

Requirements for Large-Scale Deterministic Networks

OPS area, IETF115 London

draft-liu-detnet-large-scale-requirements-05

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Why ?

FYI to (service provider) operator community:

Invite / (re-) consider to engage with DetNet WG - If you are not doing so yet

(A) DetNet finished a significant round of RFC

allowing to start thinking about DetNet solutions in networks:

2019: RFC8557 Deterministic Networking Problem Statement

RFC8578 Deterministic Networking Use Cases

RFC655 Deterministic Networking Architecture

2020 - 2021 Deterministic Data Plane Specs for IP/IPv6 and MPLS networks

RFC938, RFC8939, RFC8964, RFC9016, RFC9023, RFC9024, RFC9025,
RFC9037, RFC9055, RFC9056

(B) DetNet had charter change/extension (07/2022) to allow looking into additional forwarding plane / queuing mechanisms

DetNet so far (authors summary)

- Any subset of the following services
 - Guaranteed bandwidth of traffic flows
 - Per-flow path setup through controller, reservation
 - Maximum guaranteed end-to-end latency of traffic flows
 - Instantiation of per-hop QoS (today primarily via use of TSN QoS supporting this)
 - *This always implies guaranteed bandwidth / limits*
 - Loss reduction and undoing reordering
 - Duplicate traffic sending with sequence number, disjoint path, duplicate elimination
 - (P)acket (R)eplication (E)limination and (O)rdering (F)unctions (PREOF)
 - Currently only via MPLS, not IP (missing header)
- Maintenance (OAM),
Controller plane support (YANG) of those services

So, where are the gaps ?

- You tell us ?!
- Draft (in process of adoption in DetNet) attempts to summarize those gaps
 - For “large-scale” networks
 - Speed (≥ 100 Gbps), wide-area, variety of services, operations model
 - Total number of separate flows to support over large number of routers ?!
 - Often, those networks are “service provider” operated
Traditional TSN networks operated by whoever owns the endpoints
 - TSN network equipment usually maxes out at 1 or 10 Gbps link speed.

Vendor (author) perspective

- Worry about device cost feasibility when going to high-speed / high-scale
 - DetNet has already concept of aggregates but not sufficient
 - Scale of required control plane also an issue
 - Per-hop, per-flow signaling never used in SP cores.
Don't think operators would accept DetNet if it required it.
 - Bounded latency has variety of possible algorithms
 - Not explored by TSN
 - May only becoming possible now in next-gen hardware
 - Best ones require new packet headers (long process in IETF) – should be done only once
- Worry about overall service package that SP can sell/profit from
 - Wide range of industries who may be interested to use SP network offerings !!
 - Energy-grid, manufacturing with remote PLC/AI-analytics, URLLC control loops such as remote control/driving/robotics, multi-party-synchronous-ops, mobile networks front/backhaul improvements (eCPRI with 5/6G,...)
 - But ecosystem wide question to enable building service offering, need operators to valiate / identify gaps / requirements.
 - Minimize overall solution complexity

Current state / areas (excerpt)

- Limit/reduce/eliminate clock synchronization solution requirements
 - Larger MTIE, drift, asynchronous mechanisms
- Large-propagation delay links (Wide Area Networks)
- High-Speed links / routers
- Large number of flows
- Tolerant / minimize service disruptions on node/topology changes
- Support better queuing mechanisms
- (Scaleable) Explicit path selection

- Incomplete!

- Vendor perspective: priority on requirements that allow to build necessary next-gen hardware/firmware
 - But that also can successfully create RoI (make money..) in operator networks!

The End

- Thank you for your time!
- If you have questions, suggestions, concerns, other input
 - Please talk to us (authors, detnet WG/ mailing list)
 - Not only requirements – any solution components too!