Discussion on
TSN for Service Provider Networks

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Introduction

- 802.1 TSN has a proposal in progress to produce a Profile for TSN for Service Providers.
- We will show that TSN and DetNet, together, offer features very useful to service providers.

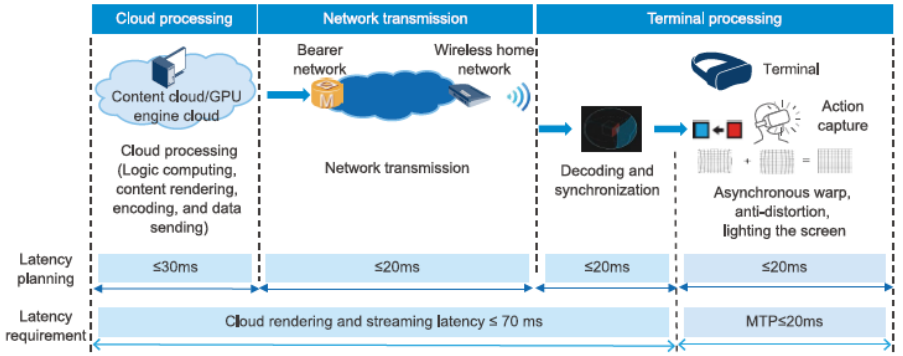
Deterministic Services over Service Provider Network

"Ready, Player one" 2018

Possible deterministic services:

- Cloud VR Game/Education/Healthcare
- Remote vehicle control
- Smart grid
- Vertical applications over carrier network, etc.

The following figure shows the E2E latency of strong-interaction Cloud VR services.



Network KPI Requirements

Service Scenario	Indicator	Reference Value
Strong-interaction VR service	Bandwidth	≥80Mbit/s
	Round trip time (RTT)	≤20ms
	Packet loss rate	1.00^{-5}
Multi-service concurrency	Internet access, VR strong interaction services, and screen mirroring	260Mbit/s

Table 2-2 Network KPI requirements for strong-interaction Cloud VR services

Network KPI Requirements

The network round trip time (RTT) must be below 20 ms, comprising the following segments:

E2E RTT	Home Wi-Fi	Fixed Access Network	Metro Bearer
≤20 ms	≤10 ms	≤2 ms	≤8 ms

Table 2-3 Network latency requirements for strong-interaction Cloud VR services

https://www.huawei.com/minisite/pdf/ilab/cloud_vr_solutions_wp_en.pdf

Network Slicing

- Network slicing is considered as a technology to provide tailor-made and quality-guaranteed services. Operators can perform on-demand network resource isolation for users/applications.
- Discussions on network slicing call for hard/soft isolation capabilities and bounded latency.
- What part of the Network Slicing Problem can we help?

10 Support of 5G Slicing in the transport network

The transport network is, in general, a multi-service network and we can expect that, in some cases, the common transport network infrastructure will be shared between 5G services and other services. It is necessary to provide isolation between each of these services. Further it is necessary to provide isolation between the different 5G transport network slice instances. From a management perspective the services are placed in virtual networks (VNs) that are established as described in section 8. The forwarding plane must ensure that the traffic from one VN is not (accidentally) delivered to a different VN. It is also necessary for the forwarding plane to provide isolation that limits the interaction between the traffic in different VNs. The transport network provides two types of traffic isolation as described below:

- **Hard isolation**: The traffic loading one VN has no impact on the traffic in any other VN, including QoS effects.
  Hard isolation is implemented by providing independent circuit switched connections for the exclusive use of one VN. A circuit switched connection is provided by, for example, a dedicated wavelength or a dedicated TDM time slot.
- **Soft isolation**: The traffic loading of one VN may have an impact on the QoS provided to the traffic in other VNs.
  Soft isolation is implemented by statistically multiplexing the traffic from two or more VNs onto a common circuit switched connection using a packet technology (e.g., Ethernet VLAN, MPLS tunnel). The impact on the QoS provided by one VN caused by the traffic on other VNs may be constrained by traffic engineering including, for example, limiting the statistical multiplexing ratio, traffic policing on each VN.

ITU-T Technical Report GSTR-TN5G: Transport network support of IMT-2020/5G

You may be interested in the work of the DetNet working group [1] which is collaborating with the IEEE802.1 TSN task group to develop mechanisms to provide deterministic data paths that operate over Layer 2 bridged and Layer 3 routed segments, where such paths can provide bounds on latency, loss, and packet delay variation (jitter), and high reliability. These features may prove to be particularly useful in supporting connectivity (or slices) for 5G services. The DetNet Architecture is largely complete and is described in [2]. DetNet's use of the IP [3] and MPLS [4] date planes is still being defined in the working group. You may also be interested in early work on configuration control in [5].

Liaison letter between 3GPP and IETF for Network Slicing relevant work

*in recent ITU-T Revision of GSTR-TN5G,
Hard isolation is replaced by "Circuit switched resources"
Soft isolation is replaced by "Packet switched resources"

Service Provider Network Features

- Service provider Ethernet network characteristics
  - Large propagation delay. (e.g. 10~100km)
  - High bandwidth. (10GE/25GE/40GE/100GE/400GE)
  - Flexible topology in meshed network
  - Multiple traffic mixed transportation sharing a physical infrastructure
    - Usually in DiffServ model
  - Converged bandwidth in backbone
    - Different type of device/bandwidth along path

Bounded Latency Solutions at Present

- Current mechanisms to provide bounded latency service.
  - Light traffic load in dedicate board bandwidth network
    - Resource reservation on explicit route;
    - Scheduling on explicit route;
  - TDM based techniques
    - SDH systems
    - OTN systems
  - Developing TSN/DetNet Ethernet

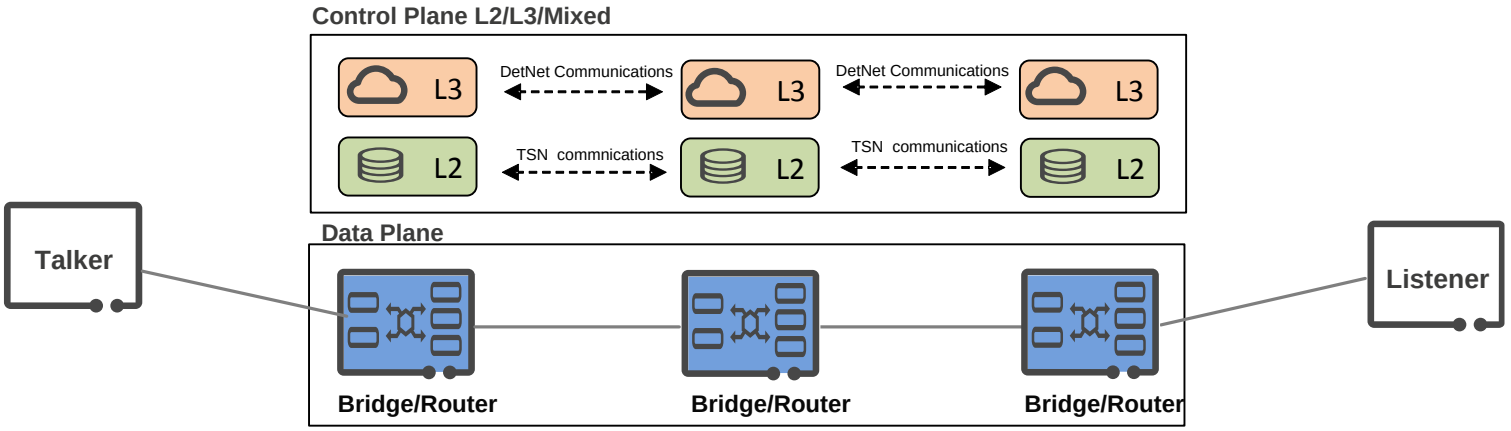
Multiple solutions for different user cases or scenarios coexist in market.

TSN/DetNet Data Plane Schemes

- Improved Qos based scheme, with proactive resource reservation
  - Guarantee average bandwidth and bounded latency, resource contention happens at times.
  - Limitation on traffic load. Latency performance degrades with increasing number of streams.
    - Examples: IEEE Std 802.1BA
  - Leverage current resource reservation and improved Qos mechanisms, fast to market.

- Time based scheme, with proactive resource reservation
  - Provide fixed bandwidth, no resource contention between traffic in different time window at any time.
    - Examples: : IEEE Std 802.1 Qbv
  - Limitation on application and network scale, due to complexity on time based planning and scheduling.
  - Develop new hardware and network planning algorithms, Need time to market.

TSN/DetNet Interworking for Service Provider Networks



A Framework for TSN/DetNet Network

- Both L2/L3 Network control plane are viable, peering with end stations(talker/listener)
- TSN Standard behaviors in data plane provide bounded latency forwarding and management capability. Multiple queueing and forwarding methods can be deployed, with different cost and performance(latency/jitter).
- TSN techniques provide soft partitioning and hard partitioning capabilities over Ethernet*.

*new-tsn-wangtt-applicability-of-TSN-for-5G-services-0318-01.pdf

Performance Isolation

- Essentially, guarantee the service quality at each network slice is similar as guarantee the service quality at each flow/stream in TSN Ethernet;
  - Improved Qos scheduling has soft partitioning capability
  - Time window based scheduling has hard partitioning capability

- This TSN Profile will show how TSN can provide *soft/hard partitioning for Service Provider Networks. The data plane QoS portions of this profile will be equally applicable to DetNet-based Network Slicing.

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Thank you