ETSI EG 202 009-2 V1.3.1 (2014-12)

ETSI GUIDE

**User Group;
Quality of telecom services;
Part 2: User related indicators on a service specific basis**

Reference

REG/USER-00042-2

Keywords

QoS, quality, service, SLA, user

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Foreword

This ETSI Guide (EG) has been produced by ETSI User Group (USER).

It includes, among other contributions, excerpts of the final report of Bannock Consulting's project for the European Commission's DG Information Society.

The present document is part 2 of a multi-part deliverable covering the quality of telecom services, as identified below:

Part 1: "Methodology for identification of indicators relevant to the Users";

Part 2: "User related indicators on a service specific basis";

Part 3: "Template for Service Level Agreements (SLA)".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**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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Introduction

Quality of Service can be evaluated from different perspectives and therefore using different measurement methods:

a) a first level of QoS is related to the reliability of the equipment and can be measured accurately via technical means;

b) a second level is related to the service provisioning and is closely linked to the kind of use of the service. Therefore appropriate criteria have to be defined according to this kind of use between the customer and the supplier; the service delivery QoS depends on the network as well as on the server behaviours;

c) the last one is intended to measure the subjective satisfaction of the customer and there is often no other means than a survey to get it (MOS value for media quality and OR for other services).

In the two first categories, technical means can be used to perform the measurements and in such cases, standards are often useful to achieve a common approach; such standards are given as references where appropriate. They include a precise definition of the relating metric and indicators and how to measure them. Unfortunately, they are not always providing enough indications on the size and how to select the samples to be measured. ETSI EG 202 009-1 [i.11] can help on these aspects but additional study may be needed to reach the right accuracy.

In the last category, the present document aims to give guidance on how to carry out the measurements including the subjective ones.

Measurements of every interesting indicator all the time might be very expensive and can even jeopardize the network and service performances. It can be more appropriate to get some of them via a poll on a limited number of users and for a limited period of time. In addition, a third party may be needed to carry out these measurements to make them more reliable and avoid any criticism from one of the involved parties.

1   Scope

In the current competitive world, Quality of Service (QoS) is becoming, jointly with cost, a key parameter in selling and buying telecommunications services. At the same time, technology and liberalization trends are raising new types of concerns unknown with the Plain Old Telephony Services (POTS) using switched connections provided by a single monopoly supplier.

Nowadays, there are several standards describing QoS measurements but the question of which indicators are the most interesting to be monitored from the users point of view and which values they should meet is still open. The present document proposes a reference model to evaluate the Quality of Service from the users point of view, defining the following concepts:

    a)   the appropriate indicators for a QoS assessment from the user point of view, i.e. KQI and SLO (see ETSI EG 202 009-1 [i.11], clause 4.3);

    b)   the methods to acquire the indicator values (KQI) needed to assess the quality of service.

The main principles for these definitions are:

- To define the services according to the applications performed by the user and not by the technical solution: for example, voice over IP is one of the many technical solutions to communicate between subscribers of the world-wide telephone network; ATM, frame Relay, IP are some of the many technical solutions to ensure a data transmission service between a terminal and a server or between networks. The quality criteria are the same, only the Service Level achieved can be different.

- To define the quality criteria with respect of usage and not technique. In speech quality, users are more interested in intelligibility than in bandwidth, distortion, signal to noise ratio or lost packets. Quality criteria should be defined as SLO (KQI), then translated into technical criteria (KPI). This means that providers may use different performance indicators to quantify and monitor the quality, depending on the technology used to match a particular SLO.

Therefore, the present document does not intend to describe measurement techniques since several ETSI TCs are dealing with such techniques and have the appropriate technical knowledge to develop standards in this area. ETSI EG 202 009-1 [i.11] gives guidance in identifying the indicators relevant from the user requirement point of view. If these metrics and indicators are used in a Service Level Agreements (SLA), it is crucial to define, at least for the most important ones, the agreed quality targets. If the aim is a comparison of the respective providers' performances, then quality targets can be provided as guidance for the general public to assess if the QoS of the results achieved is satisfactory or not. The preferred values and the means to aggregate them are provided in a separate document ETSI EG 202 934 [i.17].

The present document intends to define user related service specific KQI as far as possible using formal standards while ETSI EG 202 009-3 [i.12] proposes a template for a SLA dealing with all service aspects, including penalties, escalation procedures, areas of responsibility, etc. where these metrics and indicators can be used.

The purpose of the present document is to use the methodology described in ETSI EG 202 009-1 [i.11] to define, for each QoS criterion, the relevant metrics and indicators (KQI) for a choice of services and for each step of the customer relationship course. Hence each customer can have a comprehensive information on the features of the service he intends to buy according to the various providers. This will enable him to select the best suited to his needs.

2   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 reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://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.

2.1   Normative references

The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2   Informative references

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 G.1010: "End-user multimedia QoS categories".

[i.2]   Recommendation ITU-T P.800: "Methods for subjective determination of transmission quality".

[i.3]   Recommendation ITU-T P.800.1: "Mean Opinion Score (MOS) terminology".

[i.4]   Recommendation ITU-T P.862: "Perceptual evaluation of speech quality (PESQ), an objective method for end-to-end speech quality assessment of narrowband telephone networks and speech codecs".

[i.5]   Recommendation ITU-T P.862.1: "Mapping function for transforming P.862 raw result scores to MOS-LQO".

[i.6]   Recommendation ITU-T P.862.2: "Wideband extension to Recommendation P.862 for the assessment of wideband telephone networks and speech codecs".

[i.7]   Recommendation ITU-T P.862.3: "Application guide for objective quality measurement based on Recommendations P.862, P.862.1 and P.862.2".

[i.8]   Recommendation ITU-T P.863: "Perceptual objective listening quality assessment".

[i.9]   Recommendation ITU-T T.22: "Standardized test charts for document facsimile transmissions".

[i.10]   ETSI EG 201 769: "Speech Processing, Transmission and Quality Aspects (STQ); QoS parameter definitions and measurements; Parameters for voice telephony service required under the ONP Voice Telephony Directive 98/10/EC".

[i.11]   ETSI EG 202 009-1: "User Group; Quality of telecom services; Part 1: Methodology for identification of parameters relevant to the Users".

[i.12]   ETSI EG 202 009-3: "User Group; Quality of telecom services; Part 3: Template for Service Level Agreements (SLA)".

[i.13]   ETSI EG 202 057-2: "Speech and multimedia Transmission Quality (STQ); User related QoS parameter definitions and measurements; Part 2: Voice telephony, Group 3 fax, modem data services and SMS".

[i.14]   ETSI EG 202 057-3: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 3: QoS parameters specific to Public Land Mobile Networks (PLMN)".

[i.15]   ETSI EG 202 057-4: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 4: Internet access".

[i.16]   ETSI EG 202 843: "User Group; Quality of ICT services; Definitions and methods for assessing the QoS parameters of the customer relationship stages other than utilization".

[i.17]   ETSI EG 202 934: "User Group; The assessment of the overall Quality of Services (QoS) as perceived by the users; Definition of QoS indexes for all the customer relationship stages".

[i.18]   ETSI ES 202 057-1: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 1: General".

[i.19] ETSI ES 202 765-2: "Speech and multimedia Transmission Quality (STQ); QoS and network performance metrics and measurement methods; Part 2: Transmission Quality Indicator combining Voice Quality Metrics".

[i.20] ETSI ES 202 765-4: "Speech and multimedia Transmission Quality (STQ); QoS and network performance metrics and measurement methods; Part 4: Indicators for supervision of Multiplay services".

[i.21] ETSI TR 102 806: "User Group; Analysis of current End-to-End QoS standardization state".

[i.22] 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.23] ETSI TS 102 844: "User Group; Quality of Telecom Services; Conformity assessment; Requirements for bodies providing QoS assessments and surveys".

[i.24] CEN/CENELEC/ETSI EN 301 549: "Accessibility requirements suitable for public procurement of ICT products and services in Europe".

[i.25] CEN CWA14357: "CEN Workshop Agreement -Quality of Internet Service - Project Team Final Report - ICS 35.240.60".

[i.26] IETF RFC 792: "Internet Control Message Protocol".

[i.27] ANSI/ASA S3.5-1997 (R2012): "American National Standard Methods for Calculation of the Speech Intelligibility Index".

[i.28] Quality of Service Parameters for Internet Service Provision, final report of Bannock Consulting's project for the European Commission's DG Information Society.

[i.29] ISO/IEC 18028-4:2005: "Information technology -- Security techniques -- IT network security -- Part 4: Securing remote access".

[i.30] ISO/IEC 7498-2: "Information processing systems -- Open Systems Interconnection -- Basic Reference Model -- Part 2: Security Architecture".

[i.31] ISO/IEC 9797-1: "Information technology -- Security techniques -- Message Authentication Codes (MACs) -- Part 1: Mechanisms using a block cipher".

[i.32] ISO/IEC 13888-1: "Information technology -- Security techniques -- Non-repudiation -- Part 1: General".

[i.33] ISO/IEC 15945:2002: "Information technology -- Security techniques -- Specification of TTP services to support the application of digital signatures".

[i.34] ISO/IEC 11770-3:1999: "Information technology -- Security techniques -- Key management -- Part 3: Mechanisms using asymmetric techniques".

[i.35] ITSEC: "Information Technology Security Evaluation Criteria - Provisional Harmonized Criteria" June 1991.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI EG 202 009-1 [i.11] apply.

3.2 Abbreviations

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

ADSL	Asymmetric Digital Subscriber Line
ATM	Asynchroneous Transfer Mode
CRM	Customer Relationship Management
DNS	Domain Name System
FTP	File Transfer Protocol
GPRS	General Packet Radio Service
GSM	Global System for Mobile
HTTP	Hyper Text Transfer Protocol
ICMP	Internet Control Management Protocol
ICT	Information and Communication Technologies
IP	Internet Protocol
IPTV	Television over Internet Protocol
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
IT	Information Technology
ITSEC	Information Technology SECurity
IVR	Interactive Voice Response
KPI	Key Performance Indicator
KQI	Key Quality Indicator
MMS	Multimedia Message Service
MMSC	Multimedia Messaging Service Centre
MO	Mobile Originate
MOS	Mean Opinion Score
MT	Mobile Terminate
OR	Opinion Rating
PABX	Private Automatic Branch eXchange
PDD	Post Dialling Delay
PI	Preliminary Information
PoP	Point of Presence
POTS	Plain Old Telephony Service
PSTN	Public Switched Telephone Network
PTN	Private Telecommunications Networks
QoS	Quality of Service
RFC	Request For Comment
SDS	Short Data Service
SLA	Service Level Agreement
SLO	Service Level Objective
SMS	Short Message Service
SP	Service Provider
ST-MOS	Listen Speech Quality Stability
TV	Television
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
WGR	WAP Get Request

4 QoS methodology implementation

To implement the methodology detailed in clause 6 of ETSI EG 202 009-1 [i.11], the process consists first in defining carefully the intended service, including its conditions of use and service level range, then to check for each step of the customer relationship course and each QoS criterion what are the best suited metrics and indicators to express the user's requirements and to monitor these indicators appropriately. When this is done for each cell of the ETSI EG 202 009-1 [i.11] matrix, there will probably be too much indicators for a convenient handling, therefore only the most relevant should be taken for publication or to include in a SLA.

Trying to limit drastically the number of indicators may be counter-productive as it gives the provider an incentive to focus on a particular measure, perhaps at the expense of the general QoS. Also trade-offs may be necessary - for example between cost and reliability. Benchmarking, when available, can provide useful support in this aspect. To ensure the best compromise between the number of indicators and their ability to provide an effective assessment of the QoS, it would be helpful to use surveys focusing on users' complaints to identify where are the main non quality issues to adapt the indicator sample accordingly. This indicator selection should be reviewed regularly.

4.1 General principles for the metric and indicator definition

Every technical measurement should keep in with the customer perception (e.g. end-to-end transit time), although suppliers may need to carry out technical measurements (KPI) on particular points to ensure a good customer perceived quality even if these KPI are not directly perceptible to the user.

Some general principles should apply:

- Beware of mean values that gives figures which might be very far from a particular customer feeling.

- Focus on disturbance (should be 0) rather than performance (close to 100 %) even if it is only a presentation issue.

- Use figures that may be aggregated (disturbance rate).

- For QoS targets define thresholds suited to the user perceived QoS.

When reading the present document, anyone should have in mind that a KQI is, in the user language, the translation of a rate, a frequency or any other KPI, in a tangible perception from the user viewpoint. In this context, a KQI may involve more than one KPI. The tables provided in the following clauses endeavour to give guidance on the relevant metrics and indicators for the main electronic communication services and, when available, the corresponding standards. Nevertheless, it should be clear that users can ask for different quality levels for the same service used in different contexts. It is crucial to notice that QoS should always be assessed with regard to thresholds expected matching the current user satisfaction in order to avoid a race to useless performances. Such QoS thresholds may be defined on a case by case basis with, possibly, different requirements for different uses. In any case, the publication of KQI values is expected to help to the users' freedom of choice, making them able to make an informed choice.

KQI for the service behaviour in the service utilization are in many cases service specific while in the other steps of the customer relationship course they are often common to most services. Therefore to ease the reading, the definitions of QoS metrics and indicators are split in two parts: those related to the operational aspects (Service utilization) and those related to the other aspects of the service: sales, provision, alteration, upgrade, commercial and technical support, complaint management, repair, charging/billing, network/service management, cessation.

It is important that the following points are made:

- What are the KQI that are pertinent to the particular service?

- How are these to be assessed?

- Who will assess them?

- What are the acceptable assessment procedures (test specification, i.e. ITU-T recommendation, ETSI standard or survey and the frequency of measurement, sample size, confidence limits, etc.)?

- What are the acceptable, nominal service level ranges?

ETSI EG 202 009-1 [i.11] provides guidance on these aspects that have to be specified for any QoS assessment. In the following clauses, tables are given to define the relevant QoS metrics and indicators for a selection of services along the various aspects of the ICT customer relationship course.

Indicators may be assessed by various means: technical measurements performed by the supplier or an independent organization, or a poll of a user panel.

According to users' opinion, in most cases both technical measurements and surveys among users are useful to achieve a realistic assessment of the QoS.

Along with these considerations, the tables in the following clauses will consider various metrics for the QoS, seeking to identify a set of measures that are expected to form the basis for judging the performance of the supplier from the point of view of the consumers or business users. In this area the statistical quality is crucial to the credibility of the results and should be given for most if not all of these measurements.

In these tables, the metric gives an expression of a criterion from the user viewpoint and relevant to his dashboard. Indicators are used to give a quantifiable value allowing for the appraisal of the quality of a given service.

These tables are built on the basis of two general principles:

1)   It is crucial, to avoid misunderstanding, that the metric and indicators to measure the QoS can be used and managed by both the users and the providers, even if these metrics are viewed from different perspectives.

2)   Theoretically, at least one KPI is necessary for an actual evaluation of each criterion and all the criteria are needed for a comprehensive QoS appraisal of a given service aspect. The context for KQI is somewhat different as a KQI may involve more than one criterion. The tables are built on the principle that all the criteria are involved in at least one KQI. Nevertheless, as explained earlier, for practical reasons, a reduced set of carefully selected indicators may be used for an efficient QoS monitoring.

Hence, each table shows, for each KQI, the metrics and the related indicator definitions. In addition, for each indicator, the last column shows which type of measurement is appropriate.

As indicated earlier in this clause, the indicators given in these tables often refer to standards that provide additional information about how the measurements should be performed and who is expected to perform and provide them. Any one intending to assess QoS is invited to carefully read them. When there is no standard available to define appropriate metrics and/or indicators, definitions are nevertheless proposed to compensate for the lack of such standard.

Since the previous version, a lot of efforts have been made to make available new standards for the assessment of KQI. Not necessarily all the indicators defined in the standards are listed in clauses 5 and 6 tables but only those considered as the most relevant to the users. In addition, it is to the organization using the present document to choose among these indicators those that are appropriate to the particular situation to assess.

4.2   QoS requirements vs service element

Since nowadays, most services are in fact a service make-up, it is crucial before intending to assess the QoS of a service (behaviour), to describe what the service is intended for, what are the conditions of use, what are the service elements included, etc. In particular, for the GSM, UMTS, GPRS and ADSL services, the areas where the service is offered should be specified.

Therefore, since the tables dealing with the indicators for the technical quality are service specific, the definition of the functionality of the intended service is given at the beginning of the table.

In some cases, options can be bought to gain extended service features, e.g. flexible performances, high availability, etc. These particular issues should be considered as service elements which can have their own QoS checking process and might even impact the overall QoS. The QoS assessment of these specific service elements are tackled in the next clauses.

4.2.1   Flexibility

Once the contract signed, it can be more or less easy to adjust some service settings according to the evolution of the user needs without change in the main features of the service. This is why, according to the matrix provided in table 2 of clause 6.1 of ETSI EG 202 009-1 [i.11], such aspect of the flexibility is considered as a QoS requirement to be assessed for each customer relationship step.

Nevertheless, in some other cases, the customer may wish to have the service features matching in real time the requirements of particular type of use of the service. In such case, the flexibility can be considered as a service element and therefore its QoS having to be analyzed with its own QoS checking process i.e. with regard to the criteria of availability, integrity, time, capacity, etc.

Clause 7.2 is dedicated to the flexibility as service elements related to the service utilization, such as (re)configuration and (re)provisioning.

4.2.2   Usability

Usability represents effectiveness, efficiency and satisfaction with which specified users can achieve specified goals (tasks) in a particular environment with respect to the user profile.

As a first step the usability is considered as a QoS requirement to be assessed for each customer relationship step.

In a second time service elements such as transcoder, web browser could be defined.

4.2.3   Security

Security, data protection, privacy are key user concerns that have to be assessed for each customer relationship step. In this context, according to ITSEC [i.35] IT security embraces multiple aspects that are detailed in clause 6 of Part 1 with several service elements to achieve each of them.

Since, according to the matrix in table 2 of clause 6.1 of ETSI EG 202 009-1 [i.11], the present document is intended to identify how the means available to assess the KPI can help to check that the provider contractual commitments are met, all the security sections in clauses 5 and 6 are endeavouring to identify the KQI related to the key security objectives defined according to the guidances provided in clause 6.1 of ETSI EG 202 009-1 [i.11]. In addition, if needed, security can be assessed as a particular service element with regard to the QoS criteria and its impact on the overall QoS of any step of the customer relationship course but particularly the operational ones. The clause 7.1 is dedicated to the specific QoS criteria related to this security service element.

5   QoS metrics and indicators for the service behaviour in the service utilization

It is very important to notice that the tables in this clause are intended to be focused on the services and to be technology agnostic: being user oriented, the metric should be the same whatever the technology of the bearer network. The differences due to differing technologies are expected to appear in the results, the presentation of them taking possibly account of the communication path. These does not mean that a breakdown of the results according to the technology or to the type of contract is irrelevant. Therefore, when the QoS assessment is expected to provide for a comparison between the QoS achieved by several providers, a particular care should be given to the composition of the test sample for each of them. Particularly when IP technology is used to provide the service, location, type of contract and specification of the set-top-box of each sample item should be carefully selected to ensure the measurements actually represent the QoS provided.

The services listed here are drawn from Recommendation ITU-T G.1010 [i.1] with some changes to take into account the current market situation. The definition of the function achieved by each of them is given in the first sentence of the related clause. Some services have usually several components and, when appropriate, indicators for each of such components are identified separately in the list of the service indicators. Due to time and resource constraints, QoS metrics and indicators are not available yet for all these services. As mentioned in clause 5.13, other services could be provided in a later edition.

The methodology can be used to monitor the compliance of a provision to the provider commitments as well as a performance assessment without any reference, for example in the intention to provide comparative information to a prospect in order to help him to choose the offer best suited to his wishes.

It is worth noting that the reference to formal standards is crucial to the reliability of the results and to enable comparisons between providers. On the other hand, the targets to meet are related to a contractual approach between the provider and the regulator or between the provider and his customers.