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**ISO/IEC JTC 1/SC 29/WG 03 MPEG SYSTEMS**

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New handling of FileFormat conformance suite

During MPEG#137 a new way of handling the conformance files was adopted as proposed in [6]. All the conformance files are uploaded to MPEG File Server and published on a HTTP server with the publicly [accessible URL](https://conformance.mpeg.expert/ISOBMFF/). A [public GitHub repository](https://github.com/MPEGGroup/FileFormatConformance) was created where all the work around the file format conformance will happen from now on. New files are contributed to the conformance suite while following the new [contribution guidelines](https://github.com/MPEGGroup/FileFormatConformance/blob/main/CONTRIBUTING.md). The new GitHub repository is still work in progress and will be gradually updated to enable new features to improve the work with conformance files.

All the files which are presented in this document can be downloaded from:

<https://conformance.mpeg.expert/ISOBMFF/under_consideration/>

During MPEG#138 new conformance files were added to the suite. First, examples of event message track files were provided. A realistic example resulting from a live ingest dump by Ateme Titan Live was provided, which conforms to the ISO IEC 23001-18 specification. In addition, two example files were provided including one with and one without overlaps. All examples were in the space of carrying SCTE-35 messages. Second, the support of multiplexed timed metadata tracks ‘mebx’ was added to the reference software together with a sample file inluding a video track with a linked mebx track.

During MPEG#139 it was proposed to change the workflow of the File Format group to be more aligned with the conformance and reference software program [7]. The group agreed that conformance files of all features defined in a specification should be provided and that a cross-verification process would be beneficial for the work. This item needs some further study and an AHG mandate was created to address this work.

Compressed boxes conformance

A set of new conformance test vectors for ISOBMFF Compressed Boxes were provided by Telecom Paris during MPEG#134 meeting [1]. The conformance files were created using latest GPAC version available at <http://gpac.io>, with source code available at <https://github.com/gpac/gpac>. All sequences show a 2 seconds long video counter at 25fps. Note that due to the sequence being very short, the ‘sidx’ and ‘ssix’ boxes are being forced to their compressed versions, although their original sizes are smaller than their compressed sizes.

All 7 conformance files with compressed boxes are located in “./isobmff\_conformance/comp” directory.

comp\_moov\_isoc.mp4:

The file contains a compressed moov and ‘isoC’ brand.

comp\_moov\_otyp.mp4:

The file contains a compressed moov, a ‘ftyp’ with major brand ‘comp’ and a ‘otyp’ wrapping the original ‘ftyp’ with various brand info.

comp\_moof\_nobrand.mp4:

The file contains an empty ‘moov’, no changes in brand info and compressed ‘moof’. A player not understanding compressed boxes could see this file as an init segment (empty ‘moov’ only).

comp\_moof\_otyp.mp4:

The file contains ‘ftyp’=comp, ‘otyp’, an uncompressed empty ‘moov’ and compressed ‘moof’.

comp\_moof\_sidx\_otyp.mp4:

The file contains ‘ftyp’=comp, ‘otyp’, an uncompressed empty ‘moov’ and compressed ‘moof’ and ‘sidx’.

comp\_moof\_sidx\_ssix\_otyp.mp4:

The file contains ‘ftyp’=comp, ‘otyp’, an uncompressed empty ‘moov’ and compressed ‘moof’, ‘sidx’ and ‘ssix’.

comp\_all\_otyp.mp4:

The file contains ‘ftyp’=comp, ‘otyp’ and compressed empty ‘moov’, ‘moof’, ‘sidx’ and ‘ssix’.

Common encryption conformance

A set of new conformance test vectors for Common Encryption (CENC) were provided by Telecom Paris during MPEG#134 meeting [1]. The conformance files include common encryption technologies such as: CENC, CBC1, CENS, CBCS, sample group description for keys, Item encryption and Multi-Key per sample. The CENC conformance files were created using latest GPAC version available at <http://gpac.io>, with code source available at <https://github.com/gpac/gpac>.

All CENC conformance files are located in “./isobmff\_conformance/cenc” directory. Whereby

all DRM configuration files are located in the “./isobmff\_conformance/drm\_cfg” folder, each file containing the KID and key value for each key used. Each protected ISOBMF file also contains a PSSH box using GPAC test system ID, which contains the key values in the PSSH for simple decryption without KMS.

All video sequences show a 2s video counter at 25fps, 1280x720, 420 8 bit HEVC 3x3 motion constrained tile-set. All audio sequences play a 2s audio bip/bop at 44100Hz, mono, AAC. All image sequences show a single HEVC picture of size 1280x720, 420 8 bit, 3x3 tiled.

Basic CENC Conformance

The added sequences are covering most of 23001-7. The only feature not present in these proposed sequences is the presence of non-protected samples in a protected track, as this is under revision in 23001-7:2016 CDAM 2.

The files “**\*\_frag1s.mp4**“ test ‘seig’ sample to group mapping in movie fragments.

Item Encryption and Multi-Key Conformance

The proposed files are “**image\_\***” and “**video\_cenc\_mkey\_\***”. Both CENC-128 and CBCS with constant IV are tested.

Files “**\*\_cenc\_mkey\_subs\*”** and “**\*\_cbcs\_mkey\_const\_iv\_subs\***” only perform partial encryption of the tiles in the source frames.

When playing the content with GPAC, keys can be disabled using the option drop\_keys.

For example:

gpac -play video\_cbcs\_mkey\_const\_iv\_subs.mp4 –drop\_keys=1

This will decrypt the VCL NALUs associated with key 2 but will not decrypt NALUs associated with key 1.

VVC conformance

A set of new conformance test vectors for carriage of VVC in ISOBMFF were contributed by Nokia during MPEG#134 meeting [2] and updated during MPEG#135 [3], MPEG#136 [4] and MPEG#137 [5]. All the VVC encoded bitstreams which were used for packaging are conforming to v12.0 and/or v13.0 of the VTM reference software. The packaging was done using the software from Nokia located at: <https://github.com/nokiatech/heif/tree/VVC_MP4>

All VVC conformance files are located in “./isobmff\_conformance/VVC” directory and also at the MPEG FS server at:

https://mpegfs.int-evry.fr/mpegcontent/ under

/MPEG-04/Part15-VVC\_File\_Format/ConformanceTestVectors/Nokia/

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | **Filename** | **Source** | **Encoded/Input VVC bitstream** | **VVC FF features and related clauses of [1]** |
| 1 | vvc\_basic\_track.mp4 | BasketballPass/BlowingBubbles | HRD\_A\_Fujitsu\_3.bit \* | Single layer coded bitstream in VVC track with sample entry 'vvc1' (11.3.1) |
| 2 | vvc\_subpicture\_tracks.mp4 | Balboa 360 sequence | Balboa sequence 4 subpictures with QP 28 and 4 subpictures with QP 32 768x768\_60Hz\_8b\_420 | Single layer coded bitstream with subpictures. One VVC base track with sample entry 'vvc1' (11.3.1),  four subpictures coded with two different QPs in 8 VVC subpicture tracks with sample entry 'vvs1' (11.3.2), VVC merge base track has 'subp' track reference to VVC subpicture tracks (11.1.5) (11.3.1) (11.6.4), VVC subpicture tracks are grouped by 'alte' track grouping (11.1.5)(11.6.4), subpicture order sample grouping 'spor' with num\_subpic\_ref\_idx equal to 0 (same order) (11.4.16), Subpicture layout map entry 'sulm' (11.4.17) |
| 3 | vvc\_subpicture\_tracks\_spor\_ordered.mp4 | Balboa 360 sequence | Balboa sequence 4 subpictures with QP 32 768x768\_60Hz\_8b\_420 | Single layer coded bitstream with subpictures. One VVC base track with sample entry 'vvc1' (11.3.1),  four subpictures coded in 4 VVC subpicture tracks with sample entry 'vvs1' (11.3.2), VVC merge base track has 'subp' track reference to VVC subpicture tracks (11.1.5) (11.3.1) (11.6.4), subpicture order sample grouping 'spor' with num\_subpic\_ref\_idx greater than 0 (different order) (11.4.16), |
| 4 | vvc\_substitute\_subpicture\_single\_sample\_track.mp4 |  | Balboa sequence 4 subpictures with QP 28 768x768\_60Hz\_8b\_420 | Single layer coded bitstream with subpictures. One VVC base track with sample entry 'vvc1' (11.3.1),  four subpictures coded in 4 VVC subpicture tracks with sample entry 'vvs1' (11.3.2), 4 substitute subpicture track with sample entry 'vvs1' (only one sample in the track) (11.3.2) (In VvcNALUConfigBox flags&1=1), VVC merge base track has 'subp' track reference to VVC subpicture tracks (11.1.5) (11.3.1) (11.6.4), subpicture order sample grouping 'spor' with num\_subpic\_ref\_idx equal to 0 (same order) (11.4.16), |
| 5 | vvc\_substitute\_subpictures\_all\_frames.mp4 |  | Balboa sequence 4 subpictures with QP 28 768x768\_60Hz\_8b\_420 | Single layer coded bitstream with subpictures. One VVC base track with sample entry 'vvc1' (11.3.1),  four subpictures coded in 4 VVC subpicture tracks with sample entry 'vvs1' (11.3.2), 4 substitute subpicture track with sample entry 'vvs1' (time aligned samples) (11.3.2) (In VvcNALUConfigBox flags&1=1), VVC base track has 'subp' track reference to VVC subpicture tracks (11.1.5) (11.3.1) (11.6.4), subpicture order sample grouping 'spor' with num\_subpic\_ref\_idx equal to 0 (same order) (11.4.16), |
| 6 | vvc\_mixed\_nal\_subpicture\_tracks.mp4 |  | MNUT\_B\_Nokia\_3.bit \* | Single layer coded bitstream with subpictures having mixed NAL unit type. One VVC base track with sample entry 'vvc1' (11.3.1),  four subpictures coded in 4 VVC subpicture tracks with sample entry 'vvs1' (11.3.2), VVC merge base track has 'subp' track reference to VVC subpicture tracks (11.1.5) (11.3.1) (11.6.4), VVC merge base track has 'mixn' track reference to VVC subpicture tracks (11.4.18) (11.3.1)  subpicture order sample grouping 'spor' with num\_subpic\_ref\_idx equal to 0 (same order) (11.4.16), mixed NAL unit type pictures sample group 'minp' (11.4.18) same NAL unit type track grouping 'snut' (11.3.1) (11.4.18)(11.6.5) |
| \* VVC bitstreams submitted to JVET conformance testing | | | | |

Event Message Track Sample Files

Overview of files

|  |  |
| --- | --- |
| **File** | **Description** |
| IF1\_V2\_captures/data-2-Data3\_3.mp4 | Captured file from Ateme Titan Live of event message track |
| IF1\_V2\_captures/ audio-und-128000.isma | Associated audio track capure from titan live |
| video-720x480-500000.ismv | Associated video track capure from titan live |
| out\_avail\_track.cmfm | Avail track generated with unified open-source implementation using reference without overlaps |
| out\_avail\_track.mpd | Corresponding EventStream element |
| out\_overlap.cmfm | Avail track generated with unified open- source implementation using reference with overlaps |
| avail\_overlap.mpd | Corresponding edited EventStream element |

Ateme Titan Live Event Message Track output

Ateme Titan Live is an encoding solution that is currently developed and promoted by Ateme. As part of its implementation, it added support for the live media ingest protocol specified in DASH-IF [1] and as part of that spec references ISO/IEC 23001-18 support for timed metadata in segments was also implemented. Traces for joint audio, video and MPEG-B part 18 metadata including SCTE-35 markers are attached in the contribution.

Event Message Track implementation by Unified Streaming

Another example file is created using the open source/reference implementation from Unified streaming that is currently available In https://github.com/unifiedstreaming/EventMessageTrack.git (see m58052). This implementation includes some tools to help understanding and implementing ISO IEC 23001-18. The example track files were generated using the command line as follows:

gen\_avail\_track.exe 600000 2000 30000 180000

This command generated an event message track of 600 seconds (10 minutes) with 2 second segments, and 30 second ad break avails using a SCTE-35 splice\_insert message every 180 seconds (3 minutes). This program also created the example EventStream that is written and included as attachment in out\_avail\_track.mpd. The event message track is out\_avail\_track.cmfm and attached to the contribution.

To create a file with overlaps, the out\_avail\_track.mpd was edited to make the events overlap resulting in avail\_overlap.mpd. This avail\_overlap.mpd was then converted to another event message track file using the command:

dash\_event\_fmp4.exe avail\_overlap.mpd out\_overlap.cmfm 1 2000

This command converts an MPD or EventStream element to a sparse track with id 1 and a segment duration of 2000 ms.

Validation

A separate validation suite was implemented and added to unified validator, which is an experimental mp4 checking and conformance tool: https://validator.unified-streaming.com/. By selecting the pull down event track the checks for event tracks are chosen. The implemented checks for the event message track are documented: https://validator.unified-streaming.com/docs/available\_suites/timed-metadata-recommendations.html

All files passed the validation process.

Multiplexed timed metadata track (mebx)

The mebx sample file uses the pattern NIbFD which repeats 6 times giving a total of 30 frames for the video track (1 second duration). The metadata associated with each frame is summarized in the table below:

Table : Metadata per frame (this pattern repeats 6 times)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Metadata | N  Netherlands | I  Indonesia | b  Blue | F  France | D  Germany |
| Red | 0,0,64,16 | 0,0,64,24 | NULL | 44,0,20,48 | 0,16,64,16 |
| Blue | 0,32,64,16 | NULL | 0,0,64,48 | 0,0,20,48 | NULL |
| Yellow | NULL | NULL | NULL | NULL | 0,32,64,16 |
| White | 0,16,64,16 | 0,24,64,24 | NULL | 20,0,24,48 | NULL |
| Black | NULL | NULL | NULL | NULL | 0,0,64,16 |

Test file

The file **test\_mebx\_me4c.mp4** uses key\_namespace=me4c for all metadata items from Table 1. The color sample format is defined as:

class ColorSample extends Box(local\_key\_id){  
 unsigned int(32) x;  
 unsigned int(32) y;  
 unsigned int(32) width;  
 unsigned int(32) height;  
}

key\_value from the MetadataKeyDeclarationBox is used as the local\_key\_id with the following FourCCs:

* redd Red color
* blue Blue color
* ylow Yellow color
* whte White color
* blck Black color

References

1. Jean Le Feuvre, "Input on ISOBMFF conformance", Telecom ParisTech, MPEG#134 [m56755](https://dms.mpeg.expert/doc_end_user/current_document.php?id=78658)
2. Kashyap Kammachi-Sreedhar, Miska M. Hannuksela, Emre B. Aksu (Nokia), Lasse Heikkilä (Vincit), "VVC in 14496-15 conformance test vectors", Nokia, MPEG#134 [m56817](https://dms.mpeg.expert/doc_end_user/current_document.php?id=78720)
3. Kashyap Kammachi-Sreedhar, Miska M. Hannuksela, Emre B. Aksu (Nokia), Lasse Heikkilä (Vincit), "VVC in 14496-15 conformance test vectors update”, Nokia, MPEG#135 [m57436](https://dms.mpeg.expert/doc_end_user/current_document.php?id=79628)
4. Kashyap Kammachi-Sreedhar, Miska M. Hannuksela, Emre B. Aksu (Nokia), Lasse Heikkilä (Kodan), “VVC in 14496-15 conformance test vectors update”, [m58142](https://dms.mpeg.expert/doc_end_user/current_document.php?id=80602)
5. Kashyap Kammachi-Sreedhar, Miska M. Hannuksela, Emre B. Aksu (Nokia), Lasse Heikkilä (Kodan), “VVC in 14496-15 conformance test vectors update”, m58915
6. Dimitri Podborski, “On File Format conformance”, [m58518](https://dms.mpeg.expert/doc_end_user/current_document.php?id=81248)
7. Cyril Concolato, Dimitri Podborski, " On File Format Conformance and Reference Software", [m60397](https://dms.mpeg.expert/doc_end_user/current_document.php?id=83643)