

Solution Consideration about Differentiated DetNet QoS and TE

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Agenda

- Enhanced use cases, gaps, requirements of scaling deterministic networks
- QoS requirements for enhanced DetNet
- TE requirements for enhanced DetNet
- Existing QoS and TE solutions considerations
- Differentiated DetNet-aware TE (DD-TE)

Use cases, Gaps, Requirements of Enhanced DetNet

- Enhanced use cases in scaling deterministic networks
 - Industrial Internet
 - High Experience Video
 - Computing-aware Applications
- The new goals and gaps for enhanced DetNet
 - Support various differentiated services with guaranteed SLAs in scaling deterministic networks
 - Provide high utilization of network resources
- The requirements of scaling deterministic networks
 - Support enhancement of queuing-based mechanisms and the related DetNet-Specific metadata (The candidate queuing solutions are being discussed in DetNet DT)
 - Support different levels of applications with different SLAs requirements and DetNet technologies

What is QoS Requirements for enhanced DetNet?

- The DetNet QoS MAY be classified and divided into several traffic classes based on the applications and differentiated SLAs requirements in scaling deterministic networks.
- Applications co-existed with different SLAs

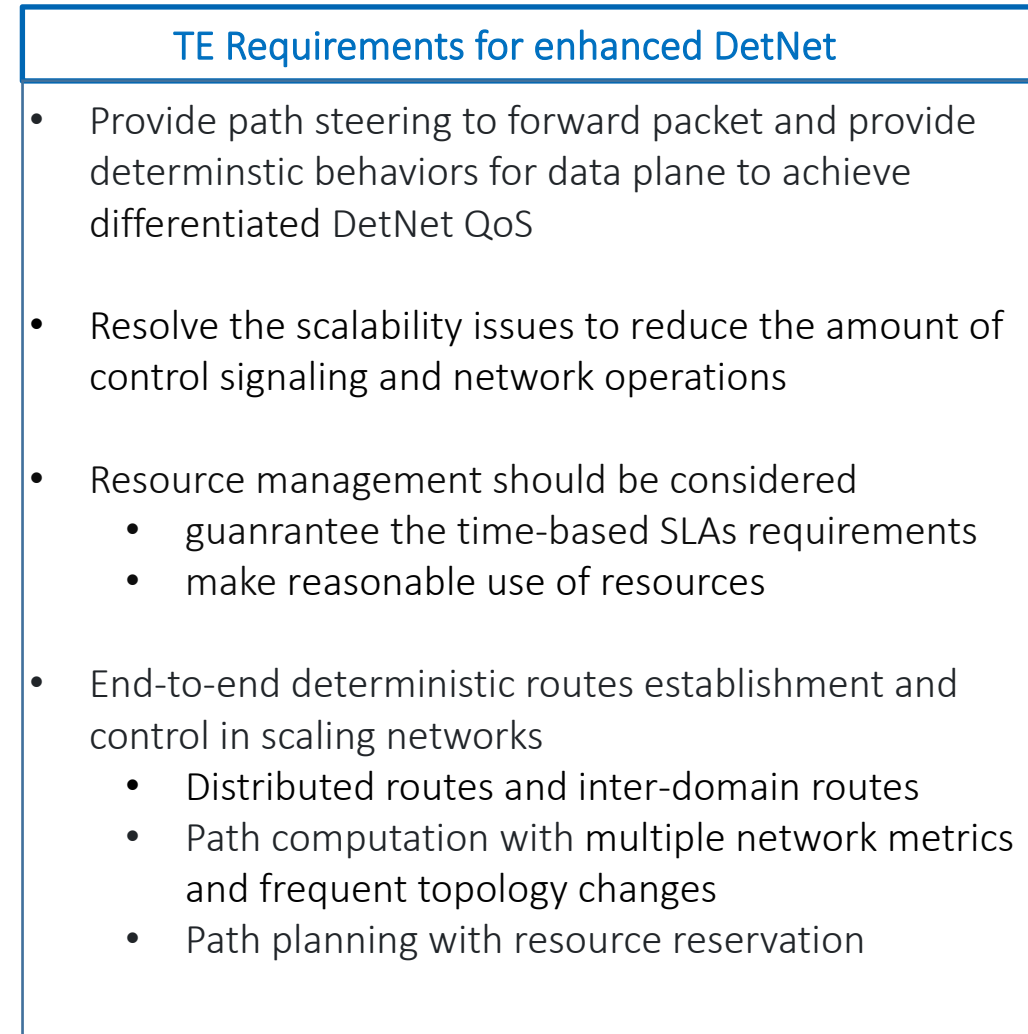
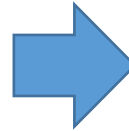
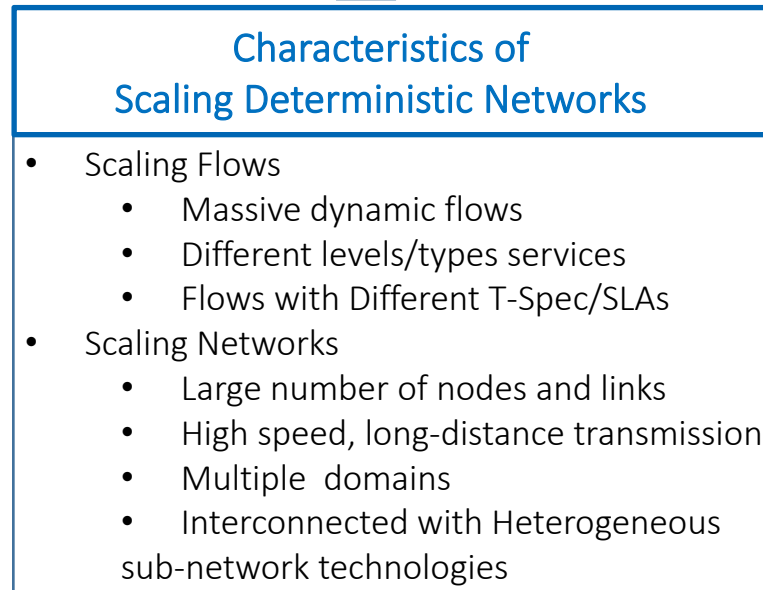
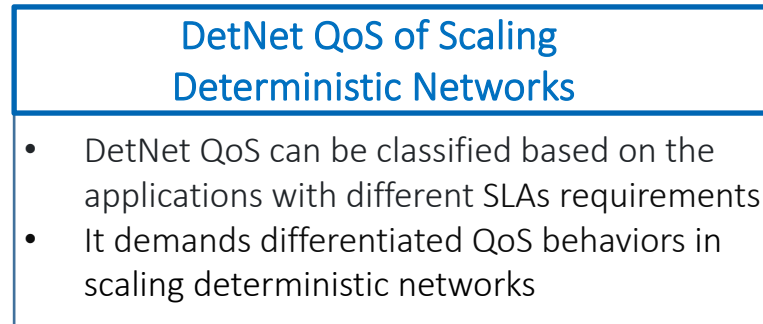
Applications	Bandwidth	Bounded Latency	Reliability
AR/VR Video	High 10Gbps	Medium delay<10ms jitter<5ms	Medium
Smart grid	N/A	High delay<15ms jitter<50us	High 99.9999%
Industrial control	Low	High MaxDelay 500us~50ms	High 99.9999%
Internet of Vehicles	Low	Medium Delay 2ms -> 20ms	Medium 99.999%
Remote control	Medium 25Mbps~6Gbps	Medium Delay 5ms -> 20ms	High 99.9999%



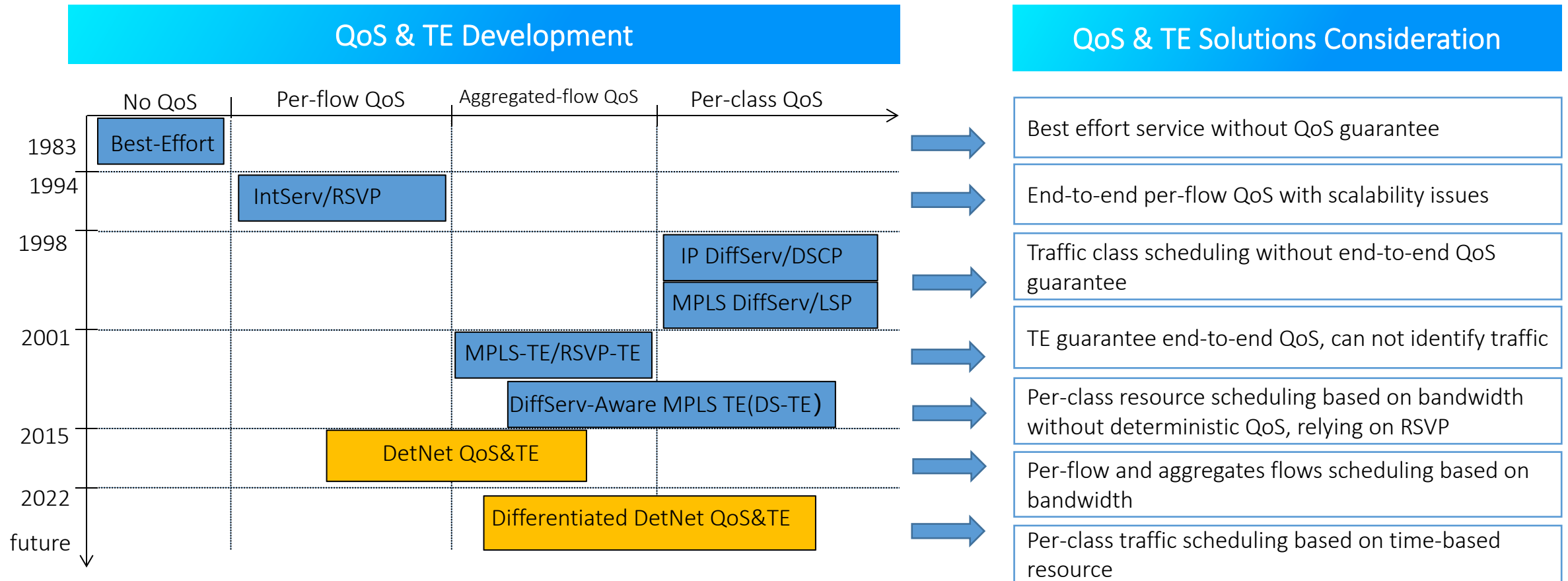
- Differentiated DetNet QoS (DD-QoS)

DD-QoS Traffic class	Class-1	Class-2	Class-3	Class-4
Deterministic Forwarding Behaviors	Jitter Guarantee	Delay Guarantee	Low Delay and Jitter Guarantee	Ultra-low Delay and Jitter Guarantee
SLAs	Delay <300ms, jitter<50ms, 99.9%	Delay <50ms, jitter<50ms, 99.99%	Delay<20ms, jitter<5ms, 99.999%	Delay<10ms, jitter<100us, 99.9999%
Applications Examples	Synchronous voice services	Video, production monitoring, and communication services	AR/VR, holographic communication, cloud video and cloud games services	Industrial services such as power protection and remote control

What is TE Requirements for enhanced DetNet?



Existing QoS and TE Solutions Considerations



Differentiated DetNet-aware TE (DD-TE)

- Consideration from TE Elements:
- Policy
 - The routing policy including **bounded latency constraint-based routing** can be considered when selecting and distributing the candidate paths.
- Path Steering
 - **Per-class traffic scheduling** should be considered for differentiated DetNet QoS.
 - The **deterministic latency information may be provided** to forward packets for path steering in IPv6/SRv6/MPLS.
- Resource management
 - **Time-based resource-aware control and forwarding** should be considered based on the queuing mechanisms and different traffic classes.

Per-class TE Vs Per-flow/aggregates TE

- DiffServ-aware MPLS TE (DS-TE) Vs MPLS-TE
 - MPLS-TE
 - per-flow/ Flow-aggregates based QoS + per-aggregates TE (Routing policy+Resource management)
 - DS-TE
 - traffic-aggregates based QoS+ per-class TE (Routing policy+Resource management)
 - Benefits
 - achieve scalable network designs supporting multiple classes of services
 - achieve fine-grained optimization of transmission resources and further enhanced network performance and efficiency
- Differentiated DetNet-aware Traffic Engineering (DD-TE) Vs DetNet
 - DetNet
 - per-flow/ Flow-aggregates based DetNet QoS + per-flow/aggregates TE (explicit path+resources allocation)
 - DD-TE
 - traffic-aggregates based Differentiated DetNet QoS + per-class TE (QoS-aware Routing policy+Time-based Resources management)
 - Benefits
 - achieve scalable network supporting different levels of deterministic applications
 - achieve fine-grained time-based resource scheduling and management to meet the bounded latency requirements, rational utilization of resources, improvement of network performance

Time-based Resources Vs Existing Resources

- TE existing resources management
 - Provides resource-aware control and forwarding (e.g. bandwidth, buffers, and queues, all of which can be managed to control loss and latency), such as
 - resources reservation and allocation based on the bandwidth constraints by carrying average bits within 1 second
 - bandwidth availability control of the BE (Best Effort) flow to meet the peak information rate (PIR) of the flow at the macro level
- Time-based resources management
 - Provides time-based resource-aware control and forwarding, such as
 - resources reservation and allocation based on the time-based constraints by carrying maximum bits within a time unit which is much shorter than 1 second (e.g. 1ms, 2ms, 10us, 20us...)
 - guarantee bounded latency by providing time-based queuing mechanisms (e.g. CSQF, TQF, Deadline, g-LBF, C-SCORE...)
 - simplify the resource scheduling by providing one-dimensional resource object instead of multiple dimensionals of resource such as bandwidth, buffers, and queues

End-to-end Deterministic Routes Establishment

- Deterministic Links
 - indicates the deterministic forwarding capabilities at different levels
 - provide one-dimensional deterministic metric for selecting path as per draft-xiong-lsr-detnet-deterministic-links
- Distributed Routes
 - compute deterministic paths with a deterministic delay metric within a distributed networks such as a Flexible-Algorithm topology as per draft-peng-lsr-flex-algo-deterministic-routing
- Inter-domain Routes
 - advertised with BGP intent routes carrying the deterministic metric credit information to provide an optional metric related BGP path attribute as per draft-peng-idr-bgp-metric-credit
- Multi-domain Routes
 - PSE extensions other than inter-PCE, hierarchical PCE as per draft-bernardos-detnet-multidomain

Related Drafts links for your reference

- <https://datatracker.ietf.org/doc/draft-xiong-detnet-enhanced-detnet-gap-analysis/>
- <https://datatracker.ietf.org/doc/draft-ietf-detnet-scaling-requirements/>
- <https://datatracker.ietf.org/doc/draft-xiong-detnet-large-scale-enhancements/>
- <https://datatracker.ietf.org/doc/draft-zhao-detnet-enhanced-use-cases/>
- <https://datatracker.ietf.org/doc/draft-xiong-detnet-differentiated-detnet-qos/>
- <https://datatracker.ietf.org/doc/draft-xiong-detnet-teas-te-extensions/>

Thank you!