This is a preview - click here to buy the full publication

INTERNATIONAL STANDARD

ISO/IEC 23000-19

Second edition
2020-03

Information technology — Multimedia application format (MPEG-A) —

Part 19: Common media application format (CMAF) for segmented media

Technologies de l'information — Format pour application multimédia (MPEG-A) —

Partie 19: Format CMAF (Common Media Application Format) pour médias segmentés

Reference number
ISO/IEC 23000-19:2020(E)

© ISO/IEC 2020

This is a preview - click here to buy the full publication

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO/IEC 2020 – All rights reserved

This is a preview - click here to buy the full publication

Contents

Page

Foreword ..... **vii**

Introduction ..... **viii**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **2**
3.1 Media objects 3
3.2 Logical structure 3
3.3 Application model 4

4 Abbreviated terms **6**

5 Document organization **8**

6 CMAF hypothetical application model, media object model and profiles **10**
6.1 Overview of the hypothetical application model and media object model 10
6.2 CMAF content processing model 11
6.3 Late binding CMAF track synchronization 12
6.4 Adaptive switching of CMAF tracks in CMAF switching sets 13
6.5 CMAF specified objects and profiles 14
6.5.1 Object derivation and interoperability code points 14
6.5.2 Encoded media objects 14
6.5.3 Logical media object sets 14
6.5.4 Addressable media objects 14
6.5.5 CMAF profiles, brand and identifiers 15
6.6 CMAF media object model 16
6.6.1 CMAF fragments 16
6.6.2 CMAF tracks 17
6.6.3 CMAF track files 17
6.6.4 CMAF segments 18
6.6.5 CMAF chunks 18
6.6.6 CMAF switching sets and adaptive switching 19
6.6.7 CMAF selection sets and late binding 22
6.6.8 CMAF presentation timing model 23
6.6.9 Manifest information 26
6.6.10 CMAF addressable media objects, resources, and resource identifiers 26

7 CMAF track format **27**
7.1 Overview 27
7.2 CMAF brands 27
7.3 CMAF media objects 28
7.3.1 CMAF boxes 28
7.3.2 CMAF track media objects 30
7.3.3 CMAF addressable media objects 34
7.3.4 CMAF switching sets 36
7.3.5 CMAF selection sets 39
7.3.6 CMAF presentations 39
7.4 Additional boxes, not defined in the ISO Base Media File Format 40
7.4.1 Track Encryption Box (`'tenc'`) 40
7.4.2 Sample Encryption Box (`'senc'`) 40
7.4.3 Protection System Specific Header Box (`'pssh'`) 40
7.4.4 Media profile specific boxes 40
7.4.5 Event Message Box (`'emsg'`) 40
7.5 Constraints on ISO Base Media File Format boxes 41
7.5.1 Movie Header Box (`'mvhd'`) 41
7.5.2 Metadata Boxes 41
7.5.3 Kind Box (`'kind'`) 41

© ISO/IEC 2020 – All rights reserved

This is a preview - click here to buy the full publication

7.5.4 Track Header Box ('tkhd') 42
7.5.5 Media Header Box ('mdhd') 42
7.5.6 Video Media Header Box ('vmhd') 42
7.5.7 Sound Media Header Box ('smhd') 43
7.5.8 Subtitle Media Header Box ('sthd') 43
7.5.9 Data Reference Box ('dref') 43
7.5.10 Sample Description Box ('stsd') 43
7.5.11 Protection Scheme Information Box ('sinf') 43
7.5.12 Track contained media sample information boxes 43
7.5.13 Edit List Box ('elst') 44
7.5.14 Track Extends Box ('trex') 44
7.5.15 Movie Fragment Header Box ('mfhd') 44
7.5.16 Track Fragment Header Box ('tfhd') 44
7.5.17 Track Run Box ('trun') 45
7.5.18 Sample Group Description Box ('sgpd') 45
7.5.19 Media Data Box ('mdat') 45
7.5.20 Sub-sample Information Box ('subs') 46
7.6 The Structural CMAF Brand 'cmfc' 46
7.7 The structural CMAF Brand 'cmf2' 46
7.7.1 General 46
7.7.2 Edit List Box ('elst') 46
7.7.3 Track Run Box ('trun') 46

8 Common encryption of CMAF tracks 46
8.1 Multiple DRM system support 46
8.2 Track encryption 47
8.2.1 General requirements 47
8.2.2 CMAF track constraints 48
8.2.3 Encryption constraints 49
8.2.4 CMAF presentation encryption 50

9 Video CMAF tracks 50
9.1 Overview 50
9.2 General video CMAF track format 51
9.2.1 General video CMAF track structure and constraints 51
9.2.2 Video Media Header ('vmhd') 51
9.2.3 Track Header Box ('tkhd') 52
9.2.4 Sample Description Box ('stsd') 52
9.2.5 Video CMAF fragment presentation time 53
9.2.6 Video media sample dependencies 53
9.2.7 Video edit lists 53
9.2.8 General video CMAF fragment random access constraints 53
9.2.9 Additional random access pictures within CMAF video fragments 53
9.2.10 Image framing and encoding constraints 54
9.2.11 General video CMAF switching set constraints 54
9.3 NAL structured video CMAF tracks 55
9.3.1 Overview 55
9.3.2 CMAF track format constraints for NAL structured video 56
9.3.3 NAL structured video access units contained in media samples 57
9.3.4 NAL structured video coding sequences corresponding to CMAF fragments 57
9.3.5 Elementary stream constraints 58
9.3.6 General CMAF switching set constraints for NAL structured video 58
9.3.7 Single initialization CMAF switching set constraints for NAL structured video tracks and media profiles 58
9.4 AVC video CMAF tracks 59
9.4.1 Storage of AVC elementary streams 59
9.4.2 Constraints on AVC elementary streams 60
9.5 AVC video Internet Media Type parameters 61
9.5.1 AVC signalling of "codecs" parameters 61

© ISO/IEC 2020 – All rights reserved

This is a preview - click here to buy the full publication

10 Audio CMAF tracks ... **62**
10.1 Overview ... 62
10.2 General audio CMAF track format ... 62
10.2.1 Derivation ... 62
10.2.2 Track Header Box (`'tkhd'`) ... 62
10.2.3 Sound Media Header Box (`'smhd'`) ... 63
10.2.4 Sample Description Box (`'stsd'`) ... 63
10.2.5 AudioSampleEntry ... 63
10.2.6 Audio offset edit list ... 63
10.3 AAC audio CMAF tracks ... 63
10.3.1 Overview ... 63
10.3.2 `"codecs"` parameter signalling ... 63
10.3.3 Considerations for AAC audio encoding ... 64
10.3.4 AAC track constraints ... 65
10.3.5 AAC elementary stream constraints ... 66
10.4 AAC core audio CMAF media profile ... 67
10.5 AAC adaptive switching audio CMAF media profile ... 67
10.5.1 General constraints ... 67
10.5.2 CMAF fragment encoding constraints ... 68
10.5.3 General considerations and requirements ... 68
10.5.4 Constraints for AAC-LC ... 68
10.5.5 Constraints for HE-AAC ... 69
10.5.6 Constraints for HE-AACv2 ... 70

11 Subtitles and captions ... **71**
11.1 Overview ... 71
11.2 WebVTT ... 71
11.3 IMSC text and image tracks ... 72
11.3.1 General ... 72
11.3.2 Common constraints ... 72
11.3.3 IMSC1 text track constraints ... 73
11.3.4 IMSC1 image track constraints ... 73
11.4 CTA-608 and CTA-708 ... 73
11.5 Metadata for subtitles ... 74

12 CMAF media profiles and CMAF presentation profiles ... **74**
12.1 CMAF media profiles ... 74
12.1.1 General guidelines for specifying CMAF media profiles ... 74
12.1.2 Guidelines for audio CMAF media profiles ... 75
12.1.3 Guidelines for video CMAF media profiles ... 75
12.2 CMAF presentation profiles ... 76
12.2.1 General ... 76
12.2.2 CMAF profile conformance ... 76

Annex A (normative) **CMAF presentation profiles, media profiles and supplemental data** ... **79**

Annex B (normative) **HEVC video CMAF track format and CMAF media profiles** ... **83**

Annex C (informative) **Subsampling of NAL structured video tracks in CMAF switching sets** ... **88**

Annex D (informative) **Hypothetical player model** ... **98**

Annex E (informative) **Event messages** ... **101**

Annex F (informative) **Error handling for missing media** ... **102**

Annex G (informative) **Recommendations for AAC CMAF switching set encoding** ... **103**

Annex H (normative) **Scalable HEVC media profile and track format** ... **106**

Annex I (normative) **AAC multichannel CMAF media profiles and track format** ... **112**

Annex J (normative) **MPEG-H 3D audio track format and CMAF media profile** ... **115**

Annex K (normative) **MPEG-D USAC track format and CMAF media profile** ... **120**

© ISO/IEC 2020 – All rights reserved

This is a preview - click here to buy the full publication

Annex L (normative) **IMSC 1.1 media profiles** **122**
Bibliography **124**

© ISO/IEC 2020 – All rights reserved

This is a preview - click here to buy the full publication

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).

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 http://patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 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 23000-19:2018), which has been technically revised. It also incorporates the Amendments ISO/IEC 23000-19:2018/Amd.1:2018 and ISO/IEC 23000-19:2018/Amd.2:2019.

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

— addition of supplemental data brands;

— modification to the structural brand cmfc for compatibility with DASH segments;

— definition of a stricter brand '`cmf2`' for legacy devices;

— refinements and updates to HEVC media profiles for SDR and HDR;

— definition of the scalable HEVC media profile;

— definition of AAC multichannel media profiles;

— definition of MPEG-H 3D audio track format and CMAF media profile;

— definition of MPEG-D USAC track format and CMAF media profile;

— definition of IMSC1.1 media profile.

A list of all parts in the ISO/IEC 23000 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.

© ISO/IEC 2020 – All rights reserved

This is a preview - click here to buy the full publication

Introduction

Common media application format (CMAF) combines and constrains several MPEG specifications to define a multimedia format that is optimized for delivery of a single adaptive multimedia presentation to a variety of devices, using a variety of adaptive streaming, broadcast, download and storage methods.

Several MPEG specifications have been adopted for much of the video delivered over the internet and other IP networks (cellular, cable, broadcast, etc.). Various organizations have taken MPEG's core coding, file format and system standards and combined them into their own specifications for their specific application. While these specifications are similar, their differences result in unnecessary duplication of engineering effort and duplication of identical content in slightly different formats, which results in increased storage and delivery costs.

CMAF provides a common media specification that application specifications, such as MPEG dynamic adaptive streaming over HTTP (DASH), can reference and a common media format that allows a single encoded multimedia presentation to be used by many applications.

© ISO/IEC 2020 – All rights reserved

This is a preview - click here to buy the full publication

Information technology — Multimedia application format (MPEG-A) —

Part 19: Common media application format (CMAF) for segmented media

1 Scope

This document specifies the CMAF multimedia format, which contains segmented media objects optimized for streaming delivery and decoding on end user devices in adaptive multimedia presentations.

CMAF specifies a track format derived from the ISO base media file format, then derives addressable media objects from CMAF tracks that can be used for storage and delivery.

CMAF specifies sets of tracks that share encoding and packaging constraints that enable the selection of multiple tracks to form a multimedia presentation and allow seamless switching of alternative encodings of the same content at different bit rates, frame rates, resolution, etc.

CMAF specifies a hypothetical application model that determines how tracks in a CMAF presentation are intended to be combined and synchronized to form a multimedia presentation. The model abstracts delivery to allow any delivery method. The hypothetical application model assumes a manifest and player, but CMAF does not specify a manifest, player, or delivery protocol, with the intent that any that support the hypothetical application model can be used.

CMAF specifies media profiles and brands that constrain media encoding and packaging of CMAF tracks to enable seamless adaptive switching of tracks and allow devices to identify compatible content by its brand.

CMAF specifies presentation profiles that conditionally require sets of CMAF tracks conforming to specified media profiles and allow content creators and devices to identify compatible multimedia presentations.

CMAF enables extensibility by specifying how new media profiles and presentation profiles can be specified and identified and includes guidelines for those specifications.

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

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

ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced video coding*

ISO/IEC 14496-12, *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 2020 – All rights reserved

This is a preview - click here to buy the full publication

ISO/IEC 14496-15, *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, *Information technology — Coding of audio-visual objects — Part 30: Timed text and other visual overlays in ISO base media file format*

ISO/IEC 23001-7, *Information technology — MPEG systems technologies — Part 7: Common encryption in ISO base media file format files*

ISO/IEC 23008-2, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding*

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

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

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

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

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

IETF RFC 5234, *Augmented BNF for Syntax Specifications: ABNF,* https://tools.ietf.org/html/rfc5234

IETF RFC 6381:2011, *The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types,* https://tools.ietf.org/html/rfc6381

ITU-R Recommendation BT.709, *Parameter values for the HDTV standards for production and international programme exchange*

ITU-R Recommendation BT.1886, *Reference electro-optical transfer function for flat panel displays used in HDTV studio production*

ITU-R Recommendation BT.2035, *A reference viewing environment for evaluation of HDTV program material or completed programmes*

ITU-T Recommendation X.667:2014, *Information technology — Open Systems Interconnection — Procedures for the operation of OSI Registration Authorities: Generation and registration of Universally Unique Identifiers (UUIDs) and their use as ASN.1 object identifier components,* https://www.itu.int/rec/T-REC-X.667

ANSI/CTA-608-E R-2014, *Line 21 Data Services,* http://www.techstreet.com/standards/cta-608-e-r2014?product_id=1815447

ANSI/CTA-708-E, *Digital Television (DTV) Closed Captioning*, http://www.techstreet.com/standards/cta-708-e?product_id=1860354

W3C IMSC1, *TTML Profiles for Internet Media Subtitles and Captions 1.0,* http://www.w3.org/TR/ttml-imsc1

W3C IMSC1.1, *TTML Profiles for Internet Media Subtitles and Captions 1.1,* http://www.w3.org/TR/ttml-imsc1.1

W3C, *TTML Media Type Definition and Profile Registry, W3C Working Group Note,* https://www.w3.org/TR/ttml-profile-registry

© ISO/IEC 2020 – All rights reserved