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Introduction

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The present document specifies minimum performance requirements for the electro-acoustic characteristics of 3G, LTE, NR and WLAN terminals when used to provide narrowband, wideband, super-wideband or fullband telephony.

The objective for narrowband services is to reach a quality as close as possible to ITU-T standards for PSTN circuits. However, due to technical and economic factors, there cannot be full compliance with the general characteristics of international telephone connections and circuits recommended by the ITU-T.

The performance requirements are specified in the main body of the text; the test methods and considerations are described in TS 26.132.

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1 Scope

The present document is applicable to any terminal capable of supporting narrowband, wideband, super-wideband or fullband telephony, either as a stand-alone service or as the telephony component of a multimedia service. The present document specifies minimum performance requirements for the electro-acoustic characteristics of 3G, LTE, NR and WLAN terminals when used to provide narrowband, wideband, super-wideband or fullband telephony.

The set of minimum performance requirements enables a guaranteed level of speech quality while taking possible physical limits of the terminal design into account. Some performance objectives are also defined, if such design limits can be overcome. Care must be taken in applying performance objectives in isolation, not to degrade overall end-user speech quality.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

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[1] 3GPP TS 26.132: "Speech and video telephony terminal acoustic test specification".

[2] ITU-T Recommendation B.12 (1988): "Use of the decibel and the neper in telecommunications"

[3] ITU-T Recommendation G.103 (1998): "Hypothetical reference connections".

[4] ITU-T Recommendation G.111 (1993): "Loudness ratings (LRs) in an international connection".

[5] ITU-T Recommendation G.121 (1993): "Loudness ratings (LRs) of national systems".

[6] ITU-T Recommendation G.122 (1993): "Influence of national systems on stability and talker echo in international connections".

[7] Void

[8] ITU-T Recommendation P.11 (1993): "Effect of transmission impairments".

[9] ITU-T Recommendation P.380 (2003): "Electro-acoustic measurements on headsets".

[10] ITU-T Recommendation P.50 (1993): "Artificial voices".

[11] ITU-T Recommendation P.79 (11/07) with Annex G (2001): "Calculation of loudness ratings for telephone sets".

[12] ITU-T Recommendation G.223 (11/88): "Assumptions for the calculation of noise on hypothetical reference circuits for telephony".

[13] ITU-T Recommendation P.340 (05/00): "Transmission characteristics and speech quality parameters of hands-free terminals".

[14] ITU-T Recommendation P.501 (01/12): "Test signals for use in telephonometry".

[15] ITU-T Recommendation P.502 (05/00): "Objective test methods for speech communication systems using complex test signals".

[16] 3GPP TS 06.77 (R99): "Minimum Performance Requirements for Noise Suppresser Application to the AMR Speech Encoder".

[17] 3GPP TS 26.114: "IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction ".

[18] 3GPP TS 23.203: "Policy and charging control architecture".

[19] 3GPP TS 23.402: "Architecture enhancements for non-3GPP accesses".

[20] 3GPP TS 24.302: "Access to the 3GPP Evolved Packet Core (EPC) via non-3GPP access networks; Stage 3".

[21] ITU-T Recommendation P.1100: "Narrowband hands-free communication in motor vehicles".

[22] ITU-T Recommendation P.1110: "Wideband hands-free communication in motor vehicles".

[23] ITU-T Recommendation P.1120: "Super-wideband and fullband stereo hands-free communication in motor vehicles".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document the terms *narrowband*, *wideband*, *super-wideband* and *fullband* refer to signals associated with the corresponding operating modes of the speech codecs specified in TS 26.132.

For the purposes of the present document, the terms dB, dBr, dBm0, dBm0p and dBA, shall be interpreted as defined in ITU-T Recommendation B.12 [2]; the term dBPa shall be interpreted as the sound pressure level relative to 1 pascal expressed in dB (0 dBPa is equivalent to 94 dB SPL).

The overload point (maximum load capacity) is for the purposes of this document defined as the RMS level of a digital representation of a full-scale pure tone at the input of the speech encoder. The overload point is defined at 3,14 dBm0 for AMR, AMR-WB and EVS speech codecs.

A 3GPP softphone is a telephony system running on a general purpose computer or PDA complying with the 3GPP terminal acoustic requirements (TS 26.131 and 26.132).

For the purposes of the present document the term *clock skew* is defined as the difference between the clock of the device under test (C_{DUT}) and the clock of the reference client (C_{REF}). The skew of C_{DUT} relative to C_{REF} is defined in parts per million (PPM) as: $(C_{DUT} - C_{REF}).10^6 / C_{REF}$.

For the purposes of the present document, the term *electrical interface* is defined as an analogue or digital access to a UE, which allows injecting and capturing signals electrically instead of through an acoustical interface. The interface can be either analogue (wired) or digital (wired or wireless). The purpose of this interface is to connect a separate device (typically a headset), which provides a receiver and transmitter for telephony.

3.2 Abbreviations

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

ADC Analogue to Digital Converter
AMR Adaptive Multi Rate
DAC Digital to Analogue Converter
DAI Digital Audio Interface
DRP Eardrum Reference Point
DTX Discontinuous Transmission
EEC Electrical Echo Control
EL Echo LossERP Ear Reference Point

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EVS	Enhanced Voice ServicesHATS Head and Torso Simulator
G-MOS-LQO$_n$	Global (Overall) Mean Opinion Score - Listening Quality Objective - Narrowband
G-MOS-LQO$_w$	Global (Overall) Mean Opinion Score - Listening Quality Objective - Wideband
G-MOS-LQO$_{fb}$	Global (Overall) Mean Opinion Score - Listening Quality Objective - Fullband
IMS	IP Multimedia Subsystem
LSTR	Listener Sidetone Rating
LTE	Long Term Evolution
MRP	Mouth Reference Point
MTSI	Multimedia Telephony Service for IMSOLR Overall Loudness Rating
N-MOS-LQO$_n$	Noise (Background) Mean Opinion Score - Listening Quality Objective - Narrowband
N-MOS-LQO$_w$	Noise (Background) Mean Opinion Score - Listening Quality Objective - Wideband
N-MOS-LQO$_{fb}$	Noise (Background) Mean Opinion Score - Listening Quality Objective - Fullband
NR	New Radio
PCM	Pulse Code Modulation
PDA	Personal Digital Assistant
POI	Point of Interconnection (with PSTN)
PSTN	Public Switched Telephone Network
RLR	Receive Loudness Rating
S-MOS-LQO$_n$	Speech Signal Quality Mean Opinion Score - Listening Quality Objective - Narrowband
S-MOS-LQO$_w$	Speech Signal Quality Mean Opinion Score - Listening Quality Objective - Wideband
S-MOS-LQO$_{fb}$	Speech Signal Quality Mean Opinion Score - Listening Quality Objective - Fullband
SLR	Send Loudness Rating
STMR	Sidetone Masking Rating
SS	System Simulator
TX	Transmission
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UPCMI	13-bit Uniform PCM Interface
WLAN	Wireless Local Area Network

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4 Interface definition

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4.1 General

The interfaces required to define terminal electro-acoustic characteristics are shown in TS 26.132. These are the air interface and the point of interconnect (POI). The interfaces are shown for one-channel (mono) operation, interfaces for two-channel (stereo) operation are for further study.

Measurements can be made using the system simulator (SS) described in TS 26.132. MTSI speech aspects are specified by TS 26.114 [17].

4.2 Air interfaces

The Air Interfaces for GSM, 3G, LTE and NR are specified by GSM 05, 3GPP 45, 3GPP 25, 3GPP 36 and 3GPP 38 series specifications, and the Air Interface for WLAN access to EPC is specified by WLAN access to EPC as defined in TS 23.402 [19] and TS 24.302 [20].

The POI with the public switched telephone network (PSTN) is considered to have a relative level of 0 dBr.

4.3 Acoustical interfaces

The following classes of acoustical interface are considered in this specification:

- Handset UE including softphone UE used as a handset;
- Headset UE including softphone UE used with headset;

- Desktop-mounted hands-free UE including softphone UE with external loudspeaker(s) used in hands-free mode;
- Hand-held hands-free UE including softphone UE with internal loudspeaker(s) used in hands-free mode.

(See definition of softphone in Clause 3.1)

NOTE: A smartphone in hands-free mode put on a table is excluded from the definition of desktop-mounted hands-free UE.

Vehicle Mounted Hands-free UE is out of scope. In case performance evaluations are planned for Vehicle Mounted Hands-free UE, test setup, methods and requirements specified in Recommendation ITU-T P.1100 [21] (for NB), P.1110 [22] (for WB) or P.1120 [23] (for SWB and FB) can be used.

The requirements and performance objectives for a softphone UE shall be derived according to the following rules:

- When using a softphone UE as a handset: requirements and performance objectives shall correspond to handset mode.
- When using a softphone UE with headset: requirements and performance objectives shall correspond to headset mode.
- When using a softphone UE in hands-free mode:
  - When using internal loudspeaker(s), requirements and performance objectives shall correspond to hand-held hands-free.
  - When using external loudspeaker(s), requirements and performance objectives shall correspond to desktop-mounted hands-free.

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4.4 Electrical interfaces

An electrical interface is considered in this specification and details on standardized analogue (wired) and digital (wired and wireless) headset interfaces can be found in TS 26.132. For the electrical interface, the POI in sending / receiving direction is respectively defined as the input / output of the reference speech coder of the system simulator.

Any of the UE types mentioned in clause 4.3 providing an electrical interface can be considered as Electrical Interface UE.

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5 Narrowband telephony transmission performance

5.1 Applicability

The performance requirements in this sub-clause shall apply when UE is used to provide narrowband telephony, either as a stand-alone service, or as part of a multimedia service.

5.2 Overall loss/loudness ratings

5.2.1 General

An international connection involving a 3G, LTE, NR or WLAN network and the PSTN should meet the overall loudness rating (OLR) limits in ITU-T Recommendation G.111 [4]. The national parts of the connection should therefore meet the send and receive loudness rating (SLR, RLR) limits in ITU-T Recommendation G.121 [5].

For the case where digital routings are used to connect the 3G, LTE, NR or WLAN network to the international chain of circuits, the SLR and RLR of the national extension will be largely determined by the SLR and RLR of the 3G, LTE, NR or WLAN network. The limits given below are consistent with the national extension limits and long term objectives in ITU-T Recommendation G.121 [5].