ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

E.803
(12/2011)

SERIES E: OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

Quality of telecommunication services: concepts, models, objectives and dependability planning – Terms and definitions related to the quality of telecommunication services

Quality of service parameters for supporting service aspects

Recommendation ITU-T E.803

ITU-T E-SERIES RECOMMENDATIONS

OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T E.803

Quality of service parameters for supporting service aspects

Summary

Performance data on the non-utilization stages of services, in addition to the service specific performance usually dealing with in-use performance, are necessary to enable customers to choose a service provider (SP) most suited to meet their specific quality of service (QoS) requirements. Recommendation ITU-T E.803 lists 88 generic parameters over the product life cycle of ICT services which will enable a regulator, stakeholder or any interested party to select a pertinent number of parameters about the SP that provide performance data.

QoS performance on non-utilization stages can benefit customers, regulators, stakeholders and service providers (SPs) to monitor performance levels for the benefit of the customers and ICT industry. The essential information to be obtained for measurement and reporting of performance levels is illustrated on a selection of parameters. Guidance on presentation of performance results is also provided. Service providers reporting of delivered performance to a recommended procedure will enable comparability among providers.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T E.803	2011-12-14	12

Keywords

Non-utilization stages of services, QoS.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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Quality of service parameters for supporting service aspects

1 Scope

This Recommendation deals with the quality of service (QoS) parameters that could be of primary interest and concern to the customers and users of ICT services who wish to compare performances of service providers (SPs) of ICT services during the non-utilization stages of such services and secondarily to regulators and service providers.

Recommendations that cover service-specific performances usually apply to services when they are in actual use. However the services surrounding ICT services offered by service providers that are outside the actual usage of services would be of interest and concern to the users. Quality and content of information on a service and its features, the contractual conditions offered by the service provider, provisioning facilities, documentation, and service support after contract with customers are examples of non-utilization stages of ICT services that could be of concern to the users. This Recommendation identifies non-utilization stages and lists a number of QoS parameters from which a selection may be made for the customer to assess the performance of the provider.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T E.800]   Recommendation ITU-T E.800 (2008), *Definitions of terms related to quality of service*.

[ITU-T E.802]   Recommendation ITU-T E.802 (2007), *Framework and methodologies for the determination and application of QoS parameters*.

[ITU-T G.1000]   Recommendation ITU-T G.1000 (2001), *Communications Quality of Service: A framework and definitions*.

[ETSI EG 202 843] ETSI Guide 202 843 (2011), *User Group; Quality of ICT Services; Definitions and Methods for Assessing the QoS parameters of the Customer Relationship Stages other than utilization*.
<http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=37753>

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 cessation [ITU-T E.800]: All activities associated with the cessation of a service by a service provider from the instant a contractual agreement is in force between the customer and the service provider to the instant all hardware and software associated with the service is made inoperative and/or removed from the customer's premises.

3.1.2 charging [ITU-T E.800]: The set of functions needed to determine the price assigned to the service utilization.

3.1.3   confidence level [ITU-T E.800]: The value of the probability associated with a confidence interval or a statistical tolerance interval.

3.1.4   customer [ITU-T E.800]: A user who is responsible for payment for the services.

3.1.5   measure [ITU-T E.800]: A unit by which a parameter may be expressed.

Example: Waiting time for provision of a service may be expressed as calendar or working days.

3.1.6   parameter [ITU-T E.800]: A quantifiable characteristic of a service with specified scope and boundaries.

Example: The parameter for estimating the 'misdialling probability' would be expressed as: 'The number of misdialled calls per 100 call attempts'.

NOTE – Parameters may be objective or subjective.

3.1.7   quality of service (QoS)   [ITU-T   E.800]:   Totality   of   characteristics   of   a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service.

3.1.8   service provider [ITU-T E.800]: An organization that provides services to users and customers.

3.1.9   user [ITU-T E.800]: User is an entity that makes use of CE (e.g., initiates or answers a call (ITU-T Q.1300 (1995)).

or

A person or entity external to the network, which utilizes connections through the network for communication.

NOTE – Connection is used in the context of establishing communication between two points in a network. Connection is "bearer path, label switched path, virtual circuit, and/or virtual path established by call routing and connection routing". (ITU-T E.360.1 (2002) and ITU-T E.361 (2003))

3.2   Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1   opinion rating (OR): OR is a quantitative value (a number) assigned to a qualitative performance criterion on a predefined rating scale to reflect the merit of that criterion to a user or customer. (Refer also to Annex C.)

4   Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CDF   Cumulative Distribution Function

CE   Communication Entity

CM   Complaint Management

OR   Opinion Rating

PDF   Probability Density Function

PI   Preliminary Information

QoSAP   QoS Assessment Party

SP   Service Provider

5   Conventions

Annex C shows time-line sequences of the progress of a criterion (expressed as a parameter) to illustrate the events significant for the identification and measurement of the parameter performance value(s).

6   Identification of QoS parameters for stages other than utilization of a service

Identification of QoS criteria for non-utilization stages of ICT services may be facilitated by the use of frameworks in [ITU-T G.1000] and [ITU-T E.802].

The QoS parameters defined in Annexes A, B and C are based on the contents of [ETSI EG 202 843]. Additional materials to implement these parameters may be found in [b-ETSI TS 102 844] and [b-ETSI TS 102 852].

The criteria have been defined as parameters and care has been taken to ensure that different viewpoints are covered. The range of parameters was intended to cater to different requirements of various customer segments of the population. When selecting a set of QoS parameters to compare performance of SPs it is only necessary to focus on those of relevance and may be restricted to as few as 5-15. Parameters identified are in Annex A.

7   Selection of parameters for the comparison of a service provider's performance by customers

The following considerations should be applied in the selection of parameters for use by customers to determine the service provider's performance.

a)   Comparison of performance of SPs is more likely to be relevant for the providers in a region or country rather than on a global basis. A recognized stakeholder, e.g., regulator may select QoS parameters for the comparison of SPs. This selection could reflect the local market characteristics, customer's preferences and requirements.

b)   The number of parameters may be chosen to be manageable both for reporting and for practical application.

c)   Where local market characteristics require different sets of parameters for different customer sectors this may be reflected in the choice of parameters.

8   Reporting of QoS performance levels for the benefit of customers

Performance levels may be estimated from one or more of the following sources:
–   data held in the SP's systems,
–   customer surveys,
–   opinion rating by expert panels.

The stakeholder/regulator of a region/country may recommend a method of presenting the performance values to enable customers to make easy comparison between SPs. The process of obtaining performance values ought to be audited to international standards.

Annex B gives more details on the procedures for measuring and reporting performance values on a selection of parameters and Annex C gives some guidance to ensure comparability of performance values.

Annex A

List of QoS parameters

(This annex forms an integral part of this Recommendation.)

The following QoS parameters have been identified as being potentially useful for comparison of SPs' performance levels.

Preliminary information on ICT services

Parameter 1: Integrity of preliminary information

Integrity of preliminary information (PI) is characterized by a true and fair view of the main points of an ICT service provided to the potential customers by the SP.

Measured as: Opinion rating.

Parameter 2: Pricing transparency

Pricing transparency of an ICT service is characterized by clarity, conciseness and unambiguity in every tariff structure for all usage conditions for every service provided by the SP.

Measured as: Opinion rating.

Parameter 3: Availability of PI

Ratio of the number of requests for PI from potential users and customers which have been delivered to the total number of requests within a pre-defined time interval.

Measured as: Fraction or percentage.

Parameter 4: Response time for the provision of PI

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.

Measured as: Time.

Contractual matters between ICT service providers and customers

Parameter 5: Integrity of contract information

True and fair view of pertinent information on supply, maintenance and cessation for a telecommunications service provided by a SP.

NOTE 1 – A contractual document describing the supply, maintenance and cessation for a telecommunication service by a SP is clear, accurate, complete, understandable and unambiguous.

NOTE 2 – The language, phrasing and expressions chosen are aimed at maximum understanding for the target customer segment.

Measured as: Opinion rating.

Parameters 6: Compliance of contractual terms with preliminary information

Degree of concurrence of the contents of the contractual document to the PI. This comparison between contractual terms and PI should be based on the PI in force during the period of the contract. Contractual document could have detailed terms which were implicit in the PI. Where differences exist these are not to be considered as errors as long as additional and non-contradictory information is provided.

Measured as: Ratio or percentage.

Parameter 7: Flexibility for customization before contract

The 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.

NOTE – These specific requirements would be departures from the standard service features, performance and terms and conditions normally offered by the SP.

Measured as: Opinion rating.

Parameter 8: Ease and flexibility to amend terms after formal contract

The scope and boundary of the amendments that could be accommodated to contractual terms to satisfy the post contractual amendments sought by a customer.

This excludes contracts which the provider has specifically stated as not considered for amendments.

Measured as: Opinion rating.

<u>Provision of services</u>

Parameter 9: Meeting promised provisioning date

Successful completion of provisioning of service on the date promised in the contract in relation to the total number of signed contracts with promised service provisioning dates.

Measured as: Ratio or percentage.

Parameter 10: Time for provisioning

Period of time between the scheduled provisioning time and the actual provisioning time

Measured as: Time.

Parameter 11: Successful provisioning within specified period

Number of successful service provisioning events in relation to all expected provision events within a pre-defined period of time.

Measured as: Ratio or percentage.

Parameter 12: Contract cancelled due to non-fulfilment

Contracts cancelled due to the ongoing non-fulfilment and considered unreasonable to wait any longer to the total number of signed contracts within a given assessment period.

Measured as: Ratio or percentage.

Parameter 13: Completeness of fulfilment of contractual specification in the provision of a service

Contracts with all network and/or service features specified in the contract fulfilled (after its provisioning) in relation to the number of contracts that have been considered fulfilled for provisioning.

Measured as: Ratio or percentage.

Parameter 14: Punctuality of service provisioning

Time difference between the actual service provisioning and that contractually specified.

Measured as: Time.

Parameter 15: Punctuality of equipment delivery of service provisioning

Time difference between the actual equipment delivery and the scheduled delivery announced by the service provider for the service provisioning.

Measured as: Time.

Parameter 16: Provisioning not complete and correct first time

Ratio of service provisioning that is either not completely carried out or not correctly carried out in the first attempt, to the total number of contracts where the provisioning is deemed completed.

NOTE – The indicator for this parameter provides how well the SP has performed in complete and correct provisioning at the first attempt.

Measured as: Ratio or percentage.

<u>**Service alteration**</u>

Parameter 17: Time for alteration of service

Time elapsed from the instant alteration notification is received by the user to the instant the alteration is completed.

Measured as: Time.

Parameter 18: Successful service alteration within specified period

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

Measured as: Ratio or percentage.

Parameter 19: Completeness of fulfilment of contractual specification in the alteration of a service

The ratio 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.

Measured as: Ratio or percentage.

Parameter 20: Punctuality of appointments for service alteration

Time difference between the actual service alteration and the scheduled alteration time announced by the SP.

Measured as: Time.

Parameter 21: Punctuality of equipment delivery for service alteration

Time difference between the actual equipment delivery and the scheduled delivery announced by the SP.

Measured as: Time.

Parameter 22: Service alteration not complete and correct first time

Ratio (percentage) of service alterations that were either not completely or not correctly carried out in the first attempt, to the total number of contracts where alterations have been requested.

Measured as: Ratio or percentage.

Parameter 23: Conformity and success of service alteration

Ratio of the number of contracts where service alterations were not according to specification and therefore requiring reworking or further service alteration, to the total number of contracts where alteration was requested.

Measured as: Ratio or percentage.

Parameter 24: Technical reliability of service within an agreed period after alteration

Number of observation phases after service alteration without any limitation to the total number of service alterations carried out.

Measured as: Ratio or percentage.

Parameter 25: Organizational efficiency of service provider to carry out service alteration

Organizational and hardware resource availability to carry out service alterations to meet the needs of the customer and/or to meet contractual promises.

Measured as: Opinion rating.

Technical upgrade of ICT services

Parameter 26: Time for technical upgrade of a service

Time elapsed from the instant the technical upgrade period was announced to the user to the instant the technical upgrade was carried out.

Measured as: Time.

Parameter 27: Successful technical upgrade within a specified period of time

Ratio of successful service technical upgrades carried out in a specified time-out interval to the total number of technical upgrades carried out within the same period.

Measured as: Ratio or percentage.

Parameter 28: Completeness of fulfilment of specification in the technical upgrade of a service

Ratio of the number of successful upgrades where all specification requirements were met to the total number of contracts with such upgrades scheduled in a specified period.

Measured as: Ratio or percentage.

Parameter 29: Punctuality of appointments for technical upgrade

Time difference between the actual technical upgrade and the scheduled upgrade time announced by the SP.

Measured as: Time.

Parameter 30: Outage time due to technical upgrade

Duration when the service in part or in full is unavailable to the customer for use due to the technical upgrade process.

Measured as: Time.

Parameter 31: Technical upgrade not complete and correct first time

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.

NOTE – The indicator for this parameter provides how well the SP has performed in complete and correct technical upgrade at the first attempt.

Measured as: Ratio or percentage.

Parameter 32: Conformity and success of technical upgrade

Ratio 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.

Measured as: Ratio or percentage.

Parameter 33: Technical reliability of service within an agreed period after technical upgrade

Ratio of the upgrades that perform satisfactorily for a specified period after the upgrade to the total number of upgrades carried out.

Measured as: Ratio or percentage.

Parameter 34: Organizational efficiency of service provider to carry out technical upgrade

Organizational and hardware 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.

Measured as: Opinion rating.

Parameter 35: Competence and preparedness of service provider for technical upgrade

Degree of ability (competence) and willingness (preparedness) to incorporate technical upgrade relevant to the service for the benefit of users.

Measured as: Opinion rating.

Documentation of services (operational instructions)

Parameter 36: Documentation of delivery time

Time taken from the instant a service is provided to the instant documentation for the commissioning and use of the service is delivered to the customer.

NOTE – Documentation not delivered before a specified timeout will be considered as not delivered in time.

Measured as: Time.

Parameter 37: Availability of documentation within specified period of time

Number of contracts where documentation was supplied within a specified period of time to the total number of contracts where documentation was expected.

Measured as: Ratio or percentage.

Parameter 38: Integrity (correctness and completeness) of documentation

Correctness, completeness and user friendliness of pertinent information associated with the use of all features of a service and its maintenance.

Measured as: Opinion rating.

Parameter 39: Modes of documentation

Number of modes in which documentation is made available to the customer or user of a service.

Measured as: Number.

Parameter 40: Legibility of documentation

Visual clarity, language, understandability and layout of the information in the medium in which it is presented.

Measured as: Opinion rating.

Parameter 41: Overall reliability of documentation services

Consistent availability, integrity and speed of provisioning of the documentation and associated support activities provided by the SP for a given service.

Measured as: Opinion rating.

<u>**Technical support provided by service provider**</u>

Parameter 42: Accessibility to technical support

Ratio of the number of successful attempts to technical support to the total number of attempts to reach this support.

Measured as: Ratio or percentage.

Parameter 43: Technical solutions achieved within a specified period

Ratio of the number of contracts with successful technical solutions applied, to the total number of contracts where solutions were sought and applied within the specified period.

Measured as: Ratio or percentage.

Parameter 44: Number of attempts before successful solutions

Number of attempts before the technical request was successfully resolved.

Measured as: Number.

Parameter 45: Integrity of technical solutions

Proportion of successful solutions with respect to the total number of requests within a specified period of time.

Measured as: Opinion rating.

Parameter 46: Reliability of technical solutions achieved

Ratio of number of services that were trouble-free for a specified period of time after the technical solution was resolved, to the total number of services where the technical support was requested and implemented.

Measured as: Ratio or percentage.

Parameter 47: Modes of technical support

Number of modes in which technical support is available to the customer or user of a service.

Measured as: Number.

<u>**Commercial support provided by service provider**</u>

Parameter 48: Accessibility of the commercial support

Ratio of the number of successful access attempts to the commercial support to the total number of attempts to reach this support.

Measured as: Ratio or percentage.

Parameter 49: Commercial solution delivery time

Time elapsed from the instant the customer raised a problem with commercial support to the instant a solution was achieved.

Measured as: Time.

Parameter 50: Commercial solutions achieved within a specified period of time

Ratio of the number of contracts with successful commercial solutions achieved, to the total number of contracts where solutions were sought within a specified period.

Measured as: Ratio or percentage.

Parameter 51: Integrity of commercial solutions achieved by service provider

Ratio of successful solutions achieved within the specified period of time to the total number of commercial support requests.

Measured as: Opinion rating.

Parameter 52: Modes of commercial support

Number of modes in which commercial support is available to the customer or user of a service.

Measured as: Number.

Parameter 53: Organizational efficiency of commercial support

Availability of organizational resource to fulfil customer needs on commercial support.

Measured as: Opinion rating.

Complaint management

Parameter 54: Accessibility of the complaint management

Ratio of the number of successful attempts to the total number of attempts to reach complaint management (CM) in a specified period.

Measured as: Ratio or percentage.

Parameter 55: Recognition of the customer complaints

Ratio of the customer claims recognized by the SP as genuine complaints to the total number of potential complaints.

Measured as: Ratio or percentage.

Parameter 56: Complaint solutions not complete and correct first time

Ratio of the number of complaints not successfully resolved at the first attempt to the total number of complaints received by the SP.

NOTE – The indicator for this parameter provides how well the SP has performed in the complete and correct handling of the customer complaint at the first attempt.

Measured as: Ratio or percentage.

Parameter 57: Integrity of complaint resolution

Ratio of the number of complete and professional resolutions of the contributory causes of a complaint, to the total number of user complaints accepted.

Measured as: Ratio or percentage.

Parameter 58: Customer perception of the complaint management

The SP's exhibition of the combination of assurance, empathy and responsiveness in dealing with complaint(s) from reporting to satisfactory resolution.

Measured as: Opinion rating.

Parameter 59: Overall quality of the complaint management process

The combined effect of accessibility of the complaint management service: correct solutions at the first attempt, speed of resolution and the organizational capability to carry out these services.

Measured as: Opinion rating.

Parameter 60: Organizational efficiency of complaint management system

The availability and deployment of organizational and hardware resources on the part of the SP to resolve user complaints.

Measured as: Opinion rating.

Repair services

Parameter 61: Accessibility of repair services

Availability of hardware, software and staff resources necessary to restore a service (and its features) to its specified level of performance.

Measured as: Ratio or percentage.

Parameter 62: Successful repairs carried out within a specified period of time

Ratio of the number of repairs successfully carried out to the total number of repair requests accepted by the SP within a specified period.

Measured as: Ratio or percentage.

Parameter 63: Repairs not complete and correct first time

Ratio 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.

Measured as: Ratio or percentage.

Parameter 64: Punctuality of appointments for repairs

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.

Measured as: Opinion rating and/or time.

Parameter 65: Efficiency of the repair services

"Efficiency of the repair service" (mainly technical) of a SP is characterised by the combined performances of:
• accessibility,
• the number of repairs in a specified period of time,
• repairs carried out successfully the first time,
• punctuality.

Measured as: Opinion rating.

Parameter 66: Organizational efficiency of repair services

"Organizational (or operational) efficiency of repair service" is characterized by the combined performances of:
• punctuality,
• time to repair,
• provision of resources (human, hardware and software),

- the organizational logistics to provide an effective repair service.

Measured as: Opinion rating.

Parameter 67: Notification of root cause of outage

Ratio of the number of repairs, the root causes of which were shared with the customer, to the total number of repairs carried out.

Measured as: Ratio or percentage.

Charging and billing

Parameter 68: Accessibility of tariff information

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).

Measured as: Ratio or percentage.

Parameter 69: Successful notification of exceeding billing budget

Ratio 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.

Measured as: Ratio or percentage.

Parameter 70: Notification time (delay) of exceeding billing budget

Time from the instant of billing budget overrun to the instant of the reception by the customer of this notification from the SP.

Measured as: Time.

Parameter 71: Accessibility of the account management

Ratio of the number of successful attempts to the total number of attempts to reach the account management.

Measured as: Ratio or percentage.

Parameter 72: Time to update charging information

The time between the use of service and the instant the related charging information is available on the account.

Measured as: Time.

Parameter 73: 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.

Measured as: Ratio or percentage.

Parameter 74: Bill delivery delay

The delay between the expected time of bill and its receipt by the customer.

Measured as: Time.

Parameter 75: Late notification of amount due

The ratio 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.

Measured as: Ratio or percentage.

Parameter 76: Modes of billing information transfer

The number of modes offered by the SP to communicate the billing information to the customers.

Measured as: Number.

Parameter 77: Organizational efficiency of the billing service

"Organizational efficiency of the billing service" of a SP is described and measured by the organizational and hardware resource availability to carry out the billing service.

Measured as: Opinion rating.

Network/Service management by customer

Parameter 78: Outage duration

The total time a network/service management facility was not accessible to the customer during a specified reporting period.

Measured as: Time.

Parameter 79: Frequency of outages

The number of times access to the network/service management facility was not available to the customer during a specified period divided by the duration of this period.

Measured as: Number.

Parameter 80: 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.

Measured as: Time.

Parameter 81: Successful request response

The ratio of the number of requests made by the customer successfully handled (within a specified time-out period) to the total number of requests made over the observation period.

Measured as: Ratio or percentage.

Parameter 82: 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.

Measured as: Opinion rating.

Parameter 83: Organizational efficiency of the network/service management service

Described and characterized by 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.

Measured as: Opinion rating.

Parameter 84: Reliability of planned outage notification

Ratio of the number of advanced notification of planned outage to customers by a service provider to the total number of planned outage carried out.

Measured as: Ratio or percentage.

Cessation of service

Parameter 85: 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.

Measured as: Time.

Parameter 86: Cessation request acknowledgement

The ratio (percentage) of the number of cessation requests that were acknowledged to the number of such requests made in a specified period.

Measured as: Ratio or percentage.

Parameter 87: Accessibility of the cessation facility

The ratio (percentage) of the number of successful attempts to the total number of attempts to reach the cessation facility.

Measured as: Ratio or percentage.

Parameter 88: Contractual cessations achieved

The ratio (percentage) of the number of contractual cessations requested to the total number of such requests made within a specified period.

Measured as: Ratio or percentage.

Annex B

Examples of QoS parameters with definitions, measures and guidelines on measurement/evaluation/observation and presentation of performance values

(This annex forms an integral part of this Recommendation.)

B.1 Example 1: Pricing transparency (Parameter 2 in Annex A)

B.1.1 Definition of the parameter

Pricing transparency of an ICT service is characterized by clarity, conciseness and unambiguity in every tariff structure for all usage conditions for every service provided by the SP.
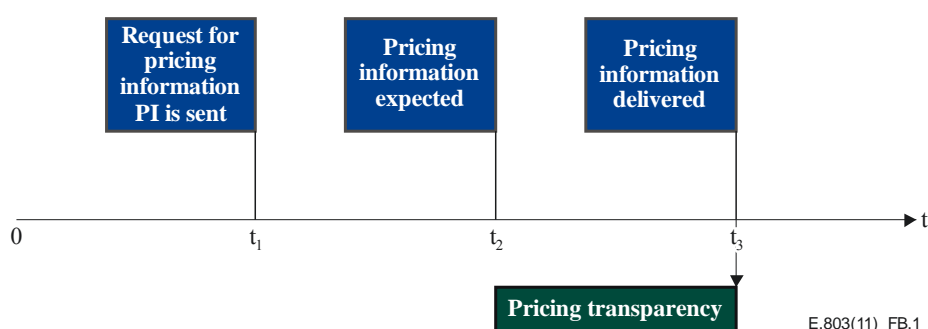
Figure B.1 – Events for preliminary information – "pricing transparency"

B.1.2 Explanation of the definition of the parameter

Pricing information should state clearly the rules for the calculation of the amount the customer has to pay under specified conditions of use and for exceeding the conditions, e.g., exceeding the usage time where there is limited allocation for a given tariff. The pricing structure should include all usage conditions.

B.1.3 Equation

$$P[OR] = \frac{\sum_{i=1}^{N} OR_i}{N}$$

where

OR is the mean opinion rating, with OR_i ($i = 1…N$) being the individual opinion ratings for the N members of the audit panel.

i Index of expert/customer.

N Number of experts/customers in the panel.

B.1.4 Measurement

Opinion rating (OR) as defined in clause 3.2.1.

B.1.5 Specific description of evaluation

Opinion rating is perhaps best carried out by an expert panel. The number of members in the panel is at the discretion of the stakeholder(s).

Examining if there is a significant difference between the opinion of the expert panel and that of the public is recommended for services where there is likelihood of such difference. The two sets of ratings (expert panel and consumer survey) could complement each other and provide assurance to

the potential customers. Opinion ratings based on the feedback from end-customers may be taken into account to adjust both sources of rating information.

Expertise required in the panel is technical familiarity with the use of the service or type of services.

Precondition: preliminary information is delivered.

B.1.6   Trigger points

OR may be established whenever PI for a new service is being introduced into the market. It is also established whenever there is/are change(s) to the tariff structure introduced by the provider and the PI is amended.

Trigger points

Event	Trigger point from customer's viewpoint	Condition
PI is delivered to the customer	t_3 in Figure B.1	
PI considered not available	Beyond t_3	

B.1.7   Representativeness

Tariffs are normally applicable to the whole customer population. Where there are special offerings to segments of the population, e.g., disabled, elderly or any other segment, the tariff information could be subject to OR scores for each of these categories.

B.1.8   Presentation of parameter values

Opinion rating of the expert panel should be presented with an indication on the distribution of the members' individual scores taking into account the various types of services. The mean value should be given as a synthetic indication.

Where the opinion of the public has also been taken into consideration the OR of both the public and the expert panel should be published.

Results should be provided on a regular basis with a clear indication on the panel composition and size.

A chart can be used to display the results of the various types of services.

B.2   Example 2: Integrity of contract information (Parameter 5 in Annex A)

B.2.1   Definition of the parameter

True and fair view of pertinent information on supply, maintenance and cessation for a telecommunication service provided by a SP.

NOTE 1 – A contractual document describing the supply, maintenance and cessation for a telecommunication service by a SP is clear, accurate, complete, understandable and unambiguous.

NOTE 2 – The language, phrasing and expressions chosen are aimed at maximum understanding for the target customer segment.
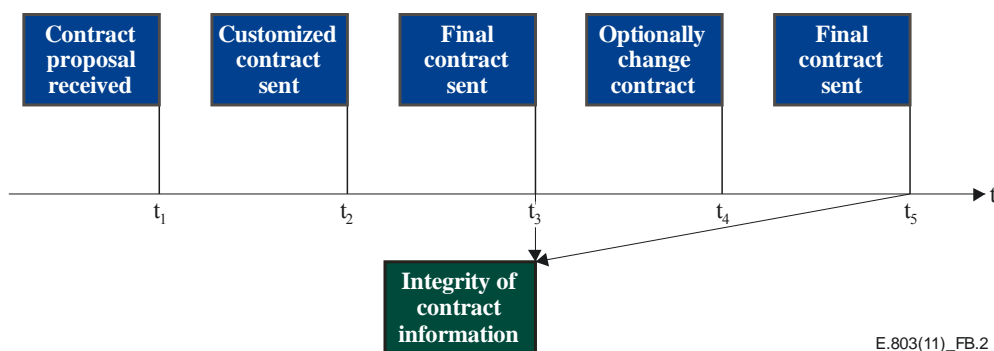
Figure B.2 – Events associated with contract information from SP to customer

B.2.2 Explanation of the definition of the parameter

The contractual document lists all pertinent terms and conditions that affect both the customer and the SP. These include escalation procedures and any compensation schemes that may apply when the implied or agreed performance of the SP is not met.

The terms and conditions stated are both fair and reasonable to both parties.

B.2.3 Equation

$$P[OR] = \frac{\sum_{i=1}^{N} OR_i}{N}$$

where

OR is the mean opinion rating, with OR_i (i = 1…N) being the individual opinion ratings for the N members of the audit panel.

i Index of expert.

N Number of experts in the panel.

B.2.4 Measurement

Opinion rating (OR) as defined in clause 3.2.1.

B.2.5 Specific description of evaluation

Preferably the opinion rating is carried out by an expert panel. The number of members in the panel is at the discretion of the stakeholder(s), which could be a regulator or any national institution that undertakes to provide responsible information to the users.

Expertise required in the panel is telecommunications law and technical familiarity with the use of the service. Members of the assessment team may be trained to professionally evaluate all aspects of the service.

There are three separate instances of integrity checks:

1) normal or standard contracts reflecting the PI supplied,

2) the customized contract where the customer has asked for specific changes in the terms and conditions of the contract,

3) amendments carried out after the standard or customized contract is signed.

The panel members should be trained to appreciate and assess the key points in a contract between the SP and a customer/user. The members ought to look specifically for compliance of the information provided in the PI with the information provided in the contract. They also ought to look for ambiguity, e.g., what has not been said being of relevance. The members will have an

insight into the legal aspects of the use of this service or family of services to enable them to critically evaluate the legal aspects from the customer's and SP's viewpoint.

B.2.6 Trigger points

Opinion rating is to be carried out whenever a new service is introduced into the market. Any significant change to the terms and conditions will also attract a review of the opinion rating. Otherwise there is no need to review the opinion rating.

Trigger points

Event	Trigger point from customer's viewpoint	Condition
Final contract is received by customer	t_3 in Figure B.2	Normal contract
Final customized contract is received by customer	t_3 in Figure B.2	When customer asks for customization
Final amended contract is received by customer	t_5 in Figure B.2	When customer asks for post contract amendment(s)

B.2.7 Representativeness

Normally the contractual terms are standard for the whole population except in cases where customization by individual organizations is required.

B.2.8 Presentation of parameter values

The rating may be expressed as the mean of the members' individual ratings at specified periods. Histograms of the panel members' OR should be provided.

A chart can be used to display the results of the different available contracts.

B.3 Example 3: Meeting promised provisioning date (Parameter 9 in Annex A)

B.3.1 Definition of the parameter

Successful completion of provisioning of service on the date promised in the contract in relation to the total number of signed contracts with promised service provisioning dates.

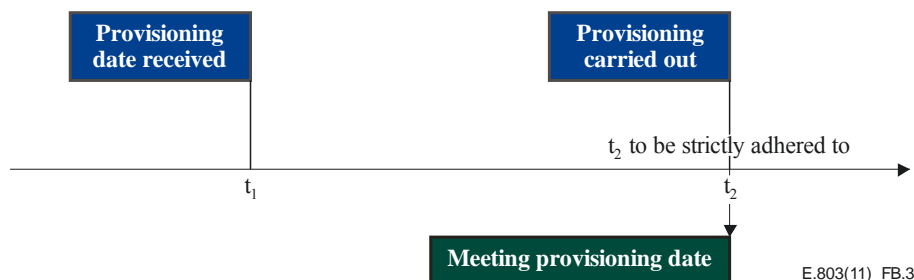**Figure B.3 – Events illustrating "meeting promised provisioning date"**

B.3.2 Explanation of the definition of the parameter

For specific customers it is of high importance that the promised date is met. This applies especially to customers whose business depends on fully operational network connections.

This parameter is only applicable if the negotiated service contract contains a fixed date for service provisioning.

B.3.3 Equation

$$P[\%] = \frac{N_p}{N_s} \times 100\%$$

where:

N_p Number of contracts with successful service provisioning on promised date.

N_s Number of signed contracts with announced service provisioning.

All measures are related to the reporting period.

B.3.4 Measurement

The indicator is expressed as percentage.

B.3.5 Specific description of evaluation

Precondition: Provisioning done by the SP.

Evaluation of this parameter can be achieved by:
*   analysis by the quality of service assessment party (QoSAP) of data stored at the SP,
*   survey of relevant customers.

B.3.6 Trigger points

Trigger points

Trigger point from customer's viewpoint	Time-line	Methodology/System specific trigger points
SP announces the scheduled provisioning date	t_1 in Figure B.3	Announcement is received by customer
Successful provisioning on announced provisioning date	t_2 in Figure B.3	Customer registers a correct provisioning on the announced date
Unsuccessful provisioning on announced provisioning date	t_2 in Figure B.3	Customer registers an unsuccessful provisioning attempt on the announced date
Successful provisioning not on the announced date	t_2 in Figure B.3	Customer registers a correct provisioning, but not on the announced date

B.3.7 Representativeness/confidence level

If not all the contracts are considered, the number of samples should be defined to ensure that the confidence level is at least x% (see Annex C).

B.3.8 Presentation of parameter values

The results of this parameter are reported as:
*   percentage of provision meeting promised date,
*   reporting period,
*   number and types of contracts considered.

Results should be provided on a regular basis with a clear indication on the panel composition and size or/and volume of SP data reviewed.

A chart can be used to display the results for the various types of services.

B.4 Example 4: Outage time due to technical upgrade (Parameter 30 in Annex A)

B.4.1 Definition of the parameter

Duration when the service in part or in full is unavailable to the customer for use due to the technical upgrade process.
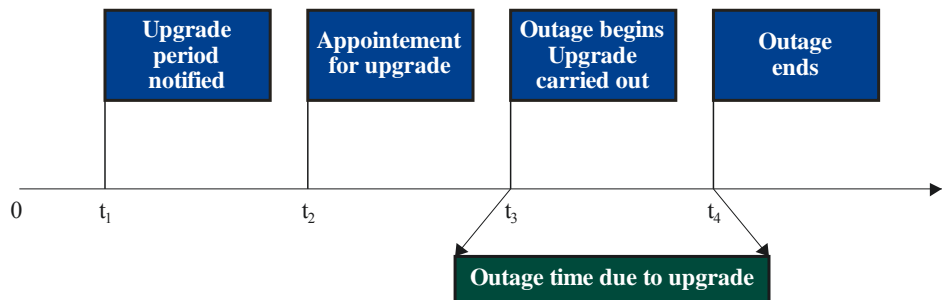
E.803(11)_FB.4

Figure B.4 – Events illustrating "outage time due to technical upgrade"

B.4.2 Explanation of the definition of the parameter

If the SP upgrades its capabilities (e.g., to improve the services offered to its customers), in many cases periods of non-availability of the service occur. The duration of these non-availability periods should be minimized to reduce the impact on the service usage.

B.4.3 Equation

$$P[Time] = \frac{\sum_{i=1}^{N}(t_{4,i} - t_{3,i})}{N}$$

where:

N Number of technical upgrade events.

i Index of each technical upgrade event.

$t_{3,i}$ Time when the outage start event i occurs.

$t_{4,i}$ Time when the outage end event i occurs.

B.4.4 Measurement

The indicator is expressed in units of time expressed in minutes, hours or days as appropriate.

A time-out value is required to prevent undue waiting for the service alteration event. Alteration events that do not occur within the time-out period are counted as unsuccessful attempts, which means they deliver no contribution to this parameter.

B.4.5 Specific description of evaluation

Precondition: Upgrade done.

The customers who have had technical upgrades carried out in the recent past may be surveyed. Evaluation of this parameter can be achieved by:

• analysis by the QoSAP of data stored at the SP,

• survey of relevant customers.

B.4.6 Trigger points

Event	Trigger point from customer's viewpoint	Condition
Outage begins	Start: t_3 in Figure B.4	Technical upgrade procedure started and causes outage of service usage
Outage ends	Stop: t_4 in Figure B.4	Procedure is finished and service returns to normal operation

B.4.7 Representativeness

The parameter can be applied to any customer group of interest (e.g., customer segments or the whole customer population of a SP).

B.4.8 Presentation of parameter values

Depending on the sample size per assessed customer segment, these presentations are recommended:

• histograms,

• probability density function (PDF),

• cumulative distribution function (CDF),

• quantile values.

Results should be provided on a regular basis (box plots) with a clear indication where the data come from (panel composition and size or SP data).

A chart can be used to display the results for the various types of services.

B.5 Example 5: Integrity (completeness and correctness) of documentation (Parameter 38 in Annex A)

B.5.1 Definition of the parameter

Correctness, completeness and user friendliness of pertinent information associated with the use of all features of a service and its maintenance.
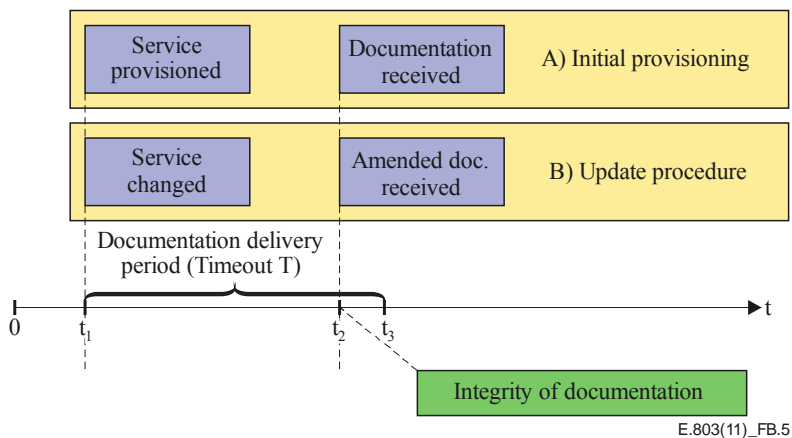

Figure B.5 – Events illustrating "integrity of documentation"

B.5.2 Explanation of the definition of the parameter

Integrity of documentation has three main components, correctness, completeness and user friendliness. The following topics are normally included in the documentation:

1) safety instructions,

2) installation instructions (where these are applicable),

3) relevant operating procedures for full use of all service features,

4) trouble-shooting procedures,

5) contact information for help,

6) service release number,

7) documentation revision number and date.

Any other service specific information would also be expected to be included.

Where new information is gathered for the documentation, based on experience, these could be added to the original or previous edition of documentation together with the revision date.

B.5.3 Equation

Opinion rating scores expressed as mean with the standard deviation.

$$P[OR] = \frac{\sum_{i=1}^{N} OR_i}{N}$$

where

OR is the mean opinion rating, with OR_i (i = 1…N) being the individual opinion ratings for the N members of the audit panel.

i Index of expert.

N Number of experts in the panel.

B.5.4 Measurement

Opinion rating (OR) as defined in clause 3.2.1.

B.5.5 Specific description of evaluation

Evaluation of documentation should be carried out by a panel of experts qualified in studying documentation of ICT services. They would be expected to have technical expertise as well as ability to look at the documentation objectively from the customer's viewpoint.

User's viewpoint may also be gathered where this is considered to add value to the opinion rating.

B.5.6 Trigger points

The evaluation will normally be carried out at the introduction of a service and whenever a new revision or addition is introduced.

Trigger points

Event	Trigger point from customer's viewpoint	Condition
Documentation is received by customer	t_2 in Figure B.5	

B.5.7 Representativeness

As the evaluation will be carried out for the whole documentation available, the results are expected to be fully representative.

B.5.8 Presentation of parameter values

Opinion rating of the panels should be presented as the distribution of the members' individual scores with an indication on the results distribution with regard to the various types of services and on the breakdown of these results.

A chart can be used to display the results of the different available modes, but more importantly each mode should be given the range of the worse decile.

B.6 Example 6: Accessibility to technical support (Parameter 42 in Annex A)

B.6.1 Definition of the parameter

Ratio of the number of successful attempts to technical support to the total number of attempts to reach this support.
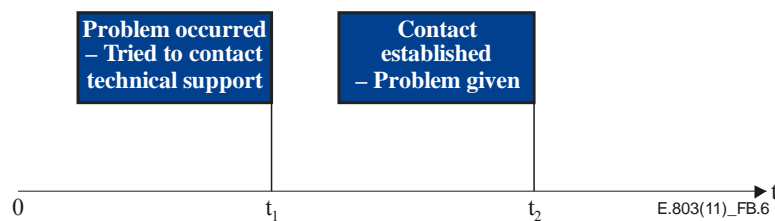
Figure B.6 – Events illustrating "accessibility to technical support"

B.6.2 Explanation of the definition the parameter

This parameter reflects the accessibility rate of the customer to the technical support of a SP in a specified time interval.

B.6.3 Equation

$$P[\%] = \frac{N_R}{N_S} \times 100\%$$

where

N_R Number of successful access events to technical support.

N_S Number of started access events to technical support.

All measures are related to the reporting period.

B.6.4 Measurement

The indicator is expressed as a percentage.

B.6.5 Specific description of evaluation

Precondition: Problem occurred and accessibility data captured.

Evaluation of this parameter can be achieved by one or more of the following means:
- analysis by the QoSAP of data stored at the SP,
- survey of relevant customers (preferred scenario),
- assessment by a panel of experts according to their own experience in contacting the technical support.

B.6.6 Trigger points

Trigger points

Event	Trigger point from customer's viewpoint	Condition
Problem occurred; try to contact support	Start: t_1 in Figure B.6	Customer wants to access technical support after occurrence of problem
Contact established	Stop: t_2 in Figure B.6	Customer established contact to SP technical support

B.6.7 Representativeness

The parameter can be applied to any customer group of interest (e.g., customer segments or the whole customer population of a SP).

B.6.8 Presentation of parameter values

Although the basic parameter delivers a single percentage, it is expected to be processed per hour so that the results are given with respect to the hour of the day, the day of the week, holiday time, etc. and higher aggregations of this parameter, depending on the sample size per assessed customer segment, can be represented in terms of:

•   histograms,

•   probability density function (PDF),

•   cumulative distribution function (CDF),

•   quantile values.

Results should be provided on a regular basis (box plots) with a clear indication where the data come from (panel composition and size, or SP data).

A chart can be used to display the results for the various types of services.

B.7 Example 7: Organizational efficiency of complaint management system (Parameter 60 in Annex A)

B.7.1 Definition of the parameter

The availability and deployment of organizational and hardware resources on the part of the SP to resolve user complaints.
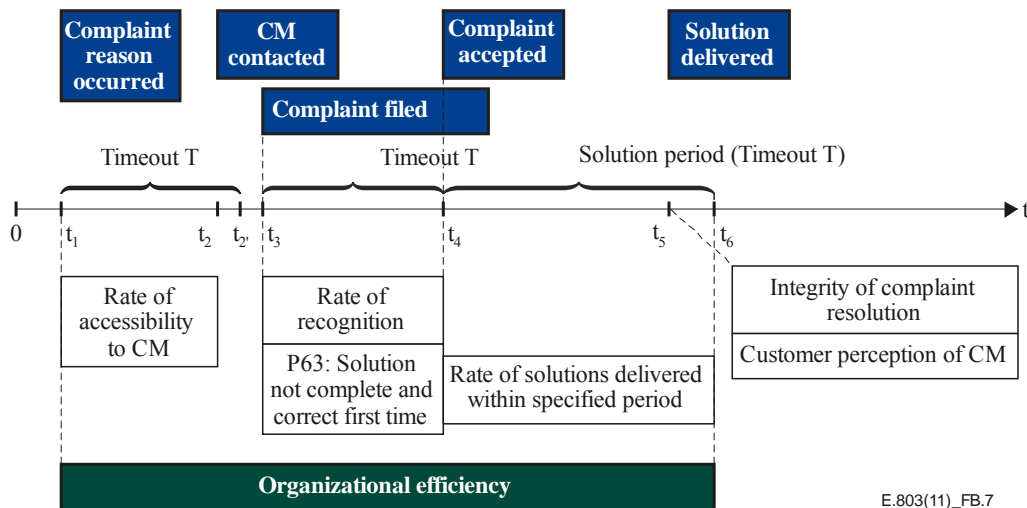
**Figure B.7 – Events affecting "Organizational efficiency
of the complaint management system"**

B.7.2 Explanation of the definition of the parameter

The SP requires organizational and hardware resources to resolve users' complaints. Shortcomings in this area could lie in shortage of staff, lack of training, shortage of hardware and logistical issues. This parameter is a measure of the efficiency of the provider in addressing these issues and providing adequate resources to satisfy customers' needs.

B.7.3 Equation

$$P[OR] = \frac{\sum_{i=1}^{N} OR_i}{N}$$

where

> OR is the mean opinion rating, with OR_i ($i = 1...N$) being the individual opinion ratings for the N members of the audit panel.
>
> i Index of expert.
>
> N Number of experts in the panel.

B.7.4 Measurement

Opinion rating (OR) as defined in clause 3.2.1.

B.7.5 Specific description of evaluation

In the evaluation of this parameter the following issues are to be addressed:

1)   handling of a high volume of complaint requests,
2)   load rate of employees at the reception,
3)   load rate of the employees handling complaints,
4)   number of attempts before complaint is acknowledged,
5)   number of attempts before complaint is resolved,
6)   availability of necessary hardware for the CM system,
7)   logistics of the management of the CM system.

Preferably an expert panel carries out the task of evaluating the above issues. It may be necessary for them to obtain relevant data, where available, from the SP and make an informed judgement in other cases to arrive at an OR value. Additionally a customer survey may also be carried out to assess first hand customers' opinions.

B.7.6   Trigger points

Not applicable as customer survey and panel ratings are carried out on a historical basis.

B.7.7   Representativeness

Not applicable.

B.7.8   Presentation of parameter values

Opinion rating of the panel should be presented with an indication on the distribution of the members' individual scores. The mean value should be given as a synthetic indication.

When a parallel customer survey is carried out those OR scores may also be provided.

Results should be provided on a regular basis with a clear indication on the panel composition and size.

A chart should be used to display the results for the hour of the day, day of the week, etc.

B.8   Example 8: Successful repairs carried out within a specified period of time (Parameter 62 in Annex A)

B.8.1   Definition of the parameter

Ratio of the number of repairs successfully carried out to the total number of repair requests accepted by the SP within a specified period.

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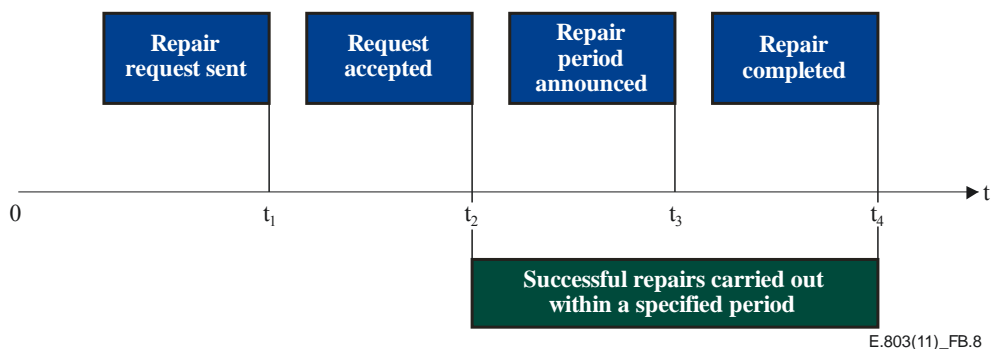
Figure B.8 – Events affecting "successful repairs carried out within a specified period of time"

B.8.2   Explanation of the definition of the parameter

Rate of repairs carried out successfully within a specified period of time.

A repair carried out is considered successful if the service is restored to its specification. This has to be agreed/confirmed by the customer.

If an additional fault is found (not reported but evident while carrying out repairs) these may also be repaired in the context of the reported fault.

It may well be that a service may fail again after some time for the same fault. This would be counted as a separate fault.

B.8.3 Equation

$$P[\%] = \frac{N_R}{N_S} \times 100\%$$

where:

N_R Number of repair requests carried out successfully within a specified period of time.

N_S Number of repair requests.

B.8.4 Measurement

The parameter is expressed as a percentage.

B.8.5 Specific description of evaluation

Only repairs successfully completed at the first attempt should be counted. Repeated repairs are to be counted separately in the total number of repair requests.

Evaluation of this parameter can be achieved by:

- analysis by the QoSAP of data stored by the SP,

- survey of relevant customers.

B.8.6 Trigger points

Trigger points

Event	Trigger condition from customer's viewpoint	Condition
Repair request accepted	t_2 in Figure B.8	Commencement of repair event
Repair completed	t_4 in Figure B.8	Repair completed and service back to normal

B.8.7 Representativeness

Customer survey may be carried out, where possible, on 100% of the customer population. Where customer population is large, a representative sample may be chosen that reflects the whole population, the geographical coverage and usage pattern.

B.8.8 Presentation of parameter values

Although the basic parameter delivers a single percentage, it is expected to be processed on a regular basis so that higher aggregations of this parameter, depending on the sample size per assessed customer segment, can be represented in terms of:

- histograms,

- probability density function (PDF),

- cumulative distribution function (CDF),

- quantile values.

Results should be provided on a regular basis with a clear indication on the panel composition and size or/and volume of SP data reviewed.

A chart can be used to display the results for the various types of services on a monthly basis.

B.9 Example 9: Accessibility to tariff (charging) information (Parameter 68 in Annex A)

B.9.1 Definition of the parameter

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).
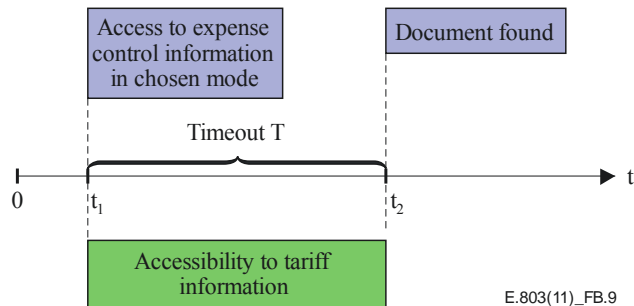
Figure B.9 – Events affecting "accessibility to tariff (charging) information"

B.9.2 Explanation of the definition of the parameter

This parameter reflects the accessibility of the SP's tariff information by the customers. Multiple modes of information have to be considered, e.g., flyers, documents, and web-pages. Tariff information is considered available either in paper at the next SP shop or via post mail, or alternatively when the hyperlink provided in electronic documentation or on flyer shows it directly.

B.9.3 Equation

$$P[\%] = \frac{N_S}{N_A}$$

where

N_S Number of successful access attempts to tariff information.

N_A Number of access events to tariff information.

B.9.4 Measurement

The indicator is expressed as a percentage.

B.9.5 Specific description of evaluation

Precondition: Access to expense control information in chosen mode.

Evaluation of this parameter can be achieved by:
* analysis by the QoSAP of data stored at the SP,
* survey of relevant customers,
* assessment by a panel of experts based on answers received from the SP.

B.9.6 Trigger points

Trigger points

Event	Trigger point from customer's viewpoint	Condition
Access to expense control information	t_1 in Figure B.9	Customer accessing expense control information in chosen mode
Document found	t_2 in Figure B.9	Expense control information accessed by customer
Timeout reached for accessing the expense control information	t_2 in Figure B.9	Timeout reached for accessing the expense control information

B.9.7 Representativeness

The parameter can be applied to any customer group of interest (e.g., customer segments or the whole customer population of a SP).

B.9.8 Presentation of parameter values

Although the basic parameter delivers a single percentage, it is expected to be processed per hour so that the results are given with respect to the hour of the day, the day of the week, holiday time, etc. and higher aggregations of this parameter, depending on the sample size per assessed customer segment, can be represented in terms of:

• histograms.

• probability density function (PDF),

• cumulative distribution function (CDF),

• quantile values.

Results should be provided on a regular basis with a clear indication where the data come from (panel composition and size or/and volume of SP data reviewed).

A chart can be used to display the results for the various types of services.

B.10 Example 10: Frequency of outages (during network/service management by customer) (Parameter 79 in Annex A)

B.10.1 Definition of the parameter

The number of times access to the network/service management facility was not available to the customer during a specified period divided by the duration of this period.
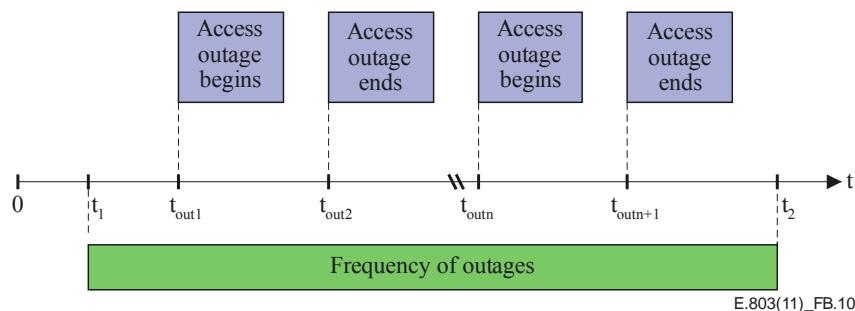
**Figure B.10 – Events identifying "frequency of outages"
for network/service management by the customer**

B.10.2 Explanation of the definition of the parameter

Lack of access to the network/service management facility should be counted as one if the unavailability is greater than a pre-defined period. Additionally the times of each outage shall also be recorded.

This specified period(s) should be set on a service by service basis by the stakeholders, e.g., regulator or a national institution responsible for QoS of telecommunication services.

B.10.3 Equation

The numerical value of the parameter can be counted as follows:

$$P\left[\frac{Number}{Time}\right] = \frac{N_{outages}}{t_2 - t_1}$$

where (see Figure B.10):

$N_{outages}$ Number of outage periods in time period $[t_1, t_2]$.

t_1 Start of observation period.

t_2 End of observation period.

B.10.4 Measurement

Frequency, which is 1/Time, calculated as number divided by time and/or cumulative number of outages during the specified period of time as preferred by the customer(s).

B.10.5 Specific description of evaluation

For an outage to be counted, the network/service management facility should be unavailable for a period longer than a threshold value, e.g., 1 second. This threshold value may be decided by stakeholders, e.g., regulator or a representative institution. The outage needs to be monitored on a customer by customer basis. This is easier to implement for large organizations than for residential customers. For the latter the SP may provide this facility on a sampling basis and this arrangement may be audited by an expert panel on request of the national stakeholder, e.g., regulator or a representative institution. Where sampling has been implemented, the SP could state in the presentation of parameter values (for a reporting period) the confidence limits for the values obtained.

B.10.6 Trigger points

Trigger points

Event	Trigger point from customer's viewpoint	Condition
Outage commences	t_{out1} in Figure B.10	First outage in specified period starts
Outage ends	t_{out2} in Figure B.10	First outage in specified period ends
....	....	....
Outage commences	t_{outn} in Figure B.10	Last outage in specified period starts
Outage ends	t_{outn+1} in Figure B.10	Last outage in specified period ends

B.10.7 Representativeness

Every large customer (e.g., corporate organization) using the network/service management facility on a regular basis would have its own monitoring devices.

While selecting residential and small and medium enterprises for presenting outages the following considerations may be taken into account:

• where there are significant differences in different geographical areas within the SP's coverage to warrant separate outage reporting,

• where there are different sensitivities among small and medium enterprises along the lines of their industry requirements to warrant reporting of outages (e.g., some industries may tolerate a large number of small outages but not one large outage and vice versa).

B.10.8 Presentation of parameter values

The frequency of outages is expressed by a number per unit of time (e.g., week or month): the cumulative number of outages during the reporting period.

Results should be provided on a regular basis (box plots) with a clear indication on size or/and volume of SP data reviewed.

Where necessary this value may be reported for various segments of the market.

Annex C

Common basis for QoS parameter assessment

(This annex forms an integral part of this Recommendation.)

To ensure comparable and reproducible results, the following topics are relevant in terms of QoS parameter assessment.

To ensure the impartiality of its results, the QoS assessment process should be, as far as possible, performed by a party independent of the service provision. Such quality of service assessment party (QoSAP) can be an SP internal department or an independent third party. The QoSAP is expected to manage the QoS assessment process, to analyse the data stored by the SP, to convene the exert panel, to launch the customer survey and to gather the results.

C.1 Opinion rating (OR)

C.1.1 Definition of OR

OR is a quantitative value (a number) assigned to a qualitative performance criterion on a predefined rating scale to reflect the merit of that criterion to a user/customer.

Examples of qualitative criteria in telecommunications are:

• user friendliness of man-machine interface of services,

• empathy shown by service provider's employees towards customers,

• ergonomics of terminal equipment,

• etc.

Predefined rating scales considered are usually 5, 7, 10 or 100. However a 7-point scale is considered most suited for recording opinion ratings. A 0-6 scale may be chosen for rating qualitative criteria.

Table C.1 – 0-6 Unipolar scale

Very poor	Poor	Below average	Average	Above average	Good	Excellent
0	1	2	3	4	5	6

Bipolar scales are numbered with the middle point as "0" and with positive and negative numbers on its either side as illustrated below:

Table C.2 – Bipolar scale with a middle point 0

Very poor	Poor	Below average	Average	Above average	Good	Excellent
–3	–2	–1	0	+1	+2	+3

In practice the wordings in the scoring boxes may be varied to suit the particular performance characteristics of the qualitative criterion being surveyed.

However all the wordings in the seven scoring boxes of the bipolar scale should be consistent and refer to the same concepts or parameters.

C.1.2 Example

For statistical purposes the scale of –3 to +3 may be converted to 0-6 or 1-7 and where necessary re-converted to –3 to +3 ratings.

Preliminary information:

–3 Definitely not satisfied with the PI provided.

i.e., Too many unanswered questions, contradictory and/or confusing information, etc. Evasive and unhelpful. Obvious lack of professionalism. Definitely not able to proceed further on decision-making about this service.

–2 Quite dissatisfied.

i.e., not forthcoming with all pertinent information unless specifically requested. For example, "I don't know what questions I have not asked!"

–1 Somewhat dissatisfied.

i.e., very little information provided. Need to make further enquiries to be in a position to make informed judgement about this service.

0 Neither satisfied nor dissatisfied.

i.e., not made any enquiries. Must seek further information before making a judgement on the PI available on this service.

+1 OK with basic information.

i.e., more queries to ensure I have all relevant information.

+2 Reasonably satisfied.

i.e., ready to make a decision – just a few clarifications needed before making it.

+3 Fully satisfied.

i.e., professionally handled all queries and provided all pertinent PI. For example, "I can now make an informed decision on this service."

C.2 Selection of an appropriate data source

This clause describes how to select appropriate data sources and how to represent the data which are generated by these sources in a meaningful manner.

In general, the measures for the parameters defined in this Recommendation can be determined by various data sources. Depending on the type of data which is used as input data, the resulting parameter values might have a different significance.

The most familiar data sources are the following:

- expert panel,
- customer survey,
- service provider (SP) data.

This list is not exclusive and may be extended by further data sources at any time; however the parameters defined in this Recommendation are assessed from the sources defined above.

For many parameters, different data sources can be taken into account. For example, there is no rule of thumb that only data source A has to be applied to get a measure for topic B. In fact, the individual application of a specific data source has to be checked individually with the aims of an audit, the allowed cost range of this activity and the representativeness of the desired output. Besides these main points, other topics might also restrict the exploitation of a specific data source.

The next clause describes in brief the characteristics of the data sources and the advantages and limitations of their usage. Additionally, some hints related to an appropriate usage of these data sources are given.

C.2.1 Expert panel

An expert panel is defined as a group of experts which are very familiar with the topic of interest. The expert panel will audit the topic of interest and give their expert opinion on this. Studies carried out on particular QoS aspects such as assessment of call centre QoS made using "mystery calls" or QoS of mobile communications by human operators belong to this category of data source.

Ideally, the selected experts bring a broad theoretical background and practical experience as well as a longer period of personal knowledge with them. Besides that, the selection of experts should take into consideration that all relevant aspects of the examined topic are covered by the combination of experts within the panel. In some cases, detailed in the related clauses, the experts' role can be played by trained customers.

Advantages of this expert panel approach include the following points:
- Only few experts are required to address a certain topic.
- The high level of expertise guarantees a high qualitative feedback.
- Feedback to one specific subject can be collected rather quickly (during an experts' meeting).
- Customers' viewpoint is reflected: Experts are used as highly-trained customers.
- Subjective feedback might give additional information to objective feedback (emotions, first thoughts, etc.).
- Data can be generated by anyone who is interested in a specific topic.

Limitations include the following points:
- Significant effort is required to find the right experts.
- Organizational effort is needed to gather all required experts together at the same place and time.
- Additional expenses are generated by the involvement of experts.
- Experts could be blinded by their routine. Their judgements may heavily differ from the feedback given by customers.

C.2.2 Customer survey

To get a broader basis of feedback, a survey of customer panels can be used. A customer panel consists of "usual" customers of products or services. The customers should be familiar with the topic they are asked for without reaching an expert level. For some stages, the customers involved in the survey should have had recent (e.g., 6 months) experience with the issue to assess.

In many cases, specialized institutes are engaged to deal with the panel recruitment. This is based on the fact that either a well-defined part of the population should be taken into consideration (e.g., only females aged 25 to 35 years with a certain net household income) or that the selected group of customers should be representative for the complete population of a country or for the complete population of customers of a service provider.

When selecting customer panel it may be useful to ask questions related to the user's background. Such examples are available in [b-ITU-T P.851] (clause 7.1).

Advantages of customer panel approach include the following points:

- This reflects the "real" customer experience.
- Subjective feedback might give more information than objective feedback (emotions, first thoughts, etc.).
- Data can be generated by anyone who is interested in a specific topic.

Limitations include the following points:

- Additional expenses are generated by the involvement of market research institutions.
- A certain level of customer attendance should be reached to assure the desired level of representativeness of data.
- In general, customer panel interrogations need a longer period of time (up to several weeks).

When an OR is sought via both a customer survey and an expert panel, there may be discrepancy between the findings of these differing channels. Where the difference is significant, reason for this discrepancy should be investigated and any necessary changes incorporated either to the panel's ratings or the way the customer survey is carried out.

C.2.3   Service provider data

For certain customer relevant processes, service providers (SP) may have available customer records for their own purposes or due to regulatory requirements. In these cases such data might be used for the determination of customer relevant parameters as well, but in a well controlled process.

However, two conditions have to be carefully checked in advance:

- For what purpose are the data collected? Does it really match the purpose it is now taken for?
- What are the measurement conditions? Or in a more detailed way: Which cases or events are shown in the data, and which are not shown – or even neglected?

Provider data can be used either by the QoSAP or an expert panel for further evaluation of customer relevant parameters, as soon as they fulfil the conditions described above.

The advantages of using SP data include the following points:

- No additional cost for data generation since the data are available from the usual day-to-day business.
- A large amount of data sets may be available (mass data), depending on the number of customers the SP has and depending on their activity.
- Automation of evaluation procedures may be achievable.
- Objective data are free of individual and subjective influences.

Limitations include the following points:

- Limited reflection of the customer perspective since customer relevant processes are already mapped to numbers.
- Data are only accessible after the SP released them for evaluation.
- The conditions under which the data have been generated have to be carefully checked.
- Representativeness of the data has to be considered.
- Lack of data for sensitive areas where service providers do not release internal data.
- Lack of data for areas which are not covered by the observation of internal processes.
- In general, subjective components are missing.

C.3 Samples sizes and examples

Data for customer relationship stages can be of different kinds and should be presented in appropriate ways.

Each data set generated by data sources can be interpreted as a so called "sample". The entirety of all samples related to one specific assessment is defined to be the "sample size".

Besides the different nature of the mentioned data sources, the number of available samples for each of these data sources may also differ greatly:

• To assess a special topic, only a few highly trained experts are required. This leads to high quality feedback, but also includes very limited information on a number of topics.

Example 1: 5 experts are requested to assess the "integrity of complaint resolution". The outcome will be 15 different opinions on a chosen scale.

• The assessment of topics which are more common to all customers and which do not require special expertise allows the involvement of a higher number of customers.

Example 2: 150 customers of SP A who complained about a certain matter are selected to give their feedback on the "customer perception of the complaint management". Here, the quality of the feedback will not be on the expert level, but represents the customer perception very clearly. Furthermore, the number of samples is higher than in the first case which improves the basis for statistical operations from the data.

• Finally, if mass data from service providers' internal processes can be assessed, there are two advantages: The weight of each data set on the overall result is negligible, and most of the data will be measured objectively.

Example 3: SP B delivers 10 000 data sets which allow for the determination of the parameter "time for alteration" on a very broad basis.

C.3.1 Statistical considerations

Having the above possible scenarios in mind, different kinds of meaningful data representation are considered in the following clauses.

C.3.1.1 Low sample sizes

For low sample sizes (order of magnitude < 100), discrete representations like histograms give the best impression of the results.
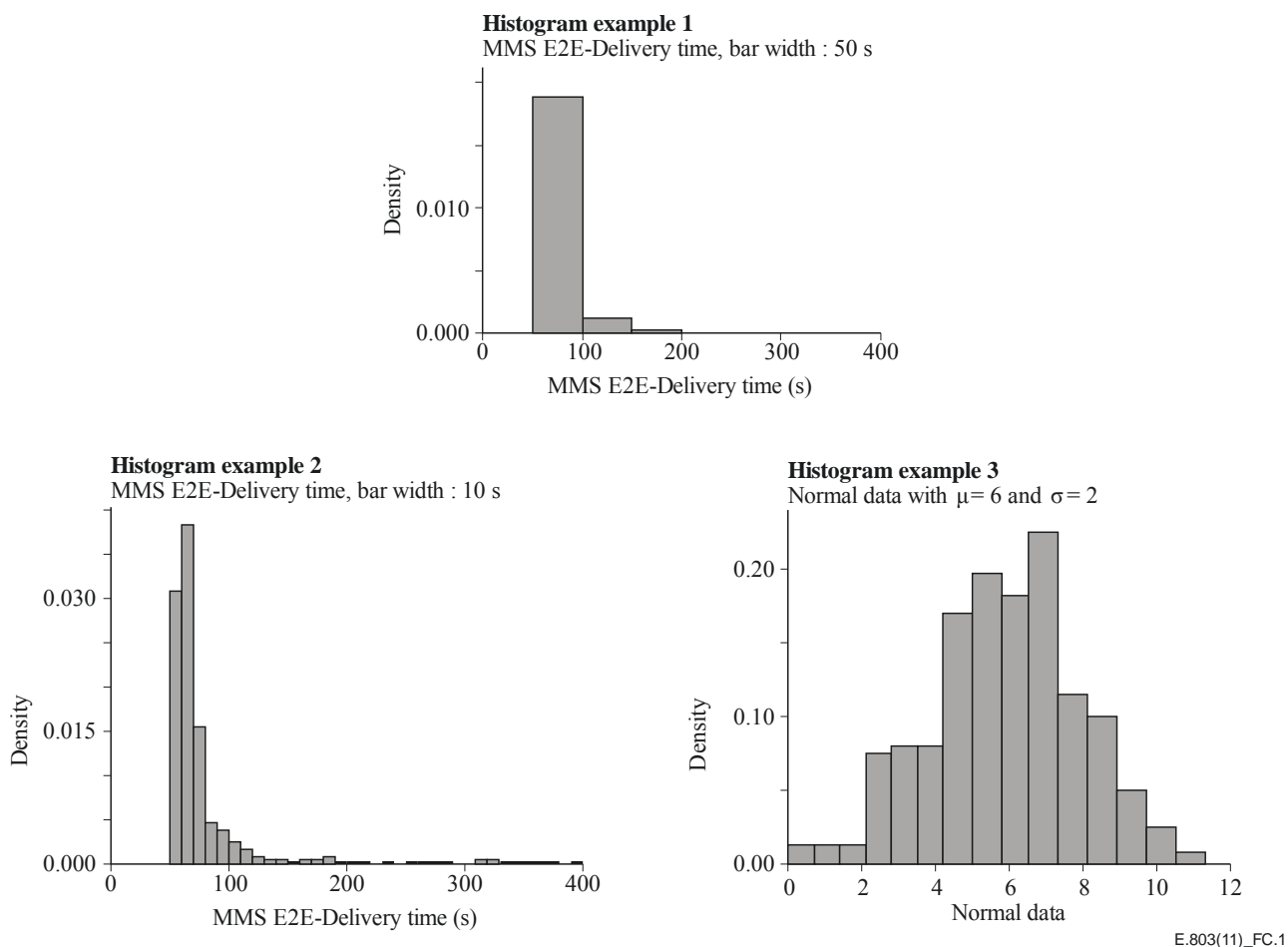
Figure C.1 – Examples of histograms

From a statistical viewpoint, each sample represents up to 1% of the overall result. The fewer samples available, the higher the influence of each single sample.

Therefore, the complete information available should be given, e.g., as a histogram figure. Statistical measures like mean values or quantile calculations are not recommended at all for this scenario.

As a consequence, single failures may be overestimated when only small sample sizes are considered.

Example: If only 10 samples are available and 1 represents a negative outcome of a process, the success rate will immediately be limited to only 90% whereas a higher sample size may show that the success rate is in the range of 98%.

NOTE – From a statistical viewpoint, the binomial distribution (representing binary decisions like "black or white" or "yes or no") can be replaced by Gaussian Normal Distribution (the "bell curve"), if the required conditions defined in [b-ETSI TS 102 250-6] are fulfilled.
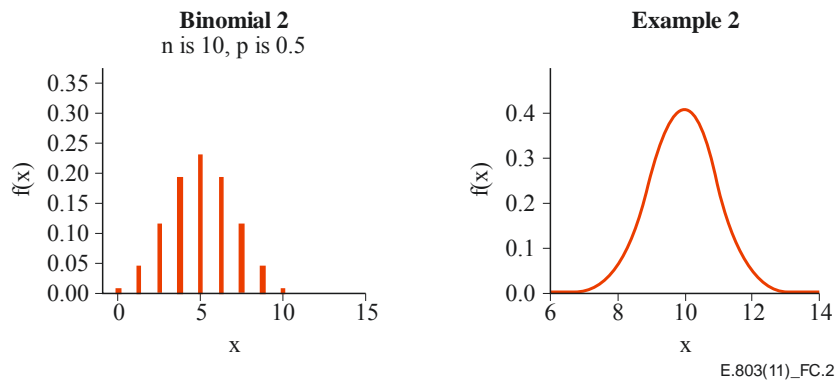
Figure C.2 – Transition from binomial to normal distribution

C.3.1.2 Medium sample sizes

If the order of available samples is higher (order of magnitude between 100 and 200), further statistical measures are meaningful. The calculation of success or failure rates based on these sample sizes is reasonable.

However, if mean rates should be calculated, the nature of the underlying distribution should also be taken into account. There are some cases where the mean rate may lead to wrong conclusions:

Example: If 200 customers are asked to assess a certain issue and 100 of them are very satisfied (rating of 7) and the other 100 are very dissatisfied (rating of 1), the mean value of 4 would imply that all requested customers are somehow satisfied. In this case, the really poor perception of half of the customers is ignored.

For an in-depth analysis, the complete set of information related to the distribution of data should be available. On higher level, aggregated information like mean values could be provided. In this case, at least the number of used samples should be given as an additional piece of information.

The calculation of quantile values is not recommended for this scenario.

C.3.1.3 Large sample sizes

For large sample sizes (order of magnitude > 300), the set of statistical measures can be further extended. In this range of samples the calculation of quantile values is also meaningful. By these calculations, questions like "What is the worst perception that 5% of the customer base has?" or "What is the median of the delay time?" can be answered.

For representation, the complete information can be given by probability density functions (PDFs) or by cumulative distribution functions (CDFs).

The relationship between a PDF and a CDF is very simple:

The PDF represents something like a spectral view on the data. It answers the question "Which part of the data is related to a dedicated value on the x-axis?" and delivers an expression of this kind:

$$f(x) - P(x)$$

However, the CDF represents the sum, respectively, of the integral value of a PDF. With this representation, the question "What is the probability that values are smaller than or equal to x_0?" can be answered. In a more formal way it looks like this:
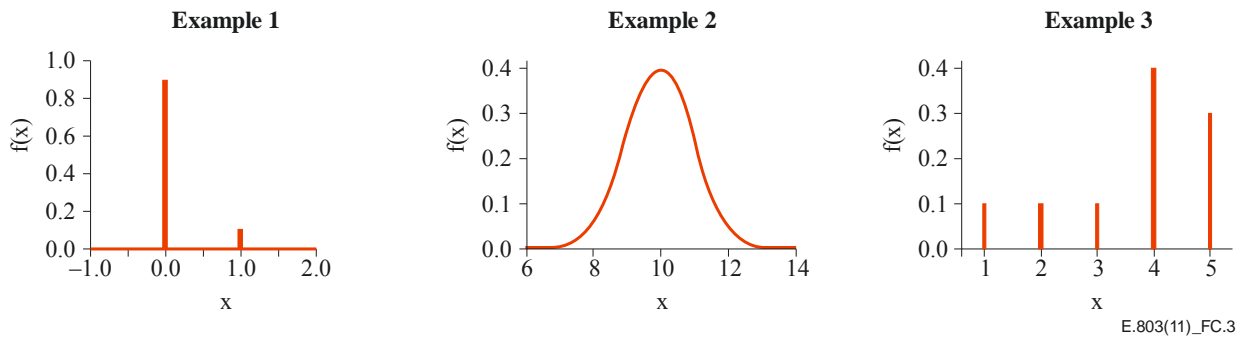
$$F(x) = P(x \leq x_0)$$

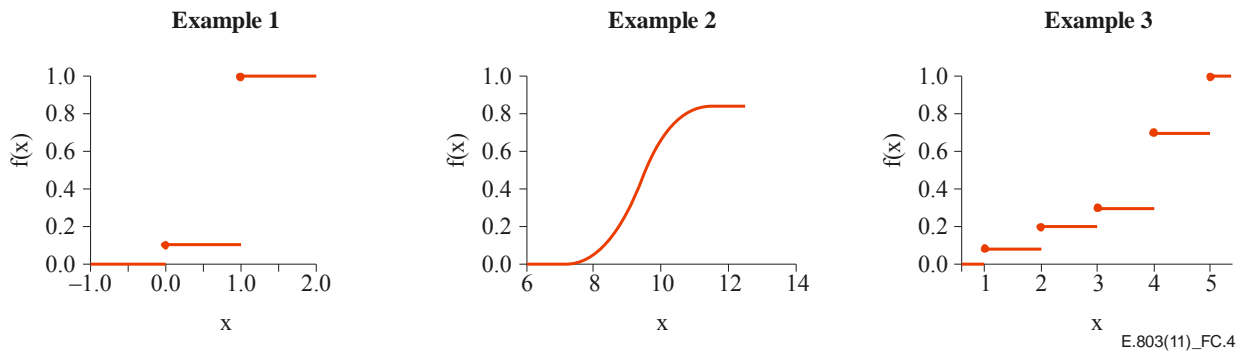**Figure C.3 – Examples of probability density functions**

Figure C.4 – Examples of cumulative distribution functions

The CDF representation allows reading all kinds of quantile value directly from the data. In this case, the desired quantile value is given (e.g., $F(x) = 95\%$) and the corresponding value x_0 can be found in the CDF figure.

To catch the main points of a statistical distribution, a condensed view can be given by picking some quantile values from the CDF, e.g., the 5%, 10%, 50%, 90% and 95% quantile (often abbreviated as q_p with p being the percentage considered). This set of quantile values gives a short description of the CDF.
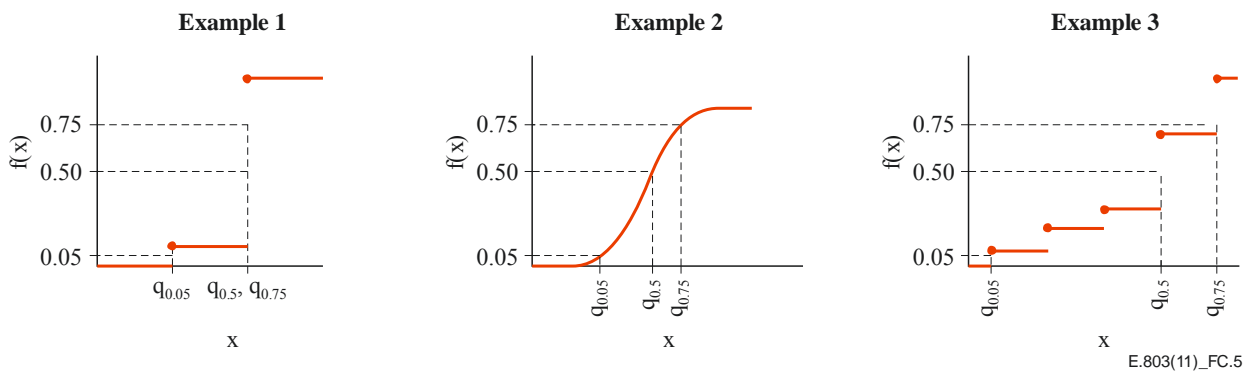

Figure C.5 – Examples for the determination of quantile values

For in-depth analysis, again the complete database should be accessible.

C.3.2 Mean value versus median

One important difference between the mean value and the median of a distribution should also be considered:

Example: If 10 samples are used to determine the delay of a certain process, a single outlier can make a big difference related to the mean and median values. Assuming that 9 samples give a delay of 1 hour and 1 sample gives a delay of 11 hours, the results would be like this:

Calculation of mean value:

$$(9 \times 1 \text{ hour} + 1 \times 11 \text{ hours}) / 10 = 2 \text{ hours}$$

To make it clear: One sample with a higher value compared to the majority of samples can have a very great influence on the mean value.

On the other side, the median is more "stable" against outliers:

Calculation of median value:

9 samples with 1 hour each, 1 sample with 11 hours

These samples are ordered in ascending order and then half of the samples are counted since the median is the 50% quantile. The outcome of this procedure would be: The median value is 1 hour.

In this case, the single outlier has no influence on the median, whereas the mean value was doubled. Therefore, the median (like all quantile values) is more robust to outlier effects and should be preferred to give the overall impression of some measure.
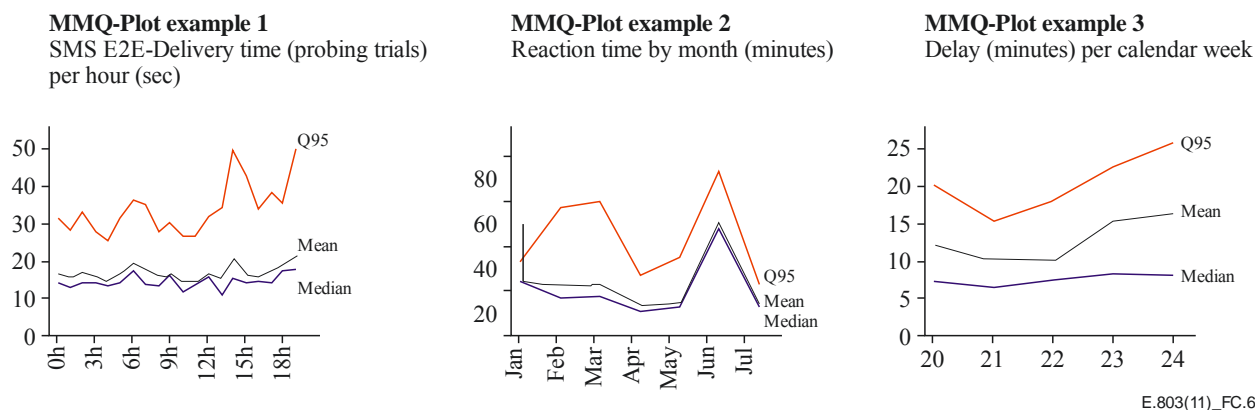
Figure C.6 – Examples showing the behaviour of mean and median

Plot 3 in Figure C.6 gives a good example of robustness. Whereas the line representing the mean value shows a variation of several minutes from week to week, the median value remains on a rather constant level. This leads to the conclusion that the underlying data are influenced by outliers.

A further sophisticated way of representing statistical data is given by the use of so-called box plots. Box plots describe the main characteristics of a data set within a very condensed representation. See more in [b-ETSI TS 102 250-6].

It appears that, in most cases, the mean value brings little useful information to the consumer. Its use should be limited to specific cases, provided the standard deviation is low with respect to the assessment range (e.g., 10%).

C.3.3 Confidence level

To describe the quality of a given data set with respect to a certain statistical measure, often the terms "confidence level" or "confidence interval" are used. In general, only a smaller part of all available data sets are used for these considerations.

Example: A network operator has 10 million customers, but can only manage to ask 1000 of them.

In this scenario there is a certain chance that the customers to be asked are not really representative but something like an inappropriate selection of customers. Therefore, if some results are calculated, there is always a chance or probability that the overall population would generate a different outcome. This relationship is covered by the terms "confidence level" and "confidence interval".

The confidence level represents the probability (e.g., 95%) that the actual value lies within a certain range which is called confidence interval. Based on a confidence level of 95%, there is still a chance of 5% that the actual value is not within the determined confidence interval.

Example: A mean value based on 200 values should be estimated to be 5%. By using an appropriate method (e.g., the Clopper-Pearson algorithm, see [b-Clopper]), the confidence interval based on a 95% confidence level can be determined to be [2.42%; 9%]. Then, the width of the confidence interval is 6.58%.

In other words, the determined mean rate of 5% lies with a probability of 95% in fact in the interval [2.42%; 9%]. There is still a probability of 5% that the real value is smaller than 2.42% or higher than 9%.

Following these examples, it is obvious that there is a relationship between the number of data sets ("samples") which are taken into consideration and the quality of the determined measures. Further information on this can be found in Annex A of [b-ETSI TS 102 250-6]

C.3.4   Accuracy of indicators

For parameters which estimate a ratio of two values, the width of the confidence interval can be determined as described in clause C.3.3. The outcome of this calculation can be interpreted as the accuracy of the relevant indicator. For other parameters like time parameters or opinion rating parameters, the width of the confidence interval must be determined on an individual basis.

C.3.5   Observation period

Many parameters defined in Annex A make use of observation periods with a limited time duration. These periods are necessary to prevent measurements or data retrieval phases from infinite waiting for events which may never occur in the future. This continued waiting for outstanding events could cause a deadlock situation and will hinder an effective application of defined parameters.

For this reason, the waiting periods or observation periods are limited in time. Every event which occurs after this time-out period is not taken into consideration for calculation of parameters. Furthermore, this concept allows one to plan the duration of data retrieval phases which will reduce the organizational cost for these evaluations.

C.3.6   Selection of panels

Opinion ratings (OR) are a commonly used method to assess parameters which are based on an individual and subjective perception. The opinion ratings are to be presented on a segment basis to represent each distinctive customer group. The following segmentation is recommended:

Residential customers:

> Young people aged between 11 and 21 years
>
> Adults aged between 21 and 65 years
>
> Elderly aged 65 years and older.

Business customers:

> Business customers aged 21 years and older.

Where other user segments are selected opinion ratings for these may also be reported.

The selection of segmentation should ensure, as far as possible, comparability within the European Union.

C.3.7 Determination of boundary conditions prior to assessment of parameters

Comparability of results is a major issue when measures are generated. To achieve this comparability, the boundary conditions of assessments to compare need to be the same.

Typical conditions which should have been defined before an assessment, measurement or opinion rating takes place are the following ones:

• Time-out values: Any kind of period that will be taken into account to terminate a measurement period in a predefined manner. This avoids deadlocks caused by infinite waiting of expected events which will not occur.

• Weighting of results for compound parameters: If a parameter is a composite parameter consisting of different contributions, the weight of each contribution should be determined in advance.

Typically, the stakeholders of an assessment determine these variables prior to any activity. For example, a national regulator defines these parameter sets before the obliged operators start their activities.

To ensure comparability of results, the variable settings must be kept constant over the period of time that should be considered in such a comparison.

C.4 Guidance on the presentation of the results

According to the previous clauses, the following statements are providing generic recommendations for the presentation of results.

Each of these measures may be presented in various combinations of elements. Hereafter are listed the preferred presentation modes for these various contexts. The clause on presentation of results for each parameter specifies which element(s) are recommended for its presentation taking into consideration the various conditions of the assessment, in particular the type of the QoS parameters (Opinion rating (OR), Percentage (%), Time (T), Number (N) or Frequency (Number/Time)) and the mode of assessment (SP data audit, expert panel or customer survey). For example, for Parameter 2 (pricing transparency) the recommended elements for the presentation of Opinion rating (OR) are: histograms and mean of expert panel and customer panel assessment ratings.

As a principle, the presentation of the results should provide as detailed information as possible on the spread of the results, including those of the expert panel members, and not a single figure, e.g., a mean value.

C.4.1 Histogram

In most cases a histogram should be provided to highlight either the breakdown of the results (% or T) or the spread of the opinion of an audit team or of an expert panel (OR).

Main exceptions are where the result is a single figure (Number or Number/Time).

C.4.2 Distribution functions

Probability density functions (PDFs) and cumulative distribution functions (CDFs) should be given as soon as the size of the data set is large enough (i.e., >300) in order to provide a more comprehensive assessment of its spread.

C.4.3　Mean value

Mean can bring additional information to a histogram if the size of the data set is large enough (i.e., >100) in order, for instance, to monitor the QoS evolution from the SP viewpoint.

In any case, the mean value should not be provided alone but, as far as possible, with the value of the standard deviation and where appropriate box plots for a condensed representation of the data set.

Where appropriate, the confidence level for mean value is given.

C.4.4　Quantile

Quantiles are meaningful provided the data set is large enough (i.e., >300). The median value may, in some cases, have some advantages compared with the mean value.

C.4.5　Chart

Charts may be needed in particular for complete information on certain QoS resulting from an aggregation of several parameters or where assessment is carried out on several consumer segments.

C.4.6　Choice of the best suited presentations

For example, in Figure B.8 histograms provide the most useful statistical information to the consumers. Where applicable the PDF, CDF and quantile should be given to provide additional information.

Charts could help to visualize and better understand the results, in particular for composite indicators.

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