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Terminal acoustic characteristics for telephony;
Requirements
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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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Introduction

The present document specifies minimum performance requirements for the acoustic characteristics of 3G, LTE, 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.

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 acoustic characteristics of 3G, LTE 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*.

- [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 Suppressor 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".

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: $(C_{DUT} - C_{REF}) \cdot 10^6 / C_{REF}$.

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
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
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

4 Interfaces

The interfaces required to define terminal 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 is for further study.

The Air Interfaces for GSM, 3G and LTE are specified by GSM 05, 3GPP 45, 3GPP 25 and 3GPP 36 series specifications, and the Air Interface for WLAN access to EPC is specified by WLAN access to EPC as defined in 3GPP TS 23.402 [19] and TS 24.302 [20]. MTSI speech aspects are specified by TS 26.114 [17].

Measurements can be made using the system simulator (SS) described in TS 26.132.

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

Five classes of acoustic 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;
- Vehicle-mounted hands-free UE including softphone UE mounted in a vehicle;
- 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: 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 a softphone UE is mounted in a vehicle: requirements and performance objectives shall correspond to vehicle-mounted handsfree 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.

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 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 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 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].

The SLR and RLR values for the 3G, LTE or WLAN network apply up to the POI. However, the main determining factors are the characteristics of the UE, including the analogue to digital conversion (ADC) and digital to analogue conversion (DAC). In practice, it is convenient to specify loudness ratings to the Air Interface. For the normal case, where the 3G, LTE or WLAN network introduces no additional loss between the Air Interface and the POI, the loudness ratings to the PSTN boundary (POI) will be the same as the loudness ratings measured at the Air Interface. However, in some cases loss adjustment may be needed for interworking situations in individual countries.

5.2.2 Connections with handset UE

The nominal values of SLR/RLR to the POI shall be:

$$\text{SLR} = 8 \pm 3 \text{ dB};$$

$$\text{RLR} = 2 \pm 3 \text{ dB}.$$

Where a user-controlled receiving volume control is provided, the RLR shall meet the nominal value for at least one setting of the control. When the control is set to maximum, the RLR shall not be \leq (equal or louder than) -13 dB.

With the volume control set to the minimum position the RLR shall not be \geq (equal or quieter than) 18 dB.

Compliance shall be checked by the relevant tests described in TS 26.132.

5.2.3 Connections with desktop and vehicle-mounted hands-free UE

The nominal values of SLR/RLR to/from the POI shall be:

$$\text{SLR} = 13 \pm 4 \text{ dB};$$

$$\text{RLR} = 2 \pm 4 \text{ dB (for vehicle-mounted hands-free UE);}$$

$$\text{RLR} = 5 \pm 4 \text{ dB (for desktop hands-free UE).}$$

1. For a vehicle-mounted hands-free UE:

Where a user-controlled volume control is provided, the RLR shall meet the nominal value for at least one setting of the control. It is recommended that a volume control giving at least 15 dB increase from the nominal RLR (louder) is provided for hands-free units intended to work in the vehicle environment. This is to allow for the increased acoustic noise level in a moving vehicle.

RLR at the maximum volume control setting should be \leq (equal or louder than) -2 dB.

2. For a desktop hands-free UE:

Where a user-controlled volume control is provided, the RLR shall meet the nominal value for at least one setting of the control. It is recommended that a volume control giving at least 15 dB increase from the nominal RLR (louder) is provided for hands-free units. This is to allow for the increased acoustic noise level in the usage environment.

RLR at the maximum volume control setting should be \leq (equal or louder than) 1 dB.

Compliance shall be checked by the relevant tests described in TS 26.132.

NOTE: The target value for nominal RLR, as recommended in ITU-T G.111 Annex B – Table B.1 [4], lies between 1 and 3 dB. The higher RLR requirement of 5 dB for desktop hands-free is appreciative of the limitations in transducer output with current typical form factors.

5.2.4 Connections with hand-held hands-free UE

The nominal values of SLR/RLR to/from the POI shall be:

SLR = 13 ± 4 dB;

RLR = $9 +9 / -7$ dB.

As a performance objective it is recommended that the RLR at the maximum volume control setting is \leq (equal or louder than) 2 dB.

Where a user-controlled volume control is provided, the RLR shall meet the nominal value for at least one setting of the control. It is recommended that a volume control range ≥ 15 dB be provided. Compliance shall be checked by the relevant tests described in TS 26.132.

NOTE: The target value for nominal RLR, as recommended in ITU-T G.111 Annex B – Table B.1 [4], lies between 1 and 3 dB. The higher RLR requirement of 9 dB for hand-held hands-free is appreciative of the limitations in transducer output with typical form factors.

5.2.5 Connections with headset UE

The nominal values of SLR/RLR to/from the POI shall be:

SLR = 8 ± 3 dB;

RLR = 2 ± 3 dB;

RLR (binaural headset) = 8 ± 3 dB for each earphone.

Where a user-controlled receiving volume control is provided, the RLR shall meet the nominal value for at least one setting of the control. When the control is set to maximum, the RLR shall not be \leq (equal or louder than) -13 dB.

With the volume control set to the minimum position the RLR shall not be \geq (equal or quieter than) 18 dB and shall not be \geq (equal or quieter than) 24 dB for a binaural headset.

Compliance shall be checked by the relevant tests described in 3GPP TS 26.132.

5.3 Idle channel noise (handset and headset UE)

5.3.1 Sending

The maximum noise level produced by the apparatus at the output of the SS under silent conditions in the sending direction shall be ≤ -64 dBm0p.

NOTE 1: This level includes the eventual noise contribution of an acoustic echo canceller under the condition that no signal is received.

NOTE 2: This figure applies to the total noise level with psophometric weighting. It is recommended that the level of single frequency disturbances should be ≤ -74 dBm0p in the frequency range from 300 Hz to 3.4 kHz.