MPLS Data Plane Encapsulation for In-situ OAM Data

draft-gandhi-mpls-ioam-05

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<table>
<thead>
<tr>
<th>Abbreviations</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>AD</td>
<td>Ancillary Data</td>
</tr>
<tr>
<td>ADL</td>
<td>Additional Data Length</td>
</tr>
<tr>
<td>BOS</td>
<td>Bottom of Stack</td>
</tr>
<tr>
<td>E2E</td>
<td>Edge To Edge</td>
</tr>
<tr>
<td>HBH</td>
<td>Hop By Hop</td>
</tr>
<tr>
<td>HPI</td>
<td>Hop By Hop Post-Stack Network Action Presence Indicator</td>
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<tr>
<td>IOAM</td>
<td>In-Situ OAM</td>
</tr>
<tr>
<td>ISD</td>
<td>In-Stack Data</td>
</tr>
<tr>
<td>IS-NAI-Op屈</td>
<td>In-Stack Network Action Indicator Opcode</td>
</tr>
<tr>
<td>INE</td>
<td>In-Stack Network Action Extension Presence Indicator</td>
</tr>
<tr>
<td>INI</td>
<td>In-Stack Network Action Presence Indicator</td>
</tr>
<tr>
<td>MNA</td>
<td>MPLS Network Action</td>
</tr>
<tr>
<td>NAI</td>
<td>Network Action Indicator</td>
</tr>
<tr>
<td>NAI-OP</td>
<td>Network Action Indicator Opcode</td>
</tr>
<tr>
<td>NASI</td>
<td>Network Action Sub-Stack Indicator</td>
</tr>
<tr>
<td>PNI</td>
<td>Post-Stack Network Action Presence Indicator</td>
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<tr>
<td>PSD</td>
<td>Post-Stack Data</td>
</tr>
<tr>
<td>bSPL</td>
<td>Base Special Purpose Label</td>
</tr>
<tr>
<td>MSD</td>
<td>Maximum Stack Depth</td>
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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:
  - draft-ietf-ippm-ioam-data
  - draft-ietf-ippm-ioam-direct-export
- Edge-to-Edge (E2E) IOAM
- Hop-By-Hop (HBH) IOAM (that includes E2E)
- MPLS Network Action (MNA) Encoding
History of the draft

- October 2018 - Published draft-gandhi-\textit{spring}-ioam-sr-mpls-00
- October 2019 - Published draft-gandhi-\textit{mpls}-ioam-sr-00
- January 2021 - Completed MPLS-RT Expert review
  - Added to use G-ACh Type for IOAM
  - Raised concerns with multiple eSPLs for different use-cases + impact on MSD
- July 2021 - draft-gandhi-mpls-ioam-00 - Renamed to scope MPLS data plane
- September 2021 - Using Entropy Label Control Flags
- February 2022 - Using ELI or SPL Indicator [\textit{draft-jags-mpls-ext-hdr}]
- July 2022 - Using MNA Encoding (bSPL TBA by IANA) [\textit{draft-jags-mpls-mna-hdr}]
MPLS Extensions
IOAM Post-Stack Network Action Indicators

- MNA (NASI) Label is a new bSPL value to be allocated by IANA
- TTL field of the next LSE to carry MNA flags
  - PNI for Post-Stack Network Action Presence Indicator
  - HPI for Hop-By-Hop Network Action Processing Indicator
- Bit location for the PNI and HPI flags to be IANA allocated

<table>
<thead>
<tr>
<th>Bit</th>
<th>MNA Label (bSPL Value TBA)</th>
<th>TC</th>
<th>S</th>
<th>TTL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MNA Flags</td>
<td>Flags</td>
<td>S</td>
<td>PNI=1, HPI</td>
</tr>
</tbody>
</table>
IOAM and HBH Indicators

- Post-Stack Network Action Presence Indicator (**PNI**) is used to indicate the presence of IOAM data fields after BOS, for both E2E and HBH cases.
- Hop-By-Hop Network Action Processing Indicator (**HPI**) is used to enable Hop-By-Hop processing on the intermediate nodes.
- In case of E2E IOAM, the IOAM Option-Type(s) in data packets are processed on edge nodes only. The intermediate nodes ignore the IOAM Option-Type(s) carried by the data packets.
- In case of HBH IOAM, the IOAM Option-Type(s) in the data packets are processed on the intermediate and edge nodes.
G-ACh for IOAM Post-Stack Network Action Common Header

- New Generic Associated Channel (G-ACh) Type (value TBA3) defined for IOAM Post-Stack Network Action Header.
- 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
- Length field added to find next G-ACh.
- Updates RFC 5586 as G-ACh carried with user traffic, length field added in the header and multiple G-ACh can be added.
- Note that the G-ACh is not really used to “transport” the user traffic but to transport the IOAM data fields with the user traffic.

- https://www.iana.org/assignments/g-ach-parameters/g-ach-parameters.xhtml#mpls-g-ach-types

Figure: IOAM G-ACh for 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 and E2E DEX Option-Type can be carried in the IOAM data field.

2. The encapsulating node inserts (1) the MNA bSPL Label (value TBA) with the PNI Indicator below the label whose FEC is the end (decapsulating) node, and (2) one or more IOAM data fields as Post-Stack Network Action.

3. The intermediate nodes skip the IOAM data fields processing as HPI flag is not set.

4. The penultimate node MUST not remove the MPLS header. This is ensured by the encapsulating node by adding the necessary MPLS header.

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, Incremental, Proof of Transit, E2E Option-Type, and HBH DEX Option-Type can be carried in the IOAM data field(s).

2. The encapsulating node inserts (1) the MNA bSPL Label (value TBA) with the PNI and HPI Indicators below the label whose FEC is the end (decapsulating) node, and (2) one or more IOAM data fields as Post-Stack Network Action.

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 HPI Flag.
   - The intermediate nodes MAY “punt the timestamped copy” of the data packet including the IOAM data field(s) to slow-path.

4. The penultimate node MUST not remove the MPLS header. This is ensured by the encapsulating node by adding the necessary MPLS header.

5. On decapsulating node, follow the same procedure as E2E IOAM case.
Next Steps

• Welcome your comments and suggestions
• Align Post-Stack Network Action Common Header with MNA Encoding
  – Currently G-ACh-based
  – E.g., draft-song-mpls-extension-header
  – As part of the WG process
• Requesting MPLS WG adoption
Thank you