Requirements of large-scale deterministic network

draft-liu-detnet-large-scale-requirements-01

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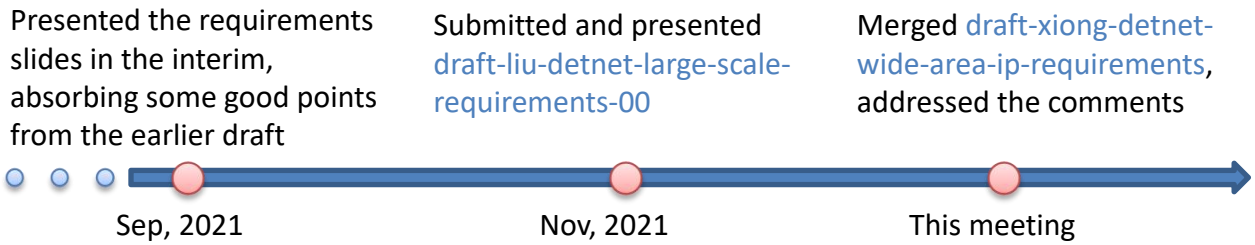
Recap and Motivations

Recap



Motivations

- This document point out the different aspects in large-scale deterministic networking, such as queuing mechanism, and configuration, interoperability,etc, based on it, and specifies the technical and operational requirements.
- Some deterministic network prototypes and trials have been performed based on the proprietary mechanism in large-scale networks. Experiences from them were used as input to this document. Hope this can be the starting point for the enhanced requirement document.

Updates from the last version

- Merged the draft draft-xiong-detnet-wide-area-ip-requirements
- Added two technical requirements(P4-P5)
  - Req6.Support Configuration of Multiple Queuing Mechanisms
  - Req7.Support Queuing Mechanisms Switchover Crossing Multi-domains
- Added an trial example of ETRI, and moved the 'Examples of Large-Scale Deterministic Network Trials' to Appendix (P6)
- Added Toerless, Quan and Jeong-dong as co-authors
- Removed the technical requirement of 'support incremental device updates'
- Removed the section of 'comparation of existing solutions besides TSN/IntServ/GS'

Req6: Support Configuration of Multiple Queuing Mechanisms

- There will be diversified deterministic traffic flows forwarded based on different queuing mechanisms in some same network devices of large-scale network. For instance, the network aggregation device may need to support both [IEEE802.1Qbv] and [IEEE802.1Qcr].
  - The network device should support multiple queuing parameters

- Accordingly, the unified or simplified configuration and management need to be supported.
  - In the distributed scenario, advertising the related information of the queuing parameters
  - In the centralized scenario, a resource topology pool may need for path calculation based on collecting the queuing parameters

Req7: Support Queuing Mechanisms Switchover Crossing Multi-domains

- In large-scale deterministic networks, it may across multiple network domains and adopt a variety of different queuing mechanisms within each domain.
  - it is required to support the inter-domain deterministic mechanism at the inter-domain boundary nodes such as the priority redefinition and rescheduling of queues

- Moreover, changing from one queuing mechanism to another may generate additional end-to-end latency and/or jitter
  - a collaboration mechanism crossing multi-domains must be considered, such as increasing the buffer of inter-domain devices to provide enough adjustment space for the flow to cross different queuing mechanisms

Appendix - Examples of Large-Scale Deterministic Network Trials

Trials:

- Trial 1:Deterministic IP on China Environment for Network Innovations (CENI)
- Trial 2:remote control on Deterministic IP on intercity network
- Trial 3:multi flows synchronization on inter-provincial network
- Trial 4(New): remote industrial Internet of Things (IIoT) service of Electronics and Telecommunications Research Institute(ETRI)
  - through three different operators' networks at a distance of 280 km.
  - demonstrated real-time remote smart manufacturing service is possible by making round-trip delay below 3 ms within a smart factory and below 10 ms between remote 5G industrial devices.
  - the team plans to further examine feasibility of large-scale deterministic networking by connecting smart factories in Gyeongsan, South Korea and Oulu, Finland.

Takeaway:

– strong motivations and demands on the enhancement to support large scale DetNet
– proprietary mechanisms co-exist with the standard technology in trials
– standardized enhancement required to better support the wider deployment

Overall technical requirements

- Req1: Tolerate time asynchrony
  - Support asynchronous clocks across domains
  - Tolerate clock jitter & wander within a clock synchronous domain
  - Provide mechanisms not requiring full time synchronization
  - Support asynchronization based methods
- Req2: Support the large single-hop propagation latency
- Req3: Accommodate the higher link speed
- Req4: Be scalable to numerous network devices and massive traffic flows
- Req5: Tolerate failures of links or nodes and topology changes
- Req6: Support configuration of multiple queuing mechanisms
- Req7: Support queuing mechanisms switchover crossing multi-domains

Potential Data Plane Implications

- IPv6 EH based enhancement to support native IPv6 network
  - Allow explicit path selection
- Redundancy related fields
- Aggregated flow identification
- queuing related info to be considered
  - Cycle identification if cycle based queuing is used
  - Timestamp/time info like fields if time based transmission selection queuing is used

Next step

- Request for an adoption call as the starting point for the enhanced requirement document.