Requirements of large scale deterministic network

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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
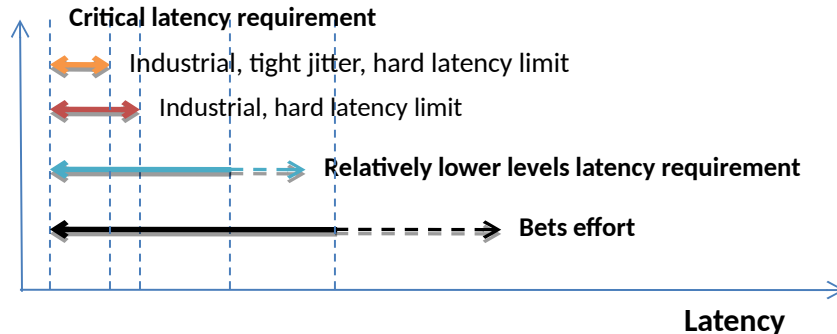
Deployment and application status

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

- Some trials of deterministic IP network has been done:
  - *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

Requirements of technique in large scale deterministic network

- *Req1: tolerate a certain degree of time variance*
  - *Synchronization*
  - *Asynchronization*
- *Req2: Consider the transmission latency*
  - *300km/ms*
- *Req3: Scalability*
  - *a large number of network devices*
  - *a massive number of traffic flows*
- *Req4: Coexist with other traffic*
- *Req5: Balance of cost and service requirements*

Req1: Tolerate a certain degree of time variance

- *Time Synchronization*
  - *tolerate clock jitter & wander within a clock synchronous domain*
  - *should support asynchronous clocks across domains(if in the scope)*
- *Frequency Synchronization*
  - *Network overhead of time Synchronization*
  - *Accuracy*
- *Asynchronization*
  - *Not all the network or device support synchronization*
  - *To be proved bounded latency to some extent(IEEE 802.1Qcr)*

Req2: Consider the transmission latency

- *The distance of transmission is long enough to generate a larger latency than a LAN*
- *In particular, it will have an impact on queuing*

Req3: Scalability

- a large number of network devices
  - *For example, to connect so many 5G base stations*
- a massive number of traffic flows
  - *Flow aggregation needed*

Req4: Coexist with best-effort traffic

- *In the view of customers, dedicated network is the best network service(in fact maybe not)*
- *Coexist with best-effort traffic can be an advantage of deterministic network*

Req5: Balance of cost and service requirements

- *Whether to update all the network devices is the issue concerned by operators and related to the price concerned by customers*
- *Some application that requires relatively lower levels of SLA may need simpler solution*

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

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

If more queuing mechanisms could be proposed and be included in the scope of DetNet?

Thanks for listening

Welcome for comments