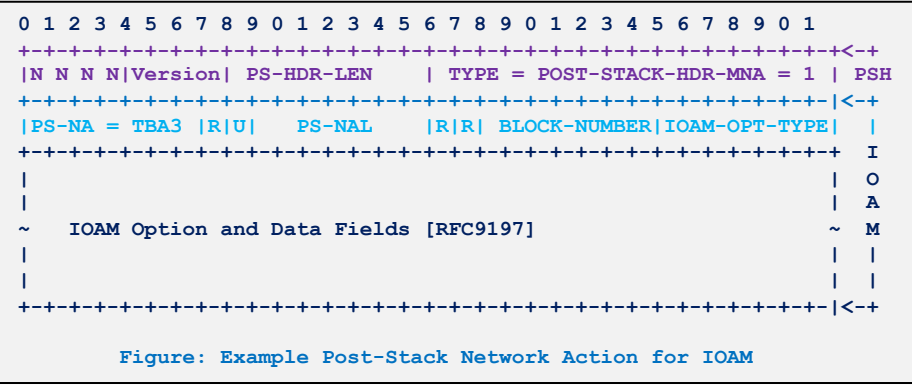
# In-Stack Network Actions for IOAM and IOAM-DEX

1. Using MPLS Network Action (MNA) Sub-stack defined in [draft-ietf-mpls-mna-hdr]
2. In Format B and/or Format C LSE:
  - a. Opcode TBA1 - In-Stack Network Action with PSNA Offset for IOAM
  - b. Opcode TBA2 - In-Stack Network Action with PSNA Offset for IOAM Direct Export
  - c. Data (10-bits) - IOAM PSNA Offset or IOAM-DEX PSNA Offset in 4-octet unit
  - d. IHS Scope: Edge-To-Edge (00b), Hop-By-Hop (01b) or Select Node (10b) Processing Scope
  - e. U Flag: Unknown Action Handling set to 0 for “Skip to the next Network Action” for IOAM/IOAM-DEX

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MNA Label (bSPL value TBA6 by IANA)																				TC		S	TTL								
Opcode = TBA1							IOAM PSNA Offset													R	IHS		S	U	NASL			NAL			
Opcode = TBA2							IOAM-DEX PSNA Offset													DATA		S	U	DATA			NAL				

# Post-Stack Network Actions for IOAM and IOAM-DEX

1. Post-Stack Header [draft-ietf-mpls-1stnibble]
  - a. NNNN - TBA5 allocated by IANA or CW 0000b
2. IOAM Post-Stack Network Action **TLV**: Opcode/Length/Data
3. Opcode
  - a. PS-NA-OPCODE : 7-bit Opcode for IOAM/IOAM-DEX
  - b. TBA3: Post-Stack Network Action for IOAM
  - c. TBA4: Post-Stack Network Action for IOAM Direct Export
4. Length
  - a. IOAM-HDR-LEN: 7-bit Length of the (one or more) IOAM Data fields in 4-octet units (not including first 4-bytes)
5. Data
  - a. 7-bit IOAM Option-Type 0, 2, or 3 defined in [RFC9197] and Option-Type 4 defined in [RFC9326]
  - b. BLOCK-NUMBER (7-bit): Aggregate IOAM/IOAM-DEX data, e.g., compute measurement metrics for each block of data flow



# Data Fields in Post-Stack Network Action

1. IOAM E2E/POT/TRACE/DEX option-type contains various data fields
2. Data fields such as 32-bit Sequence Number or 32-bit Timestamp in In-Stack LSE can lead to undesired ECMP behavior on nodes that use labels for ECMP hashing
  - ✓ Data fields in Post-Stack are not included in ECMP hashing
3. 32-bit data fields do not fit into 30-bit data in In-Stack LSE, mutability limits to 11-bit
  - ✓ RFC standard IOAM format data fields fit well into 32-bit Post-Stack AD
4. IOAM options support extensibility to optionally add many data fields
  - ✓ Node can easily skip In-Stack network action and process the next one even when Data in Post-Stack is outside RLD
5. IOAM-DEX data fields represent metadata in the received packets that data plane exports
  - ✓ Metadata can easily be in Post-Stack

# IANA Requests

Opcode	Description
TBA1	In-Stack Network Action with PSNA Offset for IOAM
TBA2	In-Stack Network Action with PSNA Offset for IOAM Direct Export

Value	Description
TBA3	Post-Stack Network Action for IOAM
TBA4	Post-Stack Network Action for IOAM Direct Export



# Next Steps

- Welcome your comments and suggestions
- Requested MPLS WG adoption on the mailing list

**Thank you!**

# Backup

# Abbreviations

Abbreviations	Meaning
AD	Ancillary Data
BOS	Bottom of Stack
bSPL	Base Special Purpose Label
DEX	Direct Export
E2E	Edge-To-Edge
HBH	Hop By Hop
I2E	Ingress-To-Egress
IHS	Ingress-To-Egress, Hop-By-Hop or Select Processing Scope
IOAM	In Situ OAM
ISD	In-Stack Data
MNA	MPLS Network Action
MSD	Maximum Stack Depth
NAI	Network Action Indicator
NAI-OP	Network Action Indicator Opcode
NAS	Network Action Sub-Stack
POT	Proof of Transit
PSD	Post-Stack Data
PSNA	Post-Stack Network Action
RLD	Readable Label Depth

# MNA Processing Scope for IOAM and IOAM-DEX

- I2E Scope:
  1. IOAM Option-Type(s) in the data packets are processed on edge nodes only. The intermediate nodes ignore the E2E IOAM Option-Type(s) carried by the data packets.
  2. E2E Option-Type (value 3) [RFC9197], Direct Export (DEX) Option-Type (value 4) [RFC9326] can be carried in the IOAM data field with I2E scope.
  3. IHS scope is set to I2E (value 0x0).
- HBH Scope:
  1. HBH IOAM Option-Type(s) in the data packets are processed on the intermediate and edge nodes.
  2. Pre-allocated (value 0) and Proof of Transit (value 2) [RFC9197], Direct Export (DEX) Option-Type (value 4) [RFC9326] can be carried in the IOAM data field with HBH Scope.
  3. Not supported: Incremental Option-Type (value 1) in IOAM data field with HBH Scope.
  4. IHS scope is set to HBH (value 0x1).
- Select Scope:
  1. HBH IOAM Option-Type(s) in the data packets are processed on Select nodes only.
  2. IOAM Option-Types same as defined for HBH IOAM Scope.
  3. IHS scope is set to SELECT (value 0x2).

**Thank you!**