

Specification	Section	Implemented Checks
<b>Information technology — Multimedia application format (MPEG-A) — Part 19: Common media application format (CMAF) for segmented media</b> <b>ISO/IEC 23000-19:2020</b>	7.2	If any of the structural CMAF brands is the major_brand, the minor_version shall be set to 0
	7.3.1	CMAF tracks shall include the following ISO BMFF boxes with nesting, optionality, and cardinality specified in Table 3 through Table 5
		A CMAF header shall contain the set of boxes in Table 3 and Table 4 with the conditions and optionality listed
		Each CMAF header shall form a valid CMAF track, as specified in subclause 7.3.2.2, when followed by a continuous sequence of associated CMAF fragments in decode order
		A CMAF header shall be conformant with ISO/IEC 14496-12 and the following additional constraints and requirements: 1) The CMAF header shall start with a FileTypeBox. 2) The CMAF header shall include exactly one MovieBox. 3) The MovieBox shall start with a MovieHeaderBox, as constrained in subclause 7.5.1. 4) The MovieBox shall contain exactly one track containing media data as specified in subclause 7.3.2.2.
		The MovieBox shall contain a MovieExtendsBox
		The MovieExtendsBox may contain a MovieExtendsHeaderBox, as defined in ISO/IEC 14496-12, and if so, shall provide the overall duration of the CMAF track. If the duration is unknown, this box shall be omitted
	7.3.2.1	
	7.3.2.2	A CMAF track shall conform to at least one structural CMAF brand and contain the set of boxes in Table 3, Table 4, and Table 5, with the conditions and optionality listed
		The concatenation of a CMAF header and all CMAF fragments in the CMAF track in consecutive decode order shall be a valid fragmented ISO BMFF file
		Each CMAF fragment in a CMAF track shall have baseMediaDecodeTime equal to the sum of all prior CMAF fragment durations added to the first fragment's baseMediaDecodeTime
		Each CMAF track contains a single ISO BMFF track and TrackBox
	7.3.2.3	A CMAF chunk shall contain the boxes in Table 7 with the conditions and optionality indicated
		The MovieFragmentBox shall conform to the constraints of the structural CMAF brand constraints specified in Table 5
		All media samples in a CMAF chunk shall be addressed by byte offsets in the TrackRunBox that are relative to the first byte of the MovieFragmentBox
		A CMAF chunk shall contain a TrackFragmentDecodeTimeBox containing the baseMediaDecodeTime of the first media sample
		CMAF chunks in a CMAF track shall not overlap or have gaps in decode time
	7.3.2.4	A CMAF fragment shall contain the boxes in Table 8, with the conditions and optionality indicated
		Each CMAF fragment, in combination with its associated CMAF header and optional decryption key(s), shall contain sufficient metadata to enable the CMAF fragment to be decoded, decrypted, and displayed when it is independently accessed
	7.3.3.1	A CMAF segment shall include the boxes in Table 9
		A CMAF segment shall contain one or more complete and consecutive CMAF fragments in decode order
	7.3.3.3	A CMAF track file shall include the boxes in Table 10
		If SegmentIndexBoxes exist, each subsegment referenced in the SegmentIndexBox shall be a single CMAF fragment contained in the CMAF track file
	7.3.4.1	A CMAF switching set shall contain one or more CMAF tracks
		A CMAF switching set shall contain CMAF tracks of only one media type

		All CMAF tracks in a CMAF switching set shall have the same duration
		All CMAF tracks in a CMAF switching set shall contain the same number of CMAF fragments
		For any CMAF fragment in one CMAF track in a CMAF switching set, there shall be a CMAF fragment with the same decode time in all other CMAF tracks
		All CMAF tracks in a CMAF switching set shall have the same value of baseMediaDecodeTime in the first CMAF fragment's TrackFragmentBaseMediaDecodeTimeBox
		The presentation time of the earliest media sample of the earliest CMAF fragment in each CMAF track shall be equal
		All CMAF tracks in a CMAF switching set shall conform to one CMAF media profile
		CMAF header parameters shall not differ between CMAF tracks, except as allowed in Table 11
	7.3.4.4	An aligned CMAF switching set shall contain two or more CMAF switching sets
		Aligned CMAF switching sets shall contain CMAF switching sets of equal duration
		Aligned CMAF switching sets shall contain the same number of CMAF fragments in every CMAF track
		Aligned CMAF switching sets shall contain CMAF fragments in every CMAF track with matching baseMediaDecodeTime and duration, for each CMAF fragment in a CMAF track
	7.3.5	A CMAF selection set shall contain one or more CMAF switching sets
		All CMAF switching sets within a CMAF selection set shall be of the same media type, e.g., audio, video, or subtitles
		All switching sets within a CMAF selection set shall be of the same duration, within a tolerance of the longest CMAF fragment duration of any CMAF track in the selection set
	7.3.6	All CMAF tracks in a CMAF presentation shall have the same timeline origin
		All CMAF tracks in a CMAF presentation containing a video switching set shall be start aligned with CMAF presentation time zero equal to the earliest video media sample presentation start time in the earliest CMAF fragment
		All CMAF tracks in a CMAF presentation that does not contain video shall be start aligned with the CMAF presentation time zero equal to the earliest audio media sample presentation start time in the earliest CMAF fragment
		The duration of a CMAF presentation shall be the duration of its longest CMAF track
		CMAF tracks in a CMAF presentation shall equal the CMAF presentation duration, within a tolerance of the longest video CMAF fragment duration
	7.4.2	it shall be present in each CMAF fragment
	7.4.5	A DASHEventMessageBox in a CMAF track shall contain the value in its timescale field equal to the value of the timescale field in the MediaHeaderBox of the CMAF track that contains it
	7.5.1	The fields rate, volume, and matrix shall be set to their default values
	7.5.2	When present, they shall not occur at file level
	7.5.4	The field duration shall be set to a value of zero
		The field matrix shall be set to their default values as defined in ISO/IEC 14496-12, except to indicate video orientation
		The width and height fields for a non-visual track (e.g., audio) shall be 0
	7.5.6	The VideoMediaHeaderBox shall conform to ISO/IEC 14496-12 with the constraints specified in subclause 9.2.2

	7.5.7	The field balance shall equal 0 (centre).
	7.5.9	The DataReferenceBox shall contain a single entry with the entry_flags field set to 0x000001 (which means that the media data is in the same file as the MovieBox containing this data reference)
	7.5.10	The SampleDescriptionBox in a CMAF track shall conform to version 0
		Sample entries for encrypted tracks (those containing any encrypted media sample data) shall encapsulate the existing sample entry with the appropriate four-character-code listed in ISO/IEC 14496-12 and include a ProtectionSchemeInfoBox ('sinf') that conforms to ISO/IEC 14496-12 and subclause 7.5.11
	7.5.11	CMAF shall use common encryption (ISO/IEC 23001-7) for CMAF tracks containing one or more encrypted CMAF fragments and use Scheme Signalling
		CMAF track shall include at least one ProtectionSchemeInfoBox ('sinf') containing a TrackEncryptionBox ('tenc') identifying a scheme
	7.5.12	The following boxes therefore shall have an entry_count of zero: <ul style="list-style-type: none"> <li>— TimeToSampleBox ('stts');</li> <li>— SampleToChunkBox ('stsc');</li> <li>— ChunkOffsetBox ('stco');</li> <li>— SampleSizeBox or CompactSampleSizeBox ('stsz' or 'stz2');</li> <li>— SyncSampleBox ('stss'), if present</li> </ul>
	7.5.13	The EditBox shall contain a single EditListBox
		The value of entry_count field in the EditListBox shall be set to 1
		The value of the media_rate_integer field shall be set to 1 and the value of the media_rate_fraction field shall be set to 0
	7.5.14	The value of the segment_duration field shall be set to 0
	7.5.14	A TrackExtendsBox shall be present
	7.5.16	The track_ID field shall contain the same value as the track_ID in the associated CMAF header
		The base-data-offset-present flag (in the tf_flags field) shall be set to zero
		The default-base-is-moof flag (in the tf_flags field) shall be set to one
	7.5.16	Every TrackFragmentBox shall contain a TrackFragmentBaseMediaDecodeTimeBox
	7.5.17	The version field shall be set to either '0' or '1'
		When the version field is set to '1', the sample_composition_time_offset of the first presented media sample in a CMAF fragment shall be such that its composition time is equal to the first media sample decode time (baseMediaDecodeTime)
		The data-offset-present flag (in the tf_flags field) shall be set to true
		Within a CMAF track, any TrackRunBox that describes any non-sync media samples shall identify sample dependency with the CMAF chunk and CMAF fragment using a combination of the sample_flags and first_sample_flags fields and default values in the TrackFragmentHeaderBox: <ul style="list-style-type: none"> <li>— sample_is_non_sync_sample shall be 0 for SAP type 1 or 2, and 1 otherwise;</li> <li>— an empty SyncSampleBox shall be present in the track</li> </ul>
	7.5.19	Each CMAF fragment shall contain one or more MediaDataBox(es)
		Each MediaDataBox in a CMAF chunk shall be immediately preceded by the MovieFragmentBox that references the media samples it contains
	7.5.20	Each CMAF fragment in a TTML image subtitle track of CMAF media profile 'im1i', as specified in subclause 11.3.4, shall contain a SubSampleInformationBox in the TrackFragmentBox

		The field entry_count shall equal 1
7.6		A CMAF track conforming to the CMAF structural brand 'cmfc' shall conform to the CMAF track constraints defined in subclauses 7.1, 7.2, 7.3, 7.4, and 7.5
7.7.1		A CMAF track conforming to the CMAF structural brand 'cmf2' shall conform to constraints of the CMAF structural brand 'cmfc' and all remaining constraints in subclause 7.7
7.7.2		For video CMAF Tracks, the EditBox and in particular the EditListBox shall not be present
7.7.3		For video CMAF Tracks not contained in Track Files, Version 1 shall be used
		default_sample_flags, sample_flags and first_sample_flags shall be set in the TrackFragmentHeaderBox and/or TrackRunBox to provide sample dependency information within each CMAF chunk and CMAF fragment
		Default values or per sample values of sample duration and sample size shall be stored in each CMAF chunk's TrackRunBox and/or TrackFragmentHeaderBox
8.2.2.1		For encrypted CMAF fragments that contain sample auxiliary information, each TrackFragmentBox shall contain a SampleAuxiliaryInformationOffsetsBox
		The entry_count field of the SampleAuxiliaryInformationOffsetsBox shall equal 1
8.2.2.2		A TrackEncryptionBox specified in subclause 7.4.1 shall be present in a CMAF header if any media samples in the track are encrypted
8.2.3.2		In an encrypted track, the isProtected flag in the TrackEncryptionBox shall be set to 1
10.3.4.2.3		The syntax and values for ES_Descriptor shall conform to ISO/IEC 14496-1, and the fields of the ES_Descriptor shall be set to the following values. — ES_ID = 0
10.4		Each AAC elementary stream shall be encoded using MPEG-4 AAC-LC, HE-AAC Level 2, or HE-AACv2 Level 2
		AAC core CMAF tracks shall not exceed two audio channels
		AAC core elementary streams shall not exceed 48 kHz sampling rate
		The AAC core FileTypeBox brand shall be 'caac' and should be used to indicate CMAF tracks that conform to this media profile
A.1.2		If containing video, it shall include at least one CMAF switching set constrained to the 'cfhd' media profile in Clause A.2
		If containing audio, it shall include at least one audio CMAF switching set constrained to the 'caac' media profile defined in Clause A.3
		If containing subtitle tracks, it shall include at least one CMAF switching set for each language and role in the 'im1t' media profile defined in Clause A.4
		All CMAF tracks shall not contain encrypted media samples or a TrackEncryptionBox
A.1.3		If containing video, it shall include at least one CMAF switching set constrained to the 'cfhd' media profile in Clause A.2
		If containing audio, it shall include at least one audio CMAF switching set constrained to the 'caac' media profile defined in Clause A.3

		If containing subtitle tracks, it shall include at least one CMAF switching set for each language and role in the 'im1t' media profile defined in Clause A.4
		At least one CMAF switching set shall be encrypted
		Any CMAF switching set that is encrypted shall be available in 'cenc' common encryption scheme specified in Clause 8
	A.1.4	If containing video, it shall include at least one CMAF switching set constrained to the 'cfhd' media profile in Clause A.2
		If containing audio, it shall include at least one audio CMAF switching set constrained to the 'caac' media profile defined in Clause A.3
		If containing subtitle tracks, it shall include at least one CMAF switching set for each language and role in the 'im1t' media profile defined in Clause A.4
		At least one CMAF switching set shall be encrypted
	A.2	For a CMAF track to comply with one of the media profiles in Table A.1, it shall not exceed the profile or level listed in the table
		For a CMAF track to comply with one of the media profiles in Table A.1, it shall conform to the colour_primaries, transfer_characteristics and matrix_coefficients values from the options listed in the table
		For a CMAF track to comply with one of the media profiles in Table A.1, it shall not exceed the width, height or frame rate listed in the table, even if the AVC level would permit higher values
	B.2.3	The HEVCSampleEntry: — shall contain an HEVCConfigurationBox ('hvcC') box containing an HEVCDecoderConfigurationRecord, as specified in ISO/IEC 14496-15
		The HEVCSampleEntry: — shall contain a ColourInformationBox ('colr') with colour_type 'nclx' and PixelAspectRatioBox ('pasp') when required per subclause 9.3.5.1
	B.2.4	CMAF switching sets shall be constrained to include identical SEI NALs and SPS VUI colour mastering and dynamic range information in the first sample entry of every CMAF header in the CMAF switching set to provide consistent initialization and calibration
	B.5	For a CMAF track to comply with one of the CMAF media profiles in Table B.1, it: — shall not exceed the tier, profile or level listed in the table
		For a CMAF track to comply with one of the CMAF media profiles in Table B.1, it: — shall conform to the colour_primaries, transfer_characteristics and matrix_coefficients values from the options listed in Table B.1 with the values defined in ISO/IEC 23008-2
		For a CMAF track to comply with one of the CMAF media profiles in Table B.1, it: — shall not exceed the width, height or frame rate listed in Table B.1, even if the HEVC level would permit higher values