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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

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Recommendation ITU-T E.803

Quality of service parameters for supporting service aspects

Summary

Recommendation ITU-T E.803 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 the performances of service providers (SPs) of the information and communications technology (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 are of interest and concern to the users. The 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 the contract with the customers are examples of non-utilization stages of the ICT services that could be of concern to the users. Similarly, users are also concerned about the indicators of the service's performance. This Recommendation identifies non-utilization stages and lists several QoS parameters from which a selection may be made for the customer to assess the performance of the provider.

History

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Parameters, performance, QoS, quality of service, services.

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Table of Contents

Recommendation ITU-T E.803

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 the information and communications technology (ICT) services who wish to compare the 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 are of interest and concern to the users. The 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 the contract with customers are examples of non-utilization stages of ICT services that could be of concern to the users. Similarly, users are also concerned about the indicators of the service's performance. This Recommendation identifies non-utilization stages and lists several 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.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 EG 202 843 V1.2.1 (2013-03), *User Group; Quality of ICT services; Definitions and methods for assessing the QoS parameters of the customer relationship stages other than utilization*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

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

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

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

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

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

3.1.6 parameter [b-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) [b-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 [b-ITU-T E.800]: An organization that provides services to users and customers.

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

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". ([b-ITU-T E.360.1] and [b-ITU-T E.361])

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 opinion rating (OR): 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 B.)

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

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

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

Some of the QoS parameters defined in Annex A 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 is intended to cater to different requirements of the various customer segments of the population. When selecting a set of QoS parameters to compare the performance of SPs, it is necessary to only focus on those that are of relevance, and which may be restricted to as few as 5 to15. The 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 (SP) 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., the 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 the 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 (OR) by expert panels.

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

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

Annex A

List of QoS parameters and procedures for measuring, computing and reporting performance values on selected parameters

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

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

A.1 Preliminary information on telecommunication services

A.1.1 Parameter 1: Integrity of preliminary information

A.1.1.1 Definition

The integrity of the 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.

A.1.1.2 Measurement

Measured as: Opinion rating.

A.1.1.3 Reference

See [ETSI EG 202 843] (in P101: Integrity of PI).

A.1.2 Parameter 2: Pricing transparency

A.1.2.1 Definition

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.
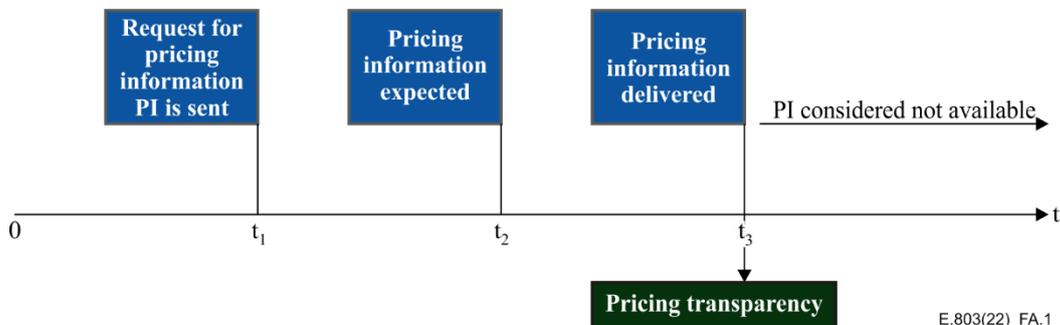
Figure A.1 – Events for preliminary information – "pricing transparency"

A.1.2.2 Explanation of the definition of the parameter

Pricing information should clearly state 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 a limited allocation for a given tariff. The pricing structure should include all the usage conditions.

A.1.2.3 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/customer

N Number of experts/customers in the panel.

A.1.2.4 Measurement

Measured as: Opinion rating (OR).

A.1.2.5 Specific description of the 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 a 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 the end-customers may be taken into account to adjust both the sources of the rating information.

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

Precondition: preliminary information is delivered.

A.1.2.6 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.

Table A.1 – Trigger points

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

A.1.2.7 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.

A.1.2.8 Presentation of parameter values

The opinion rating of the expert panel should be presented with an indication of 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 of the panel composition and size.

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

A.1.3 Parameter 3: Availability of PI

A.1.3.1 Definition

The 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.

A.1.3.2 Measurement

Measured as: Fraction or percentage.

A.1.3.3 Reference

See [ETSI EG 202 843] (in P103: Availability of PI).

A.1.4 Parameter 4: Response time for the provision of PI

A.1.4.1 Definition

Time taken from the instant a request for PI is sent to the SP to the instant all the requested information is delivered to the customer requesting the information.

A.1.4.2 Measurement

Measured as: Time.

A.1.4.3 Reference

See [ETSI EG 202 843] (P104: Response time for the provision of PI).

A.1.5 Parameter 5: Response time of the commercial desk

A.1.5.1 Definition

Time elapsed between the end of dialling and reaching a commercial operator (by a human being):

> P105a [Time]: mean time to answer; and
>
> P105b [%]: percentage of calls answered within 20 seconds.

A.1.5.2 Reference

See [ETSI EG 202 843] (in P105).

A.2 Contractual matters between ICT service providers and customers

A.2.1 Parameter 6: Integrity of contract information

A.2.1.1 Definition

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

NOTE 1 – A contractual document describing the supply, maintenance, and cessation of a telecommunication service by an 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.
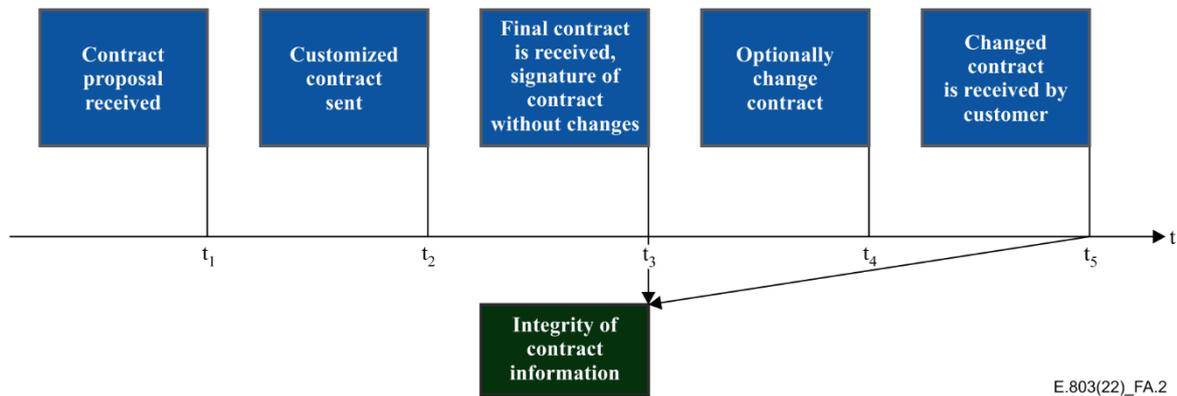
Figure A.2 – Events associated with contract information from SP to customer

A.2.1.2 Explanation of the definition of the parameter

The contractual document lists all the 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 the agreed performance of the SP is not met.

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

A.2.1.3 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 the expert

N Number of experts in the panel.

A.2.1.4 Measurement

Measured: Opinion rating (OR).

A.2.1.5 Specific description of the 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 a technical familiarity with the use of the service. Members of the assessment team may be trained to professionally evaluate all the 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.

A.2.1.6 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.

Table A.2 – Trigger points

Event	Trigger point from customer's viewpoint	Condition
Final contract is received by customer, signature of contract without changes	t_3 in Figure A.2	Normal contract
Final customized contract is received by the customer	t_4 in Figure A.2	When a customer asks for customization
Changed contract is received by the customer	t_5 in Figure A.2	When a customer asks for post contract amendment(s)

A.2.1.7 Representativeness

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

A.2.1.8 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' opinion rating (OR) should be provided.

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

A.2.2 Parameter 7: Compliance of contractual terms with preliminary information

A.2.2.1 Definition

Degree of concurrence of the contents of the contractual document to the preliminary information (PI). This comparison between the contractual terms and the PI should be based on the PI in force during the period of the contract. The 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.

A.2.2.2 Measurement

Measured as: Ratio or percentage.

A.2.2.3 Reference

See [ETSI EG 202 843] (in P202).

A.2.3 Parameter 8: Flexibility for customization before contract

A.2.3.1 Definition

The scope and boundary to meet an individual customer's specific requirements of service feature(s), service performance(s) and terms and conditions before a 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.

A.2.3.2 Measurement

Measured as: Opinion rating.

A.2.3.3 Reference

See [ETSI EG 202 843] (in P203)

A.2.4 Parameter 9: Ease and flexibility to amend terms after the formal contract

A.2.4.1 Definition

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 that the provider has specifically stated as not considered for amendments.

A.2.4.2 Measurement

Measured as: Opinion rating.

A.2.4.3 Reference

See [ETSI EG 202 843] (in P204)

A.3 Provision of services

A.3.1 Parameter 10: Meeting promised provisioning date

A.3.1.1 Definition

Successful completion of the provisioning of service on the date promised in the contract in relation to the total number of signed contracts with promised service provisioning dates.
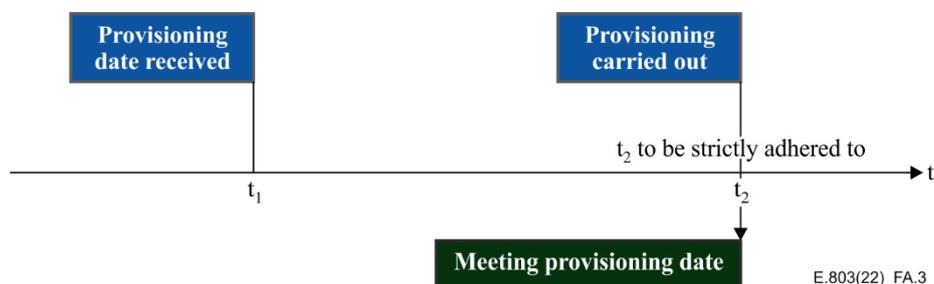
Figure A.3 – Events illustrating "meeting promised provisioning date"

A.3.1.2 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.

A.3.1.3 Equation

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

where:

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

N_s Number of signed contracts with announced service provisioning.

All measurements are related to the reporting period.

A.3.1.4   Measurement

The indicator is expressed as a percentage.

A.3.1.5   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.

A.3.1.6   Trigger points

Table A.3 – Trigger points

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

A.3.1.7   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 B).

A.3.1.8   Presentation of the parameter values

The results of this parameter are reported as:

•   percentage of the provision meeting promised date,

•   reporting period,

•   number and types of contracts considered.

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

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

A.3.2   Parameter 11: Time for provisioning

A.3.2.1   Definition

The period between the scheduled provisioning time and the actual provisioning time

A.3.2.2   Measurement

Measured as: Time.

A.3.2.3   Reference

See [ETSI EG 202 843] (in P302)

A.3.3   Parameter 12: Successful provisioning within a specified period

A.3.3.1   Definition

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

A.3.3.2   Measurement

Measured as: percentage.

A.3.3.3   Reference

See [ETSI EG 202 843] (in P303)

A.3.4   Parameter 13: Contract cancelled due to non-fulfilment

A.3.4.1   Definition

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.

A.3.4.2   Measurement

Measured as: percentage.

A.3.4.3   Reference

See [ETSI EG 202 843] (in P304)

A.3.5   Parameter 14: Completeness of fulfilment of contractual specification in the provision of a service

A.3.5.1   Definition

Contracts with all networks 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.

A.3.5.2   Measurement

Measured as: percentage.

A.3.5.3   Reference

See [ETSI EG 202 843] (in P305)

A.3.6   Parameter 15: Punctuality of the service provisioning

A.3.6.1   Definition

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

A.3.6.2   Measurement

Measured as: Time (minutes/hours/days)

A.3.6.3   Reference

See [ETSI EG 202 843] (in P306)

A.3.7   Parameter 16: Punctuality of the equipment delivery of the service provisioning

A.3.7.1   Definition

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

A.3.7.2 Measurement

Measured as: Time (days). A finer granularity of the time dimension is not required.

A.3.7.3 Reference

See [ETSI EG 202 843] (in P307)

A.3.8 Parameter 17: Provisioning not complete and correct first time

A.3.8.1 Definition

The 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 provisionings at the first attempt.

A.3.8.2 Measurement

Measured as: Percentage.

A.3.8.3 Reference

See [ETSI EG 202 843] (in P308)

A.4 Service alteration

A.4.1 Parameter 18: Time for alteration of the service

A.4.1.1 Definition

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

A.4.1.2 Measurement

Measured as: Time (days).

A.4.1.3 Reference

See [ETSI EG 202 843] (in P401)

A.4.2 Parameter 19: Successful service alteration within a specified period

A.4.2.1 Definition

Ratio (percentage) of the number of contracts (or services) with a successful service alteration to the total number of contracts (or services) with an announced service alteration within the contractual specified period of time.

A.4.2.2 Measurement

Measured as: Percentage.

A.4.2.3 Reference

See [ETSI EG 202 843] (in P402)

A.4.3 Parameter 20: Completeness of the fulfilment of the contractual specification in the alteration of a service

A.4.3.1 Definition

The ratio of all the contracts where all the specifications related to the service alteration contractually agreed are met or completed to the total number of contracts where the alteration has been requested.

A.4.3.2 Measurement

Measured as: Ratio or percentage.

A.4.3.3 Reference

See [ETSI EG 202 843] (in P403)

A.4.4 Parameter 21: Punctuality of the appointments for a service alteration

A.4.4.1 Definition

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

A.4.4.2 Measurement

Measured as: Time.

A.4.4.3 Reference

See [ETSI EG 202 843] (in P404)

A.4.5 Parameter 22: Punctuality of the equipment delivery for a service alteration.

A.4.5.1 Definition

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

A.4.5.2 Measurement

Measured as: Time.

A.4.5.3 Reference

See [ETSI EG 202 843] (in P405)

A.4.6 Parameter 23: Service alteration not complete and correct the first time

A.4.6.1 Definition

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 the alterations have been requested.

A.4.6.2 Measurement

Measured as: Percentage

A.4.6.3 Reference

See [ETSI EG 202 843] (in P406)

A.4.7 Parameter 24: Conformity and the success of the service alteration

A.4.7.1 Definition

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

A.4.7.2 Measurement

Measured as: Percentage.

A.4.7.3 Reference

See [ETSI EG 202 843] (in P407)

A.4.8 Parameter 25: Technical reliability of service within an agreed period after an alteration

A.4.8.1 Definition

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

A.4.8.2 Measurement

Measured as: Percentage.

A.4.8.3 Reference

See [ETSI EG 202 843] (in P408)

A.4.9 Parameter 26: Organizational efficiency of the service provider to carry out a service alteration

A.4.9.1 Definition

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

A.4.9.2 Measurement

Measured as: Opinion rating.

A.4.9.3 Reference

See [ETSI EG 202 843] (in P409)

A.5 Technical upgrade

A.5.1 Parameter 27: Time for a technical upgrade of a service

A.5.1.1 Definition

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

A.5.1.2 Measurement

Measured as: Time.

A.5.1.3 Reference

See [ETSI EG 202 843] (in P501)

A.5.2 Parameter 28: Successful technical upgrade within a specified period

A.5.2.1 Definition

The 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.

A.5.2.2 Measurement

Measured as: Percentage.

A.5.2.3 Reference

See [ETSI EG 202 843] (in P502)

A.5.3 Parameter 29: Completeness of the fulfilment of the specification in the technical upgrade of a service

A.5.3.1 Definition

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

A.5.3.2 Measurement

Measured as: Percentage.

A.5.3.3 Reference

See [ETSI EG 202 843] (in P503)

A.5.4 Parameter 30: Punctuality of the appointments for a technical upgrade

A.5.4.1 Definition

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

A.5.4.2 Measurement

Measured as: Time.

A.5.4.3 Reference

See [ETSI EG 202 843] (in P504)

A.5.5 Parameter 31: Outage time due to a technical upgrade

A.5.5.1 Definition

Duration when the service in part or in full is unavailable to the customer for use due to the technical upgrade process.
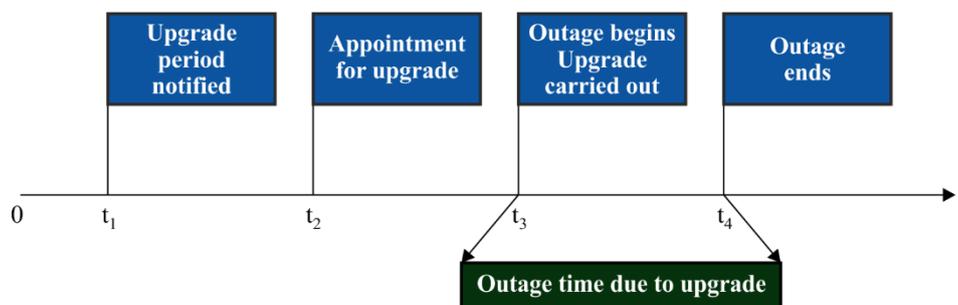
E.803(22)_FA.4

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

A.5.5.2 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 occurs. The duration of these non-availability periods should be minimized to reduce the impact on the service usage.

A.5.5.3 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.

A.5.5.4   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.

A.5.5.5   Specific description of the 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.

A.5.5.6   Trigger points

Table A.4 – Trigger points

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

A.5.5.7   Representativeness

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

A.5.5.8   Presentation of the 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 of where the data comes from (panel composition and size or SP data).

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

A.5.6   Parameter 32: Technical upgrade not complete and correct the first time

A.5.6.1   Definition

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.

A.5.6.2 Measurement

Measured as: Ratio or percentage.

A.5.6.3 Reference

See [ETSI EG 202 843] (in P506)

A.5.7 Parameter 33: Conformity and success of the technical upgrade

A.5.7.1 Definition

The ratio of technical upgrades not according to the specification and therefore requiring reworking or further service upgrade processes and resources to get it right, to the total number of contracts upgraded.

A.5.7.2 Measurement

Measured as: Percentage.

A.5.7.3 Reference

See [ETSI EG 202 843] (in P507)

A.5.8 Parameter 34: Technical reliability of the service within an agreed period after a technical upgrade

A.5.8.1 Definition

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

A.5.8.2 Measurement

Measured as: Ratio or percentage.

A.5.8.3 Reference

See [ETSI EG 202 843] (in P508)

A.5.9 Parameter 35: Organizational efficiency of the service provider to carry out a technical upgrade

A.5.9.1 Definition

Organizational and hardware resource availability on the part of the SP to carry out the technical upgrades to meet the needs of the customer and/or to meet contractual promises.

A.5.9.2 Measurement

Measured as: Opinion rating.

A.5.9.3 Reference

See [ETSI EG 202 843] (in P512)

A.5.10 Parameter 36: Competence and preparedness of the service provider for technical upgrade

A.5.10.1 Definition

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

A.5.10.2 Measurement

Measured as: Opinion rating.

A.5.10.3 Reference

See [ETSI EG 202 843] (in P513)

A.6 Documentation of services (operational instructions)

A.6.1 Parameter 37: Documentation of delivery time

A.6.1.1 Definition

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

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

A.6.1.2 Measurement

Measured as: Time.

A.6.1.3 Reference

See [ETSI EG 202 843] (in P611)

A.6.2 Parameter 38: Availability of the documentation within a specified period of time

A.6.2.1 Definition

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

A.6.2.2 Measurement

Measured as: Percentage.

A.6.2.3 Reference

See [ETSI EG 202 843] (in P612)

A.6.3 Parameter 39: Integrity (correctness and completeness) of the documentation

A.6.3.1 Definition

Correctness, completeness, and user-friendliness of pertinent information associated with the use of all the features of a service and its maintenance.
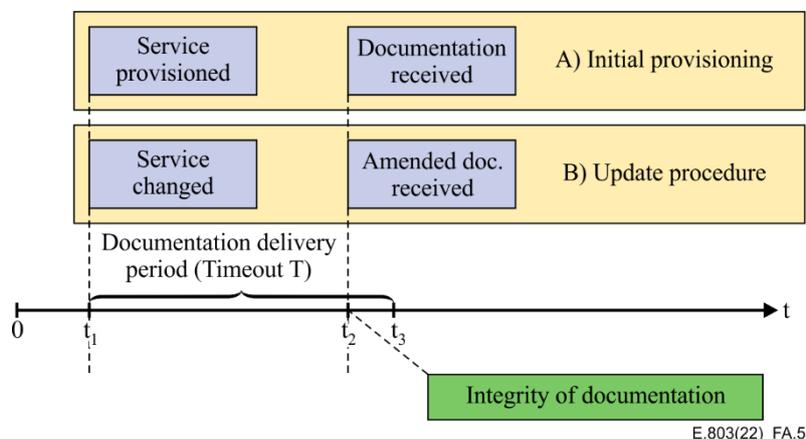
Figure A.5 – Events illustrating "integrity of documentation"

A.6.3.2 Explanation of the definition of the parameter

The integrity of the 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 the 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 the documentation together with the revision date.

A.6.3.3 Equation

Opinion rating scores are 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.

A.6.3.4 Measurement

Measured as: Opinion rating (OR)

A.6.3.5 Specific description of the evaluation

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

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

A.6.3.6 Trigger points

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

Table A.5 – Trigger points

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

A.6.3.7 Representativeness

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

A.6.3.8 Presentation of the parameter values

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

A.6.4 Parameter 40: Modes of documentation

A.6.4.1 Definition

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

A.6.4.2 Measurement

Measured as: Number.

A.6.4.3 Reference

See [ETSI EG 202 843] (in P614)

A.6.5 Parameter 41: Legibility of the documentation

A.6.5.1 Definition

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

A.6.5.2 Measurement

Measured as: Opinion rating.

A.6.5.3 Reference

See [ETSI EG 202 843] (in P615)

A.6.6 Parameter 42: Overall reliability of the documentation services

A.6.6.1 Definition

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

A.6.6.2 Measurement

Measured as: Opinion rating.

A.6.6.3 Reference

See [ETSI EG 202 843] (in P616)

A.7 Technical support provided by the service provider

A.7.1 Parameter 43: Accessibility to technical support

A.7.1.1 Definition

The ratio of the number of successful attempts to the technical support to the total number of attempts to reach this support.
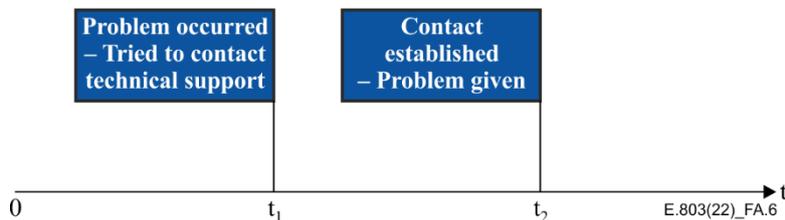
Figure A.6 – Events illustrating "accessibility to technical support"

A.7.1.2 Explanation of the definition of the parameter

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

A.7.1.3 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.

A.7.1.4 Measurement

The indicator is expressed as a percentage.

A.7.1.5 Specific description of the 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 the relevant customers (preferred scenario),
- assessment by a panel of experts according to their own experience in contacting the technical support.

A.7.1.6　Trigger points

Table A.6 – Trigger points

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

A.7.1.7　Representativeness

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

A.7.1.8　Presentation of the 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 of where the data comes from (panel composition and size, or SP data).

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

A.7.2　Parameter 44: Technical solutions achieved within a specified period

A.7.2.1　Definition

The 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.

A.7.2.2　Measurement

Measured as: Percentage.

A.7.2.3　Reference

See [ETSI EG 202 843] (in P622)

A.7.3　Parameter 45: Number of attempts before a successful solution

A.7.3.1　Definition

The number of attempts before the technical request was successfully resolved.

A.7.3.2　Measurement

Measured as: Number.

A.7.3.3　Reference

See [ETSI EG 202 843] (in P623)

A.7.4 Parameter 46: Integrity of the technical solutions

A.7.4.1 Definition

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

A.7.4.2 Measurement

Measured as: Opinion rating.

A.7.4.3 Reference

See [ETSI EG 202 843] (in P624)

A.7.5 Parameter 47: Reliability of the technical solutions achieved

A.7.5.1 Definition

The ratio of the 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.

A.7.5.2 Measurement

Measured as: Percentage.

A.7.5.3 Reference

See [ETSI EG 202 843] (in P625)

A.7.6 Parameter 48: Modes of technical support

A.7.6.1 Definition

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

A.7.6.2 Measurement

Measured as: Number.

A.7.6.3 Reference

See [ETSI EG 202 843] (in P626)

A.8 Commercial support provided by a service provider

A.8.1 Parameter 49: Accessibility of the commercial support

A.8.1.1 Definition

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

A.8.1.2 Measurement

Measured as: Percentage.

A.8.1.3 Reference

See [ETSI EG 202 843] (in P641)

A.8.2 Parameter 50: Commercial solution delivery time

A.8.2.1 Definition

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

A.8.2.2 Measurement

Measured as: Time.

A.8.2.3 Reference

See [ETSI EG 202 843] (in P642)

A.8.3 Parameter 51: Commercial solutions achieved within a specified period of time

A.8.3.1 Definition

The 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.

A.8.3.2 Measurement

Measured as: Percentage.

A.8.3.3 Reference

See [ETSI EG 202 843] (in P643)

A.8.4 Parameter 52: Integrity of the commercial solutions achieved by a service provider

A.8.4.1 Definition

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

A.8.4.2 Measurement

Measured as: Opinion rating.

A.8.4.3 Reference

See [ETSI EG 202 843] (in P644)

A.8.5 Parameter 53: Modes of commercial support

A.8.5.1 Definition

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

A.8.5.2 Measurement

Measured as: Number.

A.8.5.3 Reference

See [ETSI EG 202 843] (in P645)

A.8.6 Parameter 54: Organizational efficiency of commercial support

A.8.6.1 Definition

Availability of the organizational resources to fulfil customer needs on commercial support.

A.8.6.2 Measurement

Measured as: Opinion rating.

A.8.6.3 Reference

See [ETSI EG 202 843] (in P652)

A.9 Complaint management

A.9.1 Parameter 55: Accessibility of the complaint management

A.9.1.1 Definition

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

A.9.1.2 Measurement

Measured as: Percentage.

A.9.1.3 Reference

See [ETSI EG 202 843] (in P661)

A.9.2 Parameter 56: Recognition of the customer complaints

A.9.2.1 Definition

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

A.9.2.2 Measurement

Measured as: Percentage.

A.9.2.3 Reference

See [ETSI EG 202 843] (in P662)

A.9.3 Parameter 57: Complaint solutions not complete and correct first time

A.9.3.1 Definition

The 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.

A.9.3.2 Measurement

Measured as: Percentage.

A.9.3.3 Reference

See [ETSI EG 202 843] (in P663)

A.9.4 Parameter 58: Integrity of complaint resolution

A.9.4.1 Definition

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

A.9.4.2 Measurement

Measured as: Percentage.

A.9.4.3 Reference

See [ETSI EG 202 843] (in P664)

A.9.5 Parameter 59: Customer perception of the complaint management

A.9.5.1 Definition

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

A.9.5.2 Measurement

Measured as: Opinion rating.

A.9.5.3 Reference

See [ETSI EG 202 843] (in P665)

A.9.6 Parameter 60: Overall quality of the complaint management process

A.9.6.1 Definition

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.

A.9.6.2 Measurement

Measured as: Opinion rating.

A.9.6.3 Reference

See [ETSI EG 202 843] (in P666)

A.9.7 Parameter 61: Organizational efficiency of a complaint management system

A.9.7.1 Definition

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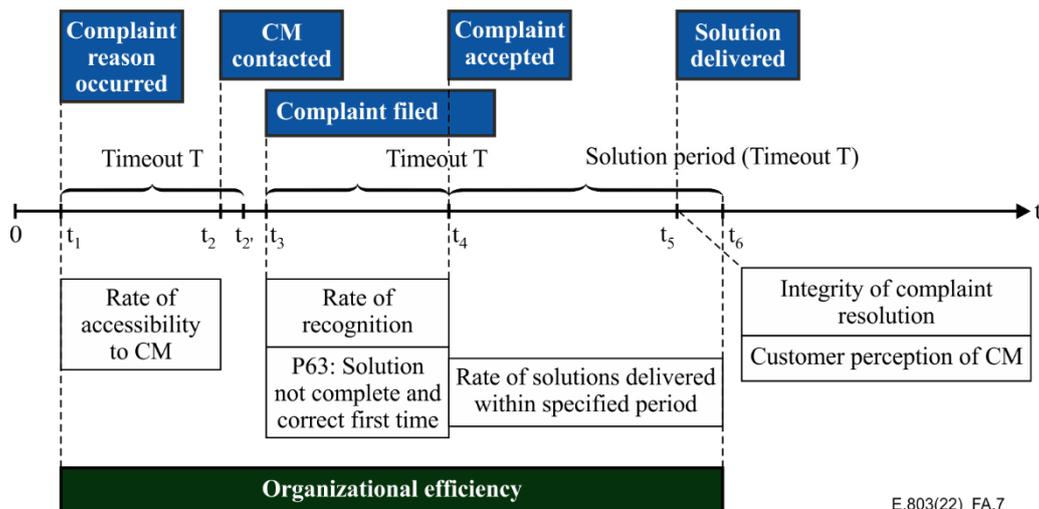
**Figure A.7 – Events affecting "Organizational efficiency
of the complaint management system"**

A.9.7.2 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 the 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.

A.9.7.3 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.

A.9.7.4 Measurement

Measured as: Opinion rating (OR).

A.9.7.5 Specific description of the 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 a complaint is acknowledged,

5)   number of attempts before a 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 in order to arrive at an OR value. Additionally, a customer survey may also be carried out to assess first-hand the customers' opinions.

A.9.7.6 Trigger points

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

A.9.7.7 Representativeness

Not applicable.

A.9.7.8 Presentation of the parameter values

The 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 of the panel composition and the size.

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

A.10 Repair services

A.10.1 Parameter 62: Accessibility of the repair services

A.10.1.1 Definition

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

A.10.1.2 Measurement

Measured as: Ratio or percentage.

A.10.1.3 Reference

See [ETSI EG 202 843] (in P701)

A.10.2 Parameter 63: Successful repairs carried out within a specified period of time

A.10.2.1 Definition

The ratio of the number of repairs successfully carried out to the total number of repair requests accepted by the SP within a specified period.
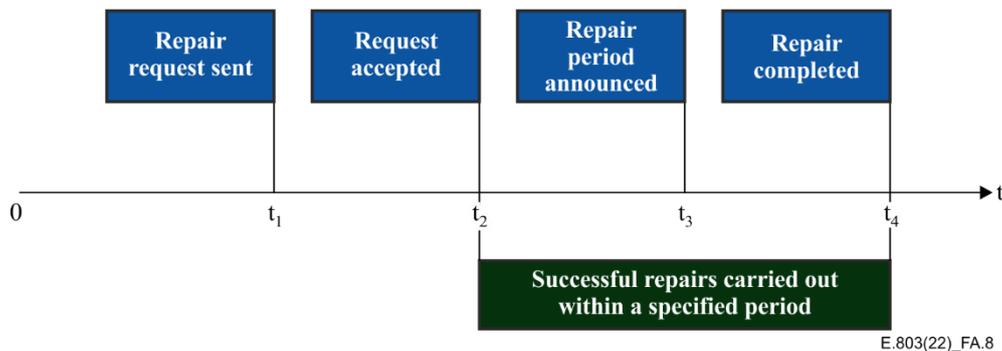
Figure A.8 – Events affecting "successful repairs carried out within a specified period of time"

A.10.2.2 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 must 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.

A.10.2.3 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.

A.10.2.4 Measurement

Measured as: Ratio or percentage

A.10.2.5 Specific description of evaluation

Only repairs that are 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.

A.10.2.6 Trigger points

Table A.7 – Trigger points

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

A.10.2.7 Representativeness

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

A.10.2.8 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 of the panel composition and size or/and volume of the SP data reviewed.

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

A.10.3 Parameter 64: Repairs not complete and correct the first time

A.10.3.1 Definition

The ratio of the number of repairs that were not successfully carried out at the first (and only) attempt to the total number of repairs carried out during the specified period.

A.10.3.2 Measurement

Measured as: Percentage.

A.10.3.3 Reference

See [ETSI EG 202 843] (in P703)

A.10.4 Parameter 65: Punctuality of the appointments for repairs

A.10.4.1 Definition

Record of attendance of an SP agent to carry out repairs at the specified time (allowing, if necessary, a grace period for lateness). It may also be expressed as an opinion rating of customers.

A.10.4.2 Measurement

Measured as: Opinion rating and/or time.

A.10.4.3 Reference

See [ETSI EG 202 843] (in P704)

A.10.5 Parameter 66: Efficiency of the repair services

A.10.5.1 Definition

"Efficiency of the repair service" (mainly technical) of an SP is characterised by the combined performances of:

• accessibility (parameter 62),

• the number of repairs in a specified period of time (parameter 63),

• repairs carried out successfully the first time (parameter 64),

• punctuality (parameter 65).

A.10.5.2 Measurement

Measured as: Opinion rating.

A.10.5.3 Reference

See [ETSI EG 202 843] (in P705)

A.10.6 Parameter 67: Organizational efficiency of repair services

A.10.6.1 Definition

"Organizational (or operational) efficiency of repair service" is characterized by the combined performances of:

• punctuality (parameter 65),

• time to repair (parameter 66),

• provision of resources (human, hardware and software),

• the organizational logistics to provide an effective repair service.

A.10.6.2 Measurement

Measured as: Opinion rating.

A.10.6.3 Reference

See [ETSI EG 202 843] (in P711)

A.10.7 Parameter 68: Notification of root cause of the outage

A.10.7.1 Definition

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

A.10.7.2 Measurement

Measured as: Ratio or percentage.

A.11 Metering, charging and billing

A.11.1 Parameter 69: Accessibility of tariff information

A.11.1.1 Definition

The ratio of the number of successful attempts to the total number of attempts to reach this facility located as indicated in the contract or regulations (access details to this facility to be provided by the SP).
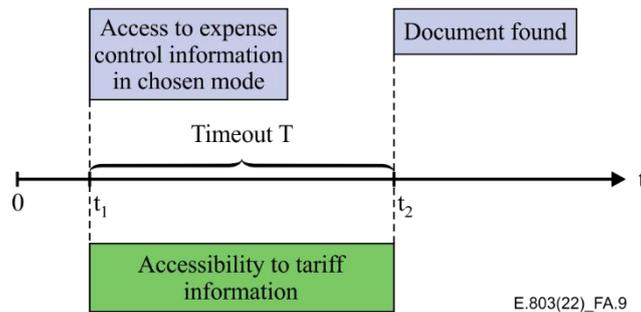
Figure A.9 – Events affecting "accessibility to tariff (charging) information"

A.11.1.2 Explanation of the definition of the parameter

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

A.11.1.3 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.

A.11.1.4 Measurement

Measured as: Ratio or percentage

A.11.1.5 Specific description of evaluation

Precondition: Access to the expense control information in the 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 the answers received from the SP.

A.11.1.6 Trigger points

Table A.8 – Trigger points

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

A.11.1.7 Representativeness

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

A.11.1.8 Presentation of the 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 of where the data comes from (panel composition and size or/and the volume of the SP data reviewed).

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

A.11.2 Parameter 70: Successful notification of the exceeding billing budget

A.11.2.1 Definition

The 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.

A.11.2.2 Measurement

Measured as: Percentage.

A.11.2.3 Reference

See [ETSI EG 202 843] (in P802)

A.11.3 Parameter 71: Notification time (delay) of the exceeding billing budget

A.11.3.1 Definition

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

A.11.3.2 Measurement

Measured as: Time.

A.11.3.3 Reference

See [ETSI EG 202 843] (in P803)

A.11.4 Parameter 72: Accessibility of the account management

A.11.4.1 Definition

The ratio of the number of successful attempts to the total number of attempts to reach the account management.

A.11.4.2 Measurement

Measured as: Percentage.

A.11.4.3 Reference

See [ETSI EG 202 843] (in P804)

A.11.5 Parameter 73: Time to update the charging information

A.11.5.1 Definition

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

A.11.5.2 Measurement

Measured as: Time.

A.11.5.3 Reference

See [ETSI EG 202 843] (in P805)

A.11.6 Parameter 74: Timeliness of the bill delivery

A.11.6.1 Definition

The ratio of the number of bills delivered within the bill expectation period is divided by the number of bills expected within the observation period.

A.11.6.2 Measurement

Measured as: Percentage.

A.11.6.3 Reference

See [ETSI EG 202 843] (in P806)

A.11.7 Parameter 75: Bill delivery delay

A.11.7.1 Definition

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

A.11.7.2 Measurement

Measured as: Time.

A.11.7.3 Reference

See [ETSI EG 202 843] (in P807)

A.11.8 Parameter 76: Late notification of the amount due

A.11.8.1 Definition

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.

A.11.8.2 Measurement

Measured as: Percentage.

A.11.8.3 Reference

See [ETSI EG 202 843] (in P808)

A.11.9 Parameter 77: Modes of the billing information transfer

A.11.9.1 Definition

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

A.11.9.2 Measurement

Measured as: Number.

A.11.9.3 Reference

See [ETSI EG 202 843] (in P809)

A.11.10 Parameter 78: Organizational efficiency of the billing service

A.11.10.1 Definition

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

A.11.10.2 Measurement

Measured as: Opinion rating.

A.11.10.3 Reference

See [ETSI EG 202 843] (in P815)

A.12 Network/service management by the customer

A.12.1 Parameter 79: Outage duration

A.12.1.1 Definition

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

A.12.1.2 Measurement

Measured as: Time.

A.12.2 Parameter 80: Frequency of outages

A.12.2.1 Definition

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.
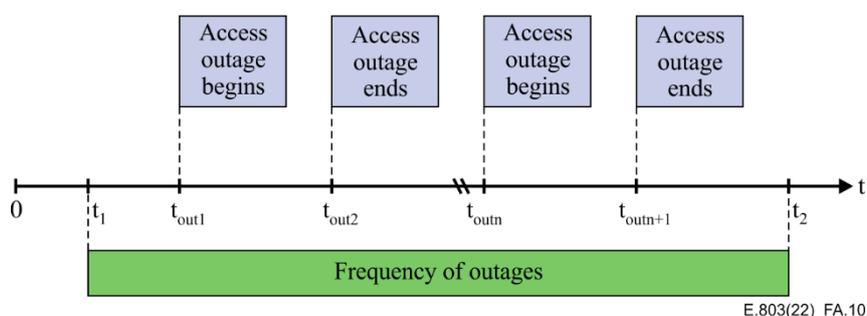
**Figure A.10 – Events identifying "frequency of outages"
for network/service management by the customer**

A.12.2.2 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., the regulator or a national institution responsible for the QoS of the telecommunication services.

A.12.2.3 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 A.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.

A.12.2.4 Measurement

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

A.12.2.5 Specific description of the 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 the stakeholders, e.g., regulators 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 at the request of the national stakeholder, e.g., a regulator or a representative institution. Where sampling has been implemented, the SP could state in the presentation of the parameter values (for a reporting period) the confidence limits for the values obtained.

A.12.2.6 Trigger points

Table A.9 – Trigger points

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

A.12.2.7 Representativeness

Every large customer (e.g., corporate organization) using the network/service management facility on a regular basis will 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).

A.12.2.8 Presentation of the parameter values

The frequency of the 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 of the size or/and the volume of the SP data reviewed.

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

A.12.3 Parameter 81: Response time for a reply to the requests

A.12.3.1 Definition

The time elapsed from the instant the customer requests access to the network/service management facility to the instant such a request was carried out.

A.12.3.2 Measurement

Measured as: Time.

A.12.3.3 Reference

See [ETSI EG 202 843] (in P903)

A.12.4 Parameter 82: Successful request response

A.12.4.1 Definition

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.

A.12.4.2 Measurement

Measured as: Percentage.

A.12.4.3 Reference

See [ETSI EG 202 843] (in P904)

A.12.5 Parameter 83: Overall reliability of the network/service management service

A.12.5.1 Definition

The consistent combined performance of the availability, response times, response rates, correctness, and completeness in the processing and fulfilment of the customer requests for network/service management facilities.

A.12.5.2 Measurement

Measured as: Opinion rating.

A.12.5.3 Reference

See [ETSI EG 202 843] (in P905)

A.12.6 Parameter 84: Organizational efficiency of the network/service management service

A.12.6.1 Definition

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.

A.12.6.2 Measurement

Measured as: Opinion rating.

A.12.6.3 Reference

See [ETSI EG 202 843] (in P913)

A.12.7 Parameter 85: Reliability of the planned outage notification

A.12.7.1 Definition

The ratio of the number of advanced notifications of planned outages to the customers by a service provider to the total number of planned outages carried out.

A.12.7.2 Measurement

Measured as: Ratio or percentage.

A.13 Cessation of service

A.13.1 Parameter 86: Cessation acknowledgement time

A.13.1.1 Definition

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.

A.13.1.2 Measurement

Measured as: Time.

A.13.1.3 Reference

See [ETSI EG 202 843] (in P1001)

A.13.2 Parameter 87: Cessation request acknowledgement

A.13.2.1 Definition

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

A.13.2.2 Measurement

Measured as: Percentage.

A.13.2.3 Reference

See [ETSI EG 202 843] (in P1002)

A.13.3 Parameter 88: Accessibility of the cessation facility

A.13.3.1 Definition

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

A.13.3.2 Measurement

Measured as: Percentage.

A.13.3.3 Reference

See [ETSI EG 202 843] (in P1003)

A.13.4 Parameter 89: Contractual cessations achieved

A.13.4.1 Definition

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

A.13.4.2 Measurement

Measured as: Percentage.

A.13.4.3 Reference

See [ETSI EG 202 843] (in P1004)

Annex B

A 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 the quality of service (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 a 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, analyse the data stored by the SP, convene the expert panel, launch the customer survey and gather the results.

B.1 Opinion rating (OR)

B.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 the service provider's employees towards the customers,

• ergonomics of the 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 B.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 either side as illustrated below:

Table B.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.

B.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. Not able to definitely proceed further with decision-making about the service.

−2 Quite dissatisfied.

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

−1 Somewhat dissatisfied.

i.e., very little information is provided. Need to make further enquiries to be able to make an informed judgement about the 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 the service.

+1 OK with basic information.

i.e., more queries to ensure I have all the 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 the queries and provided all the pertinent PI. For example, "I can now make an informed decision on the service."

B.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 the various data sources. Depending on the type of data, that 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 the appropriate usage of these data sources are also given.

B.2.1   Expert panel

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

Ideally, the selected experts bring a broad theoretical background and a 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 the 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 a few experts are required to address a certain topic.

•   The high level of expertise guarantees a high qualitative feedback.

•   Feedback on 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 the objective feedback (emotions, first thoughts, etc.).

•   Data can be generated by anyone 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 the 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.

B.2.2   Customer survey

To get a broader basis of feedback, a survey of customer panels can be used. A customer panel consists of the "usual" customers of the products or the 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 a recent (e.g., six months) experience with the issue in order 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 a representative of the complete population of a country or of the complete population of the customers of a service provider.

When selecting a 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 the 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 the 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 discrepancies between the findings of these differing channels. Where the difference is significant, the reason for this discrepancy should be investigated and any necessary changes incorporated, either into the panel's ratings or in the way the customer survey is carried out.

B.2.3 Service provider data

For certain customer relevant processes, service providers (SP) may have the available customer records for their own purposes or due to the 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 must 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 the customers' relevant parameters, as soon as they fulfil the conditions described above.

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

B.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 the 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 the 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 several topics.

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

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

   Example 2: 150 customers of service provider (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 it represents the customer's 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 the mass data from the 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: Service provider (SP) B delivers 10 000 data sets which allow for the determination of the parameter "time for alteration" on a very broad basis.

B.3.1   Statistical considerations

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

B.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.
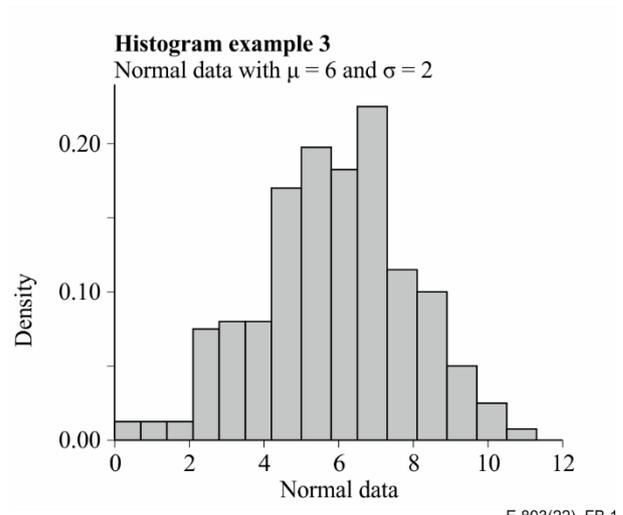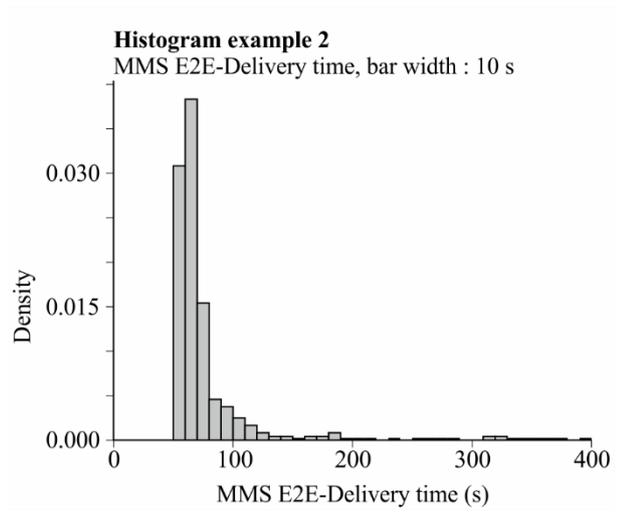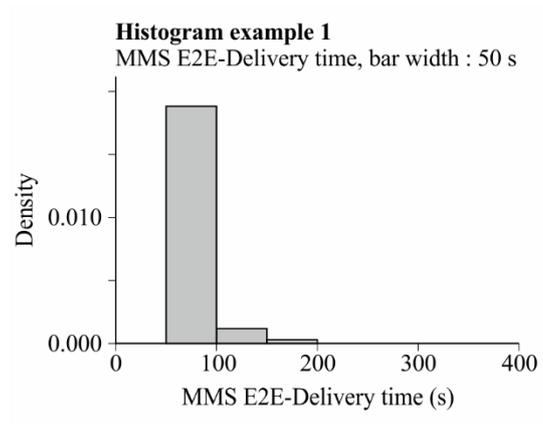
Figure B.1 – Examples of histograms

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

Therefore, the complete information available should be given, e.g., as a histogram figure (see Figure B.1). Statistical measures like mean values or quantile calculations are not recommended at all for this scenario.

Consequently, 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.
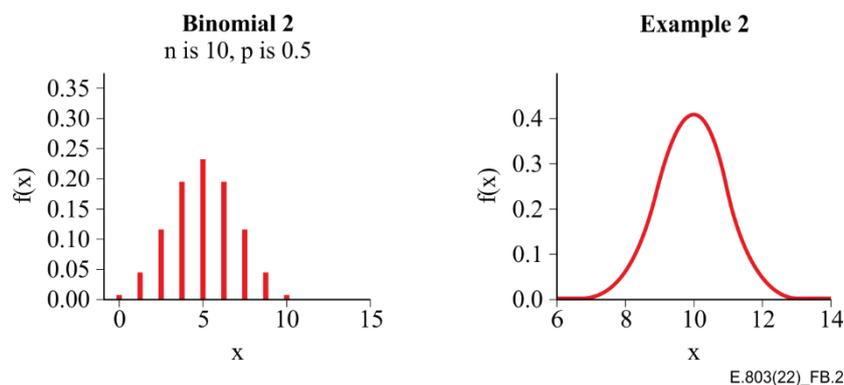
Figure B.2 – Transition from binomial to normal distribution

B.3.1.2   Medium sample sizes

If the order of the 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 the mean rates are 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 the 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 the information which is related to the distribution of the data should be available. On a higher level, aggregated information like mean values could also be provided. In this case, at least the number of the used samples should be given as an additional piece of information.

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

B.3.1.3   Large sample sizes

For large sample sizes (order of magnitude > 300), the set of the statistical measures can be further extended. In this range of samples, the calculation of the 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 the probability density functions (PDFs) or by the 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:

$$F(x) = P(x \leq x_0)$$
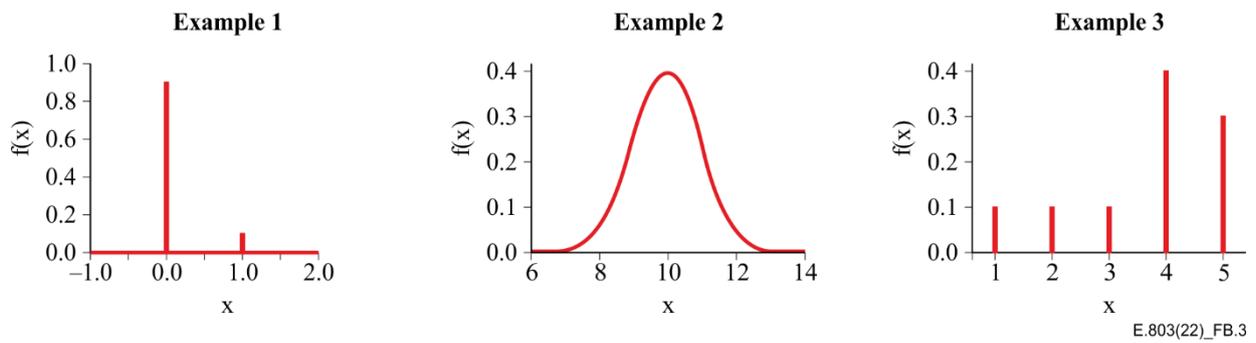
Figure B.3 – Examples of the probability density functions
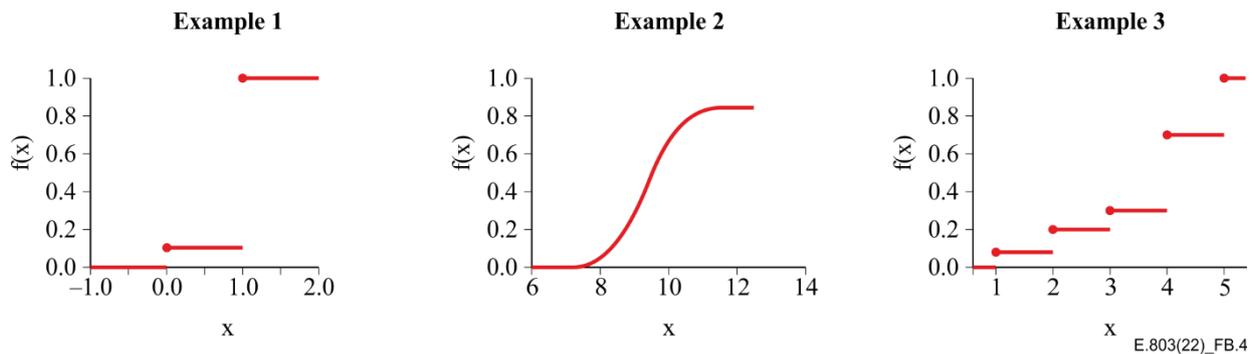
Figure B.4 – Examples of the cumulative distribution functions

The CDF representation allows the reading of all kinds of quantile values 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 B.4.

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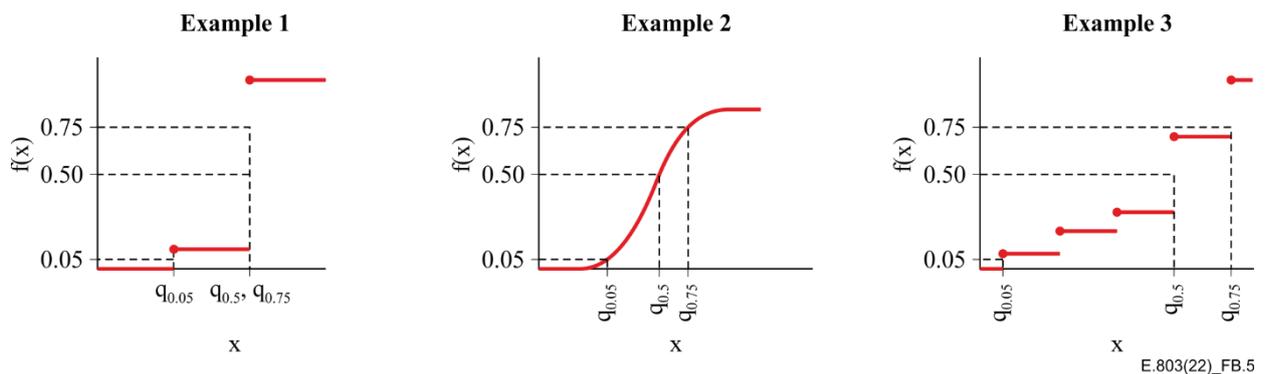
Figure B.5 – Examples for the determination of quantile values

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

B.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 the 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 the samples can have a very great influence on the mean value.

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

Calculation of the median value:

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

These samples are ordered in an 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 the outlier effects and should be preferred to give the overall impression in some measure.

MMQ-Plot example 1
SMS E2E-Delivery time (probing trials) per hour (sec)

MMQ-Plot example 2
Reaction time by month (minutes)

MMQ-Plot example 3
Delay (minutes) per calendar week

E.803(22)_FB.6
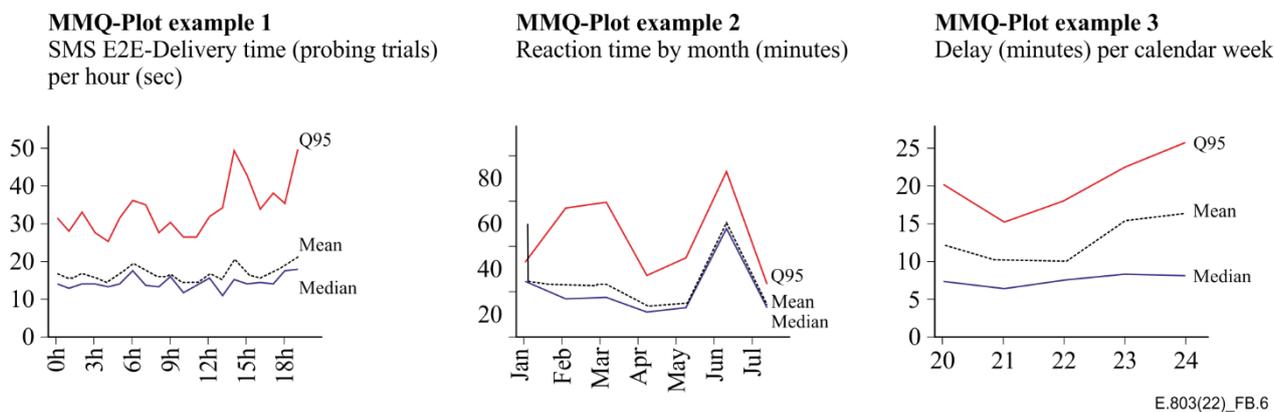
Figure B.6 – Examples showing the behaviour of the mean and median

Plot 3 in Figure B.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 the 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%).

B.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 the available data sets are used for these considerations.

Example: A network operator has 10 million customers but can only manage to ask 1 000 of them.

In this scenario, there is a certain chance that the customers to be asked are not representative but are rather 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 the 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]

B.3.4   Accuracy of indicators

For parameters that estimate a ratio of two values, the width of the confidence interval can be determined as described in clause B.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.

B.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 the data retrieval phases from infinite waiting for events that 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 the calculation of parameters. Furthermore, this concept allows one to plan the duration of the data retrieval phases which will reduce the organizational cost of these evaluations.

B.3.6   Selection of panels

Opinion ratings (OR) are a commonly used method to assess parameters that are based on an individual and a 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 the segmentation should ensure, as far as possible, a comparability within the European Union.

B.3.7 Determination of boundary conditions prior to the 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:

•   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 the 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.

B.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 the presentation of the 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 the mean of the expert panel and the customer panel assessment ratings.

As a principle, the presentation of the results should provide 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.

B.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 an expert panel (OR).

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

B.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) to provide a more comprehensive assessment of its spread.

B.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's 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 the mean value is given.

B.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.

B.4.5   Chart

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

B.4.6   Choice of the best suited presentations

For example, in Figure B.1 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, composite indicators.

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