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Speech and multimedia Transmission Quality (STQ); Transmission requirements for wideband wireless terminals (handset and headset) from a QoS perspective as perceived by the user

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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
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

Modal verbs terminology

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Introduction

The present document covers wireless speech terminals. It aims to enhance the interoperability and end-to-end quality with all other types of terminals.

The advanced signal processing of terminals is targeted to speech signals. Therefore, wherever possible speech signals are used for testing in order to achieve realistic test conditions and meaningful results.

1 Scope

The present document provides speech transmission performance requirements for wireless terminals; it addresses all types of wireless terminals, including softphones. The present document addresses handset and headset functions of wideband wireless terminals.

Differently from other standards which define minimum performance requirements, it is the intention of the present document to specify terminal equipment requirements which enable manufacturers and service providers to enable good quality end-to-end speech performance as perceived by the user whatever be the radio link (terminals may implement different radio links with the access network).

When an additional radio link between the terminal and external electroacoustical devices is used (e.g. Bluetooth® link), the present document will address the overall quality.

In the present document objective measurement methodologies and requirements for wireless speech terminals are given.

In addition to basic testing procedures, the present document describes advanced testing procedures taking into account further quality parameters as perceived by the user.

The requirements available in the present document will ensure a high compatibility across access networks with all types of terminals.

It is the aim to optimize the listening and talking quality, conversational performance, as well as the use in noisy environments. Related requirements and test methods will be defined in the present document.

For all the functions, the present document will consider the limitations in audio performance due to different form factors (e.g. size, shape).

Terminals which are not intended to be connected to public networks are outside the scope of the present document.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

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The following referenced documents are necessary for the application of the present document.

[1] Void.

[2] Void.

[3] Recommendation ITU-T P.56: "Objective measurement of active speech level".

[4] Recommendation ITU-T P.57: "Artificial ears".

[5] Recommendation ITU-T P.58: "Head and torso simulator for telephonometry".

[6] Recommendation ITU-T P.64: "Determination of sensitivity/frequency characteristics of local telephone systems".

[7] Recommendation ITU-T P.79: "Calculation of loudness ratings for telephone sets".

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

[9] Recommendation ITU-T P.380: "Electro-acoustic measurements on headsets".

[10] Recommendation ITU-T P.501 Amendment 1 (2012): "Test signals for use in telephonometry".

[11] Recommendation ITU-T P.502: "Objective test methods for speech communication systems using complex test signals".

[12] Recommendation ITU-T P.581: "Use of head and torso simulator for hands-free terminal testing".

[13] IEC 61672: "Electroacoustics - Sound Level Meters".

[14] IEC 61260: "Electroacoustics - Octave-band and fractional-octave-band filters".

[15] ETSI TS 126 171 (V6.0.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); AMR speech codec, wideband; General description (3GPP TS 26.171 version 6.0.0 Release 6)".

[16] Recommendation ITU-T G.729.1: "G.729 based embedded variable bit-rate coder: An 8-32 kbit/s scalable wideband coder bitstream interoperable with G.729".

[17] Recommendation ITU-T G.722: "7 kHz audio-coding within 64 kbit/s".

[18] Recommendation ITU-T G.711.1: "Wideband embedded extension for ITU-T G.711 pulse code modulation".

[19] Recommendation ITU-T G.722.2: "Wideband coding of speech at around 16 kbit/s using Adaptive Multi-Rate Wideband (AMR-WB)".

[20] ETSI TS 103 106: "Speech and multimedia Transmission Quality (STQ); Speech quality performance in the presence of background noise: Background noise transmission for mobile terminals-objective test methods".

[21] Recommendation ITU-T P.311: "Transmission characteristics for wideband digital handset and headset telephones".

[22] ETSI TS 126 441 (V12.0.0): "Universal Mobile Telecommunications System (UMTS); LTE; EVS Codec General Overview (3GPP TS 26.441 version 12.0.0 Release 12)".

[23] ETSI TS 103 224: "Speech and multimedia Transmission Quality (STQ); A sound field reproduction method for terminal testing including a background noise database".

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

[25] Recommendation ITU-T P.863: "Perceptual objective listening quality prediction".

[26] Recommendation ITU-T P.863.1: "Application guide for Recommendation ITU-T P.863".

[27] Recommendation ITU-T G.122: "Influence of national systems on stability and talker echo in international connections".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

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

3 Definition of terms and abbreviations

3.1 Terms

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

artificial ear: device for the calibration of earphones incorporating an acoustic coupler and a calibrated microphone for the measurement of the sound pressure and having an overall acoustic impedance similar to that of the median adult human ear over a given frequency band

codec: combination of an analogue-to-digital encoder and a digital-to-analogue decoder operating in opposite directions of transmission in the same equipment

diffuse field equalization: equalization of the HATS sound pick-up, equalization of the difference, in dB, between the spectrum level of the acoustic pressure at the ear Drum Reference Point (DRP) and the spectrum level of the acoustic pressure at the HATS Reference Point (HRP) in a diffuse sound field with the HATS absent by applying the reverse nominal curve of table 3 of Recommendation ITU-T P.58 [5]

Head And Torso Simulator (HATS) for telephonometry: manikin extending downward from the top of the head to the waist, designed to simulate the sound pick-up characteristics and the acoustic diffraction produced by a median human adult and to reproduce the acoustic field generated by the human mouth

Mouth Reference Point (MRP): point located on axis and 25 mm in front of the lip plane of a mouth simulator

nominal setting of the volume control: setting of receive volume control of a device, which obtains a RLR value close to 2 dB

3.2 Abbreviations

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

a.c.	alternating current
AM-FM	Amplitude Modulation - Frequency Modulation
AMR-WB	Adaptive Mode Rate - Wide Band
CDMA	Code Division Multiple Access
CS	Composite Source
CSS	Composite Source Signal
DECT	Digital Enhanced Cordless Telecommunications
DRP	ear Drum Reference Point
DUT	Device Under Test
ECRP	EarCap Reference Point
ELR	Echo Loudness Rating
ERP	Ear Reference Point
EVS	Enhanced Voice Services
FFT	Fast Fourier Transform
G-MOS-LQOw	Overall transmission quality for wideband systems
GSM	Global System for Mobile communication (3GPP)
HATS	Head And Torso Simulator
HRP	HATS Reference Point
LQO	Listening Quality Objective
LR	Loudness Rating
LTE	Long Term Evolution (3GPP)

MOS	Mean Opinion Score
MRP	Mouth Reference Point
NLP	Non-Linear Processing
N-MOS-LQOw	Transmission quality of the background noise for wideband systems
PN	Pseudo noise sequence
POI	Point Of Interconnect
QoS	Quality of Service
RF	Radio Frequency
RLR	Receive Loudness Rating
RMS	Root Mean Square
SLR	Send Loudness Rating
S-MOS-LQOw	Transmission quality of the speech for wideband systems
STD	Standard (handset position)
STMR	Side Tone Masking Rating
TCL	Terminal Coupling Loss
TOSQA	Telecommunications Objective Speech Quality Assessment
UMTS	Universal Mobil Telecommunications System
VAD	Voice Activity Detection
VoLTE	Voice over LTE
WB	WideBand
WIFI	Wireless fidelity
WIMAX™	Worldwide Interoperability for Microwave ACCess

4 Configurations and interfaces

4.1 Introduction

The present document is intended to be applicable for different wireless access networks and for additional radio links.

4.2 Access networks

The present document applies to any wireless terminal whatever the network access, e.g. GSM, UMTS, VoLTE, DECT, Bluetooth®, WIFI, WIMAX™ and CDMA.

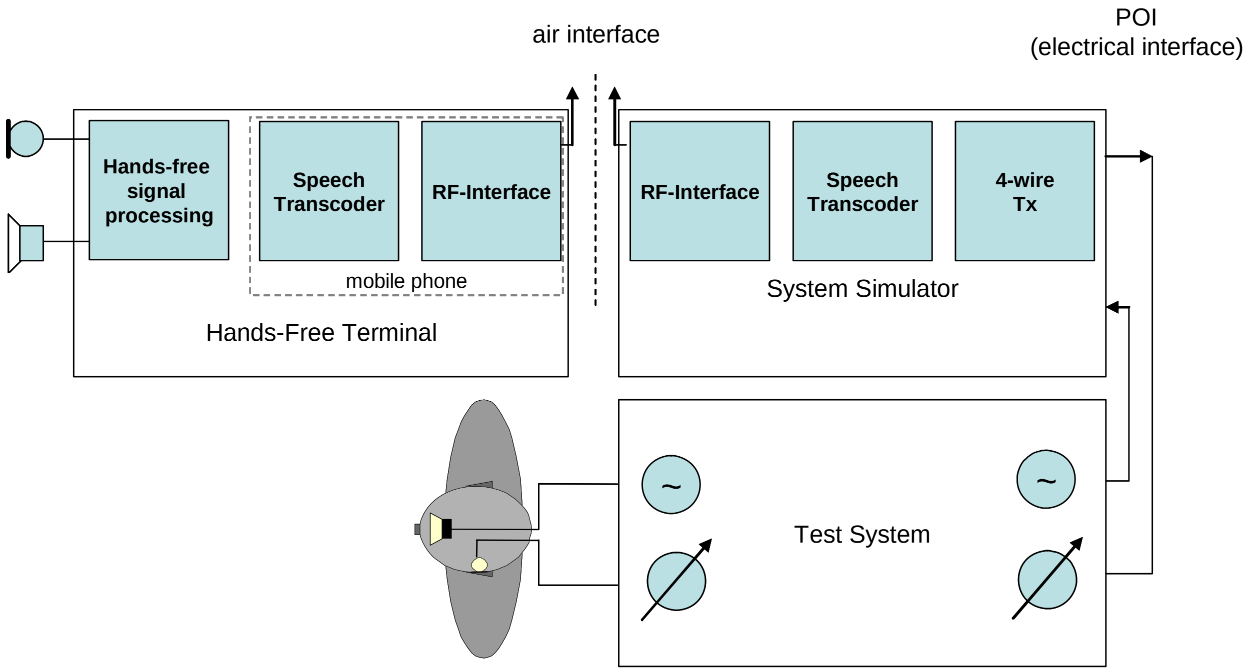
4.3 Additional (radio) links between the terminal and external electroacoustical devices

The whole terminal may include additional (radio) links. The most of the requirements and test methods apply to the whole terminal. Specific requirements and test methods on additional links are for further study.

5 Test Configurations

5.1 Set-up interface

The generic schematic as defined in figure 5.1-1 is applicable to any wireless link.



NOTE: The "whole" terminal includes all the components from "RF interface" to the transducers and may include an additional (radio) link. The air interface considered in the figure is not the additional radio link.

Figure 5.1-1: Set-up interface

5.2 Set-up for terminals

5.2.0 General

The acoustical access to terminals is the most realistic simulation of the average subscriber. This can be made by using HATS (Head And Torso Simulator) with appropriate ear simulation and appropriate means to fix handset and headset terminals in a realistic and reproducible way to the HATS. HATS is described in Recommendation ITU-T P.58 [5], appropriate ears are described in Recommendation ITU-T P.57 [4] (type 3.3 and type 3.4 ear), a proper positioning of handsets under realistic conditions is to be found in Recommendation ITU-T P.64 [6].

The preferred way of testing a terminal is to connect it to a network simulator with exact defined settings and access points. The test sequences are fed in either electrically, using a reference codec or using the direct signal processing approach and acoustically using the HATS.

When a coder with variable bit rate is used for testing terminal electroacoustical parameters, the bit rate giving the best characteristics or the most commonly used should be selected, e.g.:

- AMR-WB [15]: 12,65 kbit/s;
- Recommendation ITU-T G.729.1 [16]: 32 kbit/s;
- EVS [22]: 13,2 kbit/s.

5.2.1 Setup for handsets and headsets

When using a handset telephone the handset is placed in the HATS position as described in Recommendation ITU-T P.64 [6]. The artificial mouth shall be conform with Recommendation ITU-T P.58 [5]. The artificial ear shall be conform with Recommendation ITU-T P.57 [4], either type 3.3 or type 3.4 ears shall be used. In case of testing a flat handset (e.g. smartphone) with artificial ear of:

- Type 3.4, the *flat handset position* according to annex D.3 of Recommendation ITU-T P.64 [6] shall be used (A=0°, B=5° and C=0°).

- Type 3.3, the *alternative handset position* according to annex E.2 of Recommendation ITU-T P.64 [6] shall be used with the definition A=0°, B=5° and C=0°. This aligns measurements using artificial ears of type 3.3 and 3.4, where the flat handset position is explicitly specified (annex D.3 of Recommendation ITU-T P.64 [6]).

Unless stated otherwise, the application force of 8 N is used for handset testing. No application force is used for headset.

Recommendations for positioning headsets are given in Recommendation ITU-T P.380 [9]. If not stated otherwise headsets shall be placed in their recommended wearing position. Further information about setup and the use of HATS can be found in Recommendation ITU-T P.380 [9].

Unless stated otherwise if a volume control is provided the setting shall be chosen such that the nominal RLR is met as close as possible.

5.2.2 Setup of variable echo path

The handset is positioned d = 3 cm above a horizontal hard surface, facing the surface with speaker and microphone. The surface shall be at least 35 × 35 cm. The handset is fixed like a pendulum with a non-elastic cord 3 cm above the centre of the horizontal surface, see figure 5.2.2-1. The pivot is 55 ± 1 cm above the hard plate.

Figure 5.2.2-1: Positioning of handset under test

The "handset-pendulum" is displaced at least to the edge of the hard surface. The test signal playback shall start with the release of the displaced handset under test.

For headsets the same measurement arrangement is used as described above. However, it has to be assured that the echo path (audio path between speaker output and microphone input) changes significantly. If the pendular motion across the base surface is not producing a sufficient change in echo path, another hard surface perpendicular to the base surface can be added. The dimension and position of the additional surface should be chosen such that it is positioned within the echo path when crossed by the pendulous headset but not within the echo path when the headset reaches the turning point of the pendulous motion. At the lowest point of pendular motion, the headset speaker and microphone should not exceed a distance of 3 cm from either of the surfaces.

NOTE: Depending on the geometry of the headset (monaural / binaural, microphone integrated into earpiece / earplug with microphone on short arm / microphone on long arm) a stable pendular motion has to be established. This may require two cords fixed with respect to the headset's balance point in order to avoid tumbling motion. Alternatively, the headset may be attached to a fixed radial arm to achieve a stable pendular motion.

Figure 5.2.2-2 shows an exemplary setup for a binaural headset with long microphone arm and vertical surface to increase echo path variation by changing the coupling between speaker and microphone during pendular motion. During one pendular period, the DUT is exposed to four sudden changes in echo path when passing the vertical surface.

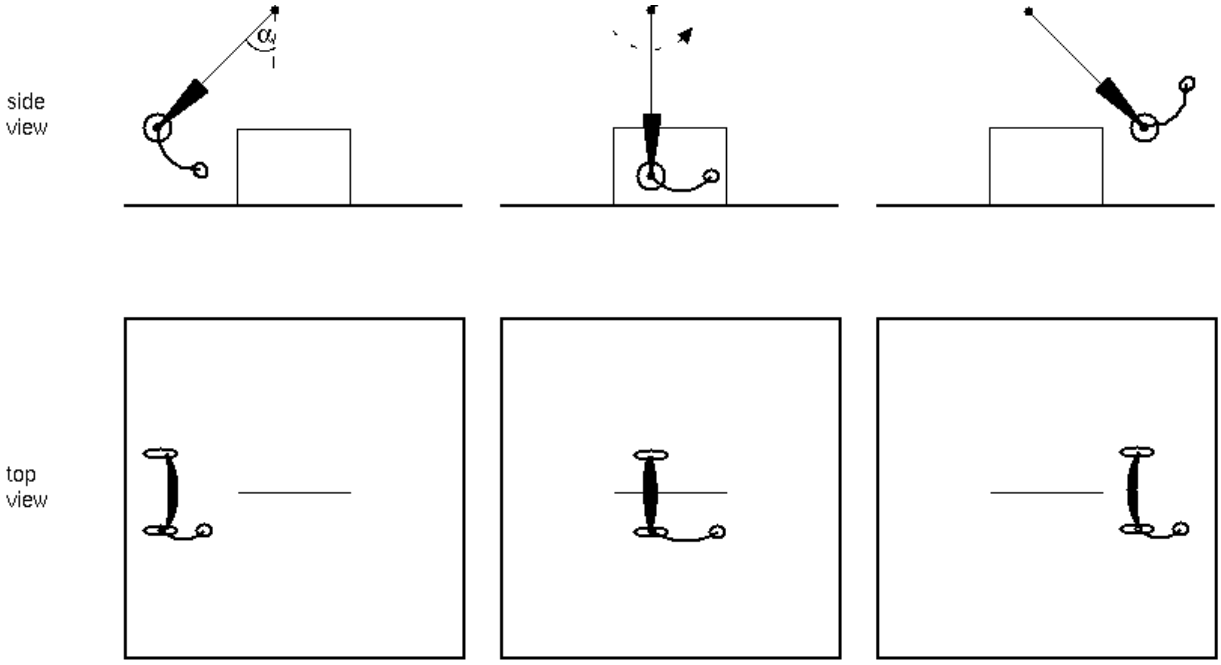


Figure 5.2.2-2: Example for positioning of a headset under test

5.2.3 Setup for testing positionial robustness of handsets

In order to investigate the robustness of certain measurements against non-default positions as described in clause 5.2.1, three modified positions are defined for the sending and receiving side. Tables 5.2.3-1 and 5.2.3-2 provide a description of these positions, which are derived from typical user behaviour. Figure 5.2.3-1 illustrates the different axes and coordinate system. More detailed explanations are provided in Recommendation ITU-T P.64 [6]. All measurements regarding positioning are only applicable for handset testing.

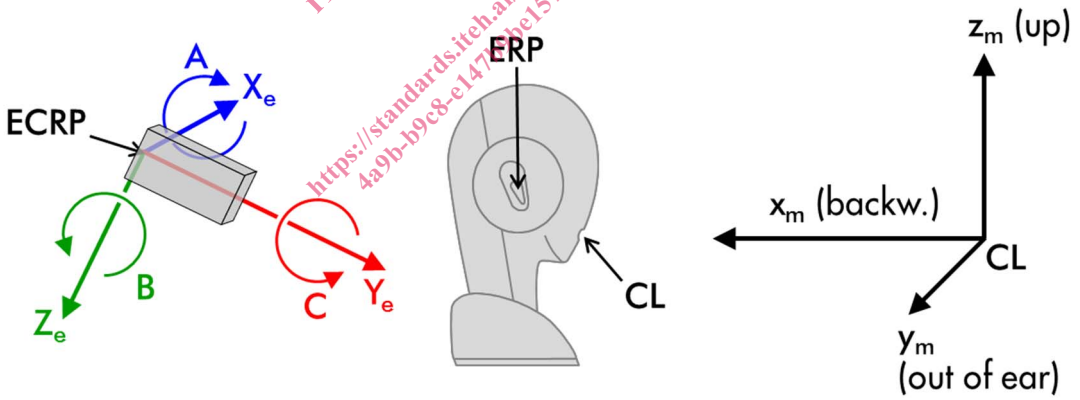


Figure 5.2.3-1: Schematic overview over positioning coordinate system

Table 5.2.3-1 provides the different angles for the positions in sending direction. With these shifts, distance and direction between MRP and microphone input of the DUT is varied.

Table 5.2.3-1: Modified test positions for sending direction

Position name	A [°] (rotation along X_e)	ΔB [°] (rotation along Z_e)	C [°] (rotation along Y_e)	Comment
STD	0	0	0	Standard position at ECRP
UP	-14	+5	0	Terminal elevated
DOWN	+30	0	0	Terminal lowered
AWAY	0	+18	0	Larger distance to MRP