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| Technical Specification | |
| 3rd Generation Partnership Project;  Technical Specification Group Services and System Aspects;  Diverse audio Capturing System for UEs (DaCAS)  (Release 19) | |
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# Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

This clause shall start on a new page.

The present document …

# 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".

…

[x] <doctype> <#>[ ([up to and including]{yyyy[-mm]|V<a[.b[.c]]>}[onwards])]: "<Title>".

It is preferred that the reference to TR 21.905 be the first in the list.

# 3 Definitions of terms, symbols and abbreviations

This clause and its three (sub) clauses are mandatory. The contents shall be shown as "void" if the TS/TR does not define any terms, symbols, or abbreviations.

## 3.1 Terms

For the purposes of the present document, the terms given in 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 TR 21.905 [1].

Definition format (Normal)

**<defined term>:** <definition>.

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Symbols

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

Symbol format (EW)

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

Abbreviation format (EW)

<ABBREVIATION> <Expansion>

# 4 UE device types

## 4.1 General

UEs are the target devices for immersive audio capture, proposals highlight the need for devices that enable spatial audio processing while addressing legacy hardware constraints. Key goals include standardizing documentation (e.g., coordinate systems for microphone placement) and accommodating diverse form factors. Two primary device categories emerge: analytical prototypes for free-field modeling and practical designs mimicking mainstream smartphones.

4.2 Device Types

### 4.2.1 Device type 1: Four-Microphone Prototype device

#### 4.2.1.1 Overview

Prior to launch of the very first immersive voice services, immersive audio capture devices in the market have generally been designed with other use cases in mind. Prototype device designs can in part help to bridge the gap between commercial example devices and new immersive service opportunities, needs, and expectations.

Device type 1 (Four-Microphone Prototype Devices) comprises two separate hardware configurations, denoted Four-Microphone Prototype Device A (clause 4.2.1.2) and Four-Microphone Prototype Device B (clause 4.2.1.3). Both prototype device configurations utilize four microphones for immersive capture thus implementing four-sided capture geometries.

Device A provides a simplified form factor for a more limited use case, whereas device B corresponds to a practical smartphone design including typical complexities related to more generalized audio design. Both prototype designs aim to optimize certain immersive audio capture principles relevant for their respective form factors, e.g., use of symmetrical microphone array design (Device A) and maximizing the microphone array aperture based on non-planar quadrilateral array shape (Device B). The effects of these choices on performance of the example solutions can provide further guidelines for diverse capture designs relevant for immersive voice services and IVAS encoder format generation.

#### 4.2.1.2 Four-Microphone Prototype Device A

Four-Microphone Prototype Device A, illustrated in Figure 4.2.1.2-1, is a prototype immersive audio capture accessory. This is a cylindrical design that could be incorporated, e.g., in a conference room telco equipment or a webcam device. Such device could, e.g., be placed on a table or on top of a display. The device dimensions and the microphone array design are described in more detail in Table 4.2.1.2-1

**Table 4.2.1.2-1: Device and microphone array information**

|  |  |
| --- | --- |
| **Property** | **Description** |
| Device category | Accessory device |
| Device shape | Cylindrical |
| Dimensions | Length 162 mm  Width 12 mm (cylinder diameter)  Connector bump (HDMI-D connector):  Width 20 mm  Height 6 mm  Protrudes by 3.95 mm |
| Microphone array design | Symmetrical array design  Planar array shape  Two-dimensional, four-sided capture geometry |
| Microphone port designations | Channel 1 – Mic Front Right  Channel 2 – Mic Rear Right  Channel 3 – Mic Front Left  Channel 4 – Mic Rear Left |
| Microphone port positions | Front microphone ports centred with a 140-mm spacing  Rear microphone ports centred with a 140-mm spacing |

The Device A form factor enables a simple two-dimensional, four-sided capture geometry by symmetrical placement of the four microphone ports towards the ends of the device’s outer shell. There is generally minimal acoustic shadowing of any of the microphone ports, especially in ideal recording scenarios. The prototype provides connectivity for recording using an HDMI-D connector on the bottom side of the device, where a protruding shape is apparent.

Four-Microphone Prototype Device A is used in landscape orientation. When device is, e.g., placed on a display, front side (Mic Front Left and Mic Front Right) faces the main user direction.

A diagram of a computer component

AI-generated content may be incorrect.

**Figure 4.2.1.2-1: Four-microphone prototype device A**

#### 4.2.1.3 Four-Microphone Prototype Device B

Four-Microphone Prototype Device B, illustrated in Figure 4.2.1.3-1, is a prototype immersive audio capture smartphone. It utilizes a typical monoblock shape with a camera bump. The device dimensions and the microphone array design are described in more detail in Table 4.2.1.3-1. Specifically, the Device B overall dimensions are derived based on the average dimensions from data collected for 2020-2024 smartphone devices in TR 26.933.

**Table 4.2.1.3-1: Device and microphone array information**

|  |  |
| --- | --- |
| **Property** | **Description** |
| Device category | Smartphone |
| Device shape | Monoblock |
| Dimensions | Length 160.6 mm  Width 74.4 mm  Depth 8.6 mm  Camera bump (for position, see Figure 4.2.1.3-1):  Length 35 mm  Width 35 mm  Depth 4 mm |
| Microphone array design | Practical array design maximizing microphone array aperture  Non-planar quadrilateral array shape  Three-dimensional, four-sided capture geometry |
| Microphone port designations | Channel 1 – Mic #1  Channel 2 – Mic #2  Channel 3 – Mic #3  Channel 4 – Mic #4  (Mic #5 and Mic #6 not used in Device B configuration) |
| Capture orientations | Landscape  Portrait  On table (display side up) |

Targeting high-quality immersive audio capture, this device geometry enables a three-dimensional, four-sided capture geometry that is designed to maximize the aperture of the microphone array. The array has a non-planar quadrilateral shape (or skew quadrilateral).

Four-Microphone Prototype Device B can be used in multiple orientations. Main orientations are portrait orientation (see Figure 4.2.1.3-1), landscape orientation (camera bump in top left corner), and flat on table with display face up. The prototype hardware does not include orientation sensors.

A diagram of a cell phone

AI-generated content may be incorrect.

**Figure 4.2.1.3-1: Four-Microphone Prototype Device B**

#### 4.2.1.4 Device electro-acoustical characteristics

TBD

### 4.2.2 Device type 2: Three-Microphone Smartphone device

#### 4.2.2.1 General

This three-microphone smartphone is modelled based on a commercially available device that exemplifies current trends in contemporary smartphone design with three built-in microphones

#### 4.2.2.2 Detailed parameters

The parameters of the devices are in the following tables of table 4.2.2.2-1, table 4.2.2.2-2 and table 4.2.2.2-3.

Table 4.2.2.2-1: Device dimensions (mm)

|  |  |
| --- | --- |
| Height | 163.6 |
| Width | 74 |
| Thickness | 8.26 |

Table 4.2.2.2-2: Camera bump size and location (mm)

|  |  |
| --- | --- |
| Width | 27 |
| Height | 33 |
| Thickness | 1.56 |
| xLocation | 6.5 |
| yLocation | 124.1 |

Table 4.2.2.2-3: Microphone port positions on device surface (mm)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ch. | Microphone Name | Defining Face | X-axis | Y-axis |
| 1 | Bottom Mic | Bottom Face | 25 | 4.16 |
| 2 | Top Mic | Top Face | 62.2 | 3.6 |
| 3 | Camera Mic | Camera Face | 26.5 | 139.9 |

The brief schematic diagram of the device is in figure 4.2.2.2-1.

163.6 mm

74 mm

8.26 mm

M1

M2

M3

M1

Figure 4.2.2.2-1: schematic diagram of the device

#### 4.2.2.3 Device electro-acoustical characteristics

TBD

4.2.3 Device type 3: Four-Microphone Smartphone device 1

#### 4.2.3.1 General

This four-microphone smartphone is modelled based on a commercially available device that exemplifies current trends in contemporary smartphone design with four built-in microphones

#### 4.2.3.2 Detailed parameters

The parameters of the devices refer to the following table 4.2.3.2-1.

Table 4.2.3.2-1: the parameters of the device

|  |  |
| --- | --- |
| **No** | Device type 3 |
| **Type** | Four-Microphone Smartphone device |
| **Size (mm)** | 161.4\*75.3\*9.2 |
| **Shape** | Rectangular |
| **Microphone type** | MEMS |
| **Number of microphones** | 4 |
| **Placement of microphones(mm)** | Mic1: (-5.2, 80.7, -10.1)  Mic2: (-4.9,80.7,9.2)  Mic3: (-1.6, -80.2, 7.4)  Mic4: (-15.7, -19.2, 0) |

The brief schematic diagram of the device is in figure 4.2.3.2-1.

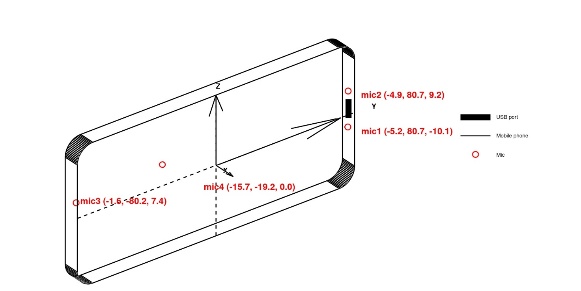


Figure 4.2.3.2-1: schematic diagram of the device

#### 4.2.3.3 Device electro-acoustical characteristics

TBD

4.2.4 Device type 4: Four-Microphone Smartphone device 2

#### 4.2.4.1 Overview

This four-microphone smartphone is similar to the device 1 in clause 4.2.3, however, there are some differences between the two devices. The parameters and differences are shown in the following clauses.

#### 4.2.4.2 Detailed parameters

The brief schematic diagram of the device is in figure 4.2.4.2-1.

Mic 3

71.5 mm

7.85 mm

38.21 mm

36.73 mm

Mic 4

160.0 mm

Mic 1

Mic 2

Display

Back plate

A drawing of a pole

AI-generated content may be incorrect.

Figure 4.2.4.2-1: schematic diagram of the device

#### 4.2.4.3 The differences between the Four-Microphone Smartphone device 1 and Four-Microphone Smartphone device 2

TBD

#### 4.2.4.4 Device electro-acoustical characteristics

TBD

4.2.5 Device type 5: Three-Microphone XR HMD device

#### 4.2.5.1 General

This XR HMD device is modelled based on a commercially available device that exemplifies current trends in contemporary XR HMD design with three built-in microphones

#### 4.2.5.2 Detailed parameters

The basic information and the microphone positions in table 4.2.5.2-1 are as follows:

- The shape of the proposed XR HMD target device wear on human head

- The microphone placement color-coded as

- Orange: mic 0

- Green: mic 1

- Red: mic 2



The illustration of the device is in Figure 4.2.5.2-1.

A white head with a red and green circle on it

AI-generated content may be incorrect.A white head with a hole in the middle

AI-generated content may be incorrect.A white object with green eyes

AI-generated content may be incorrect.A white object with a cross on it

AI-generated content may be incorrect.

**Figure 4.2.5.2-1. XR HMD device**

The right-handed coordinate system is defined for the device, and it is shown in Figure 4.2.5.2-2.

z

A white head with a virtual reality goggles

AI-generated content may be incorrect.

x

y

**Figure 4.2.5.2-2. Right-handed coordinate system for XR HMD device**

Table 4.2.5.2-1: The microphone positions of the XR HMD device

|  |  |  |  |
| --- | --- | --- | --- |
| Mic # | X | Y | Z |
| 0 | 166.818 mm | -78.55 mm | 46.124 mm |
| 1 | 163.178 mm | -24.027 mm | 11.712 mm |
| 2 | 166.796 mm | 78.457 mm | 46.133 mm |

#### 4.2.5.3 Device electro-acoustical characteristics

TBD

# 5 Prerequisites

## 5Raw

TBD

## 5.2 Compensation on microphone signals

Editor’s note: clarifications on compensation and any potential requirements needed

### 52

### 52

# 6 High-level technical description

## 6.1 Input interfaces

TBD

## 6.2 Processing procedure

TBD

# 7 Detailed algorithm description

## 7.1 General

TBD

## 7.2 Detailed algorithm of example solution 1

TBD

## 7.3 Detailed algorithm of example solution 2

TBD

# 8 Adaptability of example solutions

## 8.1 General

TBD

## 8.2 Example solution 1

TBD

## 8.2 Example solution 2

TBD

Annex <A> (informative):  
Performance of example solutions

Editor’s note: consider test methods and requirements

n

# A.1 Introduction

# A.2 Test setup

# A.3 Example solution 1

Annex <A> (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Change history | | | | | | | |
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2025-05 | SA4#132 | S4-250853 |  |  |  | Initial skeleton | 0.0.1 |
| 2025-05 | SA4#132 | S4-251027 |  |  |  | Merge the contribution S4-250935 and the initial skeleton, implement further online edits based on Audio SWG discussion | 0.1.0 |