



**International
Standard**

ISO/IEC 23000-19

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

Part 19:

**Common media application format
(CMAF) for segmented media**

**AMENDMENT 1: Low complexity
enhancement video Coding (LCEVC)
and other technologies**

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

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

*AMENDEMENT 1: Codage vidéo d'amélioration de faible
complexité (LCEVC) et autres technologies*

**Third edition
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**AMENDMENT 1
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Information technology — Multimedia application format (MPEG-A) —

Part 19:

Common media application format (CMAF) for segmented media

AMENDMENT 1: Low complexity enhancement video Coding (LCEVC) and other technologies

Clause 2, Normative references

Add the following document:

ISO/IEC 23094-2:2021, *Information technology — General video coding — Part 2: Low complexity enhancement video coding*

Clause 4

Add the following abbreviated terms:

EVC	essential video coding
LCEVC	low complexcity enhancement video coding
VVC	verstaile video coding

Clause 5

Add the following text:

Annex O describes packaging and codec constraints for some CMAF media profiles using the LCEVC video codec. Systems claiming conformance to CMAF using LCEVC shall conform to the provisions of Annex O.

Annex O

Add the following new annex after Annex N, before the Bibliography:

Annex O (normative)

LCEVC media profile and track format

0.1 Dependent CMAF tracks

The LCEVC media profile makes use of Dependent CMAF Tracks, as defined in Clause H.1.

0.2 LCEVC CMAF tracks

LCEVC CMAF tracks shall conform to Clauses 7, 8, 9, and 12 and shall additionally conform to the constraints specified in this annex.

Each LCEVC CMAF track that does not contain the Base Codec VCL NAL units is a dependent CMAF track, and the constraints specified for dependent CMAF tracks in Clause H.1 shall apply. It is expected that the manifest provides signalling to express the dependency of a dependent LCEVC CMAF track on a Base CMAF track, for example, using the @dependencyID in a DASH MPD.

0.3 CMAF switching set constraints for LCEVC CMAF tracks and media profiles

0.3.1 General

Subclause 9.2.3 shall apply with the following additional constraints.

- Each CMAF track with sample entry 'lvc1' shall conform to the LCEVC media profile and track format as specified in this annex.
- Each CMAF track containing a Base bitstream or an LCEVC bitstream or part thereof shall contain exactly one ISO BMFF track with a Base bitstream or an LCEVC bitstream, respectively.
- When two CMAF tracks are present for carrying Base and LCEVC bitstreams, the corresponding ISO BMFF tracks shall use distinct track IDs.
- CMAF switching sets containing a media profile listed in clause 0.6 with sample entry 'lvc1' shall conform to single initialization CMAF switching set constraints.

Each coded video sequence in an LCEVC bitstream shall contain the necessary parameter sets (Sequence Configuration, Global Configuration) to signal decoding parameters changes allowed between CMAF tracks in the same switching set.

0.3.2 Sample Description Box ('stds')

Subclauses 9.2.4 and 9.3.2.2 shall apply with the following additional restrictions.

A decoder configuration record:

- shall signal other parameter sets (Sequence Configuration, Global Configuration) fields used by the video track as specified in ISO/IEC 14496-15:2022, 13.7.4;
- for a visual sample entry with codingname 'lvc1', shall contain one or more decoding parameter sets (containing Sequence Configuration, Global Configuration NAL units for LCEVC video). Each video sample in the CMAF track shall reference a parameter set in the sample entry;

- may contain additional SEI NAL units to signal colour encoding and rendering, such as:
 - mastering_display_colour_volume, SEI payloadType=1 (ISO/IEC 23094-2:2021, Annex D), or
 - content_light_level_inifo, SEI payloadType=2 (ISO/IEC 23094-2:2021, Annex D).

0.3.3 Track Header Box ('tkhd')

The requirements of 7.5.4 apply.

NOTE Normalized width and height can be derived from a Global Configuration NAL unit in each segment and coded video sequence for 'lvc1' video samples. See 9.3.3 and 9.3.4 for the storage and semantics of video sequence parameter sets.

0.3.4 Access units

Subclause 9.2.6 applies.

Access units shall conform to the requirements of a sample of the indicated description ('lvc1') as specified in ISO/IEC 14496-15.

CMAF fragments containing samples identified by the 'lvc1' type shall contain all Sequence Configuration, Global Configuration NAL units referenced by a coded video sequence in the first access unit of that sequence, immediately following its first access unit delimiter NAL (if any).

NOTE Access units of type 'lvc1' can retain filler data (NAL units or SEI messages) and SEI messages that would change hypothetical reference decoder bitstream conformance if such conformance is necessary, such as the case where bitstreams are to be repackaged and conformance tested in MPEG-2 transport streams.

0.3.5 Decoding of adaptively switched LCEVC CMAF tracks

Subclause 6.6.6 applies to switching between single-layer bitstreams, wherein a “conceptual” track is generated by concatenating segments from the Base track (e.g. AVC, HEVC, EVC, VVC) and the Enhancement LCEVC track among which the switching occurs. Once the multiple “conceptual” tracks are generated, the process specified in ISO/IEC 14496-15:2022, Clause 13 is applied to construct the bitstream to be decoded by the video decoder.

0.4 Sample and CMAF fragment constraints

0.4.1 Storage of LCEVC elementary streams

0.4.1.1 Conformance

Low Complexity Enhancement Video Coding (LCEVC) video tracks shall conform to ISO/IEC 14496-15:2022, Clause 13, with the following constraints.

- Each track shall carry either the Base Layer and the Enhancement Layer, or only one layer (either Base or Enhancement).
- Aggregators (as defined in ISO/IEC 14496-15:2022, Annex A) shall not be included in any track.

The Base Layer (coded according to any specification, e.g. AVC, HEVC, EVC, VVC) shall be stored as described in the respective clause of the CMAF specification, where applicable, e.g. for AVC subclause 9.4.1, for HEVC subclause B.3.1.

0.4.1.2 Visual sample entry

The Base track's syntax and values for a visual sample entry shall conform to any regular (independent) sample entry, e.g. 'avc1', 'hev1', 'evc1', 'vvc1', as defined in ISO/IEC 14496-15.

0.4.1.3 Base DecoderConfigurationRecord and LCEVCDecoderConfigurationRecord

The Base DecoderConfigurationRecord and the Base Layer shall conform to the respective clause of the CMAF specification, where applicable, for usage of SEI messages, e.g. for HEVC subclause B.2.4.

The LCEVCDecoderConfigurationRecord and the Enhancement Layer shall conform to subclause 0.3.2, for the usage of SEI messages.

0.4.2 Constraints on LCEVC elementary streams**0.4.2.1 General**

The following constraints apply to all CMAF LCEVC elementary streams. See Clause 0.6 for media profile constraints on profile, level and frame rates.

0.4.2.2 General constraints

- The bitstream shall contain at most two layers, a Base Layer and an LCEVC Enhancement Layer.
- The Base Layer shall conform to any of the specifications for Video supported by CMAF, e.g. AVC, HEVC, EVC, VVC.
- The LCEVC Enhancement Layer shall conform to LCEVC Main profile (ISO/IEC 23094-2:2021, A.3.2) or LCEVC Main 4:4:4 profile (ISO/IEC 23094-2:2021, A.3.3).
- The spatial resolution of the LCEVC Enhancement Layer shall be equal to X times that of the base layer both horizontally and vertically. The value of X shall be 1, 2, or 4.
- The LCEVC Enhancement Layer shall conform to the LCEVC specification (ISO/IEC 23094-2).

0.4.2.3 Picture rate related constraints

The LCEVC Enhancement Layer shall have the same picture rate as the Base Layer.

0.4.2.4 Picture type

All pictures shall be encoded as coded frames, and shall not be encoded as coded fields.

0.4.2.5 Parameter sets (Sequence Configuration, Global Configuration)**0.4.2.5.1 Sequence Configuration and Global Configuration fields**

Each LCEVC video sample in the CMAF track shall reference the parameter sets (SC, GC) in the CMAF header sample entry according to ISO/IEC 14496-15. Parameter sets shall not change within CMAF tracks or between CMAF tracks in a switching set. A CMAF LCEVC track shall conform to ISO/IEC 23094-2.

0.4.2.5.2 Visual Usability Information (VUI) fields

VPS VUI parameters that occur within a CMAF LCEVC track shall conform to ISO/IEC 23094-2:2021, Annex E.

0.4.2.6 Maximum bitrate

The maximum bitrate of LCEVC elementary streams shall be calculated by implementation of the buffer and timing model defined in ISO/IEC 23094-2:2021, Annex C.

0.4.2.7 Frame rate in the elementary stream

Sample durations stored in the ISO Media TrackRunBox shall determine the frame rate of a track.