ETSI TS 126 259 V15.0.0 (2018-10)

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5G;
Subjective test methodologies for the evaluation of immersive audio systems
(3GPP TS 26.259 version 15.0.0 Release 15)

Reference

DTS/TSGS-0426259vf00

Keywords

5G

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

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Contents

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iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
https://standards.iteh.ai/catalog/standards/sist/fb7b6d55-5025-418e-a5a9-9dade4edca70/etsi-ts-126-259-v15.0.0-2018-10

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Introduction

Audio is a key component of an immersive multimedia experience and 3GPP systems are expected to deliver immersive audio with a high Quality of Experience. However, industry agreed methods to assess the Quality of Experience for immersive audio are relatively few and this Technical Specification seeks to address this gap by providing subjective test methods for the assessment of immersive audio.

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1 Scope

The present document specifies subjective test methodologies for 3GPP immersive audio systems including channel-based, object-based, scene-based and hybrids of these formats. The subjective evaluation methods described in the present document are applicable to audio capture, coding, transmission and rendering as indicated in their corresponding clauses.

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 TR 21.905: "Vocabulary for 3GPP Specifications".

[2] ITU-R Recommendation BS.1534-3: "Method for the subjective assessment of intermediate quality level of audio systems".

[3] ITU-R Recommendation BS.1116-3: "Methods for the subjective assessment of small impairments in audio systems".

[4] ITU-R Recommendation BS.2051-2: "Advance sound system for programme production".

[5] 3GPP TS 26.118: "3GPP Virtual reality profiles for streaming applications".

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3 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

4 (VOID)

This clause is left "Void" intentionally, since specific clauses of the present document have been used and referenced during the characterization exercise related to the 3GPP Virtual Reality Audio profile; therefore, a clause renumbering would misalign such specific references from other 3GPP specifications.

5 Test Methodologies for Immersive Audio Systems of TS 26.118 (Codec Quality Characterization Test)

5.1 Introduction

This clause specifies the Codec Quality Characterization Test for the audio profiles in TS 26.118. The Codec Quality Characterization Test is based on the test method defined in [2]. The Codec Quality Characterization Test assesses the *Basic Audio Quality* attribute at different bit-rates for a given audio profile.

NOTE: The reference and hidden reference for the Codec Quality Characterization Test are rendered to the loudspeakers with the reference renderer of the audio profile under test. Because the reference renderer may include degradations to the immersive audio quality, including a reduction on the number of audio streams, care will be taken when evaluating the results.

5.2 Experimental Design

The experimental design of the Codec Quality Characterization Test is such that all assessors rate all Anchor/Reference and Test Conditions. To control for possible presentation order biases, the presentation order of the samples is fully randomized during the experiment (double-blind test). To minimize listener fatigue, the following constraints on the experimental design are defined:

- Each Test Material shall be no longer than 12 s in duration.
- No more than four Codec Operating Points shall be tested for each test material.
- Each experiment shall contain no more than 10 Test Materials.

5.3 Selection of Assessors

The selection of assessors shall follow the guidelines in [2] clause 4.1. Only *experienced assessors* shall participate in the experiment and the test administrator shall employ pre- and post-screening according to [2] clause 4.1. The final test results shall include assessments from at least 10 *experienced assessors* that have passed both pre- and post-screening.

5.4 Test Materials

Critical audio materials representing typical virtual reality content shall be used as Test Materials. Each test shall include at least 3 channel-based, 3 object-based and 3 scene-based Test Materials. In the event a Test Material is a hybrid format, the primary category to which the Test Material belongs to (distributed among channels, objects and scene-based) shall be indicated in the Test Report.

All Test Materials shall be provided as either 24-bit integer or 32-bit PCM float signals with a sampling rate of 48 kHz.

5.5 Content Presentation

The content presentation and grading process are according to [2] clauses 5.3 and 5.4.

5.6 Listening Environment

The listening environment should comply with [3] clauses 8.2 and 8.3.

5.7 Listening System

The listening system shall be loudspeaker-based. The loudspeaker layout is layout J described in [4] Annex 1.

5.8 Listening Level

The listening level is according to [2] clause 8. The listening level is adjusted with channel-based content.

5.9 Anchor/Reference Conditions

All Codec Quality Characterization Tests shall include one Hidden Reference and two Anchors. The two Anchors are 3.5kHz and 7kHz low-pass filtered versions of the Reference condition, as described in [2] clause 5.1.

The Reference and Hidden Reference conditions are the source test Materials rendered to the loudspeaker setup through the Reference Renderer of the Audio Profile under test with the coding bypassed.

5.10 Test Conditions

The Test Conditions shall be generated by encoding, decoding and rendering the test Materials with the target operating points of:

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- 128 kbps (for First Order Ambisonics contents only)
- 256 kbps
- 384 kbps
- 512 kbps

A +/- 10% variation from the target operating points is acceptable. The actual bit-rate for each Test Condition shall be reported with an accompanying justification for the target operating point deviation. The renderer used for the Test Conditions shall be the same renderer used for the Anchor and Reference Conditions.

5.11 Attributes

The Codec Quality Characterization Test shall assess the *Basic Audio Quality* attribute described in [2] clause 6.4.

5.12 Test Report and Presentation of Results

The Test Report shall provide the Mean and 95 % Confidence Intervals (t-distribution) for each test Condition, Hidden Reference and Anchors. All results provided shall be post-screened results.

6 Test Methodologies for Immersive Audio Systems of TS 26.118 (Renderer Comparison Test)

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6.1 Introduction

This clause specifies the Renderer Comparison Test for the audio profiles in TS 26.118. The Renderer Comparison Test is loosely inspired by the Comparison Category Rating test paradigm described in [5] Annex E.

6.2 Experimental Design

In the Renderer Comparison Test, the assessors compare a Test Condition against Anchor Conditions on four audio quality Attributes. The presentation of the Test and Anchor Conditions is binaural using head-tracking. For each trial, the Test Condition is compared to one of the Anchor Conditions as an A v. B comparison. To control for possible presentation order biases, the Test Conditions shall be presented to the assessors as sample A in exactly half of the trials. The test shall be conducted with 12 Test Materials and two Anchors for a total of 24 trials (comparisons).

The test shall be divided in two sessions: the first session compares the Test Condition against the first Anchor and the second session compares the Test Condition against the second Anchor.

6.3 Selection of Assessors

The selection of assessors shall follow the guidelines in [2] clause 4.1. Only *experienced assessors* shall participate in the experiment and the test administrator shall employ pre- screening according to [2] clause 4.1. The final test results shall include assessments from at least 12 *experienced assessors* that have passed pre-screening.

NOTE 1: Post-screening methods for this test are for further study. In the event post-screening is performed, the test report will describe the method adopted.

NOTE 2: Post-screening methods for this test are ffs.

6.4 Test Materials

The Rendering Comparison Test shall use critical audio materials representing typical virtual reality content, with a duration longer than 6 s and no longer than 12 s. The Rendering Comparison Test shall include 4 channel-based, 4 object-based and 4 scene-based Test Materials. In the event a test Material is a hybrid format, the primary category to which the test material belongs to (distributed among channels, objects and scene-based) shall be indicated in the test report.