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Part 1: Assessment of Quality of Service

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Foreword

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

The present document is part 1 of a multi-part deliverable covering the QoS aspects for popular services in mobile networks, as identified below:

Part 1: "**Assessment of Quality of Service**";

Part 2: "Definition of Quality of Service parameters and their computation";

Part 3: "Typical procedures for Quality of Service measurement equipment";

Part 4: "Requirements for Quality of Service measurement equipment";

Part 5: "Definition of typical measurement profiles";

Part 6: "Post processing and statistical methods";

Part 7: "Network based Quality of Service measurements";

Part 8: "Formalized definition of Quality of Service parameters and their computation";

Sub-part 1: "General aspects and terminology";

Sub-part 2: "HTTP-based services".

The present document builds an umbrella document for this multi-part deliverable. It summarizes the basics of Quality of Service, always seen from the user's perspective. Differences to Quality of Experience (QoE) are also discussed. In extension to generic definitions, specific definitions for this multi-part deliverable are stated here. Furthermore, it gives guidance to assure that QoS assessments can be conducted in a meaningful way and proposes an according process.

Part 2 defines QoS parameters and their computation for popular services in mobile networks. The parameter definition is split into several parts. It contains an abstract definition which gives a generic description of the parameter, an abstract equation and the corresponding user and technical trigger points.
The harmonized definitions given in part 2 are considered as prerequisites for the comparison of QoS measurements and measurement results.

Part 3 describes the measurement procedures needed to perform the measurements of QoS parameters in line with the definitions given in part 2, applying the test profiles defined in part 5.

Part 4 defines the minimum requirements of QoS measurement equipment for mobile networks in the way that the values and trigger points needed to compute the QoS parameter as defined in part 2 can be measured following the procedures defined in part 3. Test equipment fulfilling the specified minimum requirements will allow performing the proposed measurements in a reliable and reproducible way.

Part 5 specifies typical measurement profiles which are required to enable benchmarking of different mobile networks both within and outside national boundaries.

Part 6 describes procedures to be used for statistical calculations in the field of QoS measurement of mobile networks using probing systems.

Part 7 describes how Quality of Service measurements should be done inside the network without direct access to the end point terminal.

Part 8, sub-part 1 deals with formal aspects in the definition of QoS parameters which have not been addressed appropriately by part 2. It sets up a consistent terminology for the formalized definition of QoS parameters and their computation, carefully distinguishing between measurable quantities and associated statistical aggregation formulas. In addition, a methodology is specified for constructing definitions in two stages, using the concept of abstract events and their representation by technical events at well-defined points of observation.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The term Quality of Service (QoS) is extensively used today, not just in the telecommunication world in which it has its roots, but increasingly regarding broadband, wireless and multimedia services that are based on the IP protocol. Networks and systems are gradually being designed in consideration of the end-to-end performance required by user applications; however, the term QoS is usually not well-defined, is used loosely or, worst of all, misused. Therefore, guidance is needed on how to understand and apply the term QoS.

The term "Quality of Service" addresses technical as well as non-technical aspects affecting a service. Different concepts and guidance have been developed to cover various interests and viewpoints of all parties of telecommunications service market, i.e. users, service providers, network operators, manufacturers and regulators.

In many cases, the user and his or her expectations with respect to quality are in the centre of interest. This very generic topic can have manifold characteristics:

- Depending on the role of the user, his expectations may vary: Considering service quality he might have other expectations compared with situations that are oriented more commercially, e.g. when he is in contractual discussions with his service provider.
- Not only service usage is relevant to the user. The overall impression of all touch points with his provider is influencing his personal quality reception.
- Furthermore, the user compares his expectations with the reached level of fulfilment. Future decisions will be based on his personal perception of the achieved level of quality. In this case, subjective components get an increased weight and importance. Taking these aspects also into account, the term "Quality of Service" has to be extended to "Quality of Experience" with a more subjective meaning.

This multi-part deliverable covers all facets which are relevant to the assessment of Quality of Service as seen from a user's perspective but with a technical interpretation. Whereas the "user's perspective" reflects events and triggers observable by a user, the "technical interpretation" is related to the fact that quality statements should be reproducible, comparable and reliable. Often automation techniques are used to achieve these goals based on a statistically valid data basis.

From a more practical view, different assessment methods are discussed. In a further step, the preparation and execution of assessment procedures are shown as well as the generation of key performance indicators, their aggregation and their matching against pre-defined target values. Finally, consecutive steps like optimization procedures are concluding this process-like view of QoS.

Also belonging to the more practical clause of the present document, basic definitions of measures are provided. To generate a common understanding of service independent and service dependent measures is also a goal which the last clauses of the present document should achieve.

In detail, the present document describes Quality of Service from a more theoretical and a more practical view.

Clause 5, together with the definitions given in clause 3, builds the theoretical background of all Quality of Service related matters:

- Definitions and abbreviations which are relevant in terms of Quality of Service are given in clause 3. They have been compiled from different sources like reference documents, involved services and standardization discussions.

- Clause 5 contains background information to Quality of Service. This rather theoretical clause discusses generic definitions of Quality of Service, Performance and Quality of Experience. Furthermore, QoS models defined in further standard documents and their interrelations are a subject of discussion.

Clauses 6 to 9 lead step by step from theoretical discussions on QoS to issues which are of practical and pragmatically relevance:

- Clause 6 presents a sequential order which describes a QoS assessment as being a process. Starting with the definition of targets and required preparation steps, the execution of the assessment as well as validation, reporting and optimization matters are discussed.

- Clause 7 provides basic definitions which are required to have a common understanding on fundamental topics. Examples are question like "What is a kilobyte?" or "How to define a timeout value?".

- Clause 8 deals with service independent QoS criteria, namely QoS parameters which are of relevance before a service is used. This covers e.g. the connection dialup via mobile networks.

- Clause 9 handles service dependent QoS criteria. Depending on the service, different parameters are required or not to give a complete picture of this service's QoS.

The standardization work in the QoS area is still ongoing. Therefore, the definitions and procedures given in will have to be reviewed on a regular basis to keep them up to date. The information contained in the present document will form among other input the basis for further work, but is likely to be modified and amended. Therefore, it is recommended to cross-check the given information with actual discussions within ITU-T and ETSI and with standards published after the date of publication of the present document.

1 Scope

The present document serves as a generic umbrella document for the further documents part 2 to part 8 of this series. It gives an overview over the topics addressed by these documents and enables the reader to work with the documents in the intended way. It is important to understand that the complete series of documents focuses on Quality of Service which stands for the objective discussion of quality measures from a rather technical perspective. Based on existing quality standards and further definitions, a complete picture of Quality of Service as seen from a user's point of view is drawn.

Wherever possible, existing ITU-T or ETSI definitions are referenced. If ITU-T or ETSI definitions do not exist or are considered as too generic, a more service and mobile network specific definition is made.

The present document comprises the theoretical backgrounds to understand terms like "Quality of Service", "Network Performance" and "Quality of Experience". Their meaning and interrelation are discussed by taking different QoS models into account.

2 References

2.1 Normative 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.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

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 necessary for the application of the present document.

[1] Recommendation ITU-T E.800: "Definitions of terms related to quality of service".

[2] Recommendation ITU-T G.1000: "Communications Quality of Service: A framework and definitions".

[3] ETSI TS 102 250-7: "Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in GSM and 3G networks; Part 7: Network based Quality of Service measurements".

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] Recommendation ITU-T I.350: "General aspects of quality of service and network performance in digital networks, including ISDNs".

[i.2] Recommendation ITU-T P.10/G.100: "Vocabulary for performance, quality of service and quality of experience".

[i.3] Recommendation ITU-R BT.500-11: "Methodology for the subjective assessment of the quality of television pictures".

[i.4] Recommendation ITU-T X.745: "Information technology - Open Systems Interconnection - Systems Management: Test management function".

[i.5] Recommendation ITU-T G.109: "Definition of categories of speech transmission quality".

[i.6] Recommendation ITU-R P.800: "Methods for subjective determination of transmission quality".

[i.7] Recommendation ITU-T E.802: "Framework and methodologies for the determination and application of QoS parameters".

[i.8] ETSI TR 102 493 (V1.2.1): "Speech and multimedia Transmission Quality (STQ); Guidelines for the use of Video Quality Algorithms for Mobile Applications".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in Recommendations ITU-T E.800 [1], E.802 [i.7], G.1000 [2] and the following apply:

Throughout this multi-part deliverable, the following terms and definitions apply:

1 kByte: 1 024 Byte

1 mbyte: 1 024 kbyte

access point name: used to identify a specific IP network and a point of interconnection to that network

active testing: Refers to the way that data is acquired actively for the measurement, i.e. that the test makes use of a dedicated channel for the measurement, e.g. by dialling a number and making a call, i.e. setting-up a channel for the measurement.

A-party: initiating part of a connection (also: Mobile Originating, MO) OR in direct transactions, the party initiating the transaction (calling party)

NOTE: In store-and-forward transactions, the party sending content.

benchmark: evaluation of performance value/s of a parameter or set of parameters for the purpose of establishing value/s as the norm against which future performance achievements may be compared or assessed

B-Party: in direct transactions, the termination or counterpart of a transaction

NOTE: In store-and-forward transactions, the party receiving content.

broadcast: unformation transfer from one transmitting entity to many receiving entities

content: entirety of information transferred within a transaction, seen from the user's perspective

NOTE: In case of services requiring entrance procedures (e.g. server login with FTP), information flow to achieve the state of being able to transfer actual user data is not counted as content.

cut-off: unintended termination of a communication session

data service: telecommunications service involving the transport of data via the PTN such that any user can use equipment connected to a network termination point to exchange data with another user of equipment connected to another termination point

direct service: service which makes use of direct communications between a client entity and a server entity without persistent storage of transferred data in interconnected network elements

download: transfer of data or programs from a server or host computer to one's own computer or device

drive test tool: end-point test tool which is designed to be moved around, i.e. by walking or driving a car

email: messages automatically passed from one computer user to another, often through computer networks and/or via modems over telephone lines

end-to-end quality: quality related to the performance of a communication system, including all terminal equipment. For speech services it is equivalent to mouth-to-ear quality

event: In this multi-part deliverable, an event is understood as a change of condition (the according point of time is considered in addition).

host: entity that provides client stations with access to files and printers as shared resources to a computer network

idle mode: A communication device is in this state when it is powered-on but not transmitting a signal Intrusive Testing: According to the definitions Recommendation ITU-T X.745 [i.4], clause 3.10.3, intrusive test means: "A statement made with respect to a test invocation if service/user disruption will or may occur as a result of the test". This refers to the way that data is acquired for the measurement, i.e. whether or not sending a specific predefined and known reference signal over a channel for analysis purposes is required.

NOTE 1: In contrast to active testing, intrusive testing means that a test signal is sent over the network.

NOTE 2: The combinations "active and intrusive testing" and "passive and non-intrusive testing" define the most common test situations.

IP Service Access: basic access to the generic packet-data transfer capabilities the service is based upon

landing page: first website that appears in the Internet browser when a user tries to browse the Internet. It is often used to allow the user to make some specific settings for the following Internet session

maximum expected delivery time: for store-and-forward services, this defines the time span within which a message shall be received by the B-party to rate the transaction successful from the user's perspective

mean data rate: average data rate of a data transmission, calculated by dividing the number of transmitted bits by the duration of the transmission

mean value: In this multi-part deliverable, the mean value is understood as the estimated expectation value of a distribution. See also arithmetic mean definition from statistics or part 6 of this series.

network access: access to the network under test

network accessibility: probability that the user of a service after a request (to a network) receives the proceed-to-select signal within specified conditions

network availability: probability of success of network functions performed by a network over a specified time interval

network operator: organization that provides a network for the provision of a public telecommunication service

non-intrusive testing: According to the definitions in clause 3.10.5, non-intrusive test means: "A statement made with respect to a test invocation if no service/user disruption will or may occur as a result of the test". This refers to the way that data is acquired for the measurement, i.e. whether or not sending a specific predefined and known reference signal over a channel for analysis purposes is required.

passive testing: Refers to the way that data is acquired passively for the measurement, i.e. that the test makes use of an existing channel for the measurement, e.g. by tapping a further defined point of this channel.

probing attempt: trial to examine if the service under test works as expected

QoS Criterion: single characteristic of a product or service that is observable and/or measurable

QoS Indicator: characteristic that is used to determine the Quality of Service