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Information technology — Coding of audio-visual objects —

Part 32: File format reference software and conformance

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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*.

A list of all parts in the ISO/IEC 14496 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.

Information technology — Coding of audio-visual objects —

Part 32:
File format reference software and conformance

1 Scope

This document describes the reference software and conformance suite for the file format documents in MPEG-4 and MPEG-H. Since these documents share a lot of technology, their reference software and conformance program are being handled together. These documents are: ISO/IEC 14496-12, ISO/IEC 14496-14, ISO/IEC 14496-15, ISO/IEC 14496-30 and ISO/IEC 23008-12.

The purpose of the conformance suite is to cover the set of valid features that can be exercised in the file format. Media conformance is not covered, though of course in order to exercise the file format features, media will be stored.

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 14496-12, *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 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 23008-12, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 12: Image File Format*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 14496-12, ISO/IEC 14496-14, ISO/IEC 14496-15, ISO/IEC 14496-30 and ISO/IEC 23008-12 apply.

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

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

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

4 Reference software

The reference software for ISO/IEC 14496-12, ISO/IEC 14496-14, ISO/IEC 14496-15, ISO/IEC 14496-30 and ISO/IEC 23008-12 is provided at:

https://standards.iso.org/iso-iec/14496/-32/ed-1/en/reference_software/

Additional tools exercising features of the ISO base media file format (ISOBMFF) are described in Annex A.

5 Conformance

5.1 Overview

The conformance suite for ISO/IEC 14496-12, ISO/IEC 14496-14, ISO/IEC 14496-15, ISO/IEC 14496-30 and ISO/IEC 23008-12 is provided at:

https://standards.iso.org/iso-iec/14496/-32/ed-1/en/conformance/

The suite of conformance tests does not currently cover deliberately errored files. However, such files do occur in practice and implementations should be written to be resilient.

There is no official reference tool provided to check the conformance of files. However, such tools do exist (see Annex A). The reference software can be used to open files in 'debug' mode and provide a listing of what it finds, and other trade associations and standards bodies may have validation tools tailored to their areas.

An HTML report (conformance_report.html) indicates which code points (e.g. box codes and track reference types) defined in these documents are used in which conformance file.

5.2 Standard specific considerations

5.2.1 Considerations for ISO/IEC 14496-12, 14496-14 and 14496-15

For ISOBMFF conformance, an associated file (ff-conformance.xls) is used to list the features in groups, and to document which files exercise each feature. Features not currently covered by any file are marked with the sign "---".

The file ff-conformance.xls has two spreadsheets. The first briefly lists the areas and features covered, and then has a column for each proposed file. The second sheet provides a brief description of each area and feature, by line.

5.2.2 Considerations for ISO/IEC 14496-30

Two files are proposed regarding:

— WebVTT;

— TTML.

There are several general features of ISO/IEC 14496-30 which are not exercised in the above files, specifically:

— a track with 'mul' language;

— a track sharing resources (images, ...) between samples through the use of a MetaBox;

— file with a subtitle and a font track.

There are several features specific to the carriage of TTML in MP4 which are not exercised:

— timing:
  — 'empty' sample;
  — sample with a document containing a larger time range than the sample presentation range;
  — sample with a document whose time range is smaller than the sample range;
— sample entry format:
  — with multiple namespace values;
  — with schema location;
  — with auxiliary mime types;
— sample format:
  — with additional resources.

5.2.3 Considerations for ISO/IEC 23008-12

For HEIF conformance, an associated file (HEIF_conformance.xlsx) is used to describe the current files, associated input bitstreams, and a specification coverage analysis of the conformance.

The spreadsheet "HEIF_conformance.xlsx" contains information of the tested features and their mapping to the provided conformance files. It was created by picking all normative statements (shall, shall not, etc.) in the HEIF specification. These are collected in the "Areas tested" column of the sheet.

The column "Description" presents a brief description of the tested feature, exercising the associated normative statement in the specification.

The column "File ID" provides the file name.

The column "brands" indicates the HEIF brands that are included in `FileTypeBox` of the respective file (in the "Test Content" sheet) or concern the respective test case (in the "Test Cases" sheet. The aim of the column is to help implementers to pick files that concern the brand of their interest. For example, implementers of the `'heic'` brand should only consider the files with that brand included.

Note that the spreadsheet enables filtering by content, e.g. by selecting only a particular File ID (at cell A1), one can see which features are exercised by a particular file.

5.3 File documentation

5.3.1 Files from related conformance programs

5.3.1.1 Overview

Some files provided in this suite originate from external conformance programs, from other ISO documents or external specifications. The latest version should be obtained from their original source as indicated in the following sections.

5.3.1.2 Audio-based conformance files

ISO/IEC 14496-26 provides several MP4 files containing MPEG-4 AAC, MPEG-D MPS, and MPEG-D USAC streams and exercising features of the ISOBMFF. Within these files, only some are necessary to cover all the ISOBMFF features. These files are from the "AAC-Conformance" part. The features specifically exercised by these files compared to existing files are: "padb" and "m4ae".

The following files are also included for ISOBMFF conformance:

— ./mpeg-audio-conformance/ac01.mp4 (padb)

— ./mpeg-audio-conformance/sls2100_aot02_048_16.mp4 (m4ae)

Original files can be obtained from ISO/IEC 14496-26.

5.3.1.3 Timed text conformance files

DECE produced a set of Timed Text test vector files with video and audio tracks. Some of these files exercise features of ISO/IEC 14496-12 and ISO/IEC 14496-30. The following files are added as part of ISOBMFF conformance:

— ./uvvu/Solekai002_1280_23_1x1_v7clear.uvvu

— ./uvvu/Solekai007_1920_29_1x1_v7clear.uvvu

Original files can be obtained from http://uvvuwiki.com/cff/cff-test-files.html.

5.3.1.4 DASH-based conformance files

The ISO/IEC 23009 series specifies the use of ISOBMFF files for adaptive streaming. ISO/IEC 23009-2 contains the following files that exercise specific features of the ISOBMFF:

— ./green/video_2500000bps_0.mp4

— ./green/meta_2500000bps_0.mp4m

— ./nalu/svc/mp4-onDemand-LastTime-depRep.mp4

— ./nalu/mvc/DDF_10s_25fps.mp4

Original files can be obtained from http://testassets.dashif.org/.

5.3.1.5 MAF-based conformance files

The ISO/IEC 23000 series uses the ISOBMFF standard at its core and contains some files (related to the PAAF and VSAF standards). None of these files exercise new features, but they exercise some features differently. The following files are copied in this ISOBMFF conformance:

— ./maf/vsaf/1.mp4

— ./maf/paaf/01_output_a.paf

Original files can be obtained from ISO/IEC 23000-6 and ISO/IEC 23000-10.

5.3.2 Files unique to this conformance program

5.3.2.1 a1-foreman-QCIF.mp4

This file is about as simple as it gets. It has an MPEG-4 video part 2 visual track, and an AAC track, interleaved; and a minimal BIFS scene and OD track, with an IOD.

5.3.2.2 a2-foreman-QCIF-hinted.mp4

This file is basically the same as a1-foreman-QCIF.mp4 but hinted for RTP transmission.

5.3.2.3 a3-tone-protected.mp4

This file uses the protected stream structures. The keys are also supplied (a3c-prot-keys.txt), and the result of de-protection (a3b-tone-deprot.mp4, for comparison).

5.3.2.4 a4-tone-fragmented.mp4

This file uses movie fragments. The initial 1-second movie is followed by a 1-second movie fragment. Fragment-aware readers should play 2 second of content, fragment-unaware readers only 1 second.

5.3.2.5 a5-foreman-AVC.mp4

This is a very simple video-only main profile AVC file. Since it is main profile, composition offsets are used.

5.3.2.6 a6_tone_multifile.mp4

This is the same tone as used in test a4-tone-fragmented.mp4, but the actual access units are stored in a separate file, referenced by a relative URL "./myData.dat" from the main file.

5.3.2.7 a7-tone-oddities.mp4

This file also uses the 1-second tone. However, it has:

— a UUID,

— a non-standard 'junk' atom in it (which should be ignored),

— a free space box (also ignored),

— the compact sample size table,

— a padding bits table (though the padding bits are all set to zero).

The mdat atom has an implied length (the length in the file is zero, meaning to end of file).

5.3.2.8 a8-foreman_QCIF_edit.mp4

This file has the "foreman" 10 second of video, with 5 seconds before and after, of the "container" video. However, the edit list should select only foreman. The container ship should not appear. Note that the I-frames do not land on the edit boundaries. A player will have to pre-roll the video from an I-frame to work correctly.

5.3.2.9 a9-aac-samplegroups-edit.mp4

This file demonstrates the suggested way of handling AAC: it has a pre-roll sample group, and a track edit that is not aligned at either start or end with an AAC sample boundary.

5.3.2.10 a10-foreman_QCIF-raw.mp4

This file contains 'raw' (YUV420) video. Since this is an unregistered codec type (it's actually supported in QuickTime movie files) this is an unrecognized codec type from an ISOBMFF reader's point of view.

5.3.2.11 LargerThan4GB.mp4

This file tests handling of very large (>4GB) files.

The 'mdat' atom has a large (64-bit) size, and all the samples are at the end, preceded by 4GB of zeroes. Therefore, the chunk offset table is also a co64, not an stco. The actual media data is a simple AAC tone.

5.3.2.12 f1.mp4

This file is a simple AVC + AAC file. It has an MPEG-4 AVC Baseline visual track (including the optional BitrateBox), and an AAC track.

5.3.2.13 f2.mp4

This file is a protected AVC + AAC file. The 128-bit key for the decryption process is 0x01020304050607 080102030405060708 for both tracks. The salt (counter offset) is 0x0000000000000001 for the audio and 0x0000000000000002. Because of the usage of protected streams, “isom” was replace with “iso2” in the list of compatible brands.

5.3.2.14 male_amr122.3gp

This file and the following 3GP files contain AMR speech at 12.2 or 6.7 kbps, with or without DTX (silence frames). In addition, 3GP files with hint tracks are provided.

AMR 12.2kbps, no DTX

5.3.2.15 male_amr122DTX.3gp

AMR 12.2kbps, DTX

5.3.2.16 female_amr67_hinted.3gp

AMR 6.7kbps, no DTX, hint track

5.3.2.17 female_amr67DTX_hinted.3gp

AMR 6.7kbps, DTX, hint track

5.3.2.18 pdin_example.3gp

This file contains one video track with AVC and a progressive download information box specifying required initial delays for six different download rates. The download rates 5106, 7659, 10213, 12766, 15319 and 20426 bytes per second require initial delays of 20808, 7206, 1089, 652, 396 and 200 seconds, respectively.

5.3.2.19 rs_example_r1.3gp

This file contains three video tracks with AVC at different bitrates, three audio tracks with HE-AACv2 at different bitrates, track selection box, and rate share information with two operation points. For the first operation point (100 kilobits per second), the target rate shares are 20 % for audio and 80 % for video. For the second operation point (160 kilobits per second), the target rate share *weights* are 20 and 140 for audio and video, respectively. As the sum is not 100 for the second case, the numbers correspond to weights that need to be normalized by the server/player. Depending on the available bitrate, the server selects which tracks to stream/play.

5.3.2.20 01-simple.mp4

Simple AV file (MPEG-4 ASP video, AAC audio), BIFS+OD scene, 2 timelines (BIFS/OD and A/V), interleaved.

5.3.2.21 02-dref_edts_img.mp4

Image track, audio track with edit list, with media data located outside the file.

5.3.2.22 03-hinted.mp4

Simple video file with MPEG-4 ASP visual, hinted for RTP (IETF RFC 3640 payload).

5.3.2.23 04-bifs_video.mp4

Video (MPEG-4 ASP visual) + BIFS text (reading 'unprotected video'), with a single timeline.

5.3.2.24 05-bifs_video_protected_v2.mp4

Protected video (MPEG-4 ASP visual) + BIFS text (reading 'protected video'), with a single timeline. Keys are described in an item located in a meta box at the file root level, ISMA KMS URI referring to this item. Keys are:

— key 0x2b7e151628aed2a6abf7158809cf4f3c

— salt 0xf8f9fafbfcfdfeff

Only video I-frames are encrypted.

5.3.2.25 06-bifs.mp4

Simple animation with a single BIFS track. File moov box is located after mdat box.

5.3.2.26 07-bifs_sprite.mp4

Simple looping animation with two BIFS tracks, exercising decoding dependency and synchronization track references.

Animation track uses ShadowSync samples in-between regular samples.

5.3.2.27 08-bifs_carousel_v2.mp4

Simple animation with a single BIFS track. Random access samples are inserted in-between the samples for the BIFS carrousel and signalled with a sample dependency type box.

5.3.2.28 09-text.mp4

Sample MPEG-4 streaming text file, stored in 3GPP text track format, with 2 sample descriptions.

5.3.2.29 10-fragments.mp4

Simple AV file (MPEG-4 ASP video, AAC audio), BIFS+OD scene, stored as a sequence of 500 ms fragments.

5.3.2.30 12_metas_v2.mp4

File with a single image track, containing 3 metas (root, moov and track level). Meta at moov level has an item referencing the whole file.

5.3.2.31 13_long.mp4

Long duration file, with MPEG-4 ASP track (only I-frames present). Total file duration is 5000000000 sec. (158 Years 81 Days 08:53:20).

5.3.2.32 14_large.mp4

Large file exercising 64 bits chunk offset.

5.3.2.33 16_vtt.mp4

The file 16_vtt.mp4 contains the following boxes:

- wvtt
  - vttC
- vttc
  - ctim
  - iden
  - sttg
  - payl
- vtte
- vtta

5.3.2.34 17_negative_ctso.mp4

This file contains a single AVC video track with a ctts box using version 1. The box declares negative composition offset such that the offset of the first frame is 0.

5.3.2.35 18_pssh_v2.mp4

This file contains an encrypted video track. The file also contains 2 pssh boxes: one with only opaque data and the other one with KID information.

5.3.2.36 19_ttml.mp4

This file contains a simple TTML track.

5.3.2.37 20_stxt.mp4

This file contains a track of type 'stxt' whose content is SVG, the mime type is image/svg+xml. The SVG content is distributed over 4 samples. The configuration of the track contains the header of the SVG content.

5.3.2.38 21_segment.mp4

This file contains a self-initializing DASH media segment with the following boxes: 'sdix', 'prft', trun v1, sgpd.

5.3.2.39 22_tx3g.mp4

The file provides a simple 3GPP Timed Text stream stored in an mp4 file.

5.3.2.40 compact-no-code-fec-1.iso3

This file contains one JPEG file stored as an item. Compact No-Code FEC is used and the file is partitioned into one source block. The file contains also one hint track for FLUTE transmission.

5.3.2.41 compact-no-code-fec-2.iso3

This file contains one JPEG file stored as items. Compact No-Code FEC is used and the file is partitioned into three source blocks. The file contains also one hint track for FLUTE transmission.

5.3.2.42 mbms-fec.iso3

This file contains two JPEG files stored as items. MBMS-FEC is used and both files are partitioned into one source block and several sub-blocks. Parity symbols for the source block are stored as an FEC reservoir item. The file contains also three hint tracks for FLUTE transmission with FEC overheads 10 %, 20 % and 40 %. Each hint track defines transmission of both JPEG files over one FLUTE channel.

5.3.2.43 fragment-random-access-1+AF8-rev1.mp4

This uses movie fragment random access boxes (movie fragment random access, track fragment random access, movie fragment random access offset in ISO/IEC 14496-12). These boxes help readers to search where random access points are.

There are random access points at 1-sec interval.

For the purpose of reference, the initial 1-second movie is followed by a 14-second movie fragment. The movie consists of audio and video tracks. Fragment aware readers should play 15.3 seconds of content, fragment-unaware readers only 1 second.

5.3.2.44 fragment_random_access-2.mp4

This uses movie fragment random access boxes as 1.4.

There are random access points at 5-sec interval.

For the purpose of reference, the initial 1-second movie is followed by a 10.1-second movie fragment. The movie consists of audio and video tracks. Fragment aware readers should play 15,1 seconds of content, fragment-unaware readers only 5 seconds.

5.3.2.45 timed-metadata.mp4

Simple audio file with a timed-metadata track.

5.3.2.46 restricted.mp4

Features
- Post-decoder requirements on media
  - ‘resv’ box
  - ‘rinf’ box
  - ‘stvi’ box
  - ‘schi’ box

This bitstream exercises the method of restricting access to video media. The media itself is in stereoscopic 3D format with side-by-side frame packing.

5.3.2.47 sg-tl-st.mp4

Features

- Level assignment
  - ‘leva’ box
- Sub-tracks
  - ‘strk’ box
  - ‘stri’ box
  - ‘strd’ box
  - ‘stsg’ box
- Segment index box
  - ‘sidx’ box
- Sub-segment index box
  - ‘ssix’ box
- Temporal level sample group
  - Contained in ‘sgpd’ box
- Sample groups
  - ‘spgd’ box
  - ‘sbgp’ box

This bitstream exercises a method of splitting video media data such that it can be efficiently transmitted, decoded, and played back at full framerate or half framerate.

The first M samples in the ‘mdat’ box (sample group 1) give an independently decodable media segment, and the remaining samples (sample group 2) are not referenced by any samples in group 1.

Sample groups 1 and 2 are assigned to temporal levels 1 and 2 respectively. Each level is referenced as a byte range in the sub-segment index. Two sub-tracks are defined, the first of which applies just to sample group 1, and the second of which applies to the full range of samples.

5.3.2.48 subs_tile_hvc1.mp4

Features

- sub-sample information
  - ‘subs’ box
- hvc1 sample entry
  - ‘hvc1’ box

This file contains HEVC video track with associated tile-based sub-sample (flags = 2). The sub-sample information box (‘subs’) is used to provide information such as sub-sample sizes in bytes, priority, etc. without having to decode HEVC data. The sub-samples are derived by using entry point offsets found from the HEVC slice header. The values of discardable and subsample_priority fields in the ‘subs’ box are set to 0 and the field subsample_size is set to the entry point offset value.

5.3.2.49 subs_slice_hvc1.mp4

Features

- sub-sample information
  - ‘subs’ box
- hvc1 sample entry
  - ‘hvc1’ box

The file contains HEVC video track with associated slice-based sub-sample (flags = 4). Sub-sample is constructed by using the sizes of the slices. The values of discardable and subsample_priority fields in the ‘subs’ box are set to 0 and the field subsample_size is set to the slice size in bytes.

5.3.2.50 aggr_hvc1.mp4

Features

- aggregators
  - Aggregator container in the HEVC bit stream
  - Aggregates SHVC enchancement layer
- hvc1 sample entry
  - ‘hvc1’ box

This file includes an aggregator container around SHVC enhancement layer NAL units so that the video can be viewed and decoded as normal HEVC. Decoder supporting aggregators can increase video resolution by extracting the enhancement layer. Aggregator is a special type of NAL unit including or referring to a set of data. In this coded bit stream, the aggregator includes the aggregated data.

5.3.2.51 trgr_hvc1.mp4

Features

- track groups
  - ‘trgr’ box
- hvc1 sample entry
  - ‘hvc1’ box

This bit stream includes a ‘trgr’ box that groups related tracks together and a ‘hvc1’ box that contains the HEVC video configurations.

5.3.2.52 alst_hvc1.mp4

Features

- alternative startup (alst) sequences sample group
  - ‘sgpd’ box
  - ‘sbgp’ box
- RAP sample group
  - ‘sgpd’ box
  - ‘sbgp’ box
- hvc1 sample entry
  - ‘hvc1’ box

The alternative startup sequences sample group is indicated by two parameters: roll_count and first_output_sample, which specify the number of samples in the group and the first sample in the sequence to be sent to the output, respectively. In addition, the random access point (RAP) sample group is used to point the location of the sync samples where alst sample group could be found in the stream. The RAP sample group is composed of CRA/BLA/IDR/IRAP pictures. A position in the stream is sought among the RAP samples preceding the position of interest. If the selected sample also belongs to the alst sample group, alternative startup sequence is activated. With roll_count = 2 and first_output_sample = 1, S_0 is sent to a decoder, $S_1 \ldots S_7$ are skipped, and S_8 is sent to a decoder after which alternative startup sequence is complete and the decoding continues normally.

5.3.2.53 rtp_rtcp_reception_hint_tracks_v2.mp4

Features

- RTP Reception Hint Track sample entry
  - ‘rrtp’ box
- Timescale entry box
  - ‘tims’ box
- Time offset box
  - ‘tsro’ box
- Timestamp Synchrony box
  - ‘tssy’ box
- RTP Track SDP Hint Information box
  - ‘sdp ’ box
- RTCP Reception Hint Track sample entry
  - ‘rtcp’ box
- Track Reference Type Box: Content description
  - ‘cdsc’ box

- RTP movie information box
  - ‘rtp ’ box
- Hint media header (in RTP reception hint tracks)
  - ‘hmhd’ box
- Null media header box (in RTCP reception hint tracks)
  - ‘nmhd’ box

This file contains two media tracks, two RTP Reception Hint Tracks, and two RTCP Reception Hint Tracks. The file is composed of Received RTP Hint Sample Entry box (‘rrtp’) for the RTP Reception Hint Track description, timescale entry box (‘tims’) for timescale, time offset box (‘tsro’) for first sample RTP timestamp offset, and timestamp synchrony box (‘tssy’) for signaling whether a track has been synchronized during recording. `timestamp_sync` field has been set to 1 indicating no synchronization was done during recording. Both RTP Reception Hint Tracks also have an RTP Track SDP Hint Information box (‘sdp ’) containing a media description part of an SDP message. The RTCP reception Hint Tracks are described by Received RTCP Hint Sample Entry box (‘rtcp’). In addition, RTCP tracks have a Content Description box (‘cdsc’) that refers to the associated RTP Reception Hint Track. The part of the SDP message before the Media description can be found in `rtpmoviehintinformation` box (‘rtp ’). The Hint Media Header box (‘hmhd’) has statistics on the hint track.

5.3.2.54 hvc2_extractors.mp4

Features

- 'hvc1' and 'hvc2' sample entries
- Extractors with both inline constructors and sample constructors in samples of 'hvc2' track
- 'scal' track reference type

The file contains two tracks: an hvc1 base track, and an hvc2 extractor track. Each of these tracks carry their sample data in separate mdat boxes; that is, there is one mdat box with coded samples for the hvc1 track, and there is another mdat box that carries the extractor NAL units for the hvc2 track.

The hvc1 track carries a HEVC coded sequence containing 31 frames, where the first frame in decode order is an IDR frame and the rest are predicted B frames. Each frame of the coded sequence in this track has a spatial resolution of 512 × 256. Furthermore, every frame of this coded sequence is coded in a 2 × 2 tiling mode, where each tile has a spatial resolution of 256 × 128. Each tile is coded in a single slice and every slice contains only one tile. The tiles are motion-constrained, i.e., depend only on the collocated tiles in the reference pictures.

The hvc2 track is an extractor track, hence it contains a ‘scal’ type track reference in its tref box. Each sample of this track extracts one tile (the first tile in raster scan order) of the linked hvc1 track. The extracted NAL data is such that, resolving and constructing the samples of this track results in a valid HEVC bitstream.

5.3.2.55 hvc1_only.mp4

This file contains a single, non-scalable ‘hvc1’ track

5.3.2.56 hev1_only.mp4

This file contains a single, non-scalable ‘hev1’ track

5.3.2.57 hevc_tiles_single_track_nalm.mp4

This file contains:

— independent 3x3 tiled HEVC single layer;

— one ‘hvc2’ track;

— “trif” and “nalm” with groupID=0 sample group descriptions;

— sample to group box with grouping_type=“nalm” and grouping_type_parameter=“trif”.

5.3.2.58 hevc_tiles_single_track_nalm_rle.mp4

This file contains:

— independent 3×3 tiled HEVC single layer;

— one ‘hvc2’ track;

— sample to group box with grouping_type=“nalm” and grouping_type_parameter=“trif”;

— “trif” and “nalm” run-length encoded with groupID=0 sample group descriptions.

5.3.2.59 hevc_tiles_multiple_tracks.mp4

This file contains:

— independent 3×3 tiled HEVC single layer;

— one ‘hev1’ and 9 ‘hvt1’ tracks using “trif” with default sample group description;

— ‘tbas’ / ‘sabt’ track references for implicit reconstruction.

5.3.2.60 hevc_tiles_single_track_trif_full_picture.mp4

This file contains a single ‘hvc1’ track with ‘trif’ sample group description using full_picture flag.

5.3.2.61 hevc_tiles_single_track_nalm_all_intra.mp4

This file contains:

— independent 3×3 tiled HEVC single layer;

— one ‘hvc2’ track;

— “trif” with independent_idc=2 and “nalm” with groupID=0 sample group descriptions;

— sample to group box with grouping_type=“nalm” and grouping_type_parameter=“trif”.

5.3.2.62 shvc_hvc1_single_track.mp4

See mhvc_hvc1_single_track.mp4.

5.3.2.63 mhvc_hvc1_single_track.mp4

These files contain SHVC or MV-HEVC with the following features:

— Simple LHEVC bitstream in ‘hvc1’ track;

— HEVC and LHEVC config;

— ‘oinf’ and ‘linf’ sample groups.

5.3.2.64 shvc_hev1_single_track.mp4

See mhvc_hev1_single_track.mp4.

5.3.2.65 mhvc_hev1_single_track.mp4

These files contain SHVC or MV-HEVC with the following features:

— Simple LHEVC bitstream in ‘hev1’ track;

— all parameter sets are stored in-band;

— HEVC and LHEVC config;

— ‘oinf’ and ‘linf’ sample groups.

5.3.2.66 shvc_hvc2_single_track.mp4

See mhvc_hvc2_single_track.mp4.

5.3.2.67 mhvc_hvc2_single_track.mp4

These files contain SHVC or MV-HEVC with the following features:

— Simple LHEVC bitstream in ‘hvc2’ track;

— HEVC and LHEVC config;

— ‘oinf’ and ‘linf’ sample groups.

5.3.2.68 shvc_hev2_single_track.mp4

See mhvc_hev2_single_track.mp4.

5.3.2.69 mhvc_hev2_single_track.mp4

These files contain SHVC or MV-HEVC with the following features:

— Simple LHEVC bitstream in ‘hev2’ track;

— all parameter sets are stored in band;

— HEVC and LHEVC config;

— ‘oinf’ and ‘linf’ sample groups.

5.3.2.70 shvc_hvc1_hvc2_multiple_tracks_extractors.mp4

See mhvc_hvc1_hvc2_multiple_tracks_extractors.mp4.

5.3.2.71 mhvc_hvc1_hvc2_multiple_tracks_extractors.mp4

These files contain SHVC or MV-HEVC with the following features:

— LHEVC bitstream in ‘hvc1’ track (base layer) and ‘hvc2’ track (enhancement layer);

— HEVC and LHEVC config;

— ‘oinf’ and ‘linf’ sample groups Extractors, ‘oref’, ‘sbas’ and ‘scal’ track references;

— ‘hvce’ brand.

5.3.2.72 shvc_hev1_hev2_multiple_tracks_extractors.mp4

See mhvc_hev1_hev2_multiple_tracks_extractors.mp4.

5.3.2.73 mhvc_hev1_hev2_multiple_tracks_extractors.mp4

These files contain SHVC or MV-HEVC with the following features:

— LHEVC bitstream in ‘hev1’ track (base layer) and ‘hev2’ track (enhancement layer);

— HEVC and LHEVC config;

— ‘oinf’ and ‘linf’ sample groups;

— Extractors, ‘oref’, ‘sbas’ and ‘scal’ track references;

— all parameter sets are stored in-band;

— ‘hvce’ brand.

5.3.2.74 shvc_hvc1_lhv1_multiple_tracks_implicit.mp4

See mhvc_hvc1_lhv1_multiple_tracks_implicit.mp4.

5.3.2.75 mhvc_hvc1_lhv1_multiple_tracks_implicit.mp4

These files contain SHVC or MV-HEVC with the following features:

— LHEVC bitstream in ‘hvc1’ track (base layer) and ‘lhv1’ track (enhancement layer);

— LHEVC config in ‘lhv1’ only;

— ‘oinf’ and ‘linf’ sample groups;

— No extractors, ‘oref’ and ‘sbas’ track references;

— ‘hvci’ brand.

5.3.2.76 shvc_hev1_lhe1_multiple_tracks_implicit.mp4

See mhvc_hev1_lhe1_multiple_tracks_implicit.mp4.

5.3.2.77 mhvc_hev1_lhe1_multiple_tracks_implicit.mp4

These files contain SHVC or MV-HEVC with the following features:

— LHEVC bitstream in ‘hev1’ track (base layer) and ‘lhe1’ track (enhancement layer);

— LHEVC config in ‘lhe1’ only;

— ‘oinf’ and ‘linf’ sample groups No extractors, ‘oref’ and ‘sbas’ track references;

— all parameter sets are stored in-band;

— ‘hvci’ brand.

5.3.2.78 shvc_hev1_lhe1_multiple_tracks_implicit.mp4

See mhvc_hev1_lhe1_multiple_tracks_implicit.mp4.

5.3.2.79 mhvc_hev1_lhe1_multiple_tracks_implicit.mp4

These files contain SHVC or MV-HEVC with the following features:

— LHEVC bitstream in 'hev1' track (base layer) and 'lhe1' track (enhancement layer);

— LHEVC config in 'lhe1' only;

— 'oinf' and 'linf' sample groups No extractors, 'oref' and 'sbas' track references;

— all parameter sets are stored in-band;

— 'hvci' brand.

5.3.2.80 lhevc_avc1_lhv1.mp4

This file contains an AVC base and an SHVC enhancement layer with the following features:

— one avc1 track;

— one lhv1 track with oinf and linf;

— one sbas track reference from SHEVC to AVC track;

— all parameter sets in config records.

5.3.2.81 lhevc_avc1_lhe1.mp4

This file contains an AVC base and an SHVC enhancement layer with the following features:

— one avc1 track;

— one lhv1 track with oinf and linf;

— one sbas track reference from SHEVC to AVC track;

— all parameter sets in config records for AVC, inband for SHVC.

5.3.2.82 lhevc_avc3_lhv1.mp4

This file contains an AVC base and an SHVC enhancement layer with the following features:

— one avc1 track;

— one lhv1 track with oinf and linf;

— one sbas track reference from SHEVC to AVC track;

— all parameter sets in config records for SHVC, inband for AVC.

5.3.2.83 lhevc_avc3_lhe1.mp4

This file contains an AVC base and an SHVC enhancement layer with the following features:

— one avc1 track;

— one lhv1 track with oinf and linf;

— one sbas track reference from SHEVC to AVC track;

— all parameter sets in-band AVC and SHVC.

5.3.2.84 hevc_hvc1_hvc2_implicit.mp4

This file contains an HEVC base and an HEVC temporal sublayer with the following features:

— one hvc1 track with temporalID 0;

— one hvc2 track with temporalID 1;

— linf and rap sample group;

— sbas track references from hvc2 to hvc1 track;

— all parameter sets in config records;

— no extractors;

— 'hvci' brand.

5.3.2.85 hevc_hev1_hev2_implicit.mp4

This file contains an HEVC base and an HEVC temporal sublayer with the following features:

— one hev1 track with temporalID 0;

— one hev2 track with temporalID 1;

— linf and rap sample group;

— sbas track references from hev2 to hev1 track;

— all parameter sets in-band;

— no extractors;

— 'hvci' brand.

5.3.2.86 hevc_hvc1_hvc2_extractors.mp4

This file contains an HEVC base and an HEVC temporal sublayer with the following features:

— one hvc1 track with temporalID 0;

— one hvc2 track with temporalID 1;

— linf and rap sample group;

— sbas and scal track references from hvc2 to hvc1 track;

— all parameter sets in config records;

— extractors;

— 'hvce' brand.

5.3.2.87 hevc_hev1_hev2_extractors.mp4

This file contains an HEVC base and an HEVC temporal sublayer with the following features:

— one hev1 track with temporalID 0;

— one hev2 track with temporalID 1;

— linf and rap sample group;