PCEP Extension for DetNet Bounded Latency

draft-xiong-pce-detnet-bounded-latency-06

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IETF 124 PCE, November-2025

Updates from last versions

- Presented at IETF#114, #116, #119, #121 and comments at meetings and on the mailing list are appreciated from :
  - Dhruv Dhody/Andrew Stone/Lou Berger/Janos Farkas

- Updates from version -05
  - revised the deterministic latency metadata encoding to align with the draft-ietf-detnet-dataplane-taxonomy
  - revised the metric name from "jitter" to "variation" and changed to three metric types to align with RFC8655
  - added deterministic path computation and calculation for end-to-end bounded latency metrics
  - added the defination and clarification for DP-RRO subobject
  - added clarification and encoding example for the operations of DP-ERO and DP-RRO subobject

PCEP Extensions

- METRIC Object
  - End-to-End Minimum Latency Metric
    - This document proposes the end-to-end minimum latency metric in PCEP to represent the lower bound of the end-to-end delay.
  - End-to-End Maximum Latency Metric
    - This document proposes the end-to-end maximum latency metric in PCEP to represent the upper bound of the end-to-end delay.
  - End-to-End Latency Variation Metric
    - This document proposes the end-to-end latency variation metric in PCEP to represent the difference between the end-to-end upper latency and the end-to-end lower latency.

- Calculation of End-to-end Bounded Latency
  - per-hop_delay_bound = sum{Output delay + Link delay + Frame preemption delay + Processing delay + Regulation delay + Queuing delay}.
  - end_to_end_delay_bound = sum{per hop_delay_bound(h),(h=1,2,...H)}.
  - end_to_end_delay_bound = non_queuing_delay_bound + queuing_delay_bound.
  - end_to_end_delay_variation = non_queuing_delay_variation + queuing_delay_variation.

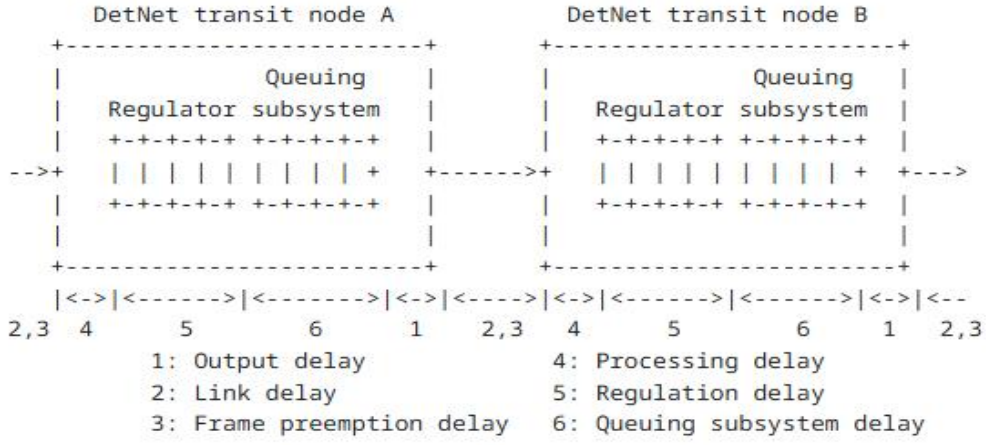


Figure 1: Timing Model for DetNet or TSN

  - End-to-end bounded latency timing model is as per RFC9320.

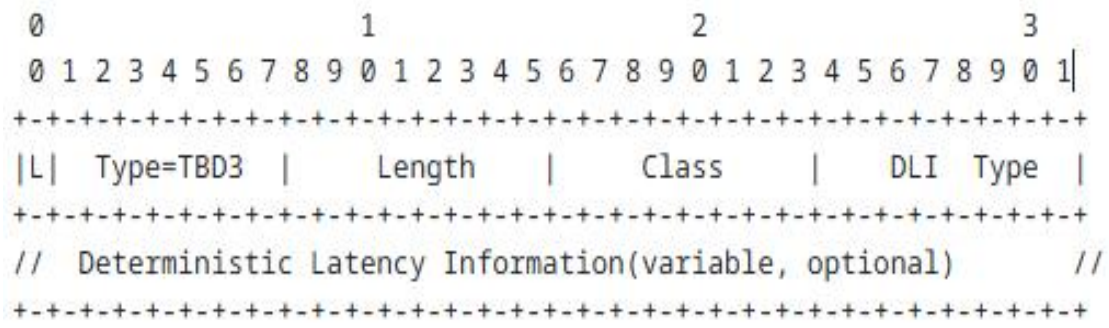
PCEP Extensions (cont)

- D flag in LSP-EXTENDED-FLAG TLV in LSP

  Object defined in RFC9357

D (Request for Deterministic Path) : If the bit is set to 1, it indicates that the PCC requests PCE to compute the deterministic path. A PCE would also set this bit to 1 to indicate that the deterministic path is included by PCE and encoded in the PCRep, PCUpd or PCInitiate message.

- Deterministic Path ERO Subobject (DP-ERO)



- Deterministic Path RRO Subobject (DP-RRO)

The format of the DP-RRO subobject is the same as that of the DP-ERO subobject, but without the L flag.

PCEP Extensions (cont)

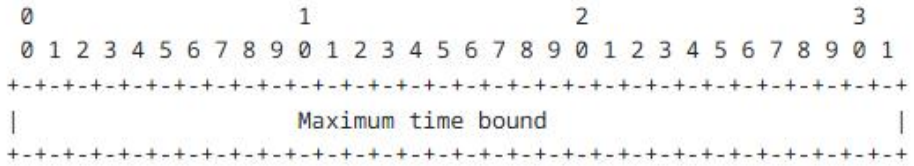
- Deterministic Latency Information(DLI) Type (8bits): indicates the type of deterministic latency information with related queuing and scheduling metadata and it aglined with the suitable categories as per [I-D.ietf-detnet-dataplane-taxonomy].
- Deterministic Latency Information(DLI) (variable): indicates the corresponding deterministic latency parameters.

Value	DLI Type
0x0000	Unassigned
0x0001	Right-bounded
0x0002	Flow level periodic bounded
0x0003	Class level periodic bounded
0x0004	Flow level non-periodic bounded
0x0005	Class level non-periodic bounded
0x0006	Flow level rate based unbounded
0x0007	Flow level rate based left-bounded

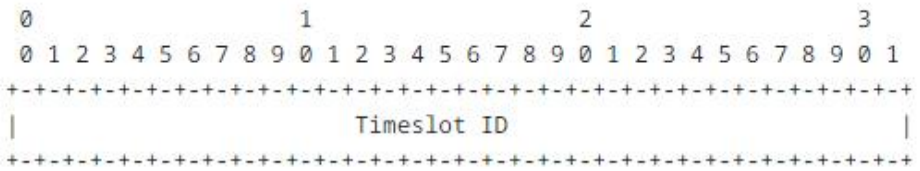
Figure 2 DLI Type

PCEP Extensions (cont)

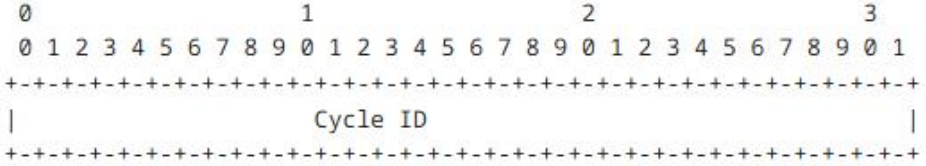
- **DLI Information for Right-bounded**



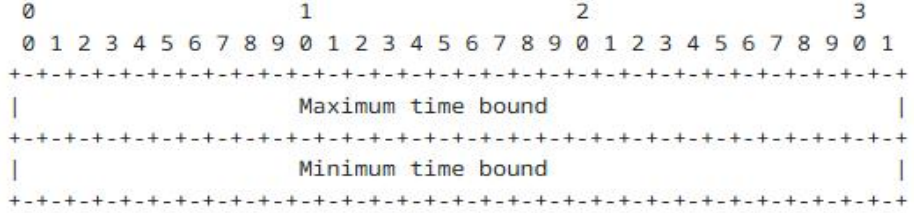
- **DLI for Flow level Periodic Bounded**



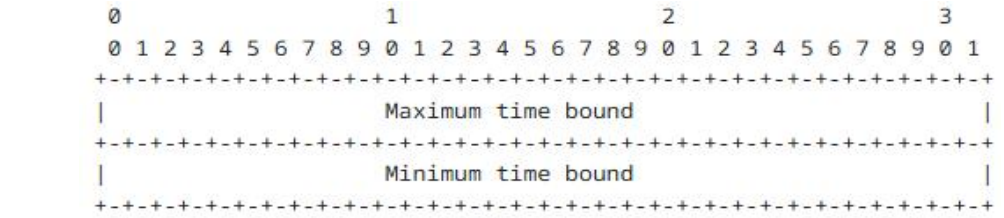
- **DLI for Class Level Periodic Bounded**



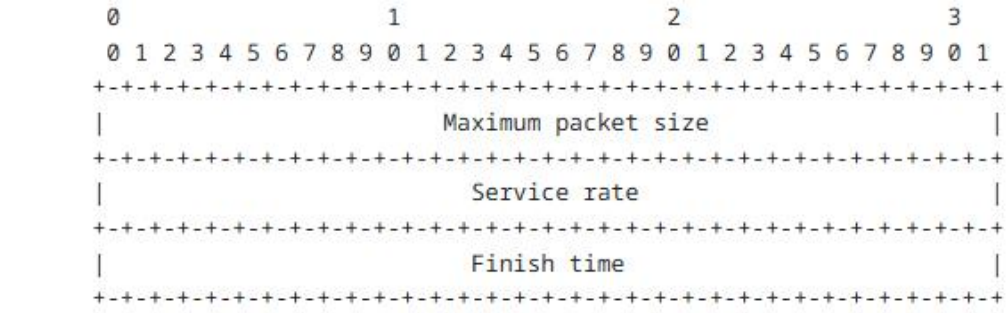
- **DLI for Flow Level Non-periodic Bounded**



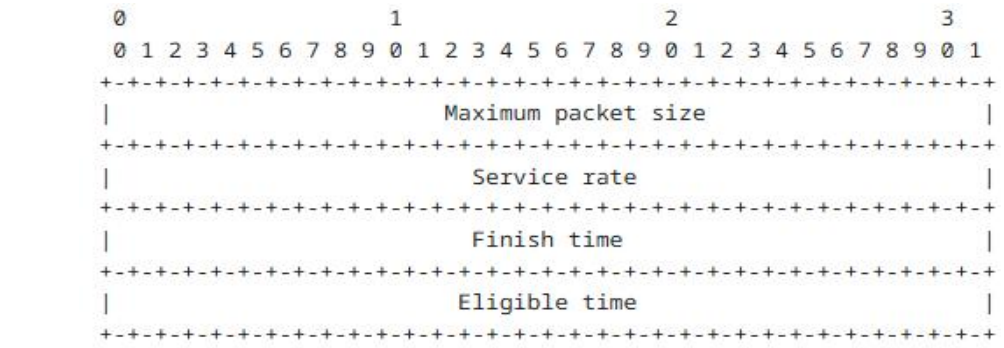
- **DLI for Class Level Non-periodic Bounded**



- **DLI for Flow Level Rate-based Unbounded**



- **DLI for Flow Level Rate-based Left-bounded**



PCEP Operations

- Metric types
  - A PCC MAY use the End-to-end Bounded Latency Metrics in a PCReq message to request a deterministic path.
  - A PCE MAY use the metrics in a PCRep message along with a NO-PATH object in the case it cannot compute a path meeting this constraints.
- ERO and RRO Subobjects
  - The DP-ERO subobject can be carried along the path to indicate the deterministic path and bounded latency information in a PCRep or PCInitiate or PCUpd message from a PCE to a PCC . And the PCC may insert the deterministic latency information as the DetNet-specific metadata into the packet headers to achieve the deterministic forwarding.
  - When the D bit in LSP object is set to 1, a DP-ERO subobject MAY be inserted directly after the existing identifying subobjects such as ERO [RFC3209] , SR-ERO [RFC8664] and SRv6-ERO [RFC9603].
    - Example: ERO(A) subobject->DP-ERO(A) subobject->ERO(B) subobject->DP-ERO(B) subobject->ERO(C) subobject->DP-ERO(C)subobject
  - The DP-RRO subobject can be also carried directly after the existing identifying RRO subobjects such as RRO [RFC3209] , SR-RRO [RFC8664] and SRv6-RRO [RFC9603].

Next Steps

- Comments and suggestions are very welcome!
- Ask adoption?
- Thanks!