SMPTE REGISTERED DISCLOSURE DOCUMENT

SMPTE ST 2098-2 Immersive Audio Bitstream and PackagingConstraints: IAB Application Profile 1

Version 1.0.0 – February 25, 2021

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Approved **February 25, 2021**

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Introduction

SMPTE ST 2098-2 Immersive Audio Bitstream (IAB) defines a bitstream to carry immersive audio. It was designed with many forward-looking features, some of which are not currently supported by renderers in the field. In order to effectively begin the rollout of IAB D-Cinema Packages (DCPs) to the industry, an agreed set of constraints for the IAB is needed. “IAB Application Profile 1” codifies these requirements and supported features. Profile 1 is based on what is implemented by the immersive audio renderers in theatres as of February 2020. As software develops and more features from ST 2098-2 are added to the renderers in the field, additional profiles may be codified, possibly until the entire feature set of ST 2098-2 is supported across the industry.

Background

There is a need for a constraining document for the immersive audio bitstream defined in SMPTE ST 2098-2:2019. The full specification is not supported by the current installed base of renderers, and they may take time to be updated. Multiple vendors are making immersive audio renderers or authoring tools and need clear guidance on necessary features for deployment. ISDCF and EDCF are jointly creating this bitstream constraint document in anticipation of future profiles that incorporate more features of the full ST 2098-2 specification.

This bitstream constraint document is intended to guide authoring products to restrict the usage of features that may not be rendered by some equipment in the field. A bitstream would be “qualified” to be an IAB Profile 1 bitstream if it did not exceed the guidance set forth in this profile. This document plus ST 2098-2 can be a fully self-contained guideline for bitstream construction.

Rendering solutions can indicate if they are capable of playing back IAB Profile 1, but this would be guidance to the user, not a definition. Future IAB Profiles (2, 3, etc.) could be supersets of Profile 1.

This document is based on the tests performed during the ISDCF Plugfest held in February 2020, and from information gathered directly by manufacturers, with their input into earlier drafts of this document. The document has item numbers for use as reference in discussions only. This list includes what is and is not currently supported in IAB bitstream based on current versions of rendering implementations.

> *IMPORTANT NOTE ABOUT LEGACY CONTENT: Legacy content (Dolby Atmos) follows the guidelines of IAB Profile 1. None of this described legacy content includes the CPL identification information defined in Section 7 below.*

1 Scope

This document specifies requirements and constraints on the authoring of a SMPTE ST 2098-2 Immersive Audio Bitstream (IAB) and mastering of an IAB D-Cinema Package (DCP) Profile 1.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

3 Normative References

The following documents contain provisions, which, through reference in this text, constitute provisions of this Application. At the time of publication, the editions indicated were valid. This document is subject to revision and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent edition of the documents indicated below.

SMPTE, ST 2098-2:2019 “Immersive Audio Bitstream Specification”

SMPTE, ST 429-18:2019 “D-Cinema Packaging - Immersive Audio Track File”

SMPTE, ST 429-19:2019 “D-Cinema Packaging — DCP Operational Constraints for Immersive Audio”

SMPTE, RDD 52:2020 “D-Cinema Packaging — SMPTE DCP Bv2.1 Application Profile”

SMPTE, ST 429-7:2006 “D-Cinema Packaging — Composition Playlist”

Inter-Society Digital Cinema Forum (ISDCF), “Digital Cinema Naming Convention v.9.6.1”, Available: “http://isdcf.com/dcnc”

4 Glossary and Acronyms

In addition to the glossary terms and acronyms presented here, the reader should also be aware of terms defined in SMPTE ST 2098-2.

CPL	Composition Playlist
DCP	Digital Cinema Package
Immersive Audio	SMPTE ST 2098-2 Essence
IAB	Immersive Audio Bitstream

5 General Notes about this Document

This document and the specifications herein, like the industry they serve, are subject to change at any time without notice. Failure to provide 100% accurate data or information, and/or failure to deliver content conforming to this Application, may result in the following, including but not limited to:

- issue(s) and/or error(s) with the audio presentation of content in a theatrical environment

6 DCP Constraints

6.1 Packaging Format

All compositions carrying SMPTE ST 2098-2 IAB within an Immersive Audio essence track, as defined in SMPTE ST 429-18, shall comply with the SMPTE packaging constraints as defined by SMPTE ST 429-19 and SMPTE RDD52.

6.2 Soundfields

All compositions shall contain either a 7.1 DS or a 9.1OH soundfield group for the bed, as defined in SMPTE ST 2098-2, and shall not contain any other bed soundfield group (e.g. 5.1, 11.1, 13.1, 15.1).

7 CPL Identification

7.1 ContentTitleText

The “Audio Type” field, as defined by the ISDCF Digital Cinema Naming Convention, for use within the CPL’s `ContentTitleText` as defined in ST 429-7 shall be “IAB”.

7.2 CompositionMetadataAsset

For CPLs conforming to this Application Profile document, the following `ExtensionMetadata`, as defined in ST 429-16, shall be present within the `CompositionMetadataAsset`:

```
<cpl-meta:ExtensionMetadata scope="http://isdcf.com/ns/cplmd/app">
  <cpl-meta:Name>Application</cpl-meta:Name>
  <cpl-meta:PropertyList>
    <cpl-meta:Property>
      <cpl-meta:Name>IAB Profile</cpl-meta:Name>
      <cpl-meta:Value>SMPTE-ST-2098-2:2019-P1</cpl-meta:Value>
    </cpl-meta:Property>
  </cpl-meta:PropertyList>
</cpl-meta:ExtensionMetadata>
```

7.3 Legacy Content

If no `ExtensionMetadata` is present and/or “IAB” is not present in the CPL’s `ContentTitleText` as defined in 7.1 and 7.2 above, it is assumed the IAB DCP is Profile 1 “legacy” content, which still conforms to this document’s guidelines and constraints.

8 ST 2098-2 Bitstream Constraints

8.1 General Constraints

8.1.1 Sample Rate

The value of all instances of `Sample Rate`, as defined by SMPTE ST 2098-2, shall be 48 kHz.

8.1.2 Frame Rates

The only values that shall be used for `IAFrame Rate`, as defined in SMPTE ST 2098-2, are: 24/1, 25/1, 30/1, 48/1, 50/1, or 60/1.

The only values that shall be used for `IAFrame.FrameRate`, also as defined in SMPTE ST 2098-2, are: 0x0 – 0x5, corresponding to the allowed values for `IAFrame Rate`, respectively.

8.1.3 Number of Channelsobjects, and MaxRendered

The maximum number of bed channels, as defined in SMPTE ST 2098-2, shall be 10.

8.1.4 Number of Objects

The maximum number of objects, as defined in SMPTE ST 2098-2, shall be 118.

8.1.5 MaxRendered

The `MaxRendered` field (which is the sum of objects and bed channels) of the `IAFrame`, both as defined in SMPTE ST 2098-2, shall have a value of 128 or less.

8.1.6 Number of Beds

A maximum of one bed per frame shall be in the bitstream, as defined in SMPTE ST 2098-2.

8.2 Channel Beds

Channel beds, as defined in SMPTE ST 2098-2, shall have the additional constraints according to Table 1 below. For convenience, section(s) within SMPTE ST 2098-2 have been provided for additional information of the items and/or values being constrained to the reader.

Table 1 - Channel Bed Constraints

ITEM #	ITEM	BITSTREAM CONSTRAINT	ST 2098-2 SECTION
B1	General Bed Parameters	- SubElementCount of BedDefinition shall be set to “0”	9.2
B2	Channel Beds	- Only the following channels (and associated ChannelIDs) or any subset of them shall be used: 0x0 CHANNEL_SCREEN_LEFT 0x2 CHANNEL_SCREEN_CENTER 0x4 CHANNEL_SCREEN_RIGHT 0x5 CHANNEL_LEFT_SIDE_SURROUND 0x7 CHANNEL_LEFT_REAR_SURROUND 0x8 CHANNEL_RIGHT_REAR_SURROUND 0x9 CHANNEL_RIGHT_SIDE_SURROUND 0xB CHANNEL_LEFT_TOP_SURROUND 0xC CHANNEL_RIGHT_TOP_SURROUND 0xD CHANNEL_LFE	10.3.5
B3	Bed Gain	- ChannelGainPrefix field shall be set to “0” - Bitstream shall not contain the ChannelGain element	9.2, 10.3.7, 10.3.8

B4	Conditional Beds	- The ConditionalBed field shall be set to "0" OR - The ConditionalBed field shall be set to "1", AND the associated BedUseCase field shall be set to 0xFF	5.3, 9.2, 10.3.2, 10.3.3
B5	Bed Remap	- Bitstream shall not contain BedRemap	10.4.1, 10.4.5, 10.4.6
B6	Channel Decorrelation	- ChannelDecorInfoExists field shall be set to "0" - Bitstream shall not contain the ChannelDecorCoefPrefix element - Bitstream shall not contain the ChannelDecorCoef element	9.2, 10.3.9, 10.3.10, 10.3.11
B7	Simultaneous Beds	- Bitstream shall not contain simultaneous beds	A.1

8.3 Objects

Objects, as defined in SMPTE ST 2098-2, shall have the additional constraints according to Table 2 below. For convenience, section(s) within SMPTE ST 2098-2 have been provided for additional information of the items and/or values being constrained to the reader.

Table 2 - Object Constraints

ITEM #	ITEM	BITSTREAM CONSTRAINT	ST 2098-2 SECTION
O1	General Object Parameters	- ObjectDefinition MetaID value shall be less than or equal to 118 - SubElementCount of ObjectDefinition shall be set to "0"	9.4, 10.3.1
O2	Snap Tolerance	- When ObjectSnapTolExists field is present, it shall be set to "0" - Bitstream shall not contain the ObjectSnapTolerance element	9.4, 10.5.9, 11.2
O3	Object Zone and Object Zone Gain	- Bitstream shall not contain ObjectZoneDefinition19	Table 3, 10.5.13, 10.5.14, 10.6
O4	ZoneGainPrefix values	- The 9 ZoneGainPrefix fields shall be assigned values only in certain combinations as defined in Section 8.5 below - ZoneGainPrefix shall only have a value of 0x0 or 0x1	9.4, 10.5.11, 10.5.13
O5	Object Gain	- ObjectGainPrefix field shall be set to "0" - Bitstream shall not contain ObjectGain	9.4, 10.5.5, 10.5.6
O6	Object Spread	- ObjectSpreadMode field shall always be set to 0x02 (OBJECT_SPREAD_1D) - Bitstream shall not contain ObjectSpreadX - Bitstream shall not contain ObjectSpreadY - Bitstream shall not contain ObjectSpreadZ	5.4, 10.5.15, 10.5.16, 10.5.17
O7	Simultaneous Objects	- There shall be a maximum 118 simultaneous objects	A.4
O8	Object Decorrelation Coefficient Prefix	- ObjectDecorCoefPrefix shall only have a value of 0x0 or 0x1 - Bitstream shall not contain ObjectDecorCoef	10.5.18, 10.5.19
O9	Conditional Object	- The ConditionalObject field shall be set to "0" OR - The ConditionalObject field shall be set to "1", AND the associated ObjectUseCase field shall be set to 0xFF	9.4,10.5.1, 10.5.2

8.4 Informational Metadata

Informational Metadata, as defined in SMPTE ST 2098-2, shall have the additional constraints according to Table 3 below. For convenience, section(s) within SMPTE ST 2098-2 have been provided for additional information of the items and/or values being constrained to the reader.

Table 3 - Informational Metadata Constraints

ITEM #	ITEM	BITSTREAM CONSTRAINT	ST 2098-2 SECTION
IM1	General informational metadata parameters or Unknown Data	- Bitstream shall not contain any element, data, or value that is not explicitly defined in SMPTE ST 2098-2	
IM2	Authoring Tool Information	- Bitstream shall not contain the AuthoringToolInfo element	9.1, Table 3, 10.1.1
IM3	User Data	- Bitstream shall not contain the UserData element	9.9, 10.1.1
IM4	AudioDataID	- AudioDataID value shall be less than or equal to 0xFFFF prior to Plex(8) encoding and 0xFF FFFF 0000FFFF after Plex(8) encoding.	10.3.6, 10.7.1
IM5	MetaID	- All MetaID values shall be less than or equal to 0xFFFF prior to Plex(8) encoding and 0xFF FFFF 0000FFFF after Plex(8) encoding.	10.3.1

8.5 ZoneGainPrefix

Table 4 below, defines the sets of ZoneGainPrefix values, as defined in SMPTE ST 2098-2, that shall be supported, as noted in item #O4 in 8.3 above.

Table 4 - ZoneGainPrefix Settings by Zone

Zone	ZoneGainPrefix Settings										
	Set #1a	Set #1b	Set #2a	Set #2b	Set #3a	Set #3b	Set #4a	Set #4b	Set #5a	Set #5b	Set #6
All Screen Loudspeakers Left of Center	1	1	1	1	0	0	1	1	0	0	1
Screen Center Loudspeakers	1	1	1	1	1	1	1	1	0	0	1
All Screen Loudspeakers Right of Center	1	1	1	1	0	0	1	1	0	0	1
All Loudspeakers on Left Wall	1	1	0	0	0	0	0	0	1	1	1
All Loudspeakers on Right Wall	1	1	0	0	0	0	0	0	1	1	1
All Loudspeakers on Left Half of Rear Wall	0	0	1	1	1	1	0	0	1	1	1
All Loudspeakers on Right Half of Rear Wall	0	0	1	1	1	1	0	0	1	1	1
All Overhead Loudspeakers Left of Center	1	0	1	0	1	0	1	0	1	0	0
All Overhead Loudspeakers Right of Center	1	0	1	0	1	0	1	0	1	0	0

NOTE: The IAB renderer may default to "all Zones enabled" unless the ZoneGainPrefix fields are assigned values in accordance with one of the sets defined above.