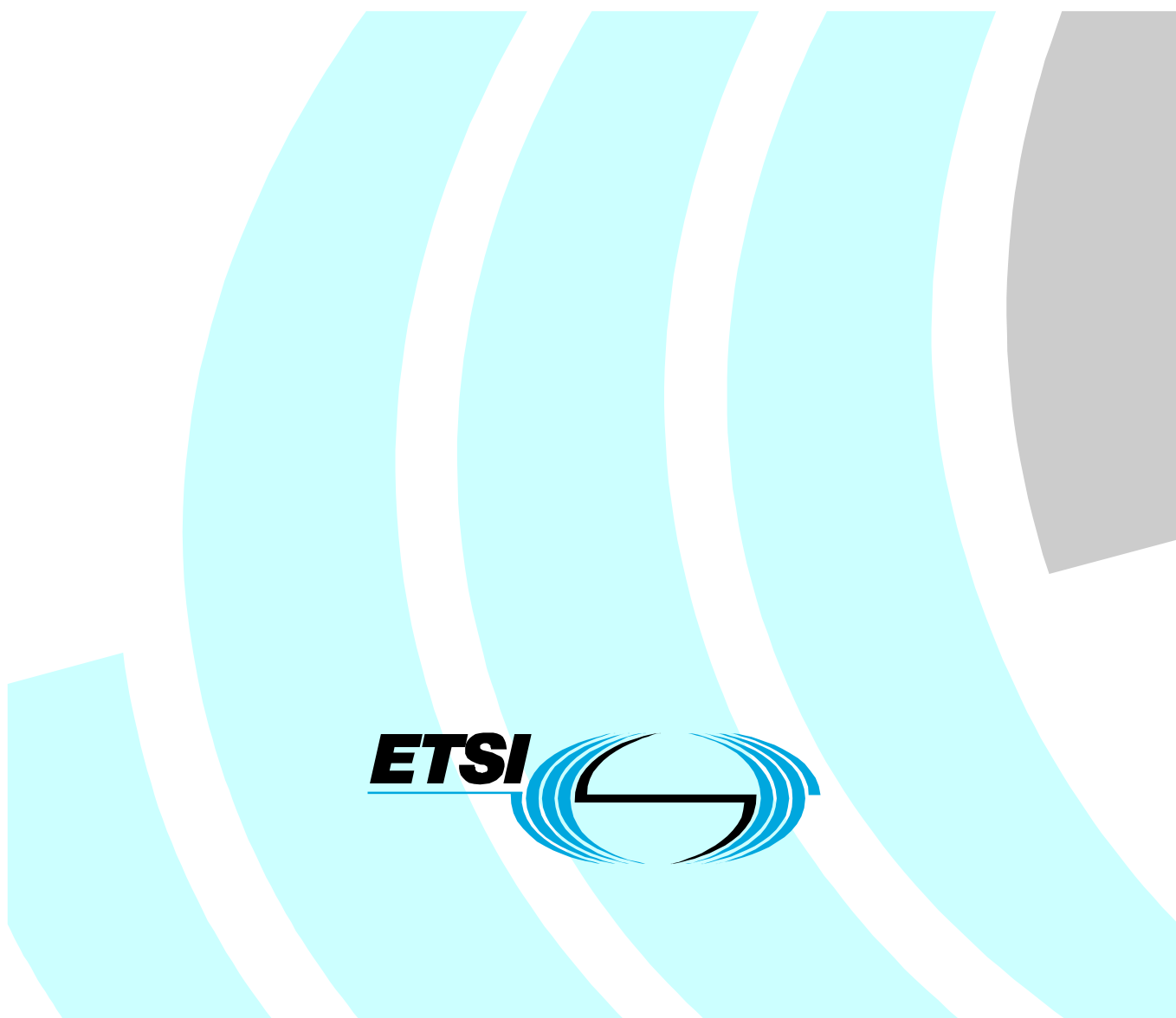Final draft **ETSI EG 202 057-3** V1.1.1 (2005-02)

Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 3: QoS parameters specific to Public Land Mobile Networks (PLMN)

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Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Speech Processing, Transmission and Quality Aspects (STQ), and is now submitted for the ETSI standards Membership Approval Procedure.

The present document is part 3 of a multi-part deliverable covering Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements, as identified below:

Part 1: "General";

Part 2: "Voice telephony, Group 3 fax and modem data services";

Part 3: "QoS parameters specific to Public Land Mobile Networks (PLMN)".

Part 1 contains general user related QoS parameter definitions and measurement methods that can be applied to any service. The present document contains user related QoS parameter definitions and measurement methods for voice, data and fax services accessed via the public telecommunication network.

Part 2 contains user related QoS parameter definitions and measurement methods for voice, data and fax services accessed via the public telecommunication network. The data parameters are specified for the case where a V.9x series modem is used since this kind of modem is in common use.

Part 3 (the present document) contains user related QoS parameter definitions and measurement methods specific to public mobile telecommunication networks (PLMN).

The present document takes into account as far as practicable the following eight principles:

1) 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 (where appropriate).

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 must be carried out at the NTP. However, the NTP in PLMNs is not precisely defined. Other methods must be used to achieve an adequate representation of the quality that would be perceived at the NTP for the parameters defined in the present document.

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 present document 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.

1 Scope

The present document contains definitions and measurement methods for a range of user perceivable Quality of Service (QoS) parameters. The purpose of these parameters is to define objective and comparable measures of the QoS delivered to users/customers for use by users/customers. The present document applies to any telecommunication service however some parameters may have a limited application.

The Guide is intended to provide a menu from which individual items can be selected. There is no obligation to use any or all of the parameters.

The QoS parameters are related primarily to services and service features and not to the technology used to provide the services. Therefore the parameters should be capable of use when the services are provided on new technologies such as packet switched technologies as well as on circuit switched technologies.

The establishment of target values for QoS is outside the scope of the present document. The QoS parameters listed in the present document are also not intended to assess the complete QoS of a telecommunication service. The present document provides a set of QoS parameters that covers specific user related QoS aspects rather than a complete list of QoS parameters. This set has been chosen to address areas where monitoring of QoS is likely to be most worthwhile, i.e. the areas that are most likely to be affected by any QoS problems.

If stakeholders wish to examine other QoS aspects they are recommended to follow the general approach of the present document - as far as practicable - as a basis for the development of definitions and measurement methods for new specific QoS parameters.

The set of QoS parameters is designed to be understood by the users of various telecommunications services. Sub-sets of these parameters can be selected for use in different circumstances. For example a specific parameter might be relevant for many users in some countries or markets but the same parameter might not be of relevance in others. Therefore stakeholders - users, customers, regulators, service providers, network operators and other parties interested in the use of QoS parameters - should decide in co-operation, which parameters should be used in their particular situation. This decision should take account of:

- The precise purpose for which they will be used.

- The general level of quality achieved by most operators.

- The degree to which the parameters will provide a reliable comparison of performance.

- The cost of measuring and reporting each parameter.

Part 1 contains general user related QoS parameter definitions and measurement methods that can be applied to any telecommunications service. The QoS parameters in part 1 are focused on non call related QoS aspects. Additional parts of the present document will contain service specific user related QoS parameter definitions and measurement methods.

Part 2 contains user related QoS parameter definitions and measurement methods for voice, data and fax services accessed via public telecommunication networks. The QoS parameters in part 2 are focused on call related QoS aspects. The data parameters are specified for the case where a V.9x series modem is used.

Part 3 (the present document) contains user related QoS parameter definitions and measurement methods specific to Public Land Mobile Networks (PLMN).

The present document includes the parameters unsuccessful call ratio and dropped call ratio even though they would logically be covered in part 2. The reasons for their inclusion in the present document are:

- These parameters are more important for mobile networks than the other call related parameters covered in part 2 and their inclusion makes the present document more self contained.

- Dropped call ratio is not included in part 2 because when part 2 was written the main focus was on fixed networks where this parameter is much less important than in mobile networks.

The parameters in the present document apply to call related services but not to Internet access provided by GPRS or later technologies.

For some of the parameters in the present document, alternative measurement methods are given based either on drive round tests and or on network element counters. Each method has its own advantages and disadvantages and the results of one approach are not comparable with the results of the other approach, and therefore, if comparability is needed, operators and regulators should decide which approach should be used in their country and all network operators should use the same approach.

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 and/or edition number or version number) or non-specific.

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

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

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

[1]   ETSI TS 102 250: "Speech Processing, Transmission and Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks".

3   Definitions and abbreviations

3.1   Definitions

For the purposes of the present document, the following term and definition applies:

mobile service: The term mobile service is used for various telecommunication services when access via a PLMN is provided.

NOTE: Since the purpose of the present document is to formulate definitions for QoS parameters, these definitions are given in the main body of the text and are not repeated here.

3.2   Abbreviations

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

GPRS   General Packet Radio Service
ISDN   Integrated Services Digital Network
NTP   Network Termination Point
PLMN   Public Land Mobile Network
PSTN   Public Switched Telephone Network
QoS   Quality of Service

4   General considerations

4.1   Services covered

The present document applies exclusively to call related services provided on mobile networks, but not to Internet access provided by GPRS or later technologies.

The parameters are end-user/customer and end-to-end orientated and are not intended to address the quality of interconnection services explicitly. Where test calls are made the numbers called may be chosen to include or exclude interconnection depending on the purposes of the tests.

In many cases the provider of telecommunications services 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 try 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.

4.2   Use of the parameters

Quality of service parameters are used for various purposes including:

- Specifying the level of quality of service in customer telecommunication service contracts or in the description or terms and conditions of the service.

- Comparing the quality of service of different service providers.

- Comparing the quality of service aspects of different service offers.

- Preparing long term studies on the quality of service aspects of a specific service.

Care should be taken, however, over the use of quality of service parameters for mobile networks because of the effects of the radio coverage, which makes the absolute values of parameters less meaningful and less comparable than is the case for networks with wireline access.

The following factors need to be considered:

- Networks may not be designed with the same priorities for coverage. Network design may be biased towards particular areas or particular types of user. During the early years of operation competing networks may focus their roll out on different areas of a country.

- The absolute average performance level of networks may be of little interest to users who are only interested in the performance in the area where they are located, and one network may provide better coverage in one area and another in a different area.

- The capacity and coverage of mobile networks changes frequently, especially in the earlier years of operation and networks leap-frog each other in performance as they add channels and base station sites. Consequently test drives conducted at one point in time during a reporting period may not be indicative of the average performance over the whole period.

- The performance measured on test drives applies only to the routes chosen. The choice of routes may not represent the average of user's locations over the whole network but gives a snap-shot in time and location of the performance of the network. Furthermore, if test drives are carried out independently of the operators, then it is advisable that the operators do not have knowledge of the routes in advance. Relevant parts of TS 102 250 [1] will give more detailed advice on sampling and the design of drive round tests.

4.3   Reporting for different classes of customers

Mobile networks do not normally make distinctions in the class of customer in terms of the quality of service offered and therefore separate reporting for different classes of customers is less likely to be relevant than it is for fixed networks.

4.4   Differences in levels of QoS

Mobile networks do not normally make distinctions in the levels of the quality of service offered and therefore separate reporting for different offers of quality of service is less likely to be relevant than it is for fixed networks.

4.5   Reporting for directly and indirectly served customers.

The general 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 would have the responsibility for QoS and provision of QoS statistics when it is selected to carry a call. Carrier selection is, however, less common on mobile networks than on fixed networks.

4.6   Data processing issues

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.

4.7   Data collection period

Where the measurements are to be used for long term comparisons, it is recommended that QoS data should be collected and calculated on a quarterly basis starting on 1 January, 1 April, 1 July and 1 October.

Stakeholders may also decide to use longer or shorter data collection periods. For most QoS parameters a data collection period on a quarterly basis is suitable, and will provide adequately up-to-date information. But there may also be cases were a longer period is more practicable, e.g. extensive customer surveys. Shorter periods are advisable for QoS aspects where frequent and fast changes in quality are likely to occur.

4.8   Sampling and test calls

Test drives should be planned to ensure as far as practicable that the results adequately reflect the QoS perceived by customers for the period under review.

Test calls should be made to a test number in an interconnected fixed network (PSTN/ISDN).

The drive round surveys shall be designed to be representative of the population to measure for the results to have the needed accuracy. 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, and user's behaviour.

4.9   Comparability of measurements

Results should be compared only where the same measurement methods are used. For example, measurements made with drive round tests on one network may be compared with measurements made with drive round tests on another network but not with measurements made with network element counters.

4.10   Publication of QoS parameters

Where measurements are made and published in accordance with the present document, it is recommended that an explicit reference to the present document should be given so that readers can be made aware of the background of the definitions and measurement methods. The reader should be enabled to understand the meaning, purpose and areas of application of the QoS parameters.

It is important that the reader is aware of the scope of the parameters and the intended use of the QoS statistics, otherwise there is a high risk that the measurement results are misinterpreted.

Stakeholders who publish QoS statistics in accordance with the present document should provide additional and explanatory text in order to facilitate the understanding of the statistics. It may be assumed that a reader who is interested in comparable QoS statistics and QoS parameters of different nature is willing and capable to understand technical and operational background information on telecommunication services. A balanced approach should be used taking into account on the one hand the need for easy understandable information and on the other hand the requirement of correctly edited data derived from the measurements.

5   The use of drive round tests versus measurements based on network element counters

There are two different and complementary approaches to mobile QoS:

-    drive-round tests;

-    measurements based on network element counters.

The approach of drive-round tests has the following advantages:

•   It measures the network from an external point as would be seen by the user and so does not depend on any correct functioning of the network to enable a measurement to be made.

•   The same test system can be used to compare results for different networks and so the comparability of results at the same point and time is high, although the results are not necessarily highly representative of the performance of the whole network.

•   Locations where there is no coverage are taken fully into account.

This approach of drive-round tests has the following disadvantages:

•   The test configurations (i.e. the terminal and its method of use) are not indicative of how users actually handle their terminals.

•   To obtain adequate accuracy (representing a whole network) for comparison purposes, a very large number of samples is needed on the chosen test drives.

There are severe problems in selecting test drives that are representative of users' behaviour in both location and timing. Both the user density and the complexity of providing service in different areas vary, and a test drive will not necessarily be representative of the performance of the whole network. This means that to try to be more representative more and longer test drives should be used and different parts of each test drive should be weighted differently. More information on drive-round tests is given in annex A.

Measurements based on network element counters offer the following advantages:

•   They include the effects of all calls, and so provide better comparability of congestion and network failures.

•   They take account of changes in terminals and the actual performance achieved by real terminals used by real users.

•   The quality indicators may be produced for the whole network as well as for different regions and periods out of the same data base.

Measurements based on network element counters have the following disadvantages:

- Call attempts made out of coverage are not taken into account as the network does not get information from them.

- They depend on software algorithms in the switches and base station controllers that implement the counters and the algorithms of different manufacturers may differ and there may be differences between algorithms in different versions of the same software.

More information on measurements based on network element counters is given in annex B.

6   QoS parameters specific to PLMNs

6.1   General

It is important to understand the interaction between:

- network coverage;

- network availability;

- service accessibility;

- service retainability; and

- voice quality (covered in part 2).

The network coverage is the basic and most important parameter of a network: the ability to provide the services where they are required by the user. If there is no possibility to have access to the network, there is no possibility to use the services provided by the network and the rest of parameters that measure the quality of service have no importance. Coverage is normally predicted from radio modelling and checked by the network operators.

Network availability is also very important for the user. It is perceived by the user as a lack of service where it was expected. Depending on the kind of network failure, it can be seen as no coverage in the mobile, as an impossibility to make calls having coverage, or as an impossibility to access a concrete service.

Service accessibility is the accessibility to a service when there is network access. Where there is network access, service access may not be possible because:

- There are no available radio channels to support the service.

- There are no available transmission links between the base station and the mobile switching centre.

The availability of a service is therefore a combination of network accessibility and service accessibility.

Measurements of voice quality on a PLMN will be influenced by both the transmission capabilities of the network and the state of the radio access. A network with a higher access threshold will support better speech quality but poorer network accessibility in an area of weak coverage.

Network coverage is not included in the present document. Information on network coverage is normally made available to potential users.

Network coverage and network availability are for further studies.

NOTE: In some countries national roaming is provided between operators as a means of achieving coverage. Whilst measurements should normally be made using a mobile or test equipment that is registered on the network that is being measured, in some cases networks achieve the coverage required under their licence through national roaming arrangements and in these cases the measurements will need to include roaming. When roaming the target network indicator identifies the operator on whose network the mobile is roaming. Where roaming is supported, information should be given in conjunction with the results to indicate whether or not the results include the effects of roaming.

6.2   Considerations on drive-round tests

The air interface of a PLMN is to a large extent equivalent to the NTP of a fixed network. Measurements of some of the parameters defined in the present document can only be made using special test equipment and the results obtained may depend to some extent on the design of this test equipment.

The QoS experienced by users will also be influenced to some extent by the design of their terminals and therefore may differ somewhat from the results of formal tests.

There are several factors that could affect the comparability of measurements of different networks:

-      use of different measurement equipment;

-      use of different design settings in the networks that deliberately trade one aspect of quality against another;

-      the locations where measurements are made during the drive round survey;

-      the time when measurements are made;

-      weather conditions and date when measurements are made (the performance of the radio access will be affected by weather conditions, seasons (extent of tree foliage), and recent weather history (wetness of the ground and foliage).

Consequently any measurements that are intended to compare the quality of different networks should use a common measurement system and the different networks should be sampled simultaneously from the same locations, and the number of different locations should be sufficiently large to provide some statistical averaging to take account of the different locations of the base stations.

6.3   Considerations on measurements based on network element counters

The QoS experienced by users will be taken into account as the calls are made with the real terminals by the users, so the results from the measurements will reflect accurately the QoS.

Any measurements intended to compare the quality of different networks should use a common measurement system agreed by the network operators. As the real traffic provides measurements from the entire network, all the different locations and different times are measured, so the representativity is assured. The network operators should agree on the set of network element counters that are equivalent for different network manufacturers in order to get comparable results.

6.4   QoS parameters

6.4.1   Unsuccessful call ratio for telephony

6.4.1.1   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, while in a coverage area, where neither the call is answered nor called party busy tone nor ringing tone, is recognized at the access of the calling user within 40 seconds from the instant when the last digit of the destination subscriber number is received by the network.

6.4.1.2   Measurement and statistics

Measurements should reflect accurately traffic variations over the hours of a day, the days of the week and the months of the year.

When using the measurements based on network element counters, the measurement must be made using an automatic data collection system, based on network element counters, which register the real traffic of the network. The network counters collect information for 24 hours a day, every day of the year. The following statistics should be provided:

> The percentage of unsuccessful calls, calculated from all the call attempts in the period.

When using test calls, the following statistics should be provided:

> The percentage of unsuccessful calls, together with the number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number.

For both methods, the measurements must provide a relative accuracy greater than 10 % with a level of reliability of 95 %.

6.4.2   Dropped call ratio

The objective of this parameter is to obtain a measurement of the ability of the mobile network used by the service provider to maintain a call once it has been correctly established. This parameter measures failures in coverage, problems with the quality of the signal, network congestion and network failures.

6.4.2.1   Definition

The proportion of incoming and outgoing calls which, once they have been correctly established and therefore have an assigned traffic channel, are dropped or interrupted prior to their normal completion by the user, the cause of the early termination being within the operator's network.

6.4.2.2   Measurement and statistics

Measurements should reflect accurately traffic variations over the hours of a day, the days of the week and the months of the year.

When using the measurements based on network element counters, the measurement must be made via an automatic data collection system, based on the network counters which register the real traffic of the network. The network counters collect information for 24 hours a day, every day of the year. The following statistics should be provided:

> The percentage of dropped calls, calculated from all the calls in the period.

When using test calls, the following statistics should be provided:

> The percentage of dropped calls, together with the number of observations used and the absolute accuracy limits for 95 % confidence calculated from this number.

For both methods, the measurements must provide a relative accuracy greater than 10 % with a level of reliability of 95 %.

Annex A (informative):
Design of drive round surveys

Drive round surveys are commonly used to measure parameters such as:

- Unsuccessful call ratio.

- Dropped call ratio.

- Voice quality (although the issues concerning voice quality are more an indication of problems with the radio signal as discussed in clause 6.1 than as assessment of the performance of the codecs and the terminals and the digital transmission in the network).

The design of a drive round survey depends very much on the objective of the survey, i.e. what the survey is attempting to measure. There are two extremes and a range of possibilities in between:

- The simplest and cheapest objective is to provide an external indicative snapshot of the performance of a network on the limited routes chosen for the survey.

- The most complex and expensive objective is to obtain a scientifically accurate measure of the traffic weighted average performance of the whole network as would be perceived by a real user, with a given level of statistical confidence in the measured result.

The simplest approach may be useful to obtain an impression of the performance, especially if the performance is believed to be very poor, and repeated simple surveys may be useful in determining if the performance is improving or deteriorating. The simplest approach will not, however, produce results that are free from bias and necessarily representative of the whole network and therefore the comparability of the results will be necessary.

The performance of the network is the result of the combination of many different variables whose relationships to each other are not fully understood. To measure the traffic weighted average performance accurately, each variable must be sampled with a sufficient number of calls, and the samples must be representative of the whole network, the user's behaviour handling of the terminal, the location and the timing of the calls.

The most fundamental issue is the selection of the route for the survey. The area to be surveyed may be considered to be made up of many different sample areas whose size should be inversely proportional to the expected traffic density, so that each sample area would need the same number of samples for a given accuracy. Since the performance will be affected by the geography (both in terms of land forms and buildings) of the sample area, the sample areas chosen for the survey should cover all the types of geography in the whole area or country in a representative proportion.

The survey will also need to cover:

- The different types of mobile terminal used.

- The different circumstances in which mobiles are used e.g. in car, in building, walking, in homes, in offices, in trains and the different ways in which mobiles are held by their users.

The test calls will need to be made at representative times of day in proportion to the time distribution of real traffic.

For the measurement of dropped calls, the test calls will need to be made for durations that are representative of the durations of real calls.

The survey will need to be repeated at intervals over the reporting period to take account of changes with time of the demand for calls and the capacity of the network.

Information on the relationship between the size of the sample and the accuracy of the estimate of the unsuccessful call ratio may be found in the relevant parts of TS 102 250 [1].

Annex B (informative):
Measurements based on network element counters

This annex covers the QoS indicators that could be defined when evaluating the telephony service provided by a PLMN with measurements based on network element counters.

B.1 Service accessibility: Unsuccessful call ratio

Objective

To obtain a measurement of the reliability of the mobile network used by the service provider for establishing and receiving calls. This parameter measures both congestion and network failures.

Definition

This is the percentage of attempts to access a traffic channel whose objective is to initiate a call, with origin or destination in the mobile network, and which cannot be completed, in such a way that the network is unable to determine the status of the called user. This includes blockage as a result of network congestion.

Measurement

The measurement is made using an automatic data collection system, based on network counters, which register the real traffic of the network.

The network counters collect information for 24 hours a day, every day of the year, in such a way that they reflect the variations in traffic which occur during the different days, weeks and months of the year.

The measurements must provide a relative accuracy greater than 10 % with a level of reliability of 95 %.

Counters

The formula used for calculating the percentage of uncompleted calls is:

$$\left(\frac{\text{Attempts at taking TCH for a call - Successful taking of TCH for a call}}{\text{Attempts at taking TCH for a call}} \right) \times 100$$

The formula includes the attempts to seize a TCH for an originated or terminated call and the success at assigning a TCH for an originated or terminated call.

B.2 Service retainability: Dropped calls ratio

Objective

To obtain a reliable measurement of the mobile network used by the service provider for maintaining a call once it has been correctly established. Failures in coverage, problems with the quality of the signal, network congestion and network failures have important impact on this indicator.

Definition

The percentage of calls which, once they have been correctly established and therefore have an assigned traffic channel, are interrupted prior to their normal completion by the user, the cause of the early termination being within the operator's network.

Measurement

The measurement is made via an automatic data collection system, based on the network counters which register the real traffic of the network.

The network counters collect information for 24 hours a day, every day of the year, in such a way that they reflect the variations in traffic which occur during the different days, weeks and months of the year.

The measurements must provide a relative accuracy greater than 10 % with a level of reliability of 95 %.

Counters

The formula used to calculate the percentage of dropped calls is:

$$\left(\frac{\text{Interrupted calls}}{\text{Successful calls}} \right) \times 100$$

The formula includes the interrupted calls which consist of failures which cause the dropping of the channel once the TCH has been successfully established, and the successful seizure of TCH for an originated or terminated call.

Annex C (informative):
Bibliography

ETSI EG 201 769: "Speech Processing, Transmission and Quality Aspects (STQ); QoS parameter definitions and measurements; Parameters for voice telephony service required under the ONP Voice Telephony Directive 98/10/EC".

History

Document history			
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