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Information technology — High efficiency coding and media delivery in heterogeneous environments —

Part 3: 3D audio

Technologies de l'information — Codage à haute efficacité et livraison des medias dans des environnements hétérogènes —
Partie 3: Audio 3D

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 23008-3:2015), which has been technically revised. It also incorporates ISO/IEC 23008-3:2015/Amd.1:2016, ISO/IEC 23008-3:2015/Amd.2:2016, ISO/IEC 23008-3:2015/Amd.3:2017 and ISO/IEC 23008-3:2015/Amd.4:2016.

The main changes compared to the previous edition are as follows:

— unreadable equations have been corrected;

— profiles have been defined;

— transport of MPEG-H 3D audio in MPEG-4 ISO Base Media File Format has been defined;

— coding efficiency, especially for low bitrate coding modes, has been improved (for scene-based as well as for object-based and for multichannel-based content);

— descriptive metadata has been added;

— MHAS description has been updated;

— usage of MPEG-H 3D audio in broadcasting applications has been greatly improved;

— a tool for Advanced Loudness Control has been added;

— a layered coding mode for coding of scene-based content has been added;

— carriage of systems metadata has been defined.

A list of all parts in the ISO/IEC 23008 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

3D sound systems are able to realize a significantly enhanced sound experience relative to current widespread 5.1 channel audio programs and playback systems. These systems demand high quality audio coding and error-free transmission in order to keep the timbre, sound localization and sound envelopment of the original audio program. Presentation over headphones with suitable spatialization are also considered.

This document provides means for all scenarios where there is a need to compress a multi-channel audio program (e.g. 22.2 channel program) and to render it to the native target number of loudspeakers. In order to reach a wide market, a 3D audio program is able to be downmixed to a lower hierarchy of loudspeakers, for example 10.1 or 8.1 channels. In addition, all scenarios support a level of random access to facilitate broadcast break-in, and “trick modes” such as fast forward when playing from stored media.

This document focuses on applications such as audio for home theatres where the audio presentation is immersive, involving many loudspeakers (e.g. from 10 to more than 20) surrounding the listener and placed below, at and above ear-level. Moreover, applications as personal TV, TV for smartphones and multi-channel audio-only programs are envisioned. These require that 3D audio encoding/decoding systems are able to operate at low bitrates appropriate for efficient transmission over a cellular channel. At the same time, the sense of envelopment and accurate sonic localization even for systems having a tablet-sized visual displays with loudspeakers built into the device and headphone listening are maintained.

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Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 3: 3D audio

1 Scope

This document specifies technology that supports the efficient transmission of immersive audio signals and flexible rendering for the playback of immersive audio in a wide variety of listening scenarios. These include home theatre setups with 3D loudspeaker configurations, 22.2 loudspeaker systems, automotive entertainment systems and playback over headphones connected to a tablet or smartphone.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 13818-1, *Information technology — Generic coding of moving pictures and associated audio information — Part 1: Systems*

ISO/IEC 14496-3:2009, *Information technology — Coding of audio-visual objects — Part 3: Audio*

ISO/IEC 14496-11, *Information technology — Coding of audio-visual objects — Part 11: Scene description and application engine*

ISO/IEC 23001-8, *Information technology — MPEG systems technologies — Part 8: Coding-independent code-points*[1]

ISO/IEC 23003-1:2007, *Information technology — MPEG audio technologies — Part 1: MPEG Surround*

ISO/IEC 23003-2, *Information technology — MPEG audio technologies — Part 2: Spatial Audio Object Coding (SAOC)*

ISO/IEC 23003-3:2012, *Information technology — MPEG audio technologies — Part 3: Unified speech and audio coding*

ISO/IEC 23003-4:2015, *Information technology — MPEG audio technologies — Part 4: Dynamic range control*

IETF RFC 4122, July 2005, *A Universally Unique IDentifier (UUID) URN Namespace*

[1] ISO/IEC 23001-8 has been superseded by ISO/IEC 23091 (all parts).

3 Terms, definitions, symbols, abbreviated terms and mnemonics

3.1 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviations in ISO/IEC 14496-3:2009, 1.3 and 1.4 and in ISO/IEC 23003-3:2012, 3.1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.2 Mnemonics

The following mnemonics are defined to describe the different data types used in the coded bitstream payload.

bslbf	Bit string, left bit first, where “left” is the order in which bit strings are written in ISO/IEC 14496 (all parts). Bit strings are written as a string of 1s and 0s within single quote marks, for example '1000 0001'. Blanks within a bit string are for ease of reading and have no significance.
uimsbf	Unsigned integer, most significant bit first.
vlclbf	Variable length code, left bit first, where “left” refers to the order in which the variable length codes are written.
tcimsbf	Two’s complement integer, most significant (sign) bit first.

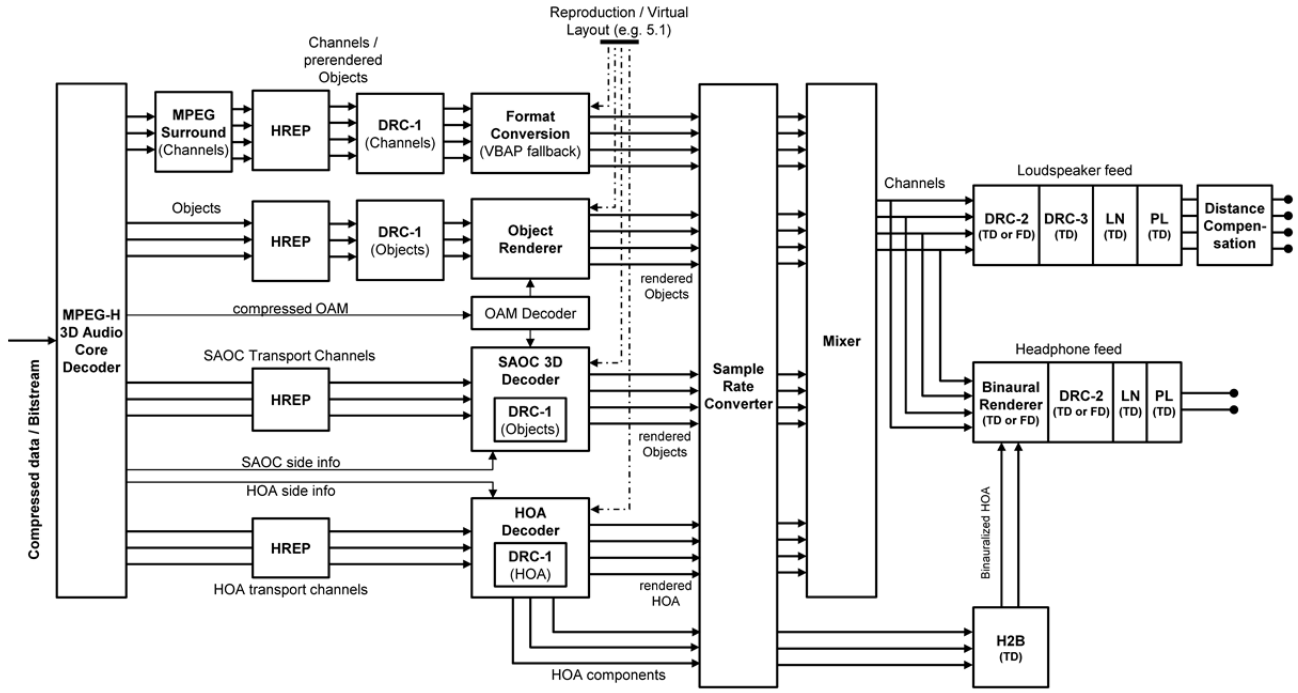
4 Technical overview

4.1 Decoder block diagram

The 3D audio codec system consists of an MPEG-H 3D audio core codec for coding of channel, object and higher order ambisonics (HOA) signals. The core codec is based on the MPEG-D USAC codec. To increase the efficiency for coding a large amount of objects, MPEG SAOC technology has been adopted. Several types of renderers perform the tasks of rendering objects to channels, rendering channels to a different loudspeaker setup, rendering HOA signals to the loudspeaker setup or rendering virtual loudspeaker channels or HOA components to headphones.

When object signals are explicitly transmitted or parametrically encoded using SAOC, the corresponding object metadata information is compressed and multiplexed into the 3D audio bitstream.

Figure 1 shows the different algorithmic blocks of the 3D audio system.



Key

DRC	dynamic range control	HREP	high resolution envelope processing
SAOC	spatial audio object coding	OAM	object audio metadata
HOA	higher order ambisonics	H2B	HOA to binaural
LN	loudness normalization	PL	peak limiter

Figure 1 — 3D audio decoder

4.2 Overview over the codec building blocks

The MPEG-H 3D audio core codec for loudspeaker-channel signals, discrete object signals, object downmix signals and pre-rendered signals is based on MPEG-D USAC technology. It handles the coding of the multitude of signals by creating channel- and object-mapping information based on the geometric and semantic information of the input's channel and object assignment. This mapping information describes how input channels and objects are mapped to channel elements (CPEs, SCEs, LFEs) and the corresponding information is transmitted to the decoder.