# **IPv6 Encapsulation for IOAM -** Enhancement of IPv6 Extension Headers

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draft-li-6man-enhanced-extension-header-00

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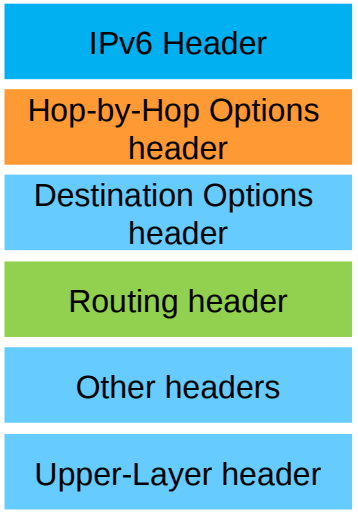
# Consideration of IPv6 Encapsulation for IOAM

- Path services such as IOAM need a field to record its met adata information

- In the incremental tracing mode of IOAM, as the number of nodes traversed by the IPv6 packets increases, the rec orded IOAM information will increase accordingly, which will increase the length of the Metadata field.

- If the Metadata is placed before RH, it will cause increasi ng difficulties in reading the following RH and thereby re duce the forwarding performance of the data plane great ly.




IPv6 Header [RFC8200]

# Optimization of IPv6 Encapsulation for IOAM: Instruction and Recording are separated

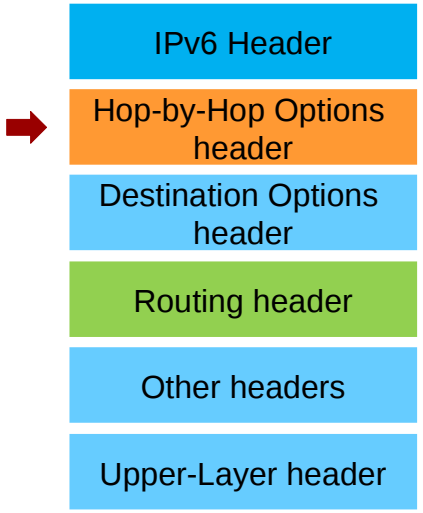
- **The instruction part (uniform IPv6 service option)**
  - Placed in the IPv6 extension headers, i.e. HBH and SRH
    - either in the HBH indicating the path service processed by all IPv6 enabled nodes along the path
    - or in the SRH TLVs indicating the path service processed only by the SRv6 nodes along the SRv6 path
  - fixed as much as possible to facilitate hardware processing to keep forwarding performance

- **The recording part (unified container)**
  - to record the service metadata of IOAM and other possible path services
  - enables to stop recording when too much data carried to reach the hardware limitation

# Issues with Hop-by-Hop Options Header

- More and more services require to process the information carried in the packets or write metadata into the packets in a hop-by-hop behavior but at wire speed
  - IOAM

- Currently, due to lack of service requirements as well as limited hardware processing capabilities, the HBH Options are usually dispatched to CPU or ignored
  - Reduce the forwarding performance greatly
  - Damage the end-to-end service consistency due to the different handling of various vendors

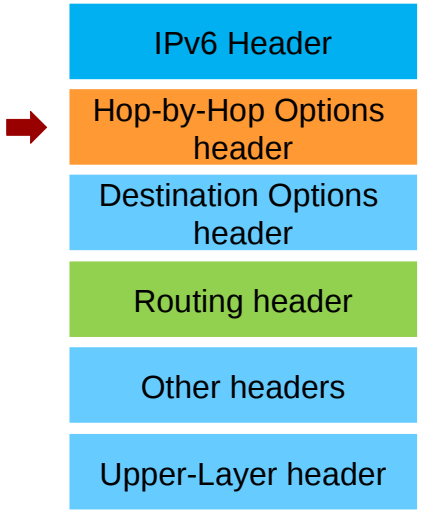



IPv6 Header [RFC8200]

# Issues with Hop-by-Hop Options Header - Cont

- The existing specs such as [RFC8200] and [RFC6564] only define
  - nodes may be configured to ignore the Hop-by-Hop Options header (HBH)
  - the packets containing a HBH may be dropped
  - the packets containing a HBH may be assigned to a slow processing path

- Can we solve it only by configuration?
  - All the HBH options will be treated in the same way, however, they may have different processing requirements
  - Every option needs to be checked one by one and decide how to process against the pre-configuration




IPv6 Header [RFC8200]

# Enhanced Hop-by-Hop Options Header

- All the options that need to be treated at wire speed will be put in the new H BH Options Header, with a different next header value to indicate

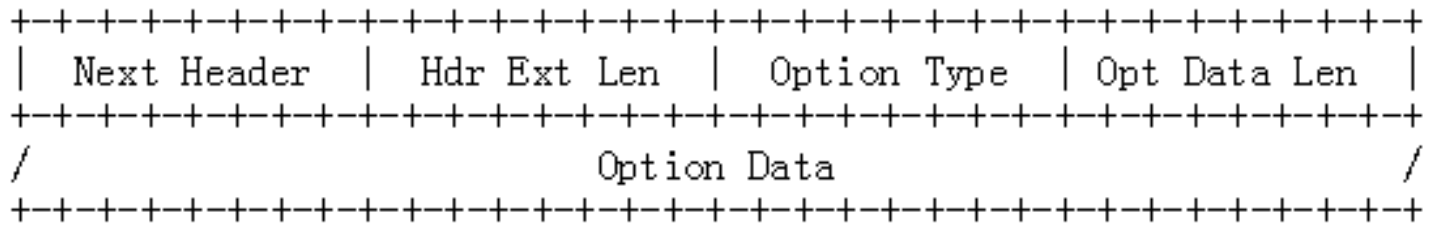
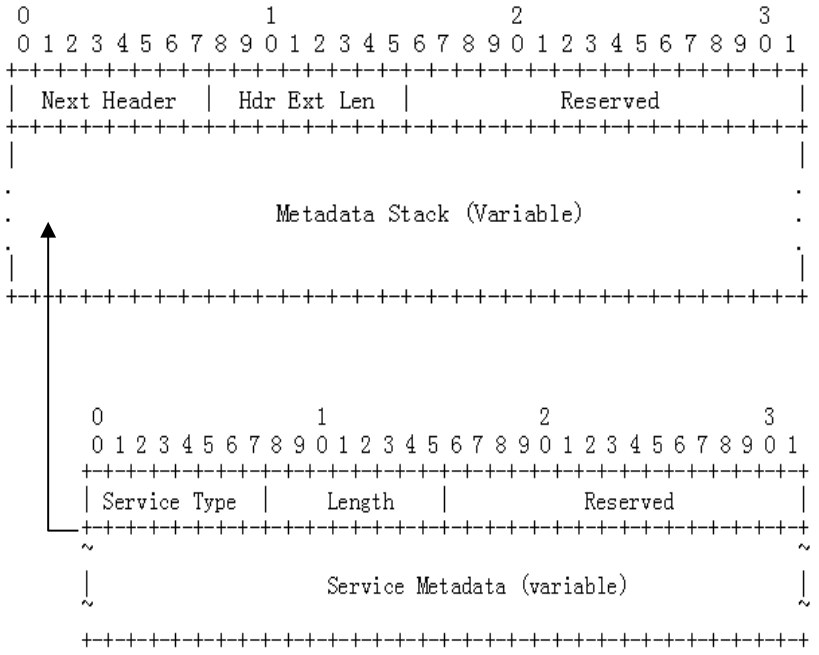



Figure. 1 Enhanced Hop-by-Hop Options Header

- New specifications on the missing procedures are required to be defined for serving the new services well, i.e. IOAM

# IPv6 Metadata Header

- A unified metadata header, IPv6 Metadata Header (MH), is defined as a container to record the metadata of SFC, IOAM and other newly emerging path services in IPv6.
  - The IPv6 Metadata Header is defined as a new type of IPv6 extension header, which is identified by a Next Header value (TBD_2).
  - The metadata is the information recorded by each hop for specific path services.
  - The length of the metadata is variable.

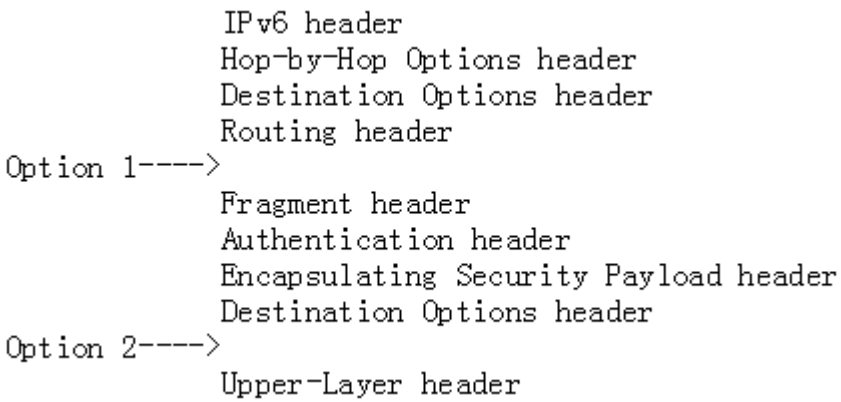


# The locations for the IPv6 Metadata header

- If the IPv6 MH is placed before RH (SRH for SRv6), it will cause increasing difficulties in reading the following SRH and thereby reduce the forwarding performance of the data plane greatly.

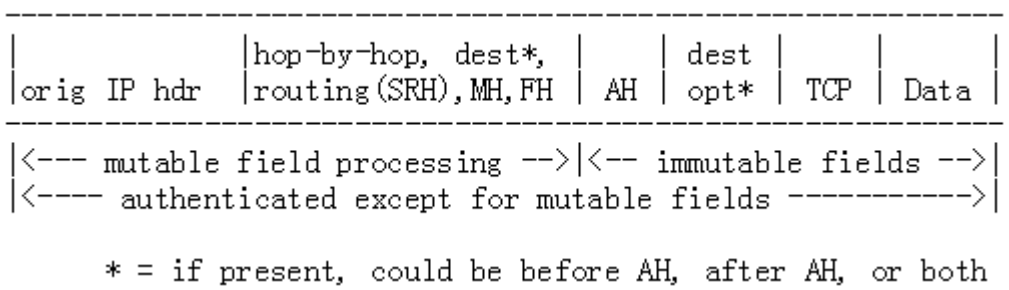
- Two options in the IPv6 extension headers are recommended for inserting the IPv6 MH.

- The different locations for inserting the IPv6 MH will also impact the processing of the AH, ESP, and FH, which will be discussed in the following section.
  - MH is changing and not predictable

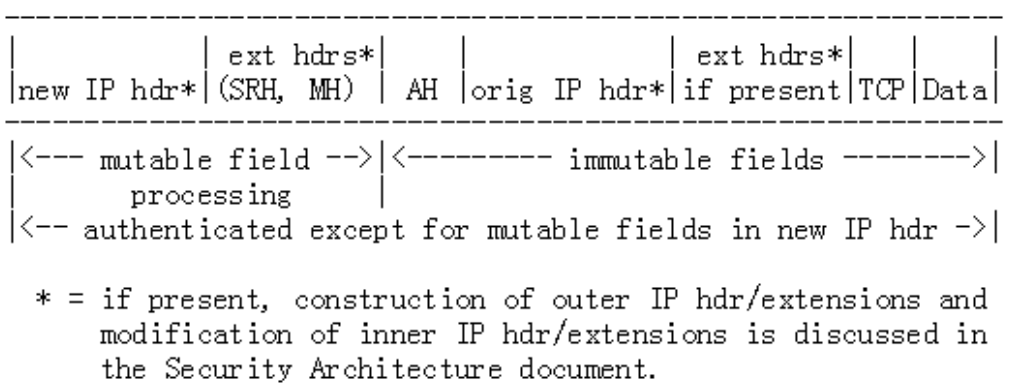


# Interactions between IPv6 MH and AH

**Transport Mode Processing**

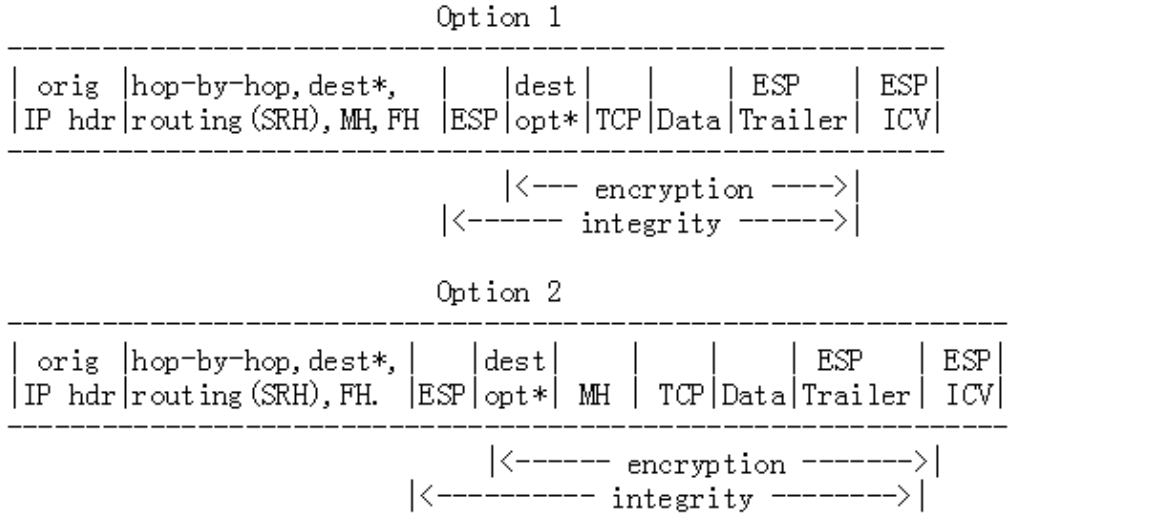



**Tunnel Mode Processing**



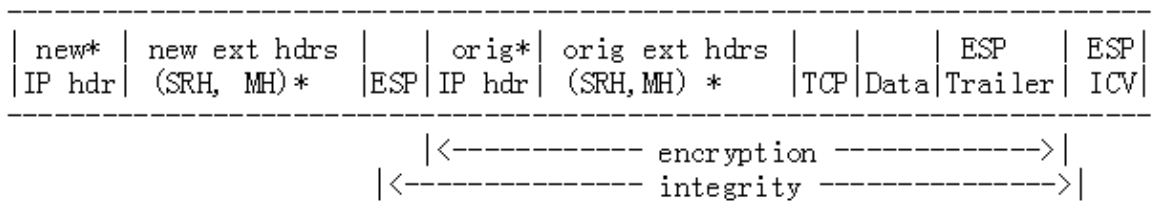
# Interactions between IPv6 MH and ESP

## Transport Mode Processing




* = if present, could be before ESP, after ESP, or both

## Tunnel Mode Processing




* = if present, construction of outer IP hdr/extensions and
modification of inner IP hdr/extensions is discussed in
the Security Architecture document

# Interactions between IPv6 MH and Fragment Header

- When the IPv6 Metadata is presented, the processing of FH needs to be specified.
- In AH/ESP transport mode, for "bump-in-the-stack" or "bump-in- th e-wire" implementations, inbound and outbound IP fragments may r equire an IPsec implementation to perform extra IP reassembly/frag mentation in order to both conform to this specification and provide transparent IPsec support.
- Special care is required to perform such operations within these impl ementations when multiple interfaces are in use.

# Next steps

- Questions and Comments are welcome
- Consolidate comments
- Refine drafts

***Thank you!***