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TECHNICAL REPORT

**Speech and multimedia Transmission Quality (STQ);
Quality of Service aspects for 5G;
Discussion of QoS aspects of services related
to the 5G ecosystem**

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

While - at the time of publication - there is no final, complete specification of 5G, its essential properties are well defined. The present document addresses the question if, and potentially how, these properties require an extension of the current portfolio of QoS metrics which describe the technology from a strictly end user, service-oriented point of view. For this purpose, a systematic analysis of 5G features and their relation to QoS is presented.

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Executive summary

The present document addresses the question if the inventory of QoS parameters needs to be expanded to adequately cover the upcoming 5G standard. Thorough examination leads to the conclusion that, as 5G does not provide any new type of service, no such extension is intrinsically required. Likewise, the inventory of methodologies used for performance testing is adequate. However, due to new properties of 5G such as network slicing and dynamic prioritization of services, the role of careful design of test scenarios will be more prominent.

In particular, the understanding of a packet data network as a static medium ("bit pipe") becomes even less applicable than in existing technologies. As a consequence, predictions derived from testing with a particular use case, which is in general a particular set of parameters for a generic test case, become less reliable. Also, the range of comparability between QoS parameters which have been derived with different parameter sets may become smaller, increasing the need for careful design of test conditions, thorough understanding of methodologies, and comprehensive documentation of tests.

Introduction

5G is the upcoming new generation of mobile network technology. It is characterized by an increase in general performance on the transport plane, i.e. data rates and latency, but also by a range of new features such as network slicing and dynamic prioritization of data transport. The present document addresses the question if the current inventory of QoS parameters is adequate to cover and serve the 5G ecosystem, or if new services have to be considered or QoS parameters of existing services have to be adapted.

1   Scope

The present document summarizes the results of an analysis of the impact of the upcoming 5G on existing QoS metrics, and the question if extensions or modifications of the portfolio of QoS parameters portfolio are required to capture respective properties of 5G.

The analysis starts with a summary of features and properties of 5G which can be expected to be relevant for QoS assessment.

The first question addressed is if there are features of the 5G roadmap - as far as technically stable as of the time of publication, or reasonably stable projections - which constitute new services which would then require new sets of QoS parameters. The second question is in what way projected 5G properties may require adaptations with respect to measurement methodologies, computation, or usage of existing QoS parameters.

2   References

2.1   Normative references

Normative references are not applicable in the present document.

2.2   Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1]   3GPP TS 22.261 (V16.1.0) (2017-09): "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Service requirements for the 5G system; Stage 1 (Release 16)".

3   Abbreviations

For the purposes of the present document, the following abbreviations apply:

AR	Augmented Reality
eV2X	enhanced Vehicle-to-Anything
FTP	File Transfer Protocol
NG-RAN	New Generation Radio Access Network
OTT	Over The Top
QoE	Quality of Experience
QoS	Quality of Service
SMS	Short Message Service
UE	User Equipment
VR	Virtual Reality

4 QoS relevant innovation in 5G

4.1 Overview

This clause provides a quick overview of the most important QoS related aspects of 5G. The following clause will then present a systematic, step-by-step analysis of 5G features (according to 3GPP TS 22.261 [i.1]) and their relevance for QoS and QoE.

4.2 Central features

5G features can, from a QoS and QoE point of view, be divided into two categories:

- Quantitative improvements such as an increase in available data rate or reduction of latency.

- Qualitative expansions which by themselves constitute new types of service by themselves.

Quantitative improvements can act, in a more or less direct way, as enablers for new types of services. They do, however, carry respective properties. For instance, an ecosphere around multimedia services such as Video Streaming will only evolve if the medium provides a certain minimum bandwidth. Likewise, an ecosphere of smartphone based applications - and in particular the rich OTT world that can observed at times of the publication of the present document - is linked to availability of devices as well as of sufficiently mature wideband network coverage. The performance increases promised by 5G do not, however, provide compelling reasons to assume new types of service linked to 5G alone. Emerging new types of application such as Augmented Reality (AR) or Virtual Reality (VR) can be expected to require a new layer of QoS parameters dealing with physiological effects or an extension of subjective perception into new areas, but this is not seen as tightly linked to 5G.

New services would ask for respective QoS parameters to describe their perception from an end-user perspective. For instance, SMS, first offered by 2G, was a new class of service which was not offered and which needed respective coverage by QoS metrics. There is, however, no such 5G specific service in sight.

4.3 Methodology in general

As far as new types of radio access or end user device behaviour are concerned, conducting QoS relevant 5G-specific tests will require respective devices, much in the same way as it was the case for previous mobile network technology generations.

Also, with an increase in overall performance, parameters of a typical service usage will change. Again, this is not different from previous generations where e.g. the size and composition of web sites used for testing was adapted to reflect an overall increase in performance.

5G has, however, a feature which are in a less obvious way requiring careful consideration of existing methodology. This is Network Slicing which in effect means that the network properties depend on the particular service usage, i.e. on the use case itself.

It can be argued that this is not an entirely new property of mobile networks. Performance optimization strategies, such as Performance Enhancement Proxies, service-dependent data rates, or even Fair Use policies mean that a network is not a static bit pipe. In contrast to previous generations, 5G Network Slicing makes such behaviour an explicit, well-defined property of the medium.

The consequence for testing can be described as a narrowing of the prediction horizon of a particular test. If the performance of a packet network under test is essentially independent from the service it carries, i.e. from the protocol being used and the structure of data traffic, a measurement using test method A (e.g. FTP download) can be carried out, and the results can be assumed to be valid, or at least indicative to a large degree, for services B (e.g. http download), C (e.g. e-mail) or even D (e.g. video streaming).

With consequent application of the Network Slicing paradigm, it cannot be taken for granted that such inference still works. As a consequence, if information about network performance for a particular end to end service usage type is required, explicit tests with a respective scenario will be required - or at last explicit quantitative validation that a given "proxy service" test can produce useful results.

4.4 Quick Summary

In summary, 5G offers several enhanced features which can be expected to improve QoS and QoE from an end-user perspective. There are, however, no intrinsic new services which would require addition of new QoS parameters. Improvements will materialize in the form of better numerical values of respective indicators but along the dimensions already existing.

There are changes to expect from a methodology point of view, though. Features such as Network Slicing and dynamic prioritization of services mean that essentially each service will encounter its own, specific network. It is even possible that different parameter ranges for the same basic type of service - e.g. downloading large or small data volumes - will exhibit this effect. Moreover, there may be service types which need specific types of devices.

This can be described as a reduction in the prediction range of a given test. It means that before applying results gained by a particular test scenario, careful consideration - and, ideally, some validation tests - are highly advisable. While this kind of context sensitivity is a property encountered in existing network generations already, its importance is again greatly increased for 5G.

5 Discussion of 5G features in 3GPP TS 22.261 clause 6 w/r to relevance for QoS and QoE

5.1 Network slicing

As discussed in preceding clauses of the present document, Network Slicing will presumably have a large impact on QoS measurement methodology. In particular, multi-service or even multi-device test setups may be required to effectively invoke and assess respective network behaviour.

However, as the individual use cases and services are covered by existing QoS standards (either directly or in a generic way as e.g. for the family for video streaming services), it is not expected that extension of the inventory of QoS parameters will be necessary.

The need for extensions may arise in cases where a deeper diagnostic perspective is required, which is however considered to be outside the primary scope of QoS.

5.2 Diverse mobility management

As stated in 3GPP TS 22.261 [i.1], 5G will support the UE with different mobility management needs. Again, this requirement or offering of 5G relates to possible refinements in measurement methodology, as greater care may have to be taken when designing test scenarios. Again, this angle is not actually new as existing standard literature has dealt with these requirements long before. It may, however, be useful to emphasize the fact that the test scenario - including the selection of devices used - can have substantial impact on test results, and that methodology is an integral part of QoS testing rather than an optional element.

5.3 Multiple access technologies

This element is also considered to be relevant for testing methodology, in the sense that the selection of devices, and the possible behaviour with respect to selection of radio access technologies should be considered as part of the parameter space of testing with possible impact on outcome and comparability. There is no reason to expect that new services arise in this context, and therefore relevance for QoS is not assumed to exist.

5.4 Resource efficiency

This element relates to a possibly increased diversity of device types and therefore the impact, if not covered by the discussion in other clauses, is considered to belong to the space of testing methodology if at all. It is not assumed that this 5G feature will entail qualitatively new services types with subsequent requirement for new QoS parameters.

5.5   Efficient user plane

This feature may influence the performance experienced by end users, i.e. the quantitative level of QoS parameters, but does not constitute new services. Therefore, it is not considered to produce a need for new QoS parameters.

5.6   Efficient content delivery

This feature may influence the performance experienced by end users, i.e. the quantitative level of QoS parameters, but does not constitute new services. Therefore, it is not considered to produce a need for new QoS parameters.

5.7   Priority, QoS, and policy control

This feature can be understood as a practical aspect of the more generic feature "network slicing". It may have an effect on the performance experienced by end users, i.e. the quantitative level of QoS parameters, for each particular service, and may require multi-service or even multi-device testing, i.e. an appropriate design of scenarios but within the scope of existing methodologies and service QoS parameters.

5.8   Dynamic policy control

This feature may have an effect on the performance experienced by end users, i.e. the quantitative level of QoS parameters, for particular services. It will require an appropriate design of scenarios but is expected to do so within the scope of existing methodologies and service QoS parameters.

5.9   Connectivity models

This feature will have an impact on the design of test scenarios and, potentially, also on the choice of devices to be used. It does not involve the necessity of new services or service QoS parameters.

5.10   Network capability exposure

This feature may have an impact on the design of test scenarios and, potentially, also on the choice of devices to be used. It does not involve the necessity of new services or service QoS parameters because for the typical end user, they are an integral part of his usage experience.

5.11   Context aware network

This feature may have an impact on the design of test scenarios and, potentially, also on the choice of devices or hardware extensions to testing systems, which can support or create the required scenario.

However, it does not involve the necessity of new services or service QoS parameters because for the typical end user and a particular service, they are an integral part of his usage experience.

5.12   Self backhaul

This feature may have an impact on the design of test scenarios and, potentially, also on the choice of devices. It does not involve the necessity of new services or service QoS parameters because for the typical end user, they are an integral part of his usage experience.

5.13   Flexible broadcast/multicast

This feature may have an impact on the design of test scenarios and, potentially, also on the choice of devices. It does not involve the necessity of new services or service QoS parameters because for the typical end user, they are an integral part of his usage experience. Services which fall under this category (e.g. video/multimedia services) are already covered by existing sets of QoS parameters.