Draft new Recommendation ITU-T Y.det-qos-intwk-wan

Requirements and framework of deterministic QoS interworking mechanism in wide area network including IMT-2020 and beyond

Summary

This recommendation specifies the requirements and framework of deterministic QoS interworking mechanism in wide area network including IMT-2020 and beyond. This recommendation will provide an overview and analyze the characteristics of deterministic QoS in wide area network, and then specify the functional requirements for deterministic QoS interworking capabilities and framework which can provide deterministic QoS interworking mechanisms.

Keywords

Deterministic QoS, interworking, heterogeneous network, differentiated SLA

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1. Scope

The scope of this new work item is functional requirements and framework for deterministic QoS interworking mechanism in wide area network limited to fixed networks such as backbone network or metropolitan area network within a single provider. It addresses the following subjects:

- Overview of deterministic QoS interworking including typical scenarios, characteristics, and challenges;

- Functional requirements for deterministic QoS to support interworking capability across multiple technology domains within a single provider;

- Framework of deterministic QoS interworking mechanism including the interworking functions at edge nodes and optimal resource control and management;

[Editor's Note] The scope of deterministic QoS interworking is limited between technology domain, which is at least one existing deterministic QoS mechanism or technology in Q6/SG13.

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2. Reference

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.3106] Recommendation ITU-T Y.3106, *QoS functional requirements for the IMT-2020 network.*

[ITU-T Y.3107] Recommendation ITU-T Y.3107, *Functional architecture for QoS assurance management in the IMT-2020 network.*

[ITU-T Y.3113] Recommendation ITU-T Y.3113, *Requirements and framework for latency guarantee in large scale networks including IMT-2020 and beyond.*

[ITU-T Y.3118] Recommendation ITU-T Y.3118, *Requirements and framework for jitter guarantee in large scale networks including IMT-2020 and beyond.*

[ITU-T Y.3120] Recommendation ITU-T Y.3120, *Functional Architecture for latency guarantee in large scale networks including IMT-2020 and beyond.*

[ITU-T Y.3121] Recommendation ITU-T Y.3121, *QoS requirements and framework for supporting deterministic communication services in local area network for IMT-2020.*

[ITU-T Y.3126] Recommendation ITU-T Y.3126, *QoS requirements and framework of interworking capability for supporting deterministic communication services in local area network for IMT-2020 and beyond.*

[ITU-T Y.3129] Recommendation ITU-T Y.3129, *Requirements and framework for stateless fair queuing in large scale networks including IMT-2020 and beyond.*

3. Definition

3.1. Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 IMT-2020 [ITU-T Y.3100]: (Based on [ITU-R M.2083]) Systems, system components, and related technologies that provide far more enhanced capabilities than those described in [ITU-R M.1645].

3.2. Terms defined in this Recommendation

This Recommendation defines the following terms:

[TBD]

4. Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

QoS Quality of Service

5. Conventions

In this Recommendation:

The keywords "is required" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

6. Overview of deterministic QoS interworking in wide area network

The use cases in IMT-2020 and beyond such as ultra-reliable and low latency communications (URLLC) has stringent requirements for capabilities such as throughput, latency and availability. It is required to provide deterministic QoS for various applications which demand deterministic SLA guarantees such as bounded latency and high reliability. For example, intelligent electrical network, intelligent factory, internet of vehicles, industry automation and other industrial internet scenarios.

In Figure 1, the end-to-end deterministic QoS may be provisioned and the deterministic transport network may interconnect between the deterministic Access Network and deterministic Core Network/Data Network. ~~The~~ These local area networks may be connected by a wide area network (which is limited to backbone network or metropolitan area network within a single provider) to provide end-to-end deterministic services. The networks and nodes in local area networks may be interconnected with heterogeneous wide area networks such as dedicated line or private network, tunnels and so on. The interworking mechanism should provide the capability across multiple domains with different technologies. For example, the interworking function at edge nodes should be supported and routes with allocated resources should be established when large-scale deterministic networks across multi-domains.But it is not covered by existing QoS mechanisms.

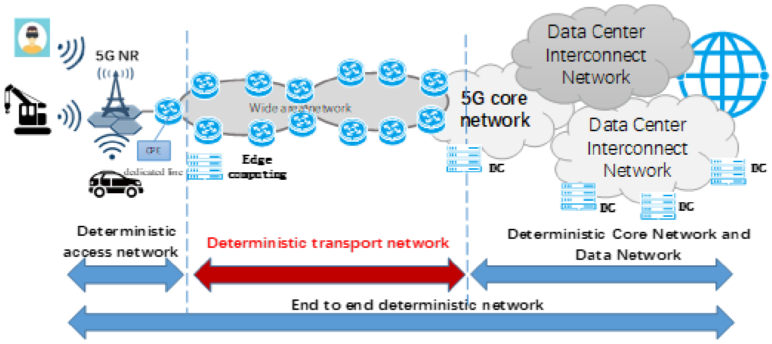

Figure 1. End-to-end deterministic QoS deployments

It is necessary to divide the deterministic SLAs requirements into different domains to map and match among different QoS mechanisms, the interworking capability should be provided such as dividing deterministic SLAs requirements, control and management of flow admission, resource scheduling, routes planning, mapping among multiple QoS mechanisms.

7. Functional requirements for deterministic QoS to support interworking capability in wide area network

7.1 Interworking capability between heterogeneous technology domains

The flows may be transmitted over the large scale heterogeneous networks where the network topology may be partitioned into multiple technology domains within a single provider. The mechanism should be considered to interwork among different technologies, e.g. interworking among different large scale deterministic QoS mechanisms. The figure 2 shows an example for interworking scenario, the metropolitan area network may be divided into access and aggregation and core networks and each may implement different technologies. The capability should be provided for interworking between the deterministic QoS of technology A and technology B.

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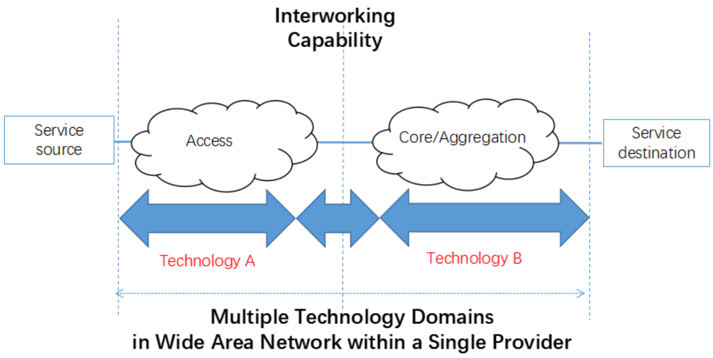

Figure 2. Interworking scenario across multiple technology deployments

[Editor's Note] The technology domain A and B is at least one existing deterministic QoS mechanisms or technology in Q6/SG13.

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7.2 QoS assurance requirements of interworking capability

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[ITU-T Y.3106] specifies QoS functional requirements for the IMT-2020 network. Functional requirements are expected for deterministic QoS to support interworking capability in ~~large-scale~~ heterogeneous wide area network within the scope of IMT-2020 network. -It is required to provide interworking capability~~traffic scheduling to resolve interworking scalability issues and provide fine-grained resource control and management to achieve high utilization.~~ -respectively in applications and service plane, control plane and data plane to support QoS assurance management in IMT-2020 network [ITU-T Y.3107] .

Requirements for interworking capability in applications and service plane:

- It is required to support the interworking capability to provide deterministic QoS monitoring for services across multiple domains in applications and service plane.
- It is required to support the interworking capability to provide diversified deterministic SLAs across multiple domains in applications and service plane.

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Requirements for interworking capability in control plane:

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~~**Requirement 1:**~~

- It is required to~~provide interworking function at edge nodes to transmit the traffic and~~ support the interworking capability ~~such as~~for -advertising the deterministic information (e.g. technology type, available resource and so on) in control plane. ~~To control plane~~

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~~**Requirement 2:**~~It is required to support the interworking capability for route planning to establish deterministic paths across multiple domains in control plane.

- It is required to support the interworking capability for resource optimization to improve the heterogeneous resource control in control plane.
- It is required to support the interworking capability for QoS provisioning to achieve end-to-end QoS in control plane.

Requirements for interworking capability in data plane:

- It is required to provide interworking capability at edge nodes for QoS mapping to perform the flow classification and flow mapping between technology domains in data plane.
- It is required to provide interworking capability for QoS policy enforcement to transmit the traffic through interworking interface in data plane.

~~Deterministic QoS is required to be classified and divided into several traffic classes based on the differentiated applications.~~

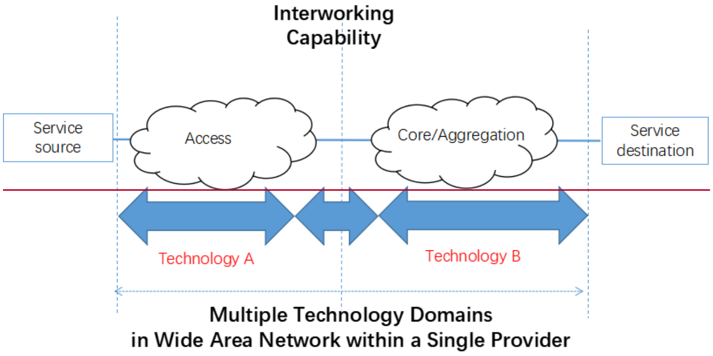
~~**Requirement 3**:It is required to support per-class traffic scheduling to reduce the amount of control signaling and network operations and provide fine-granularity services. Per-flow~~

~~**Requirement 4**: It is required to support the inter-domain deterministic metric and routes to achieve the end-to-end bounded latency. Deterministic routes MAY be established based on the generic resource pool across heterogeneous networks.~~

~~**Requirement 5**: It is required to provide generic resources scheduling model based on the inter-layers capability and heterogeneous resources including resources reservation and allocation based on the time-based constraints.~~

~~**Requirement 6**: It is required to provide fine-grained resource control based on the different levels of deterministic capability.~~

8. Framework of d~~D~~eterministic QoS interworking mechanism in wide area network



~~Figure 1. Interworking scenario across multiple technology deployments~~

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8.1~~2~~ Framework and components for interworking mechanism ~~of deterministic QoS interworking mechanism~~

The framework~~implementation technology~~ of deterministic QoS interworking involves the data plane, control plane and ~~management~~applications and service plane. And each plane consist of different technologies and components ~~in data plane~~.

The data plane needs to provide the functions such as interworking functions at edge nodes, ~~and scheduling mechanisms, traffic scheduling and~~ flow ~~identification~~ classification and mapping.

The control plane needs to provide the functions such as resource ~~modeling and control~~optimization, ~~path~~ route planning, capability advertisement and QoS provisioning ~~and computation and multi-domain routes~~.

The applications and service~~management~~ plane needs to provide the functions such as ~~topology~~ service monitoring ~~management , fault~~ and diversified deterministic SLAs.~~traffic monitoring and performance measurement~~.

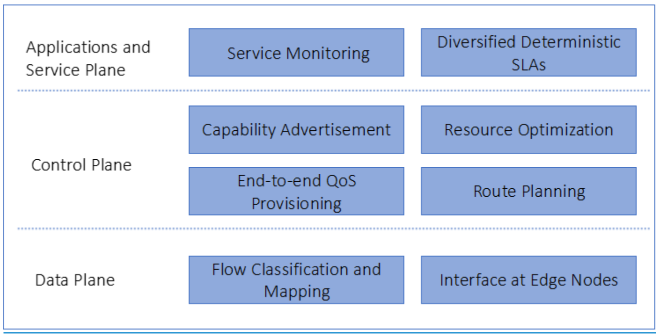

Figure 3. Framework and components of deterministic QoS interworking

8.1~~2~~.1 Data plane

[Editor's Note] This clause will describe the deterministic QoS interworking mechanism ~~technologies~~ and components in data plane.

8.1~~2~~.1.1 Interface~~Interworking functions~~ at edge nodes

[TBD]

~~8.2.1.2 scheduling mechanisms~~

~~[TBD]~~

~~8.2.1.3 Traffic scheduling~~

~~[TBD]~~

8.1~~2~~.1.2~~4~~ Flow ~~identification~~ classification and mapping

[TBD]

8.1~~2~~.2 Control plane

[Editor's Note] This clause will describe the deterministic QoS interworking mechanism ~~technologies~~ and components in control plane.

8.1~~2~~.2.1 Resource ~~modeling and control~~optimization

[TBD]

8.1~~2~~.2.2 ~~Path~~ Route planning ~~and computation~~

[TBD]

8.1~~2~~.2.3 End-to-end QoS provisioning~~Multi-domain routes~~

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[TBD]

8.1.2.4 Capability advertisement

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8.1~~2~~.3 A~~Management~~pplications and service plane

[Editor's Note] This clause will describe the deterministic QoS interworking ~~technologies~~ mechanism and components in ~~management~~ application and service plane.

8.1~~2~~.3.1 Diversified deterministic SLAs~~Topology management~~

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[TBD]

8.1~~2~~.3.2 Service ~~Fault and traffic~~ monitoring

[TBD]

~~8.2.3.3 Performance Measurement~~

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~~[TBD]~~

8.2 Workflow and procedures of interworking capability

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[Editor's Note] This clause will describe the deterministic QoS interworking workflow and procedures.

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Appendix I. Use cases of deterministic QoS interworking in wide area network.

[Editor's Note] This clause will describe the typical use cases which need deterministic QoS interworking mechanism.

Use case 1: Electrical safety control

[Editor's Note] This clause will describe the electrical safety control use case which need deterministic QoS interworking mechanism such as remote-control applications.

Use case 2: 5G+Cloud X

[Editor's Note] This clause will describe the 5G+ Cloud X use case which need deterministic QoS interworking mechanism such as cloud AR/VR/game applications.

Appendix Ⅱ Experiment data

[Editor's Note] This clause will describe experiments based on China Environment for Network Innovations (CENI).