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TECHNICAL SPECIFICATION

**LTE;  
5G;  
Codec for Immersive Voice and Audio Services (IVAS);  
C code (fixed-point)  
(3GPP TS 26.251 version 19.0.0 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;
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  - 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.

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# 1 Scope

Attached to this document is an electronic copy of the fixed-point C code for the Immersive Voice and Audio Services (IVAS) Codec. This C code is the unique alternative reference specification besides the floating-point C code for the IVAS Codec (3GPP TS 26.258) for a standard compliant implementation of the IVAS Codec (3GPP TS 26.253), Rendering (3GPP TS 26.254), Error Concealment of Lost Packets (3GPP TS 26.255) and Jitter Buffer Management (JBM) (3GPP TS 26.256).

The bit-exact fixed-point C code is the preferred implementation for all applications, but the floating-point codec as specified in 3GPP TS 26.258 may be used instead of the fixed-point codec when the implementation platform is better suited for a floating-point implementation.

Requirements for any implementation of the IVAS codec to be standard compliant are specified in 3GPP TS 26.252 (Test sequences).

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# 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] 3GPP TS 26.253: "Codec for Immersive Voice and Audio Services - Detailed Algorithmic Description incl. RTP payload format and SDP parameter definitions".
- [3] 3GPP TS 26.254: "Codec for Immersive Voice and Audio Services - Rendering".
- [4] 3GPP TS 26.255: "Codec for Immersive Voice and Audio Services - Error concealment of lost packets".
- [5] 3GPP TS 26.256: "Codec for Immersive Voice and Audio Services - Jitter Buffer Management".
- [6] 3GPP TS 26.252: "Codec for Immersive Voice and Audio Services – Test Sequences".
- [7] 3GPP TS 26.258: "Codec for Immersive Voice and Audio Services – C code (floating-point)".

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# 3 Definitions of terms, symbols and 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].

## 3.2 Symbols

Void.

## 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].

HRTF	Head Related Transfer Function
IVAS	Immersive Voice and Audio Services
ISAR	Immersive Audio for Split Rendering Scenarios
JBM	Jitter Buffer Management
MASA	Metadata-Assisted Spatial Audio

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## 4 C code structure

This clause gives an overview of the structure of the fixed-point C code and provides an overview of the contents and organization of the C code attached to the present document.

C was selected as the programming language because portability was desirable.

### 4.1 Contents of the C source code

The C code is organized as listed in Table 1:

**Table 1: Source code directory structure**

Directory	Description
readme.txt	information on how to compile and use
Makefile	UNIX style encoder Makefile
Workspace_msvc/	Directory for the MSVC 2017 (or newer) project files
apps/	Source code files used solely for the encoder/decoder/renderers applications; these applications make use of the libraries built from lib_com, lib_dec, lib_enc, lib_rend, and lib_util
lib_basop/	Source code files containing the BASOP operators
lib_com/	Source code files used both in encoder and decoder
lib_dec/	Source code files used solely in the decoder
lib_enc/	Source code files used solely in the encoder
lib_isar/	Source code files used solely for split rendering
lib_lc3plus/	Source code files used solely for split rendering
lib_rend/	Source code files used solely in the renderer
lib_util/	Source code files solely for utility functions used by the applications

The distributed files with suffix ".c" contain the source code and the files with suffix ".h" are the header files. The table ROM data is contained in files named "rom\_\*.c" and "ivas\_rom\_\*.c" with suffix ".c".

Makefiles are provided for the platforms in which the C code has been verified (listed above). Once the software is installed, this directory will have a compiled version of the encoder (named IVAS\_cod), the decoder (named IVAS\_dec), the renderer (named IVAS\_rend) and the split rendering post-renderer (named ISAR\_post\_rend). In addition, this directory will have a compiled version of the encoder with support for format switching (named IVAS\_cod\_fmstsw) and an example program for Ambisonics format conversion (named ambi\_converter).

## 4.2 Program execution

The codec for Immersive Voice and Audio Services is implemented in four programs and two utility executables:

- IVAS\_cod: encoder;
- IVAS\_dec: decoder;
- IVAS\_rend: renderer,
- ISAR\_post\_rend: split rendering post-renderer;
- IVAS\_cod\_fmstsw: encoder with support for format switching;
- ambi\_converter: example program for Ambisonics format conversion.

The programs should be called like:

- IVAS\_cod [encoder options] <input file> <bitstream file>;
- IVAS\_dec [decoder options] <bitstream file> <output file>;
- IVAS\_rend [renderer options] -i <input file> -if <input format> -o <output file> -of <output format>;
- ISAR\_post\_rend [post-renderer options] -i < bitstream file or input file> -if <input format> -o <output file>;
- IVAS\_cod\_fmstsw <format\_switching\_file>;
- ambi\_converter <input file> <output file> <input convention> <output convention>.

The input and output files contain 16-bit linear encoded PCM samples (headerless or in WAVE format) and the bitstream file contains encoded data.

The encoder, decoder, and renderer options will be explained by running the programs without any input arguments. See the file `readme.txt` for more information on how to run the *IVAS\_cod*, *IVAS\_dec*, *IVAS\_rend*, *ISAR\_post\_rend*, *IVAS\_cod\_fmstsw*, *ambi\_converter* programs.

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## 5 File Formats

This clause describes the file formats used by the encoder and decoder programs. The test sequences defined in [6] also use the file formats described here.

### 5.1 Audio Input/output file format

Audio input/output file format is in accordance with TS 26.258 [7], clause 5.1.

### 5.2 Rate switching profile (encoder input)

Rate switching profile (encoder input) is in accordance with TS 26.258 [7], clause 5.2.

### 5.3 Bandwidth switching profile (encoder input)

Bandwidth switching profile (encoder input) is in accordance with TS 26.258 [7], clause 5.3.

## 5.4 Channel-aware configuration file (encoder input and decoder output)

Channel-aware configuration file (encoder input and decoder output) is in accordance with TS 26.258 [7], clause 5.4.

## 5.5 Object based audio metadata file (encoder/renderer input and decoder output)

Object based audio metadata file (encoder/renderer input and decoder output) is in accordance with TS 26.258 [7], clause 5.5.

## 5.6 Metadata-assisted spatial audio (MASA) metadata file (encoder/renderer input and decoder output)

Metadata-assisted spatial audio (MASA) metadata file (encoder/renderer input and decoder output) is in accordance with TS 26.258 [7], clause 5.6.

## 5.7 Parameter bitstream file (encoder output / decoder input)

Parameter bitstream file (encoder output / decoder input) is in accordance with TS 26.258 [7], clause 5.7.

## 5.8 VoIP parameter bitstream file (decoder input)

VoIP parameter bitstream file (decoder input) is in accordance with TS 26.258 [7], clause 5.8.

## 5.9 JBM trace file (decoder output)

JBM trace file (decoder output) is in accordance with TS 26.258 [7], clause 5.9.

## 5.10 HRTF filter file (decoder/renderer input)

HRTF filter file (decoder/renderer input) is in accordance with TS 26.258 [7], clause 5.10.

## 5.11 Head rotation trajectory file (decoder/renderer input)

Head rotation trajectory file (decoder/renderer input) is in accordance with TS 26.258 [7], clause 5.11.

## 5.12 Reference rotation/vector file (decoder/renderer input)

Reference rotation/vector file (decoder/renderer input) is in accordance with TS 26.258 [7], clause 5.12.

## 5.13 External orientation file (decoder/renderer input)

External orientation file (decoder/renderer input) is in accordance with TS 26.258 [7], clause 5.13.

## 5.14 Renderer config file (decoder/renderer input)

Renderer config file (decoder/renderer input) is in accordance with TS 26.258 [7], clause 5.14.

## 5.15 Scene description file (renderer input)

Scene description file (renderer input) is in accordance with TS 26.258 [7], clause 5.15.

## 5.16 Split rendering pose correction file (decoder/renderer output, post-renderer input)

Split rendering pose correction file (decoder/renderer output, post-renderer input) is in accordance with TS 26.258 [7], clause 5.16.

## 5.17 Split rendering bitstream file (decoder/renderer output, post-renderer input)

Split rendering bitstream file (decoder/renderer output, post-renderer input) is in accordance with TS 26.258 [7], clause 5.17.

## 5.18 Object editing file (decoder input)

Object editing file (decoder input) is in accordance with TS 26.258 [7], clause 5.18.

## 5.19 RTPDUMP file (encoder output, decoder input)

RTPDUMP file (encoder output, decoder input) is in accordance with TS 26.258 [7], clause 5.19.

## Annex A (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
01-2024	SA4#127	SA4-24xxxx				Presented to Audio SWG for information	0.0.1
03-2024	SA#103	SP-240023				Version 1.0.0 created by MCC	1.0.0
05-2024	SA4#128	SA4-241067				Integrated changes wrt ISAR integration; presented to Audio SWG	1.0.1
06-2024	SA#104					Change of spec title as approved by TSG SA in SP-240917	1.0.2
11-2025	SA4#134	S4-251866				Editor's input to SA4#134	1.0.3
11-2025	SA4#134	S4-251951				Editor's input to SA4#134, including Electronic Attachment	1.0.4
11-2025	SA4#134	S4-252020				Audio SWG output to SA4#134	1.1.0
12-2025	SA#110	SP-251444				Version 2.0.0 created by MCC to be sent to TSG SA for approval	2.0.0
12-2025						Version 19.0.0 created by MCC upon approval at TSG SA#110	19.0.0

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## History

<b>Version</b>	<b>Date</b>	<b>Status</b>
V19.0.0	January 2026	Publication