# Queuing-based Enhancement

draft-xiong-detnet-6man-queuing-option-01
draft-sx-detnet-mpls-queue-00

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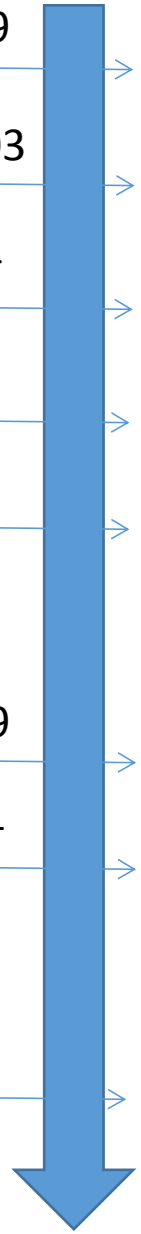
DetNet Interim, 2022-12

# Recap of the Queuing-based Enhancement



2021-09

- DetNet Interim Meeting : Discuss the queuing-based topics

2021-11/2022-03

- IETF 112 and 113 DetNet Meeting: Discuss the queuing-based requirements in large-scale networks

2022-04

- Submit draft-xiong-detnet-6man-queuing-option-00 for IPv6 queuing-based data plane solution

2022-06

- Submit draft-sx-detnet-mpls-queue-00 for MPLS queuing-based data plane solution

2022-07

- IETF 114 DetNet Meeting: new charter and milestones for enhanced DetNet
- Update draft-xiong-detnet-6man-queuing-option-01 and prensent in IETF114

2022-09

- Update draft-xiong-detnet-6man-queuing-option-02 to align with the terminology of requirement

2022-11

- IETF 115 DetNet Meeting: Discuss the gap analysis and enhancement of DetNet Data Plane
- Update draft-sx-detnet-mpls-queue-03 to align with MPLS WG and prensent in IETF115

2022-12

- DetNet Interim Meeting: Discuss the queuing-based solutions
- Update draft-xiong-detnet-6man-queuing-option-03 to propose queuing-based enhancement

# Gap analysis

**Primary Goals**

- Support the Different Levels of DetNet QoS for Multiple Services
  - Guarantee the end-to-end bounded latency

**Characteristics of Large-Scale Deterministic Networks**

- Large-scale Dynamic Flows
- Large-scale Network Topology
  - large number of nodes and links
  - High speed, long-distance transmission and asymmetric links
  - multiple domains
  - nodes may be interconnected with different sub-network technologies

**Gap Lists for RFC8938**

- Providing Aggregated Flows Identification in service sub-layer
  - it requires large amount of control signaling to establish and maintain DetNet Data Plane DetNet per-flows or aggregated flows
- Providing Deterministic Latency in forwarding sub-layer
  - Explicit Routes
    - be challenging to compute paths due to the multiple network metrics and frequent topology changes
    - loose routes, inter-domain routes and multiple disjoint paths should be considered in large-scale nworks
  - Resources Allocation
    - rational allocation of deterministic latency resources for different levels of services
  - Queuing Mechanisms
    - Enhancement of queuing-based mechanisms and the related DetNet-Specific Metadata
- DetNet-Specific Metadata for enhanced functions
- DetNet-Specific treatment at ingress nodes and transit nodes
- Encapsulations for IPv6/MPLS/SR-MPLS/SRv6

- Refer to draft-xiong-detnet-enhanced-detnet-gap-analysis.

# Queuing-based Enhanced Functions and Metadata

- The packet treatment should indicate the behaviour action ensuring the deterministic latency at DetNet nodes. New functions and specific metadata should be supported in enhanced DetNet such as queuing mechanisms and information.
- For aggregated or per flow at a DetNet node, an unique behaviour may be enhanced in data plane such as queuing-based shceduling. For some queuing mechanisms, queuing-based information should be carried in metadata for coordination between nodes. The data plane enhancement must be generic and the format must be applied to all functions and queuing mechanisms.
  - TAS (Time Aware Shaping) as defined in [IIEEE802.1Qbv].
  - CBS (Credit-Based Shaper) as defined in [IEEE802.1Q-2014].
  - CQF (Cyclic Queuing and Forwarding) as defined in [IEEE802.1Qch] .
  - ATS (Asynchronous Traffic Shaping) as defined in [IEEE802.1Qcr] .
  - Cyclic Queuing as defined in [I-D.dang-queuing-with-multiple-cyclic-buffers] and cycle information should be carried in metadata.
  - Deadline-based Queuing as defined in [I-D.peng-detnet-deadline-based-forwarding] and deadline information should be carried in metadata.
  - Deadline-based Queuing as defined in [I-D.stein-srtsn] and local deadline information should be carried in metadata.
  - ADN (Asynchronous Deterministic Networking) as defined in [I-D.joung-detnet-asynch-detnet-framework].
  - .....

# Queuing-based Enhancement in IPv6/SRv6 Data Plane

- Purpose
  - Provide encapsulation for the information of DetNet flows to achieve the end-to-end deterministic latency in IPv6 and SRv6 data plane.

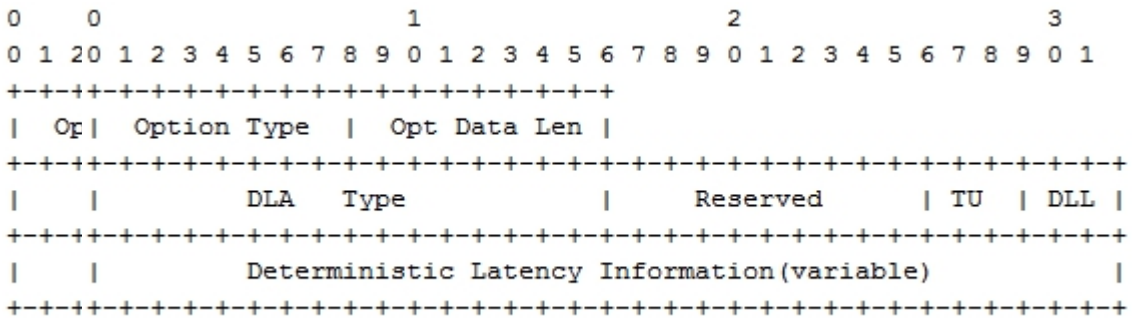



Figure 1: Deterministic Latency Option Format

- Considerations on DetNet Queuing-based Information Encapsulation
  - Define new IPv6 options for DetNet to signal deterministic latency information
  - Define the DLA(Deterministic Latency Action) Type to indicate the deterministic latency actions.
  - Type(8 bits): indicates the behaviour action type of packet treatment.
  - Sub-type(8 bits): indicates the type of functions ensuring the deterministic latency and related metadata.

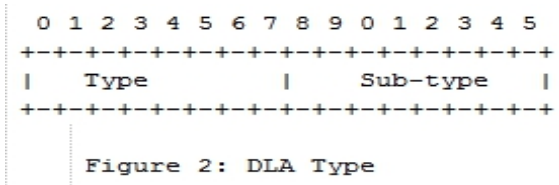



Figure 2: DLA Type

| Type | Behaviour Action |
|---|---|
| 0x0000 | Unassigned |
| 0x0100 | Bandwidth guarantee |
| 0x0200 | Jitter guarantee |
| 0x0300 | Delay guarantee |
| 0x0400 | Low delay and jitter guarantee |
| 0x0500 | Ultra-low delay and jitter guarantee |

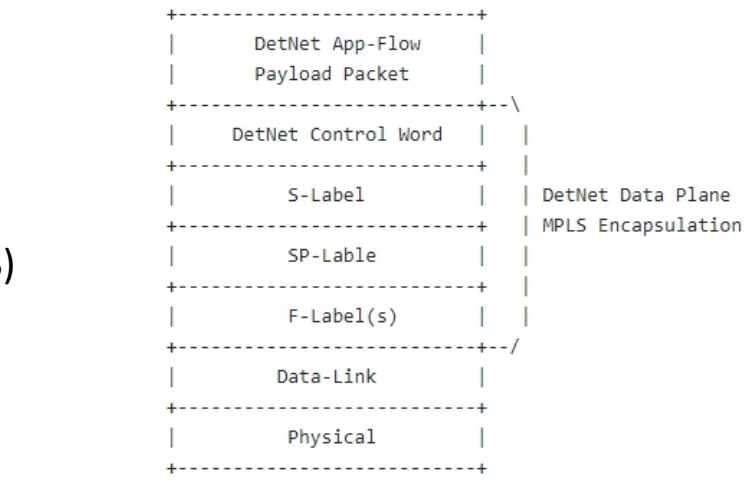
Figure 3: Behaviour Action Type

| Sub-type | Function Action |
|---|---|
| 0x0000 | Unassigned |
| 0x0001 | Cycle Information |
| 0x0002 | Deadline Information |
| 0x0003 | Local Deadline Information |

Figure 4: Function Action Sub-type

# Queuing-based Enhancement in SR/MPLS Data Plane

- Purpose
  - Provide encapsulation for the queuing-based metadata of DetNet flows in MPLS data plane specified in [RFC8964].
  - Align with the ongoing work in MPLS WG (e.g., [I-D.jags-mpls-mna-hdr] and [I-D.ietf-mpls-mna-fwk],).
- Considerations on DetNet MPLS Queue Encapsulation
  - the SP-Lable (SPL) is added to indicate Deterministic Latency Action (DLA)
  - use b-SPL to indicate the presence of the MPLS Network Action Sub-Stack (NASS)
  - MPLS DLA Sub-Stack
    - NAI-Opcode field, DLA indicator
    - Flag-Based NAI field, flags for DLA queuing mechanisms
    - NAL field value MUST set to 2, used for indication of the numbers of LSE (Label Stack Entry)
    - R bit, reserved for future use
    - S bit, indicator for bottom of MPLS stack
    - IHS field, selection for E2E or HBH
    - NASL field, indicates the total length of MPLS DLA sub-stack



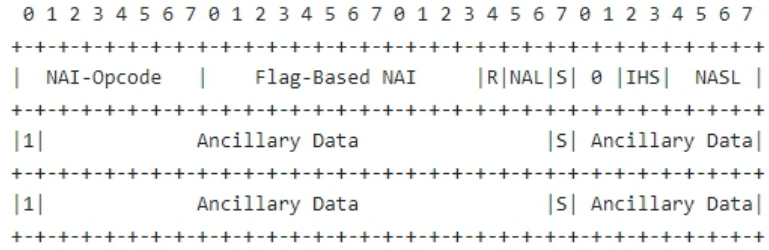




Figure 3: MPLS LSE Format for DLA

# Next Steps

- Types for queuing mechanisms used for DetNet service should get a confirmation from WG and related queuing information should be discussed in details for each particular .
- Follow the charter and milestones of DetNet and align with the terminology.
- Comments and Questions are appreciated.