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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

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

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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*.

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This third edition cancels and replaces the second edition (ISO/IEC 23000-19:2020), which has been technically revised. It also incorporates the Amendment ISO/IEC 23000-19:2020/Amd.1:2021.

The main changes are as follows:

— addition of subclauses 9.6, 10.6 and 11.7,

— addition of Annexes M and N.

A list of all parts in the ISO/IEC 23000 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

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.

Clause 6 provides a description of the objects and terminology specified, the CMAF object model, and the hypothetical application model, which defines how these objects can be combined to form adaptive multimedia presentations.

The specifications in Clauses 7 through Clause 12 are terse to facilitate development and testing and assume an understanding of Clause 6. Clause 7 specifies ISO Base Media File Format boxes and structures such as movie fragments and tracks that are used to construct all CMAF media objects. Clause 8 through Clause 11 contain details specific to encryption, audio, video, and subtitle tracks. Clause 12 specifies the combination of CMAF tracks and media profiles into CMAF presentations. It also recommends how to specify additional CMAF media profiles and presentation profiles, which can be specified by other documents and organizations.

CMAF presentation profiles and CMAF media profiles are specified in annexes to allow the addition of new profiles without changing the core document. Additional informative annexes have been added to provide explanations and recommendations on specific topics.

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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*

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

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

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

ISO/IEC 23008-3:2022, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 3: 3D audio*

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

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

ISO/IEC 23090-3, *Information technology — Coded representation of immersive media — Part 3: Versatile video coding*

ISO/IEC 23094-1, *Information technology — General video coding — Part 1: Essential video coding*

IETF RFC 5234, *Augmented BNF for Syntax Specifications: ABNF*[1)]

IETF RFC 6381, *The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types*[2)]

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*[3)]

ANSI/SCTE 214-1, *MPEG DASH for IP-Based Cable Services Part 1: MPD Constraints and Extensions*, https://www.scte.org/standards/library/catalog/scte-214-1-mpeg-dash-for-ip-based-cable-services-part1-mpd-constraints-and-extensions/

W3C IMSC1, *TTML Profiles for Internet Media Subtitles and Captions 1.0.1*, https://www.w3.org/TR/ttml-imsc1

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

1) https://tools.ietf.org/html/rfc5234

2) https://tools.ietf.org/html/rfc6381

3) https://www.itu.int/rec/T-REC-X.667

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W3C WebVTT, *The Web Video Text Tracks Format, Candidate Recommendation 4 April* 2019 https://www.w3.org/TR/webvtt1/

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1 Media objects

3.1.1
CMAF fragment
encoded ISO BMFF media segment conforming to CMAF constraints

3.1.2
CMAF header
sequence of CMAF constrained ISO BMFF boxes that do not reference any *media samples* (3.3.15), but are associated with a *CMAF track* (3.2.1) and necessary for the decoding of its *CMAF fragments* (3.1.1)

3.1.3
CMAF addressable media object
CMAF media object packaged for storage or delivery

Note 1 to entry: Examples include a *CMAF track file* (3.1.6) containing a *CMAF header* (3.1.2) and *CMAF fragments* (3.1.1), or a *CMAF segment* (3.1.5) containing one or more CMAF fragments, or a *CMAF chunk* (3.1.4) containing a partial sequence of the *media samples* (3.3.15) of a CMAF fragment.

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3.1.4
CMAF chunk
CMAF media object that contains a consecutive subset of the *media samples* (3.3.15) of a *CMAF fragment* (3.1.1), where only the first CMAF chunk of a CMAF fragment is constrained to be an adaptive *switching* (3.3.9) point

3.1.5
CMAF segment
CMAF addressable media object (3.1.3) consisting of one or more consecutive *CMAF fragments* (3.1.1) from the same *CMAF track* (3.2.1)

Note 1 to entry: A “CMAF segment” is conformant to an “ISO BMFF segment” and a “DASH segment”.

3.1.6
CMAF track file
one *CMAF track* (3.2.1) stored consecutively in a single ISO BMFF file with the earliest *CMAF fragment* (3.1.1) constrained to start at decode time zero

3.1.7
CMAF principal header
CMAF header (3.1.2) that includes sufficient information to initialize the media decoder and decryption for all *CMAF tracks* (3.2.1) of the *CMAF switching set* (3.2.2)

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3.2 Logical structure

3.2.1
CMAF track
sequence of *CMAF fragments* (3.1.1) that are consecutive in presentation time, contain one media stream, conform to at least one structural CMAF brand, together with an associated *CMAF header* (3.1.2) that can initialize playback

3.2.2
CMAF switching set
set of one or more *CMAF tracks* (3.2.1), where each track is an alternative encoding of the same source content, and are constrained to enable seamless track *switching* (3.3.9)

3.2.3
aligned CMAF switching set
set of *CMAF switching sets* (3.2.2), the *CMAF tracks* (3.2.1) of which all contain alternative encodings of the same source content in time-aligned *CMAF fragments* (3.1.1), but all CMAF tracks do not conform to a single CMAF switching set

3.2.4
CMAF selection set
set of one or more *CMAF switching sets* (3.2.2), where each CMAF switching set encodes an alternative aspect of the same presentation over the same time period, only one of which is intended to be played at a time, e.g. an alternative language or codec

3.2.5
CMAF presentation
set of one or more *CMAF selection sets* (3.2.4) that can be simultaneously decoded to produce a multimedia user experience, potentially including synchronized audio, video, and subtitles

3.2.6
CMAF media profile
encoding constraint on a *CMAF track* (3.2.1) and its contained *media samples* (3.3.15) associated with a CMAF structural brand

3.2.7
CMAF presentation profile
requirement on the *CMAF media profiles* (3.2.6) contained in a *CMAF presentation* (3.2.5)

3.2.8
required media profile
CMAF media profile (3.2.6) conditionally required by a *CMAF presentation profile* (3.2.7)

3.2.9
manifest
document describing one or more *CMAF presentations* (3.2.5)

Note 1 to entry: Manifest formats are not specified in this document.

3.2.10
audio programme
complete collection of all audio programme components and, if present, a set of accompanying presets

3.2.11
audio programme component
smallest addressable unit of an audio programme

3.2.12
CMAF supplemental data
data that can be present in a *CMAF track* (3.2.1) and its contained *media samples* (3.3.15) conformant to a set of requirements identified by a brand

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3.2.13
CMAF structural brand
four-character code used in brand-signaling boxes to indicate compliance to box-level constraints as opposed to media-level constraints

3.3 Application model

3.3.1
CMAF hypothetical application model
CMAF presentation (3.2.5) application model based on *late binding* (3.3.3) and synchronization of *CMAF tracks* (3.2.1) that partly determines the CMAF track encoding constraints necessary for an intended CMAF presentation

3.3.2
player
component of the *CMAF hypothetical application model* (3.3.1) responsible for interpreting a *manifest* (3.2.9), requesting resources, and rendering a *CMAF presentation* (3.2.5)

3.3.3
late binding
selection (3.3.8) and synchronization of separately stored *CMAF tracks* (3.2.1) by a *player* (3.3.2) resulting in a synchronized multimedia presentation

3.3.4
CMAF presentation timeline
timeline shared by all *CMAF tracks* (3.2.1) in a *CMAF presentation* (3.2.5), starting at CMAF presentation time zero, which is coincident with the earliest *media samples* (3.3.15) intended for presentation

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3.3.5
presentation time offset
earliest presentation time of each *CMAF track* (3.2.1) at the start of a *CMAF presentation* (3.2.5)

Note 1 to entry: Presentation time offset is an encoded property of tracks in a presentation, but it can also refer to that value stored in a *manifest* (3.2.9).

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3.3.6
CMAF fragment duration
sum of the *media sample* (3.3.15) durations documented in the `TrackFragmentRunBox` of all `MovieFragmentHeaderBoxes` in the *CMAF fragment* (3.1.1)

3.3.7
CMAF presentation duration
sum of the *CMAF fragment durations* (3.3.6) of the longest *CMAF track* (3.2.1) in a *CMAF presentation* (3.2.5), starting from its earliest presentation time on the *CMAF presentation timeline* (3.3.4)

3.3.8
selection
choice of a *CMAF track* (3.2.1) from alternatives in a selection set (e.g. selecting an audio track by language), possibly by user action or stored user preference

3.3.9
switching
changing to a different *CMAF track* (3.2.1) during presentation, including adaptively switching between *CMAF fragments* (3.1.1) in a *CMAF switching set* (3.2.2)

3.3.10
seamless switching
switching (3.3.9) between *CMAF tracks* (3.2.1) without interrupting presentation of the media content, i.e., decoding *media samples* (3.3.15), at the same time and quality as though their containing CMAF track was decoded without switching

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3.3.11
CMAF switching set constraints
CMAF media profile (3.2.6) constraints that enable seamless *switching* (3.3.9) between *CMAF tracks* (3.2.1) in a *CMAF switching set* (3.2.2) conforming to that media profile

3.3.12
single initialization CMAF switching set constraints
additional *CMAF switching set constraints* (3.3.11) so *CMAF fragments* (3.1.1) do not depend on a different *CMAF header* (3.1.2) when *switching* (3.3.9)

3.3.13
resource identifier
externally specified identifier that identifies a *CMAF addressable media object* (3.1.3)

Note 1 to entry: An example is a URI or other object identifier specified by a delivery protocol and *manifest* (3.2.9).

3.3.14
stream access point
media sample (3.3.15) random access property

3.3.15
media sample
media data in a *CMAF fragment* (3.1.1) associated with a single decode start time and duration

Note 1 to entry: The term "sample" is often used in the context of video to refer to the spatial samples of an image and in the context of audio to refer to PCM waveform samples. In this document, each type of sample is identified by a defined term. A media sample defined by ISO BMFF is always identified by the term "media sample". The word "sample" is frequently used in ISO BMFF to refer to objects and parameters such as a "sample entry", "sample size", etc., and those terms are used without modification in this document.

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3.3.16
audio PCM sample
digital sample quantizing the amplitude of an audio waveform at regular and frequent intervals, e.g. 48 kHz

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3.3.17
video spatial sample
quantized values representing the colour and brightness of an area of an image corresponding to a two-dimensional spatial tessellation of the image

3.3.18
subsampling
video encoding using a smaller number of *video spatial samples* (3.3.17) than the source video, that number being an integer submultiple that can be scaled to the source video size based on video stream parameters without position shift or picture aspect ratio distortion

4 Abbreviated terms

AAC	advanced audio coding
ABNF	augmented backus-naur form
ADIF	audio data interchange format
ADTS	audio data transport stream
AOT	audio object type
ASC	audio specific configuration

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