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Foreword

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

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).

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

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.

What is at stake is that the user can know and possibly negotiate the targets on which the provider is committed and then to get access to the information enabling him to check whether these commitments are met.

Users should be interested to have some guidance on which targets KQI should reach to ensure a good QoS but at this stage of the work, it was not possible to provide such guidance. This will be for a later revision if the QoS measurement experience has grown enough.

5.1 Audio broadcast - Audiostreaming

Audio broadcast/streaming: A mechanism whereby audio content can be rendered at the same time that it is being transmitted to the client over the data network.

NOTE: The indicator evaluates the quality of audio stream.
In the context of end user evaluation without access to provider network, the assessment method should perform a methodology "without reference".
Speech evaluation methodologies or speech quality assessment models are not appropriate to evaluate audio quality. These methodologies or these models cannot be performed for audio quality evaluation.
In this context the most suitable approach is to determine "audio cut" (or "audio lack") occurrence and low audio level sequence in the audio stream.
This analysis should be performed on the left and right channels, when available.
This indicator could be presented as the number of degradation or in ratio (number of degradation by time unit).
An alternative assessment of the audio quality may be based on subjective tests or surveys by a representative user panel (MOS value).

Availability

Metric	Related indicator definition (KQI)
Rate of server accessibility	Percentage of successful log-ins with respect to the total number of attempts, {**Reference:** Successful log-in ratio; ETSI EG 202 057-4 [i.15]}

Integrity

Metric	Related indicator definition (KQI)
Listening audio loss ratio	Consolidated duration of audible audio cut over one minute listening. {**Reference:** Audio quality; ETSI ES 202 765-4 [i.20], clause 8.4}
Listening audio loss frequency	Number of audible audio cut over one minute listening. {**Reference:** Audio quality; ETSI ES 202 765-4 [i.20], clause 8.4}
Successful one minute listening ratio	Number of continuous listening minutes without audio loss over the required listening time. {**Reference:** Audio quality; ETSI ES 202 765-4 [i.20], clause 8.4}

Time

Metric	Related indicator definition (KQI)
Access time	Time in seconds within the fastest 80 % and 95 % of logins {**Reference:** Login time; ETSI EG 202 057-4 [i.15]}
Media establishment time	Maximum and mean time in seconds between the start order and the beginning of the hearing.
Listening audio break-up ratio	Consolidated duration of audible audio cut over one minute listening. {**Reference:** Audio quality; ETSI ES 202 765-4 [i.20], clause 8.4}
Listening audio break-up frequency	Number of audible audio cut over one minute listening. {**Reference:** Audio quality; ETSI ES 202 765-4 [i.20], clause 8.4}
Successful one minute listening ratio	Number of continuous listening minutes without audio break-up over the required listening time. {**Reference:** Audio quality; ETSI ES 202 765-4 [i.20], clause 8.4}

Capacity

Metric	Related indicator definition (KQI)
Throughput of the application achieved	Ratio of the data bit-rate provided compared to the contractual commitment.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the audio broadcast service {**References: P9** Number of customer complaints per data collection period; ETSI ES 202 057-1 [i.18], **P669**: Number of customer complaints of any kind [Number]; ETSI EG 202 843 [i.16]}

Flexibility

Range of available means to access the service (Mobile, fixed, Internet, etc.).

KQI: Assessment of the adjustment capacity by a representative user panel (OR value).

Usability

KQI: Assessment of the user friendliness by a representative user panel (OR value).

Security

KQI: Efficiency and robustness of the authentication (Certificate from an entitled body).
Efficiency and robustness of the protection mechanism (Certificate from an entitled body).

5.2 Directory enquiry services

Directory enquiry services: operator or machine based service intended to provide information on phone number, addresses or e-mail addresses of people or organizations on user request.

This service is currently more and more often replaced by on line information. It has been left in the present document without change for historical purpose.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to the service	Number of successful attempts to access an operator with respect to the total number of attempts required over a given period.
Number of outage frequency per data collection period	Number of times the user's connection is terminated for reasons other than their choosing to disconnect by agreed period of time.
Served call rate (provider)	Rate of calls providing the caller with the ability to place his request.

Integrity

Metric	Related indicator definition (KQI)
Rate of correctness in answering the customer questions	Survey.

Time

Metric	Related indicator definition (KQI)
Response time for directory enquiry services	Duration from the dialling to the instant the human operator or an equivalent voice-activated response system answers the calling user: a) mean time to answer; b) percentage of calls answered within 20 seconds. {**Reference: P7** Response time for directory enquiry services; ETSI ES 202 057-1 [i.18]}
Reply time	Period starting when the operator pick-up the receiver until the user has got the expected answer.

Capacity

Metric	Related indicator definition (KQI)
Adequacy of the number of operators to the number of call (provider)	Occupation rate of the operators.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the directory enquiry service {**Reference: P9** Number of customer complaints per data collection period; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: List of available means to access the service (Mobile, fixed, Internet, etc.).

Usability

KQI: Assessment of the user friendliness by a representative user panel (OR value).
Languages taken into account (Survey)

Security

KQI: Robustness of the customer's private data protection mechanism: Certificate from an entitled body.

5.3 E-mail

email: exchange of text files with possible attached files between two terminals via networks and through distant servers where the message can be stored until the recipient download it.

Availability

Metric	Related indicator definition (KQI)
Login Non-Accessibility	Probability that the e-mail client is not able to get access to the e-mail server. **{Reference:** E-mail Login Non-Accessibility [%]; ETSI TS 102 250-2 [i.22]}
End-to-End Failure Ratio	Probability that the complete service usage from the start of e-mail upload at the A-party to the complete e-mail download at the B-party with an e-mail client cannot be completed successfully. This transmission is unsuccessful if the e-mail upload, the header download (if applicable) or the e-mail download fails. **{Reference:** E-mail End-to-End Failure Ratio [%]; ETSI TS 102 250-2 [i.22]}
Notification Push Failure Ratio	Probability that the notification announcement was not successfully conveyed to the receiver party**.** **{Reference:** E-mail Notification Push Failure Ratio [%]; ETSI TS 102 250-2 [i.22]}
Session Failure Ratio	Proportion of unsuccessful sessions vs sessions that were started successfully. {**Reference:** E-mail {Upload|Download} Session Failure Ratio [%]; ETSI TS 102 250-2 [i.22]}

Integrity

Metric	Related indicator definition (KQI)
Data Transfer Cut-off Ratio	Proportion of unsuccessful data transfers vs data transfers that were started successfully. **{Reference:** E-mail {Upload|Header Download|Download} Data Transfer Cut-off Ratio [%]; ETSI TS 102 250-2 [i.22]}

Time

Metric	Related indicator definition (KQI)
Data Transfer Time	The time period from the start to the end of the complete transfer of e-mail content. **{Reference:** E-mail {Upload|Header Download|Download} Data Transfer Time [s]; ETSI TS 102 250-2 [i.22]}
Login Access Time	The time period from starting the login procedure to the point of time when the client is authenticated. **{Reference:** E-mail Login Access Time [s]; ETSI TS 102 250-2 [i.22]}
Notification Push Transfer Time	The time period from starting the notification push to the successful confirmation of the e-mail server of the end of the idle period. **{Reference:** E-mail Notification Push Transfer Time [s]; ETSI TS 102 250-2 [i.22]}

Capacity

Metric	Related indicator definition (KQI)
Mean Data Rate	*"Average data transfer rate measured throughout the entire connect time to the email service. The data transfer shall be successfully terminated."* **{Reference:** E-mail {Upload|Header Download|Download} Mean Data Rate [kbit/s]; ETSI TS 102 250-2 [i.22]}

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the email service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the change ease by a representative user panel (OR value)
Time to change the mailbox size.

Usability

KQI: Assessment of the user friendliness by a representative user panel (OR value).

Security

KQI: Robustness of the customer's private data protection mechanism: Certificate from an entitled body.

5.4 Fax

Fax service: Telecommunications service of transport of facsimile via the PTN such that any user can use equipment connected to a network termination point to exchange facsimiles with another user of equipment connected to another termination point.

Availability

Metric	Related indicator definition (KQI)
Refer to the telephony service both in terms of availability of the service and availability of the connection.	

Integrity

Metric	Related indicator definition (KQI)
Transmission fidelity test	Recommendation ITU-T T.22 [i.9] test {**Reference:** Test ~5; Recommendation ITU-T T.22 [i.9]}.

Time

Metric	Related indicator definition (KQI)
Page time transmission (time is defined by the terminal available)	Time between the sending of one specific page and the reception of the full page.

Capacity

Metric	Related indicator definition (KQI)
Throughput (Capacity is defined by the terminal available)	Number of pages by time unit

Reliability

Metric	Related indicator definition (KQI)
Successful fax transactions ratio at the highest mutual transmission speed of the send and receive fax machines;	Successful fax transactions ratio at the highest mutual transmission speed of the send and receive fax machines: a) the percentage of successful fax transactions; b) the number of test calls. (Total number effective transactions/ Total number of required observations) × 100 {**Reference:** Fax connection quality; ETSI EG 202 057-2 [i.13]}
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the fax service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: N/A: no change expectable in the service.

Usability

KQI: N/A: aspect linked to the terminal and not to the service.

Security

KQI: Robustness of the customer's private data protection mechanism: Certificate from an entitled body.

5.5 Internet services

Internet access: Making available of facilities and/or services for the purpose of providing an access to the public Internet in order to provide a user with access to services or resources of the Internet.

NOTE 1: The Internet access can be separated in two parts, the physical and the logical access. The physical access provides a connection form the user's premises to, but not including, the PoP (normally a dial-up circuit or broadband link or leased line) whereas the logical access consist of the setting up of an account that later on enables the user by a login process with the ability to access to the services and resources of the Internet (normally by assigning an IP address).

NOTE 2: The physical and logical access may be provided by different service providers.

NOTE 3: The function of the physical access may be provided by several interconnected networks.

Internet access is an example of multicomponents services: it cannot work without authentication and domain name services but it usually also includes other components such as Web browsing (consultation, data transfer), web page hosting, etc. Where appropriate, specific metrics and indicators are defined for such components.

Availability of Internet access

Metric	Related indicator definition (KQI)
Successful log-in ratio	Percentage of successful log-ins with regard to the total attempt number required. {**Reference:** Successful log-in ratio; ETSI EG 202 057-4 [i.15]}
Outage rate	Total sum of access outage durations by agreed period of time. {**Reference:** Duration of ISP outages; Report of Bannock Consulting's [i.28]}
Outage frequency	Number of access outages by agreed period of time {**Reference:** Frequency of ISP outages; Report of Bannock Consulting's [i.28]} Number of times the user's connection is terminated for reasons other than their choosing to disconnect by agreed period of time. {**Reference:** Frequency of connection termination; Report of Bannock Consulting's [i.28]}
Rate of successful access to authentication	Number of successful attempts with respect to the total number of attempts required over a given period (e.g. 100 attempts a day).
Rate of successful access to generic name translation	Number of successful attempts with respect to the total number of attempts required over a given period (including authorized masked servers). {**Reference:** Domain Name System (DNS) performance; CWA14357 [i.25]}
Availability of Internet Access	The probability for a customer that Internet applications are attainable from his Internet access. It denotes the probability for a customer that his Internet access is available. {**Reference:** Availability of Internet Access; ETSI ES 202 765-4 [i.20]}
Unsuccessful FTP Download session Ratio	The ratio of unsuccessful FTP download sessions as a measure of the Internet service accuracy. {**Reference:** Unsuccessful FTP Download session Ratio [%]; ETSI ES 202 765-4 [i.20]}
Unsuccessful FTP Upload session Ratio	The ratio of unsuccessful FTP upload sessions as a measure of the Internet service accuracy. {**Reference:** Unsuccessful FTP Upload session Ratio [%]; ETSI ES 202 765-4 [i.20]}

Availability for Web browsing

Metric	Related indicator definition (KQI)
Outage rate to a set of designated sites	Break-up rate during the consultation of a set of 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. {**Reference:** Proportion of time which designated sites are unreachable. Report of Bannock Consulting's [i.28]}
Availability of a set of web pages hosted by the ISP	Generic scenario availability: Percentage of time a generic scenario ends successfully.
Frequency of untimely break-up during data transfer	Number of untimely break-up during the data transfers over the required period. {Frequency and duration of ISP outages; **Reference:** Report of Bannock Consulting's [i.28]}
Rate of accessibility to the ISP input ports	Number of successful attempts to access the ISP input ports with respect to the total number of attempts required over a given period.
Rate of accessibility to the ISP output ports	Number of successful attempts to access the ISP links with the Internet network with respect to the total number of attempts required over a given period.
Unsuccessful HTTP session Ratio	The ratio of unsuccessful web browsing attempts as a measure of the Internet service accuracy. {**Reference:** Unsuccessful HTTP session Ratio [%]; ETSI ES 202 765-4 [i.20]}

Availability for Web page hosting

Metric	Related indicator definition (KQI)
Rate of accessibility to the allocated space	Number of successful attempts with respect to the total number of attempts required over a given period.

Integrity for Internet access

Metric	Related indicator definition (KQI)
Unsuccessful data transmissions ratio Error	Number of unsuccessful transmissions of a test file due to data alteration with respect to the total number of transmission attempts. {Unsuccessful data transmissions ratio; **Reference:** ETSI EG 202 057-4 [i.15]}

Integrity for Web browsing

Metric	Related indicator definition (KQI)
Rate of packet loss during the consultation	The percentage of packets that the ISP sends which are unable to find their destination (are dropped) during a site consultation. {Packet loss statistics; **Reference:** [i.28]}
Error rate in data transmissions	Number of unsuccessful transmissions of a predefined file due to data alteration with respect to the total number of transmissions attempts during a data transfer. {Unsuccessful data transmissions ratio; **Reference:** ETSI EG 202 057-4 [i.15]}
NOTE: The fidelity failures on authentication or domain name attribution have an impact on availability that cannot be discriminated from other causes by the users.	

Time for Internet access

Metric	Related indicator definition (KQI)
Internet Login Time	End to end measurement of service availability in term of capacity for an Internet customer to access to the Internet. {**References:** Internet Login Time; ETSI EG 202 057-4 [i.15], ETSI ES 202 765-4 [i.20]}
Ping Delay	Half the time in milliseconds, that is needed for an ICMP Echo Request/Reply (Ping) to a valid IP address. This metric indicates the network performance in terms of the transmission parameters (delay and delay variation). (RFC 792 [i.26]). {**References:** Delay (one way transmission time); ETSI EG 202 057-4 [i.15], ETSI ES 202 765-4 [i.20]}
Radio channel access delay (mobiles)	round-trip-MS/PLMN delay;
Authentication time	Time in seconds within the fastest 80 % and 95 % of attempts. {**Reference:** Login time; ETSI EG 202 057-4 [i.15]}
Generic domain name translation time	Time in seconds within the fastest 80 % and 95 % of attempts. {**Reference:** Domain Name System (DNS) performance; CWA14357 [i.25]}

Time for Web browsing

Metric	Related indicator definition (KQI)
Web response time	Time between the start and the end of display while playing a generic scenario to connect in HTTP to a standard webpage within the ISP network Time between the start and the end of display while playing a generic scenario to connect in HTTP to a standard webpage beyond the ISP network.

Time for Web page hosting

Metric	Related indicator definition (KQI)
Time to upload a test web page by the owner of the allocated space	Time to upload a web page of a given size by the owner of the allocated space from the ISP network. Time to upload a web page of a given size by the owner of the allocated space from another network than the ISP one.
Time to display a test web page by any web user	Time to display a web page of a given size by any web user from the ISP network. Time to upload a web page of a given size by any web user from another network than the ISP one.

Capacity for Internet access

Metric	Related indicator definition (KQI)
Data transmission speed achieved	The following statistic should be provided separately for download and upload direction: a) The highest 95 % of the data transmission rate in kbit/s achieved. b) The lowest 5 % of the data transmission rate in kbit/s achieved. c) The mean value and standard deviation of the data transmission rate in kbit/s. {**Reference:** Data transmission speed achieved; ETSI EG 202 057-4 [i.15]}
Data rate of dial-up access to the Internet	Transmission rate of modem data of 80 % of connections in bit/s. {**Reference:** Data rate of dial-up access to the Internet; ETSI EG 202 057-2 [i.13]}
Internet Download Bit Rate	2 types of measurement should be performed: • Internet Download bit rate measurement in presence of other services (VoIP, IPTV or VoD); and • Internet Download bit rate measurement without other services. The 95 quantile can be determined. {**Reference:** Internet Download Bit Rate [kbit/s]; ETSI ES 202 765-4 [i.20]}
Internet Upload Bit Rate	2 types of measurement should be perform: • Internet Upload bit rate measurement in presence of other services (VoIP, IPTV or VoD); and • Internet Upload bit rate measurement without other services. The 95 quantile can be determined. {**Reference:** Internet Upload Bit Rate [kbit/s]; ETSI ES 202 765-4 [i.20]}
FTP download Speed	The data transmission speed is defined as the data transmission rate that is achieved for downloading specified test files between a remote web site and a user's computer. The following statistics should be provided: a) the highest 95 % of the data transmission rate in kbit/s achieved; b) the lowest 5 % of the data transmission rate in kbit/s achieved; c) the mean value and standard deviation of the data transmission rate in kbit/s {**Reference:** FTP download Speed [kbit/s]; ETSI ES 202 765-4 [i.20]}
FTP upload Speed	The data transmission speed is defined as the data transmission rate that is achieved uploading specified test files between a remote web site and a user's computer. The following statistics should be provided: a) the highest 95 % of the data transmission rate in kbit/s achieved; b) the lowest 5 % of the data transmission rate in kbit/s achieved; c) the mean value and standard deviation of the data transmission rate in kbit/s {**Reference:** FTP upload Speed [%]; ETSI ES 202 765-4 [i.20]}

Capacity for Web browsing

Metric	Related indicator definition (KQI)
Web page download Speed	The Web page download speed is defined as the data transmission speed that is achieved separately for downloading and uploading specified test files between a remote web site and a user's computer. The following statistics should be provided: a) the highest 95 % of the data transmission rate in kbit/s achieved; b) the lowest 5 % of the data transmission rate in kbit/s achieved; c) the mean value and standard deviation of the data transmission rate in kbit/s. {**Reference:** Web page download Speed [kbit/s]; ETSI ES 202 765-4 [i.20]}

Reliability for the overall service

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the Internet access service. {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}
Fault report rate per fixed access lines	Number of fault reports separately for access and core network. {**Reference:** P4 Fault report rate per fixed access lines; ETSI ES 202 057-1 [i.18]}

Flexibility for the overall service

KQI: Assessment of the change ease by a representative user panel (OR value).
Time to change one contractual specification.

Usability for the overall service

KQI: Assessment of the user friendliness by a representative user panel (OR value).
Assessment of the user friendliness by a representative user panel of people with disabilities (OR value).

Security for the overall service

KQI: Efficiency and robustness of the authentication (Certificate from an entitled body).
Efficiency and robustness of the protection mechanism (Certificate from an entitled body).
Robustness of the customer's private data protection mechanism (Certificate from an entitled body).

5.6 Multimedia Message Service (MMS)

Multimedia Message Service (MMS): transfer of multimedia messages between users. There is no requirement for the multimedia messages to be transferred in real-time.

Availability

Metric	Related indicator definition (KQI)
MMS end-to-end failure ratio [%]	The probability that the Multimedia Messaging Service (MMS) is unable to deliver a MMS-message to the recipient. The following statistics should be provided separately: The ratio of Multimedia messages end-to-end failure, together with the number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number. {**Reference:** MMS end-to-end failure ratio [%], ETSI TS 102 250-2 [i.22]}
MMS notification failure ratio [%]	The probability that the Multimedia Messaging Service (MMS) is unable to deliver the notification of a MMS-message arrival to the recipient. The following statistics should be provided separately: The ratio of Multimedia messages notification failure, together with the number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number. {**Reference:** MMS notification failure ratio [%], ETSI TS 102 250-2 [i.22]}
MMS send failure Ratio	Probability that a user cannot send a MMS successfully from a terminal equipment to a MMS centre: a) percentage of unsuccessful MMS send attempts, b) number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number. {**Reference:** MMS send failure ratio [%], ETSI TS 102 250-2 [i.22]}
MMS retrieval failure ratio [%]	The probability that the MMS-message cannot be downloaded by the MT mobile, which received a MMS notification before. {**Reference:** MMS Delivery Failure Ratio [%], ETSI TS 102 250-2 [i.22]}

Integrity

Metric	Related indicator definition (KQI)
Ratio of MMS content degradation	The probability that the content of the received MMS differs from the original content.

Time

Metric	Related indicator definition (KQI)
MMS end-to-end delivery time	The end-to-end delivery time for MMS is the period starting when sending a MMS from a terminal equipment to a MMS centre and finishing when receiving the very same MMS on the recipient terminal equipment. The following statistics should be provided separately: a) the time in seconds within which the fastest 95 % of standard sized MMS (e.g. 5 Mo) are received; b) the number of observations performed. {**Reference:** MMS end-to-end delivery time [%], ETSI TS 102 250-2 [i.22]}
MMS notification time [s]	The time elapsing from the complete submission of the Multimedia-Message to the MMSC to the reception of the Notification (MT). The following statistics should be provided separately: a) the time in seconds within which the fastest 95 % of notifications are received; b) the number of observations performed. {**Reference:** MMS notification time [%]; ETSI TS 102 250-2 [i.22]}
MMS send time	The time elapsing from pushing the send button after the editing of a MMS-message to the completion of the data transfer {**Reference:** MMS send time [Time], ETSI TS 102 250-2 [i.22]}
MMS retrieval time	The time elapsing between the WGR and the completion of the download of the MMS {**Reference:** MMS Delivery time [Time], ETSI TS 102 250-2 [i.22]}

Capacity

Metric	Related indicator definition (KQI)
The impact of the server capacity to process multiple simultaneous messages is not directly perceived by the users.	
NOTE: The size of the MMS storage space allowed, the maximum storage time and MMS number allowed on the server are important features to the user that can differentiate the suppliers and therefore should be specified in the contract but are not per se KQI.	

Reliability

Metric	Related indicator definition (KQI)
Fulfilment of QoS targets	This indicator aims at assessing the fulfilment over a given period of time of the SP commitment to comply with QoS targets well-defined either by the SP himself or any other organization for a set of criteria:
Number of customer complaints	Number of complaints per data collection period about the MMS service. {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the change ease by a representative user panel taking into account the following aspects: time, user friendliness [OR]. {**Reference:** P14 - OR of customer relations; ETSI ES 202 057-1 [i.18]}
List of available modes to send and receive MMS (Mobile, fixed, Internet, etc.) (Survey).

Usability

KQI: Assessment of the user friendliness to people with disabilities by a representative user panel [OR]. {**Reference:** P14 - OR of customer relations; ETSI ES 202 057-1 [i.18]}
Assessment of the user friendliness by a representative user panel [OR]. {**Reference:** P14 - OR of customer relations; ETSI ES 202 057-1 [i.18]}

Security

KQI: Robustness of the customer's private data protection mechanism (Certificate from an entitled body).

5.7 Operator services

Operator services: Service provided by human operator to establish or assist customers in establishing local or long-distance telephone connections.

This service is currently less and less in use. It has been left in the present document for memory.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to the service	Number of successful attempts to access an operator with respect to the total number of attempts required over a given period.
Outage frequency	Number of times the user's connection is terminated for reasons other than their choosing to disconnect by agreed period of time.
Served call rate (provider)	Rate of calls providing the caller with the ability to place his request.

Integrity

Metric	Related indicator definition (KQI)
Rate of correctness in fulfilling the customer request	Survey

Time

Metric	Related indicator definition (KQI)
Response time for operator services	Duration from the dialling to the instant the human operator answers the calling user: a) mean time to answer; b) percentage of calls answered within 20 seconds. {**References:** Response time for operator services; ETSI EG 201 769 [i.10] and ETSI ES 202 057-1 [i.18]}
Call set-up time	Period starting when the operator pick-up the receiver until the expected ringing tone or answer signal is received by the calling party.

Capacity

Metric	Related indicator definition (KQI)
Adequacy of the number of operators to the number of call (provider)	Occupation rate of the operators.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period of time. {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI List of available means to access the service (Mobile, fixed, Internet, etc.): Survey.

Usability

KQI Assessment of the user friendliness by a representative user panel.
(OR value).
Languages taken into account to cope with the caller language: Survey.

Security

KQI Robustness of the customer's private data protection mechanism: Certificate from an entitled body.

5.8 Short Message Service (SMS)

Short Message Service (SMS): gives the ability to send character messages to phones. SMS messages can be Mobile Originate (MO) or Mobile Terminate (MT).

NOTE: SMS allows alphanumeric messaging between mobile phones and other equipment such as voice mail systems and email.

Availability

Metric	Related indicator definition (KQI)
Successful SMS Ratio	Probability that a user can send a SMS successfully from a terminal equipment to a SMS centre: The percentage of successfully sent short messages, together with the number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number. {**Reference:** Successful SMS Ratio: ETSI EG 202 057-2 [i.13]}
Service Non-Accessibility	The probability that the end-user cannot access the Short Message Service (SMS) or Short Data Service (SDS) when requested while it is offered by display of the network indicator on the UE. {**Reference:** {SMS | SDS} Service Non-Accessibility [%]; ETSI TS 102 250-2 [i.22]}
{SMS | SDS} Completion Failure Ratio	Ratio of correctly sent and received SMS between two terminal equipments. The following statistics should be provided separately: a) ratio of successfully sent and received short messages; b) number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number. {**References:** Completion Rate for SMS; ETSI EG 202 057-2 [i.13] SMS | SDS} Completion Failure Ratio [%]; ETSI TS 102 250-2 [i.22]}
{SMS | SDS} Receive Confirmation Failure Ratio	The probability that the receive confirmation for a sent attempt is not received by the originating UE although requested. {**Reference:** {SMS | SDS} Receive Confirmation Failure Ratio [%]; ETSI TS 102 250-2 [i.22]}
{SMS | SDS} Consumed Confirmation Failure Ratio	The probability that the consumed confirmation for a sent attempt is not received by the originating UE although requested. {**Reference:** {SMS | SDS} Consumed Confirmation Failure Ratio [%]; ETSI TS 102 250-2 [i.22]}

Integrity

Metric	Related indicator definition (KQI)
Ratio of SMS content degradation	The probability that the content of the received SMS differs from the original content.

Time

Metric	Related indicator definition (KQI)
End-to-End delivery time for SMS	The end-to-end delivery time for SMS is the period starting when sending a SMS from a terminal equipment to a Short Message centre and finishing when receiving the very same SMS on another terminal equipment. The following statistics should be provided separately: a) the mean value in seconds for sending and receiving short messages; b) the time in seconds within which the fastest 95 % of short messages are sent and received; c) the number of observations performed. {**Reference:** End-to-End delivery time for SMS [s]; ETSI EG 202 057-2 [i.13], ETSI TS 102 250-2 [i.22]}
{SMS | SDS} Receive Confirmation Time	The time period between sending a short message to the network and receiving the receive confirmation for this message from the network. {**Reference:** {SMS | SDS} Receive Confirmation Time [s]; ETSI TS 102 250-2 [i.22]}
{SMS SDS} Access Delay	The time period between sending a short message to the network and receiving a send confirmation from the network at the originating side. {**Reference:** {SMS | SDS} Access Delay [s]; ETSI TS 102 250-2 [i.22]}
{SMS | SDS} Consumed Confirmation Time	The time period between sending a short message to the network and receiving the consumed confirmation from the network. {**Reference:** {SMS | SDS} Consumed Confirmation Time [s]; ETSI TS 102 250-2 [i.22]}

Capacity

Metric	Related indicator definition (KQI)
The server capacity to process multiple simultaneous messages is perceived by the users on the end-to-end delivery time.	
NOTE: The size of the SMS storage space allowed, the maximum storage time and SMS number allowed on the server are important features to the user that can differentiate the suppliers and therefore should be specified in the contract but are not per se KQI.	

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period of time. {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI List of available means to send and receive SMS (Mobile, fixed, Internet, etc.); Survey.

Usability

KQI Assessment of the user friendliness by a representative user panel (OR value).

Security

KQI Robustness of the customer's private data protection mechanism (Certificate from an entitled body).

5.9 Telephony

Telephony: A person to person voice distant conversation.

Availability

Metric	Related indicator definition (KQI)
Unsuccessful call ratio	An unsuccessful call is a call attempt to a valid number, properly dialled following dial tone, where neither called party busy tone, nor ringing tone, nor answer signal, is recognized on the access line of the calling user within 30 seconds from the instant when the address information required for setting up a call is received by the network. Unsuccessful call ratio is defined as the ratio of unsuccessful calls to the total number of call attempts in a specified time period. The following statistics should be provided separately: a) The percentage of unsuccessful calls for national calls, together with the number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number. b) The percentage of unsuccessful calls for international calls, together with the number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number. {**References:** Unsuccessful call ratio; ETSI EG 201 769 [i.10], ETSI EG 202 057-2 [i.13], ETSI EG 202 057-3 [i.14] ETSI ES 202 765-2 [i.19], clause 7.3}
Dropped call ratio	The percentage of dropped calls, calculated from all the calls in the period, e.g. interruptions due to the network during a standard duration of the communication. {**Reference:** Dropped call ratio; ETSI EG 202 057-3 [i.14]}
Retainability rate	a) The percentage of standard duration communications (e.g. 2 minutes) that are successfully maintained until hang up. b) The percentage of standard duration communications (e.g. 2 minutes) that are successfully maintained until hang up while roaming (mobiles).
Outage rate	Total sum of outages durations of the faulty lines by agreed period of time (day, week, month, year).

Integrity

Metric	Related indicator definition (KQI)
Listening speech quality	Represents the intrinsic quality of speech signal after transmission. This indicator takes into account the degradations generated on the signal by the transmission links. This indicator should be evaluated separately between call types (IP to IP, IP to PSTN, IP to Mobile, etc.) for a detailed analysis. Rating between 1 (= very bad) and 5 (= excellent) determines on MOS-LQOM scale with a resolution of two digits after the decimal point. {**References:** {MOS-LQO} Listening speech quality; ETSI ES 202 765-2 [i.19], Recommendation ITU-T P.800 [i.2], Recommendation ITU-T P.800.1 [i.3], Recommendation ITU-T P.862 [i.4], Recommendation ITU-T P.862.1 [i.5], Recommendation ITU-T P.862.2 [i.6], Recommendation ITU-T P.862.3 [i.7], Recommendation ITU-T P.863 [i.8], ETSI TR 102 806 [i.21]
Listening speech quality stability	The assessment of Listening Speech Quality Stability is performed in 5 steps described in ETSI ES 202 765-2 [i.19] and represented by the indicator ST-MOS calculated as: • ST-MOS = 100 - (250 × INS_MOS); and • ST-MOS = 0 if [100-(250 × INS_MOS)] < 0. This indicator is determined in the two directions of transmission. Statistics on MOS-LQO score variation are plotted on a 0 to 100 scale. {**Reference:** {ST-MOS} Listening speech quality stability; ETSI ES 202 765-2 [i.19]}
Speech Intelligibility Index	This indicator is very important for any kind of user (with or without hearing impairment) and is influenced by environmental conditions (e.g. noise, reverberation) and transmission impairments. The only standardized model available for the time being is: {**Reference:** ANSI/ASA S3.5-1997 (R2012): American National Standard Methods for Calculation of the Speech Intelligibility Index [i.27]}.
NOTE: It crucial to have in mind that the methodology described in the above statements is applicable to dedicated calls and cannot be carried out on live calls.	

Time

Metric	Related indicator definition (KQI)
Call set-up time:	The period starting when the address information required for setting up a call is received by the network and finishing when the called party busy tone or ringing tone or answer signal is received by the calling party. The following statistics should be provided separately: a) The mean value in seconds for national calls. b) The time in seconds within which the fastest 95 % of national calls are set-up. c) The mean value in seconds for international calls. d) The time in seconds within which the fastest 95 % of international calls are set-up. e) The number of observations performed for national and international calls. {**References:** Call set-up time; ETSI EG 201 769 [i.10], ETSI EG 202 057-2 [i.13], clause 5.2}
Alternative: Post dialling delay	Post Dialling Delay (PDD) evaluates service availability to set up calls in an acceptable delay. It is linked to the service architecture complexity, and to the performance of the constituting network elements. Post Dialling Delay is the time interval between the end of dialling by the caller and the reception back by him of the appropriate ringing tone or recorded announcement. Metric determines on one of the two access of the communication. Indicator determines sequentially from the two access of call configuration. This indicator characterizes only the caller part of the configuration. This indicator has to be separated between call types (IP to IP, IP to PSTN, IP to mobile, etc.) for a detailed analysis. {**Reference:** Post Dialling Delay; ETSI ES 202 765-2 [i.19]}

Capacity

Metric	Related indicator definition (KQI)
Trafficability provided	Number of voice channel available with regard to the contractual commitment.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period of time. {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}
Fault report rate per fixed access lines	Number of fault reports separately for access and core network. {**Reference: P4** Fault report rate per fixed access lines; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI Assessment of the change ease by a representative user panel. (OR value).
Time to change one contractual specification.

Usability

KQI Assessment of the user friendliness of the interface by a representative user panel. (OR value).
Assessment of the adaptability to make use easier to people with disabilities by a representative user panel of people with disabilities (OR value).
{**Reference:** CEN/CENELEC/ETSI EN 301 549 [i.24], clause 6}

Security

KQI Qualification of the customer's private data protection system against user identity theft (Certificate from an entitled body).
Qualification of the customer's private data protection system against intrusion, fraudulent listening and breach of customer's privacy (Certificate from an entitled body).

5.10 Video broadcast - Video streaming

Video broadcast/streaming: A mechanism whereby video content can be rendered at the same time that it is being transmitted to the client over the data network.

NOTE: Video broadcast or IPTV differs from Video streaming or VoD as it is delivered simultaneously to a group of subscribers, while the last on is delivered to a single subscriber but the technology is very similar.

Availability

Metric	Related indicator definition (KQI)
Rate of server accessibility	Percentage of successful log-ins with respect to a required number of attempts. {**References:** Successful log-in ratio; ETSI EG 202 057-4 [i.15] - Channel Availability - VoD Service Availability; ETSI ES 202 765-2 [i.19], clauses 8.1 and 9.1}

Integrity

Metric	Related indicator definition (KQI)
Audio quality	Currently, there is no standardized model "without reference" for audio quality evaluation. In this context the most suitable approach is to determine "audio cut" (or "audio lack") occurrence and low audio level sequence in the audio stream. This analysis should be performed on the left and right channels. This indicator could be presented as the number of degradation or in ratio (number of degradation by time unit). An alternative assessment of the audio quality is to perform subjective tests by a representative user panel. {**Reference:** Audio quality; ETSI ES 202 765-4 [i.20], clauses 8.4 & 9.5}
Video quality	This indicator is intended to evaluate the quality of video stream delivered to the user and to characterize its perception by the end-users in term of video quality. Taking into account that for the time being there is no standardized model working without reference, it is proposed to qualify video quality by the occurrence of particular degradations like "black screen", blockiness and frozen picture. An alternative assessment of the video quality is to perform subjective tests by a representative user panel. (OR value) {**Reference:** Video Quality; ETSI ES 202 765-4 [i.20], clause 8.3}
"Black Screen" Occurrences	This metric corresponds to the number of "black screen" sequences during a time period (24 hours, 1 week, etc.). {**Reference:** "Black Screen" Occurrences; ETSI ES 202 765-4 [i.20], clause 8.5}
Blockiness Occurrences	This metric corresponds to the number of blockiness sequences during a time period (24 hours, 1 week, etc.). {**Reference:** Blockiness Occurrences; ETSI ES 202 765-4 [i.20], clause 8.6}
Frozen Picture Occurrences	This metric corresponds to the number of frozen picture sequences during a time period (24 hours, 1 week, etc.). {**Reference:** Frozen Picture Occurrences; ETSI ES 202 765-4 [i.20], clause 8.7}

Metric	Related indicator definition (KQI)
Lip Desynchronization Occurrences	This metric correspond to the number of desynchronization sequences during a time period (24 hours, 1 week, etc.). There is no non-intrusive methods available for the time being. {**Reference:** Lip Desynchronization Occurrences; ETSI ES 202 765-4 [i.20], clause 8.8; CEN/CENELEC/ETSI EN 301 549 [i.24]}

Time

Metric	Related indicator definition (KQI)
Access time	Time in seconds within the fastest 80 % and 95 % of logins. {**Reference:** Login time; ETSI EG 202 057-4 [i.15]}
Starting time	Maximum and mean time in second between the start order on the screen or on the remote control and the beginning of the display; i.e. the time needed to fill the application buffer and start the display. No standard methodology available at the time the present document is made available. (see also; IPTV service boot delay)
IPTV service boot delay	This indicator measures the delay of service provision between a user command and the display of the first image associated with audio. 2 types of boot delay may be discerned: the starting up after a command supply switching and the starting up after a command of standby exit. {**Reference:** IPTV service boot delay; ETSI ES 202 765-4 [i.20], clause 8.11}
Zapping Delay	This indicator describes the duration to switch from one TV channel to another (channel zapping). The duration is measured from the request to change the channel sent by the client until the channel switch request is completed (both audio and video present on the receiver). This metric should be measured on -P/+P of the remote control. {**Reference:** Zapping Delay; ETSI ES 202 765-4 [i.20], clause 8.9}

Capacity

Metric	Related indicator definition (KQI)
Throughput achieved	Ratio of the data bit-rate provided compared to the contractual commitment.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period of time {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI Assessment of the change ease by a representative user panel (OR value)
Time to change one contractual specification.

Usability

KQI Assessment of the user friendliness of the interface by a representative user panel (OR value).

Security

KQI Efficiency and robustness of the authentication (Certificate from an entitled body).
Efficiency and robustness of the protection mechanism against intrusion and breach of customer's privacy (Certificate from an entitled body).

5.11 Voice mail

Voice mail: Any system for sending, storing and retrieving audio messages, like a telephone answering machine. A voice mailbox is typically associated with a telephone number or extension. This service is a multi-components service generally including:

a) recording, storage and transmission of a welcome message by the voicemail owner;

b) recording and storage of a message by a caller on no reply or busy line under the guidance of a voice server;

c) information of the voicemail owner that a message is available;

d) listening of a recorded message by the voicemail owner.

Other systems making a caller able to directly record a message in a voice mailbox using either phone or digital voice record exchange are not in the scope of this clause.

Availability

Metric	Related indicator definition (KQI)
Voice messaging availability	The probability that voice messaging application is attainable when the customer calls it. Successful access to voice messaging is performed when a call attempt to this service is correctly set up and release. {**Reference:** Voice messaging availability; ETSI ES 202 765-4 [i.20], clause 7.1}

Integrity

Metric	Related indicator definition (KQI)
Rate of message spoiling Failure of the information to the voice mailbox owner	Number of messages spoiled (incoming message without information to the voice mailbox owner, disjointed, truncated, etc.) with respect to the total number of messages received.
Voice message quality	This indicator characterizes quality of voice messages. This quality takes into account the degradation due to network transmission during the deposal period on messaging platform, the degradation due to saving process on the server and the degradation due to network transmission during message restoration period. {**Reference:** Voice message quality; ETSI ES 202 765-4 [i.20], clause 7.5}

Time

Metric	Related indicator definition (KQI)
Response time of the voice guide after the reply time out	Time in seconds within the fastest 80 % and 95 % of connection to the message recording server (voice guide) on busy line or no reply after the reply time out.
Message recording server response time	Time in seconds after the end of the welcome message within the fastest 80 % and 95 % of connection to the message recording server (start of recording signal).
Time to receive the notification of a message record in the voice mailbox	Time in seconds within the fastest 80 % and 95 % of delay between a message record and its announcement to the voice mailbox owner.
Message listening server response time	Time in seconds after the end of the welcome message within the fastest 80 % and 95 % of connection to the message listening server (start of the first message transmission).

Metric	Related indicator definition (KQI)
Message provisioning delay	The indicator evaluates the delay corresponding to the time interval between the end of message deposal on the server and the provisioning of this message to the customer. {**Reference:** Message provisioning delay; ETSI ES 202 765-4 [i.20], clause 7.4}

Capacity

Metric	Related indicator definition (KQI)
The server capacity to process multiple simultaneous messages is perceived by the users by the time to send the record signal.	
NOTE: The number of simultaneous messages, the size of the message storage space allowed, the maximum storage time and size allowed on the server are important features to the user that can differentiate the suppliers and therefore should be specified in the contract but are not per se KQI.	

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period of time. {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the ease to change the contractual specifications (options and set-up) by a representative user panel (OR value)
Time to change one contractual specification.
List of available means to record and receive (Mobile, fixed, Internet, etc.); Survey

Usability

KQI: Assessment of the user friendliness of the interface by a representative user panel. (OR value).

Security

KQI: Robustness of the customer's private data protection mechanism in particular: protection against fraudulent message listening and change of the recorded welcome message. (Certificate from an entitled body).

5.12 Voice messaging

Voice message refers to a message that could be sent to a destination using voice media. Voice itself could be 'packaged' and sent through the IP backbone so that it reaches its marked 'address'. In a technical sense, the process of sending 'voice packets' is a semi passive way of communication. However, given the speed at which it could be delivered can make the communication sound seamless.

Availability

Metric	Related indicator definition (KQI)
Voice messaging availability	The probability that voice messaging application is attainable when the customer calls it. Successful access to voice messaging is performed when a call attempt to this service is correctly set up and release. {**Reference:** Voice messaging availability; ETSI ES 202 765-4 [i.20]}

Integrity

Metric	Related indicator definition (KQI)
Voice message quality	This indicator characterizes speech quality of voice messages. Rating between 1 (= very bad) and 5 (= excellent) determined on MOS-LQOM scale with a resolution of two digits after the decimal point. {**Reference:** Voice message quality; ETSI ES 202 765-4 [i.20]}

Time

Metric	Related indicator definition (KQI)
Pick Up Delay	The indicator evaluates service availability to voice messaging connection in an acceptable delay. This delay corresponds to the Post Dialling Delay increased by time interval between the beginning of ringing tone and the call establishment. {**Reference:** Pick Up Delay; ETSI ES 202 765-4 [i.20]}
Message Provisioning Delay	This delay corresponds to the time interval between the end of message deposal on the server and the provisioning of this message to the customer. This indicator is the number of successive call attempts to voice messaging (immediately after voice message deposit) necessities to obtain voice message diffusion. {**Reference:** Message Provisioning Delay; ETSI ES 202 765-4 [i.20]}

Capacity

Metric	Related indicator definition (KQI)
The impact of the server capacity to process multiple simultaneous messages is perceived by the users by the time to send the record signal but not directly.	
NOTE: The size of the message storage space allowed, the maximum storage time and size allowed on the server are important features to the user that can differentiate the suppliers and therefore should be specified in the contract but are not per se KQI.	

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period of time. {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the ease to change the contractual specifications (options and set-up) by a representative user panel (OR value)
Time to change one contractual specification.
List of available means to record and receive (Mobile, fixed, Internet, etc.).

Usability

KQI: Assessment of the user friendliness of the interface by a representative user panel. (OR value).

Security

KQI: Robustness of the customer's private data protection mechanism (Certificate from an entitled body).

5.13 For further study

Several services have been identified for further study and are expected to be dealt in subsequent revisions.

6 QoS metrics and indicators for all steps of the customer relationship course other than utilization

This clause deals with sales, service management and network/service management by the customer. The reader can find a detailed description of the activities related to each step of the customer relationship course in clause 6.1 of ETSI EG 202 009-1 [i.11], particularly on the tuning of the QoS criterion to these particular aspects of the services. For an easier reading, the scope of each step is given in the first sentence of the related clause.

6.1 Sales

Embraces all QoS assessments related to activities from the time communications are established between the provider and the customer to the time the contract is signed for the provision of a service or a set of services by the provider.

6.1.1 Preliminary information

All QoS assessments related to information on the service provided on request of the prospect to help him choosing the service and provider most appropriate to his needs.

Availability

Metric	Related indicator definition (KQI)
Availability of preliminary information (PI)	Ratio of the number of requests from potential users and customers for PI which have been delivered to the total number of requests within the pre-defined timeout interval T11. {**Reference: P103** Availability of PI [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Integrity of preliminary information (PI)	"integrity of PI" is expressed by a true and fair view of the main points of a telecommunications service provided by a SP for the attention of the potential user/customer. {**Reference: P101** integrity of PI [OR]; ETSI EG 202 843 [i.16]}
Pricing transparency	"pricing transparency" is expressed by an OR on clarity, conciseness and unambiguity for all usage conditions in every tariff structure for every service provided by the SP given by an expert panel. {**Reference: P102** Pricing transparency [OR]; ETSI EG 202 843 [i.16]}
Overall rating of the responsiveness of the service desk	Assessment of the responsiveness of the information desk by a representative user panel. {**Reference:** P106 Overall rating of the responsiveness of the service desk[OR]; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Response time for the provision of preliminary information (PI)	"response time for the provision of PI" is expressed as the time taken from the instant a request for PI was sent to the SP to the instant all requested information was delivered to the customer requesting the information. Mean of the N measurements taken for the supply of PI for a given number of modes. {**Reference: P104** response time for the provision of PI [Time]; ETSI EG 202 843 [i.16]} (Consumer Survey or Expert panel (preferred scenario))
Response time of the commercial desk	For voice calls, the time elapsed between the end of dialling and reaching a human operator. For other types of enquiries the time elapsed between the answer from the user and the answer from SP. P8.1 Percentage of enquiries handled by IVR systems. P8.2 Percentage of enquiries transferred to a human operator by the IVR systems. P8.3 Percentage of admin/billing enquiries answered within the delay taken as a commitment by the provider. P8.x1: The time by which the fastest 80 % of enquiries to the commercial desk are answered (expressed in clock hours) [Time] and/or P8.x2: The time by which the fastest 95 % of enquiries to the commercial desk are answered (expressed in clock hours) [Time] and/or P8.x3: Percentage of enquiries to the commercial desk answered within the delay taken as a commitment by the provider. [%] x: index for each mode of enquiry e-mail (8.11, 8.12 and 8.13) Voice call (8.21, 8.22 and 8.23) Letter/postcard (8.31, 8.32 and 8.33) Web page (8.41, 8.42 and 8.43) Shop (8.51, 8.52 and 8.53) {**References: P105** Response time of the commercial desk [Time &%]; ETSI EG 202 843 [i.16]. **P8** Response time for admin/billing enquiries [Time]; ETSI ES 202 057-1 [i.18]}

Capacity

Metric	Related indicator definition (KQI)
N/A	No SLO expected from the user side on this aspect.

Reliability

Metric	Related indicator definition (KQI)
Fulfilment of QoS targets	Percentage of time the service is compliant with all the defined targets within a specified observation period.

Flexibility

KQI: List of available information channels (phone, Internet, information desk, etc.).

Usability

KQI: Assessment of the user friendliness of the Internet user interface by a representative user panel. {**Reference: P107** User friendliness of the Internet user interface [OR]; ETSI EG 202 843 [i.16]}. Assessment of the assurance, empathy and responsiveness of the information desk operators by a representative user panel. {**Reference: P108** User friendliness of the service desk operators [OR]; ETSI EG 202 843 [i.16]}

Security

KQI: Efficiency and robustness of the protection mechanism against breach of customer's privacy (Certificate from an entitled body).
Guarantee that no contractual obligation is taken against the customer without his consent (Audit by an entitled body)

6.1.1.1 Preliminary information needed by the customer for a telephony contract (fixed or mobile)

1) Conditions of customer membership, including tariff (subscription and communications) and options.
2) Duration of the commitment with the provider.
3) Help line availability + tariff details.
4) Description of the services available.
5) Contract management facilities offerings:
   - Restriction services: parental screening; etc.
   - Cost management services: expense signal, limited account, expense information, expense summary, etc.
   - Charging/Billing medias available: paper, WEB, eBilling, CDRom, etc.
   - Payment means available: cash, standing order; etc.
   - Bill collection means available.
6) Availability and conditions for security and privacy offerings.
7) Coverage: geographic area and percentage of the inhabitants (GSM, UMTS, GPRS and ADSL services).

6.1.1.2 Preliminary information needed by the customer for an ISP contract

1) Conditions of customer membership, including tariff and options.
2) Data bit rate offered.
3) Number of email addresses.
4) Size of email, storage size, storage time and other relevant details.
5) Availability + conditions for web space.
6) Help line availability + tariff details.
7) Data protection practices.
8) Availability and conditions for control of "spam".
9) Availability and conditions for control of "virus".
10) Availability and conditions for parental control.
11) Availability and conditions for security offerings.
12) Interaction with other ISPs.
13) Residues after uninstallation of ISP software.

6.1.1.3 Preliminary information needed by the customer for a multi-services contract (fixed or mobile)

1) Conditions of customer membership, including tariff (subscription and communications) and options.
2) Duration of the commitment with the provider.
3) Help line availability + tariff details.
4) List and description of the services available.
5) Contract management facilities offerings:
   - Restriction services: parental screening; etc.
   - Cost management services: expense signal, limited account, expense information, expense summary; etc.
   - Charging/Billing medias available: paper, WEB, eBilling, CDRom; etc.
   - Payment means available: cash, standing order; etc.
   - Bill collection means available.
6) Additional facilities.
7) Availability and conditions for security offerings.
8) Coverage (mobile networks).

6.1.2 Establishment of the contract (Terms and conditions)

All QoS assessments related to activities from the customer decision to contract with the provider to the time the contract is effective. Establishment of the contract is meant here for agreeing to the contractual conditions, conditions of use, customer and provider commitments whether or not there is a formal signature of the contract.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to a trading desk	The ratio of the number of successful access attempts to the total number of attempts to reach the contracting service in a specified period of time {**Reference:** P641: Accessibility of the commercial support [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Integrity of contract information	"integrity of contract information" is expressed by a true and fair view of the information on supply, maintenance and cessation for a telecommunications service provided by a SP. {**Reference: P201** Integrity of contract information[OR]; ETSI EG 202 843 [i.16]}
Compliance rate of the information contained in the contract with that previously supplied to the customer	The degree of concurrence of the contents of the contractual document to the PI. **P202** Number of delivered contract proposals without errors/Number of delivered contract proposals. [%] {**Reference: P202** Compliance of contractual terms with PI[%]; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Response time of the commercial desk	For voice calls, the time elapsed between the end of dialling and reaching a commercial operator: For other types of enquiries the time elapsed between the question from the user and the answer from SP.: **P205.x1:** The time by which the fastest 80 % of enquiries to the commercial desk are answered (expressed in clock hours) [Time] and/or **P205.x2:** The time by which the fastest 95 % of enquiries to the commercial desk are answered (expressed in clock hours) [Time] and/or **P205.x3:** Percentage of enquiries to the commercial desk answered within the delay taken as a commitment by the provider [%]. **x:** index for each mode of enquiry e-mail (105.11, 105.12 and 105.13) Voice call (105.21, 105.22 and 105.23) Letter/postcard (105.31, 105.32 and 105.33) Web page (105.41, 105.42 and 105.43) Shop (105.51, 105.52 and 105.53) {**Reference: P6** Response time for admin/billing enquiries; ETSI ES 202 057-1 [i.18]}
Delay to settle a contract:	Time taken from the initial contact between the customer and the commercial operator to the instant the contract is placed for a service. **a**) the time by which the fastest 50 % and 95 % of contract settlements have been completed (expressed in clock hours): **P206.11:** the time by which the fastest 50 % contract settlements have been completed [Time] and/or **P206.12:** the time by which the fastest 95 % of contract settlements have been completed[Time]; and/or **b**) the percentage of contract settlements completed any time stated as an objective by the service provider. **P206.2:** the percentage of contract settlements completed any time stated as an objective by the service provider[%]. (Survey) {**Reference:** No exact reference but the assessment process can be easily derived from the one described for **P2** "Supply time for Internet access"; ETSI ES 202 057-1 [i.18]}
Delay for a contract acknowledgment:	Time taken from the registration by the prospect to the acknowledgment received by the customer. **a)** the time by which the fastest 50 % and 95 % of acknowledgments have been sent (expressed in clock hours); **P207.11:** the time by which the fastest 50 % of acknowledgments have been sent [Time]; and/or **P207.12:** the time by which the fastest 95 % of acknowledgments have been sent[Time]; and/or **b)** the percentage of acknowledgments sent any time stated as an objective by the service provider. **P207.2:** the percentage of acknowledgments sent any time stated as an objective by the service provider[%]. (Survey) {**Reference:** No exact reference but the assessment process can be easily derived from the one described for **P2** "Supply time for Internet access"; ETSI ES 202 057-1 [i.18]}

Capacity

Metric	Related indicator definition (KQI)
N/A	No SLO expected from the user side on this aspect.

Reliability

Metric	Related indicator definition (KQI)
Assessment of the responsiveness of the sales desk by a representative user panel.	Assessment of the responsiveness of the sales desk by a representative user panel. {**References: P208** Overall rating of the responsiveness of the sales desk[OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
Fulfilment of QoS targets	This indicator aims at assessing the fulfilment over a given period of time of the SP commitment to comply with QoS targets well-defined either by the SP himself or any other organization for a set of criteria: Percentage of time the service is compliant with all the defined targets within a specified observation period.

Flexibility

KQI: Scope and boundary of the amendments that could be accommodated to contractual terms to satisfy the post contractual amendments sought by a customer.
{**Reference: P204** Ease and flexibility to amend terms after formal contract [OR]; ETSI EG 202 843 [i.16]}
Scope and boundary to meet individual customer's specific requirements of service feature/s, service performance/s and terms and conditions before formal signature on the contract.
{**Reference: P203** Flexibility for customization before contract [OR]; ETSI EG 202 843 [i.16]}

Usability

KQI: The degree of satisfaction that customers have with the overall way in which they are treated.
P209a: Assessment of the ease of the subscription process by a representative user panel. [OR]
P209b: Ease with which all activities associated with the establishment of the contract may be carried out with the provider. [OR]
P209c: Ease with which forms can be filled and ease with which orders can be placed. [OR]
{**References: P209:** Ease of the subscription process [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
Assessment of the empathy and responsiveness of the service desk operators by a representative user panel.
{**References: P210**: Assessment of the empathy and responsiveness of the information desk operators by a representative user panel. [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Security

KQI: Efficiency and robustness of the authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications
Compliance to the specific customer premises security conditions if the provider staff has to work in these premises
Conformity of the contract to the laws on trade and electronic communication (Survey).

6.2 Service provisioning

All QoS assessments related to activities associated with the provision of a telecommunication service, from the time of effective contract to the time the customer is able to use the service.

Availability

Metric	Related indicator definition (KQI)
Proportion of problems with number portability procedures	Ratio between the number of portability requests having experienced problems and the total portability request number. {**References: P3** Proportion of problems with number portability procedures; ETSI ES 202 057-1 [i.18]. **P314** Proportion of problems with number portability procedures [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Rate of conformity of the delivery with the contractual specifications	"completeness of fulfilment of contractual specification in the provision of a service" is expressed as the ratio (percentage) of contracts with all network and/or service features specified in the contract fulfilled (after its provisioning) to the number of contracts that have been considered fulfilled for provisioning. {**Reference: P305** Completeness of fulfilment of contractual specification in the provision of a service [%]; ETSI EG 202 843 [i.16]}
Provisioning not complete and correct first time	The ratio (percentage) of service provisioning procedures which are either not completely carried out or not correctly carried out in the first attempt to the total number of contracts with the provisioning deemed completed. {**Reference: P308** Provisioning not complete and correct first time [%]; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Successful completion of provisioning of service on the date promised in the contract	The ratio (percentage) of successful completion of provisioning of service on the date promised in the contract to the total number of signed contracts with promised service provisioning. {**Reference: P301** Meeting promised provisioning date[%]; ETSI EG 202 843 [i.16]}
Spread between the scheduled provisioning time and the actual provisioning time	The period of time between the scheduled provisioning time and the actual provisioning time. {**Reference: P302** Time for provisioning[Time]; ETSI EG 202 843 [i.16]}
Successful provisioning within specified period	the ratio (percentage) of the number of successful service provisioning events to all expected provision events within a pre-defined period of time. {**Reference: P303** Successful provisioning within specified period[%]; ETSI EG 202 843 [i.16]}
Timeliness in appointments	"punctuality of service provisioning" is expressed as the time difference between the actual service provisioning time and the contractually specified provisioning time. {**Reference: P306** Punctuality of service provisioning[Time]; ETSI EG 202 843 [i.16]}
Timeliness in equipment delivery	Number of delays in equipment delivery with respect to the total number of new connections in percentage. {**Reference: P307** Punctuality of service provisioning[Time]; ETSI EG 202 843 [i.16]}
Provisioning time	Time elapsed between the request and the completion of the network connection a) the times by which the fastest 50 % and 95 % of orders are completed; **P309.11:** the times by which the fastest 50 % of orders are completed[Time]; **P309.12:** the times by which the fastest 95 % of orders are completed[Time]; b) percentage of orders completed by the date agreed with the customer, and, where the percentage of orders completed by the date agreed with the customer is below 80 %, the average number of days, for the late orders, by which the agreed date is exceeded. **P309.2:** percentage of orders completed by the date agreed with the customer[%], where the percentage of orders completed by the date agreed with the customer is below 80 %, **P309.3:** the average number of days, for the late orders, by which the agreed date is exceeded[Time] separately for fixed network access provision for: a) narrowband PSTN or ISDN basic rate access where a physical change is required; b) narrowband PSTN or ISDN basic rate access where a physical change is not required; c) xDSL access provided over an existing installed access line; d) any other kind of technology in order to provide a fixed network access. separately for Internet access for: a) the provision of physical Internet access;

Metric	Related indicator definition (KQI)
	b) the provision of logical Internet access; c) the provision of Internet access including both physical or logical access. {**References: P1** Supply time for fixed network access; **P2** Supply time for Internet access; ETSI ES 202 057-1 [i.18]}
Portage delay (when applicable)	a) Time taken from the portage request by the customer to its achievement for the fastest 50 % and 95 % of requests **P313.11:** the time by which the fastest 50 % of portage have been completed [Time] and/or **P313.12:** the time by which the fastest 95 % of portage have been completed[Time]; and/or b) Time taken from the portage request by the incoming operator to the reception of the acknowledgment by the departing operator for the fastest 50 % and 95 % of requests. **P313.21:** the time by which the fastest 50 % of portage acknowledgments have been received [Time] and/or **P313.22:** the time by which the fastest 95 % of portage acknowledgments have been received [Time]. {**Reference: P313** Portage delay; ETSI EG 202 843 [i.16]}

Capacity

Metric	Related indicator definition (KQI)
N/A	

Reliability

Metric	Related indicator definition (KQI)
Ratio of contract cancelled due to non fulfilment	The ratio (percentage) of the number of contracts cancelled due to the ongoing non-fulfilment as it is considered unreasonable to wait any longer to the total number of signed contracts within the assessment period. {**Reference: P304** Contract cancelled due to non fulfilment [%]; ETSI EG 202 843 [i.16]}
Overall quality of the provisioning process including the reception desk	Assessment of the overall quality of the provisioning process by a representative user panel {**References: P310:** Overall quality of the provisioning process including the reception desk [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
Fulfilment of QoS targets	This indicator aims at assessing the fulfilment over a given period of time of the SP commitment to comply with QoS targets well-defined either by the SP himself or any other organization for a set of criteria: Percentage of time the service is compliant with all the defined targets within a specified observation period.

Flexibility

KQI: Provider ability to match the customer's wishes for conditions of achievement by a representative user panel.
{**References: P311:** Provider ability to match the customer's wishes for conditions of achievement [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Usability

KQI: Assessment of the user friendliness of the means available to the customer for the operations he has to perform by a representative user panel.
{**References: P312:** User friendliness of the means available to the customer for the operations he has to perform. [OR] **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications.
Compliance to the specific customer premises security conditions if the provider staff has to work in these premises.

6.3 Service alteration and technical upgrade

Alteration is an operation requested by the customer, while a technical upgrade is proposed or imposed by the provider as a consequence of the technical evolution of his own equipment.

6.3.1 Service alteration

All QoS assessments related to activities associated with the alteration of a telecommunication service, from the time alteration to a service is requested by the customer to the time this alteration is carried out to the satisfaction of the customer.

Availability

Metric	Related indicator definition (KQI)
Accessibility to resources from the provider to carry out alteration to the service as requested by the customer	The time difference between the actual service alteration and the scheduled alteration time announced by the SP {**Reference: P404** Punctuality of appointments for service alteration; ETSI EG 202 843 [i.16]} The time difference between the actual equipment delivery and the scheduled delivery announced by the SP. {**Reference: P405** Punctuality of equipment delivery for service alteration; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Service alteration error rate	The ratio (percentage) of service alteration procedures which are either not completely or not correctly carried out in the first attempt to the total number of contracts where alteration has been requested. {**Reference: P406** Service alteration not complete and correct first time; ETSI EG 202 843 [i.16]}
Rate of compliance with the customer request	The ratio (percentage) of all contracts where all specifications related to the service alteration contractually agreed are met or completed to the total number of contracts where alteration has been requested. {**Reference: P403** Completeness of fulfilment of contractual specification in the alteration of a service; ETSI EG 202 843 [i.16]} The ratio (percentage) of the number of contracts where service alteration was not according to specification and therefore requiring reworking or further service alteration to the total number of contracts where alteration was requested. {**Reference: P407** Conformity and success of service alteration; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Response time of the alteration service	The time taken from the request to the provider for an alteration to a service to the instant the altered service is available for use: a) the times by which the fastest 50 %, 95 % and 99 % of orders are completed; b) percentage of orders completed by the date agreed with the customer, and, where the percentage of orders completed by the date agreed with the customer is below 80 %, the average number of days, for the late orders, by which the agreed date is exceeded. separately for each type of alteration. {**References: P409** Response time of the alteration service; ETSI EG 202 843 [i.16]. **P1** Supply time for fixed network access; **P2** Supply time for Internet access; ETSI ES 202 057-1 [i.18]}

Capacity

Metric	Related indicator definition (KQI)
Efficiency of the services in charge of carrying out alterations	The ratio (percentage) of the number of contracts (or services) with successful service alteration to the total number of contracts (or services) with announced service alteration within the contractual specified period of time. {**Reference: P402** Successful service alteration within specified period; ETSI EG 202 843 [i.16]} The organizational and hardware resource availability to carry out service alterations to meet the needs of the customer and/or to meet contractual promises. {**Reference: P412** Organizational efficiency of service provider to carry out service alteration; ETSI EG 202 843 [i.16]}

Reliability

Metric	Related indicator definition (KQI)
Rate of overall reliability	The number of observation phases after service alteration without any limitation to the total number of service alteration carried out. Without any limitation means that, all the indicator of availability, integrity, time and capacity are complying to the specified ratings if any, over a given period. {**Reference: P408** Technical reliability of service within an agreed period after alteration; ETSI EG 202 843 [i.16]}
Overall quality of the alteration process	The degree of satisfaction that a customer has with the overall way in which they are treated. {**References: P410** Overall quality of the alteration process [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the provider ability to match the customer's wishes by a representative user panel. (OR value)
{**Reference: P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Usability

KQI: Assessment of the user friendliness of the means available to the customer for the operations he has to perform by a representative user panel.
(OR value).
{**References: P411** User friendliness of the means available to the customer for the operations he has to perform [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations;
ETSI ES 202 057-1 [i.18]}

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications .
Compliance to the specific customer premises security conditions if the provider staff has to work in these premises.

6.3.2 Technical upgrade

All QoS assessments related to activities associated with the alteration of a telecommunication service, from the time the user is informed of a technical upgrade by the provider to the time this upgrade is carried out to the satisfaction of the customer.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to technical upgrade	Provider capacity to take into account the technology evolution: Assessment of the provider ability to take into account the technology evolution by a representative user panel. (OR value) Hours staff can be accessed - (Audit)
Rate of technical upgrade failure	The ratio (percentage) of technical upgrade not according to specification and therefore requiring reworking or further service upgrade processes and resources to get it right to the total number of contracts upgraded. {**Reference:** P507 Conformity and success of technical upgrade [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Completeness of fulfilment of specification in the technical upgrade of a service	The ratio (percentage) of the number of successful upgrades where all specification requirements have been met to the total number of contracts with such upgrades due in a specified period. {**Reference: P503** Completeness of fulfilment of specification in the technical upgrade of a service [%]; ETSI EG 202 843 [i.16]}
Technical upgrade not complete and correct first time	The ratio (percentage) of the number of contracts not completely carried out or not correctly carried out in the first attempt to the total number of contracts. {**Reference: P506** Technical upgrade not complete and correct first time [%]

Time

Metric	Related indicator definition (KQI)
Upgrade duration	The time elapsed from the instant the technical upgrade period was announced to the user to the instant the technical upgrade was carried out. {**Reference: P501** Time for technical upgrade of a service [Time]; ETSI EG 202 843 [i.16]}
Punctuality of appointments	The time difference between the actual technical upgrade and the scheduled upgrade time announced by the SP. {**Reference:** P504 Punctuality of appointments for technical upgrade [Time]; ETSI EG 202 843 [i.16]}
Outage time due to technical upgrade	The duration when the service in part or in full is unavailable to the customer for use due to the technical upgrade process. {**Reference:** P505 Outage time due to technical upgrade [Time]; ETSI EG 202 843 [i.16]}

Capacity

Metric	Related indicator definition (KQI)
Successful technical upgrade within a specified period	The ratio of successful service technical upgrades carried out in a specified timeout interval to the total number of technical upgrades carried out within the same period. {**Reference: P502** Successful technical upgrade within a specified period [%]; ETSI EG 202 843 [i.16]}
Organizational efficiency of SP to carry out technical upgrade	The organizational and hardware SP resource availability on the part of the SP to carry out technical upgrades to meet the needs of the customer and/or to meet contractual promises. {**Reference: P512** Organizational efficiency of SP to carry out technical upgrade [OR]; ETSI EG 202 843 [i.16]}
Competence and preparedness of SP for technical upgrade	The degree of SP ability (competence) and willingness (preparedness) to incorporate technical upgrade relevant to the service for the benefit of users. {**Reference: P513** Competence and preparedness of SP for technical upgrade [OR]; ETSI EG 202 843 [i.16]}

Reliability

Metric	Related indicator definition (KQI)
Rate of overall reliability	The ratio (percentage) of the upgrades that perform satisfactorily for a specified period after the upgrade to the total number of upgrades carried out. {**Reference: P508** Technical reliability of service within an agreed period after technical upgrade [%]; ETSI EG 202 843 [i.16]}
Overall quality of the technical upgrade process	Assessment of the overall quality of the technical upgrade process by a representative user panel (OR value). {**References: P509** Overall quality of the technical upgrade process [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the provider ability to match the customer's wishes by a representative user panel - (OR value).
{**References: P510** Provider ability to match the customer's wishes for conditions of achievement [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Usability

KQI: Assessment of the user friendliness of the technical upgrade process by a representative user panel - (OR value).
{**References: P511** User friendliness of the means available to the customer for the operations he has to perform [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications
Compliance to the specific customer premises security conditions if the provider staff has to work in these premises.

6.4 Service support

All QoS assessments related to activities associated with the support of a telecommunication service to enable the customer's use of the service.

6.4.1 Documentation

All QoS assessments related to activities associated with provision of documentation to install, set-up and use the various features of the service as well as to identify and fix possible troubles.

Availability

Metric	Related indicator definition (KQI)
Availability of the documentation in due time	The ratio (percentage) of the number of contracts where documentation was supplied within a specified period of time to the total number of contracts where documentation was expected. {**Reference: P612** Availability of documentation within specified period of time [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Correctness and completeness of the documentation	Assessment of the correctness, completeness and user friendliness of pertinent information associated with the use of all features of a service and its maintenance (release, version, etc.) via an audit. {**Reference: P613** Integrity (correctness and completeness) of documentation [OR]; ETSI EG 202 843 [i.16]}
Legibility of documentation	"Legibility of documentation" is characterized by visual clarity, language, understandability and layout of the information in the medium in which it is presented. {**Reference: P615** Legibility of documentation [OR]; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Documentation delivery time	The time taken from the instant a service is provided to the instant the documentation for the commissioning and use of the service is delivered to the customer. {**Reference: P611** Documentation delivery time [Time]; ETSI EG 202 843 [i.16]}

Capacity

Metric	Related indicator definition (KQI)
N/A	No SLO expected from the user side on this aspect.

Reliability

Metric	Related indicator definition (KQI)
Overall reliability of the documentation services	Consistent availability, integrity, time of provisioning of the documentation and associated support activities provided by the SP for a given service. {**Reference: P616** Overall reliability of documentation services [OR]; ETSI EG 202 843 [i.16]}

Flexibility

KQI: The number of modes in which documentation is made available to the customer or user of a service (paper, phone, Internet, information desk, etc.). Audit.
{**Reference: P614** Modes of documentation [Number]; ETSI EG 202 843 [i.16]}

Usability

KQI: Assessment of the legibility of the documentation (Size of the print font, ease of reading, use of words from the common language) by a representative user panel.
(OR value)

Security

KQI: Efficiency and robustness of the customer's private data protection mechanism: Certificate from an entitled body.

6.4.2 Technical support

All QoS assessments related to activities associated with the technical support of a telecommunication service to help users experiencing problems in the use of the service.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to the technical support	The ratio of the number of successful attempts to technical support to the total number of attempts to reach this support. {**Reference: P621** Accessibility of the technical support [%]; ETSI EG 202 843 [i.16]}
Number of attempts before successful solution	The number of attempts before the technical request was successfully solved. {**Reference:** P623 Number of attempts before successful solution [Number]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Rate of recognition of the customer request	Exhaustiveness and clarity of the recognition of the customer request: {**References: P627** Recognition of the customer technical request [%]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
Integrity of technical solution	The proportion of successful solutions with respect to the total number of requests within a specified period of time. {**Reference: P624** Integrity of technical solution; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Response time of the technical support	Time elapsed between the end of dialling and reaching a technical operator (The average of and variation in the time taken to establish a call) P628a) the times by which the fastest 50 %, 95 % and 99 % of calls reach an operator. P628b) percentage of calls answered within 2 minutes. (Information from switchboard (PABX)). {**References: P628** Response time of the technical support; ETSI EG 202 843 [i.16]. **P8** Response time for admin/billing enquiries; ETSI ES 202 057-1 [i.18]}
Customer complaints resolution time	P629a) the time by which the fastest 80 % and 95 % of complaints have been resolved (expressed in clock hours); or P629b) the percentage of complaints resolved any time stated as an objective by the service provider. {**References: P629** Customer complaints resolution time; ETSI EG 202 843 [i.16]. **P10** Customer complaints resolution time; ETSI ES 202 057-1 [i.18]}

Capacity

Metric	Related indicator definition (KQI)
N/A	Ideally services should run smoothly without any need for technical support, therefore no SLO is expected from the user side on this aspect.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any. {**Reference: P625** Reliability of technical solutions achieved [%]; ETSI EG 202 843 [i.16]
Number of customer requests	Number of customer requests logged per customer. **{References: P630** Number of customer requests to technical support logged per customer [Number]; ETSI EG 202 843 [i.16]. **P9** Number of customer complaints per data collection period [Number]; ETSI ES 202 057-1 [i.18]}
Professionalism of help line	The degree of satisfaction that a customer has with the professionalism of a help line. Assessment carried out by a representative user panel. {**Reference: P15** Professionalism of help line [OR]; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: The number of modes in which technical support is available to the customer or user of a service (phone, Internet, FAQ, e-mail, chat, support at home, etc.). Audit
{**Reference: P626** Modes of technical support [Number]; ETSI EG 202 843 [i.16]}

Usability

KQI: Assessment of the assurance, dependability, empathy and responsiveness of the technical support by a representative user panel.
(OR value)
{**References: P631** User friendliness of the technical support [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
Qualification of the Customer Relationship Management (CRM). Certificate from an entitled body

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications
Compliance to the specific customer premises security conditions if the provider staff has to work in these premises.

6.4.3 Commercial support

All QoS assessments related to activities associated with the commercial support of a telecommunication service.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to the commercial support	The ratio of the number of successful access attempts to the commercial support to the total number of attempts to reach this support. {**Reference: P641** Accessibility of the commercial support [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Rate of recognition of the customer request	Exhaustiveness and clarity of the recognition of the customer request: Rate of call to the support due to an issue not solved after the first call. {**References: P646** Recognition of the customer commercial request [%]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
Integrity of solution achieved by the SP	The ratio of successful solutions achieved within the specified period of time to the total number of commercial support requests. {**Reference: P644** Integrity of solution achieved by the SP [OR]; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Response time of the commercial support	Time elapsed between the end of dialling and reaching a commercial operator: (The average of and variation in the time taken to establish a call) P647a) mean time to answer; and P647b) percentage of calls answered within 20 seconds; {**References: P647** Response time of the commercial support [Time & %]; ETSI EG 202 843 [i.16]. **P8** Response time for admin/billing enquiries; ETSI ES 202 057-1 [i.18]} c) percentage of calls answered within 2 minutes (Information from switchboard (PABX)).
Customer complaints resolution time	The duration from the instant a customer complaint is notified to the published point of contact of a service provider and is not found to be invalid to the instant the cause for the complaint has been resolved. P648a) the time by which the fastest 80 % and 95 % of complaints have been resolved (expressed in clock hours); or P648b) the percentage of complaints resolved any time stated as an objective by the service provider. {**References: P648** Request to commercial support resolution time [Time & %]; ETSI EG 202 843 [i.16]. **P10** Customer complaints resolution time; ETSI ES 202 057-1 [i.18]}
Commercial solution delivery time	The time elapsed from the instant the customer raised a problem with commercial support to the instant a solution is achieved. {**Reference: P642** Commercial solution delivery time [Time]; ETSI EG 202 843 [i.16]}

Capacity

Metric	Related indicator definition (KQI)
Organizational Efficiency of the commercial support	The organizational resource availability to fulfil customer needs. {**Reference: P652** Organizational efficiency of commercial support [OR]; ETSI EG 202 843 [i.16]}
Commercial solutions achieved within a specified period	The ratio (percentage) of the number of contracts with successful commercial solutions achieved, to the total number of contracts where solutions were sought within a specified period. {**Reference: P643** Commercial solutions achieved within a specified period [%]; ETSI EG 202 843 [i.16]}

Reliability

Metric	Related indicator definition (KQI)
Rate of overall reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of customer requests to commercial support logged per customer. {**References: P649** Number of customer requests to commercial support [Number]; ETSI EG 202 843 [i.16]. **P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}
Overall quality of the commercial support	Assessment of the overall quality of the commercial support by a representative user panel. (OR value) {**References: P650** Quality of the commercial support [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: The number of modes in which commercial support is available to the customer or user of a service (phone, Internet, FAQ, e-mail, chat, etc.). Audit
{**Reference: P645** Modes of commercial support [Number]; ETSI EG 202 843 [i.16]}

Usability

KQI: Assessment of the commercial support dependability, assurance, empathy and responsiveness by a representative user panel.
(OR value)
{**References: P651** User friendliness of the commercial support; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
Qualification of the Customer Relationship Management (CRM) Certificate from an entitled body.

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body. Protection against unexpected customer's data modifications.

6.4.4 Complaint management

All QoS assessments related to activities associated with the customer's complaints to the provider about the service provided.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to the complaint management desk	The ratio of the number of successful attempts to the total number of attempts to reach this support in a specified period. {**Reference: P661** Accessibility of the complaint management desk [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Rate of recognition of the customer claim	The ratio (percentage) of the customer claims recognized by the SP as complaints to the total number of claims made as potential complaints. {**Reference: P662** Recognition of the customer complaints [%]; ETSI EG 202 843 [i.16]}
Integrity of complaint resolution	The ratio (percentage) of the number of complete and professional resolution of the contributory causes of a complaint to the total number of accepted user complaints accepted. {**Reference: P664** Integrity of complaint resolution [%]; ETSI EG 202 843 [i.16]}
Complaint solutions not complete and correct first time	The ratio (percentage) of the number of complaints which were not successfully resolved at the first attempt to the total number of complaints received by the SP. {**Reference: P663** Complaint solutions not complete and correct first time [%]; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Response time of the complaint management desk	Time elapsed between the end of dialling and reaching an operator at complaint management desk: (The average of and variation in the time taken to establish a call) P667a) mean time to answer; and P667b) percentage of calls answered within 20 seconds; {**References: P667** Response time of the complaint management desk [Time & %]; ETSI EG 202 843 [i.16]. **P8** - Response time for admin/billing enquiries; ETSI ES 202 057-1 [i.18]}; c) percentage of calls answered within 2 minutes. (Information from the switchboard (PABX)).
Customer complaints resolution time:	The duration from the instant a customer complaint is notified to the published point of contact of a service provider and is not found to be invalid to the instant the cause for the complaint has been resolved: P668a) the time by which the fastest 80 % and 95 % of complaints have been resolved (expressed in clock hours); or P668b) the percentage of complaints resolved any time stated as an objectively the service provider. {**References: P668** Customer complaints resolution time [Time & %]; ETSI EG 202 843 [i.16]. **P10** Customer complaints resolution time; ETSI ES 202 057-1 [i.18]}

Capacity

Metric	Related indicator definition (KQI)
Efficiency of the complaint management	The availability and deployment of organizational and hardware resources on the part of the SP to resolve user's complaints. {**Reference: P671** Organization efficiency of complaint management system [OR]; ETSI EG 202 843 [i.16]}

Reliability

Metric	Related indicator definition (KQI)
Rate of overall reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Qualification of the Customer Relationship Management (CRM)	Certificate from an entitled body.
Number of customer complaints	Number of complaints logged per customer for unsolved complaints. {**References: P669** Number of customer complaints of any kind [Number]; ETSI EG 202 843 [i.16]. **P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}
Professionalism of help line	Assessment of the professionalism of help line by a representative user panel. (OR value) {**References: P670** Professionalism of the complaint management desk [OR]; ETSI EG 202 843 [i.16]. **P15** Professionalism of help line; ETSI ES 202 057-1 [i.18]}
Overall quality of the complaint management process	Assessment of the overall quality of the complaint management process by a representative user panel - (OR value). {**References: P666** Overall quality of the complaint management process [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: List of available complaint channels (phone, Internet, e-mail, chat, etc.). Audit.

Usability

KQI: The exhibition by the SP of combination of Assurance, Empathy and Responsiveness in dealing with the complaints from their reporting to their satisfactory resolution.
[**Reference: P665** Customer perception of the complaint management [OR];
ETSI EG 202 843 [i.16]}
Qualification of the Customer Relationship Management (CRM) Certificate from an entitled body.

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications

6.5 Repair services

All QoS assessments related to activities associated with the restoration of a telecommunication service to the customer after a fault resulting in partial or complete loss of service or part of service features.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to resources at the provider to carry out repair as requested by the customer	The availability of hardware, software and staff resources necessary to restore a service (and its features) to its specified level of performance. {**Reference: P701** Accessibility of repair services [%]; ETSI EG 202 843 [i.16]}
Rate of successful repairs carried out within a specified period	The ratio of the number of repairs successfully carried out to the total number of repair requests accepted by the SP within a specified period. {**Reference:** P702 Successful repairs carried out within a specified period [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Rate of repairs not complete and correct first time	The ratio (percentage) of the number of repairs which were not successfully carried out at the first (and only) attempt to the total number of repairs carried out during the specified period. {**Reference: P703** Repairs not complete and correct first time [%]; ETSI EG 202 843 [i.16]}

Time

Metric	Related indicator definition (KQI)
Punctuality of appointments for repairs	A record of attendance of a SP agent to carry out repair at the specified time (allowing, if necessary, a grace period for lateness). It may also be expressed as an opinion rating of customers. P704a OR of a user sample on punctuality of appointments for repairs P704b Mean difference between actual time repair occurs ant the announced time. {**Reference: P704** Punctuality of appointments for repairs [OR & Time]; ETSI EG 202 843 [i.16]}
Fault repair time	The duration from the instant a fault has been notified by the customer to the published point of contact of the service provider to the instant when the service element or service has been restored to normal working order: P706a) Time to repair 80 % and 95 %, and %age on target date for any category of faults. P706b) The percentage of faults cleared any time stated as an objective by the service provider. {**References: P706** Fault repair time [Time & %]; ETSI EG 202 843 [i.16]. **P5** Fault repair time for fixed access lines; ETSI ES 202 057-1 [i.18]}

Capacity

Metric	Related indicator definition (KQI)
Efficiency of the repair service	The parameter "efficiency of the repair service" (mainly technical) of a SP is characterized by the combined performances of: accessibility (P701); the number of repairs in a specified period of time (P702); repairs carried out successfully first time (P703); and punctuality (P704). {**Reference: P705** Efficiency of the repair service [OR]; ETSI EG 202 843 [i.16]}
Organizational efficiency of repair service	The combined performances of: • punctuality (P703); • time to repair (P706); • provision of resources (human, hardware and software); and • the organizational logistics to provide an effective repair service. {**Reference: P711** Organizational efficiency of repair service [OR]; ETSI EG 202 843 [i.16]}

Reliability

Metric	Related indicator definition (KQI)
Rate of overall reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints related to repair services logged per customer {**References: P707** Number of customer complaints related to repair services; ETSI EG 202 843 [i.16]. **P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]**}**
Professionalism of the repair staff	Assessment of the repair staff professionalism by a representative user panel. (OR value) {**References: P708** Professionalism of the repair staff [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the provider ability to match the customer's wishes for conditions of achievement by a representative user panel.
(OR value)
{**References: P709** Provider ability to match the customer's wishes for conditions of achievement [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}

Usability

KQI: Assessment of the repair staff assurance, dependability, empathy and responsiveness by a representative user panel.
(OR value)
{**References: P710** User friendliness of the repair service; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
Qualification of the Customer Relationship Management (CRM) Certificate from an entitled body.

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications.
Compliance to the specific customer premises security conditions if the provider staff has to work in these premises.

6.6 Metering/charging/billing

All QoS assessments related to relevant activities associated with the metering, charging and billing for a telecommunication service to a customer.

The indicators given in the following tables should be applied separately to the different services:

- Fixed service.
- Mobile services.
- ISP.
- Etc.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to the documents enabling for expense control Accessibility of the tariff information	The ratio of the number of successful attempts to the total number of attempts to reach this facility located as indicated in the contract or regulations (Access details to this facility to be provided by the SP). {**Reference: P801** Accessibility of the tariff information [%]; ETSI EG 202 843 [i.16]}
Accessibility of the account management	The ratio of the number of successful attempts to the total number of attempts to reach the account management. {**Reference: P804** Accessibility of the account management [%]; ETSI EG 202 843 [i.16]}
Successful notification of exceeding billing budget	The ratio (percentage) of the number of successful notifications by the SP of exceeding the customer's billing budget to the total number of exceeding customer's billing budget events. {**Reference: P802** Successful notification of exceeding billing budget [%]; ETSI EG 202 843 [i.16]}
Rate of accessibility to the expense signal (beyond fixed rate expenses)	Audit.
Rate of accessibility to the real time expense information (beyond fixed rate expenses)	Audit.

Integrity

Metric	Related indicator definition (KQI)
Counting accuracy	Audit and certification of the charging/billing system by a trusted third party.
Discrepancy between the actual use of the service and the accounting	
Accuracy of the compliance to the published tariff	
Limited account undue overrun	
Errors in detailed bill	
Errors in real time expense information	

Time

Metric	Related indicator definition (KQI)
Notification time (delay) of exceeding billing budget	The time from the instant of billing budget overrun to the instant of the reception by the customer of this notification from the SP. {**Reference: P803** Notification time (delay) of exceeding billing budget [Time]; ETSI EG 202 843 [i.16]}
Time to update charging information	The time between the use of service and the instant the related charging information is available on the account. {**Reference: P805** Time to update charging information [Time]; ETSI EG 202 843 [i.16]}
Timeliness of bill delivery	The ratio of the number of bills delivered within the bill expectation period divided by the number of bills expected within the observation period. {**Reference: P806** Timeliness of bill delivery [%]; ETSI EG 202 843 [i.16]}
Bill delivery delay	The delay between the expected time of bill and its receipt. {**Reference: P807** Bill delivery delay [Time]; ETSI EG 202 843 [i.16]}
Late notification of amount due	The ratio (percentage) of the number of bills whose "Direct Debit" amount was not advised to the customers before payment was taken from their account to the total number of "Direct Debit" payment arrangements in place. {**Reference: P808** Late notification of amount due [%]; ETSI EG 202 843 [i.16]}

Capacity

Metric	Related indicator definition (KQI)
No SLO expected from the user side on this aspect.	
Organizational efficiency of the billing service (provider)	The organizational and hardware resource availability to carry out the billing service. {**Reference: P815** Organizational efficiency of the billing service [OR]; ETSI EG 202 843 [i.16]}

Reliability

Metric	Related indicator definition (KQI)
Rate of bill correctness complaints	The proportion of bills resulting in a customer complaint about the correctness of a given bill. {**References: P810** Bill correctness complaints [%]; ETSI EG 202 843 [i.16]. **P11** Bill correctness complaints [%]; ETSI ES 202 057-1 [i.18]}
Rate of prepaid account credit correctness complaints	The proportion of prepaid accounts resulting in a customer complaint about the correctness of its credit or the charges made. {**References: P811** Prepaid account credit correctness complaints [%]; ETSI EG 202 843 [i.16]. **P12** Prepaid account credit correctness complaints [%]; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the provider ability to match the customer's wishes for charging/billing conditions (e.g. for outstanding debt, last bills, etc.) by a representative user panel.
(OR value)
{**References: P812** Provider ability to match the customer's wishes for charging/billing conditions [OR]; ETSI EG 202 843 [i.16]. **P14** OR of customer relations; ETSI ES 202 057-1 [i.18]}
The number of modes offered by the SP to communicate the billing information to the customers (phone, Internet, e-mail, chat, etc.).
{**Reference: P809** Modes of billing information transfer [Number]; ETSI EG 202 843 [i.16]}

Usability

KQI: Assessment of the assurance, empathy and responsiveness of the commercial support by a representative user panel.
(OR value)
{**References: P813** User friendliness of the desk in charge of billing issues [OR]; ETSI EG 202 843 [i.16]. **P14** Customer relations [OR]; ETSI ES 202 057-1 [i.18]}
Qualification of the Customer Relationship Management (CRM) Certificate from an entitled body
The degree of satisfaction that a customer has with the bill presentation quality.

P814a) How easy is it to find exactly which tariffs and optional services you are subscribing to?
P814b) How easy is it to locate the record of a specific call to a specific number?
P814c) How easy is it to find the exact price paid including VAT and any discounts, for a specific call?
P814d) How easy is it to find which charge band and which rate (peak/off-peak) is applied to a specific call?
P814e) How do you rate the bill overall in terms of clarity, understandability and ease of use?

{**References: P814** Bill presentation quality [OR]; ETSI EG 202 843 [i.16]. **P13** Bill presentation quality [OR]; ETSI ES 202 057-1 [i.18]}

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications

6.7 Network/service management by the customer

All QoS assessments related to activities associated with the customer's control of predefined changes to telecommunication services or network configurations.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to the network/service management facility	P906a) Hours staff can be accessed (human operator) - (Survey). P906b) Percentage of attempts where an operator was not reach in less than 3 minutes. P906c) Percentage of successful log-ins to the server with regard to the total attempt number required. {**References: P906** Accessibility of the network/service management facility [Time & %]; ETSI EG 202 843 [i.16]. Successful log-in ratio; ETSI EG 202 057-4 [i.15]}
Outage duration	The total time a Network/Service Management facility was not accessible to the customer during a specified reporting period. {**Reference: P901** Outage duration [Time]; ETSI EG 202 843 [i.16]}
Number of outages	The number of times access to the Network/Service Management facility was not available to the customer during a specified period. {**Reference: P902** Number of outages [Number]; ETSI EG 202 843 [i.16]}
Rate of successful request response	The ratio (percentage) of the number of requests made by the customer successfully handled (within the specified time out period) to the total number of requests made over the observation period. {**Reference:** P904 Successful request response [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Compliance rate of the server features to the specifications	(Audit or survey)

Time

Metric	Related indicator definition (KQI)
Response time of the operator of the network/service management facility	Time elapsed between the end of dialling and reaching an operator: (The average of and variation in the time taken to establish a call) P907a) mean time to answer; and P907b) percentage of calls answered within 20 seconds; P907c) percentage of calls answered within 2 minutes. Information from switchboard (PABX). {**References: P907** Response time of the operator of the network/service management facility [Time & %]; ETSI EG 202 843 [i.16]. **P8** Response time for admin/billing enquiries [Time & %]; ETSI ES 202 057-1 [i.18]}
Network/Service (N/S) Management access time	Time in seconds within the fastest 80 % and 95 % of logins to the network/service management server. {**References: P908** Network/Service (N/S) Management access time [Time]; ETSI EG 202 843 [i.16]. Login time; ETSI EG 202 057-4 [i.15]}
Response time for reply to requests	The time elapsed from the instant customer requests access to the Network/Service Management facility to the instant such a request was carried out. {**Reference: P903** Response time for reply to requests [Time]; ETSI EG 202 843 [i.16]}

Capacity

Metric	Related indicator definition (KQI)
Volume of network service management transaction	The SLO expected from the user side on this aspect is the number of network service management transactions over a given period of time.
Efficiency of the network/service management service	The combined effects of human, network and other pertinent resources made available by the SP to process and fulfil any volume of customer requests to the Network /Service Management facility on a 24/7 basis. {**Reference: P913** Organizational efficiency of the network / service management service [OR]; ETSI EG 202 843 [i.16]}
Range of configuration parameters accessible by the user	List of configuration parameters (Audit).

Reliability

Metric	Related indicator definition (KQI)
Overall reliability of Network/Service management service	The consistent combined performance of availability, response times, response rates, correctness and completeness in the processing and fulfilment of customer requests for Network/Service management facilities. {**Reference: P905** Overall reliability of Network/Service management service [OR]; ETSI EG 202 843 [i.16]}
Number of customer complaints	Number of customer complaints related to network/service management by the customer. {**References: P909** Number of customer complaints related to network/service management by the customer [Number]; ETSI EG 202 843 [i.16]. **P9** Number of customer complaints [Number]; ETSI ES 202 057-1 [i.18]}
Overall quality of the network/service management process	Assessment of the overall quality of the network/service management process by a representative user panel. (OR value) {**References**: **P910** Overall quality of the network/service management process [OR]; ETSI EG 202 843 [i.16]. **P14** Customer relations [OR]; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: Assessment of the provider ability to match the customer's wishes by a representative user panel. {**References: P911** Provider ability to match the customer's wishes for network/service management conditions [OR]. **P14** Customer relations [OR]; ETSI ES 202 057-1 [i.18]}
List of available means for network/service management (phone, Internet, specific workstation, etc.) (Survey).

Usability

KQI: Assessment of the user friendliness of the means available to the customer for the operations he has to perform by a representative user panel - (OR value).
{**References: P912** User friendliness of the means available to the customer for the operations he has to perform [OR]; ETSI EG 202 843 [i.16]. **P14** Customer relations [OR]; ETSI ES 202 057-1 [i.18]}

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body. Protection against unexpected customer's data modifications.

6.8 Cessation

All QoS assessments related to activities associated with the cessation of a telecommunication service from the time it was requested by a customer, to the time it was completed to the satisfaction of the customer.

Availability

Metric	Related indicator definition (KQI)
Rate of accessibility to the cessation facility	The ratio (percentage) of the number of successful attempts to the total number of attempts to reach the cessation facility. {**References: P1003** Accessibility of the cessation facility [%]; ETSI EG 202 843 [i.16]}

Integrity

Metric	Related indicator definition (KQI)
Rate of correctness and completeness in taking the customer request into account.	P1005a) First time failure: Number of times the request has not been completed satisfactorily at the first time with respect to the total number of requests. P1005b) Rate of call to the support due to an issue not solved after the first call. P1005c) Number of attempts before reception of any kind of acknowledgment from the provider. P1005d) Number of cessation requests that are not completed satisfactorily within a given period of time stated as an objective by the service provider. {**References: P1005** Correctness and completeness in taking the customer cessation request into account [Number & %]; ETSI EG 202 843 [i.16]. **P14** Customer relations [OR]; ETSI ES 202 057-1 [i.18]}

Time

Metric	Related indicator definition (KQI)
Response time of the cessation facility	Time elapsed between the end of dialling and reaching an operator to cessation facility: (The average of and variation in the time taken to establish a call) P1006a mean time to answer [Time]; and P1006b percentage of calls answered within 20 seconds [%]. {**References: P1006** Response time of the cessation facility [Time & %]; ETSI EG 202 843 [i.16]. **P8** Response time for admin/billing enquiries [Time & %]; ETSI ES 202 057-1 [i.18]}
Cessation acknowledgement time	The time elapsed from the instant of sending the cessation request to the instant of receipt by the customer of the acknowledgment from the SP. {**Reference: P1001** Cessation acknowledgement time [Time]; ETSI EG 202 843 [i.16]}
Rate of cessation request acknowledgements	The ratio (percentage) of the number of cessation requests that were acknowledged to the number of such requests made in a specified period. {**Reference: P1002** Cessation request acknowledgement [%]; ETSI EG 202 843 [i.16]}

Capacity

Metric	Related indicator definition (KQI)
N/A	No SLO expected from the user side on this aspect.
Efficiency of the cessation facility. Contractual cessation achieved	The ratio (percentage) of the number of contractual cessations requested to the total number of such requests made within a specified period. {**Reference: P1004** Contractual cessation achieved [%]; ETSI EG 202 843 [i.16]}

Reliability

Metric	Related indicator definition (KQI)
Qualification of the Customer Relationship Management (CRM)	Certificate from an entitled body.
Overall quality of the cessation process	Assessment of the overall quality of the cessation process by a representative user panel. (OR value) {**References: P1007** Overall quality of the cessation process [OR]; ETSI EG 202 843 [i.16]. **P14** Customer relations [OR]; ETSI ES 202 057-1 [i.18]}
Number of customer complaints	Number of complaints related to cessation logged per customer. {**References: P1008** Number of customer complaints related to cessation [Number]; ETSI EG 202 843 [i.16]. **P9** Number of customer complaints [Number]; ETSI ES 202 057-1 [i.18]}

Flexibility

KQI: List of available means for network/service management (phone, Internet, specific workstation, etc.) (Survey).

Usability

KQI: Assessment of the ease of the cessation process by a representative user panel:
P1009 Ease of the cessation process [OR]
P1009a Ease with which all activities associated with the cessation of the contract may be carried out with the provider [OR].
P1009b Ease with which forms can be filled and ease with which they are taken into account by the provider [OR].
{**Reference:** P14 Customer relations [OR]; ETSI ES 202 057-1 [i.18]}
List of available channels for cessation (phone, Internet, information desk, etc.)

Security

KQI: Efficiency and robustness of the customer authentication: Certificate from an entitled body.
Protection against unexpected customer's data modifications.

7 Specific service elements

This clause is dedicated to specific service elements intended to enhanced particular aspects of a service offer. It is not the purpose here to assess the effectiveness of these service elements regarding the function they are supposed to achieve but only to assess their impact on the main service QoS with regard to its availability, integrity, time and capacity requirements.

7.1 Security as a service element

To ensure its aims the security service includes the following elements:

- Identification
- Authentication
- Authorization
- Encryption
- Non repudiation
- Time stamping

- Digital signature
- Certificate management

7.1.1 Identification service element

Identification is the process of establishing the identity of an object or person.

Identity management describes the management of the authentication and authorization of an object or a person, and related access rights. It focuses on granting authorized users the right to use a service, while preventing access to non-authorized users.

Availability

Metric	Related indicator definition (KQI)
Unsuccessful identification request ratio	An unsuccessful identification request is an identification attempt with valid parameters that did not get any reply in a specified timeout period. Unsuccessful request ratio is defined as the ratio of unsuccessful requests to the total number of request attempts in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of wrong reply to identification requests	A wrong reply to an identification requests is an unexpected reply with regard to the validity of the identification request. The rate of wrong reply to identification requests is the percentage of requests getting a false reply to the total number of requests.

Time

Metric	Related indicator definition (KQI)
Response time to the identification request	Elapsed time between the sending of the request and the server reply The times by which the fastest 50 %, 95 % and 99 % of replies are provided.

Capacity

Metric	Related indicator definition (KQI)
Identification request flow	Maximum number of identification requests handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the identification service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.1.2 Authentication service element

Authentication is the provision of assurance of the claimed identity of an entity. (ISO/IEC 18028-4:2005 [i.29])

Availability

Metric	Related indicator definition (KQI)
Unsuccessful authentication request ratio.	An unsuccessful authentication request is an authentication attempt with valid parameters that did not get any valid reply in a specified timeout period. Unsuccessful request ratio is defined as the ratio of unsuccessful requests to the total number of request attempts in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of wrong reply	A wrong reply to an authentication requests is an unexpected reply with regard to the validity of the authentication request. The rate of wrong reply to authentication requests is the percentage of requests getting a wrong reply to the total number of requests.

Time

Metric	Related indicator definition (KQI)
Response time to the authentication requests	Elapsed time between the sending of the request and the server reply. The times by which the fastest 50 %, 95 % and 99 % of replies are provided.

Capacity

Metric	Related indicator definition (KQI)
Authentication request flow	Maximum number of authentication requests handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the authentication service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.1.3 Authorization service element

Authorization is the process of granting of permission based on authenticated identification (see ISO/IEC 7498-2 [i.30]).

Availability

Metric	Related indicator definition (KQI)
Unsuccessful authorization request ratio	An unsuccessful authorization request is an authorization attempt with valid parameters that did not get any reply in a specified timeout period. Unsuccessful request ratio is defined as the ratio of unsuccessful requests to the total number of request attempts in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of wrong reply	A wrong reply to an authorization requests is an unexpected reply with regard to the validity of the authorization request. The rate of wrong reply to authorization requests is the percentage of authorization requests getting a wrong reply to the total number of requests.

Time

Metric	Related indicator definition (KQI)
Response time to the authorization requests	Elapsed time between the sending of the request and the server reply. The times by which the fastest 50 %, 95 % and 99 % of replies are provided.

Capacity

Metric	Related indicator definition (KQI)
Authorization request flow	Maximum number of authorization requests handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the authorization service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.1.4 Encryption service element

Encryption is the (reversible) transformation of data by a cryptographic algorithm to produce ciphertext, i.e. to hide the information content of the data. (ISO/IEC 9797-1 [i.31]).

Availability

Metric	Related indicator definition (KQI)
Unsuccessful encryption invocation ratio	An unsuccessful encryption invocation is an encryption invocation attempt that did not obtain any outcome in a specified timeout period. Unsuccessful encryption invocation ratio is defined as the number of unsuccessful encryption invocations to the total number of encryption invocations in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of encryption process errors	An encryption process error occurs when the decryption output is different from the encryption input. The rate of encryption process errors is the percentage of encryption process errors to the total number of encryption requests.

Time

Metric	Related indicator definition (KQI)
Response time to the encryption invocation	Elapsed time between the sending of the request and the server reply The times by which the fastest 50 %, 95 % and 99 % of replies are provided.

Capacity

Metric	Related indicator definition (KQI)
Encryption invocations flow	Maximum number of encryption invocations handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the encryption service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.1.5 Non repudiation service element

Non-repudiation is the ability to prove an action or event has taken place, so that this event or action cannot be repudiated later (ISO/IEC 13888-1 [i.32]; ISO/IEC 7498-2 [i.30]).

Usually, non repudiation is based on digital certificates, electronic signatures and/or other similar data stored safely as the proof of the occurrence of an action or event.

Availability

Metric	Related indicator definition (KQI)
Accessibility rate to the non repudiation service	An unsuccessful non repudiation request is a non repudiation attempt with valid parameters that did not get any reply in a specified timeout period. The accessibility rate is defined as the ratio of unsuccessful valid requests to the total number of request attempts in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of non-repudiation errors	A non-repudiation error occurs when a request for proof data obtains an invalid outcome from the server. The rate of non repudiation errors is the percentage of a non repudiation request obtaining an invalid outcome to the total number of requests.

Time

Metric	Related indicator definition (KQI)
Response time to non repudiation requests	Elapsed time between the sending of the request and the server reply. The times by which the fastest 50 %, 95 % and 99 % of replies are provided.

Capacity

Metric	Related indicator definition (KQI)
Non repudiation request flow	Maximum number of non repudiation requests handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the non repudiation service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.1.6 Time stamping service element

Time stamping service is a service which attests the existence of electronic data at a precise instant of time. (ISO/IEC 15945:2002 [i.33]).

NOTE: Time stamping services are useful and probably indispensable to support long-term validation of signatures.

Availability

Metric	Related indicator definition (KQI)
Accessibility rate to the time stamping service	An unsuccessful time stamping request is a time stamping attempt that did not get any reply in a specified timeout period. The accessibility rate is defined as the ratio of unsuccessful requests to the total number of request attempts in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of time stamping errors	A time stamping error occurs when a request for a time stamp obtain an invalid outcome from the server. The rate of time stamping errors is the percentage of time stamp request attempts obtaining an invalid outcome to the total number of requests.

Time

Metric	Related indicator definition (KQI)
Response time to time stamping requests	Elapsed time between the sending of the request and the server reply The times by which the fastest 50 %, 95 % and 99 % of replies are provided

Capacity

Metric	Related indicator definition (KQI)
Time stamping request flow	Maximum number of time stamping requests handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the time stamping service. {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.1.7 Digital signature service element

A digital signature consist of data appended to, or a cryptographic transformation of, a data unit that allows a recipient of the data unit to prove the origin and integrity of the data unit and protect the sender and the recipient of the data unit against forgery by third parties and sender against forgery by the recipient
(ISO/IEC 11770-3:1999 [i.34]).

Availability

Metric	Related indicator definition (KQI)
Accessibility rate to the digital signature service.	An unsuccessful digital signature request is a digital signature request attempt that did not get any reply in a specified timeout period. The accessibility rate is defined as the ratio of unsuccessful requests to the total number of request attempts in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of digital signature errors	A digital signature error occurs when a request for a digital signature obtain an invalid outcome from the server. The rate of time stamping errors is the percentage of digital signature request attempts obtaining an invalid outcome to the total number of requests.

Time

Metric	Related indicator definition (KQI)
Response time to digital signature requests	Elapsed time between the sending of the request and the server reply The times by which the fastest 50 %, 95 % and 99 % of replies are provided.

Capacity

Metric	Related indicator definition (KQI)
Digital signature request flow	Maximum number of digital signature requests handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the digital signature service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.1.8 Certificate management service element

A certificate is issued by a certification body in accordance with the conditions of its accreditation and bearing an accreditation symbol or statement.

The certificate management service includes all services needed for the maintenance of the lifecycle of certificates, including registration, certification, distribution, and revocation of certificates.

Availability

Metric	Related indicator definition (KQI)
Accessibility rate to the certificate management service.	An unsuccessful certificate management service request is a request attempt to the certificate management service that did not get any reply in a specified timeout period. Unsuccessful request rate is defined as the ratio of unsuccessful requests to the total number of request attempts in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of certificate management service errors	A certificate management service error occurs when a request for a certificate obtain an invalid outcome from the server. The rate of certificate management service errors is the percentage of certificate request attempts obtaining an invalid outcome to the total number of requests.

Time

Metric	Related indicator definition (KQI)
Response time to certificate management service requests	Elapsed time between the sending of the request and the server reply. The times by which the fastest 50 %, 95 % and 99 % of replies are provided.

Capacity

Metric	Related indicator definition (KQI)
Certificate management service request flow	Maximum number of certificate requests handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the certificate management service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.2 Flexibility as a service element

flexibility: ability of a service to be customized with elasticity and scalability features.

The properties of flexibility are customization of services in relation to the offer and the contract SLA, elasticity and scalability.

To ensure its aims, the flexibility service includes the following elements:

- (Re)configuration
- (Re)provisioning

7.2.1 (Re)configuration service element

Availability

Metric	Related indicator definition (KQI)
Rate of inaccessibility to the (re)configuration service transaction	An unsuccessful (re)configuration service transaction is a transaction attempt to that did not get any reply in a specified timeout period or that was rejected. Unsuccessful rate is defined as the number of unsuccessful (re)configuration transaction to the total number of (re)configuration transaction attempts in a specified time period.

Integrity

Metric	Related indicator definition (KQI)
Rate of transaction (re)configuration service errors	The rate of (re)configuration service errors is the percentage of invalid (re)configuration transaction outcome to the total number of (re)configuration transaction.

Time

Metric	Related indicator definition (KQI)
Response time to (re)configuration service transaction	Elapsed time between the sending of the request and the server reply.

Capacity

Metric	Related indicator definition (KQI)
Response time to (re)configuration service transaction	Elapsed time between the sending of the request and the server reply.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the flexibility service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

7.2.2 (Re)provisionning service element

Availability

Metric	Related indicator definition (KQI)
Rate of inaccessibility to the (re) provisionning service transaction	An unsuccessful (re)provisionning service transaction is a transaction attempt to that did not get any reply in a specified timeout period or that was rejected.

Integrity

Metric	Related indicator definition (KQI)
Rate of transaction (re)provisionning service errors	The rate of (re)provisionning service errors is the percentage of invalid (re)provisionning transaction outcome to the total number of (re)provisionning transaction.

Time

Metric	Related indicator definition (KQI)
Response time to (re)provisionning service transaction	Elapsed time between the sending of the request and the server reply.

Capacity

Metric	Related indicator definition (KQI)
(Re)provisionning service transaction flow	Number of (re)provisionning service transaction handled per second.

Reliability

Metric	Related indicator definition (KQI)
Rate of overall technical reliability	Proportion of time during which, over a given period, all the indicators of availability, integrity, time and capacity are complying to the specified ratings if any.
Number of customer complaints	Number of complaints per data collection period about the flexibility service {**Reference: P9** Number of customer complaints; ETSI ES 202 057-1 [i.18]}

8 Specific aspects of the general public users' criteria

Unlike QoS measurements concerning business users which results are intended to be checked privately with respect to a SLA, measurements related to the general public users are expected to be made publicly available.

Since general public users do not have the resources needed to make their own QoS measurements, they 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 tables of clauses 5 and 6 allow to identify the metrics and indicators relevant to any kind of users, in particular the general public. Nevertheless, two aspects particularly important to the users have to be pointed out:

- The QoS thresholds given there, when available, should be taken as guidance when choosing the most suited supplier and not an obligation; unless a regulatory target is defined.
- Survey and Opinion Rating (OR) should be carried out among a carefully selected panel of the general public.

In addition, the general public users do not want to enter in all details of the QoS and need an information focused on his current concerns. As a general principle, to provide such information a set of indicators should be usefully chosen using up-to-date statistics on the users' complaints as well as available surveys on issues of their dissatisfaction. This should enable to focus on the most relevant KQI depending on the market conditions from the users' perspective. Hence, it would be easier to publish a limited set of indicators more convenient to understand and use by the common end-users.

As well it would be useful to make available KQI value according to the various timeframes, e.g. business hours, busiest hours, evening, etc.

It should also be highlighted that a private user needs two types of QoS information:

1) when a user wants to find the most suited SP to his particular expectations
2) once subscribed to check whether his SP fulfil its commitments

In both cases, the user is more interested in information related to his/her own context than in the mean QoS the SP provides across the country. From this point of view, crowdsourcing may provide useful end-to-end information, provided such statistics are collected and processed according to the rules of the art.

9 Conclusion

There are obvious lacks at this stage of the document that could hopefully be filled with further revisions. For example, there are several services of interest identified but the related indicator tables need additional work before publication. Further work is also needed to have better metrics and indicators defined..

The present document is intended to provide useful guidance to the standard makers, regulators and providers on the users expectations regarding the QoS of ICT services. 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 chosen provider. ETSI EG 202 009-3 [i.12] is intended to provide useful additional support on this last aspect.

The present document aims at providing help to define SLO on every aspect of the a large scope of the available ICT services with the related metrics and indicators to assess and monitor them. This does not mean that all these indicators should be measured all the time on all communications. Instead, these measurements should focus on the current users' concerns with a reduced set of indicators related to a carefully selected user panel. It is crucial to notice that the choice of this user panel is critical to ensure that the results provide the actual QoS perceived by the users.

Regulation is crucial in the QoS area. Although some big users can have a specific private contract with a provider dedicated to QoS measurements, most users have to rely on third party to monitor the QoS either via information made publicly available by a trusted party or via information provided by their own provider in a SLA context. Therefore, the accuracy and truthfulness of the process of the QoS measurements should be certified by a trusted party so that users can have confidence on the reliability of these measurements. This is the purpose of ETSI TS 102 844 [i.23].

In addition, it is of tremendous importance that a focus point be available to the public for such information.

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