

# MPLS Data Plane Encapsulation for In-situ OAM Data

*draft-gandhi-mpls-ioam-sr-06*

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# Agenda

- Requirements and Scope
- Summary
- Discussions
- Next Steps

# Requirements and Scope

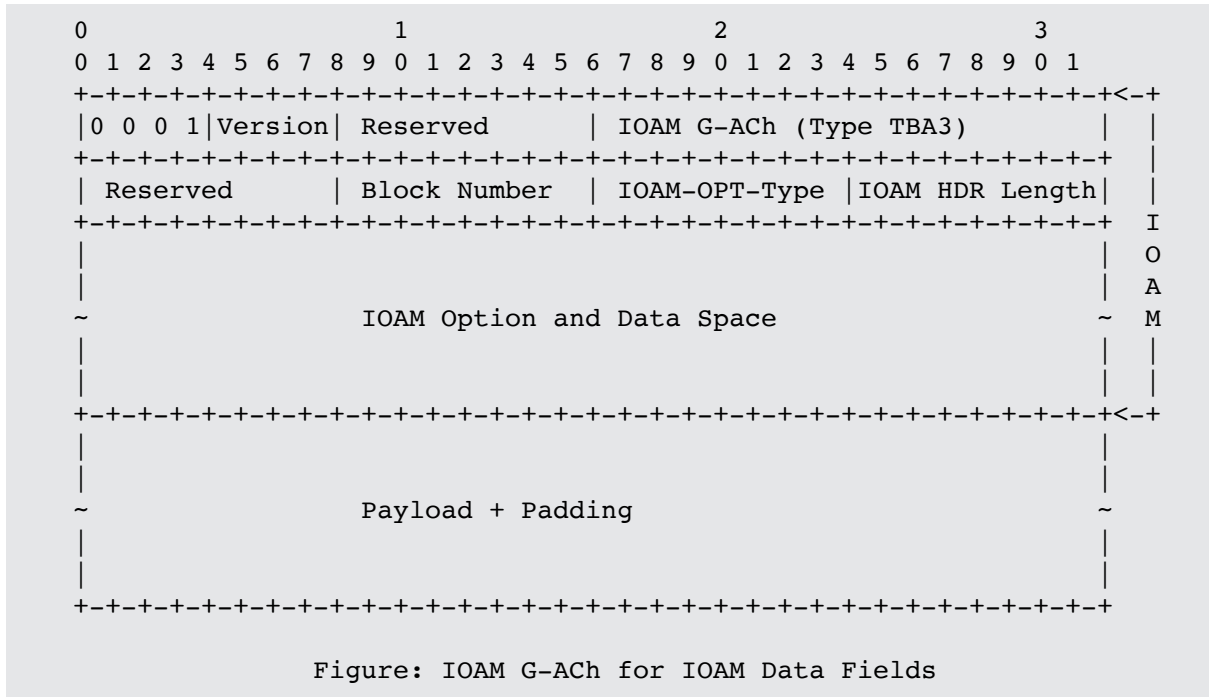
## Requirements:

- 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*
  - *draft-ietf-ippm-ioam-flags*
- Edge-to-edge (E2E) IOAM
- Hop-by-hop (HbH) IOAM (that includes E2E)

# IOAM G-ACh for IOAM Data Fields



# IOAM G-ACh Header

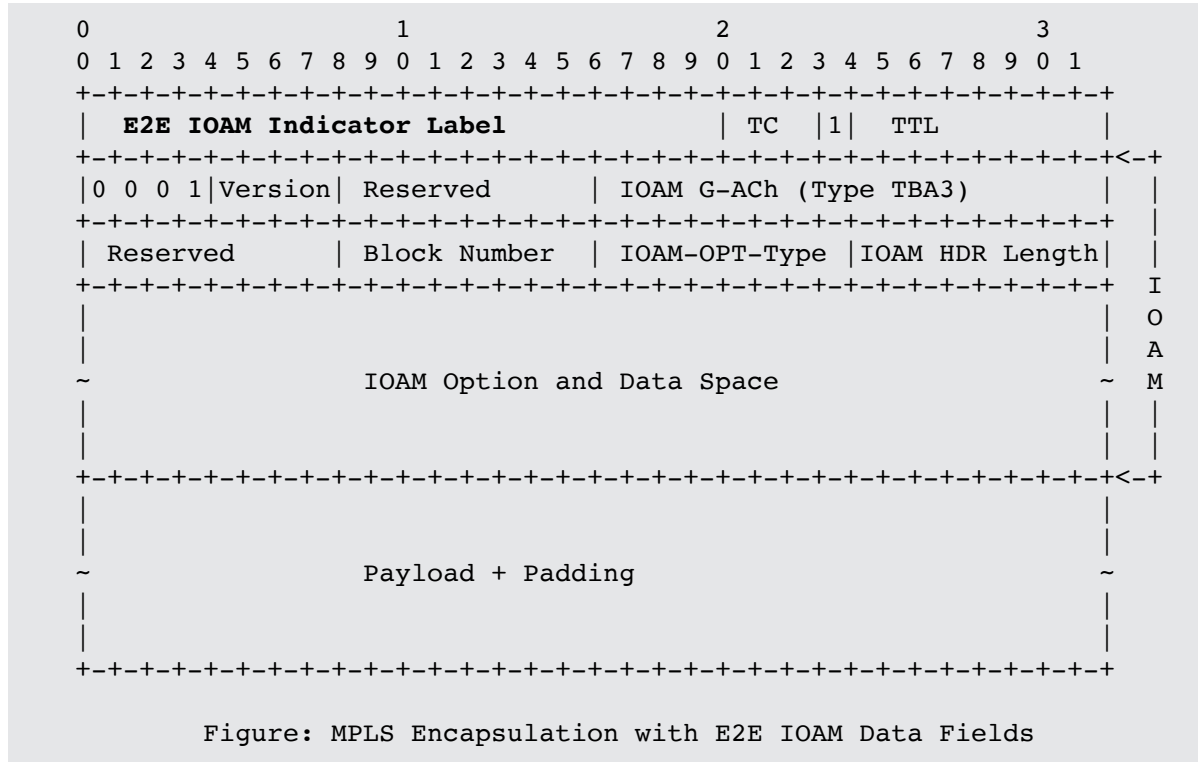
- New Generic Associated Channel (G-ACh) Type (value **TBA3**) defined for IOAM
- Protocol value *0001b* allows to avoid incorrect IP header based hashing over ECMP paths
- Note: GAL with G-ACh is used for control-channel/OAM packets whereas IOAM Label with G-ACh is used for user data packets
- Block 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

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

# IOAM Indicator Labels

- “IOAM Indicator Label” is used to indicate the presence of IOAM data fields after EOS in the MPLS Encapsulation.
- Separate Indicator Labels defined for E2E IOAM (for edge nodes) and HbH IOAM (*for edge and intermediate nodes*).
  - E2E IOAM Label allows to bypass IOAM processing on intermediate nodes.
- In case of E2E IOAM, the IOAM Option-Type(s) in the 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 intermediate and edge nodes.

# MPLS Encapsulation with E2E IOAM Data Fields



# E2E IOAM Indicator Label Allocation Methods

1. Extension Label (15) and Indicator Label assigned by IANA with value [TBA1](#)
  - From Extended Special Purpose Labels (eSPL) range
  - Both Labels are carried at the [bottom](#) of the label stack
2. Global Indicator Label allocated by a controller
  - The controller provisions the label on encapsulating and decapsulating nodes
  - The Label is carried at the [bottom](#) of the label stack
3. Indicator Label allocated by the decapsulating node
  - Signaling/advertisement extensions needed to convey the label to all encapsulating nodes (out of scope)
  - The Label is carried at the [bottom](#) of the label stack



# E2E IOAM Procedure

1. E2E IOAM includes IOAM processing on encapsulating and decapsulating nodes.
  - Only E2E Option-Type is carried in the IOAM data field.
2. The encapsulating node inserts an E2E Indicator Label and one or more IOAM data field(s) in the MPLS header.
3. The intermediate (intermediate) nodes do not process IOAM data.
4. The decapsulating node “punts the timestamped copy” of the data packet including IOAM data field(s).
  - The decapsulating node processes IOAM data field(s) from the punted packet.
5. The decapsulating node also pops the IOAM Indicator Label and the IOAM data field(s) from the MPLS encapsulation.
  - The decapsulating node forwards the data packet downstream.

# Example - SR-MPLS Encapsulation with IOAM Data Fields

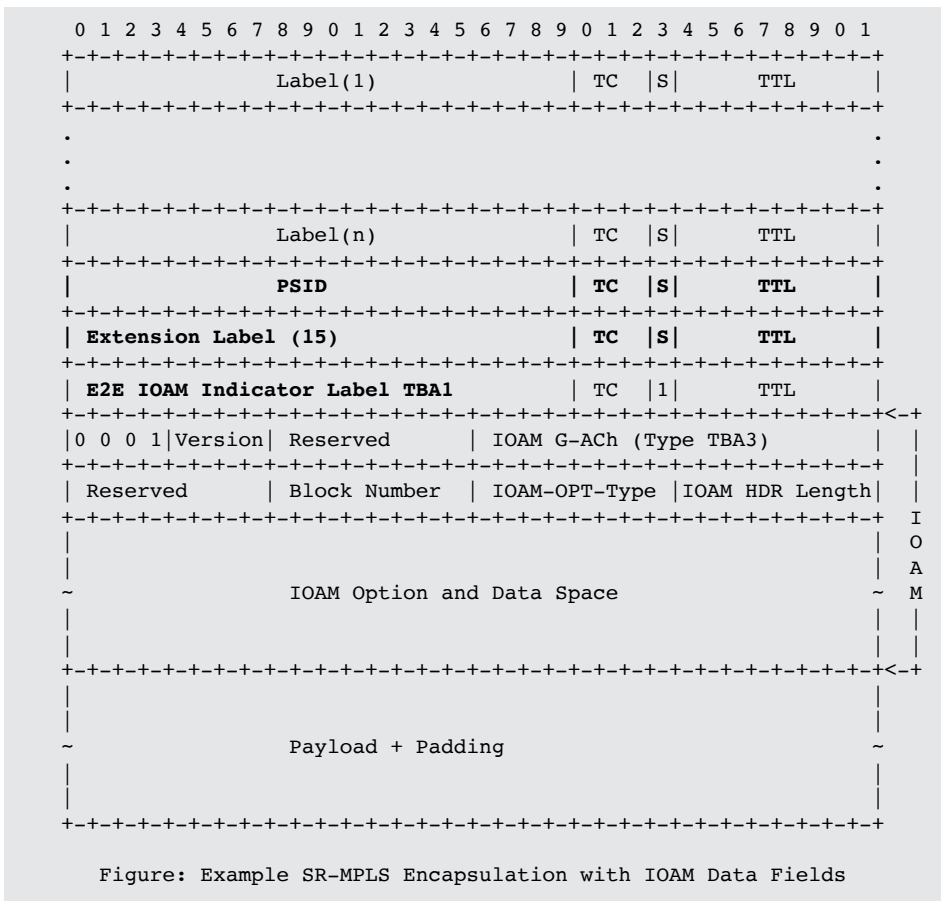


Figure: Example SR-MPLS Encapsulation with IOAM Data Fields

# MPLS Encapsulation with HbH IOAM Data Fields

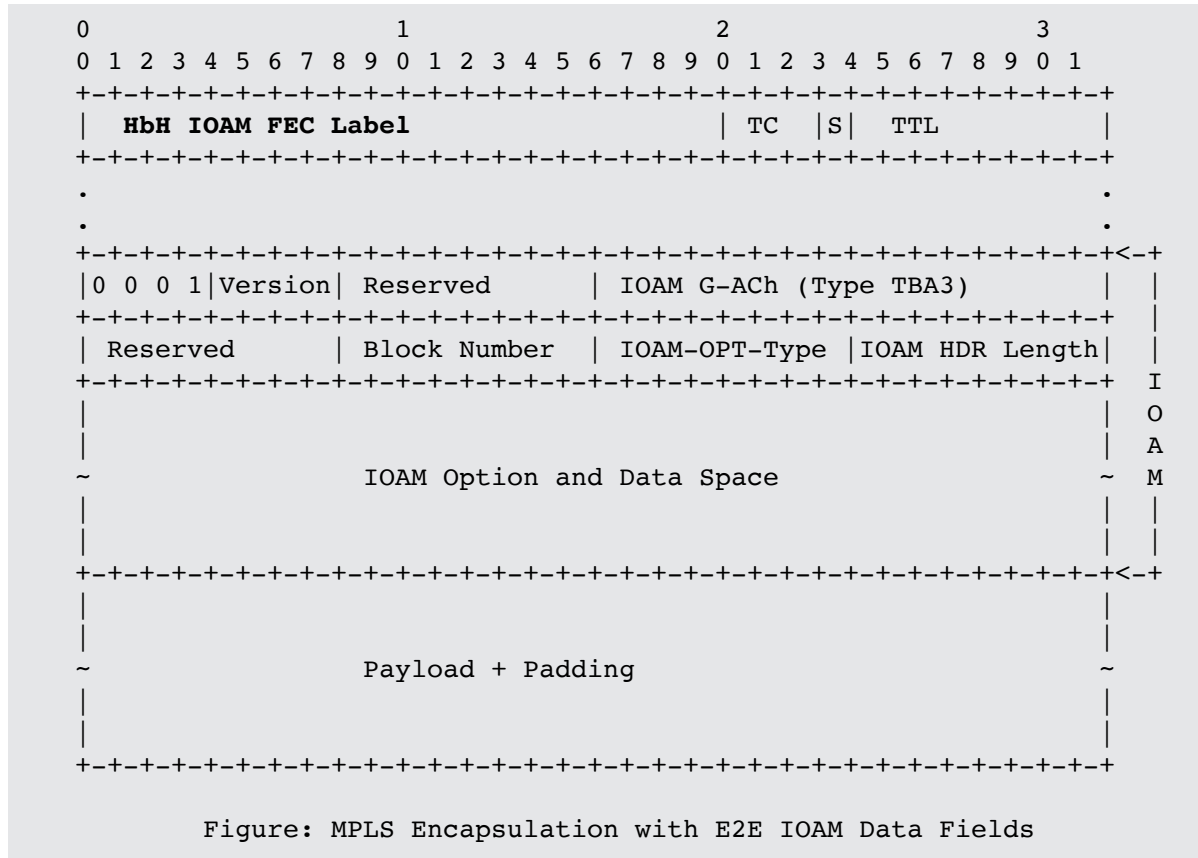


Figure: MPLS Encapsulation with E2E IOAM Data Fields

# HbH IOAM Indicator Label Allocation Methods

1. Extension Label (15) and Indicator Label assigned by IANA with value [TBA2](#)
  - From Extended Special Purpose Labels (eSPL) range
  - Both Labels are carried at the [bottom](#) of the label stack (as top label can break heterogenous network)
2. Global Indicator Label allocated by a controller
  - The controller provisions the label on encapsulating, intermediate and decapsulating nodes
  - The Label is carried at the [bottom](#) of the label stack (as top label can break heterogenous network)
3. IOAM FEC Label allocated by the intermediate and decapsulating nodes
  - Signaling/advertisement extensions needed to convey the label to all encapsulating nodes (out of scope)
  - The Label is carried at the [top](#) of the label stack

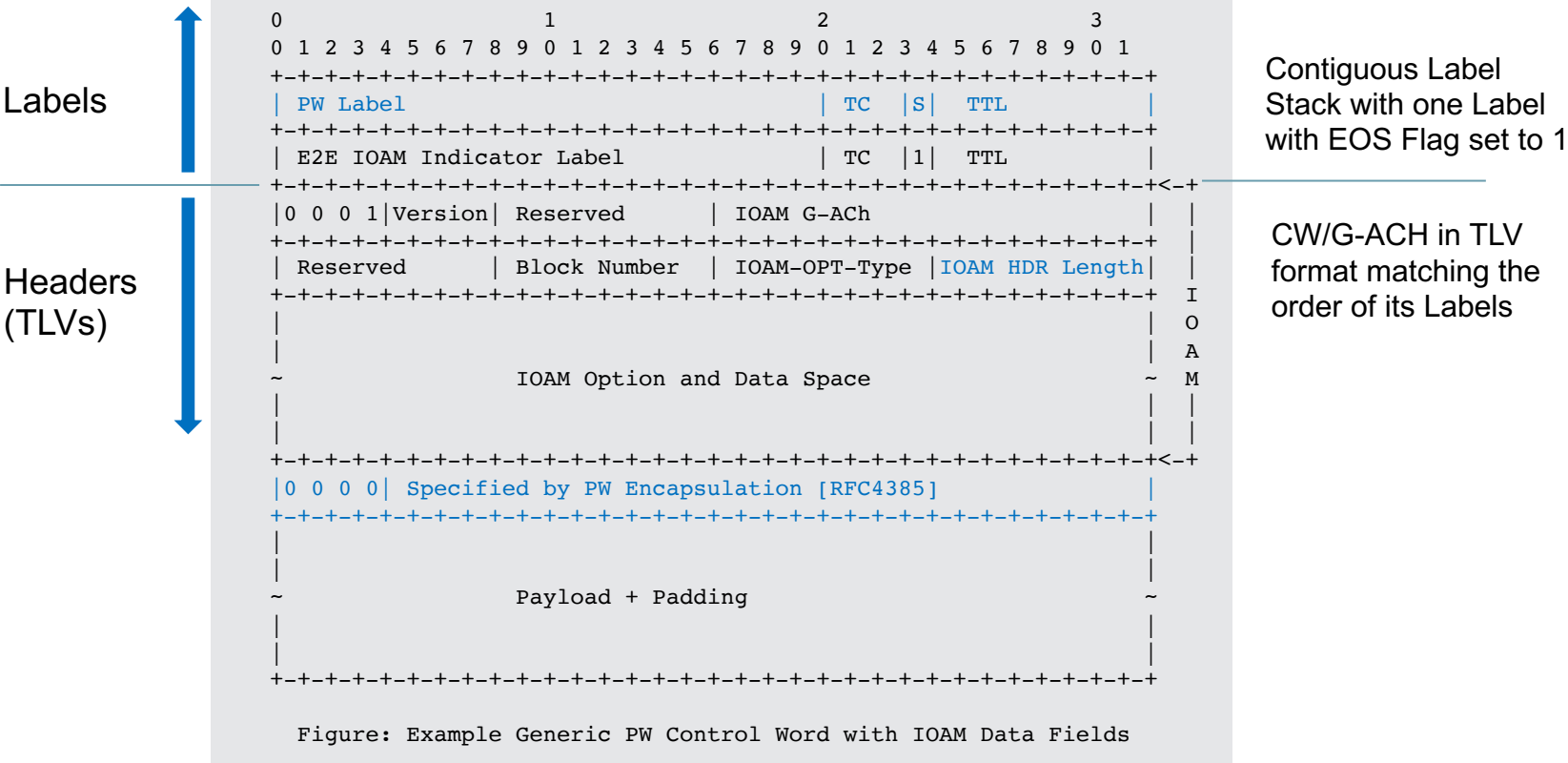
# HbH IOAM Procedure

1. HbH IOAM includes IOAM processing on encapsulating, intermediate and decapsulating nodes.
  - Pre-allocated, Incremental, Proof of Transit and E2E Option-Types are carried in the IOAM data field(s).
2. The encapsulating node inserts a HbH Indicator Label and one or more IOAM data field(s) in the MPLS encapsulation.
3. The intermediate nodes process HbH IOAM data field(s) and forward the data packet including updated IOAM data field(s).
4. The decapsulating node "punts the timestamped copy" of the data packet including IOAM data field(s).
  - The decapsulating node processes IOAM data field(s) from the punted packet.
5. The decapsulating node also pops the IOAM Indicator Label and the IOAM data field(s) from the MPLS encapsulation.
  - The decapsulating node forwards the data packet downstream.

# IOAM Data Fields with Control Word and Additional G-ACh

- E2E Indicator or HbH Indicator/FEC IOM Label with EOS Flag set is added after the PW Label.
- IOAM Data Fields, including IOAM G-ACh header are added in the MPLS encapsulation after the EOS.
- This allows the intermediate nodes to easily locate and update the HbH IOAM data field(s) after the EOS.
- Control Word or additional G-ACh is added after the IOAM Data Fields in the packet.
- The decapsulating node removes the MPLS encapsulation including the IOAM Data Fields and then processes the Control Word or G-ACh following it.
  - The presence of this is known due to the PW Label on the Label Stack.
  - *IOAM HDR Length* allows to locate the Control Word and G-ACh after the IOAM Data Fields.

# Generic PW Control Word [RFC4385] with IOAM Data Fields



# MPLS Encap with Additional G-ACh [RFC5586] with IOAM Data Fields

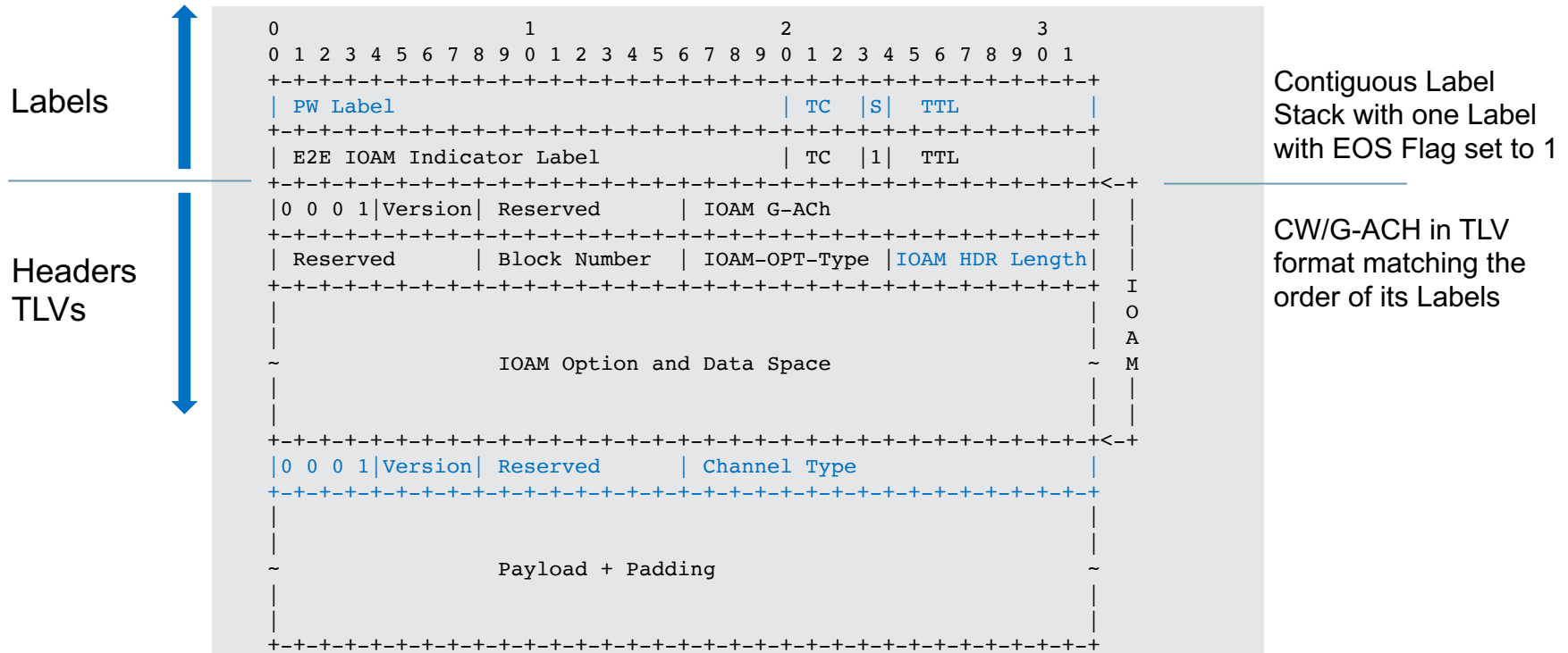


Figure: Example MPLS Encapsulation with Additional G-ACh with IOAM Data Fields



# Example - Generic Delivery Function with IOAM Data Fields

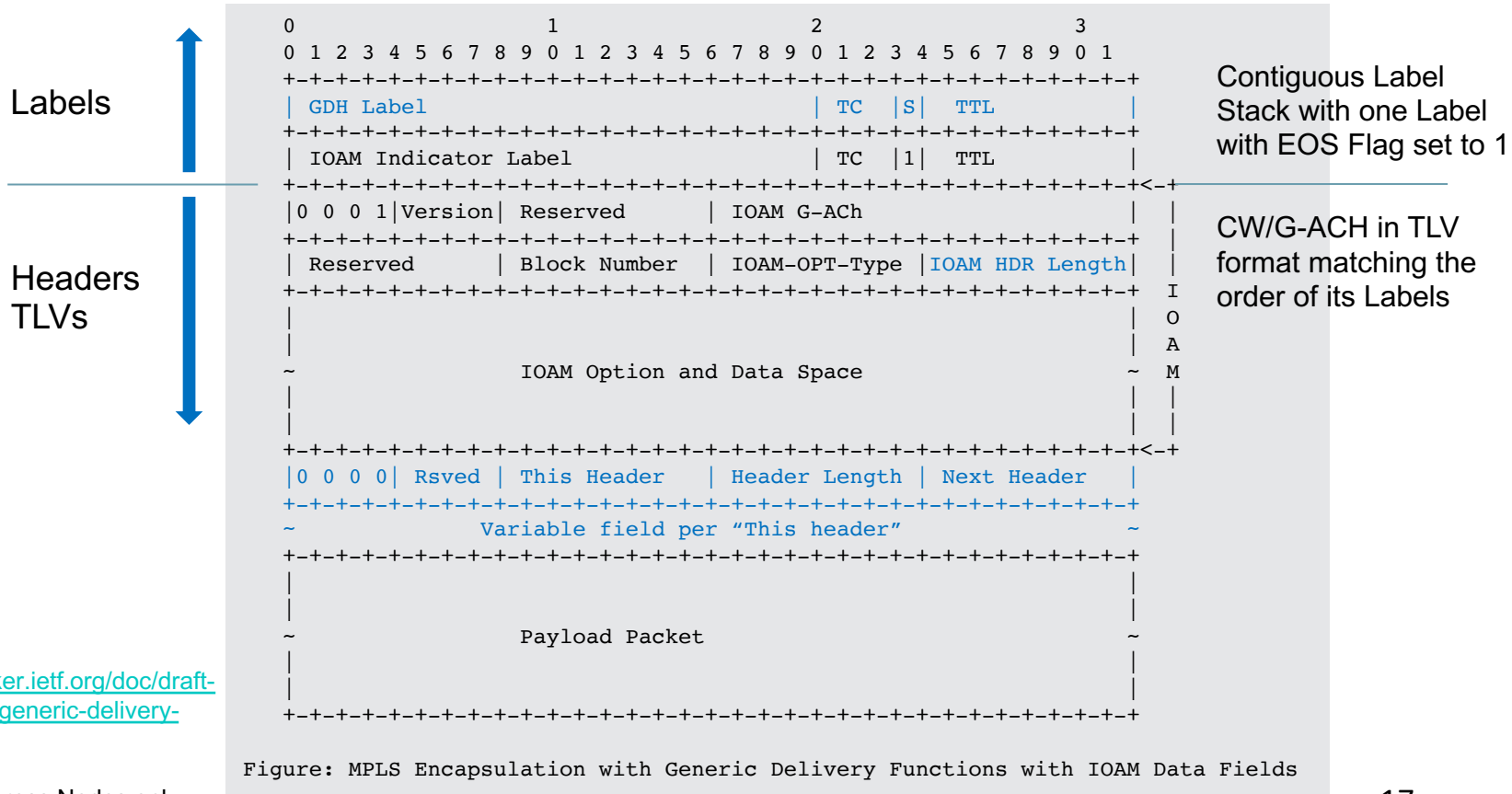
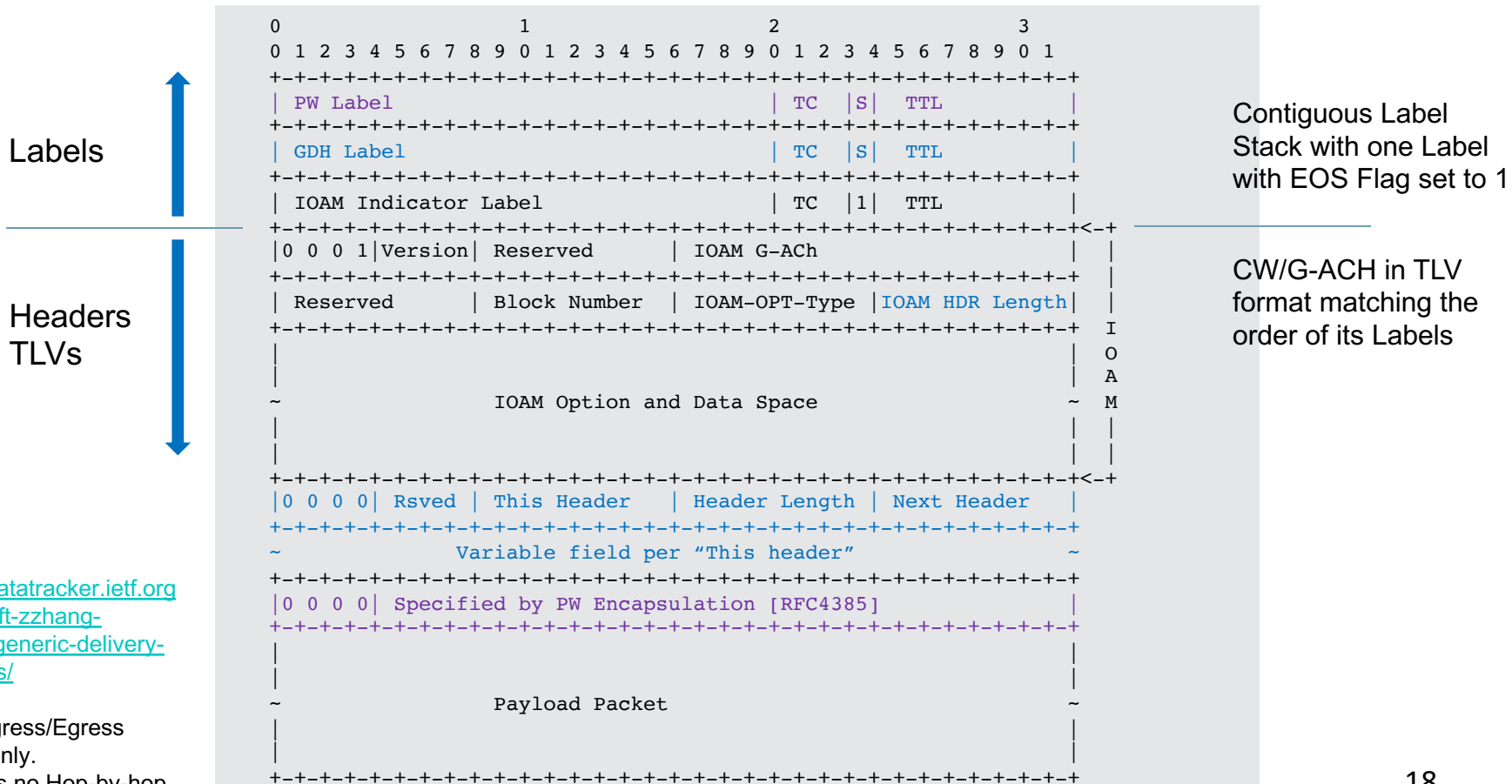


Figure: MPLS Encapsulation with Generic Delivery Functions with IOAM Data Fields

- <https://datatracker.ietf.org/doc/draft-zhang-intarea-generic-delivery-functions/>

- GDF Ingress/Egress Nodes only.
- GDF has no Hop-by-hop processing

# Example - Generic Delivery Function with IOAM Data Fields and PW



- <https://datatracker.ietf.org/doc/draft-zzhang-intarea-generic-delivery-functions/>
- GDF Ingress/Egress Nodes only.
- GDF has no Hop-by-hop processing

Figure: MPLS Encapsulation with Generic Delivery Functions with IOAM Data Fields

# Example - DetNet Control Word [RFC8964] with IOAM Data Fields

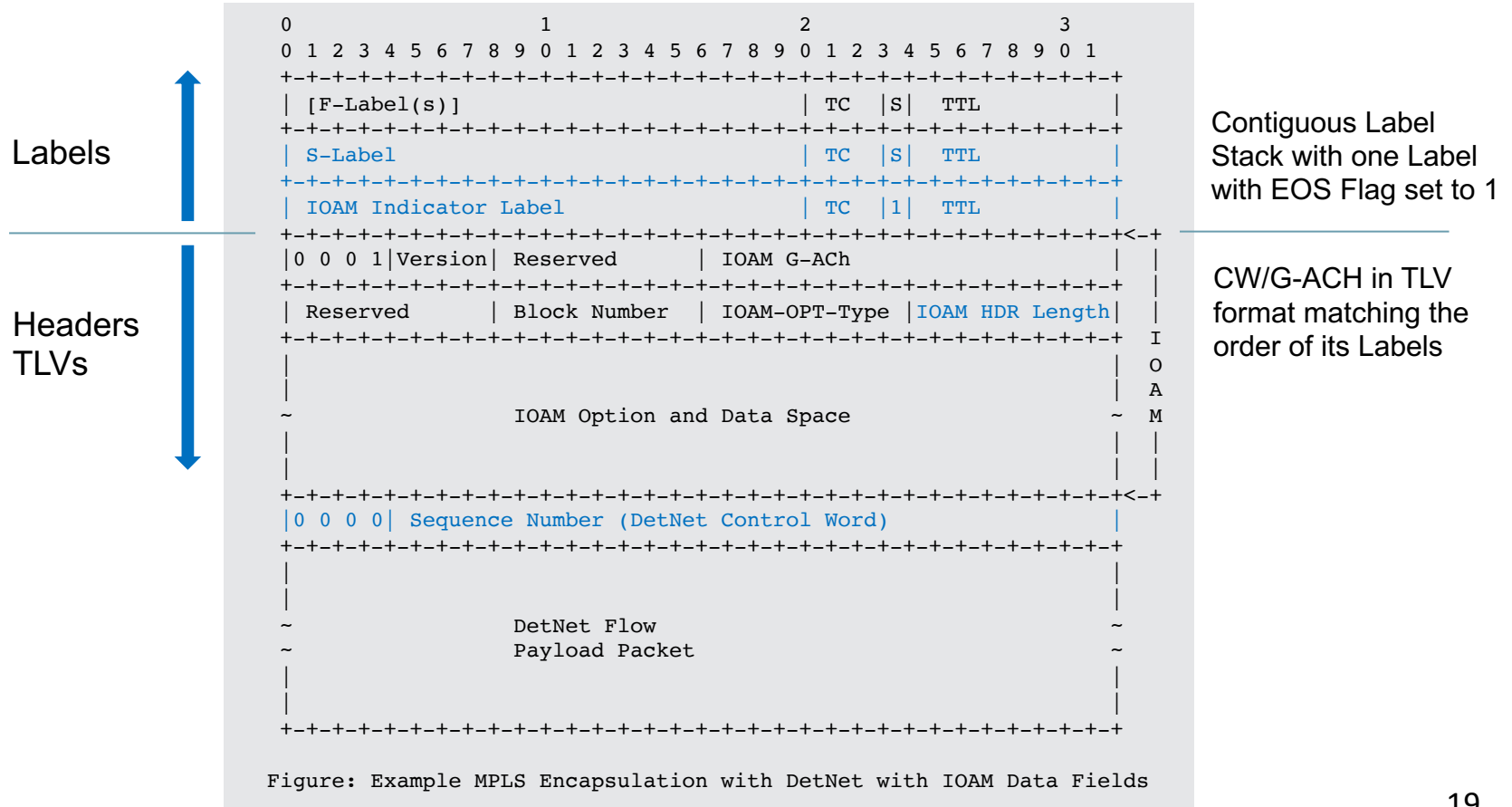


Figure: Example MPLS Encapsulation with DetNet with IOAM Data Fields

Thank you