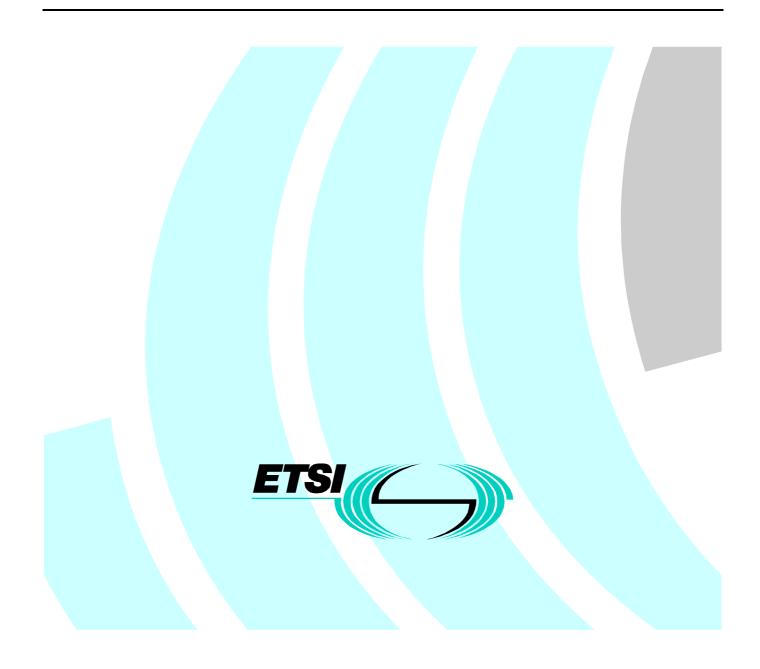# ETSI EG 201 769 V1.1.2 (2000-10)

ETSI Guide

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Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Speech processing, Transmission and Quality aspects (STQ).

The present document has taken into account as far as practicable the following principles which have been endorsed by the ONP Committee:

1) ONP QoS parameters should be easily understood by the public, and be useful and important to them.

2) All parameters are applicable at the network termination point.

3) Where measurements are possible they should be made on the customer's premises, using in-service lines.

NOTE: Literally principles 2 and 3 imply that all measurements are to be carried out at the NTP, which would require co-operation by users, and be excessively intrusive as would require many visits to the premises of users. Measurements at the subscriber side of the local exchange (e.g. at the MDF or other possible connection point/distribution frame in the access network) generally give an adequate representation of the quality that would be perceived at the NTP for the parameters defined in the present document, and so this approach is used because it is more practicable and meets the underlying objectives of these principles.

4) To be as realistic as possible, real traffic rather than test calls should be used as a basis of the measurements, wherever possible.

5) Parameters should be capable of verification by independent organizations. This verification might be made by direct measurements or by audit of service provider's measurements.

6) The accuracy of QoS values should be set to a level consistent with measurement methods being as simple as possible with costs as low as possible.

7) The parameters are designed for both statistical and individual application. The statistical values should be derived by the application of a simple statistical function to the individual values. The statistical function should be specified in the standard. The standard should also contain guidelines on how statistically significant samples should be selected.

8) The statistical functions should be designed so QoS figures from different service providers can be compared easily by users and in particular consumers.

In addition, several measures have been re-designed (compared to version 1) to identify more transparently the service experienced by the user and to ensure that changes to that service are reflected more accurately in the measurements. An example is the change from measuring supply time and fault repair in working days/hours to measuring in calendar days/hours (elapsed time).

1 Scope

The present document contains harmonized definitions and measurement methods for a range of user perceivable Quality of Service (QoS) parameters for the voice telephony service. The set of parameters have been produced in response to the ONP Voice Telephony Directive 98/10/EC. The present document addresses the parameters listed in annex 3 of the Directive.

The purpose of these parameters is to define objective and comparable measures of the QoS delivered to users/customers for use by NRAs as set out in the Directive. The establishment of target values for QoS is beyond the scope of the present document.

The Quality of Service parameters apply to the services governed by the Voice Telephony Directive (98/10/EC [1]), i.e. fixed public telephone services, irrespective of the network technology chosen by the service provider, e.g. PSTN, ISDN or other technology, and the destination of the call.

The parameters specified apply to fixed public telephony services irrespective of whether supplementary services are offered, subscribed to or invoked for a particular call.

Annex E provides a proforma for the provision of statistics to an NRA.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies.

[1] Directive 98/10/EC of the European Parliament and of the Council of 26 February 1998 on the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment.

[2] Directive 97/51/EC of the European Parliament and of the Council of 6 October 1997 amending Council Directives 90/387/EEC and 92/44/EEC for the purpose of adaptation to a competitive environment in telecommunications.

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

[4] ITU-T Recommendation I.210: "Principles of telecommunication services supported by an ISDN and the means to describe them".

[5] Directive 90/387/EC of the European Parliament and of the Council on harmonized conditions of access to public networks and service.

3 Definitions and abbreviations

3.1 Definitions

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

access line: connection from the Network Termination Point to the entry point to the local switch or remote concentrator, whichever is the nearer. In many cases this is the main distribution frame

access network operator: organization that provides the access line. In many cases the access network operator will be the direct service provider, but if the line is unbundled, the direct service provider would be a separate organization

customer: party that pays for the telecommunication service(s) provided. Customers can generally be categorized as business or residential; the definition of business and residential customers is left to individual service providers. Service providers who receive interconnect services from other service providers are not considered to be customers for the purpose of the present document. The term "customer" is equivalent to "subscriber", which is used in Directive 98/10/EC [1]. "Customer" is the more modern term

direct service: service where the service provider that provides the telecommunication service(s) also provides the access network or rents an unswitched local loop (unbundled local loop) to use for the provision of the service to the customer

fixed public telephony service: service where the call originates on a fixed public telephone network irrespective of its destination. This service may include access to emergency services, the provision of operator assistance, directory services, provision of public payphones, provision of service under special terms and/or provision of special facilities for customers with disabilities or with special social needs, as set out in this Directive, but does not include value added services provided over the public telephone network. (Second part copied from Directive 98/10/EC [1])

indirect service: service where the service provider that provides the telecommunication service(s) does not provide the access network but is selected by the customer or user using a form of carrier selection

network operator: organization that provides a network for the provision of a public telecommunication service. If the same organization also offers services it also becomes a service provider

network termination point: physical point at which a user is provided with access to a public telecommunications network. The locations of network termination points shall be defined by the national regulatory authority and shall represent a boundary, for regulatory purposes, of the public telecommunications network; (Copied from Directive 97/51/EC [2] which amended the original ONP Directive 90/387/EC [5])

ported number: subscriber number (directory number) where the location of the NTP and/or the identity of the service provider has changed after the number was originally allocated

public pay-telephone: telephone available to the general public, for the use of which the means of payment are coins and/or credit/debit cards and/or pre-payment cards (copied from Directive 98/10/EC [1])

   NOTE 1: This definition excludes courtesy telephones whose outgoing call capabilities are strictly limited and where no charges are normally made.

quality of service: collective effect of service performance which determines the degree of satisfaction of a user of the service. (Taken from ITU-T Recommendation E.800 [3])

service provider: organization that offers a telecommunication service to the customer and/or user. A service provider need not be a network operator

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

supplementary service: additional service that modifies or supplements a basic telecommunication service. Consequently, it cannot be offered to a customer as a stand-alone service; it has to be offered in association with a basic telecommunication service. The same supplementary service may be common to a number of basic telecommunication services. See ITU-T Recommendation I.210 [4]

user: individuals, including consumers, or organizations using or requesting publicly available telecommunications services. (Copied from Directive 98/10/EC [1])

voice telephony service: service available to the public for the commercial provision of direct transport of real-time speech via the public switched network or networks such that any user can use equipment connected to a network termination point at a fixed location to communicate with another user of equipment connected to another termination point. (Copied from Directive 98/10/EC [1])

3.2   Abbreviations

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

CLI	Calling Line Identity
CPE	Customer Premises Equipment (controlled and normally provided by the customer)
ISDN	Integrated Services Digital Network
MDF	Main Distribution Frame
n/a	not applicable
NRA	National Regulatory Authority
NTP	Network Termination Point
ONP	Open Network Provision
PSTN	Public Switched Telephone Network
QoS	Quality of Service

4   General considerations

4.1   Services covered

The parameters specified apply to fixed public telephony services irrespective of whether supplementary services are offered, subscribed to or invoked for a particular call. The parameters do not apply to the quality of supplementary services themselves.

The parameters are end-user / customer and end-to-end orientated and are not intended to address the quality of interconnect services explicitly. Any dependence on interconnect services is included implicitly in the measures of QoS provided to the end user.

In many cases the provider of the voice telephony service to the customer may depend on other providers for part of the service. An example is an international call where several service providers are normally involved. In such cases the provider of the service to the customer is responsible for all elements for which it receives payment from the customer. In order to provide satisfactory QoS, this service provider will need to ensure that adequate QoS is provided by the other interconnected service providers. QoS figures for the responsible service provider will reflect both its own capability and that of the interconnected service providers.

The parameters apply to all fixed voice telephony services irrespective of the network technology chosen by the service provider, e.g. PSTN, ISDN or other technology, and the destination of the call. Service providers should include in their measurements calls to numbers served by mobile networks and calls to international destinations, however for some parameters separate measures are required for national and international destinations.

4.2   Reporting for different classes of customers

For each parameter, service providers should provide statistics aggregated over all classes of customer. In addition to the provision of aggregated information, service providers who distinguish between different classes, e.g. residential and business, may provide separate statistics, but they are not required to do so.

4.3   Non standard levels of QoS

Statistics provided should apply only to the standard level of QoS for each parameter. Cases where customers choose to pay more for enhanced or less for lower QoS should be excluded.

4.4   Reporting for directly- and indirectly-serviced customers

The principle used is that the service provider who charges the customer should be responsible for the quality of the service and for providing QoS statistics relevant to the service provided. Thus, in the case of carrier selection, the indirect service provider has the responsibility for QoS and provision of QoS statistics when it is selected to carry a call.

For each parameter in clause 5 a statement is made on whether it is applicable to indirect services.

Some service providers provide both direct and indirect services. Where there are likely to be significantly different levels of performance for these two service types, separate reporting is required for each service type, otherwise only a single combined statistic needs to be reported.

The treatment of direct and indirect services is summarized in the last column of table 1.

NOTE: Where only a combined statistic for both types of service is specified, separate statistics for each service type may be provided in addition if the service provider wishes to do so.

4.5   Data processing issues

Where the measures are based on all actual occurrences rather than samples, service providers may prefer to process data on a weekly or monthly basis, discard the detailed data and use a statistical method such as that specified in annexes A and B for combining the weekly or monthly results. Whether or not this approach may be used should be agreed with the NRA concerned.

For several parameters the statistic required is "the time by which the fastest X % is ...". This statistic is explained in annex B.

Service providers should agree with the NRA how instances of data loss, corruption or incompleteness should be handled.

In some cases disasters, freak weather, etc. may distort measured QoS figures. Such occurrences may not necessarily damage a network, but could degrade QoS by inducing exceptional traffic levels etc. In these cases, service providers should provide the measured QoS and may additionally provide a second figure which excludes the effects of the exceptional circumstances. A note clearly explaining the difference should also be provided. Service providers covering large geographical areas are likely to be more prone to these effects than service providers serving smaller areas. The effect on the reported QoS of a service provider covering a small area is likely to be more severe, however, should such an event occur.

4.6   Data collection period

QoS data should be collected and calculated on a quarterly basis starting 1 January, 1 April etc.

NOTE: Reporting and publication arrangements are not specified in the Directive and would normally be decided by the NRA.

4.7   Sampling and test calls

Where sampling and test calls are used the approach should ensure that the results adequately reflect the QoS perceived by customers for the period under review.

5   QoS parameters

Table 1 summarizes the QoS parameters defined in the present document.

Table 1: Summary of QoS Parameters

Parameter	Measure	Measurement Method	Application to direct and/or indirect services
5.1 Supply time for initial connection	Time to supply 95 % and 99 % in elapsed days, and %age by agreed date Hours for taking orders and stated accuracy for appointments	All actual	Direct only
5.2 Faults rate	Faults/access line/year	All actual	Direct and indirect with separate reporting
5.3 Fault repair time	Time to repair 80 % and 95 %, and %age on target date for faults on access lines	All actual	Direct only
	Time to repair 80 % and 95 %, and %age on target date for all other faults	All actual	Direct and indirect with combined reporting
	Hours for reporting faults and stated accuracy for appointments		Direct and indirect with combined reporting
5.4 Unsuccessful call ratio	% for national and international calls (separately)	All or sample or test calls	Direct and indirect with combined reporting
5.5 Call set-up time	Time for mean and 95 % for national and international calls (separately)	All or sample or test calls	Direct and indirect with combined reporting
5.6 Response times for operator services	Mean time to answer % answered within 20 seconds	All or sample	Direct and indirect with combined reporting
5.7 Response time for directory enquiry services	Mean time to answer % answered within 20 seconds	All or sample	Direct and indirect with combined reporting
5.8 Public pay-telephones in working order	% in full working order	All or sample	n/a
5.9 Bill correctness complaints	%	All actual	Direct and indirect with combined reporting

NOTE 1:   Many of the parameters have several subtleties associated with their definition, applicability and measurement. The parameters are fully explained in the relevant subclauses of clause 5.

Table 2 summarizes the information to be provided from the perspective of the user, who may have both a direct service provider (whose service includes the access line) and one or more indirect service providers that may be selected for different calls using call-by-call selection or pre-selection. For each parameter, the table shows what will be measured and which service provider will report an event covered by the parameter.

NOTE 2:   All service providers with significant market power are required to report statistics to the NRA. NRAs may choose to require statistics from other service providers as well but they are not obliged by the Directive to do so and therefore the extent to which smaller service providers will be required to provide reports may vary from Member State to Member State. It is a matter for the NRA to decide what information should be published and how is should be published.

Table 2: QoS parameters from the perspective of the user

Parameter	Measure	Information provided to NRA by
5.1 Supply time for initial connection	Time to supply 95 % and 99 % in elapsed days, and %age by agreed date Hours for taking orders and stated accuracy for appointments	Direct service provider (in all cases except where an unbundled local loop is used, this will be the access network operator)
5.2 Faults rate	Faults /access line/year	Service provider selected for call that is faulty
5.3 Fault repair time	Time to repair 80 % and 95 %, and %age on target date for faults on access lines Time to repair 80 % and 95 %, and %age on target date for all other faults Hours for reporting faults and stated accuracy for appointments	Direct service provider (in all cases except where an unbundled local loop is used, this will be the access network operator) Service provider selected for call that is faulty Each service provider
5.4 Unsuccessful call ratio	% for national and international calls (separately)	Service provider selected for call that is unsuccessful
5.5 Call set-up time	Time for mean and 95 % for national and international calls (separately)	Service provider selected for call
5.6 Response times for operator services	Mean time to answer % answered within 20 seconds	Service provider selected
5.7 Response time for directory enquiry services	Mean time to answer % answered within 20 seconds	Service provider selected
5.8 Public pay-telephones in working order	% in full working order	Payphone provider
5.9 Bill correctness complaints	%	Service provider complained to

5.1 Supply time for initial connection

5.1.1 Definition

The duration from the instant of a valid service order being received by a direct service provider to the instant a working service is made available for use. This should include cases where:

- a new access line is installed;

- an existing access line is taken over by another customer;

- an additional access line is provided to a customer who already has service, this includes an upgrade from PSTN to ISDN,

but should exclude:

- cancelled orders;

- cases where a customer changes operator and the new operator, who is responsible for reporting supply time, uses an unbundled local loop as the access line.

A valid order may be made verbally, or in writing or in any other acceptable form.

Where a service provider and customer agree that an order for multiple connections or service instances will be completed in stages, each agreed delivery time counts as a separate customer order for measurement purposes.

Where a customer orders service to be provided at several sites the provision of service at each site counts as a separate customer order for measurement purposes.

5.1.2 Measurement and statistics

The following statistics should be provided:

    a) the times by which the fastest 95 % and 99 % of orders are completed; and

    b) percentage of orders completed by the date agreed with the customer.

The time should be measured in elapsed days (including all public holidays etc).

Service providers may exclude from a) cases where delays to provision are requested by the customer.

Service providers may exclude from "a" and "b" cases where essential access to customer premises is not provided by the customer on the agreed date and time.

    NOTE 1: Supply time and its agreement with the customer is a complex process and it is impossible to find a single measure that adequately reflects all aspects of the interactions. Statistic a) is meant to cover the majority of cases except where delays are specifically requested by the customer. It includes cases where the service provider offers one or more closely spaced possible appointment times. Only cases where the customer actively rejects an appointment time and asks for a later time because, for example, other essential work will not be ready, should be excluded.

    NOTE 2: The basis of measurement has been changed from working days to elapsed days because:

        - elapsed time better reflects the user experience and ensures that overall improvements in service are adequately reflected in the results;

        - users increasingly require telecommunications outside traditional working hours (move to the 24 hour society);

        - changes in working hours can introduce anomalies into measures of performance based on working hours;

        - elapsed time provides better comparability of results between service providers.

In addition, the service provider should provide information on the hours during which orders may be taken.

    NOTE 3: This requirement has been added to provide greater visibility of improvements in the QoS perceived by customers. This is necessary because increases in the hours during which orders may be taken which improve the service to the customer may lead to an increase in the measured time to supply. This situation would occur if the hours for taking orders extend beyond the hours for actioning those orders.

Where service providers quote a standard accuracy for keeping appointments (e.g. they quote anytime within an hour or a half day) this period should also be provided.

    NOTE 4: This requirement has been added to provide greater visibility of improvements in the QoS perceived by customers. This is necessary because a reduction in window for keeping appointments, which improves the service to the customer, may lead to an decreased number of cases where the narrower appointment window is met.

Measurements apply only to direct services. The provision of service on an unswitched unbundled local loop should count as a direct service and be reported by the direct service provider, which in this case is different from the access network operator.

The provision of service on ISDN basic access should count as a single connection.

Statistics should include all connections supplied in the data collection period.

5.1.3 Further considerations

The supply of any customer premises equipment as part of or in conjunction with the order may be excluded from the measurement.

5.2   Faults rate per access line

5.2.1   Definition

A fault report is a report of disrupted or degraded service that is made by a customer and is attributable to the network of the service provider or any interconnected public network, and that is not found to be invalid. Faults in any equipment on the customer side of the network termination point are excluded.

Network faults reported against either basic or primary rate access, or single or multi-line analogue access, should be counted as one fault, regardless of the number of channels activated or affected. The count of the number of access lines should be one for basic or primary rate access regardless of the number of channels activated. For indirect service provision the number of service registrations (CLI registrations or registered pin codes) should be used instead of the number of access lines.

5.2.2   Measurement and statistics

The number of valid fault reports per access line per year should be provided.

This statistic should be calculated by dividing the number of valid fault reports observed during the data collection period (see subclause 4.6) by the average number of access lines or service registrations in the network under consideration during the same data collection period. The averaging is necessary because the number of access lines may vary during the data collection period. Service providers that cannot distinguish between:

-    valid faults attributable to the network;

-    faults attributable to CPE; or

-    invalid faults,

may use the total number of reported faults.

Fault reports should be assumed to be valid unless there is a specific reason to consider that they are invalid. Cases where a customer reports a fault that is found to be cleared when tested should be counted as a valid report unless the service provider has reason to believe that the fault did not occur.

A report that concerns more than one access line between customers and the local exchange should be counted in terms of the number of fault reports received rather than the number of lines affected. However only one fault report should be included for each access line affected.

Statistics should include all valid fault reports in the data collection period.

Separate statistics should be provided for both:

-    direct services; and

-    indirect services,

by the contracted service provider.

5.3   Fault repair time

5.3.1   Definition

The duration from the instant a fault has been notified by the customer to the published point of contact of the service provider to the instant when the service element or service has been restored to normal working order.

This measure applies only to services that offer the "standard repair" times to customers. Cases where the service provider agrees with the customer to provide faster repair for payment of higher maintenance fees are excluded, as are cases where lower fees are charged in return for a lower level of repair service.

   NOTE: "Fault reports" in this definition includes all valid reported faults as defined in subclause 5.2.1.

5.3.2   Measurement and statistics

The following statistics should be provided:

   a)   the time by which the fastest 80 % and 95 % of valid faults on access lines are repaired (expressed in clock hours);

   b)   the time by which the fastest 80 % and 95 % of all other valid faults are repaired (expressed in clock hours); and

   c)   the percentage of faults cleared any time stated as an objective by the service provider.

   NOTE 1:   The basis of measurement has been changed from working hours to elapsed clock hours because:

   -   elapsed time better reflects the user experience and ensures that overall improvements in service are adequately reflected in the results;

   -   users increasingly require telecommunications outside traditional working hours (move to the 24 hour society);

   -   changes in working hours can introduce anomalies into measures of performance based on working hours;

   -   elapsed time provides better comparability of results between service providers.

The statistics should include all fault repairs in the data collection period, but excluding those traced to other interconnected networks where the service provider does not receive information on the clearing of the fault. The statistics should be based on faults cleared in the data collection period, irrespective of when they are reported.

Separate statistics should be provided:

   -   by direct service providers for faults on local access networks;

   -   by direct and indirect service providers for all other faults. Where a service provider provides both direct and indirect services then it should provide a combined report for these service types for other faults.

In addition, the service provider should provide information on the hours during which faults may be reported.

   NOTE 2:   This requirement has been added to provide greater visibility of improvements in the QoS perceived by customers. This is necessary because increases in the hours during which faults may be reported which improve the service to the customer may lead to an increase in the measured time to repair faults. This situation would occur if the hours for reporting faults extend beyond the hours for actioning those faults.

Where service providers quote a standard accuracy for keeping appointments (e.g. they quote anytime within an hour or a half day) this period should also be provided.

   NOTE 3:   This requirement has been added to provide greater visibility of improvements in the QoS perceived by customers. This is necessary because a reduction in the quoted window for keeping appointments, which improves the service to the customer, may lead to an decreased number of cases where the narrower appointment window is met.

5.3.3   Further considerations

Cases where:

   -   repair depends upon access to the customer premises and this access is not possible at the desired time; or

   -   the customer requests a delay,

may be excluded from the statistics. When calculating the repair time, service providers who choose to include these cases may subtract from the measured time the delay introduced by the customer.

5.4   Unsuccessful call ratio

5.4.1   Definition

Unsuccessful call ratio is defined as the ratio of unsuccessful calls to the total number of call attempts in a specified time period.

An unsuccessful call is a call attempt to a valid number, properly dialled following dial tone, where neither called party busy tone, nor ringing tone, nor answer signal, is recognized on the access line of the calling user within 30 seconds from the instant when the address information required for setting up a call is received by the network.

5.4.2   Measurement and statistics

The following statistics should be provided separately:

-     the percentage of unsuccessful calls for national calls;

-     the percentage of unsuccessful calls for international calls;

-     the number of observations performed for each value.

The statistics should be calculated from:

-     measurements on all real traffic; or

-     measurements on real traffic for outgoing calls in a representative population of local exchanges to a representative set of destinations; or

-     test calls in a representative population of local exchanges or NTPs to a representative set of destinations; or

-     a combination of the above.

Measurements should be scheduled so as to reflect accurately traffic variations over the hours of a day, the days of the week and the months of the year. Call monitoring should be done by monitoring every K^{th} call where K is to be calculated from the total expected number of calls in the relevant time intervals and from the needed number of observations. When measuring values for different destination categories (national or international) this applies to each destination category separately. In the case of test calls the choice of destination exchanges (or NTPs) should be traffic weighted.

The following accuracy objectives apply:

-     For test calls the number of observations should be sufficient to provide an absolute accuracy of 0,1 %
      (e.g. unsuccessful call ratio = 0,3 % ± 0,1 %) or at least a relative accuracy of 10 % (e.g. unsuccessful call ratio =
      5 % ± 0,5 %) with 95 % confidence for national and international calls. The one of the two figures which
      requires the least number of observations could be chosen.

-     For observations performed at the exchange processor the number of observations should be sufficient to provide
      an absolute accuracy of 0,05 % (e.g. unsuccessful call ratio = 0,3 % ± 0,05 %) or at least a relative accuracy of
      5 % (e.g. unsuccessful call ratio = 5 % ± 0,25 %) with 95 % confidence for national and international calls. The
      one of the two figures which requires the least number of observations could be chosen.

A method for deriving the number of observations needed is given in annex C.

   NOTE 1:   These alternative methods each have different advantages and disadvantages. The use of test calls is
             expensive and provides only an estimate of the actual performance but involves measurement at the
             access line side of the local exchange. Observations performed at the exchange processor are cheaper and
             more data can be obtained giving more accurate estimates, but the data does not come from so close to the
             NTP.

Notwithstanding the accuracy objectives given above, the number of test calls is not required to exceed 1 in 1 000.

Measurements apply to both direct and indirect services. Where a service provider provides both direct and indirect services, it should provide a combined report for these service types.

For directly connected customers service providers should exclude from the statistics calls that they deliver to an indirect service provider who then completes the call and charges the customer.

For indirectly connected customers, either:

- measurement should be based on call data from the processor of the originating local exchange for real calls; or

- measurement should be made from the subscriber line side of the local exchange in the access network; or

- measurement should be made from the NTP.

The first two arrangements will require co-operation by the access network operator in making the measurements or providing the call data. For the third arrangement there is no co-operation with the access network operator necessary. Both the second and third arrangements involve disturbance to the customer.

NOTE 2: The indirect service provider may have to pay the access network operator to make measurements or special test calls from the local exchange. Special confidentiality requirements may apply to this information.

NOTE 3: Care should be taken not to degrade the customer's service by making an excessive number of test calls in periods of high traffic levels.

NOTE 4: No intrusive measurements should be made by the access network operator without the agreement of the indirect service provider.

NOTE 5: In determining whether or not to apply these reporting requirements to indirect operators without significant market power, NRAs may wish to consider the costs of these measures. They may also wish to consider whether they can facilitate any co-operation arrangements needed for the measurements.

NOTE 6: In view of the costs and administrative overhead involved with recording data or taking measurements from the originating local exchange, NRAs may accept simplifications or approximations for indirect services such as making measurements from the point of interconnection and using an appropriate adjustment to make allowance for the current performance of the access network to calculate the resulting end to end quality.

5.5   Call set up time

5.5.1   Definition

The call set up time is the period starting when the address information required for setting up a call is received by the network (e.g. recognized on the calling user's access line) and finishing when the called party busy tone or ringing tone or answer signal is received by the calling party (e.g. recognized on the calling user's access line). Where overlap signalling is used the measurement may start when sufficient address information has been received to allow the network to begin routeing the call.

5.5.2   Measurement and statistics

The following statistics should be provided separately:

- the mean value in seconds for national calls;

- the time in seconds within which the fastest 95 % of national calls are set-up;

- the mean value in seconds for international calls;

- the time in seconds within which the fastest 95 % of international calls are set-up;

- the number of observations performed for national and international calls. Calls that are classified as unsuccessful calls should be excluded.

Calls to ported numbers should be included.

The statistics should be calculated from:

- measurements on real traffic for outgoing calls; or

- measurements on real traffic for outgoing calls in a representative population of local exchanges to a representative set of destinations; or

- test calls in a representative population of local exchanges or NTPs to a representative set of destinations; or

- a combination of the above.

Measurements should be scheduled so as to reflect accurately traffic variations over the hours of a day, the days of the week and the months of the year. Call monitoring can be done by monitoring every K^{th} call where K is to be calculated from the total expected number of calls in the relevant time intervals and from the needed number of observations. When measuring values for different destination categories (national or international) this applies to each destination category separately. In the case of test calls the choice of destination exchanges (or NTPs) are required to be traffic weighted.

NOTE 1:   These alternative methods each have different advantages and disadvantages. The use of test calls is expensive and provides only an estimate of the actual performance but involves measurement at the access line side of the local exchange. Observations performed at the exchange processor are cheaper and more data can be obtained giving more accurate estimates, but the data does not come from so close to the NTP.

Annex D gives a formula for calculating the number of observations needed.

Measurements apply to both direct and indirect services. Where a service provider provides both direct and indirect services, it should provide a combined report for these service types.

For directly connected customers service providers should exclude from the statistics calls that they hand over to an indirect service provider who then completes the call and charges the customer.

For indirectly connected customers, either:

- measurement should be based on call data from the processor of the originating local exchange for real calls; or

- measurement should be made from the subscriber line side of the local exchange in the access network; or

- measurement should be made from the NTP.

The first two arrangements will require co-operation by the access network operator in making the measurements or providing the call data. For the third arrangement there is no co-operation with the access network operator necessary. Both the second and third arrangements involve disturbance to the customer.

NOTE 2:   The indirect service provider may have to pay the access network operator to make measurements or special test calls from the local exchange. Special confidentiality requirements may apply to this information.

NOTE 3:   Care should be taken not to degrade the customer's service by making an excessive number of test calls in periods of high traffic levels

NOTE 4:   No intrusive measurements should be made by the access network operator without the agreement of the indirect service provider.

NOTE 5:   In determining whether or not to apply these reporting requirements to indirect operators without significant market power, NRAs may wish to consider the costs of these measures. They may also wish to consider whether they can facilitate any co-operation arrangements needed for the measurements.

NOTE 6:   In view of the costs and administrative overhead involved with recording data or taking measurements from the originating local exchange, NRAs may accept simplifications or approximations for indirect services such as making measurements from the point of interconnection and using an appropriate adjustment to make allowance for the current performance of the access network to calculate the resulting end to end quality.

5.6   Response times for operator services

5.6.1   Definition

The duration from the instant when the address information required for setting up a call is received by the network (e.g. recognized on the calling user's access line) to the instant the human operator answers the calling user to provide the service requested. Services provided wholly automatically, e.g. by voice response systems, are excluded.

The services covered are the services for operator controlled and assisted calls that are accessed with special access codes. Access to emergency services is excluded.

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

5.6.2   Measurement and statistics

The following statistics should be provided:

   -   mean time to answer; and

   -   percentage of calls answered within 20 seconds.

   NOTE: The first statistic gives the more comparable measure of overall performance, and the second statistic indicates the proportion of calls where the waiting time is unacceptably long. The percentage of calls answered within 20 seconds was chosen rather than the time to answer the fastest 90 % because the calculation does not require large quantities of data to be stored.

Statistics should either:

   -   include all calls to operator assisted services in the data collection period; or

   -   be based on a representative sample, in which case the number of observations should be provided.

Measurements apply to both direct and indirect services. Where a service provider provides both direct and indirect services, it should provide a combined report for these service types.

Annex D gives a formula for calculating the number of observations needed.

5.6.3   Further considerations

Where a service provider re-sells to customers operator services provided by a third party, the service provider has responsibility for reporting on quality but may subcontract the measurements to the third party who will have to make separate measurements for each service provider that it supports.

Many operator call centres are equipped to measure response times locally and exclude the call set-up time. In this case, service providers should agree with the NRA an appropriate adjustment to the statistics to take account of the call set-up time from the NTP to the call centre.

   NOTE: Call set-up times measured for national calls could be used in this adjustment if appropriate. Care should be taken to use an adequate adjustment, since calls to operator call centres are often set up by using different routeing mechanisms.

5.7   Response times for directory enquiry services

5.7.1   Definition

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

NOTE: The period in this definition includes waiting times because attendants are busy, and times for going through voice response systems to reach the point where the enquiry can be handled. However it excludes the handling of the enquiry itself, e.g. conversation with the attendant and the response of any database used by the attendant. The reasons are that the variety of enquiries is too wide and that it is too difficult/costly in practice to measure when the answer is given.

5.7.2   Measurement and statistics

The following statistics should be provided:

- mean time to answer; and

- percentage of calls answered within 20 seconds.

NOTE: The first statistic gives the more comparable measure of overall performance, and the second statistic indicates the proportion of calls where the waiting time is unacceptably long. The percentage of calls answered within 20 seconds was chosen rather than the time to answer the fastest 90 % because the calculation does not require large quantities of data to be stored.

Statistics should either:

- include all calls to directory enquiry services in the data collection period; or

- be based on a representative sample, in which case the number of observations should be provided.

Annex D gives a formula for calculating the number of observations needed.

Measurements apply to both direct and indirect services. Where a service provider provides both direct and indirect services, it should provide a combined report for these service types.

5.7.3   Further considerations

Where a service provider re-sells to customers directory services provided by a third party, the service provider has responsibility for reporting on quality but may subcontract the measurements to the third party who will have to make separate measurements for each service provider that it supports.

Many directory enquiry call centres are equipped to measure response times locally and exclude the call set-up time. In this case, service providers should agree with the NRA an appropriate adjustment to the statistics to take account of the call set-up time from the NTP to the call centre.

NOTE: Call set-up times measured for national calls could be used in this adjustment if appropriate. Care should be taken to use an adequate adjustment since calls to directory enquiry call centres are often set up by using different routeing mechanisms.

5.8   Proportion of card and coin operated public pay-telephones in working order

5.8.1   Definition

The proportion of public pay-telephones in full working order, i.e. the user is able to make use of the services advertised as normally available.

A public pay-telephone that is capable of accepting both coin and card payment should be regarded as not being in working order when it is unable to accept further coins because, for example, the coin box is full.

5.8.2   Measurement and statistics

The percentage that is the sum total of "working order pay-telephone"-days, divided by the sum total of the pay-telephone-days should be provided. A "working order pay-telephone"-day occurs when a pay-telephone is in full working order for the whole day.

Statistics may be based on all cases or a representative sample, in which case the number of observations should be provided.

5.9 Bill correctness complaints

5.9.1 Definition

The proportion of bills resulting in a customer complaining about the correctness of a given bill.

A bill correctness complaint is an expression of dissatisfaction with a bill received from a customer. A bill correctness complaint should not be confused with a billing query (a request for information) or with a fault report.

5.9.2 Measurement and statistics

The percentage of bills resulting in a customer complaint should be provided.

Statistics should include all billing complaints received in the reporting period, regardless of the validity of the complaint and the dates of calls or any other occurrences that are the subject of the complaint.

Measurements apply to both direct and indirect services. Where a service provider provides both direct and indirect services, it should provide a combined report for these service types.

In those cases were the billing for the indirectly connected call is performed by the access service provider a separate statistic is required that should be agreed with the NRA concerned.

Annex A (normative):
Combination of weekly or monthly results

Mean values and percentages produced weekly or monthly may, with the consent of the NRA, be aggregated into quarterly statistics using one of the following formulae:

   a)   For weekly statistics:

$$S_{quarterly} = (\sum N_i.S_i) / (\sum N_i) \text{ where } i = 1, 2...13$$

and:

N_i = The number of events in each week.

S_i = The statistic for each week.

   b)   For monthly statistics:

$$S_{quarterly} = (\sum N_i.S_i) / (\sum N_i) \text{ where } i = 1, 2, 3$$

and:

N_i = The number of events in each month.

S_i = The statistic for each week.

For aggregating the median or the 95 %-quantile into quarterly statistics, one has to apply the same procedure as explained in annex B.

Annex B (normative):
Further explanation of "fastest X %"

Several parameters require a statistic of the form:

- "the time by which the fastest X % of <relevant event>".

This annex explains what is meant.

The measurements give a list of times recorded for the events, for example a list of supply times. This list of times should be counted and sorted into ascending order.

X % of the total number of measurements counted should be calculated giving an number, say "n" which would be rounded down to the nearest integer.

The "n"th time in the sorted ascending list will then be "the time by which the fastest X % of <relevant event>" occurred and is the statistic to be reported.

Annex C (normative):
Relationship between the accuracy of the estimator of the unsuccessful call ratio and the number of calls to be observed

If k unsuccessful calls are observed out of N call attempts, then the true value of the unsuccessful call ratio lies between k/N - Δ and k/N + Δ with a confidence level 1-α, Δ being approximated (for large value of N) by:

$$\Delta \approx \sigma(\alpha) \times \sqrt{\frac{p(1-p)}{N}}$$

where p is the expected unsuccessful call ratio and σ(α) is the (1-(α/2)) × 100 percentile of the normal distribution with mean 0 and standard deviation 1 (N(0,1)). I.e. the number of call attempts to be observed should be:

$$N = \frac{\sigma(\alpha)^2 \times p(1-p)}{\Delta^2}$$

If the confidence level is 1 - α = 0,95 then σ(α)=1,96 ≈ 2.

If the required accuracy for p ≤ 0,01 is Δp = 0,001, then the number of call attempts to be observed should be N = $4 \times 10^6 \times$ p(1-p) for a confidence level of 95 %.

If the required accuracy for p > 0,01 is Δp/p = 0,1, then the number of call attempts to be observed should be N = 400 × ((1 - p)/p) for a confidence level of 95 %.

For example, if the expected unsuccessful call ratio is 1 %, the number of call attempts to be observed should be N = $4 \times 10^6 \times$ 0,01(1 - 0,01) = 39 600 for an accuracy of Δp = 0,001 with a confidence level of 95 %.

If the unsuccessful call ratio is expected to be 3 %, then the number of call attempts should be N = 400 × ((1 - 0,03)/0,03) ≈ 13 000 for a relative accuracy of Δp/p = 0,1 and with a confidence level of 95 %.

Annex D (normative):
Method of calculating the number of observations required for measures of time

The number of observations for quantitative variables depends on the variability of the measurements. It can be calculated by the formula:

$$n = \frac{(z_{1-\alpha/2})^2}{a^2} \times \left(\frac{s}{mean(x)}\right)^2$$

Where:

- $z_{1-\alpha/2}$: is the 1-α/2-percentile of the standard normal distribution;

- s: is the expected standard deviation of the call setup time (calculated from former measurements);

- mean(x): is the expected mean value of the call setup time (calculated from former measurements);

- a: is the relative accuracy.

Even though there is no requirement to provide the standard deviation, an estimate should be available for use in this formula.

The following table gives the resulting values where:

- $z_{1-\alpha/2}$ = 1,96 for a confidence level of 95 %;

- a = 2 %.

s/mean(x)	observations
< 0,1	100
0,1 - 0,3	1 000
>0,3 - 0,5	2 500
>0,5 - 0,7	5 000
>0,7 - 0,9	7 500
> 0,9	10 000

Annex E (normative):
Proforma for providing statistics

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Table E.1

Parameter	Measure	Statistic for direct services
5.1 Supply time for initial connection	Time for fastest 95 %	(elapsed days) (direct services only)
	Time for fastest 99 %	(elapsed days) (direct services only)
	% supplied by agreed date	%
	Hours for taking orders	From.....to..... on weekdays From.....to..... on Saturdays From.....to..... on Sundays
	Periods for appointments	From.....to..... on weekdays From.....to..... on Saturdays From.....to..... on Sundays
5.2 Fault rate	Faults/access line/year	reports per 100 lines for direct services reports per 100 lines for indirect services
5.3 Fault repair time	Time to repair 80 % of faults on access lines	.................elapsed hours for direct services
	Time to repair 95 % of faults on access lines	.................elapsed hours for direct services
	Time to repair 80 % of all other faults	.................elapsed hours (combined figure for direct and indirect services)
	Time to repair 95 % of all other faults	.................elapsed hours (combined figure for direct and indirect services)
	% repaired on target date	.................% for direct services ....% for indirect services
	Hours for reporting faults	From.....to..... on weekdays From.....to..... on Saturdays From.....to..... on Sundays (direct and indirect services)
	Periods for appointments	From.....to..... on weekdays From.....to..... on Saturdays From.....to..... on Sundays (direct services only)
5.4 Unsuccessful call ratio	% for national calls	% (combined figure for direct and indirect services) Number of observations =
	% for international calls	% (combined figure for direct and indirect services) Number of observations =
5.5 Call set-up time	Mean time for national calls	.................(Seconds) (combined figure for direct and indirect services) Number of observations =
	Time for fastest 95 % for national calls	.................(Seconds) (combined figure for direct and indirect services) Number of observations =
	Mean time for international calls	.................(Seconds) (combined figure for direct and indirect services) Number of observations =
	Time for fastest 95 % for international calls	.................(Seconds) (combined figure for direct and indirect services) Number of observations =
NOTE:	Where the number of observations is required, if an operator chooses to observe all events then just "All" should be written on this form.	

Table E.2

Parameter	Measure	Statistic
5.6 Response times for operator services	Mean time to answer % answered within 20 seconds	Secs % Number of observations =
5.7 Response times for directory enquiry services	Mean time to answer % answered within 20 seconds	Secs % Number of observations =
5.8 Public pay-telephones in working order	% in full working order	% Number of observations =
5.9 Bill correctness complaints	%	%
NOTE: Where the number of observations is required, if an operator chooses to observe all events then just "All" should be written on this form.		

History

Document history		
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