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Information technology — Multimedia application format (MPEG-A) — Part 19: Common media application format (CMAF) for segmented media, AMENDMENT 2: New structural CMAF brand profile and new media profiles

WD stage

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The committee responsible for this document is ISO/IEC JTC1 SC29.

# Introduction to Amendment 2

This amendment adds support for

* A new structural media profile.

Information technology — Multimedia application format (MPEG-A) — Part 19: Common media application format (CMAF) for segmented media, AMENDMENT 2: New Structural Profile and Other Technologies

# Clause 4 changes

*Add new abbreviation for MV - multi-view:*

|  |  |
| --- | --- |
| ... | ... |
| MSE | media source extension |
| MV | multi-view |
| NAL | network adaptation layer |
| ... | ... |

# Clause 7 changes

## Overview

*Replace 7.1 overview with the following:*

The CMAF track format is derived from the ISO base media file format in this clause and structural brands are specified. At this point, the 'cmfc', the 'cmf1' and the 'cmf2' CMAF structural brands are defined. The 'cmf2' brand further restricts the 'cmfc' brand. The 'cmf1' brand extends and restricts the 'cmfc' brand.

Several CMAF media objects are derived from the CMAF track format.

## CMAF brands

*Add the 'cmf1' entry to Table 1 — CMAF brands:*

Table — CMAF brands

|  |  |  |
| --- | --- | --- |
| **Brand** | **Location** | **Conformance requirements** |
| cmfc | FileTypeBox and SegmentTypeBox | 7.6 |
| cmf1 | FileTypeBox and SegmentTypeBox | 7.8 |
| cmf2 | FileTypeBox and SegmentTypeBox | ‎7.7 |
| ... | ... | ... |

## New Clause 7.8

*Add a new Clause 7.8*

**7.8 The Structural CMAF Brand 'cmf1'**

**7.8.1 General**

A CMAF track conforming to the CMAF structural brand 'cmf1' shall conform to constraints of the CMAF structural brand 'cmfc' and all remaining constraints and exceptions in this clause 7.8.

These constraints introduced to signal that the CMAF tracks and CMAF switching set track headers are conforming as if all CMAF Tracks of the presentation also conforming to this brand would be included in a single ISO BMFF file.

**7.8.2 Track Header Box (**'tkhd'**)**

CMAF TrackHeaderBoxes shall conform to subclause 7.5.4 with the following additional constraints.

— If all CMAF Tracks of the CMAF Presentation are combined into a single ISO BMFF container, then the track header shall be valid. This for example included that:

— The track\_ID is set to a unique identifier over within this CMAF presentation.

— All tracks within one CMAF Switching Set have alternate\_group shall be set to the same value. Each CMAF Switching Set in the CMAF Presentation shall have a unique value for the alternate\_group.

— For a video track, every decoder output signal shall have decoded and cropped image size in video spatial samples measured on a uniformly sampled square grid identical to the value of width and height defined in the Track Header.

# Clause 9 changes

*In Clause 9.2.4 add the following bullet point at the end of the section:*

— one or more ColourInformationBoxes with sub-type 'nclx' as specified in ISO/IEC 14496-12.

*In Clause 9.3.2.2 fix the spelling of the ColorInformationBox:*

— shall contain one or more ColourInformationBoxes with sub-type 'nclx' and a PixelAspectRatioBox 'pasp', as documented in ISO/IEC 14496-12, if the first sample entry contains no SPS NAL with VUI in the decoder configuration record.

*In Clause 9.3.7 fix the spelling of the ColorInformationBox:*

2) may contain a sample entry without NALs that shall include one or more ColourInformationBoxes with sub-type 'nclx' and a PixelAspectRatioBox, as specified in ISO/IEC 14496-12.

[Ed. Note: Dimitri: With the generalized requirement in clause 9.2.4 other shall requirements for the nclx colr box could be removed in derived clauses.]

# Annex B changes

*Replace Clause B.1 with the following:*

This annex defines HEVC video tracks and specific CMAF media profiles with HEVC elementary stream constraint sets. Applications that do not conform to the HEVC video track or any of these CMAF media profiles can either specify their own HEVC video track definition or CMAF media profile or both. Applications can also signal brand conformance to just a CMAF structural brand defined in this document (e.g. 'cmfc', 'cmf1' or 'cmf2').

HEVC tracks shall conform to 9.3, as additionally constrained in this annex.

# Annex H changes

*Remove the scalable resolution restriction in H.4.2.2:*

— The bitstream shall contain at most two layers, a base layer and possibly an enhancement layer.

— The base layer shall conform to HEVC Main 10 profile and main tier.

— The enhancement layer, when present, shall conform to HEVC scalable Main 10 profile and main tier.

— ~~The spatial resolution of the enhancement layer shall be equal to X times that of the base layer both horizontally and vertically. The value of X shall be 1.5, 2 or 3.~~

— Each layer shall contain at most two sub-layers, with TemporalId equal to 0 and 1 when there are two sub-layers, and the value of sps\_max\_sub\_layers\_minus1 of each SPS shall be set equal to 0 or 1. If there is only one sub-layer, the TemporalId shall be 0.

— The value of sub\_layer\_level\_present\_flag[ 0 ] shall be equal to 1. This constraint requires the signalling of the level of the sub-layer representation with TemporalId equal to 0.

[Ed. Note: Dimitri: NB comments are welcome on this change as it removes an existing restriction to allow other important resolution ratios such as 1.0, 1.25, 4.0, etc.]

# Annex O changes

*Replace Clause O.6 with the following:*

LCEVC media profiles and track brands shall conform to Table O.1.

CMAF file with brand 'clv1' shall contain only LCEVC samples with sample entry 'lvc1'.

clv1.vprf<prof>.vlev<level>

**Table O.1 — Video codecs parameters for the LCEVC media profiles**

|  |  |  |  |
| --- | --- | --- | --- |
| **codec parameter** | Description | CMAF LCEVC Main Profile | CMAF LCEVC Main 4:4:4 Profile |
| **<prof>** | profile\_idc | 0 | 1 |
| **<level>** | level\_idc | <level>  Examples   * For level 4.1: 41 * For level 5.1: 51 * For level 6.1: 61 | |

[Ed. Note: Dimitri: To me it looks like this should be another table and not replace the existing one from FDAM1. Is my understanding correct? Please verify.]

# New Annex P on MV-HEVC

**Annex P**

(normative)

**CMAF Track and media profiles for MV-HEVC**

[Ed. Note: Dimitri: This is a starting point for the profile definition based on the discussion of the group at MPEG145. Contributions are expected/welcome for this section.]

[Ed. Note: The current profile definitions do not account for the fact that Multiview HEVC profiles and levels are defined per layer and not per bitstream. Therefore, the current definitions may not be accurate or sufficient and further work seems necessary to account for such property.]

**P.1 Introduction**

This Annex defines CMAF tracks and media profiles for MV-HEVC. It also defines the CMAF Switching Set constraints for MV-HEVC in CMAF.This Annex defines a single media profile for MV-HEVC, the *restricted MV-HEVC media profile* in clause P.2. The codecs parameter for CMAF Tracks conforming to MV-HEVC media profiles is provided in clause M.4.

**P.2 Restricted MV-HEVC Media Profile**

P.2.1 General

This clause P.2 defines the CMAF restricted MV-HEVC media profile. If a CMAF track conforms to these requirements, it may use the brand 'cvh1'. The restricted MV-HEVC CMAF media profile are stores for all video layers in a single CMAF track.

The definition includes the definition of a CMAF track and specific CMAF media profiles with HEVC elementary stream constraint sets. Applications that do not conform to the MV-HEVC video track or any of these CMAF media profiles can either specify their own MV-HEVC video track definition or CMAF media profile or both. Applications can also signal brand conformance to just a CMAF structural brand defined in this document (e.g. 'cmfc', 'cmf1' or 'cmf2').

P.2.2 CMAF track constraints

A CMAF Track conforming to the restricted MV-HEVC media profile shall conform to

* a L-HEVC Track as defined in ISO/IEC 14496-15,
* the requirements of NAL structured video CMAF tracks as defined in subclause 9.3, and
* the additional constraints defined in clause P.2.

P.2.3 CMAF switching set constraints

For a CMAF Switching Set conforming to the restricted MV-HEVC media profile the following applies:

— Each CMAF Track in the CMAF Switching Set shall conform to CMAF track constraints as defined in clause P.2.2.

— The CMAF Switching Set shall conform to constraints for NAL structured video CMAF switching sets as specified in subclause 9.3.6 or 9.3.7.

— the additional constraints defined in clause P.2.5 for CMAF Switching Sets.

**P.2.4 HEVC video track constraints**

**P.2.4.1 Sample Description Box (**'stsd'**)**

The specification of Annex B.2.2 shall apply for the Sample Description Box ('stsd').

P.2.4.2 Visual sample entry

The specification of Annex B.2.3 shall apply with the following additional constraints:

* The syntax and values of a visual sample entry shall conform to HEVCSampleEntry ('hvc1') or HEVCSampleEntry ('hev1') sample entries as defined in ISO/IEC 14496-15 and constrained as follows.
* For the HEVCSampleEntry:
* An LHEVCConfigurationBox may be present as specified in ISO/IEC 14496-15;
* Extractors and aggregators shall not be present.
* If one of the layers carries alpha the VisualSampleEntry attribute depth shall be set to 0x20 (32).

P.2.4.3 HEVCDecoderConfigurationRecord colour and dynamic range information

Specification of Annex B.2.3 applies.

Question: I assume all the MDCV, CLLV, AMVE etc. SEIs are the same in both config records (for layer 0 and layer 1 for example) or can they differ? If yes, we need some additional bullet points here.

P.2.4.4 Track Header Box ('tkhd')

Specification of Annex B.2.5 applies.

P.2.4.5 Storage of HEVC elementary streams

HEVC video tracks shall comply with ISO/IEC 14496-15 and subclause 9.3.

P.2.4.6 Access units

Access units and media samples shall conform to subclause 9.3.

Access units shall conform to the requirements of a media sample of the indicated description ('hvc1' or 'hev1') as specified in ISO/IEC 14496-15.

CMAF fragments containing access units identified by the 'hev1' sample description shall contain all SPS and PPS NALs referenced from a coded video sequence in the first access unit of that sequence, immediately following its first access unit delimiter NAL, if an access unit delimiter NAL is present.

Access units identified by the 'hev1' sample description may retain filler data (in NAL units or SEI messages) and SEI messages that would change hypothetical reference decoder bitstream conformance if removed.

Access units of type 'hvc1' shall reference a video parameter set in the sample entry of the CMAF header associated with the containing CMAF track.

P.2.4.7 MV-HEVC video CMAF switching set constraints

Additionally, the following constraints apply:

* VPS shall be present and for each layer SPS VPS shall be complete so that every layer is decodable
* vps\_extension shall be present in VPS as specified in HEVC Annex F

**P.2.5 MV-HEVC video track constraints**

P.2.5.1 Overview

The following general constraints apply to all CMAF HEVC elementary streams, and their values are additionally constrained in clause B.5 with constraints on tier, profile, level, resolution, video characteristics, and frame rates specified by HEVC video CMAF media profile in Table B.1.

P.2.5.2 Video parameter sets (VPS)

When there are multiple VPSs within a CMAF HEVC track, they shall have the same content.

* VPS shall be present and for each layer SPS VPS shall be complete so that every layer is decodable
* vps\_extension shall be present in VPS as specified in HEVC Annex F

P.2.5.3 Sequence parameter sets (SPS)

#### P.2.5.3.1 SPS fields

Sequence parameter set NAL units that occur within a CMAF HEVC track shall conform to ISO/IEC 23008-2 with the following additional constraints.

— The following fields shall have pre-determined values as follows.

— vui\_parameters\_present\_flag shall be set to 1.

The value for each of the following fields in the active SPS shall not change from one coded video sequence to another throughout a CMAF HEVC track:

— general\_profile\_space

— general\_profile\_idc

— general\_tier\_flag

— general\_level\_idc

#### P.2.5.3.2 Visual usability information (VUI) parameters

VUI parameters that occur within a CMAF HEVC track shall conform to ISO/IEC 23008-2 with the following additional constraints.

— The following fields shall have pre-determined values as follows.

— aspect\_ratio\_info\_present\_flag shall be set to 1.

— video\_full\_range\_flag shall be set to 0.

— The following fields have the following values.

— colour\_description\_present\_flag should be set to 1.

NOTE As defined in ISO/IEC 23008-2, if the colour\_description\_present\_flag is set to 1, the colour\_primaries, transfer\_characteristics and matrix\_coefficients fields are present in the VUI.

— If colour\_description\_present\_flag is set to 1, then colour\_primaries, transfer\_characteristics and matrix\_coefficients shall be set to one of the values permitted for the media profile (see Table B.1).

— If colour\_description\_present\_flag is set to 0, this shall indicate the following values are to be assumed:

— colour\_primaries = 1;

— transfer\_characteristics = 1;

— matrix\_coefficients = 1.

— overscan\_info\_present\_flag shall be set to 0, therefore overscan\_appropriate shall not be present,

— aspect\_ratio\_idc shall be set to 1.

— The values of the following fields shall not change throughout a CMAF track and CMAF switching set.

— low\_delay\_hrd\_flag

— colour\_description\_present\_flag

— colour\_primaries, when present

— transfer\_characteristics, when present

— matrix\_coeffs, when present

— The values of the following fields should not change throughout a CMAF track.

— vui\_time\_scale

— vui\_num\_units\_in\_tick

P.2.5.4 Frame rate in the elementary stream

The frame timing, including frame rate, is determined by the media sample presentation times and durations provided in the TrackRunBox(es) in each CMAF fragment.

**P.3 Video codec parameters**

**P.3.1 HEVC signalling of "codecs" parameters**

Presentation applications should signal video codec profile and levels of each HEVC track and CMAF switching set using parameters conforming to IETF RFC 6381 and ISO/IEC 14496-15.

**P.3.2 Image cropping parameters**

When necessary, picture cropping shall be indicated by setting SPS cropping parameters conf\_win\_bottom\_offset and/or conf\_win\_right\_offset to remove video spatial samples not intended for display, and conf\_win\_top\_offset and conf\_win\_left\_offset set to zero.

**P.5 MV-HEVC video CMAF media profiles and brands**

MV-HEVC media profiles and track brands shall conform to Annex B except for Table P.1.

**Table P.1 — MV-HEVC video media profiles**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Media profile** | **Codec** | **Profile** | **Level** | colour\_primaries **in VUI** | transfer\_characteristics **in VUI a** | matrix\_coefficients **in VUI** | **Max frame height** | **Max frame width** | **Max frame rate** | **CMAF file brand** |
| MVH10 | MV-HEVC | Multiview Main 10 | 5.2 | 1a  9b | 1a  14b | 1a  9c | 2 160 | 3 840 | 120 | 'cvh1' |
| MVH |  | Multiview main |  |  |  |  |  |  |  |  |
| TBD |  |  |  |  |  |  |  |  |  |  |
| a   This value is equivalent to the definitions in ITU-R BT.709. For details refer to ISO/IEC 23008-2.  b   This value is equivalent to the definitions in ITU-R BT.2020. For details refer to ISO/IEC 23008-2.  c   This value is commonly also known as ITU-R BT.2020 non-constant luminance. For details refer to ISO/IEC 23008-2. | | | | | | | | | | |

# On standalone auxiliary video tracks in CMAF

As agreed during the discussion of m67719 we add the Note below in (potentially) Annex P. This note will need to be resolved before the DIS stage of Amd. 2

[Editor’s note: Comments are welcome for the presence or not of the Track Reference Box in the MV-HEVC video CMAF track. And if present, what values in the Track\_IDs array should be used. This note applies generically to any track using a Track Reference box when they are all stored in a single file, for instance in the case of scalable HEVC.]

# Improvement on switching group box in ISOBMFF

Contribution m67527 at the joint Exploration project of ISOBMFF/CMAF/DASH on that topic was accepted in the next Amendment of part 12. For CMAF the questions are:

* Are the semantics for this box corresponding to switching set semantics for CMAF?
* Should CMAF has an informative Annex/Example on how to use it?

We need to resolve this before the DIS stage of Amd. 2.