ETSI TS 102 250-8-1 V1.1.1 (2018-12)

Speech and multimedia Transmission Quality (STQ);
QoS aspects for popular services in mobile networks;
Part 8: Formalized definition of Quality of Service parameters and their computation;
Sub-part 1: General aspects and terminology

Reference
DTS/STQ-00218m

Keywords
3G, GSM, network, QoS, service, speech

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Contents

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

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

The present document is part 8, sub-part 1 of a multi-part deliverable. Full details of the entire series can be found in part 1 [36].

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 definition of quality of service (QoS) parameters and their computation, as in ETSI TS 102 250-2 [i.1], involves a couple of formal aspects which require special attention but have not been addressed systematically so far by the ETSI TS 102 250 document series. These aspects include:

- Introduction and consistent usage of appropriate symbols in mathematical equations according to the ETSI Drafting Rules.
- Clear distinction between measurable quantities and associated statistical aggregations.
- Unambiguous naming of trigger events which occur in the definitions of several different QoS parameters.
- Systematic introduction and definition of appropriate points of observation which form the link between harmonized, abstract QoS parameter definitions and their application to specific contexts, e.g. particular types of access networks.

Over the years, application and maintenance of ETSI TS 102 250-2 [i.1] has revealed some deficiencies in this respect, which are not easily solvable via ordinary change requests, but would require structural changes of ETSI TS 102 250-2 [i.1]. Therefore, a new part 8 of the ETSI TS 102 250 series is introduced, of which the present document represents the first sub-part.

The present document treats the aspects listed above in a systematic way and specifies general requirements for a formalized definition of QoS parameters. Subsequent sub-parts of ETSI TS 102 250-8 are envisaged to contain QoS parameter definitions in accordance with the present document. These definitions will then replace, and thus obsolete, corresponding parts of ETSI TS 102 250-2 [i.1].

Clause 4 introduces the basic terminology used in a formalized treatment of QoS parameters: After clarifying the difference between measurable quantities and statistical averages, the concept of points of observation is explained in detail. Afterwards, the notion of abstract and technical events is introduced and used to specify a methodology for deriving harmonized QoS parameters in two stages. Finally, a formalized, event-based characterization of the term "transaction" is given, which proves to be useful when modelling complex scenarios of service usage.

Clause 5 specifies generic symbols and formulas for types of quantities frequently occurring in QoS parameter definitions, like event indicators, time durations or data rates. In addition, formally correct definitions for commonly used sample averages are given.

A systematic approach for deriving QoS parameters for non-trivial services, which may be subdivided into different "phases", is outlined in clause 6.

Finally, clause 7 defines user-oriented points of observation for different types of access networks. The exact locations of these points are illustrated in protocol stack overview figures, and reference is made to the corresponding protocol specifications.

Two informative annexes complement the main text of the present document:

- Annex A gives some guidance how to apply the rather formal definitions of clause 5 in practice by outlining a contrived, but complete, example.
- Annex B contains guidelines for writing specifications according to the present document. These guidelines include suggestions for structuring the respective document (for example, one of the intended further sub-parts of ETSI TS 102 250-8 [i.3]) as well as templates for particular parts of such specifications.

1 Scope

The present document defines a consistent terminology for the formalized definition of quality of service (QoS) parameters and their computation. In doing so, it carefully distinguishes between measurable quantities and associated statistical aggregation formulas. For frequently used types of quantities and aggregations, generic symbols and calculation formulas are specified.

For a large class of QoS parameters, which are basically determined by the observation of events, the present document specifies a methodology for constructing definitions in two stages, using the concept of abstract events and their representation by technical events at well-defined points of observation.

In addition, a framework is presented which indicates how QoS parameters may be derived in a generic way via sub-dividing the usage of a service into meaningful sub-transactions, called "phases".

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] ETSI TS 102 250-6: "Speech Processing, Transmission and Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks; Part 6: Post processing and statistical methods".

[2] 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".

[3] ETSI TS 124 002: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; GSM - UMTS Public Land Mobile Network (PLMN) Access Reference Configuration (3GPP TS 24.002)".

[4] ETSI TS 143 051: "Digital cellular telecommunications system (Phase 2+); Overall description; Stage 2 (3GPP TS 43.051)".

[5] ETSI TS 123 060: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS); Service description; Stage 2 (3GPP TS 23.060)".

[6] ETSI TS 123 401: "LTE; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (3GPP TS 23.401)".

[7] ETSI TS 127 007: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; AT command set for User Equipment (UE) (3GPP TS 27.007)".

[8] ETSI TS 127 060: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Packet domain; Mobile Station (MS) supporting Packet Switched services (3GPP TS 27.060)".

[9] IETF RFC 3501: "Internet message access protocol - version 4rev1".

[10] IETF RFC 1939: "Post Office Protocol - Version 3".

[11] IETF RFC 5321: "Simple Mail Transfer Protocol".

[12] IEEE Std 802.11™: " IEEE Standard for Information technology - Telecommunications and information exchange between systems Local and metropolitan area networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[13] IETF RFC 1034: "Domain names - concepts and facilities".

[14] IETF RFC 1035: "Domain names - implementation and specification".

[15] IETF RFC 959: "File Transfer Protocol".

[16] IETF RFC 3261: "SIP: Session Initiation Protocol".

[17] IETF RFC 3550: "RTP: A Transport Protocol for Real-Time Applications".

[18] IETF RFC 3711: "The Secure Real-time Transport Protocol (SRTP)".

[19] IETF RFC 7826: "Real-Time Streaming Protocol Version 2.0".

[20] IETF RFC 7230: "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing".

[21] IETF RFC 2131: "Dynamic Host Configuration Protocol".

[22] ETSI EN 300 392-5: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D) and Direct Mode Operation (DMO); Part 5: Peripheral Equipment Interface (PEI)".

[23] ETSI TS 144 001: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface; General aspects and principles (3GPP TS 44.001)".

[24] ETSI TS 144 004: "Digital cellular telecommunications system (Phase 2+) (GSM); GSM/EDGE Layer 1; General Requirements (3GPP TS 44.004)".

[25] ETSI TS 144 005: "Digital cellular telecommunications system (Phase 2+) (GSM); GSM/EDGE Data Link (DL) Layer; General aspects (3GPP TS 44.005)".

[26] ETSI TS 145 008: "Digital cellular telecommunications system (Phase 2+) (GSM); GSM/EDGE Radio subsystem link control (3GPP TS 45.008)".

[27] ETSI TS 124 007: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Mobile radio interface signalling layer 3; General Aspects (3GPP TS 24.007)".

[28] ETSI EN 300 392-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 1: General network design".

[29] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

[30] ETSI TS 125 301: "Universal Mobile Telecommunications System (UMTS); Radio interface protocol architecture (3GPP TS 25.301)".

[31] ETSI TS 124 301: "Universal Mobile Telecommunications System (UMTS); LTE; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 (3GPP TS 24.301)".

[32] ETSI TS 136 331: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (3GPP TS 36.331)".

[33] Recommendation ITU-T I.411: "ISDN user-network interfaces - Reference configurations".

[34] Recommendation ITU-T I.412: "ISDN user-network interfaces - Interface structures and access capabilities".

[35] Recommendation ITU-T Q.931: "ISDN user-network interface layer 3 specification for basic call control".

[36] ETSI TS 102 250-1: "Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 1: Assessment of Quality of Service".

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] ETSI TS 102 250-2: "Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 2: Definition of Quality of Service parameters and their computation".

[i.2] Recommendation ITU-T X.290: "OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications - General concepts".

[i.3] ETSI TS 102 250-8 (all sub-parts): "Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 8: Formalized definition of Quality of Service parameters and their computation".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

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

abstract event: abstractly formulated proposition, which can be said to be either true or false

point of observation: combination of a particular reference point with a particular protocol layer or service access point at that reference point

technical event: observation that a well-defined piece of data has been either sent or received

3.2 Symbols

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

$:=$	"is defined by" operator stating that the quantity on its left-hand side is defined by the expression on its right-hand side
d_T	data rate of a data transfer transaction T
$\widetilde{d_T}$	mean data rate of a data transfer transaction T
Δt_T	duration of a transaction T
$\widetilde{\Delta t_T}$	mean duration of a transaction T
ΔD_T	amount of data transferred in a transaction T
$E_{\mathrm{end},T}$	event defining the end of a transaction T
$E_{\mathrm{start},T}$	event defining the start of a transaction T
$E_{\mathrm{success},T}$	success condition of a transaction T
I_{A}	indicator of an event A
$n(A)$	number of measurement cycles where an event A has occurred

Q	measurable quantity
$\bar{Q}$	sample average of a measurable quantity
$\overline{Q\|B}$	sample average of a measurable quantity Q under the condition that an event B has occurred
$r(A)$	sample ratio of an event A
$r(A\|B)$	sample ratio of an event A under the condition that an event B has occurred
$r_{\mathrm{fail},T}$	failure ratio of a transaction T
$r_{\mathrm{success},T}$	success ratio of a transaction T
T	transaction
t_{A}	time of occurrence of an event A

3.3 Abbreviations

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

API	Application Programming Interface
AT	ATtention command prefix
CLI	Calling Line Identification
CMCE	Circuit Mode Control Entity
CR	Change Request
CS	Circuit Switched
DHCP	Dynamic Host Configuration Protocol
EDGE	Enhanced Data rates for GSM Evolution
FTP	File Transfer Protocol
GERAN	GSM/EDGE Radio Access Network
GSM	Global System for Mobile communications
HTTP	Hyper Text Transport Protocol
ISDN	Integrated Services Digital Network
LLC	Logical Link Control
MAC	Medium Access Control
MLME	MAC subLayer Management Entity
MMI	Man Machine Interface
MMS	Multimedia Messaging Service
MOS	Mean Opinion Score
MS	Mobile Station
MT	Mobile Termination
n.a.	not available
PCO	Point of Control and Observation
PO	Point of Observation
PPP	Point-to-Point Protocol
PS	Packed Switched
QoS	Quality of Service
RT	Reference point between TE and MT in TETRA
RTP	Realtime Transport Protocol
RTCP	Realtime Transport Control Protocol
RTSP	Real Time Streaming Protocol
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SME	Station Management Entity
SNDCP	SubNetwork Dependant Convergence Protocol
TA	Terminal Adapter
TE	Terminal Equipment
TETRA	TErrestrial Trunked RAdio
UE	User Equipment
UMTS	Universal Mobile Telecommunications Service
UNI	User Network Interface
UTRAN	Universal Terrestrial Radio Access Network
XML	eXtensible Markup Language

4 QoS parameter basics

4.1 Measurable quantities and sample averages

The document series ETSI TS 102 250-8 [i.3] defines QoS parameters as quantitative measures for particular quality aspects of popular services in mobile networks. The definition of such a quantitative measure shall consist of two parts:

1) A **measurable quantity** Q associated with the respective QoS parameter shall be defined. This means, an explicit equation or algorithm shall be given which represents a unique instruction how to determine the measured value of the respective QoS parameter from more elementary observation data (like events, speech samples, etc.) in a single measurement.

2) An **aggregation formula or algorithm** shall be specified which maps a set $\{q_1, \ldots, q_N\}$ of results of repeated measurements of the same quantity Q to a single value. This aggregated value then provides the desired **measure** associated with the respective QoS parameter.

The rationale behind this approach is the following: Mobile networks are complex dynamical systems, whose state undergoes non-systematic fluctuations on small time scales (in fact, the same is true not only for mobile networks, but for any telecommunication network). Possible origins of these fluctuations are varying radio conditions, varying utilization by different users and many other factors.

Due to this fluctuating behaviour, a single measurement of any quantity representing a QoS aspect (e.g. the time needed to set up a particular telephony call) usually does not yet yield a meaningful measure for this QoS aspect: Repeated measurements of the same quantity will in general yield different results which may exhibit considerable variations, even while there is no systematic change in the network conditions.

NOTE: These variations have their origin in the incomplete control over the state of the network (it is practically impossible to know all the parameters influencing this state) and should not be confused with uncertainties introduced by the measurement equipment - the variations would be present even if measured with an ideal, error-free measurement device. Of course, any real measurement system will add yet another contribution (to be kept as small as possible) to the variability of the results.

In order to deal with the fluctuating nature of a mobile network, a statistical approach is taken: The same quantity is measured repeatedly, and statistical aggregation of the single results will then provide the desired measure. Loosely speaking, statistical aggregation will "cancel out" non-systematic fluctuations of the single measurement results in favour of statistically relevant information, like mean or median values, variances, percentiles, etc.

A frequently used aggregation of a set of N measurement results $\{q_1, \ldots, q_N\}$ for the same quantity Q is the arithmetic mean of the result set, also called the "sample average":

$$\bar{Q} := \frac{1}{N}\sum_{i=1}^{N} q_i \qquad (4.1)$$

For specific purposes, other statistical aggregations, like median, quantiles, etc. may be used as well (for details please refer to ETSI TS 102 250-6 [1]).

The reader should distinguish between the **measurable quantity** Q associated with a QoS parameter on the one hand, and the **sample average** $\bar{Q}$ of this quantity on the other hand: The former comprises the elementary definition of the QoS parameter by a measurement instruction, while the latter represents the proper **measure** (involving statistical aggregation) associated with this QoS parameter.

Nevertheless, for the sake of simplicity, the term "QoS parameter" will be used in the present document with either meaning whenever it is clear from the context that no ambiguity can arise.

Depending on the specific quality aspects to be reflected by a particular QoS parameter, the formula or algorithm defining the corresponding measurable quantity Q may already involve aggregation itself (from yet more elementary measurement data). However, this kind of aggregation still needs to be distinguished from the one employed to get sample averages. In other words, the definition of the measurable quantity determines what is regarded to be a "sample" in a particular context. Several alternatives may be possible, the choice being a matter of convenience.