Requirements for Scaling Deterministic Network

draft-ietf-detnet-scaling-requirements-03

Peng Liu liupengyj@chinamobile.com
Yizhou Li liyizhou@huawei.com
Toerless Eckert tte@cs.fau.de
Xiong Quan xiong.quan@zte.com.cn
Jeong-dong Ryoo ryoo@etri.re.kr
Shiyin Zhu zhushiyin@h3c.com
Xuesong Geng gengxuesong@huawei.com
Motivations and Status

Motivations
Aiming at scaling deterministic network with large variation in latency among hops, great number of flows and/or multiple domains without the same time source, this document describes the technical requirements including the data plane enhancement requirements when the different deterministic levels of applications co-exist and are transported.

Status
This document was updated from v01 to v03 according to the discussion in the bi-weekly interim. Add some new requirements with some changes(not too much) of the structure. Add some analysis of the related TSN method in the text. Some of the solution drafts has evaluated themselves according to the requirements.
Main Updates(v01-v03)

- In Section 3.2, add some words about the bandwidth utilization.
- In section 3.4, change the title to 'Be Scalable to The Large Number of Flows and Tolerate High Utilization' and add some texts to describe the 'high utilization' and 'traffic class'.
- For section 3.5 and 3.6, exchange the order of them, because one of the potential reason of flow fluctuation(3.6) is the traffic steering caused by topology changes(3.5).
- In section 3.6, remove 'from Disrupting Service' of the section title and abstract some points which might cause flow fluctuation based on the text and discussion to make it clear.
- In section 3.7, add a new reqs 'Be Scalable to a Large Number of Hops with Complex Topology'. For most of the applications, the bounded latency is a constant so the scalability of the queuing mechanisms is required.
- In section 3.8, change the title to 'Support Multi-Mechanisms in Single Domain and Multi-Domains' considering other sub sections in section 3 are also for the queuing mechanisms.
- In Section 4, delete section 4.3 and section 4.4 since there is no direct mapping items in section 3.
- Add the references related to the adding texts.

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Technical Requirements

- Req 1. Tolerate Time Asynchrony
  - Support Asynchronous Clocks Across Domains
  - Tolerate Clock Jitter & Wander within a Clock Synchronous Domain
  - Provide Mechanisms not Requiring Full Time Synchronization
  - Provide Mechanisms not Requiring Synchronization
- Req 2. Support Large Single-hop Propagation Latency
- Req 3. Accommodate the Higher Link Speed
- Req 4. Be Scalable to The Large Number of Flows
- Req 5. Tolerate Failures of Links or Nodes and Topology Changes
- Req 6. Prevent Flow Fluctuation
- Req 7. Be Scalable to a Large Number of Hops with Complex Topology
- Req 8. Support Multi-Mechanisms in Single Domain and Multi-Domains
  - Support Configuration of Multiple Mechanisms
  - Support Mechanisms Switchover Crossing Multi-domain
Req 6. Prevent Flow Fluctuation

More kinds of traffic flows described in Section 3.4 will cause more dynamic joining or leaving of the flows, which will further cause more flow fluctuation as well as more unpredictability of the DetNet flows. Such as:

* Various and massive traffic flows of different applications in scaling network easily cause more bursty traffic.
* There will be more aggregation nodes which receives the flows from more upstream nodes adding the nondeterministic delay of the packet treatment.
* The bursts of flows can be accumulated as the flows traverse, join, and separate over hops. Once one of the nodes makes the minor error of packet treatment, it will have the cumulative effect for the downstream nodes.
* Loops formed in a network topology increase the maximum bursts of flows exponentially [ANDREWS][BOUILLARD][THOMAS]
* The node and link failures are more common in a large network (Section 3.5) which requires dynamic traffic steering to an alternate path, it will also easily cause the flow fluctuation.

It is required to support bursty traffic and some methods to decrease the micro-burst. So the pre-planned, ingress traffic conditioning, scalable queuing, and enhanced capacity of buffer are required to accommodate the flow fluctuation, and the time required for network reconfiguration to reflect such changes is required to be controlled, e.g., less than a specified amount of time.
Req 7. Be Scalable to a Large Number of Hops with Complex Topology

Scaling networks often results in situations where an end-to-end flow involves a large number of hops, e.g., 15 or more. The network topology can also be complex, including star, ring, mesh, and their combinations, and can possibly be hierarchical. It is required to support networks with such various types of topologies and large hop Counts.

Normally, bounded latency is a constant of application regardless of the number of hops. So keeping the bounded latency with the variety of hops is required in scaling detnet, especially for the lower end-to-end latency bound. The queuing mechanisms should be enhanced, for instance, adjust the cycle time in CQF to meet the end to end latency while considering the feasibility with the dead time.
Next step

• Refine the document and address the comments
• Coordinate with the solution documents for evaluation