Requirements of large scale deterministic network

draft-liu-detnet-large-scale-requirements-00

Peng Liu liupengyjy@chinamobile.com

Yizhou Li liyizhou@huawei.com
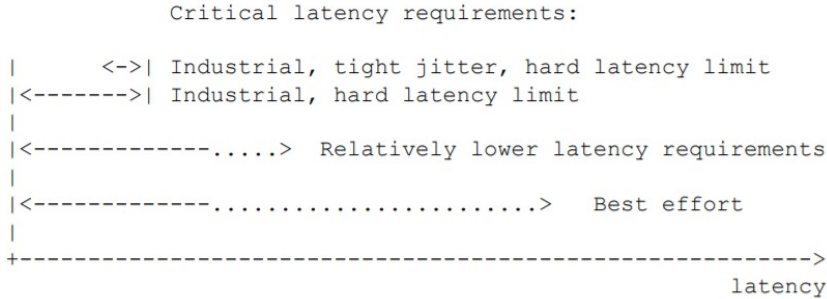
Toerless Eckert tte@cs.fau.de

Motivations

- In the last interim meeting about the queuing mechanism, the requirements was presented, and the WG would like to work in requirements draft first.

- So we submit the new draft draft-liu-detnet-large-scale-requirements-00 , and hope it can be used as the starting point.

- Minutes:

  Lou Berger: Maybe only people interested in this topic are here, so need to go to the list, but plan would be to get req'ts doc done then go to process to look at solutions. Peng's draft is a good starting point (for problem statment and requirements). If you want to add to this, please contact Peng. It is also possible to submit an individual draft if you prefer.

Different levels of application requirements

- Critical SLAs - For "Industrial" networks
  - Manufacture: Control/remote control-Cloud PLC
  - Electricity: differential protection
- Relatively lower levels of SLA- For "Consumer" networks
  - Cloud gaming/Cloud VR
  - Online meeting

```
         Critical latency requirements:

|      <->| Industrial, tight jitter, hard latency limit
|<------->| Industrial, hard latency limit
|
|<------------.....>  Relatively lower latency requirements
|
|<------------.....................>   Best effort
|
+----------------------------------------------------->
                                          latency
```

Deployment and application status

- TSN has been used in several industries
- DetNet has done a lot of work and the standards are mature

- Examples in terms of large scale:
  - *Deterministic IP on CENI 3000 km and 13 hop devices, jitter<100 μs *
  - *Remote control with Deterministic IP (Cooperate with Baosteel, 600km, latency<=4ms, jitter <20us)*
  - *Multi flows' synchronization in an exhibition (Cooperate with Emergen, Inter provincial)*

- More work for network service providers to successfully sell DetNet type services to customers:
  - Service Level objective definitions absolute/relative latency/jitter/loss bounds, #flows, physcial scale, …
  - More option of queuing mechanisms for different service level
  - Deployment considerations such as integration into existing networks/service/controller-plane

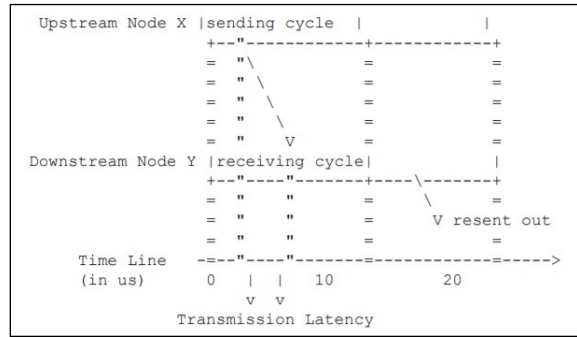# Technical requirements in large scale deterministic network

- *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*
  - *Be scalable to numerous network devices*
  - *Be scalable to massive traffic flows*
- *Req5: Tolerate failures of links or nodes and topology changes*
- *Req6: Support incremental device updates*

Req1: Tolerate time asynchrony

- *Support asynchronous clocks across domains*
  - Stitch TSN islands together which have different clocks

- *Tolerate clock jitter & wander within a clock synchronous domain*
  - recover or absorb time variance caused by different clock accuracy within a domain

- *Provide mechanisms not requiring full time synchronization*
  - the bounded latency and jitter should be achieved when full time synchronization is not in used, such as frequency synchronization

- *Support asynchronization based methods*
  - If not all the network or device support synchronization, asynchronization based methods should be used and proved bounded latency to some extent(IEEE 802.1Qcr)

Req2: Support the large single-hop propagation latency

- *The distance of transmission is long enough to generate a larger latency than a LAN-200km/ms in fiber.*
- *For cyclic based method, the length of cycle must be either set long enough in 2-buffer case or other mechanisms should be provided.*

```
Upstream Node X |sending cycle  |          |
               +--"-----------+-----------+
               =  "\            =          =
               =  " \           =          =
               =  "  \          =          =
               =  "   \         =          =
               =  "    V        =          =
Downstream Node Y |receiving cycle|        |
               +--"----"------+----\------+
               =  "    "       =    \      =
               =  "    "       =     V resent out
               =  "    "       =          =
   Time Line   -==-"----"------------------==--->
   (in us)      0  | |   10         20
                   v v
               Transmission Latency
```

Req3: Accommodate the higher link speed

- *With the increasing of the data rate in large scale network, the scheduling cycle can be reduced- requires the more precise time control*
- *If the network cycle time remains the same, more data can be sent - more buffer space is required*

Req4: Be scalable

- *Be scalable to numerous network devices*
  - *The increase or decrease of network devices influences the topology discovery, queuing mechanism and packet replication and elimination*
- *Be scalable to massive traffic flows*
  - *Flow aggregation is required, Individual flow may join and exit the aggregated flow rapidly which causes the dynamic in identification of the aggregated Detnet flow.*

Req5: Tolerate failures of links or nodes and topology changes

- Network link failures are more common in large-scale networks.
  - *Support certain mechanisms to adapt to failures of links or nodes and topology changes.*
  - *For PREOF, it brings the challenges of finding paths with similar distance and/or number of hops - sufficient buffer space is required to absorb the latency difference .*

Req6: Support incremental device updates

- *Do more shaping work on edge devices, so as to reduce the task of intermediate devices, could meet some applications that requires relatively loose levels of SLA*

- *For application with the critical SLA, it is acceptable that more devices including intermediate ones would require more functions implemented.*

Proposed queuing mechanisms beside TSN and IntServ/GS
(Mechanisms not included in draft-ietf-detnet-bounded-latency)

	Mechanisms	Levels of deterministic	*Synchronization*	cost	Scalability	Flow aggregation
1	draft-dang-queuing-with-multiple-cyclic-buffers/ draft-qiang-detnet-large-scale-detnet-05	high	yes	high	good	Yes
2	draft-du-detnet-layer3-low-latency-03	medium	no	high	good	Yes
3	draft-stein-srtsn-01	Statistical determinism	yes	high	good	?
4	draft-shi-quic-dtp-04	low	yes	low	good	no

Next steps

- More analysis and discussion about the requirements are welcome

- People who are interested in this work, please contact liupengyjy@chinamobile.com

Comments?