

Traffic Engineering Extensions for Enhanced DetNet

draft-xiong-detnet-teas-te-extensions-00

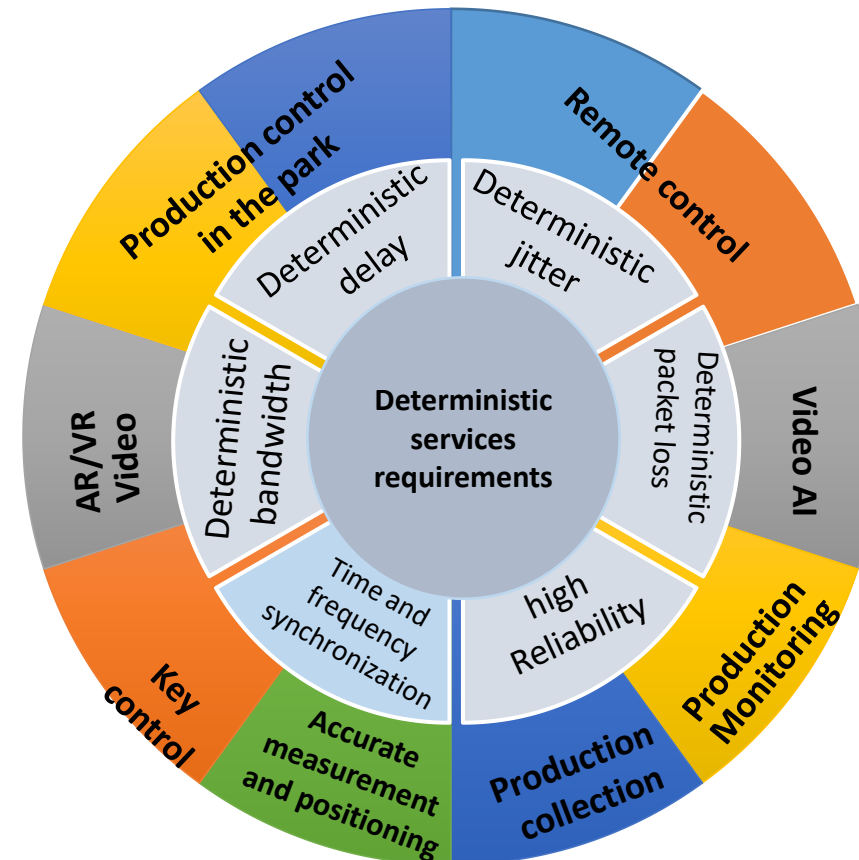
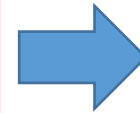
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Diversified SLOs Requirements for Deterministic Services

	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%



- As per [draft-ietf-detnet-scaling-requirements], different deterministic levels of applications co-exist and are transported in scaling network and this services demand different levels of SLOs guarantees .
 - Cloud-based applications and remote control** :strict delay/jitter deterministic and high reliability
 - Smart grid**: ultral-low latency+ultral-low jitter+high-precision synchronization
 - Industrial Internet** : low latency+low jitter+high reliability+high bandwidth
 - Consumer entertainment**: high bandwidth+low latency

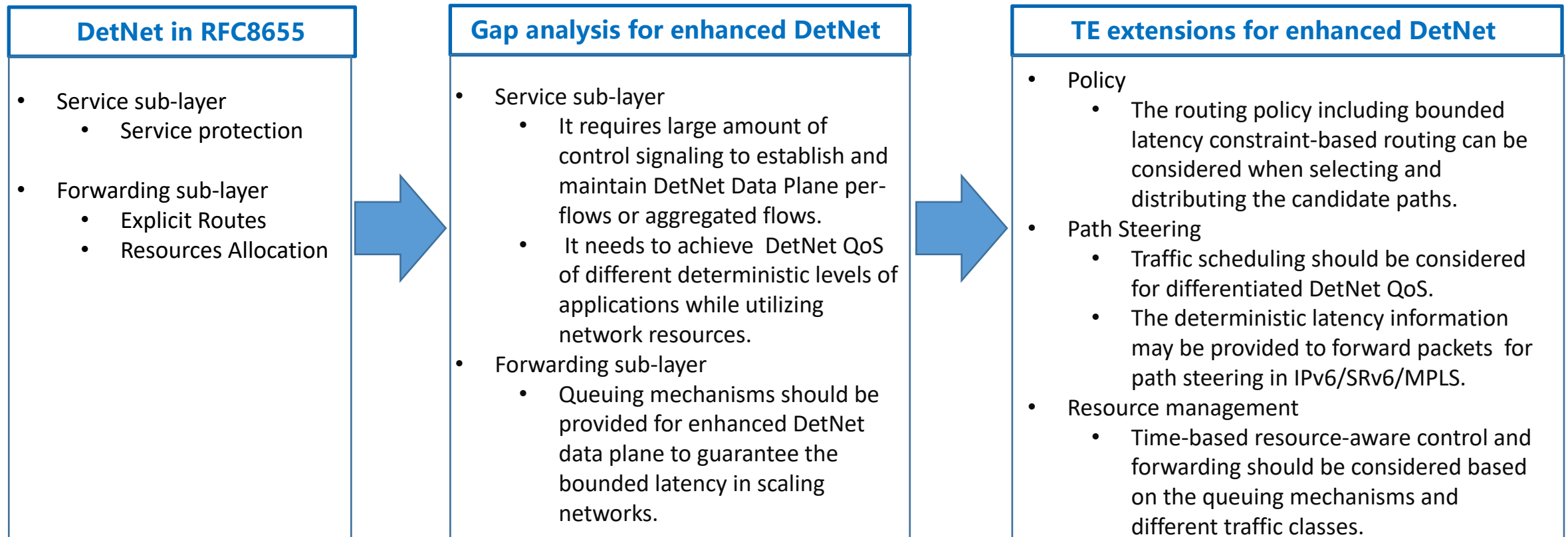
Traffic Classes for Differentiated QoS of Deterministic Services

QoS	Class-1	Class-2	Class-3	Class-4
Deterministic services Requirements	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

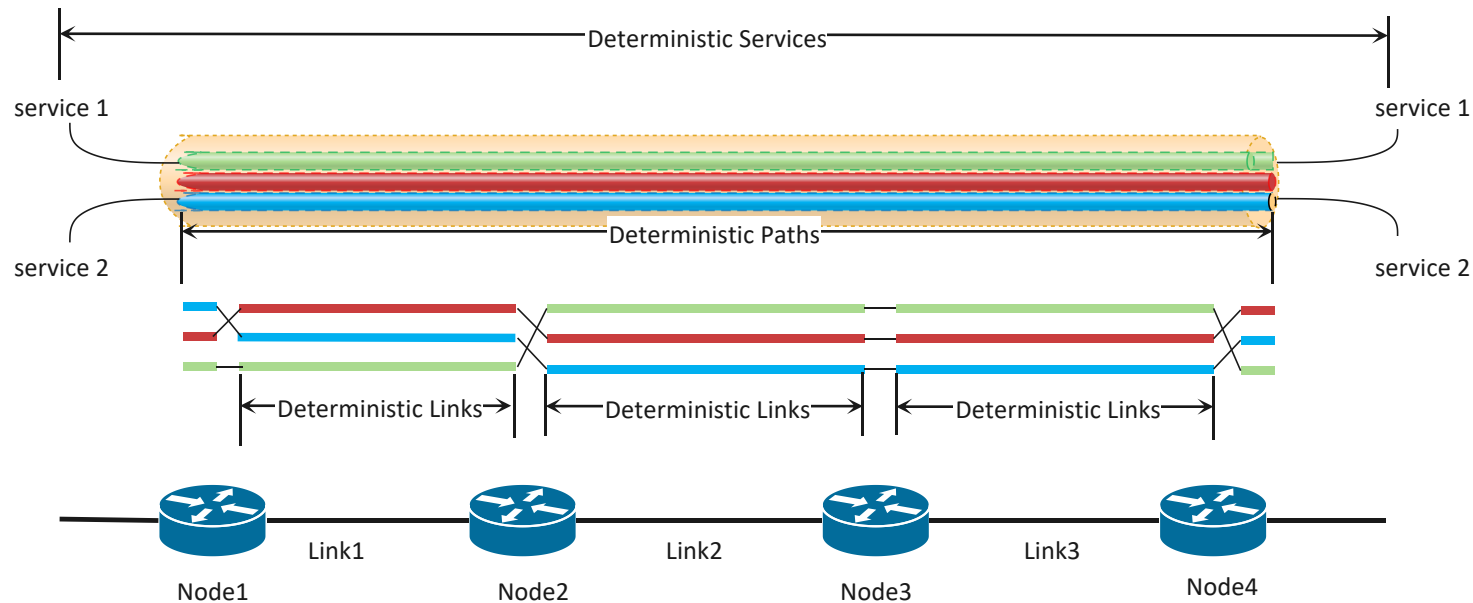
- The **differentiated QoS MAY be classified** based on the applications in large-scale networks.
- The figure shows an example for **differentiated QoS with 4 traffic classes of deterministic services** based on the diversified SLAs such as bandwidth, delay, jitter, loss, reliability and availability and so on. Each class can be divided into several sub-classes based on the requirements of the applications.

TE Extensions for Enhanced DetNet

- As per [I-D.ietf-teas-rfc3272bis], DetNet can be viewed as a TE mechanism to achieve DetNet QoS. DetNet performs the per-flow or flow-aggregate scheduling in service sub-layer and uses resource allocations and explicit route mechanisms in forwarding sub-layer.
- As the enhanced DetNet should support the differentiated DetNet QoS and the queuing-based enhancements, TE extensions can be provided **to achieve the differentiated QoS of multiple levels of deterministic services and optimize the resources utilization in scaling networks.**

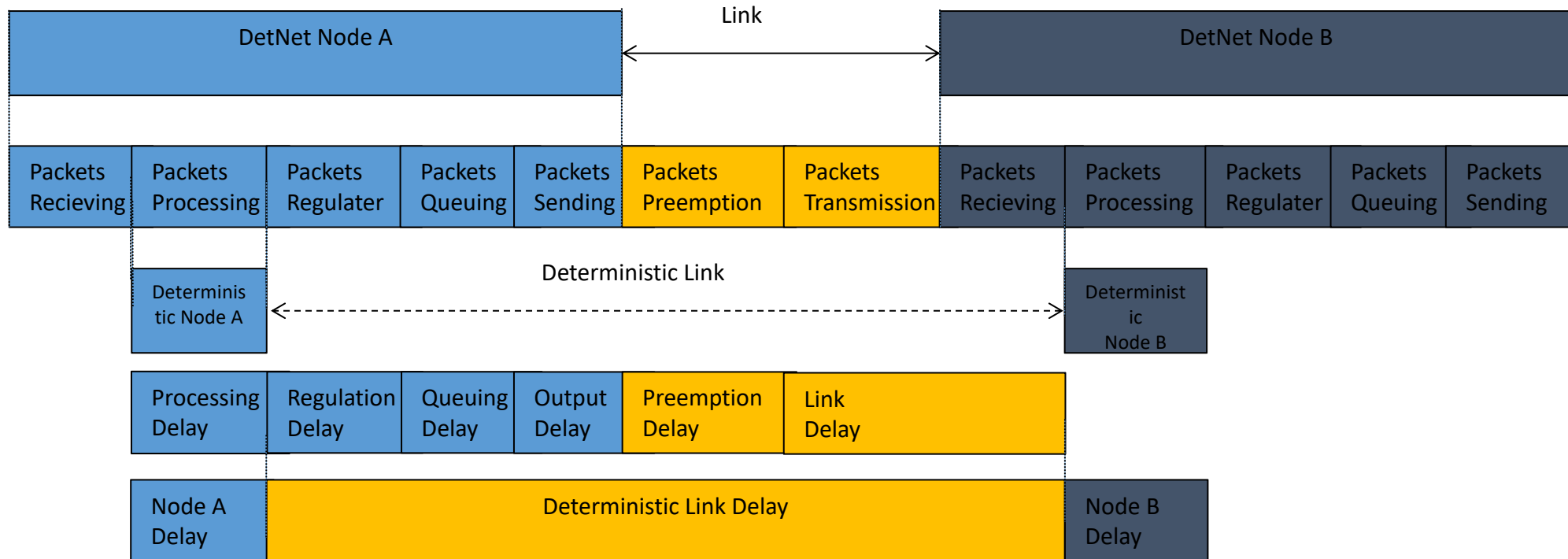


Layers Model for TE to Guarantee Differentiated QoS



- **Deterministic links:** provide time-based resources and resolve competition among different traffic classes and provide deterministic forwarding capabilities at multiple levels.
- **Deterministic paths:** provide deterministic path guaranteed by time-based resources and resolve competition among different paths within the same traffic class.
- **Deterministic services:** provide deterministic services with time-based resources allocation on the deterministic path and resolve competition among different flows on the same path to achieve the differentiated QoS guarantees.

Deterministic Link Model



- As per [RFC9320], 6 types of delays are defined in timing model of DetNet. This document proposes the deterministic links to **provide a one-dimensional deterministic metric to guarantee the deterministic forwarding capabilities at different levels.**
- The end-to-end bounded latency depends on the sum of the deterministic link delay.
 - Deterministic Link Delay = Regulation delay + Queuing subsystem delay + Output delay + Link delay + Frame preemption delay
 - Deterministic Node Delay = Processing delay

Time-based Resources with different Types

- Each deterministic link provides **different level of deterministic forwarding capabilities** which is indicated by Deterministic Class-Type (DT) and guaranteed by time-based resources.
- **Deterministic Class-Type (DT)**: indicate the set of Traffic Trunks crossing a deterministic link that is governed by a specific set of bounded latency constraints. DT is used for the purposes of deterministic link resource planning, reservation and allocation, deterministic link resource constraint-based routing and admission control. A given Traffic Trunk belongs to the same DT on all links. Each DT can be divided into sub-DTs.
 - deterministic link 1, DT=1 (Jitter Guarantee), 10us/20us/30us.
 - deterministic link 2, DT=2 (Delay Guarantee), 1ms/2ms.
 - deterministic link 3, DT=3 (Low delay and jitter Guarantee), 1ms~2ms/2ms~3ms.
- **Time-based Resources Container (TRC)**: the entity which is used for deterministic link to provide the time-based resources with deterministic capabilities by resolving resource conflicts between different levels. The container indicates the transmitting bits per scheduling timeslot and contains the corresponding scheduling resources reserved to guarantee the capability of deterministic link and it may include queuing, buffer or bandwidth.

TE extensions for Control Plane

- Particular considerations and requirements for the Control Plane should be taken into consideration according to TE extensions.
 - Management and Scheduling of Deterministic Latency Resources
 - Deterministic Resource Collection
 - Distributed Deterministic Path Establishment
 - Inter-domain Deterministic Path Establishment
 - Deterministic Path Computation and Time-based Resource Planning
 - Configuration of Flow Mapping

Next Step

- Seek feedback in TEAS WG.
- Comments and discussions are very welcome!

Thank you!