

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



Reference

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Foreword

This ETSI Guide (EG) has been produced by ETSI User Group (USER), and is now submitted for the ETSI standards Membership Approval Procedure.

During the editing process, among other contributions, excerpts of the final report of Bannock Consulting's project for the European Commission's DG Information Society have been introduced.

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 parameters relevant to the users";

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

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

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 because of both the dispersion of the test and the size of the sample to be tested;
- b) a second level is related to the service provision 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;
- 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).

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 what is meant as a failure: total failure, poor performance, backup situation, etc.

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 parameter all the time might be very expensive and can even jeopardize the network performances. It is often cheaper to get some of them via a poll. In addition, a third party can usefully 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 questions of which indicators are to be monitored from the users point of view and which values they should meet are 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 indicator values from the user point of view;
- b) the pertinent performance or quality criteria with reference to the above indicator values;
- c) the methods to acquire the indicator values needed to measure the performance or 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 is 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 from the functional criteria, then translated into technical criteria. This means that different performance parameters may be used to quantify and monitor the quality, depending on those that are relevant for the technology used.

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. EG 202 009-1 [24] gives guidance in using such standards to identify the indicators relevant from the user point of view, in particular to be used in a Service Level Agreements (SLA). The present document intends to define user related service specific QoS parameters while EG 202 009-3 [25] proposes a template for a SLA dealing with all service aspects, including penalties, escalation procedures, areas of responsibility, etc.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.

[1] ITU-T Recommendation E.721: "Network grade of service parameters and target values for circuit-switched services in the evolving ISDN".

[2] ITU-T Recommendation E.800: "Terms and definitions related to quality of service and network performance including dependability".

[3] ITU-T Recommendation G.107: "The E-Model, a computational model for use in transmission planning".

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

- [5] ITU-T Recommendation G.111: "Loudness ratings (LRs) in an international connection".
- [6] ITU-T Recommendation G.121: "Loudness ratings (LRs) of national systems".
- [7] ITU-T Recommendation I.430: "Basic user-network interface - Layer 1 specification".
- [8] ITU-T Recommendation I.431: "Primary rate user-network interface - Layer 1 specification".
- [9] ITU-T Recommendation P.64: "Determination of sensitivity/frequency characteristics of local telephone systems".
- [10] ITU-T Recommendation P.76: "Determination of loudness ratings; fundamental principles".
- [11] ITU-T Recommendation P.79: "Calculation of loudness ratings for telephone sets".
- [12] ITU-T Recommendation P.800 (1996): "Methods for subjective determination of transmission quality".
- [13] ITU-T Recommendation O.172: "Jitter and wander measuring equipment for digital systems which are based on the synchronous digital hierarchy (SDH)".
- [14] ITU-T Recommendation V.90 (1996): "A digital modem and analogue modem pair for use on the Public Switched Telephone Network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream".
- [15] ETSI ETR 003: "Network Aspects (NA); General aspects of Quality of Service (QoS) and Network Performance (NP)".
- [16] ETSI ETR 138: "Network Aspects (NA); Quality of service indicators for Open Network Provision (ONP) of voice telephony and Integrated Services Digital Network (ISDN)".
- [17] ETSI EG 201 769-1: "Speech Processing, Transmission and Quality Aspects (STQ); QoS parameter definitions and measurements; Part 1: Parameters for voice telephony service required under the ONP Voice Telephony Directive 98/10/EC".
- [18] ETSI TR 101 329-1: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); End to End Quality of Service in TIPHON Systems; Part 1: General aspects of Quality of Service (QoS)".
- [19] ETSI TR 121 905: "Universal Mobile Telecommunications System (UMTS); Vocabulary for 3GPP Specifications (3G TR 21.905 version 3.0.0 Release 1999)".
- [20] ETSI TS 101 113: "Digital cellular telecommunications system (Phase 2+) (GSM); General Packet Radio Service (GPRS); Service description; Stage 1 (GSM 02.60 version 7.5.0 Release 1998)".
- [21] ETSI TS 101 329-2: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; End-to-end Quality of Service in TIPHON Systems; Part 2: Definition of Speech Quality of Service (QoS) Classes".
- [22] ETSI TS 101 329-5: "Telecommunications and Internet protocol Harmonization Over Networks (TIPHON) Release 4; Technology Compliance Specification; Part 5: Quality of Service (QoS) measurement methodologies".
- [23] Directive 98/10/EC of the European Parliament and of the Council of 26 February 1998 on the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment. (article 12 & annex III).
- [24] ETSI EG 202 009-1: "User Group (USER); Quality of Telecom Services; Part 1: Methodology for Identification of Parameters relevant to the Users".
- [25] ETSI EG 202 009-3: "User Group (USER); Quality of Telecom Services; Part 3: Service Level Agreements Template".
- [26] ITU-T Recommendation G.108: "Application of the E-model: A planning guide".

3 Definitions and abbreviations

3.1 Definitions

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

advantage factor A: represents an "advantage of access" which certain systems may provide in comparison to conventional systems

NOTE: Examples of such advantages are cordless and mobile systems or connections into hard-to-reach regions via multi satellite hops. The use and the amount of the advantage factor A fall into the responsibility of the individual transmission planner and are for further study (see TS 101 329-5 [22]).

assurance: knowledge and courtesy of employees and their ability to convey trust and confidence

empathy in the supplier-customer interface: degree of caring and individual attention provided to customers

call: logical association between two or more endpoints, offering the possibility to make use of a telecommunication service (see TR 121 905)

Call Detail Record (CDR): formatted collection of information about a chargeable event (e.g. time of call set-up, duration of the call, amount of data transferred, etc) for use in billing and accounting

NOTE: For each party to be charged for parts of or all charges of a chargeable event a separate CDR should be generated, i.e. more than one CDR may be generated for a single chargeable event, e.g. because of its long duration, or because more than one charged party is to be charged (see TR 121 905 [19]).

call set up time: period starting when the address information required for setting up a call is received by the network (e.g. recognized on the calling user's access line) and finishing when the called party busy tone or ringing tone or answer signal is received by the calling party (e.g. recognized on the calling user's access line) (see ETR 138).

NOTE: In some standards, Post Dialing Delay (PDD) is used instead of call set up time. See the definition below (TS 101 329-5 [22]).

Circuit Loudness Rating (CLR): loudness loss between two electrical interfaces in a connection or circuit, each interface terminated by its nominal impedance which may be complex

NOTE: This is 0 for a digital circuit, 0,5 for a mixed analogue/digital circuit (TR 101 329-1 [18]).

connection: connection provides for transfer of information between endpoints (see ITU-T Recommendation I.113-504 modified)

connection set up time: time between end of dialling and start of display of the first screen of a web page

defect: limited interruption of the ability of an item to perform a required function

NOTE: It may or may not lead to maintenance actions depending on the results of additional analysis (see ITU-T Recommendation I.113-601).

fault: inability of an item to perform a required function, excluding that inability due to preventive maintenance, lack of external resources, or planned actions (ITU-T Recommendation I.113-603)

function: set of processes defined for the purpose of achieving a specified objective (see ITU-T Recommendation I.112-403).

NOTE: Functions may be ordered in a logical hierarchy.

jitter: Functional description for measuring output jitter at a digital interface can be found in ITU-T Recommendation O.172.

Loudness Rating (LR): loudness rating is an (LR) objective measure of the loudness loss, i.e. a weighted, electro-acoustic loss between certain interfaces in the telephone network

NOTE 1: If the circuit between the interfaces is subdivided into sections, the sum of the individual section LRs is equal to the total LR. In loudness rating contexts, the subscribers are represented from a measuring point of view by an artificial mouth and an artificial ear respectively, both being accurately specified (ITU-T Recommendation G.111 [5], TR 101 329-1 [18]).

NOTE 2: As used in the G-Series Recommendations for planning.

Mean Opinion Score (MOS): Panel of a sufficient number of users or observers are asked to give their opinion on the quality of a service amongst the following score (5 to 1): Excellent, High, Fair, Poor, Bad. The MOS is the mean value of these scores

NOTE: This score when applied to voice telephony is evaluated according to the effort required to understand the meanings of group of sentences:

- Excellent: Complete relaxation possible; no effort required.
- High: Attention necessary; no appreciable effort required.
- Fair: Moderate effort required.
- Poor: Considerable effort required.
- Bad: No meaning understood with any feasible effort.

An assessment about the quality of service can also be obtained by calculating the percentage of all test persons rating the configuration as "Good or Better" or as "Poor or Worse". For a given connection these results are expressed as "Percentage GOOD or BETTER" (GoB) and "Percentage POOR or WORSE" (PoW).

When speech samples of good quality are evaluated, *degradation mean opinion scores* (DMOS) may be more suitable where:

- Excellent: Degradation is inaudible.
- High: Degradation is audible but not annoying.
- Fair: Degradation is slightly annoying.
- Poor: Degradation is annoying.
- Bad: Degradation is very annoying.
- Every detail on how to perform these measurements is given in ITU-T Recommendation P.800 [12].

overall transmission quality rating (R): full acoustic-to-acoustic (mouth to ear) quality, experienced by an average user, for a typical situation using a "standard" telephony handset

NOTE: The overall transmission quality rating is calculated using the E-Model (see ITU-T Recommendation G.107 [3]). The relation between overall transmission quality rating (R) and user perception of quality is defined in ITU-T Recommendation G.109 [4].

Post Dialing Delay (PDD): time in milliseconds between dialling the last digit and an audible tone being heard at the originating end

NOTE 1: The audible tone is typically ring-back or the engaged tone (ITU-T Recommendation E.721 [1], TS 101 329-5 [22]).

NOTE 2: Some systems have shown to present the user with a ring-back tone before a connection has been established, this gives the impression that the PDD is low. If the connection fails this is later switched to an engaged tone. This is an unacceptable operation and should be tested.

Quality of Service (QoS): collective effect of service performance which determines the degree of satisfaction of a user of the service (see ITU-T Recommendation E.800).

NOTE 1: The quality of service is characterized by the combined aspects of service support performance, service operability performance, serviceability performance, service security performance and other factors specific to each service. The term "quality of service" is not used to express a degree of excellence in a comparative sense nor is it used in a quantitative sense for technical evaluations. In these cases a qualifying adjective (modifier) should be used.

NOTE 2: Complementary definition on QoS requirements of the user/customer, QoS offered by service provider, QoS achieved by service provider, QoS perceived by the user/customer are given in ETR 003 [15].

Receiving Loudness Rating (RLR): loudness loss between an electric interface in the network and the listening subscriber's ear (from ITU-T Recommendation G.111)

NOTE: The loudness loss is here defined as the weighted (dB) average of driving e.m.f to measured sound pressure. The weighted mean value for ITU-T Recommendations G.111 and G.121 is 1 to 6 in the short term, 1 to 3 in the long term. The rating methodology is described in ITU-T Recommendations P.64, P.76 and P.79.

reliability in the supplier-customer interface: ability to provide what was promised, dependably and accurately

response time for operator services: duration from the instant when the address information required for setting up a call is received by the network (e.g. recognized on the calling user's access line) to the instant the human operator answers the calling user to provide the service requested

NOTE 1: Services provided wholly automatically, e.g. by voice response systems are excluded (ETR 138 [16] and EG 201 769-1 [17]). The services covered are the services for operator controlled and assisted calls that are accessed with special access codes. Access to emergency services is excluded.

NOTE 2: The period in this definition includes waiting times because operators are busy, and times for going through voice response systems to reach the operator. However it excludes the handling of the call by the operator, e.g. conversation with the operator. The reasons are that the variety of calls to operators is too wide and that it is too difficult/costly in practice to measure the operator's performance precisely.

response time for directory enquiry services: duration from the instant when the address information required for setting up a call is received by the network (e.g. recognized on the calling user's access line) to the instant the human operator or an equivalent voice-activated response system answers the calling user to provide the number information requested (TR 121 905)

responsiveness in the supplier-customer interface: willingness to help customers and provide prompt services

service provider: organization that offers a telecommunication service to the customer and/or user

NOTE 1: A service provider needs not to be a network operator (EG 201 769-1 [17]).

NOTE 2: A service provider that is subject to the requirements of the ONP Voice Telephony Directive will in most cases also be a network operator.

Sending Loudness Rating (SLR): loudness loss between the speaking subscriber's mouth and an electric interface in the network (from ITU-T Recommendation G.111)

NOTE: The loudness loss is here defined as the weighted (dB) average of driving sound pressure to measured voltage. The weighted mean value for ITU-T Recommendations G.111 and G.121 is 7 to 15 in the short term, 7 to 9 in the long term. The rating methodology is described in ITU-T Recommendations P.64, P.76 and P.79.

Terminal Equipment (TE): functional group on the user side of a user-network interface (see ITU-T Recommendation I.112-417)

NOTE: In ITU-T Recommendation I.430 [7] and I.431 [8], "TE" is used to indicate terminal terminating layer 1 aspects of TE1, TA and NT2 functional groups.

time to connect: time between the end of dialling and ringing or lift up or busy tone

user: individuals, including consumers, or organizations using or requesting publicly available telecommunications services (copied from Directive 98/10/EC)

3.2 Abbreviations

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

CDR	Call Detail Record
CLR	Circuit Loudness Rating
DMOS	Degradation Mean Opinion Score
ISP	Internet Service Provider
LR	Loudness Rating
MOS	Mean opinion Score
PDD	Post Dialling Delay
POTS	Plain Old Telephony Service
PSQM	Perceptual Speech Quality Measurement
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RLR	Receiving Loudness Rating
SLA	Service Level Agreement
SLR	Sending Loudness Rating
TE	Terminal Equipment

4 Criteria related measurements

Every technical measurement should keep in with the customer perception and criteria (e.g. end-to-end transit time), although suppliers may need to carry out specific technical measurements to ensure the customer perceived quality.

Some general principles should apply:

- Beware of mean values that gives figures which might be very far from the customer feeling;
- Focus on disturbance (should be 0) rather than performance (close to 100 %);
- Use figures that may be consolidated (disturbance rate);
- For required time define thresholds relevant to the aim.

The following tables endeavour to give guidance for several communication types and the related thresholds as well as, where appropriate, the corresponding standards. Nevertheless, it should be clear that users can ask for different quality levels for the same service used in different contexts. Therefore thresholds have to be defined on a case by case basis with possibly, different requirements in the same SLA for different uses.

Performance criteria are in many cases service specific. Therefore it is important that in a SLA the following points are made:

- what are the performance criteria that are pertinent to the particular service?
- what are the acceptable range of performance?
- how are these to be measured?
- who will measure it?
- what are the acceptable measuring procedures (test specification, i.e. ITU-T recommendation, or ETSI standard and the frequency of measurement, sample size, confidence limits, etc).

Several tables are given to take into account the various aspects of the communication quality: Voice communications (fixed and mobile), Internet connection, Data communications to client server applications, service break-out, customer support and other provisions.

The indicators may have various origins: technical measurements performed by the supplier or an independent organization, or poll of a user panel. It is to the involved parties to decide which are the most appropriate on a case by case basis.

It is users' opinion that in most cases both technical measurements and surveys among users are useful to draw a realistic picture of the QoS.

Therefore, the Total Quality Management process used in many organizations for internal uses should be extended to the customers. Supplier's own ISO 9000 auditors could conduct random sample reviews when conducting ISO reviews and that they express an opinion on how effectively their operator measurements comply. Incidentally, such survey could include open area to detect unforeseen quality issues.

Trying to limit the number of parameters may be counter-productive as it gives the provider an incentive to focus on a particular measure, perhaps at the expense of general QoS. There will also be trade-offs between certain measures - for example between cost and reliability of service. Benchmarking, when available, can provide useful support in this aspect, both in defining the reference values and as an indicator value.

Along with these considerations the following tables will consider various parameters for QoS, seeking to identify a set of measures that may most usefully form the basis for judging the performance of the supplier from the point of view of the consumer or SME. 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.

Table 1: Voice communications over the world-wide telephone network

Criterion	Definition	Threshold (PSTN) (≠ depending on the type of access)	Measurement method
Call set up time	Time between the end of dialling and ringing or lift up or busy tone.	<ul style="list-style-type: none"> – 5 s to 6 s for national calls – 8 s to 12 s for international calls depending on the destination. 	Number of calls above the threshold or call set-up time for 95 % of the communications. External survey Call Detail Record (CDR) (beware differences between signalling time and time perceived by the caller). Relevant standards: [15], [16], [17], [19], [21] and [22]
Call failures	All rejected calls due to any kind of error, unavailability of network resources, congestion, time out, etc.	All failures are counted except as for call set up time, no answer or busy terminal.	External survey Call Detail Record (beware of not detected failures or with a wrong code) Relevant standards: [15], [16] and [17]
Interruptions (dropouts)	Interruptions due to the network	During a standard duration of the communication (e.g. 2 minutes)	External survey (mobiles or voice over IP) Indirect measurements carried out internally. Relevant standards: [15] and [16]
Speech quality	Absence of hindering disturbance	Quality classes have to be defined: Bad Poor Fair High Excellent ([21] uses a single category "Best effort" instead of the 2 "Bad" and "Poor" ones).	The overall transmission quality rating (R) provides objectives indications on the quality classes. External survey (PSQM) Internal measurement with probe monitoring non intrusive traffic Relevant standards: [1], [3], [4], [15], [16], [17], [18], [19], [21] and [22]
NOTE: Time tolerances should be measured on well defined timeslots (to be defined on a case by case basis).			

Table 1A: Addendum to table 1 for Mobile communications

Criterion	Definition	Threshold	Measurement method
Interruptions (dropouts)	Interruptions due to the network. For mobile communications There could be instances where network resources cannot reasonably be provided e.g. a train passing through a long tunnel. The limitations and exclusions for these conditions ought to be clearly specified.	Drop out classes have to be defined: Bad (more than 10 % of communications) Poor (5 % to 10 %) Fair (2,5 % to 5 %) High (1 % to 2,5 %) Excellent (less than 1 %)	Measurement to be performed during a standard duration of the communication (e.g. 2 m) and in real conditions, e.g. with handover and roaming.
Coverage	It could be based on geographical coverage or population. - Mobility by cellular network in a building. - Mobility in a geographical area or moving in a vehicle. - Access to hard to reach locality (e.g. via satellite connections).	Advantage factor is defined in ITU-T Recommendation G.108 [22]	To be further elaborated.
Speech quality	As in table 2 but measurements are to be carried out for: - Mobile to land line termination, - Mobile to mobile termination, - Land to mobile termination. In every case, the speech quality should be measured in both directions. - Mobility by cellular network in a building - Mobility in a geographical area or moving in a vehicle - Access to hard to reach locality (e.g. via satellite connections).	As in table 2. Application of the Advantage factor is defined in ITU-T Recommendation G.108 [22].	As in table 2. Measurement methods are defined in ITU-T Recommendation G.108 [22].
Data speed	Average and standard deviation of data transfer rates actually achieved.	To be defined according to the standard of the connection.	To be further elaborated.
Quality of Data transmission	- user data throughput; - radio channel access delay; - round-trip-MS/PLMN delay; and - reliability.	According to the application	Relevant standards: [20]

NOTE: This table will be updated as soon as the results of the STQ Ad-Hoc Group on mobile QoS are available.

Table 2A: Internet Connection via an ISP - Ability to connect

Criterion	Definition	Threshold (PSTN) (≠ depending on type of access, day and hour)	Measurement method
Number of attempts required to achieve connection	The average of and variation in the number of attempts the user has to make before successfully connecting to the ISP.	Ideally, connection would be achieved first time, every time, so both the average and the variation should be low.	External survey (see note 2). Internal: network + handshake + login + access to the ISP home page. Reference: [15] (see note 3)
Time to connect	The average of and variation in the time taken to establish a connection and log on to the ISP server	Around 10 s to 30 s according to the connection technology.	External survey (see note 2). Internal: network + handshake + login + access to the ISP home page. Reference: [15] (see note 3)
Time to connect during the busiest hour of the week.	The average of and variation in the time taken to establish a connection and log on to the ISP server during their busiest hour (i.e. that when the most users are online).	Less than 20 s (40 s could be acceptable in some specific cases)	External survey (note 2). Internal: network + handshake + login + access to the ISP home page. Reference: [15] (see note 3)
Frequency of connection termination Interruptions	Number of times per month the user's connection is terminated for reasons other than their choosing to disconnect.	Zero should be the target. In fact, since there are many reasons for such interruptions, monitoring it is an indication of something being or becoming wrong. Users report experiences of very different results from one to another ISP.	External survey (note 2). Internal? Reference: [15] (see note 3)
Frequency and duration of ISP "outages"	Occurrence and duration of ISP server being unobtainable.	Time out 30 s. HTTP, FTP and mail servers should be checked separately. Namely unavailability < 5 ‰	External survey (note 2). Internal: polling of successful entering calls. Reference: [15] (see note 3)
NOTE 1: Ability to connect depicts how quick and easy it is to connect to the ISP. In case of permanent connection to the ISP, the last criterion should be the only relevant one. Nevertheless, users may have also problems with "permanent" connections at the boot time of their computer.			
NOTE 2: When an external survey is performed it should use as far as possible the measurement method known as "Customer Centric". The above criteria are applicable to mobile Internet access with possible changes in the thresholds.			
NOTE 3: "A methodology to capture users' Quality of Service Requirements", Antony Oodan" (see Bibliography).			

Table 2B: Internet Connection via an ISP - Downstream connectivity

Criterion	Definition	Threshold (PSTN) (≠ depending on type of access, day and hour)	Measurement method
Connection speed achieved	Average and standard deviation of data transfer rates actually achieved.	To be defined according to the standard of the connection.	External survey (see note 4). Reference: [14]
Latency, jitter and packet loss statistics communicating with the ISP	Average and variation in latency, jitter and packet loss (as defined below) when communicating with ISP servers.	To be defined according to the standard of the connection. Namely latency < 30 ms to 100 ms	External survey (see note 4). Internal? Reference: [15] (see note 3).
Speed of download from ISP's server(s)	Average and standard deviation of time to download files from websites hosted by the ISP.	+ 10 to 20 % with respect to the optimal time on the network used.	External survey (see note 4). Internal measurement of the treatment duration. Reference: [15] (see note 3)
Speed of download from ISP's mail-server	Average and standard deviation of time to download a standard-sized attachment from the ISP's mail-server (e.g. 1 megabyte).	To be defined according to the standard of the connection.	External survey (see note 4). Internal measurement of the treatment duration. Reference: [15] (see note 3)
Speed of upload to ISP's mail-server	Average and standard deviation of time to upload files from the ISP's mail-server (e.g. 1 megabyte).	To be defined according to the standard of the connection.	External survey (see note 4). Internal measurement of the treatment duration. Reference: [15] (see note 3)
<p>NOTE 1: Downstream connectivity depicts how quick and reliable the connection between the user and their ISP is.</p> <p>NOTE 2: Latency, jitter and reliability. If you "ping" an Internet host (i.e. measure the duration of a round-trip for a small amount of data – a packet – to another computer):</p> <ul style="list-style-type: none"> - latency refers to how long the trip takes - jitter refers to how much the latency varies, generally between specific source and destination computers. High levels of jitter can cause the server to make very conservative estimates of the speed at which the recipient can download the data, leading to non-efficient use of the network. - reliability refers to how often the data makes it back – it is the converse of "packet loss", which measures how many packets sent out get lost. Packets are deemed to be lost once they have passed through a certain number of routers - typically 255 - without reaching their destination. <p>NOTE 3: "A methodology to capture users' Quality of Service Requirements", Antony Oodan" (see Bibliography).</p> <p>NOTE 4: When an external survey is performed it should use as far as possible the measurement method known as "Customer Centric". The above criteria are applicable to mobile Internet access with possible changes in the thresholds.</p>			

Table 2C: Internet Connection via an ISP - Upstream connectivity

Criterion	Definition	Threshold (PSTN) (≠ depending on type of access, day and hour)	Measurement method
Proportion of packets travelling through the ISP's routers which are lost	The percentage of packets that the ISP sends which are unable to find their destination (are dropped).	Anything above 5 % is unacceptable	These statistics are available from Internet monitoring companies.
Proportion of time which designated sites are unreachable	Proportion of time that designated sites (e.g. for a business its most demanded or business-critical websites – such as its suppliers' websites, or websites used for research, and for indiscriminate users, this could be the top 50 visited websites) are unavailable.	To be defined according to the type of application used.	External survey (see note 2). Internal measurement of the treatment duration. Reference: [15] (see note 3)
Duration of the transmission of the ISP pages	Time between start and end of display of one page.	+ 30 % with respect to the optimal time on the network used.	External survey (see note 2). Internal measurement of the treatment duration. Reference: [15] (see note 3)
Duration of the transmission of any URL	Time between a command and the end of display	+10 % to 20 % with respect to the optimal time on the network used.	External survey (see note 2). Internal measurement of the treatment duration. Reference: [15] (see note 3)
NOTE 1: Upstream connectivity depicts how quick and reliable the connection between their ISP and the rest of the Internet is.			
NOTE 2: When an external survey is performed it should use as far as possible the measurement method known as "Customer Centric". The above criteria are applicable to mobile Internet access with possible changes in the thresholds.			
NOTE 3: "A methodology to capture users' Quality of Service Requirements", Antony Oodan" (see Bibliography).			

Table 3: Data communications to client-server applications

Criterion	Definition	Threshold (≠ depending on type of access, day and hour)	Measurement method
Connection failures	Failure to connect to the server whatever the cause.	Time out 40 s	At the terminal level: failure of a connection request. Reference: [15] (see note 2)
Time to set up the connection	Time between end of dialling and start of display of the first page.	20 s	At the terminal level: time between a connection request and the answer. Reference: [15] (see note 2)
Response time	Time between entry and feedback	Figure to be defined in the absolute	At the terminal level: Time between entry and feedback Internal measurement of the transit time. Reference: [15] (see note 2)
Duration of the transmission of data between the server and the terminal	Time between start and end of display of one page.	% to be defined with respect to the optimal transmission on the network used on standard transactions.	At the terminal level: Time between start and end of display of one page. Internal measurement of the transmission time. Measurement of the data flow Reference: [15] (see note 2)
Interruptions	Interruptions without any request of the user.	All	At the terminal level: internal measurement of interruptions. Reference: [15] (see note 2)
Errors or lacks in transmitted pages	Incomplete or altered data content.	Although users report that such disturbances are very rare, monitoring such occurrence is a good means to detect dysfunction.	External measurement? Internal measurement? Reference: [15] (see note 2)

NOTE 1: In case of permanent connection to the server, the last criterion should be the only relevant one. Even if such a case is widely spread among big companies, switched connection is of particular interest to business users on the move, SME and SOHO.

NOTE 2: "A methodology to capture users' Quality of Service Requirements", Antony Oodan" (see Bibliography).

Table 4: Service outage

Criterion	Definition	Threshold (≠ depending on type of service, day and hour)	Measurement method
Total duration by period	Total sum by agreed period of time (day, week, month, year)	Different thresholds should be defined according to the kind of period (time of the day, peak hour, day of the week, of the month, etc.)	As far as possible, the volume of disturbed traffic should be measured. Relevant standards: [15]
Duration by outage	Time elapsed between the identification by the user and comeback on duty.	Different thresholds should be defined according to the kind of period (time of the day, peak hour, day of the week, of the month, etc.)	Relevant standards: [15]
Frequency	Number of outages by period	One threshold should be defined for each period	Relevant standards: [15]

Table 5: Customer Support

Criterion	Definition	Threshold (≠ depending on type of service, day and hour)	Measurement method
Accessibility	Call not treated during open hours.	All	External survey. Information from switchboard (PABX). Reference: [15] (see note)
Swiftness in answering the call	Time between end of dialling and obtaining the called person.	20 s to 30 s	External survey. Information from switchboard (PABX). Reference: [15] (see note)
Swiftness in processing the request	Time between expressing the request and obtaining an answer deemed relevant.	MOS high or better	Survey Reference: [15] (see note)
Reliability	The ability to provide what was promised, dependably and accurately.	MOS high or better	Survey Reference: [15] (clause A.3)
Assurance	The knowledge and courtesy of employees and their ability to convey trust and confidence.	MOS high or better	Survey Reference: [15] (clause A.3)
Empathy	The degree of caring and individual attention provided to customers.	MOS high or better	Survey Reference: [15] (clause A.3)
Responsiveness	The willingness to help customers and provide prompt services.	MOS high or better	Survey Reference: [15] (clause A.3)

NOTE: "A methodology to capture users' Quality of Service Requirements", Antony Oodan" (see Bibliography).

Table 6: Other services provided

Domain	Parameter	Measurement
Provision of access	Time elapsed between the request and the completion of the connection	Time elapsed in days in 95 % of the cases Time elapsed in days in 99 % of the cases Number of delay with respect of the contractual time in percentage.
	Timeliness in appointments	Number of delays in appointments with respect to a defined threshold in percentage.
	Open hours	?
		Reference: [15] (see note)
Access to the provider services	Time to answer	Rate of answers beyond 20 s Reference: [15] (see note)
Access to the directory services	Time to answer	Rate of answers beyond 20 s Reference: [15] (see note)
Billing	Claims on the amount of bills	Rate of claims per point of billing per year Reference: [15] (see note)
	Accuracy (counting and tariff)	Survey Reference: [15] (see note)

NOTE: "A methodology to capture users' Quality of Service Requirements", Antony Oodan" (see Bibliography).

5 Specific aspects of the private users' criteria

Unlike business users measurements, private users related ones are expected to be made publicly available and not to be checked with respect to any SLA.

Since private users have to rely on publicly available QoS information, the way the QoS measurements are performed and results made available is obviously a regulatory issue.

The following tables summarize which information is expected by the private users with the aim to propose tracks to the regulators and standard makers in this area. In particular, specific values of thresholds are given where appropriate. In general, these thresholds should be taken as guidance when choosing the most suited supplier unless a regulatory target is defined.

As a general principle, survey and MoS should be carried out among a panel of private users. As well it would be useful to make available QoS indicators in the various timeframes, e.g. business hours, busiest business hours, evening, etc.

Table 7: Specific aspects of private users on voice communications

Criterion	Specific aspects
Call set up time	Nothing specific with respect to other PSTN users. Measuring the time for 95 % of the communications is probably the most appropriate indicator. Survey or monitoring by a third party is probably the best suited means to get the statistics.
Call failures	
Interruptions (dropouts)	
Speech quality	

Table 7A: Specific aspects of private users on mobile communications

Criterion	Specific aspects
Coverage	Nothing specific except that private users might be almost everywhere and not only in the busiest areas
Speech quality	

Table 8A: Specific aspects of private users on Internet connection - Ability to connect

Criterion	Specific aspects
Number of attempts required to achieve connection	Nothing specific with respect to other PSTN users
Time to connect	Nothing specific with respect to other PSTN users
Time to connect during the busiest hour of the week	In a private user perspective, busiest hour should be understood in the timeframe where private users use Internet
Frequency of connection termination - Interruptions	Nothing specific with respect to other PSTN users
Frequency and duration of ISP "outages"	The timeframe of the outage occurrence is particularly relevant (to be related to the time where users are surfing on Internet at home, possibly during the night!).

Table 8B: Specific aspects of private users on Internet connection – Downstream connectivity

Criterion	Specific aspects
Connection speed achieved	Nothing specific with respect to other PSTN users
Latency, jitter and packet loss statistics communicating with the ISP	This indicator is likely irrelevant for private users
Speed of download from ISP's server(s)	Nothing specific
Speed of download from ISP's mail-server	Nothing specific
Speed of upload to ISP's mail-server	Nothing specific

Table 8C: Specific aspects of private users on Internet connection – Upstream connectivity

Criterion	Specific aspects
Proportion of packets travelling through the ISP's routers which are lost	Nothing specific
Proportion of time which designated sites are unreachable	Nothing specific, considering that designated sites should be the Top 50 sites elected by a panel of private users
Duration of the transmission of the ISP pages	Nothing specific
Duration of the transmission of any URL	Nothing specific

Table 9: Specific aspects of private users on data communications to client-server applications

Criterion	Specific aspects
Connection failures	Nothing specific with respect to other PSTN users
Time to set up the connection	Nothing specific with respect to other PSTN users
Response time	Nothing specific
Duration of the transmission of data between the server and the terminal	Nothing specific
Interruptions	Nothing specific
Errors or lacks in transmitted pages	Nothing specific

Table 10: Specific aspects of private users on service break-out

Criterion	Specific aspects
Total duration by period	Nothing specific, although the timeframe for the calculation should be defined or weighted according to the private use. This could be completed by some awards (e.g. top 10).
Duration by outage	
Frequency	

Table 11: Specific aspects of private users on customer support

Criterion	Specific aspects
Accessibility	Nothing specific except that since many providers have different call number for business and private users, it is crucial to use the appropriate number.
Swiftness in answering the call	
Swiftness in processing the request	
Reliability	
Assurance	
Empathy	
Responsiveness	

Table 12: Specific aspects of private users on other services provided

Criterion	Specific aspects	
Provision of access	Time elapsed between the request and the completion of the connection.	Nothing specific
	Timeliness in appointments	Private users are particularly interested in getting appointments in a narrow timeslot
	Open hours	Private users are particularly interested in open hours over a wide timeslot
Access to the provider services	Time to answer	Nothing specific
Access to the directory services	Time to answer	
Billing	Claims on the amount of bills	
	Accuracy (counting and tariff)	

6 Conclusion

The ETSI User group hopes the present document provides useful guidance on the users expectations about the QoS to the standard makers, regulators and providers. It is expected also that the users themselves can find here some help, e.g. private users when choosing a provider or business users when establishing an SLA with their favourite provider. EG 202 009-3 [25] is intended to provide useful additional support on this last aspect.

There are obvious lacks at this stage of the document that could hopefully be filled with a further revision. For example, while security is clearly a very important issue, we were unable to find a parameter that objectively measures, in numerical terms, the level of security offered. The situation is the same for content control and SPAM control in the Internet area, particularly in the case of private users.

Regarding the regulatory aspects of QoS, since users have to rely on third party to monitor the QoS either via information made publicly available by the regulators or within a specific private contract with a provider dedicated to QoS, it is of tremendous importance that a focus point be available to the public for such information and trusted parties able to provide QoS specific information.

Annex A (informative): Bibliography

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History

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