Deadline based Forwarding

draft-peng-detnet-deadline-based-forwarding-01

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Motivations

• Detnet (RFC8655) defines QoS goals of deterministic routing: bounded delay/jitter; bounded packet loss ratio; bounded out-of-order delivery.
  – Uses resource reservation, explicit routing, and service protection, to achieve these goals.

• Resource reservation is the basis of ensuring bounded delay/jitter, and ultimately depends on the queue mechanism of the forwarding plane.

• The widely used priority based queuing scheme may give better average latency, but with worst case latency. Thus, an enhancement scheme of PQ is proposed.
Deadline Queues

- Deadline queues are variants of PQ and are also based on priority scheduling.
  - All deadline queues have **TTL attributes**, staggered from each other, decreasing with the passage of time (timer interval \( I \)).
  - The deadline queue with **TTL=0**, has the highest priority, higher than the existing SP's priority. Subsequently, 0 will be reversed to the maximum initial value.
  - The deadline queue with **TTL≠0**, has normal priority if in-time policy, and **prohibition priority if on-time policy**. The former can be involved in scheduling, while the latter cannot.

E.g, 4 deadline queues:

\[
\begin{align*}
&\text{TTL} = 0 \\
&\text{TTL} = 1 \\
&\text{TTL} = 2 \\
&\text{TTL} = 3
\end{align*}
\]

Buffer size:

\[ \text{buffer size} = \text{reserved bandwidth} \times \text{measure interval} \]

Note:

1) reserved bandwidth may equal to port bandwidth.
2) measure interval may equal to timer interval
Put Packets to Deadline Queues

• First, get the deadline information of the packet, including:
  – **Planned deadline** (D)
  – **Accumulated delay variation** (E) by all upstream nodes.
    can be get from: packet itself, FIB entry, policy entry, etc.

• Second, put the packet in the specific deadline queue.
  – **Allowable scheduling delay** (Q) = D + E - F
  – Q ---> TTL

packet 1 to queue-26
packet 2 to queue-46
Traffic Regulation and Shaping

- Traffic regulation on UNI port, to ensure that the reserved bandwidth of service, M₀, is not exceeded.
  - If there are N source, the reserved bandwidth of deadline queue at the intermediate aggregate node, Mₓ, should meet: \( N \times M₀ \leq Mₓ \).
  - For simplicity, Mₓ may equal to port bandwidth. It does not necessarily consume the whole port bandwidth due to admission control on all ingress.

- Traffic shaping on NNI port, to distribute packets into deadline queues.

If allowable queuing delay is Q, then,
- Time1: packet 1,2 in queue-A with TTL=Q;
- Time2: packet 3 in queue-B with TTL=Q;
- Time3: packet 4,5 in queue-C with TTL=Q;
- Time4: packet 6 in queue-A with TTL=Q;
Benefits

• Cost:
  – Time synchronization is not required between network nodes. Operate based on relative time.

• Deployment:
  – Packet multiplexing based, it is an enhancement of PQ scheduling algorithm, friendly to upgrade.
  – Each node can independently set the authorization time of the deadline queues, based on self port bandwidth.
  – Support partial upgrade.

• Scalability:
  – A single set of deadline queues supports multiple levels of dwell time.

• Performance:
  – Good jitter control, just a single authorization time.
Next step

• Any questions and comments?

Thank you!