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Information technology — Coded representation of immersive media —

Part 2: Omnidirectional media format

Technologies de l'information — Représentation codée de média immersifs —

Partie 2: Format de média omnidirectionnel

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 or www.iec.ch/members_experts/refdocs).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see patents.iec.ch).

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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. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint 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 23090-2:2019), which has been technically revised.

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

— Multiple viewpoints have been added. Viewpoints can be used for example to provide several user-switchable camera positions to view the content or to express a storyline where the user is given the choice to select which storyline path is followed.

— Sphere-relative and viewport-relative video and image overlays have been added.

— Mesh omnidirectional video where the video is projected on an indicated set of mesh elements has been added.

— Two tiling OMAF video profiles for viewport-dependent streaming have been added.

A list of all parts in the ISO/IEC 23090 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

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Introduction

When omnidirectional media content is consumed with a head-mounted display and headphones, only the parts of the media that correspond to the user's viewing orientation are rendered, as if the user were in the spot where and when the media was captured. One of the forms of omnidirectional media applications is omnidirectional video, also known as 360° video. Omnidirectional video is typically captured by multiple cameras that cover the entire sphere or at least a large part of the sphere. Compared to traditional media application formats, the end-to-end technology for omnidirectional video (from capture to playback) is more easily fragmented due to various capturing and video projection technologies. From the capture side, there exist many different types of cameras capable of capturing 360° video, and on the playback side there are many different devices that are able to playback 360° video with different processing capabilities. To avoid fragmentation of omnidirectional media content and devices, a standardized format for omnidirectional media applications is specified in this document.

This document defines a media format that enables omnidirectional media applications, focusing on 360° video, images, and audio, as well as associated timed text. What is specified in this document includes (but is not limited to):

— a coordinate system that consists of a unit sphere and three coordinate axes, namely the X (back-to-front) axis, the Y (lateral, side-to-side) axis, and the Z (vertical, up) axis;

— projection and rectangular region-wise packing methods that may be used for conversion of a spherical video sequence or image into a two-dimensional rectangular video sequence or image, respectively;

— storage of omnidirectional media and the associated metadata using the ISO Base Media File Format (ISOBMFF) as specified in ISO/IEC 14496-12;

— storage of video or image overlays and the associated metadata using ISOBMFF;

— encapsulation, signalling, and streaming of omnidirectional media and overlays in a media streaming system, e.g. dynamic adaptive streaming over HTTP (DASH) as specified in ISO/IEC 23009-1 or MPEG media transport (MMT) as specified in ISO/IEC 23008-1;

— media profiles and presentation profiles that provide conformance points for media codecs as well as media coding and encapsulation configurations that may be used for compression, streaming, and playback of the omnidirectional media content;

— toolset brands that provide conformance points for functionalities beyond plain 360° video, images and audio.

This document is organized as follows:

a) Clause 1 specifies the scope of this document.

b) Clause 2 contains the normative references.

c) Clause 3 specifies the terms, definitions, abbreviated terms, arithmetic operations, mathematical functions and other conventions used in this document.

d) Clause 4 contains an overview of this document.

e) Clause 5 specifies a coordinate system used in this document and the equations for the equirectangular and cubemap omnidirectional projection formats, the conversion from the local coordinate axes to the global coordinate axes, and the rectangular region-wise packing.

f) Clause 6 specifies syntax structures that are common for fisheye video and fisheye images.

g) Clause 7 specifies extensions to the ISOBMFF for omnidirectional media as well as for timed metadata for sphere regions. It also specifies generic extensions to ISO/IEC 14496-12 and ISO/IEC 14496-15, which may be used also for other purposes than for omnidirectional media.

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h) Clause 8 specifies extensions to DASH for omnidirectional media.

i) Clause 9 specifies extensions to MMT for omnidirectional media.

j) Clause 10 specifies OMAF media profiles.

k) Clause 11 specifies OMAF presentation profiles based on some of the OMAF media profiles specified in Clause 10.

l) Clause 12 specifies OMAF toolset brands.

m) Annex A contains the OMAF DASH XML schema.

n) Annex B specifies the DASH integration of all the OMAF media profiles for timed media specified in Clause 10.

o) Annex C specifies the CMAF integration of some of the OMAF media profiles specified in Clause 10.

p) Annex D describes some schemes for viewport-dependent omnidirectional video processing.

q) Annex E contains some DASH MPD examples.

r) Annex F contains some MMT signalling examples.

s) Annex G specifies the expected OMAF player behaviour for rendering overlays.

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Information technology — Coded representation of immersive media —

Part 2: Omnidirectional media format

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1 Scope

This document specifies the omnidirectional media format for coding, storage, delivery and rendering of omnidirectional media, including video, images, audio and timed text. Omnidirectional image or video can contain graphics elements generated by computer graphics but encoded as image or video. Multiple viewpoints, each corresponding to an omnidirectional camera, are supported. The document also specifies storage and delivery of overlay images or video intended to be rendered over the omnidirectional background image or video.

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 10918-1, *Information technology — Digital compression and coding of continuous-tone still images — Part 1: Requirements and guidelines*

ISO/IEC 14496-1, *Information technology — Coding of audio-visual objects — Part 1: Systems*

ISO/IEC 14496-3:2019, *Information technology — Coding of audio-visual objects — Part 3: Advanced audio coding*

Rec. ITU-T H.264 (06/19) | ISO/IEC 14496-10:2014, *Information technology — Coding of audio-visual objects — Part 10: Advanced video coding*

ISO/IEC 14496-12:2020, *Information technology — Coding of audio-visual objects — Part 12: ISO base media file format*

ISO/IEC 14496-14, *Information technology — Coding of audio-visual objects — Part 14, MP4 file format*

ISO/IEC 14496-15:2019, *Information technology — Coding of audio-visual objects — Part 15, Carriage of network abstraction layer (NAL) unit structured video in the ISO base media file format*

ISO/IEC 14496-30:2018, *Information technology — Coding of audio-visual objects — Part 30: Timed text and other visual overlays in ISO base media file format*

ISO/IEC 23000-19:2020, *Information technology — Multimedia application format (MPEG-A) — Part 19: Common media application format (CMAF) for segmented media*

ISO/IEC 23000-22:2019, *Information technology — Multimedia application format —Part 22 Multi-image application format (MIAF)*

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ISO/IEC 23003-3:2020, *Information technology — MPEG audio technologies — Part 3: Unified speech and audio coding*

ISO/IEC 23003-4:2020, *Information technology — MPEG audio technologies — Part 4: Dynamic range control*

ISO/IEC 23008-1:2017, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 1: MPEG media transport (MMT)*

Rec. ITU-T H.265 | ISO/IEC 23008-2:2020, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding*

ISO/IEC 23008-3:2019, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 3: 3D audio*

ISO/IEC 23008-12, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 12: Image file format*

ISO/IEC 23009-1:2019, *Information technology — Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats*

ISO/IEC 23091-2, *Information technology — Coding-independent code points — Part 2: Video*

ISO/IEC 23091-3, *Information technology — Coding-independent code points — Part 3: Audio*

IETF BCP 47, *Tags for Identifying Languages*

IETF Internet Standard 66, *Uniform Resource Identifier (URI): Generic Syntax*

IETF RFC 6381, *MIME Codecs and Profiles*

W3C Candidate Recommendation, *WebVTT, The Web Video Text Tracks Format*

W3C Recommendation, *TTML Profiles for Internet Media Subtitles and Captions 1.0.1 (IMSC1)*

W3C Recommendation, *XML schema part 1: Structures*

W3C Recommendation, *XML schema part 2: Datatypes*

W3C Recommendation, *XML Path Language (XPath) 2.0 (Second Edition)*

3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions in ISO/IEC 14496-12, ISO/IEC 23008-12 and the following apply.

NOTE In particular, the terms coded image, coded image item, derived image, derived image item, image item, reconstructed image and source image item are defined in ISO/IEC 23008-12.

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/

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