CHANGE REQUEST

DASH-IF IOP	CR	0002	rev	-	Current version:	3.3

Status:		Draft		Internal Review	X	Community Review		Agreed

Title:	Addition of HEVC-based UHD Video to DASH-IF IOP
Source:	DASH-IF UHD Task Force
Supporting Companies:	Qualcomm Incorporated, Comcast/NBCUniversal, Brightcove, Harmonic, Ericsson
Category:	**A** ***Date:*** 2016-07-14 *Use one of the following categories:* ***C*** *(correction)* ***A*** *(addition of feature)* ***B*** *(editorial modification)*

Reason for change:	UHD is a relevant technology for improved user experience. UHD includes the ability to distribute video signals at higher spatial resolution, higher frame rates, wider color gamut and higher dynamic range. This first set of extensions for UHD focus on HEVC-based technologies to address higher spatial resolution in one case, and in the second case the addition of wide color gamut and high dynamic range. All technologies are based on HEVC decoding and regular display processing technologies. DASH is primarily used as a carriage format.
Summary of change:	Two Extensions are added: 1) 4K Extension 2) 4K Extension with HDR and WCG In all cases the elementary stream constraints as well as DASH-specific aspects are addressed.
Consequences if not approved:	Not applicable.

Sections affected:	Acronyms, Abbreviations and Definitions; References; 1; 10 (new)
Other comments:	

Disclaimer:	This document is not yet final. It is provided for public review until the deadline mentioned below. If you have comments on the document, please submit comments by one of the following means: - at the github repository https://github.com/Dash-IndustryForum/IOP/issues (public at https://gitreports.com/issue/haudiobe/DASH-IF-IOP) - dashif+iop@groupspaces.com with a subject tag [UHD], or Please add a detailed description of the problem and the comment. Based on the received comments a final document will be published latest by the expected publication date below, integrated in a new version of DASH-IF IOP if the following additional criteria are fulfilled: - All comments from community review are addressed - The relevant aspects for the Conformance Software are provided - Verified IOP test vectors are provided
Commenting Deadline:	August 15th, 2016
Expected Publication:	August 31st, 2016

Acronyms, abbreviations and definitions

Add at the end

HDR	High Dynamic Range
HFR	High Frame Rate
UHD	Ultra High Definition
WCG	Wider Colour Gamut

References

[XX] SMPTE ST 2084:2014, “Mastering Display Color Volume Metadata Supporting High Luminance and Wide Color Gamut Images”

[XY] ISO/IEC 23001-8:2013, “Information technology -- MPEG systems technologies -- Part 8: Coding-independent code points”, available here: http://standards.iso.org/ittf/PubliclyAvailableStandards/c062088_ISO_IEC_23001-8_2013.zip

[ZX] Recommendation ITU-R BT.709-6 (06/2015): "Parameter values for the HDTV standards for production and international programme exchange".

[ZY] Recommendation ITU-R BT.2020-1 (06/2014): "Parameter values for ultra-high definition television systems for production and international programme exchange".

[ZZ] ETSI TS 101 154 v2.2.1 (06/2015): "Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream."

[BB] ETSI TS 103 285 v1.1.1 (05/2015): "Digital Video Broadcasting (DVB); MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks.”

[CC] 3GPP TS 26.116 (03/2016): "Television (TV) over 3GPP services; Video Profiles.”

[DD] DECE (05/2015): “Common File Format & Media Formats Specification”, http://uvcentral.com/sites/default/files/files/PublicSpecs/CFFMediaFormat-2_2.pdf

1 Introduction

This document extends the DASH-IF's InterOperability Points (IOPs) to add support for UHD Extensions, see Table 2.

Extensions	Identifier	Version	Section
DASH-IF UHD HEVC 4k	`http://dashif.org/guidelines/dash-if-uhd#4k`	3.X	10.2
DASH-IF UHD HDR10	`http://dashif.org/guidelines/dash-if-uhd#hdr10`	3.X	10.3

10 DASH-IF UHD Extensions

10.1 Introduction

This version of the document defines UHD Extensions in this section.

10.2 DASH-IF UHD HEVC 4k

10.2.1 Introduction

For the support of broad set of use cases the DASH-IF IOP HEVC 4k Extension is defined. UHD 4k video encoded with H.265/HEVC is an advanced distribution format for TV services that enables higher resolution experiences in an efficient manner.

In addition, the features of DASH-IF IOP Main as defined in section xxx and DASH-265/HEVC as defined in section xxx, this extension adds the Main interoperability point to include 4k resolutions at 60fps, and restricts the codec support to HEVC Level 5.1.

The conformance to *DASH-IF IOP 4k* may be signaled by a `@profile` attribute with the value `http://dashif.org/guidelines/dash-if-uhd#4k`

10.2.2 Elementary Stream Requirements

10.2.2.1 Constraints on Picture Formats

NAL Structured Video streams conforming to this Media Profile SHALL NOT exceed the following coded picture format constraints:

- Maximum encoded horizontal sample count of 3840 samples
- Maximum encoded vertical sample count of 2160 samples
- Maximum Frame Rate of 60000 / 1000 (Frame Rate is calculated as per Section xxx)

Additional coded picture format constraints:

- The source video format shall be progressive.
- Representations in one Adaptation Set shall only differ on the following parameters: Bitrate, spatial resolution, frame rate
- The condition of the following SHALL NOT change throughout one HEVC video track:
    - `aspect_ratio_idc`
    - `cpb_cnt_minus1`

    - bit_rate_scale
    - bit_rate_value_minus1
    - cpb_size_scale
    - cpb_size_value_minus1
- The following fields SHALL NOT change throughout an HEVC elementary stream:
    - pic_width_in_luma_samples
    - pic_height_in_luma_samples
- YCbCr shall be used as the Chroma Format and 4:2.0 for color sub-sampling.The bit depth of the content shall be either 8 bit or 10 bit. The content shall be restricted to the HEVC video codec. See Section xxx for details about HEVC encoding.
- The color primaries shall be ITU-R BT.709.

10.2.2.2 Bitstream Requirements and Recommendations

A bitstream conforming to the H.265/HEVC 4k media profile shall comply with the Main Tier Main Profile Level 5.1 restrictions, as specified in Recommendation ITU-T H.265 / ISO/IEC 23008-2 [35].

UHD HEVC 4k Bitstreams shall set `vui_parameters_present_flag` to 1 in the active Sequence Parameter Set, i.e. HEVC bitstreams shall contain a Video Usability Information syntax structure.

The sample aspect ratio information shall be signaled in the bitstream using the `aspect_ratio_idc` value in the Video Usability Information (see values of `aspect_ratio_idc` in Recommendation ITU-T H.265 / ISO/IEC 23008-2:2013 [35], table E-1). UHD HEVC 4k bitstreams shall represent square pixels indicated by `aspect_ratio_idc` SHALL be set to 1.

In addition to the provisions set forth in Recommendation ITU-T H.265 / ISO/IEC 23008-2:2013 [35], the following restrictions shall apply for the fields in the sequence parameter set:

- `vui_parameters_present_flag = 1`
- `sps_extension_flag = 0`
- `fixed_pic_rate_general_flag = 1`
- `general_interlaced_source_flag = 0`

In addition to the provisions set forth in Recommendation ITU-T H.265 / ISO/IEC 23008-2:2013 [35], the following restrictions shall apply for the fields in the `profile_tier_level` syntax structure in the sequence parameter set:

- `general_tier_flag` = 0
- `general_profile_idc` = 0 or 2

UHD HEVC 4k bitstreams shall obey the limits in Recommendation ITU-T H.265 / ISO/IEC 23008-2:2013 [35], table A.1 and table A.2 associated to Level 5.1. `general_level_idc` shall be less than or equal to `153` (level 5.1).

It is recommended that bitstreams which are compliant with the Main or Main10 profile set `general_profile_compatibility_flag[1]` to 1.

The chromaticity co-ordinates of the ideal display, opto-electronic transfer characteristic of the source picture and matrix coefficients used in deriving luminance and chrominance signals from the red, green and blue primaries shall be explicitly signaled in the encoded HEVC Bitstream by setting the appropriate values for each of the following 3 parameters in the VUI: `colour_primaries`, `transfer_characteristics`, and `matrix_coeffs`.

BT.709 [ZX] colorimetry usage is signalled by setting `colour_primaries` to the value `1`, `transfer_characteristics` to the value `1` and `matrix_coeffs` to the value `1`.

The bitstream may contain SEI messages as permitted by the Recommendation ITU-T H.265 / ISO/IEC 23008-2:2013 [35]. Details on these SEI messages are specified in Recommendation ITU-T H.265 / ISO/IEC 23008-2 / Annex D.

10.2.2.3 Receiver Requirements

Receivers conforming to the HEVC 4k media profile SHALL support decoding and displaying H.265/HEVC 4kbitstreams as defined in clause 10.2.2.2.

No additional processing requirements are defined, for example processing of SEI messages is out of scope.

10.2.3 Mapping to DASH

10.2.3.1 Media Profile Identifier

If all Representations in an Adaptation Set conforms to the elementary stream constraints for the Media Profile as defined in clause 10.2.2.3 and the Adaptation Set conforms to the MPD signaling according to clause 10.2.3.2 and 10.2.3.4, and the Representations conform to the file format constraints in clause 10.2.3.3, then the `@profiles` parameter in the Adaptation Set may signal conformance to this operation point by using "`http://dashif.org/guidelines/dash-if-uhd#4k`"

10.2.3.2 MPD Signaling

The MPD shall conform to DASH-IF HEVC Main IOP as defined with the additional constraints defined in clause 10.2.3.4.

10.2.3.3 File Format Requirements

Representations used in the context of the specification shall conform to the ISO BMFF Segment format with the following further requirements:

- The value of the `duration` field in the Movie Header Box ('`mvhd`') shall be set to a value of '0'
- The Track Header Box ('`tkhd`') shall obey the following constraints:
    - The value of the `duration` field shall be set to '0'.
    - The `width` and `height` fields for a visual track shall specify the track's visual presentation size as fixed-point 16.16 values expressed in on a uniformly sampled grid (commonly called square pixels)
- The Media Header Box ('`mdhd`') shall obey the following constraints:
    - The value of the `duration` field shall be set to '0'.
- The Video Media Header ('`vmhd`') shall obey the following constraints:
    - The value of the `version` field shall be set to '0'.
    - The value of the `graphicsmode` field shall be set to '0'.
    - The value of the `opcolor` field shall be set to {'0', '0', '0'}.

- The Sample Description Box (‘stsd’) shall obey the following constraints:
    - A visual sample entry shall be used.
    - The box shall include a NAL Structured Video Parameter Set
    - the maximum width and height values shall correspond to the maximum cropped horizontal and vertical sample counts indicated in any Sequence Parameter Set in the track
    - It shall contain a Decoder Configuration Record which signals the Profile, Level, and other parameters in the video track.
- The entry_count field of the Sample-to-Chunk Box (‘stsc’) shall be set to ‘0’.
- Both the sample_size and sample_count fields of the Sample Size Box (‘stsz’) box shall be set to zero (‘0’). The sample_count field of the Sample Size Box (‘stz2’) box shall be set to zero (‘0’). The actual sample size information can be found in the Track Fragment Run Box (‘trun’) for the track.

  Note: this is because the Movie Box (‘moov’) contains no media samples.
- The entry_count field of the Chunk Offset Box (‘stco’) shall be set to ‘0’.
- Movie Fragment Header Boxes (‘mfhd’) shall contain sequence_number values that are sequentially numbered starting with the number 1 and incrementing by +1, sequenced by movie fragment storage and presentation order.
- Any Segment Index Box (‘sidx’), if present, shall obey the additional constraints:
    - The timescale field shall have the same value as the timescale field in the Media Header Box (‘mdhd’) within the same track; and
    - the reference_ID field shall be set to the track_ID of the ISO Media track as defined in the Track Header Box (‘tkhd’).
- For HEVCSampleEntry (‘hev1’) NAL Structured Video tracks, the 'first_sample_flags' shall signal the picture type of the first sample in each movie fragment as specified below.
    - sample_is_non_sync_sample=0: If the first sample is a sync sample.
    - sample_is_non_sync_sample=1: If the first sample is not a sync sample.
    - sample_depends_on=2: If the first sample is an I-frame.
- The Colour Information Box should be present. If present, it shall signal the transfer characteristics of the elementary stream.
- The sample timing shall obey the frame rate requirements.

10.2.3.4 Adaptation Set Constraints

For a video Adaptation Set, the following constraints apply, which are identical to the constraints as specified in clause 3.3:

- The @codecs parameter shall be present on Adaptation Set level and shall signal the maximum required capability to decode any Representation in the Adaptation Set.
- The @profiles parameter may be present to signal the constraints for the Adaptation Set

- The attributes `@maxWidth` and `@maxHeight` shall be present. They are expected be used to signal the source content format. This means that they may exceed the actual largest size of any coded Representation in one Adaptation Set.

- The `@width` and `@height` shall be signalled for each Representation (possibly defaulted on Adaptation Set level) and shall match the values of the maximum width and height in the Sample Description box of the contained Representation.

- The maximum frame rate may be signalled on Adaptation Set using the `@maxFrameRate` attribute.

- The `@frameRate` should be signalled for each Representation (possibly defaulted on Adaptation Set level).

In addition to the above referenced constraints, this profile specifies the following additional contraints:

- The Color Space in use may be signalled. If signalled,

    - an Essential or Supplemental Descriptor shall be used to signal the value by setting the `@schemeIdURI` attribute to `urn:mpeg:mpegB:cicp:MatrixCoefficients` as defined ISO/IEC 23001-8 [10] and the `@value` attribute according to Table 4 of ISO/IEC 23001-8 [XY]. The values shall match the values set in the VUI.

    - The signalling shall be on Adaptation Set level, i.e all Representations in one Adaptation Set are required to have the same Chroma Format.

- The Color Primaries and Transfer Function may be signalled. If signalled,

    - an Essential or Supplemental Descriptor shall be used to signal the value by setting the `@schemeIdURI` attribute to `urn:mpeg:mpegB:cicp: ColourPrimaries` and `urn:mpeg:mpegB:cicp:TransferCharacteristics` as defined ISO/IEC 23001-8 [XY] and the `@value` attribute according to Table 4 of ISO/IEC 23001-8 [XY]. The values shall match the values set in the VUI.

    - The signalling shall be on Adaptation Set level only, i.e all Representations in one Adaptation Set are required to have the same Color Primaries and Transfer Function.

10.2.4 Compatibility Aspects

This specification is designed such that content that is authored in conformance to this IOP is expected to conform to the media profile defined by DVB DASH in ETSI TS 103 285 [BB] and following the 3GPP *H.265/HEVC UHD Operation Point* in section 5.6 of 3GPP TS26.116 [CC]. However, in contrast to DVB and 3GPP, only BT.709 may be used and not BT.2020.

In addition, clients conforming to this extension should be capable to play content authored as conform to the media profile defined by DVB DASH in ETSI TS 103 285 [BB] and following the 3GPP *H.265/HEVC UHD Operation Point* in section 5.6 of 3GPP TS26.116 [CC], if BT.709 colour space is used.

10.3 DASH-IF IOP UHD HDR10

10.3.1 Introduction

For the support of broad set of use cases addressing higher dynamic range and wider colour gamut, the DASH-IF IOP HDR10 Extension is defined. This interoperability point allows for additional UHD features including Wide Color Gamut, High Dynamic Range and a new electro-optical transfer curve. These features are in addition to the existing features described in the DASH-IF UHD 4k interoperability point, except that that this profile is designed for HDR, and requires the use of SMPTE-2084 and Rec. 2020 colorspace.

Note that this IOP does not require the use of the maximum values, such as 60fps or 4K resolution. The content author may offer lower spatial and temporal resolutions and may use the regular DASH signalling to indicate the actual format of the source and rendering format. Typical cases may be to use HDR together with an HD 1080p signal. Note also that Adaptation Set Switching as defined in section 3.2.X may be used to separate different spatial resolutions in different Adaptation Sets to address different capabilities, but still permit the use of lower resolutions for service continuity of higher resolutions.

The compliance to *DASH-IF IOP HDR10* may be signaled by a `@profile` attribute with the value `http://dashif.org/guidelines/dash-if-uhd#hdr10`

10.3.2 Elementary Stream Requirements

10.3.2.1 Introduction

The same requirements as for UHD HEVC 4k as documented in [10.2] hold, expect for the changes as detailed below.

The changes in the HEVC HDR10 profile that extend it beyond the HEVC 4K profile include:

- the Main10 Profile is used instead of the Main Profile, as specified in Recommendation ITU-T H.265 / ISO/IEC 23008-2 [35].
- NAL Structured Video Streams conforming to this interoperability point SHALL be encoded using the REC-2020 color parameters as defined in [xxx]. Clients shall be able to correctly decode content that is encoded using that colorspace.

- NAL Structured Video Streams conforming to this interoperability point SHALL be encoded using the SMPTE-2084 electro-optic transfer function as defined in [xxx]. Clients shall be able to correctly decode content that is encoded using that electro-optic transfer function

Note that one cannot author a single piece of content that is compliant with both this profile and HEVC 4k profile. However, the content may be offered in one MPD in two different Adaptation Sets.

10.3.2.2 Bitstream Requirements and Recommendations

A bitstream conforming to the HEVC HDR-10 media profile shall comply with the Main Tier Main10 Profile Level 5.1 restrictions, as specified in Recommendation ITU-T H.265 / ISO/IEC 23008-2.

In addition the requirements in section 10.2.2.2 apply, except that this profile requires the use of Recommendation ITU-R BT.2020 [ZY] non-constant luminance colorimetry and SMPTE-2084 [ZZ].

SMPTE-2084 [ZZ] usage SHALL be signaled by setting `colour_primaries` to the value `9`, `transfer_characteristics` to the value `16` and `matrix_coeffs` to the value `9`.

The bitstream may contain SEI messages as permitted by the Recommendation ITU-T H.265 / ISO/IEC 23008-2:2013 [35]. Details on these SEI messages are specified in Recommendation ITU-T H.265 / ISO/IEC 23008-2 / Annex D. SEI message may for example support adaptation of the decoded video signals to different display capabilities or more detailed content description, in particular the Mastering display colour volume SEI and the Content light level info SEI as specified in Recommendation ITU-T H.265 / ISO/IEC 23008-2 / Annex D.

10.3.2.3 Receiver Requirements

Receivers conforming to the HEVC HDR-10 media profile shall support decoding and displaying HEVC HDR-10 bitstreams as defined in 10.3.2.2.

No additional processing requirements are defined, for example processing of SEI messages is out of scope.

10.3.3 Mapping to DASH

10.3.3.1 Media Profile Identifier

If all Representations in an Adaptation Set conforms to the elementary stream constraints for the Media Profile as defined in clause 10.3.3.2 and the Adaptation Set conforms to the MPD signalling according to clause 10.3.3.2 and 10.3.3.4, and the Representations conform to the file format constraints in clause 10.3.3.3, then Option 1: the `@profiles` parameter in the Adaptation Set may signal conformance to this operation point by using "`http://dashif.org/guidelines/dash-if-uhd#hdr10`".

10.3.3.2 MPD Signaling

The MPD shall conform to DASH-IF HEVC Main IOP as defined with the additional constraints defined in clause 10.3.3.4.

10.3.3.3 File Format Requirements

The file format requirements as defined in clause 10.2.3.3 shall apply.

10.3.3.4 Adaptation Set Constraints

The same requirements as defined in clause 10.2.3.4 shall apply.

10.3.4 Compatibility Aspects

Content authored according to this media profile is interoperable with the HDR 10 profile defined in the DECE CFF Content Specification v2.2 [DD], although it should be noted that the DECE CFF profile may have additional constraints, such as bitrate restrictions and required metadata.