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Foreword

This ETSI Technical Report (ETR) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

ETSI STC NA 4 gratefully acknowledges the useful contribution of FITCE (Federation of Telecommunications Engineers of the European Community). FITCE's work on non-technical indicators for telephony formed the foundation upon which the final ETSI definitions are based.

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1 Scope

This ETR contains harmonised definitions and measurement methods for a range of user perceivable Quality of Service (QoS) indicators. Two sets of indicators are proposed; one for voice telephony and one for Integrated Services Digital Network (ISDN). The sets of indicators have been produced in response to Mandates BC-T-175-B1 and BC-T-174-B1 respectively.

The purpose of these indicators is to allow customer choice of different service providers offering the voice telephony or ISDN services by comparison of published QoS figures. To ensure a fair comparison, common definitions and measurement methods are proposed. In addition, common presentation of results is recommended for individual countries. The establishment of target values for QoS is beyond the scope of this ETR.

The voice telephony QoS indicators are applicable to the telephony service carried on the Public Switched Telephone Network (PSTN). The ISDN indicators apply to a range of circuit- and packet-switched services carried by the ISDN. When the ISDN is used to carry voice traffic, the voice telephony indicator Speech Transmission Quality is applicable.

The indicators specified apply to basic services only. Measurements made against these indicators exclude calls involving Intelligent Network (IN), mobile, private networks and supplementary services etc. For the ISDN packet services, the indicators are only applicable when fully integrated packet services are provided (i.e. Case B of ITU-T Recommendation X.31 [1] where the packet handling function resides within the ISDN).

2 References

This ETR incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in this ETR by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ITU-T Recommendation X.31: "Support of packet mode terminal equipment by an ISDN".

[2] ITU-T Recommendation P.82: "Method for evaluation of service from the standpoint of speech transmission quality".

[3] ITU-T Recommendation E.125: "Inquiries among users of the international telephone service".

[4] ITU-T Recommendation G.821: "Error performance of an international digital connection forming part of an integrated services digital network".

[5] ITU-T Recommendation X.25: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions apply.

Customer: The party that pays for the telecommunication service(s) provided.

Network provider: An organisation that provides a network for the provision of telecommunication service. If the same organisation also offers services it also becomes the service provider.

Service provider: An organisation that offers a telecommunication service to the customer and/or users. A service provider need not be a network provider.

User: The party that makes use of the telecommunication service(s) provided.

3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply.

IN	Intelligent Network
ISDN	Integrated Services Digital Network
ONP	Open Network Provision
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
QoS	Quality of Service
SES	Severely Errored Second

4 General considerations

With regard to the definitions and measurement methods specified in Clauses 5 and 6, the following should be considered:

for some indicators the presentation methods and the accuracy of the measurements are left as option to be decided by agreement between the national regulator and the service providers concerned. These choices can be influenced by customer preference and current operating practice within a given country;

- many of the indicators appear to be not wholly in the domain of a given service provider, e.g. in setting up an international call, exchanges of several network providers are usually involved. It is recognised that a customer, in general, sees only the service provider off whom he/she buys the service and regards this service provider as responsible for end-to-end quality. In order to deliver satisfactory QoS of its customers, a given service provider must ensure that satisfactory QoS is delivered by its "suppliers". Consequently, a service provider's published QoS figures reflect its own capability and the capability of its suppliers;

- as mentioned in Clause 1, calls involving IN, mobile, private networks and supplementary services are excluded from the scope of these indicators. However, telephony voice transmission quality, which is based on surveys of customer perception, may be distorted in cases where customers unwittingly dial such numbers and experience lower QoS;

- 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 publish the measured QoS and may additionally publish a second figure which excludes the effects of the exceptional circumstances. A note clearly explaining the difference should also be published. 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.

5 Voice telephony QoS indicators

5.1 Fault reports per access line per year

5.1.1 Definition

A valid fault report is a report of disrupted or degraded service that is made by a customer and is attributable to the network and requires repair action. This excludes faults of any equipment on the customer side of the network termination point.

An access line is a circuit capable of supporting one speech path linking a customer's equipment with a local exchange.

NOTE 1: The case where a customer reports a fault that is found to be cleared when tested should be counted as a valid report if the service provider is aware that the fault had occurred at the time referred to in the report.

NOTE 2: The network termination point may be different in different countries and would be normally defined by the national regulator in each country.

5.1.2 Measure

Number of valid faults reported by customer or customer representative.

5.1.3 Presentation of results

The statistics should be presented as the average value of faults per access line per year for the network under consideration. The statistics should be presented once a year.

NOTE: It is up to the individual service providers to additionally provide explanations to make this value more understandable for the public.

5.1.4 Measurement

The counting of faults should be based on valid reports by customers. A report that concerns more than one access line between customers and the local exchange shall be counted once for each of these access lines.

The "Fault reports per access line per year" is measured by dividing the number of valid fault reports observed during one year by the average number of access lines in the network under consideration during the same year.

NOTE 1: Only valid customer reports are taken into account.

NOTE 2: The averaging is necessary because the number of access lines may vary during one year.

5.2 Unsuccessful call ratio

5.2.1 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, where neither called party busy tone, nor ringing tone, nor answer signal, is recognised on the access line of the calling user within 30 seconds for national and intra-community calls and 1 minute for extra-community calls, from the instant when the address information required for setting up a call is received by the network.

5.2.2 Measure

The unsuccessful call ratio should be expressed as a percentage.

5.2.3 Presentation of the results

The statistics should be presented as the percentage of unsuccessful calls for national, intra-community and extra-community calls separately. The statistics should be presented once a year.

NOTE 1: National calls are calls between parties within the same country. Intra-community calls are calls between parties within the European Community. Extra-community calls are calls between one party within the European Community and another party outside the European Community.

NOTE 2: This percentage is based on the total number of observations during the year.

5.2.4 Measurement

The measurement should be made by:

- collecting real traffic data for outgoing calls in a representative population of local exchanges; or
- generating test calls in a representative population of local exchanges to fixed numbers in a representative population of terminating exchanges and collect the relevant data; or
- a combination of these.

Measurements should be scheduled so as to accurately reflect traffic variations over the hours of a day, the days of the week and the months of the year (e.g. for national and intra-community calls, measurements could be made for a period of one or more complete weeks each month or every day during the year. Measurement could be made either during busy hours or on a 24 hour per day basis. For extra-community calls, measurements could be made 24 hours per day for one week each month).

NOTE 1: Portioning extra-community calls according to the destination continent can be envisaged.

The number of observations should be sufficient to provide an absolute accuracy of 0,1 % (e.g. unsuccessful call ratio = 0,3 % $\pm$ 0,1 %) or at least a relative accuracy of 10 % (e.g. unsuccessful call ratio = 5 % $\pm$ 0,5 %) with 95 % confidence for national and intra-community calls, an absolute accuracy of 0,1 % or at least a relative accuracy of 20 % with 90 % confidence for extra-community calls. The one of the two figures which requires the least number of observations could be chosen. This applies to both monitoring and test calls.

NOTE 2: A method for deriving the number of observations needed is given in Annex B.

Call monitoring can be done by monitoring every N^{th} call where N 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, intra-community or extra-community) this applies to each destination category separately. In the case of test calls the choice of destination exchanges must be traffic weighted.

5.3 Call set up time

5.3.1 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 (i.e. recognised 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 (i.e. recognised on the calling user's access line).

5.3.2 Measure

The time interval should be expressed in seconds.

5.3.3 Presentation of the results

The statistics should be presented as 95^{th} percentile values for national, intra-community and extra-community calls separately. The statistics should be presented once a year.

NOTE: The provision of this indicator for national calls should be agreed between the national regulator and the service providers concerned.

5.3.4 Measurement

The measurement should be made by:

- collecting real traffic data for outgoing calls in a representative population of local exchanges; or
- generating test calls in a representative population of local exchanges to fixed numbers in a representative population of terminating exchanges and collect the relevant data; or
- a combination of these.

Measurements should be scheduled so as to accurately reflect traffic variations over the hours of a day, the days of the week and the months of the year (e.g. for national and intra-community calls, measurements could be made for a period of one or more complete weeks each month or every day during the year. Measurement could be made either during busy hours or on a 24 hour per day basis. For extra-community calls, measurements could be made 24 hours per day for one week each month).

NOTE: Portioning extra-community calls according to the destination continent can be envisaged.

The number of observations should be at least 10^4 for each destination category (national, intra-community or extra-community). This applies to both monitoring and test calls.

Call monitoring can be done by monitoring every N^{th} call where N 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, intra-community or extra-community) this applies to each destination category separately.

Calls that are classified as unsuccessful calls shall be excluded.

5.4 Speech transmission quality

5.4.1 Definition

Speech transmission quality is a quantitative value (ranging from 1 to 4) derived from a survey of customers in which the quality of speech transmission is classified as poor, fair, good or excellent.

5.4.2 Measure

p_e being the fraction of answers classifying the last call as of excellent quality, p_g being the fraction of answers classifying the last call as of good quality, p_f being the fraction of answers classifying the last call as of fair quality and p_p being the fraction of answers classifying the last call as of poor quality, the measure is

$$I = (4 \times p_e) + (3 \times p_g) + (2 \times p_f) + p_p$$

5.4.3 Presentation of results

Three speech transmission quality indicators should be measured, one for national calls, one for intra-community calls and the last one for extra-community calls.

Each indicator should be presented once a year based on the accumulated questionnaires from the periodic surveys conducted throughout the year (e.g. quarterly).

5.4.4 Measurement

To assure statistical significance a total survey of at least X questionnaires should be collected each year. (X to be defined and may be different for each call category). This total should be distributed throughout the year and relate to calls made or received within the survey period.

The survey should be representative of the distribution of the users within the service providers domain. The survey should be based on the method described in ITU-T Recommendations P.82 [2] and E.125 [3].

5.5 Supply time for initial network connection

5.5.1 Definition

The duration from the instant of valid contract (NOTE 1) between the service provider and the customer to the instant the network connection is made available for use (NOTE 2). This will include take-overs of existing connections.

5.5.2 Measure

The duration may be expressed in units of time, i.e. working days and/or working hours.

NOTE 1: Procedures for a valid contract may vary within the European Union countries. A valid contract is one recognised to be valid in the country of the resident administration and the customer. The contract may be made verbally, or in writing or in any acceptable form.

NOTE 2: The measure would normally deal with only the network connection required for the use of the telephony services. The telephony instrument for the use of the service may or may not be obtained from the service provider. In order to keep the user's freedom to choose the terminal instrument from a wide range of sources its inclusion in the supply time is not, therefore, considered pertinent unless provision of the telephone instrument is included in the contract.

At least one out of two basic statistics should be published.

a) firstly, for the achieved time to supply when the customer has stated 'as soon as possible' for supply;

b) secondly, for those customers who have agreed a date convenient to them. These dates may be well beyond the date when the service provider could provide the service.

The choice of which measures to use is a matter of agreement between the national regulator and the service providers concerned.

For the first category the statistics mentioned below would apply. For the second category the percentage of orders met on the specified date would be the relevant statistical result.

5.5.3 Presentation of the results

The results may be called "supply time statistics" and would have the following components:

1.3.1 the supply time statistics should be published once a year;

1.3.2 supply time statistics will be expressed in working days and/or working hours;

1.3.3 the supply time statistics may be provided as follows for a given summary period:

for those in category 1:

- time for supply of 95 % of connections;

for those in category 2:

- percentage of connections met at the agreed date.

5.5.4 Measurement

Supply time statistics should not be on a sample basis. The statistics should summarise all connections made in the summary period.

The recording of times to calculate the above statistical figures is straightforward and requires no special set-ups. It will be necessary for computing facilities to be available for the production of statistical information from the raw data. The administration is free to organise their own recording systems.

5.6 Response time for operator services

5.6.1 Definition

The duration from the instant the last address digit for an operator service is correctly sent to the instant the human operator answers the calling customer to provide the service requested.

NOTE: If the operator establishes communication with the calling customer but is unable to deal with the customer's request for service then the duration shall be until the instant the operator is able to deal within the service.

EXAMPLE: If the operator answers the call and asks the caller to hold until, say s/he completes an existing enquiry from another customer, this instant is not deemed to be the correct instant for the establishment of the time for response to the operator service.

5.6.2 Measure

The duration may be expressed in seconds.

5.6.3 Presentation of results

Performance statistics may be provided as follows:

Percentage of human operator calls within x seconds.

The performance statistics should be published annually averaged over 12 months for operator assisted calls.

NOTE 1: The national regulator should in agreement with the involved service providers decide which operator services are measured.

NOTE 2: The value of x is a matter of agreement between the national regulator and the service providers involved. A value of 10 - 30 seconds may be typical.

5.6.4 Measurement

Normally measurement will be carried out by the network provider.

In the event an independent organisation requires a measurement check, the following guidelines may be observed to set up the measurement process:

a) the independent organisation or body should establish:

- the services to be checked;
- the approximate sample size to be monitored (based on the confidence limit required);

b) a list of volunteer or paid private telephone customers (to represent business and residential customers, if possible) spread randomly nation-wide, who will provide access to telephones, should be kept for possible use in the event of check being necessary, by the independent body;

c) a set of people competent people to carry out operator response times (e.g. university students) should be used to carry out the sample checks;

d) a simple mechanism should be established to check the veracity of the measurements taken;

e) the organisation should have access to a computer to convert the measured values to the above statistical figures.

5.7 Availability (i.e. in working order) of card and coin operated public pay phones

5.7.1 Definition

The proportion of public pay phones (see NOTE) in working order, i.e. the user is able to make use of the services advertised as normally available.

NOTE: "Public pay phone" means either coin or card operated telephones and excludes courtesy telephones, including public telephones which provide only outgoing calls. Public telephones provided by authorities other than service providers such as hotel rooms, businesses who rent pay phones from the service providers and offer these to public at their own rates etc. are also excluded.

Only public pay phones wholly owned and operated by service providers are to be included in this definition.

5.7.2 Measure

The proportion of the public pay phones in working order is expressed as a percentage of the total number of public pay phones.

5.7.3 Presentation of performance statistics

Statistics may be presented as percentage of coin and card public pay phones in working order averaged over 12 months.

5.7.4 Measurement

Measurement of the available public pay phones (those in working order) would normally be provided by the service provider.

In the event of this figure requiring estimation by an independent body the guidelines given for the response times of operator services are recommended.

5.8 Fault repair time

5.8.1 Definition

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

The above definition applies only to the "standard repair" times for residential customers. It does not apply to those arrangements where the service provider agrees with the customer to provide faster repair for payment of higher maintenance fees.

NOTE: "Fault reports" in this definition embraces all valid reported faults as defined in the "fault report per access line per year" indicator defined elsewhere in the directive for the same purpose as above.

5.8.2 Measure

The fault repair time shall be expressed in working hours.

5.8.3 Presentation of performance statistics

Performance statistics on fault repair time should be presented as the percentage of fault repairs completed within x working hours. The value of x is a matter of agreement between the national regulator and the service providers concerned.

The results shall summarise the actual number of repairs and not a sample. The results shall be produced and published once a year based on the data collected over the year.

Cases where repair depends upon access to the customer premises and this access is not possible at the desired time, should be excluded from the statistics.

5.8.4 Measurement

Fault repair time should not be on a sample basis. The statistics should summarise all such repairs made in the summary period.

6 ISDN QoS indicators

6.1 For all bearer services

6.1.1 Fault reports per ISDN access per year

6.1.1.1 Definition

A valid fault report is a report of disrupted or degraded service affecting one or more ISDN channels that is made by a customer and is attributable to the network and requires repair action. This excludes faults of any equipment on the customer side of the network termination point.

NOTE 1: The case where a customer reports a fault that is found to be cleared when tested should be counted as a valid report when the service provider is aware that the fault had occurred at the time referred to in the report.

NOTE 2: The network termination point may be different in different countries and would be normally defined by the national regulator in each country.

6.1.1.2 Measure

Number of valid faults reported by customer or customer representative.

6.1.1.3 Presentation of the results

The statistics should be presented as the average value of fault reports per ISDN access per year for the network under consideration. The statistics should be presented once a year.

NOTE: It is up to the individual service providers to additionally provide explanations to make this value more understandable for the public*.*

6.1.1.4 Measurement

The counting of faults shall be based on valid reports by customers. A report that concerns more than one access line between customers and the local exchange shall be counted once for each of these access lines.

The "fault reports per ISDN access per year" is measured by dividing the number of valid faults observed during one year by the average number of ISDN access lines in the network under consideration during the same year.

NOTE 1: Only valid customer reports are taken into account.

NOTE 2: The averaging is necessary because the number of access lines may vary during one year.

NOTE 3: Primary rate access and basic access should be reported separately.

6.1.2 Severely errored seconds performance

6.1.2.1 Definition

A Severely Errored Second (SES) is a one second interval with a bit error ratio worse than 10^{-3} as defined in ITU-T Recommendation G.821 [4].

6.1.2.2 Measure

SES performance should be expressed as the percentage of seconds that are severely errored.

6.1.2.3 Presentation of the results

The statistics should be presented as the percentage of severely errored seconds for a representative population of ISDN 64 kbit/s connections. The statistics should be presented once a year and separately for national, intra-community and extra-community connections.

6.1.2.4 Measurement

Measurements could be done:

a) by generating test calls in a representative population of local exchanges to fixed numbers in a representative population of terminating exchanges and collect the relevant data; or

b) by continuously monitoring transmission systems (e.g. by checking the frame alignment signal) and from this estimate the performance of each connection by assuming equal distribution of bit errors among every single connection.

NOTE: Option b) would require the use of a reference connection (average connection) involving a portion for each relevant transmission system. This reference connection is a matter of agreement between the national regulator in each country and the service providers concerned.

The measurement period shall exclude periods of unavailability (see ITU-T Recommendation G.821 [4]).

6.2 For circuit mode switched bearer services

6.2.1 Unsuccessful call ratio

6.2.1.1 Definition

This is defined as the ratio of unsuccessful calls to the total number of call attempts in a specified period of time. An unsuccessful call is a call attempt to a valid number, properly dialled, for which the calling user's signalling system does not receive called party ALERT or CONNECT message or a "user busy" indication or other far end rejection indications with location value corresponding to public/private network serving the remote user within 30 seconds from the instant when the INITIAL ADDRESS MESSAGE or the SUBSEQUENT ADDRESS MESSAGEs necessary for outgoing circuit selection is received by the network.

NOTE: A time out of 30 seconds is chosen to allow for a "no user responding" indication in case the far end terminal is switched off. Call attempts where the "no user responding" indication occurs before 30 seconds shall be counted as successful calls.

6.2.1.2 Measure

The unsuccessful call ratio should be expressed as a percentage.

6.2.1.3 Presentation of the results

The statistics should be presented as the percentage of unsuccessful calls for national, intra-community and extra-community calls separately. The statistics should be presented once a year.

6.2.1.4 Measurement

The measurement should be made by:

- collecting real traffic data for outgoing calls in a representative population of local exchanges; or
- generating test calls in a representative population of local exchanges to fixed numbers in a representative population of terminating exchanges and collect the relevant data; or
- a combination of these.

Measurements should be scheduled so as to accurately reflect traffic variations over the hours of a day, the days of the week and the months of the year (e.g. for national and intra-community calls, measurements could be made for a period of one or more complete weeks each month or every day during the year. Measurement could be made either during busy hours or on a 24 hour per day basis. For extra-community calls, measurements could be made 24 hours per day for one week each month).

NOTE: Portioning extra-community calls according to the destination continent can be envisaged.

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 intra-community calls, an absolute accuracy of 0,1 % or at least a relative accuracy of 20 % with 90 % confidence for extra-community calls. The one of the two figures which requires the least number of observations could be chosen. This applies to both monitoring and test calls.

NOTE 1: This level of accuracy may be a problem to reach in the first years with ISDN. It is then up to the national regulator, in agreement with the service providers concerned, to decide the level of accuracy for each country.

NOTE 2: A method for deriving the number of observations needed is given in Annex B.

Call monitoring can be done by monitoring every N^{th} call where N 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, intra-community or extra-community) this applies to each destination category separately. In the case of test calls the choice of destination exchanges must be traffic weighted.

6.2.2 Call set up time

6.2.2.1 Definition

The Call set up time is the period starting with the instant when the INITIAL ADDRESS MESSAGE or the SUBSEQUENT ADDRESS MESSAGEs necessary for outgoing circuit selection is received by the network, and finishing with the instant when an ALERT or CONNECT message or a "user busy" indication or other far end user rejection indications with location value corresponding to public/private network serving the remote user is passed to the calling user's signalling system.

NOTE: This call set up time will include some processing time in the far end terminal.

6.2.2.2 Measure

The time interval should be expressed in seconds.

6.2.2.3 Presentation of the results

The call set up time should be specified either as a 95th percentile value or as the percentage of calls set up within x seconds for national, intra-community and extra-community calls separately. The statistics shall be published once a year.

NOTE: The national regulator, in agreement with the service providers concerned, shall decide which of these presentations to use and in the second case shall set the value of x.

6.2.2.4 Measurement

The measurement should be made by:

- collecting real traffic data for outgoing calls in a representative population of local exchanges; or
- generating test calls in a representative population of local exchanges to fixed numbers in a representative population of terminating exchanges and collect the relevant data; or
- a combination of these.

Measurements should be scheduled so as to accurately reflect traffic variations over the hours of a day, the days of the week and the months of the year (e.g. for national and intra-community calls, measurements could be made for a period of one or more complete weeks each month or every day during the year. Measurement could be made either during busy hours or on a 24 hour per day basis. For extra-community calls, measurements could be made 24 hours per day for one week each month).

NOTE: Portioning extra-community calls according to the destination continent can be envisaged.

The number of observations should be at least 10^4 for each destination category (national, intra-community or extra-community). This applies to both monitoring and test calls.

Call monitoring can be done by monitoring every Nth call where N 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, intra-community or extra-community) this applies to each destination category separately.

Calls that are classified as unsuccessful calls shall be excluded. If the far end terminal is switched off the called party will receive a "no user responding" indication. These cases shall also be excluded from the statistics.

6.3 For circuit mode permanent bearer services

This subclause should be covered under BTC2's work on Open Network Provision (ONP) for leased lines.

6.4 For all packet mode bearer services

6.4.1 Throughput efficiency

6.4.1.1 Definition

Throughput efficiency is defined for a (virtual) connection as the ratio of the number of user data bits successfully transferred end to end in one direction per unit time to the throughput class of the considered (virtual) connection.

6.4.1.2 Measure

Throughput efficiency should be expressed as a percentage.

6.4.1.3 Presentation of the results

The throughput efficiency should be specified as a 95th percentile value for national, intra-community and extra-community connections. The statistics shall be published once a year for each of the throughput classes 9,6 kbit/s and 64 kbit/s.

6.4.1.4 Measurement

Measuring throughput efficiency can be done by measuring the actual traffic rate and subtract the unsuccessful transferred data bits.

The measurement should be made by generating test calls.

Measurements should be scheduled so as to accurately reflect traffic variations over the hours of a day, the days of the week and the months of the year (e.g. for national and intra-community calls, measurements could be made for a period of one or more complete weeks each month or every day during the year. Measurement could be made either during busy hours or on a 24 hour per day basis. For extra-community calls, measurements could be made 24 hours per day for one week each month).

NOTE: Portioning extra-community calls according to the destination continent can be envisaged.

The throughput efficiency should be calculated for ten second intervals in periods where the connection is active. The number of observations should be a matter of agreement between the national regulator and the service providers concerned.

6.4.2 Round trip delay

6.4.2.1 Definition

The round trip delay is defined for data packets of looped connections as the time interval from the instant the first bit of the packet is passed to the access line of the sending unit until the last bit of the same packet is received by the receiving unit.

6.4.2.2 Measure

Round trip delay should be measured in seconds.

6.4.2.3 Presentation of the results

The round trip delay should be specified as a 95th percentile value for national, intra-community and extra-community (virtual) connections. The statistics shall be published once a year.

6.4.2.4 Measurement

The measurement should be made by generating looped test calls using data packets of 128 bits. Unsuccessfully transferred data packets shall be excluded from the statistics.

Measurements should be scheduled so as to accurately reflect traffic variations over the hours of a day, the days of the week and the months of the year (e.g. for national and intra-community calls, measurements could be made for a period of one or more complete weeks each month or every day during the year. Measurement could be made either during busy hours or on a 24 hour per day basis. For extra-community calls, measurements could be made 24 hours per day for one week each month).

NOTE: Portioning extra-community calls according to the destination continent can be envisaged.

The number of observations should be a matter of agreement between the national regulator and the service providers concerned.

6.5 For packet mode switched bearer services

The indicators listed below do not apply when the ISDN is used to access Packet Switched Public Data Network (PSPDN), i.e. when:

- the packet services is obtained according to case A of ITU-T Recommendation X.31 [1];

- the packet service is obtained according to case B of ITU-T Recommendation X.31 [1], if the packet handler resides outside the ISDN.

When the packet service is obtained according to case B of ITU-T Recommendation X.31 [1], and the packet handler resides inside the ISDN, the packet service may be provided either by using the D channel or a B channel. In case of using a B channel the establishment of this channel for connecting to the packet handler, if not already done, needs to be done before it is possible to establish the virtual call. Subclauses 6.5.1 and 6.5.2 only apply to virtual call establishment after the physical channel on the sending side is already established.

6.5.1 Unsuccessful call ratio

6.5.1.1 Definition

This is defined as the ratio of unsuccessful virtual calls to the total number of virtual call attempts in a specified period of time. An unsuccessful virtual call is a virtual call attempt to a valid number which does not receive a ITU-T Recommendation X.25 [5] call connected packet or a clear indication initiated by the receiving side within 200 seconds from the instant when a ITU-T Recommendation X.25 [5] call request packet is passed from the calling party to the access channel.

NOTE 1: The reason for the clear indication is indicated by the clearing cause field.

NOTE 2: The ITU-T Recommendation X.25 [5] timer T11 time-out value is 180 seconds. After expiry of this timer the virtual call will anyhow be cleared. 200 seconds allow for an extra delay of 20 seconds between the packet handler and the calling user's access line.

NOTE 3: Cases when the physical channel between the far end packet handler and the far end terminal has to be established, and when this is not possible, shall be excluded from the statistics.

6.5.1.2 Measure

The unsuccessful call ratio should be expressed as a percentage.

6.5.1.3 Presentation of the results

The statistics should be presented as the percentage of unsuccessful calls for national, intra-community and extra-community calls separately. The statistics should be presented once a year.

6.5.1.4 Measurement

The measurement should be made by:

- collecting real traffic data for outgoing calls in a representative population of local exchanges; or
- generating test calls in a representative population of local exchanges to fixed numbers in a representative population of terminating exchanges and collect the relevant data; or
- a combination of these.

Measurements should be scheduled so as to accurately reflect traffic variations over the hours of a day, the days of the week and the months of the year (e.g. for national and intra-community calls, measurements could be made for a period of one or more complete weeks each month or every day during the year. Measurement could be made either during busy hours or on a 24 hour per day basis. For extra-community calls, measurements could be made 24 hours per day for one week each month).

NOTE: Portioning extra community calls according to the destination continent can be envisaged.

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 intra-community calls, an absolute accuracy of 0,1 % or at least a relative accuracy of 20 % with 90 % confidence for extra-community calls. The one of the two figures which requires the least number of observations could be chosen. This applies to both monitoring and test calls.

NOTE 1: This level of accuracy may be a problem to reach in the first years with ISDN. It is then up to the national regulator, in agreement with the service providers concerned, to decide the level of accuracy for each country.

NOTE 2: A method for deriving the number of observations needed is given in Annex B.

Call monitoring can be done by monitoring every N^{th} virtual call where N is to be calculated from the total expected number of virtual calls in the relevant time intervals and from the needed number of observations. When measuring values for different destination categories (national, intra-community or extra-community) this applies to each destination category separately. In the case of test calls the choice of destinations must be traffic weighted.

6.5.2 Call set up delay

6.5.2.1 Definition

The virtual call set up delay is defined as the interval between the instant when the first bit of a ITU-T Recommendation X.25 [5] call request packet is passed from the calling party to the access line and the instant when the last bit of a ITU-T Recommendation X.25 [5] call connected packet is received by the calling user.

NOTE: This call set up delay will include some processing time in the far end terminal. In cases were the B-channel has to be set up, that time is included.

6.5.2.2 Measure

The delay should be expressed in seconds.

6.5.2.3 Presentation of the results

The call set up delay should be specified as a 95^{th} percentile value for national, intra-community and extra-community calls separately. The statistics shall be published once a year for virtual call set up between B-channels and virtual call set up between D-channels separately.

6.5.2.4 Measurement

The measurement should be made by:

- collecting real traffic data for outgoing calls in a representative population of local exchanges; or
- generating test calls in a representative population of local exchanges to fixed numbers in a representative population of terminating exchanges and collect the relevant data; or
- a combination of these.

Measurements should be scheduled so as to accurately reflect traffic variations over the hours of a day, the days of the week and the months of the year (e.g. for national and intra-community calls, measurements could be made for a period of one or more complete weeks each month or every day during the year. Measurement could be made either during busy hours or on a 24 hour per day basis. For extra-community calls, measurements could be made 24 hours per day for one week each month).

NOTE: Portioning extra-community calls according to the destination continent can be envisaged.

The number of observations should be at least 10^4 for each destination category (national, intra-community or extra-community). This applies to both monitoring and test calls.

Calls that are classified as unsuccessful calls shall be excluded. Cases when the physical channel between the far end packet handler and the far end terminal has to be established, and this is not possible, shall be excluded from the statistics.

6.6 For packet mode permanent services

6.6.1 Availability of the bearer service

6.6.1.1 Definition

An unavailable state starts with the first occurrence of ten consecutive seconds where for each second either the service is interrupted due to a network failure or the residual error ratio is worse than 10^{-3}. These ten seconds are considered part of the unavailable time. The unavailable state ends with the first occurrence of ten consecutive seconds during non of which the service is interrupted due to a network failure or the residual error ratio is worse than 10^{-3}. These ten seconds are considered part of the available time. The availability of the bearer service is then defined as the average, for all packet mode permanent connections, of the number of hours in a period of time for which the service is available to the user, divided by the total number of hours.

The residual error ratio for a (virtual) connection in a given time interval is defined as the ratio of total incorrect, lost and extra (i.e. misdelivered or duplicated) user data bits to the total user data bits transferred end to end in this time interval. Bits lost in association with an interruption of the transfer of packets caused by one user are excluded in calculating residual error ratio.

6.6.1.2 Measure

Availability should be presented as a percentage.

6.6.1.3 Presentation of the results

The statistics should be presented as the average value of the availability of the considered permanent connections. The statistics should be presented once a year.

6.6.1.4 Measurement

The availability can be measured by monitoring the connections under consideration. Monitoring must be done on both the sending and the receiving side. The one second intervals refers to monitoring on the sending side. The residual error ratio is calculated by comparing the user data on the sending side with the corresponding user data monitored on the receiving side. Faults due to equipment and/or installations that is not the service providers responsibility are excluded here. The observation period is one year.

The number of connections to monitor and the accumulated observation period should be sufficient to provide an accuracy of ± x % with 95 % confidence. This applies to both monitoring and test calls. The value of x is a matter of agreement between the national regulator and the service providers concerned.

NOTE: Some difficulties are foreseen in measuring this parameter both by doing in service and out of service measurements.

6.6.2 Number of service interruptions per year

6.6.2.1 Definition

A service interruption of a packet mode permanent (virtual) connection occurs when the connection is entering an unavailable state.

6.6.2.2 Measure

Number of interruptions.

6.6.2.3 Presentation of the results

The statistics should be presented as the average value of service interruptions per packet mode permanent connection per year. The statistics should be presented once a year.

6.6.2.4 Measurement

The measurement should be in accordance with the measurement of availability by counting the number of unavailable periods and dividing by the number of connections under consideration.

NOTE: Some difficulties are foreseen in measuring this parameter both by doing in service and out of service measurements.

Annex A: The five principles for ONP QoS Indicators

Principle No 1

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

Principle 2

All parameters are applicable at the network termination point.

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

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

Principle 3

Parameters should be capable of verification by independent organisations. This verification might be made by direct measurements or by audit of operator's measurements.

Principle 4

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.

Principle 5

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.

Annex B: 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:

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

where p is the expected unsuccessful call ratio and $\sigma(\alpha)$ 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:

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

If the confidence level is 1 - α = 0,95 then $\sigma(\alpha) = 1{,}96 \approx 2$.

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 x 10^6 x 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 x ((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 x 10^6 x 0,01(1 - 0,01) = 39600 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 x ((1 - 0,03)/0,03) ≈ 13 000 for a relative accuracy of Δp/p = 0,1 and with a confidence level of 95 %.

History

Document history	
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