CHANGE REQUEST

DASH-IF IOP	CR	xxxx	rev	0	Current version:	4.3

Status:		Draft		Internal Review	X	Community Review		Editor's Proposal		Agreed

Title:	Alignment of the MPEG-H IOP with the IOP for ATSC 3.0 services
Source:	Fraunhofer IIS, Dolby Labs, and Xperi
Supporting Companies:	Fraunhofer IIS, Dolby Labs, Xperi
Category:	**A** ***Date:*** 2020-04-20 *Use one of the following categories:* ***A*** *(addition of feature)* ***B*** *(editorial modification)* ***C*** *(correction)*

Reason for change:	AC-4 and MPEG-H have diverged over time from the specifications in the DASH-IF spec for ATSC. For MPEG-H: Due to the strict timeline of the ATSC 3.0 specification, the MPEG-H Audio efforts have been mainly focused on the DASH-IF IOP for ATSC 3.0 services. As a result, the main MPEG-H IOP is lacking additional ISO BMFF encapsulation, as specified in the profile for ATSC 3.0 services. This misalignment is at all effects not beneficial for DASH-IF. This document proposes an update to the main DASH-IF IOP such that it aligns with the IOP for ATSC 3.0. In particular, meeting the following objectives is desired: • The general DASH MPEG-H IOP (this document) is a superset of the IOP for ATSC 3.0 with regard to ISO BMFF encapsulation. • The document includes the correct references, a short description of the general MPD signalling and a small restructuring of the sections to better fit the changes For AC-4: Updates to AC-4 have been introduced to other important specifications, including ATSC 3.0. These specifications cover use cases not previously covered by DASH-IF IOP. This document proposes an update that aligns with ATSC 3.0 IOP, and includes signalling for the advanced use cases enabled by those services. For DTS: Updates to general sections in include DTS-UHD
Summary of change:	The proposed changes aim at aligning the general MPEG-H and AC-4 IOP with the IOP for ATSC 3.0 services with regard to ISO BMFF encapsulation.
Consequences if not approved:	AC-4 and MPEG-H bit streams for DASH-IF ATSC profile are not valid for the DASH-IF IOP, making the convergence of broadcast and OTT delivery harder.

Sections affected:	9.2.5, 9.4.6
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/Audio/issues - dashif+iop@groupspaces.com with a subject tag [Audio], 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:	June 15th, 2020
Expected Publication:	Q3/2020

Change #1

Add the following definitions:

MHAS	MPEG-H 3D Audio Stream
MHA	Encapsulation of raw MPEG-H 3D Audio frames into ISO BMFF
MHM	Encapsulation of MHAS packets into ISO BMFF
Audio Component	An Audio Component is a Media Component as defined in ISO/IEC 23009-1 Amd. 4 Clause 5.3.11.

Change #2

Update references as follows:

[64] ISO/IEC 23008-3:2019, Information technology -- High efficiency coding and media delivery in heterogeneous environments -- Part 3: 3D Audio, Second Edition

[88] ISO/IEC 23003-4:2015 - MPEG audio technologies -- Part 4: Dynamic Range Control

Add the following references as follows:

[YY] ETSI TS 103 190-2 v1.2.1 2018-02 Digital Audio Compression (AC-4) Standard Part 2: Immersive and personalized audio

[ZZ] IETF RFC 6381 The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types

[AB] ETSI TS 103 491 v 1.2.1 (2019-05), “DTS-UHD Audio Format; Delivery of Channels, Objects and Ambisonic Sound Fields”:

Change #3

Update Table 2 as indicated below:

Table 1 DASH-IF Interoperability Point Extensions

Extension	Identifier	Version	Section
DASH-IF multichannel audio extension with MPEG-H 3D Audio	~~http://dashif.org/guidelines/dashif#mha1~~ ~~http://dashif.org/guidelines/dashif#mha2~~ http://dashif.org/guidelines/dashif#mpeg-h-3da	4.x	9.4.6.3

Change #4

Change section 9.2.5.1 as follows:

9.2.5.1. Overview

MPEG-H 3D Audio is defined in ISO/IEC 23008-3 [64] and is a Next Generation Audio (NGA) codec. MPEG-H 3D Audio encoded content shall comply with Level 1, 2 or 3 of the MPEG-H Low Complexity (LC) Profile, as defined in ISO/IEC 23008-3, clause 4.8 [64].

The sections to follow clarify DASH specific requirements for MPEG-H 3D Audio, such as:

- Codec parameters settings and signalling
- Usage of MPD elements and attributes
- File format encapsulation modes and requirements
- Loudness and Dynamic Range Control requirements

Change #5

Add Section 9.1.1 and 9.1.2

9.1.1 NGA Overview

Next Generation Audio (NGA) codecs include AC-4, defined in ETSI TS 103 190-2 [x] and MPEG-H 3D Audio, defined in ISO/IEC 23008-3 [64], and DTS-UHD defined in ETSI TS 103 491 [AB].

New concepts and signalling mechanisms have been introduced as part of ISO/IEC 23009-1:2019 [4] in order to support the variety of new use-cases that AC-4 and MPEG-H 3D Audio enables. In particular, the concept of Preselections has been introduced as a method for defining and signalling audio personalization options.

9.1.2 Signalling of Preselections

The NGA codecs support the concept of component based audio, i.e. the audio program can be constructed from set of separate Audio Components (i.e. media content components containing audio). Examples of Audio Components are: dialogs (in potentially different languages), ambient background sound, music or effects.

The concept of “Preselections” as defined in ISO/IEC 23009-1:2019 [4], allows the codec to offer different combinations of those Audio Components, either for automatic selection based on user preferences or for manual selection by the user. The Audio Components may be delivered in a single stream or in multiple streams.

Two different methods are defined to signal Preselections in the MPD: The Preselection Descriptor and the Preselection Element. The Preselection descriptor is defined in 5.3.11.2 of ISO/IEC 23009-1:2019 [4]. It enables simple setups and backward compatibility but may not be suitable for advanced use cases. See codec-specific details below.

The Preselection Element is defined in 5.3.11.3 and 5.3.11.4 of ISO/IEC 23009-1:2019 [4]. The Role and Accessibility descriptors on the Preselection Element, as well as other parameters, such as a profile & level indication on the `@codecs` attribute are related only to that Preselection and not to the stream(s) referenced by the Preselection element.

For all AdaptationSets referenced by Preselection elements, the following rules presented in Table 2 shall apply:

Table 2 NGA Element and Attribute Settings

Element or Attribute Name	Description
SupplementalProperty	If an `AdaptationSet` referring to the Main Audio stream is referenced by one or more `Preselection` elements, the `AdaptationSet` should include a `Preselection SupplementalProperty` descriptor as specified in MPEG-DASH
EssentialProperty	An `AdaptationSet` referring to Auxiliary audio streams shall include a Preselection `EssentialProperty` descriptor as specified in MPEG-DASH
`@preselectionComponents`	Specifies the ids of the contained Adaptation Sets or Content Components that belong to this Preselection as white space separated list in processing order. The first tag defines the main media component

Additional MPD Elements and Attributes are recommended for use when describing an NGA Preselection. These are listed in Table 3. Note that additional guidance in applying these parameters to specific NGA Audio codecs may be included in their respective sections.

Table 3 Additional recommended MPD Elements for NGA Audio

Element or Attribute Name	Description
@lang	If a Preselection includes a dialog component, this attribute should be used to indicate the language.
Role	DASH role scheme, urn:mpeg:dash:role:2011, to indicate a key attribute of the Preselection.
Accessibility	Indicate whether a Preselection or a Component has accessibility considerations.
Label	If there are multiple Preselections, this label should be set by the content author.

Change #6

Add section 9.2.1.3 as follows:

9.2.1.3. Dolby AC-4 specific issues

9.2.1.3.1 General

This section provides more details on Attributes and Elements used with AC-4. See ATSC A/342-2 [8].

ISO Base Media File Format Packaging Rules for AC-4 are described in ETSI TS 103 190-2 [x], Annex E.

9.2.1.3.2 AC-4 Element and Attribute Settings

Table XX summarizes the mapping of relevant MPD elements and attributes to AC-4 Audio.

Most of the elements can be derived from the AC-4 `ac4_dsi_v1` structure as described in Annex E of ETSI TS 103 190-2 [YY].

Note that usage of the elements and attributes listed below depends on the employed DASH profile.

Table 3 AC-4 Element and Attribute Settings

Element or Attribute Name	Description
`@codecs`	For AC-4 the value of the codecs attribute shall be created according to the syntax described in RFC 6381 [ZZ]. The value shall consist of the dot-separated list of the 4 following parts of which the latter three are represented by two-digit hexadecimal numbers: • The `fourCC` ”ac-4” • The `bitstream_version` as indicated in the `ac4_dsi_v1` structure. • The `presentation_version` as indicated for the referenced presentation in the `ac4_dsi_v1` structure. • The `mdcompat` parameter, indicating the compatibility level for the referenced presentation. Example: `ac-4.02.01.03` In case of AdaptationsSets, the term *referenced presentation* shall refer to that presentation with the lowest `mdcompat` value amongst all presentations with `presentation_version < 2` and that are fully contained in this AdaptationSet.
Preselection`@tag`	This field shall correspond to the value of the `presentation_id` in the `ac4_presentation_v1_dsi` associated with the referenced AC-4 presentation.
AudioChannelConfiguration	For AC-4 the Audio Channel Configuration descriptor shall use one of the following schemes o `urn:mpeg:mpegB:cicp:ChannelConfiguration` as defined in ISO/IEC 23001-8 [49] o `tag:dolby.com,2015:dash:audio_channel_configuration:2015` as defined in TS 103 190-2 [YY] , Annex G.3.1 `urn:mpeg:mpegB:cicp:ChannelConfiguration` is the preferred scheme.

@audioSamplingRate	The value shall be set to the sampling frequency as specified in TS 103 190-2 [YY], Annex G.2.6. Example: For fs_index = 1 and dsi_fs_multiplier = 0, the value is 48000.
RandomAccess@type	The type attribute of the RandomAccess element shall be set to "closed".
@mimeType	The MIME type attribute shall be set to "audio/mp4".
@startWithSAP	The startWithSAP attribute shall be set to 1.
@lang	The language indicated by the lang attribute should correspond to that language signalled in the language_tag_bytes, which is tagged as "dialog" or "complete main" in the corresponding content_classifier. NOTE: The language_tag_bytes are contained in the ac4_substream_group_dsi structure, within the ac4_dsi_v1 structure. For AdaptationSets that are referenced by Preselection elements, the lang attribute should not be present on the AdaptationSet element. In cases where it is present, the indicated language should correspond to that presentation with the lowest mdcompat value amongst all presentations with presentation_version < 2 and that are fully contained in this AdaptationSet.
Role	The Role for a Preselection should be set by the content author. Note: The indication of the content_classifier from the ac4_substream_group_dsi structure is not sufficient to enable setting of an accurate indication for the Role descriptor in context of Preselections, describing entire experiences rather than individual audio elements.
Accessibility	In case one or more audio elements contained in a Presentation indicate a content type visually impaired, an Accessibility descriptor shall indicate descriptions according to the Role scheme defined in ISO/IEC 23009-1 [xx]. If one or more audio elements contained in a Presentation indicate a content type other than music and effects, an Accessibility descriptor indicating enhanced-audio-intelligibility according to the Role scheme defined in ISO/IEC 23009-1 [xx] may be used. In case one or more audio elements contained in a Presentation indicate Associated service: emergency (E), an Accessibility descriptor may indicate emergency according to the Role scheme defined in ISO/IEC 23009-1 [xx].

SupplementalProperty	If the content of a Presentation has been tailored for consumption via headphones, an Immersive Audio for Headphones `SupplementalProperty` descriptor should be used as specified in ETSI TS 103 190-2 [33], clause G.2.12.1. An audio framerate `SupplementalProperty` descriptor should be used as specified in ETSI TS 103 190-2 [33], clause G.2.12.2.

Change #7

Rename the current section 9.2.5.2 “DASH-specific issues” as section 9.2.5.3 “MHA encapsulation” and update Table 29 as follows:

Table 29: Codecs parameter for ISO BMFF encapsulation (MHA flavour)

Codec	Codecs Parameter	ISO BMFF Encapsulation	SAP Type
MPEG-H 3D Audio LC Profile Level 1	`mha[1, 2].0x0B`	ISO/IEC 23008-3	1
MPEG-H 3D Audio LC Profile Level 2	`mha[1, 2].0x0C`	ISO/IEC 23008-3	1
MPEG-H 3D Audio LC Profile Level 3	`mha[1, 2].0x0D`	ISO/IEC 23008-3	1

Change #8

Add the following as section 9.2.5.2 “DASH-specific issues”.

9.2.5.2. DASH-specific issues

The carriage of MPEG-H 3D Audio in the ISO BMFF is specified in ISO/IEC 23008-3, clause 20 [64]. Two different packaging methods are specified:

- **MHA**: storage of raw audio frames, as specified in ISO/IEC 23008-3, clause 20.5 [64]. Section 9.2.5.3. provides more information on this encapsulation.
- **MHM**: storage of MHAS streams, as specified in ISO/IEC 23008-3, clause 20.6 [64]. The MPEG-H Audio Stream (MHAS) format is defined in ISO/IEC 23008-3, clause 14 [64]. Section 9.2.5.4. provides more information on this encapsulation.

9.2.5.2.1 Element and Attribute Settings

Table 26 summarizes the mapping of relevant MPD elements and attributes to MPEG-H Audio.

Table 26: Summary of relevant MPD elements and attributes for MPEG-H Audio

Element or Attribute Name	Description
`@codecs`	The signalling of the codecs parameters is according to RFC6381 [10] and ISO/IEC 23008-3, clause 21 [64]. The value consists of the following two parts separated by a dot:

	• the sample entry 4CC code (‘mha1’, ‘mha2’, ‘mhm1’, ‘mhm2’) • ‘0x’ followed by the hex value of the profile-level-id, as defined in in ISO/IEC 23008-3 [64] See Table 27 and Table 28 for more details.
AdaptationSet@tag	This field lists the mae_groupIDs as defined in ISO/IEC 23008-3 [64] that are contained in the Adaptation Set separated by white spaces.
Preselection@tag	This field indicates the mae_groupPresetID as defined in ISO/IEC 23008-3 [64] that refers to a Preset in the scope of MPEG-H Audio.
ContentComponent@tag	This field indicates the mae_groupID as defined in ISO/IEC 23008-3 [64] which contains the Media Content Component.
AudioChannelConfiguration	For MPEG-H Audio, the Audio Channel Configuration descriptor shall use the scheme URI “urn:mpeg:mpegB:cicp:ChannelConfiguration”. The value shall be taken from the ChannelConfiguration table as defined in ISO/IEC 23001-8:2016 [49]. Valid numbers for value are 0-7, 9-12, 14-17 or 19. The value 0 should only be used if the exact Audio Channel Configuration cannot be determined, e.g. a live service with in-band configuration changes within a period, or for object only audio scenes.
@audioSamplingRate	Example: "48000" for 48 kHz The indication shall correspond to the sampling frequency derived from the usacSamplingFrequencyIndex or usacSamplingFrequency as defined in ISO/IEC 23003-3 [64].
RandomAccess	The type to be used with MPEG-H Audio shall be “closed”, i.e. the SAP type is 1.
@mimeType	The MIME type to be used with MPEG-H Audio shall be ”audio/mp4”.
@lang	The language indicated should correspond to the information conveyed in mae_contentLanguage of the default dialog element. The default dialog corresponds to the Group (mae_groupDefinition()) which is marked as default in mae_switchGroupDefaultGroupID and is tagged in mae_contentKind as dialogue. This information is carried in the mae_audioSceneInfo() of the MPEG-H Audio stream as defined in ISO/IEC 23008-3 [64]. The language of a Preselection should correspond to the information conveyed in mae_contentLanguage of the selected dialog. The selected dialog corresponds to the Group (mae_groupDefinition()) which is marked as on (mae_groupPresetConditionOnOff == 1) for the given

	Preselection@tag and is tagged in mae_contentKind as dialogue. This information is carried in the mae_audioSceneInfo() of the MPEG-H Audio stream as defined in ISO/IEC 23008-3 [64].
Role	The Role for a Preselection should be set by the content author.
Accessibility	If the mae_contentKind value of at least one Audio Element is set to '9' ("audio-description/visually impaired"), an Accessibility descriptor shall indicate "descriptions" according to the Role scheme defined in ISO/IEC 23009-1 [4]. If at least the Audio Elements with a mae_contentKind value of '2' ("dialogue") have mae_allowGainInteractivity set to '1' and mae_interactivityMaxGain set to a non-zero value in the corresponding mae_GroupDefinition() structure, an Accessibility descriptor with the value "enhanced-audio-intelligibility" according to the Role scheme defined in ISO/IEC 23009-1 [4] may be used to indicate that the Preselection enables the ability for a receiver to change the relative level of dialog to enhance dialog intelligibility. If the mae_contentKind value of at least one Audio Element is set to '12' ("emergency"), an Accessibility descriptor may indicate "emergency" according to the Role scheme defined in ISO/IEC 23009-1. The accessibility information indicated for a Preselection should also correspond to the mae_groupPresetKind. The mae_contentKind field and all other fields mentioned above that start with a "mae_" prefix are carried in the AudioSceneInformation() of the MPEG-H Audio stream as defined in ISO/IEC 23008-3 [64].

If present, the Preselection Tag value of the Preselection Descriptor, shall be set to the corresponding mae_groupPresetID as defined in ISO/IEC 23008-3 [64].

Change #9

Add the following as section 9.2.5.4 "MHM encapsulation".

9.2.5.4. MHM encapsulation

Storage of MHAS into ISO BMFF shall be according to ISO/IEC 23008-3 clause 20 [64] with the additional constraints described below.

The sample entry 'mhm1' shall be used for encapsulation of MHAS packets into ISO BMFF files, according to ISO/IEC 23008-3, clause 20.6 [64]. The sample entry 'mhm2' shall be used in cases of multi-stream delivery, i.e. the MPEG H Audio Scene is split into two or more streams for delivery as described in ISO/IEC 23008-3, clause 14.6 [64].

All MHAS packet types defined in ISO/IEC 23008-3, clause 14 [64], may be present in the stream, except the following packet types that shall not be present:

- PACTYP_CRC16
- PACTYP_CRC32
- PACTYP_GLOBAL_CRC16
- PACTYP_GLOBAL_CRC32

If Audio Scene Information, defined in clause 15 of ISO/IEC 23008-3 [64], is present, it shall be always encapsulated in an MHAS packet of type PACTYP_AUDIOSCENEINFO [64]. Audio Scene Information shall not be included in the mpegh3daConfig() structure carried in the MHAS packet of type PACTYP_MPEGH3DACFG.

As defined in ISO/IEC 23008-3 clause 20.6 [64], the MHAConfigurationBox() is optional for MHM, but if present it shall also be consistent with the configuration of the audio bitstream, as described in 9.2.5.3.

Note: In case of in-band configuration changes within a period, the MHAConfigurationBox() should not be present in the corresponding sample entry.

The content is expected to be prepared according to the MPEG-DASH Implementation Guidelines [6] to make sure each (sub-)segment starts with a Stream Access Points (SAP) of type 1 (i.e. a sync sample). For MHM encapsulation in particular, a sync sample shall consist of the following MHAS packets, in the following order:

- PACTYP_MPEGH3DACFG
- PACTYP_AUDIOSCENEINFO (if Audio Scene Information is present)
- PACTYP_BUFFERINFO
- PACTYP_MPEGH3DAFRAME

MPEG-H Audio sync samples contain Immediate Playout Frames (IPFs), as specified in ISO/IEC 23008-3, clause 20.2 [64], thus the audio data encapsulated in the MHAS packet PACTYP_MPEGH3DAFRAME shall contain the AudioPreRoll() syntax element, as defined in sub-clause 5.5.6 of ISO/IEC 23008-3 [64], and shall follow the requirements for stream access points as defined in clause 5.7 of ISO/IEC 23008-3 [64].

The audio configuration is delivered as part of the MHAS packet PACTYP_MPEGH3DACFG and, therefore, the AudioPreRoll() structure carried in the MHAS packet PACTYP_MPEGH3DAFRAME shall not contain the Config() structure, i.e. the configLen field of the AudioPreRoll() shall be 0. All rules defined in ISO/IEC 23008-3, clause 20.6.1 [64] regarding sync samples shall also apply.

The MHASPacketLabel shall have different values for all representations that comprise an experience.

Additional MHAS packets may be present between the MHAS packets listed above or after the MHAS packet PACTYP_MPEGH3DAFRAME, with one exception: when present, the PACTYP_AUDIOSCENEINFO packet shall directly follow the PACTYP_MPEGH3DACFG packet, as defined in ISO/IEC 23008-3, clause 14.4 [64].

Table 30: Codecs parameter for ISO BMFF encapsulation (MHM flavour)

Codec	Codecs Parameter	ISO BMFF Encapsulation	SAP Type
MPEG-H 3D Audio LC Profile Level 1	mhm[1, 2].0x0B	ISO/IEC 23008-3	1
MPEG-H 3D Audio LC Profile Level 2	mhm[1, 2].0x0C	ISO/IEC 23008-3	1

9.2.5.4.1. Configuration Change Constraints

A configuration change takes place in an audio stream when the content setup or the Audio Scene Information changes (e.g., when changes occur in the channel layout, the number of objects etc.) and, therefore, new `PACTYP_MPEGH3DACFG` and `PACTYP_AUDIOSCENEINFO` packets are required upon such occurrences. A configuration change usually happens at program boundaries but it may also occur within a program.

The following constraints apply:

- At each configuration change, the `MHASPacketLabel` shall be changed to a different value from the `MHASPacketLabel` in use before the configuration change occurred. A configuration change may happen at the beginning of a new ISO BMFF file or at any position within the file. In the latter case, the File Format sample that contains a configuration change shall be encoded as a sync sample (i.e. an IPF) as defined above. Note, that also after a configuration change the `MHASPacketLabel` needs to have different values for all representations comprising an experience.
- A sync sample that contains a configuration change and the last sample before such a sync sample may contain a truncation message (i.e., a `PACTYP_AUDIOTRUNCATION` packet in the MHAS stream) as defined in ISO/IEC 23008-3, clause 14.4 [61]. If MHAS packets of type `PACTYP_AUDIOTRUNCATION` are present, they shall be used as described in ISO/IEC 23008-3, clause 14.4 [64].

9.2.5.4.2. MPEG-H Audio Multi-Stream Constraints

The multi-stream-enabled MPEG-H Audio System is capable of handling Audio Components delivered in several different elementary streams (e.g., the main MHAS stream containing one complete audio main, and one or more auxiliary MHAS streams, containing different languages and audio description). The MPEG-H Audio Metadata information (MAE) allows the MPEG-H Audio Decoder to correctly decode several MHAS streams.

The following constraints apply when using the sample entry `'mhm2'`:

- One MHAS stream shall be the main stream (Main Adaptation Set), i.e., in exactly one MHAS stream the Audio Scene Information shall have the `mae_isMainStream` field set to 1. In all other MHAS streams the `mae_isMainStream` shall be set to 0. All Representations of an MHAS stream with `mae_isMainStream` set to 1 form the Main Adaptation Set.
- In each auxiliary MHAS stream (i.e., streams with `mae_isMainStream` field set to 0) the `mae_bsMetaDataElementIDoffset` field in the Audio Scene Information shall be set to the index of the first metadata element in the auxiliary MHAS stream minus one. Each auxiliary Stream (and all its representations) form(s) an Partial Adaptation Set.
- For the main and the auxiliary MHAS stream(s), the `MHASPacketLabel` shall be set according to ISO/IEC 23008-3, clause 14.6 [64].
- All MHAS elementary streams that carry Audio Components of one complete experience shall be time aligned.

- In each auxiliary MHAS elementary stream (i.e., streams with `mae_isMainStream` field set to 0), IPFs shall be aligned to the IPFs present in the main stream (i.e., the stream with `mae_isMainStream` field set to 1).

Change #10

Add the following as section 9.2.5.5 “Loudness and Dynamic Range Control”.

9.2.5.5. Loudness and Dynamic Range Control

Loudness metadata shall be embedded within the `mpegh3daLoudnessInfoSet()` structure as defined in ISO/IEC 23008-3, clause 6.3 [64]. Such loudness metadata shall include at least the loudness of the content rendered to the default rendering layout as indicated by the `referenceLayout` field (see ISO/IEC 23008-3, clause 5.3.2 [64]). More precisely, the `mpegh3daLoudnessInfoSet()` structure shall include at least one `loudnessInfo()` structure with `loudnessInfoType` set to 0, whose `drcSetId` and `downmixId` fields are set to 0 and which includes at least one `methodValue` field with `methodDefinition` set to 1 or 2 (see ISO/IEC 23008-3, clause 6.3.1 [64] and ISO/IEC 23003-4, clause 7.3 [88]). The indicated loudness value shall be measured according to applicable regional loudness regulations.

DRC metadata shall be embedded in the `mpegh3daUniDrcConfig()` and `uniDrcGain()` structures as defined in ISO/IEC 23008-3, clause 6.3 [64]. For each included DRC set the `drcSetTargetLoudnessPresent` field as defined in ISO/IEC 23003-4, clause 7 [88] shall be set to 1. The `bsDrcSetTargetLoudnessValueUpper` and `bsDrcSetTargetLoudnessValueLower` fields shall be configured to continuously cover the range of target loudness levels between -31 dB and 0 dB. The embedded DRC metadata should allow for a decoder output loudness of at least -16 LKFS.

Loudness compensation information (`mae_LoudnessCompensationData()`), as defined in ISO/IEC 23008-3, clause 15.5 [64] shall be present in the Audio Scene Information if the `mae_allowGainInteractivity` field (according to ISO/IEC 23008-3, clause 15.3 [64]) is set to 1 for at least one group of audio elements.

Change #11

Update section 9.4.6 accordingly:

9.4.6.1. Introduction

Compliance to DASH-IF multichannel audio extension with MPEG-H 3D Audio [x] may be signaled by a @profile attribute with the value `http://dashif.org/guidelines/dashif#mpeg-h-3da`.

9.4.6.3. Definition

Content may be authored claiming conformance to DASH-IF multichannel audio extension with MPEG-H 3D Audio,

- if the content is multichannel audio content as defined in section 9.4.1, and
- if a client can properly play the content by supporting at least the following features:
    - all multichannel audio client features as defined in section9.4.1,

- MHA, MHM and the DASH-specific features defined in section 9.2.5.