Segment Routing (SR) Based Bounded Latency

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Motivation

• Achieving end-to-end bounded latency is one of the goals of DetNet.
  • Time-based scheduling is one of the ways to achieve bounded latency.

• Segment Routing is a source routing technology without per-flow states maintained at intermediate nodes;
  • Scale to large number of flows;

• This draft combines Segment Routing and Time-based scheduling to implement bounded latency.
  • Scalable fine-grained and accurate latency control.
One Example of Time-based scheduling : IEEE TSN CQF

• CQF: Cyclic Queuing and Forwarding (802.1Qch)
  • The sending time of an interface is divided into a series of equal time intervals with the duration of T, each time interval is called a "cycle";
  • CQF assumes that a packet is transmitted from an upstream node in a cycle and the packet must be received at the downstream node in the same cycle, and it must be transmitted out in the next cycle to the nexthop downstream node.
  • The critical traffic is transmitted and queued for transmission along a path in a cyclic manner;
  • Suitable for small networks, where link delay is trivial, and processing delay and jitter is small. Otherwise, more bandwidth has to be reserved as a guard band for each cycle, and the effective bandwidth for critical services will be greatly reduced.

• LDN: Large-scale Deterministic IP Networking
  • A cycle based latency control framework for IP/MPLS network;
  • https://datatracker.ietf.org/doc/draft-qiang-detnet-large-scale-detnet/
Cycle Specified Queuing and Forwarding (CSQF)

• Improves on CQF by explicitly specifying the sending cycles of a packet at every node along the path.
• Relieves the limitation that the sending and receiving cycle have to be done within the same cycle.
Segment Routing based CSQF (SR-CSQF)

- Defines a new segment: Cycle Segment, two meanings:
  - Identify an interface/link, just like an adjacency segment does; and
  - Identify a cycle of the interface/link.
  - E.g., 101 identifies cycle 1 of interface 1 at node A, 102 identifies cycle 2 of interface 1 at node A, 103 identifies cycle 3 of interface 1 at node A …

- By attaching a Cycle Segment to a packet,
  - Can specify to which interface and in which cycle a packet should be transmitted

- By attaching a list of Cycle Segments to a packet, it can:
  - Specify the sending cycle at each node along the path, without maintaining per-flow states at the intermediate and egress nodes.
  - E2E bounded latency achieved
SR-MPLS based CSQF

- E2E Jitter $\leq 2 \times \text{cycle}$
- E2E Bounded Latency $= (2 \times \text{Cycle} + \text{process delay}) \times \text{hops} + \text{link delay}$
SRv6 based CSQF

- E2E Jitter $\leq 2 \times \text{cycle}$
- E2E Bounded Latency = $(2 \times \text{Cycle} + \text{process delay}) \times \text{hops} + \text{link delay}$
Next Steps

• Solicit more reviews/comments, refine the draft accordingly.
• Define SR extensions in support of Cycle Segment.
Thanks