DetNet Enhanced Data Plane

draft-yzz-detnet-enhanced-data-plane-00

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Targets

1. DetNet is required to support bounded latency
2. DetNet solutions are proposed to support bounded latency
3. DetNet data planes will be enhanced to add bounded latency specific metadata

Goals and Requirements of DetNet Bounded Latency

1. **DetNet Goal "Minimum and maximum end-to-end latency" in RFC8655**
   - DetNet-specific metadata ***Flow-ID*** is used to identify the DetNet flow
   - However, no DetNet-specific metadata is defined to guarantee the end-to-end latency

2. **Requirements of DetNet data plane in draft-liu-detnet-large-scale-requirements**
   - Explicit inclusion of the metadata used for traffic treatment, especially for bounded latency and jitter
   - Compatibility to different options of queuing, shaping, policing or any other underlying network technologies
   - Minimize the end-to-end delay difference of multiple forwarding paths that are used for packet replication and elimination
   - DetNet data plane processing of DetNet flow coexists with the non-DetNet flows

Existing Proposals of DetNet Bounded Latency

Various mechanisms:

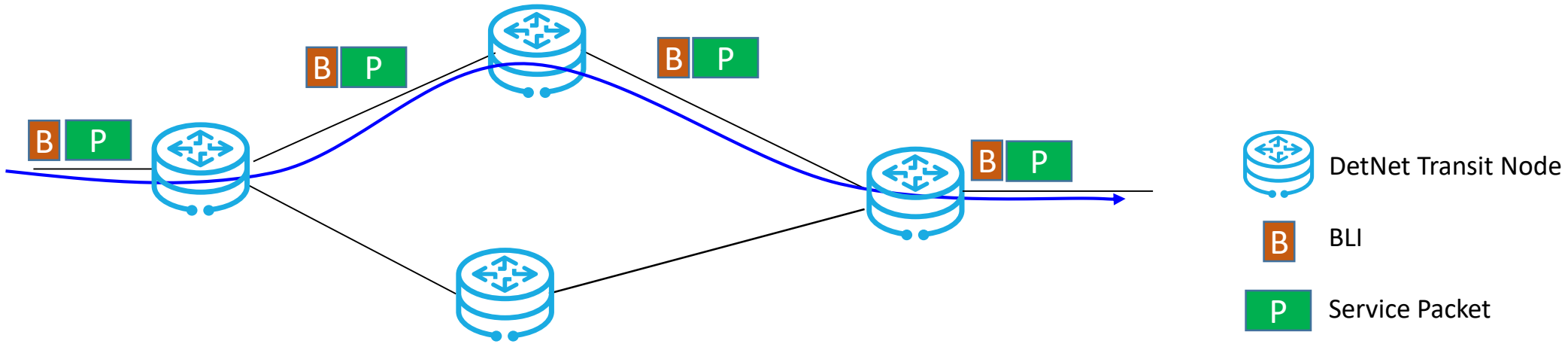
- Time Aware Shaper
- Credit-Based Shaper
- Guaranteed-Service IntServ
- Cyclic Queuing and Forwarding
- Longest in System (LIS)/Earliest Deadline First (EDF)
- Deadline Based Deterministic Forwarding
- … …

in different I-Ds

- *draft-ietf-detnet-bounded-latency*
- *draft-stein-srtsn*
- *draft-eckert-detnet-mpls-tc-tcqf*
- *draft-dang-queuing-with-multiple-cyclic-buffers*
- *draft-yizhou-detnet-ipv6-options-for-cqf-variant*
- *draft-peng-detnet-deadline-based-forwarding*

A New DetNet-Specific Metadata - BLI

- **Bounded Latency Information (BLI)** is used to facilitate DetNet transit nodes to guarantee the bounded latency transmission in data plane
- BLI is transmitted across multiple DetNet transit nodes and used by the DetNet forwarding sub-layer
- The format and encapsulations of BLI are proposed in this I-D



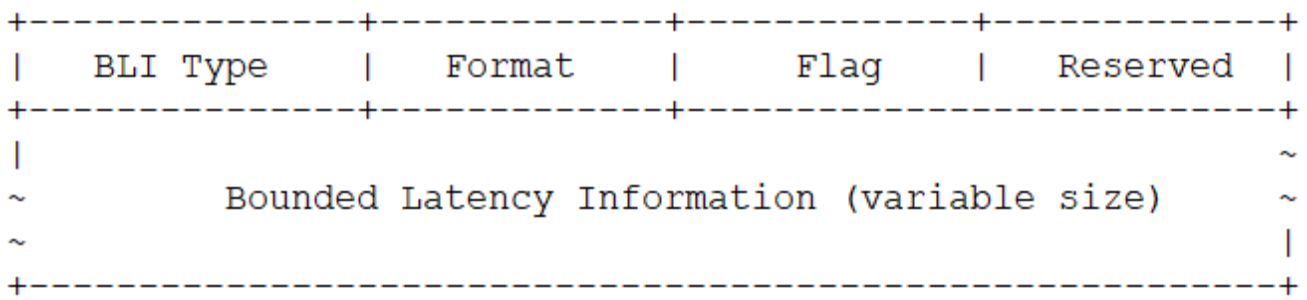
Design Rationale

1. In order to provide bounded latency, the metadata information carried in data plane should facilitate DetNet flow to map the forwarding and scheduling resources, not focus on the local mechanisms
2. Good to have a uniform format to accommodate various scheduling mechanisms
3. BLI is classified into two categories:
   - Requirement: summarize the requirements from DetNet services and map to the resources
   - Resource: indicate the resources directly

Classification	Requirements
Budget of Delay	End-to-end delay budget
	Local delay budget
Deadline	End-to-end deadline
	Local deadline
Budget of Delay Variation	End-to-end delay variation budget
	Local delay variation budget
Priority	SVC/App specific priorities

Classification	Resources
Resource ID	Cycle ID
	Queue ID
	Time Slot ID

BLI Data Field



Data Field of Bounded Latency Information

where:

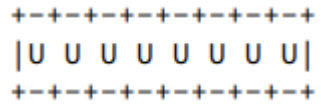
- **BLI Type:** 8-bit identifier to represent the type of bounded latency information
- **Format:** 8-bit value to indicate the format of bounded latency information
- **Flags:** 8 bits of flags

BLI Type Value	Bounded Latency Information
0	Reserved
1	Time resource ID
2	Priority
3	End-to-end delay budget
4	Local delay budget
5	End-to-end deadline
6	Local deadline
7	End-to-end delay variation budget
8	Local delay variation budget

BLI Type

Format Value	Format
1	32-bit unsigned Integer
2	16-bit unsigned Integer
3	8-bit unsigned Integer
4	PTP 80-bit Timestamp
5	PTP 64-bit Timestamp
6	NTP 64-bit Timestamp
7	NTP 32-bit Timestamp

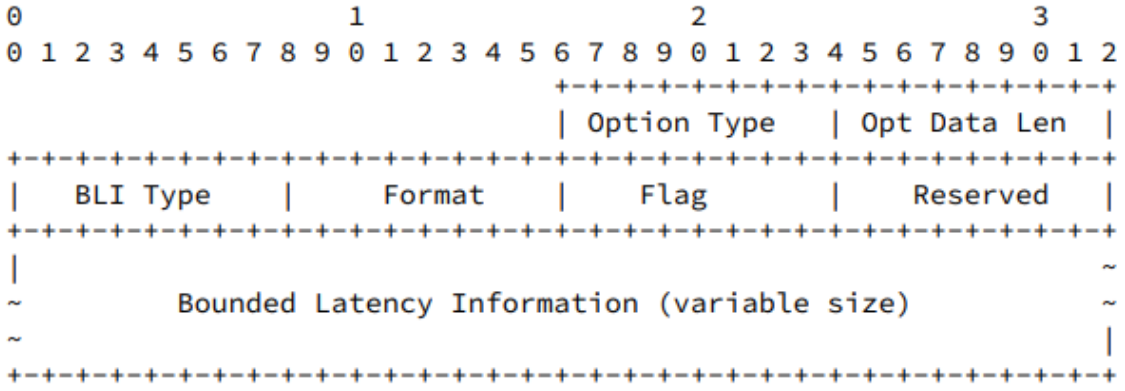
Format



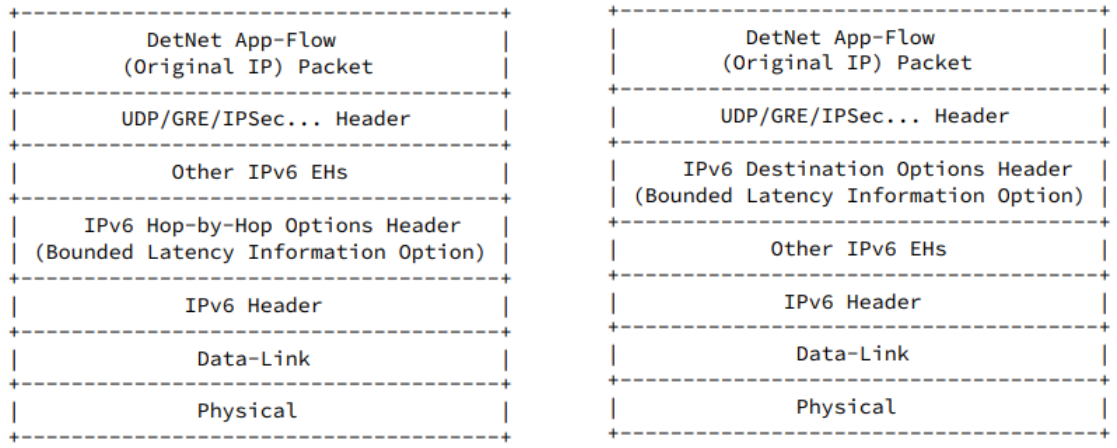
Flags

Encapsulation of DetNet IP Data Plane

- For IPv6 based DetNet DP, a new IPv6 Extension Header Option called **BLI Option** is defined
- BLI data field is encapsulated in either IPv6 HbH or IPv6 DOH depending on the processing happens at each hop or at the last hop
- More than one bounded latency information can appear in one BLI Option



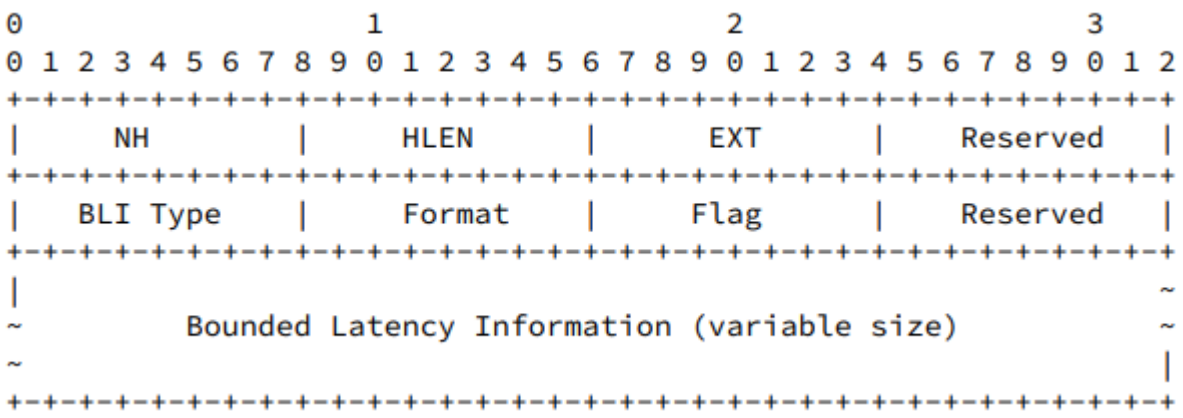
Bounded Latency Information Option



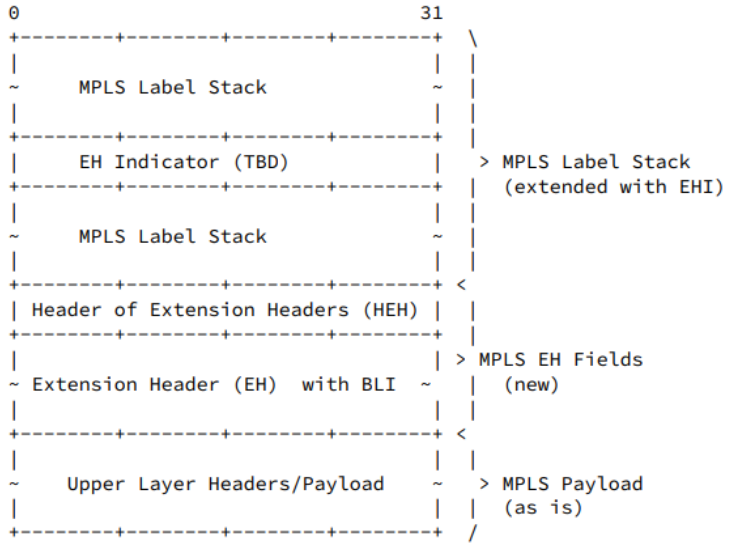
Encapsulation of BLI Option in IPv6 HbH or DOH

Encapsulation of DetNet MPLS Data Plane

- For MPLS based DetNet data plane, a new MPLS Extension Header called **BLIEH** is defined
- BLIEH is processed either HbH or E2E depending on the processing required at each hop or at the last hop
- More than one bounded latency information can appear in one BLIEH



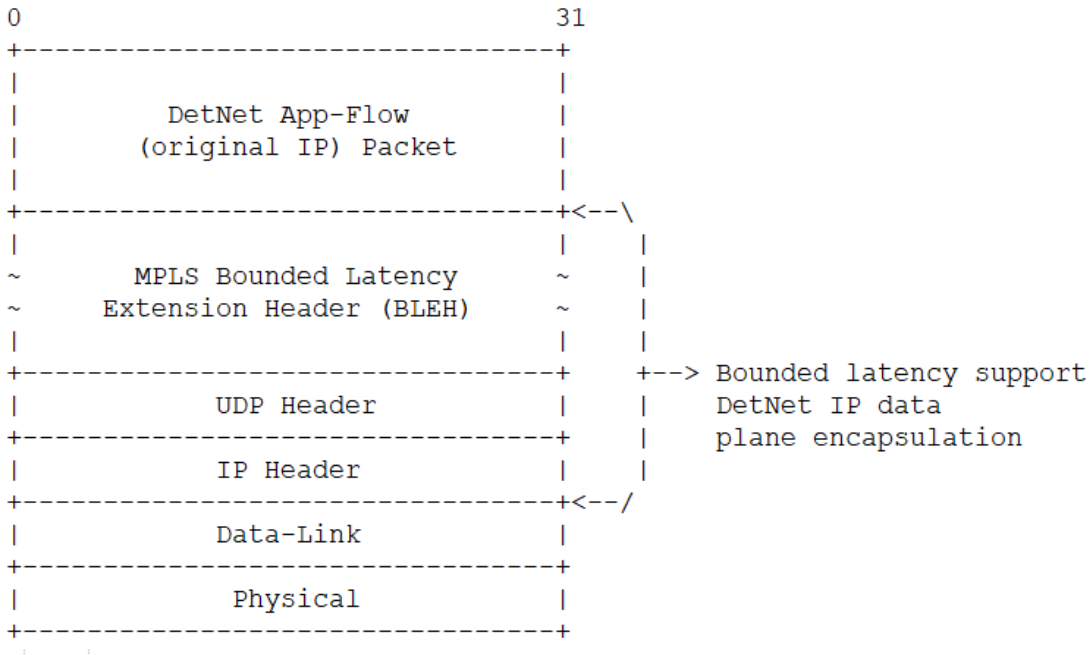
Bounded Latency Information Extension Header (BLIEH)



MPLS Encapsulation of BLIEH

Encapsulation of DetNet MPLS over UDP/IP Data Plane

- The BLI encapsulation in MPLS over UDP/IP based DetNet data plane leverages the encapsulations of MPLS BLIEH, but without any MPLS forwarding labels



MPLS over UDP/IP Encapsulation of BLI

Next Step

- Discussions of BLI data fields
- Other format alternatives? e.g. different format for each scheduling mechanism or uniform format for all scheduling mechanisms

As always, comments and suggestions are greatly welcome!
Thank you for listening!