Segment Routing (SR) Based Bounded Latency

draft-chen-detnet-sr-based-bounded-latency-00

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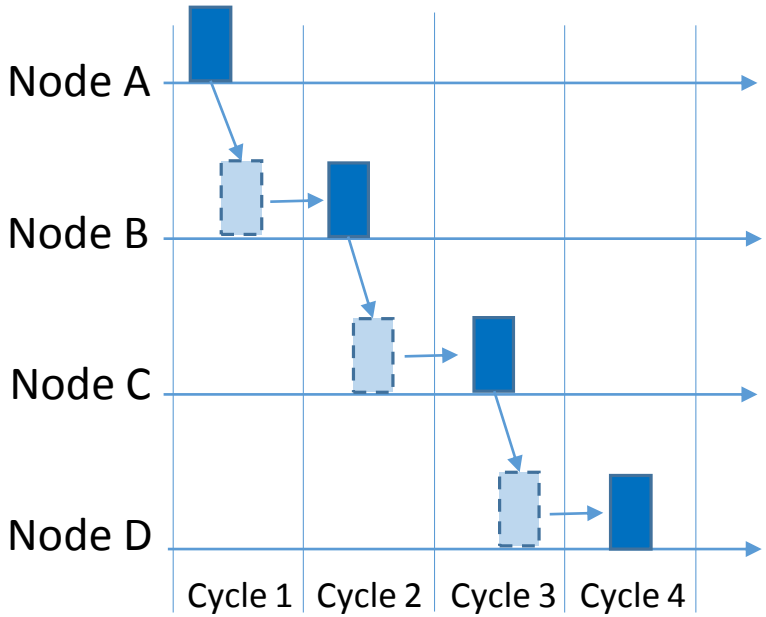
Motivation

- 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

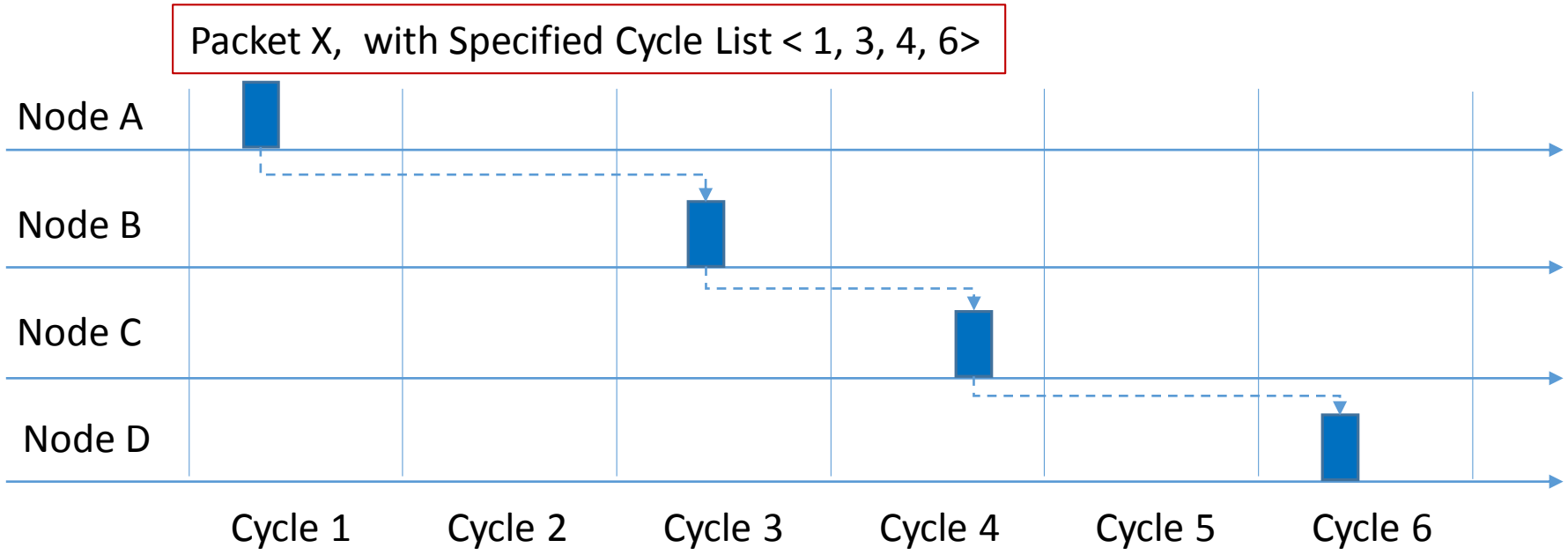
- CQF: Cyclic Queuing and Forwarding (802.1Qch)
  - The sending time of an interface is divided into a series of equal time intervals with the duration of T, each time interval is called a "cycle“;
  - CQF assumes that a packet is transmitted from an upstream node in a cycle and the packet must be received 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/



E2E Jitter <= 2T；
E2E Delay <= (N+1) * T；
where N is the hops of the path.

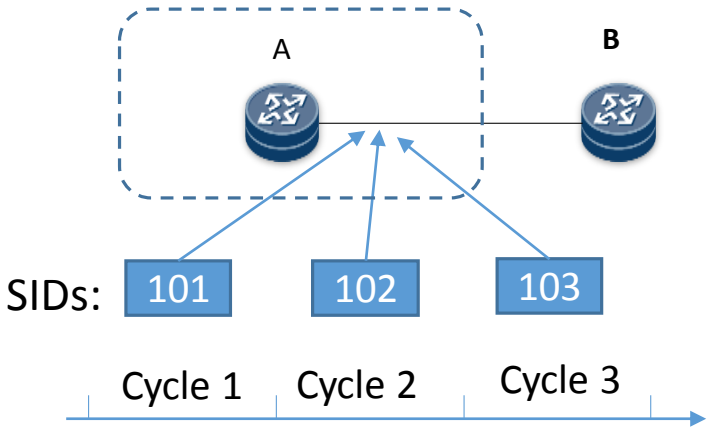
Cycle Specified Queuing and Forwarding(CSQF)

- 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.



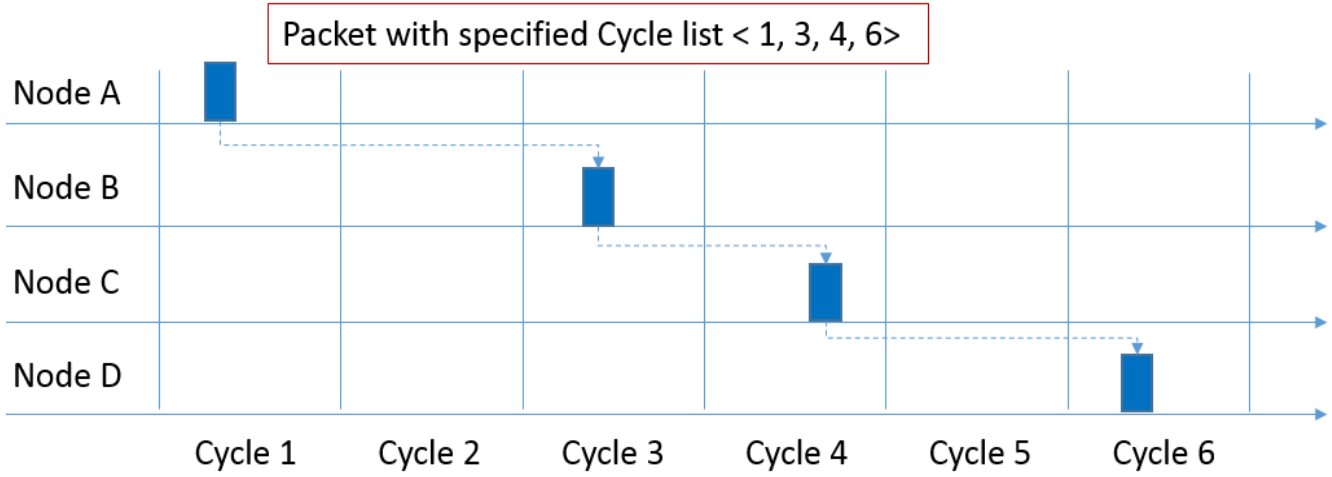
Segment Routing based CSQF (SR-CSQF)

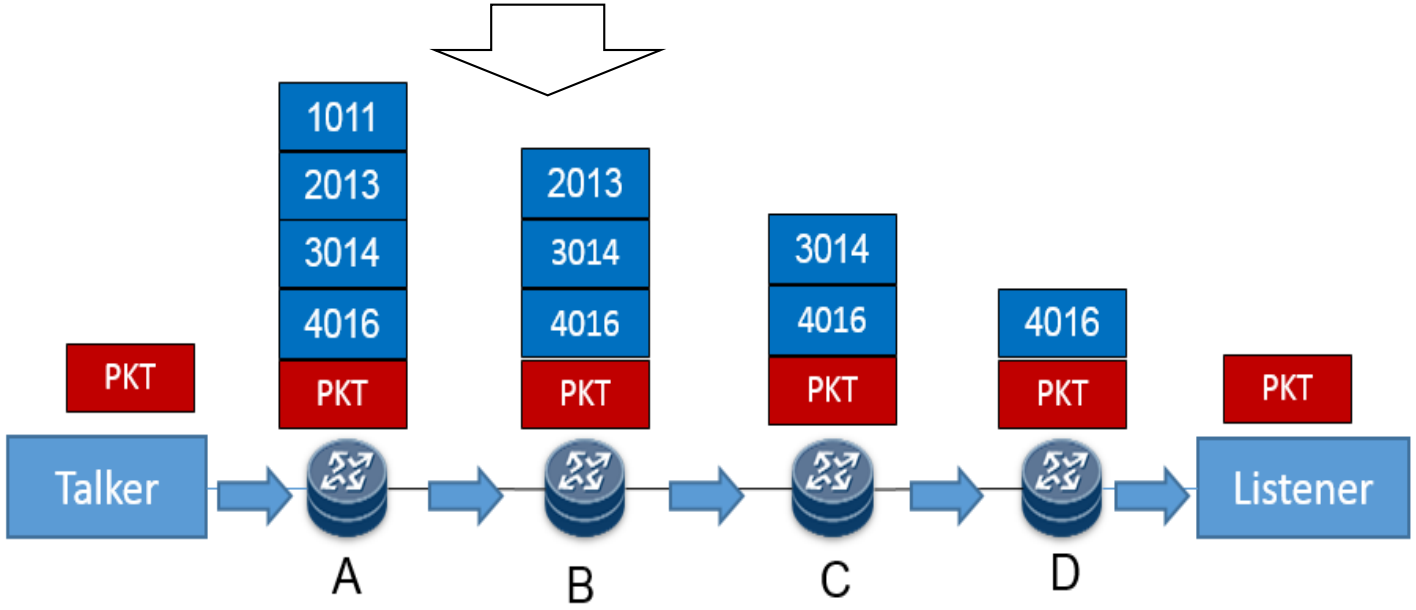
- Defines a new segment: Cycle Segment, two meanings:
  - Identify an interface/link, just like an adjacency segment does; and
  - Identify a cycle of the interface/link.
  - E.g., 101 identifies cycle 1 of interface 1 at node A, 102 identifies cycle 2 of interface 1 at node A, 103 identifies cycle 3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

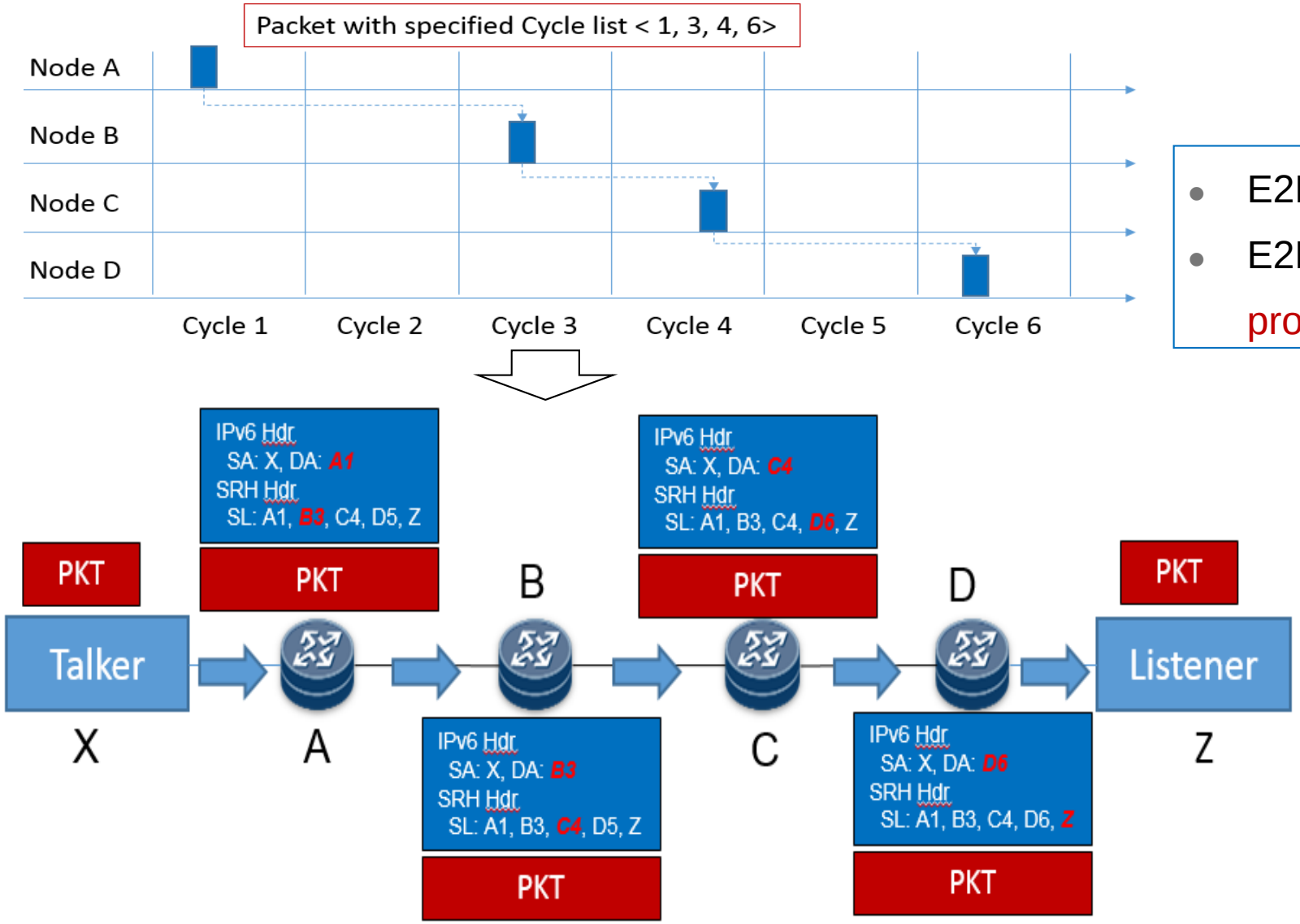
SR-MPLS based CSQF





- E2E Jitter<= 2*cycle
- E2E Bounded Latency = (2*Cycle + process delay)*hops + link delay

SRv6 based CSQF



- E2E Jitter<= 2*cycle
- E2E Bounded Latency = (2*Cycle + process delay)*hops + link delay

Next Steps

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

Thanks