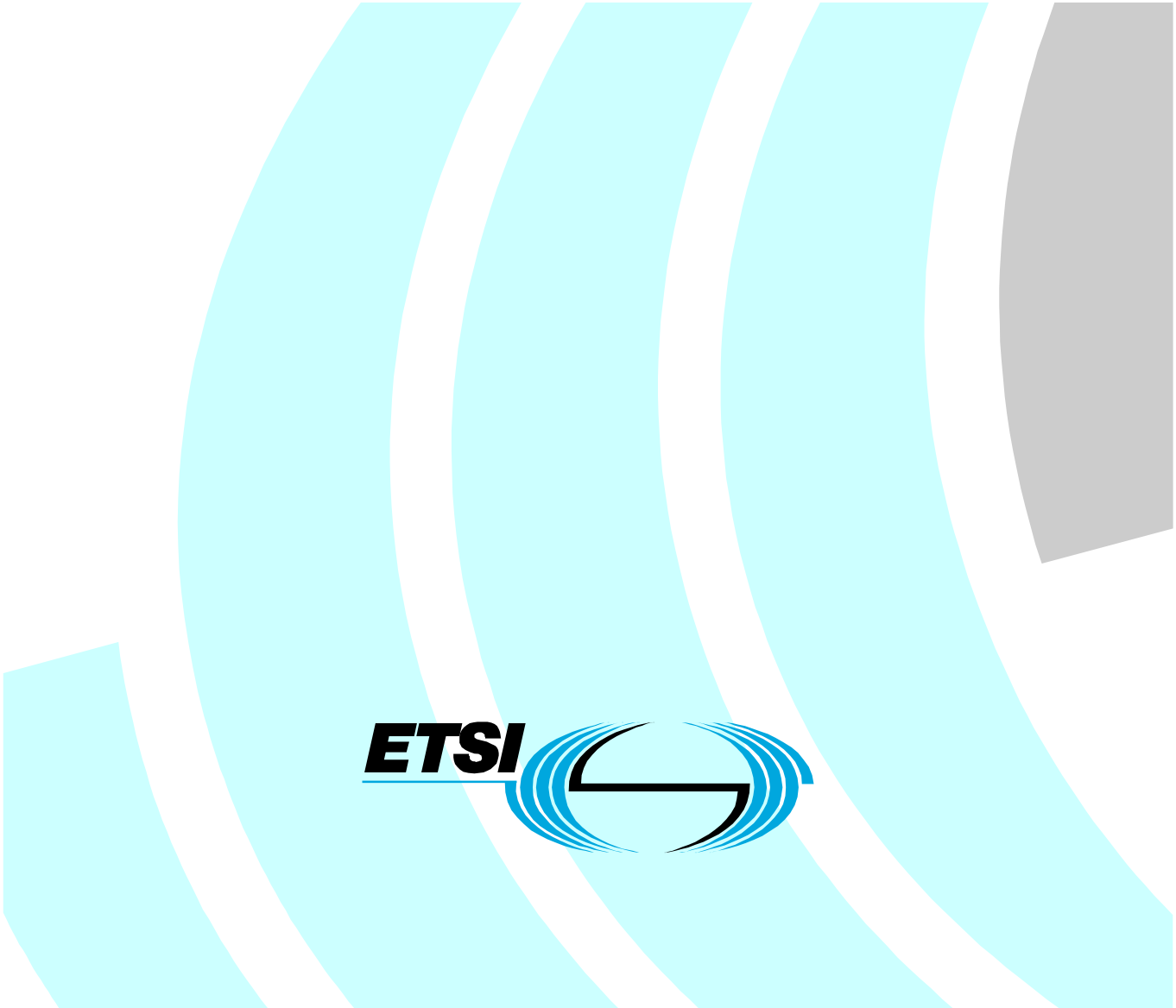
ETSI TR 102 521 V1.1.1 (2006-05)

Technical Report

Speech Processing, Transmission and Quality aspects (STQ); Support to TC EMTEL for QoS and Transmission Quality aspects for end-to-end services



Reference
DTR/STQ-00080

Keywords
QoS, quality, speech, transmission

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Speech Processing, Transmission and Quality Aspects (STQ).

1 Scope

The present document provides basic information on the planning and provision of end-to-end services with respect to transmission quality. Network management, signalling and traffic engineering aspects are out of the scope of the present document.

The purpose of the present document is to describe the basic approach in order to identify QoS requirements and objectives for end-to-end services and to list critical technical aspects that have an influence on the resulting service quality. Also references to appropriate existing standards are given.

Based on this information technical requirements and thresholds for the telecommunications network infrastructure and terminal equipment needed in order to support the desired end-to-end services can be derived.

The present document takes into account traditional circuit switched as well as packet switched technology.

2 References

For the purposes of this Technical Report (TR), the following references apply:

[1] ETSI EG 201 377-1: "Speech Processing, Transmission and Quality Aspects (STQ); Specification and measurement of speech transmission quality; Part 1: Introduction to objective comparison measurement methods for one-way speech quality across networks".

[2] ETSI EG 201 377-2: "Speech Processing, Transmission and Quality Aspects (STQ); Specification and measurement of speech transmission quality; Part 2: Mouth-to-ear speech transmission quality including terminals".

[3] ETSI EG 201 377-3: "Speech Processing, Transmission and Quality Aspects (STQ); Specification and measurement of speech transmission quality; Part 3: Non-intrusive objective measurement methods applicable to networks and links with classes of services".

[4] ETSI EG 202 057-1: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 1: General".

[5] ETSI EG 202 057-2: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 2: Voice telephony, Group 3 fax, modem data services and SMS".

[6] ETSI EG 202 057-3: "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)".

[7] ETSI EG 202 057-4: "Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 4: Internet access".

[8] ETSI EG 202 086: "Speech Processing, Transmission and Quality Aspects (STQ); Objectives and principles for the transmission performance of multiple interconnected networks that aim to provide "traditional quality" telephony services".

[9] ETSI TBR 038: "Public Switched Telephone Network (PSTN); Attachment requirements for a terminal equipment incorporating an analogue handset function capable of supporting the justified case service when connected to the analogue interface of the PSTN in Europe".

[10] ETSI TR 102 430: "Speech Processing, Transmission and Quality Aspects (STQ); Basic Issues concerning the Quality of Speech over Packet Technology (both Internet and Next Generation Networks)".

[11] ITU-T Handbook on "Quality of Service and Network Performance".

[12] ITU-T Recommendation G.101: "The transmission plan".

[13] ITU-T Recommendation G.109: " Definition of categories of speech transmission quality".

[14] ITU-T Recommendation G.114: "One-way transmission time".

[15] ITU-T Recommendation G.131: "Talker echo and its control".

[16] ITU-T Recommendation G.1000: "Communications Quality of Service: A framework and definitions".

[17] ITU-T Recommendation G.1010: "End-user multimedia QoS categories".

[18] ITU-T Recommendation I.350: "General aspects of quality of service and network performance in digital networks, including ISDNs".

[19] ITU-T Recommendation P.300: "Transmission performance of group audio terminals (GATs) ".

[20] ITU-T Recommendation P.310: "Transmission characteristics for telephone band (300-3400 Hz) digital telephones".

[21] ITU-T Recommendation P.311: "Transmission characteristics for wideband (150-7000 Hz) digital handset telephones".

[22] ITU-T Recommendation P.313: "Transmission characteristics for cordless and mobile digital terminals".

[23] ITU-T Recommendation P.330: "Speech processing devices for acoustic enhancement".

[24] ITU-T Recommendation P.340: "Transmission characteristics and speech quality parameters of hands-free terminals".

[25] ITU-T Recommendation P.341: "Transmission characteristics for wideband (150 7000 Hz) digital hands free telephony terminals".

[26] ITU-T Recommendation P.342: "Transmission characteristics for telephone band (300-3400 Hz) digital loudspeaking and hands-free telephony terminals".

[27] ITU-T Recommendation P.1010: "Fundamental voice transmission objectives for VoIP terminals and gateways".

[28] ITU-T Recommendation Y.1541: "Network Performance Objectives for IP-based Services".

[29] ETSI SR 002 180: " Requirements for communication of citizens with authorities/organizations in case of distress (emergency call handling)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in SR 002 180 [29] apply.

3.2 Abbreviations

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

IP	Internet Protocol
ITU-T	International Telecommunications Union - Telecommunications sector
QoS	Quality of Service
SMS	Short Message Service
TDM	Time Division Multiplex
TE	Terminal Equipment
UNI	User Network Interface
VoIP	Voice over Internet Protocol

4 Quality of end-to-end services

This clause provides a brief overview on general principles on how to assess the quality of end-to-end services. For any telecommunication service the infrastructure and the terminal equipment needs to investigated in order to identify essential quality aspects. These are influenced by technical parameters.

Based on this information objectives for the technical performance of the telecommunications infrastructure and the implementation and monitoring of the services can be given.

General information on QoS and its principles can be found in:

- ITU-T Handbook [11] on Quality of Service and Network Performance.

- ITU-T Recommendation G.1000 [16].

Examples of already defined QoS parameters for various services that can be used as a basis for setting up quality objectives are given in EG 202 057 (Part 1 to 4) [4] to [7].

4.1 End-to-end reference configuration

The QoS of end-to-end services as perceived by the user is a result of the combined performance of different network components and terminal equipment. This is illustrated in the following figure (taken from ITU-T Recommendation G.101 [12]).

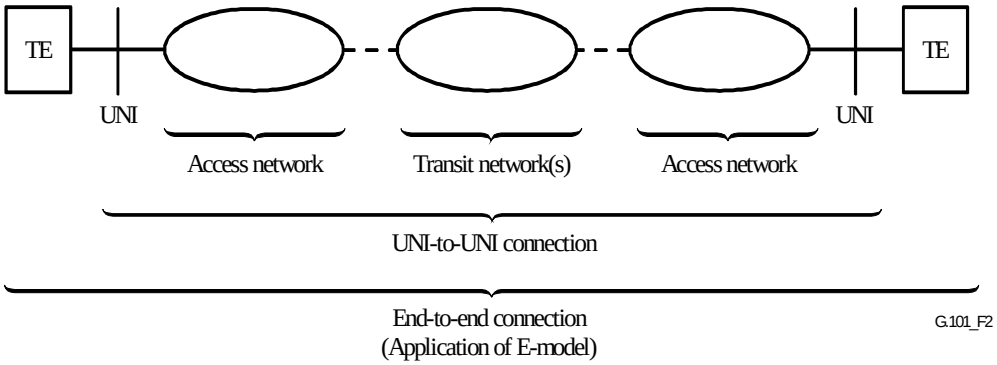


Figure 4.1: Reference configuration

This reference configuration provides information on all relevant terminal, connection and transmission elements having an influence on the end-to-end performance of the connection. The performance is effected, i.e., degraded, by various kinds of impairments. They are identified and assessed by transmission parameters. Depending on the technology used for setting up the end-to-end connection, specific transmission impairments/parameters have to be taken into account. The combined influence of these transmission impairments determine the resulting end-to-end performance of the connection.

In most cases the influence of the terminal equipment performance on the resulting QoS is out of the control of the service provider since the end users themselves are choosing and maintaining the equipment. However, the service provider can give recommendations for suitable terminals that will support good quality conditions.

Normally the involved networks are under control of the service provider since either he is also the operator of the networks or he has service level agreements with the network operators he is directly interconnected to. However if the service is provided over multiple connected networks of different operators there might be no continuous chain of responsibility for the end-to-end connection. In this cases there should be a regional, national or European transmission plan with general rules and requirements for the handling of calls over these networks.

4.2 Relationship between network performance and QoS

Network performance contributes towards QoS as experienced by the user/customer. Network performance may or may not be on an end-to-end basis. The network performance is assessed by measuring technical parameters. The main difference between QoS and network performance is that QoS provides quality information on an end-to-end and service related basis, whereas network performance specifies the technical operativeness of network and terminal elements or of network sections.

ITU-T Recommendation I.350 [18] provides the following conceptual categorization of Quality of Service (QoS) and Network Performance (NP) metrics as follows:

Table 4.1 : Categorization of QoS and NP parameters

Quality of Service parameter	Network Performance parameter
User oriented	Network provider oriented
Service related attributes	Network element and technology related attributes
Focus on user observable effects	Focus on planning development (design), operations and maintenance
Observed at service access points for the users, independent of network process and events	Observed at network connection element boundaries, e.g. relating to protocol specific interface signals

While QoS and NP parameters are different in nature and serve different purposes, it is clear that there exist intrinsic relationships between QoS and NP parameters, one having a direct or indirect, and sometimes even inverse, influence on the other.

Network performance parameters are used to measure objectively the performance of specific network and terminal elements that have an influence on the resulting end-to-end quality of a service. The measured performance can either be directly (without any changes) transferred into a QoS statement or measured values of different parameters can be combined into a single QoS measure. When doing so the different focus of network parameters and the interfaces they are measured at have to be taken into account in order to map them correctly to service related interfaces as seen by a user.

4.3 Identification of QoS parameters and objectives

In order to identify the performance aspects and thus the quality criteria of an end-to-end service models are used. A common model that is used for the determination of performance criteria of a telecommunication service is the one shown in table 4.2.

The objective of the model is to provide a structured approach to analyse the performance aspects in detail. The benefit of this model is that the quality criteria identified can be easily transferred into parameters since it is very detailed and close to the understanding of network performance parameters and management functions. Thus the definitions and measurement methods of the parameters can be expressed on commonly used and well understood technical terms.

Table 4.2 : Performance Model

		Service Quality Criteria						
		SPEED 1	ACCURACY 2	AVAILABILITY 3	RELIABILITY 4	SECURITY 5	SIMPLICITY 6	FLEXIBILITY 7
Service Function								
SERVICE MANAGE -MENT	Sales and Pre-Contract Activities 1							
	Provision 2							
	Alteration 3							
	Service Support 4							
	Repair 5							
	Cessation 6							
CON- NECTION QUALITY	Connection Establish. 7							
	Information Transfer 8							
	Connection Release 9							
Billing 10								
Network/Service management by customer 11								

Each cell of the matrix is investigated in an iterative process. All cells may not be populated for every service function. Depending upon the kind of service under investigation or on the desired granularity of the quality criteria determination more or fewer cells would be populated. It would be rare for all cells to be populated for any one function. After determining the quality criteria, quality parameters can be defined and performance objective set.

5 Performance and quality objectives

5.1 Network performance

In order to support end-to-end services at a desired quality the networks involved have to provide a certain transmission performance. This is normally achieved by elaborating a transmission plan that sets limits and objectives for fundamental transmission parameters and specifies the interfaces between networks and to the terminal equipment.

For each network there should be a respective transmission plan; if several networks are involved, an overall transmission plan covering end-to-end transmissions over all the networks is needed.

General information on transmission planning can be found in ITU-T Recommendation. G.101 [12] where recommendations on limits and references to important parameters like loudness ratings, delay, echo, synchronization etc. are given.

For traditional, i.e. circuit-switched networks with TDM based transmission, EG 202 086 [8] provides performance objectives for 'traditional quality' telephone services.

For IP based networks ITU-T Recommendation Y.1541 [28] defines different network classes and gives information on the implementation of services.

5.2 Terminal equipment

Even though service providers will in most cases have no influence on the terminal equipment used by the users of the service, the provider should recommend performance objectives for adequate terminal equipment. There is a close relationship and dependency between the performance objectives of the terminal and of the network the terminal is intended to be connected to. Therefore both areas should always be examined together.

References for the transmission performance of telephony terminals can be found in ITU-T Recommendation P.300 [19] and P.342 [26] and for VoIP terminals in ITU-T Recommendation P.1010 [27].

Depending on the service to be offered, the terminal may have to support specific features beyond basic access to the network and. These have to be specified in detail.

5.3 Quality objectives

5.3.1 Services in general

Generally speaking the quality of any end-to-end service is determined by:

- availability;
- connection set-up;
- information transfer; and
- connection release.

The availability of a service covers all aspects of having access to the telecommunications network and whether the access can satisfy a service request of an end user/terminal. These quality aspects are the same for any service as they cover the basic access to the telecommunications network infrastructure.

Therefore a basic set of quality objectives for the availability of network access should be determined. Examples for quality parameters can be found in EG 202 057-1 [4]. For emergency telecommunications one would probably specify that the network access should be available all the time and that faults and disruptions should be repaired within a short time period. There are no generally recommended limits for this quality aspects because it is up to the network operator to decide on adequate availability levels. Also availability is mainly influenced by operational rather than technical aspects. Thus it is up to the authority to decide on limits.

For the connection set-up/release and the information transfer specific quality objectives will apply depending on the kind of end-to-end service under consideration. For all three functions the speed (call set-up and release times, information transfer rate) and the accuracy (connection to the correct destination, transmission error, information loss) are important QoS criteria. Each kind of service will react differently on impairments in the functions. For example, real-time services like telephony will be very sensitive to delay and information loss as this will result in a decrease of speech quality and interactiveness. For each service under consideration the quality criteria have to be identified and objectives set individually.

There is a relationship between the quality criteria and their objectives and the network performance of the telecommunication infrastructure used. The quality objectives can be mapped to network performance parameters. Thus quality objectives for specific services will result in minimum requirements for the transmission characteristics of the network. Therefore it should be cross-checked whether quality objectives will require minimum levels of network performance and whether the network is capable of supporting the service.

EG 202 057-2 [5] provides fundamental QoS parameters for telephony, fax, data and SMS services that can be used for determining quality objectives for these services. In ITU-T Recommendation G.1010 [17] "End-user multimedia QoS categories" based on tolerance to information loss and delay of commonly used applications in IP networks are given.

In modern telecommunication networks the most significant impairments are delay and information/packet loss. ITU-T Recommendation G.114 [14] represents an essential standard for delay consideration. In combination with ITU-T Recommendation G.131 [15] that provides recommendations for the control of echo it can be used to determine basic delay objectives.

5.3.2 Voice services

When talking about emergency telecommunications, voice services are the most important ones. Since voice services are very sensitive to variations in delay and transmission quality (information loss and transmission impairments) special care needs to be taken to ensure an adequate quality.

ITU-T Recommendation G.109 [13] defines five categories of speech transmission quality from mouth to ear for 3,1 kHz handset telephony across networks in terms of "user satisfaction". This categories are tied to the so-called E-model, a transmission rating model for assessing the combined effects of variations in several transmission parameters that affect conversational quality of 3,1 kHz handset telephony. It has been proven useful for transmission planning purposes to help ensure that users will be satisfied with end-to-end transmission performance whilst avoiding over-engineering of networks. The speech transmission quality categories of ITU-T Recommendation G.109 [13] can be used to fix speech quality objectives for emergency telecommunications.

Detailed information on delay requirements specific to voice telephony can be found in ITUT Recommendation G.114 [14]. Guidance on one-way delay for Voice over IP is given in Appendix II of ITUT Recommendation G.114 [14]. Also TR 102 430 [10] provides basic information on the quality of speech when transmitted of packet based technology. In digital networks also the use of voice codecs and speech processing devices have to be taken into account. Information on this mater can also be found in the previously mentioned standards.

A comprehensive comparison/correlation of voice and related standards between TIA TR-41/IEEE STIT, ATIS T1A1.3, ITU-T SG12 (+ other study groups) and ETSI STQ (+ other committees) can be found under http://portal.etsi.org/stq/VoiceStandardsComparison.asp.

5.4 Monitoring of network performance and QoS objectives

The performance and quality objectives have to be monitored on a regular basis in order to verify whether the performance and quality objectives have been met. The choice of appropriate measurement methods is heavily influenced by the telecommunications infrastructure and the technology used. It has to be decided individually for each situation which measurement methods are the most effective.

In principle it has to be decided which parameters should be monitored and where and how they should be measured. There are various subjective and objective measurement methods available. In most cases objective measurement methods are used as they can quite easily be measured via adequate probes in appropriate locations. Measurements can be made either on real traffic or on artificially generated traffic. Since performance and quality may be different with respect to the location, the geography of the network should be taken into account for the measurements particularly if the choice is done not to monitor all the parts of the network. Also the number and temporal distribution of the measurement samples taken need to be considered. Optimization of the measurements may need to focus on some key point of the network or to perform the measurements at busiest hours of the day or week. Both intrusive and non-intrusive methods are useful and can be combined. Besides active and passive measurement methods performance and quality evaluations can also be based on the analysis of automatically stored signalling and protocol data.

For the monitoring of speech services EG 201 377 [1] to [3] should be taken into account. It provides guidance on the specification and measurement of mouth-to-ear (also end-to-end) speech transmission quality. Its main objective is to describe objective comparison-based methods and systems for measuring mouth-to-ear speech quality in networks. Apart from this, it gives an overview on other important aspects of mouth-to-ear speech quality.

6 Conclusions

In order to guarantee QoS for emergency telecommunications (from a transmission quality point of view) the basic task to do is to specify the performance requirements for the telecommunication networks involved. The number and kind of different telecommunication services to be associated with emergency telecommunications will determine the minimum requirements for the transmission performance of the network(s). The respective technical parameters for specifying the performance limits are available and well described in standardization. Depending on the network technology (circuit/packet switched, fixed/wireless) used different network performance parameters need to be specified.

Once the performance limits are fixed, end-to-end quality objectives for the different services can be described by the use of respective QoS parameters. For the most important services like voice, fax, data parameters are available. For other services existing parameters can be adopted. The quality objectives for the end-to-end services can be defined technologically neutral, i.e. irrespective whether the underlying technology is circuit or packet switched.

History

Document history		
V1.1.1	May 2006	Publication