SMPTE REGISTERED DISCLOSURE DOCUMENT

Material Exchange Format (MXF) — Mapping Immersive Audio Bitstream into the MXF Generic Container for Repository File Formats

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Introduction

The Immersive Audio Bitstream (IAB) defined in SMPTE ST 2098-2 has proven effective in representing cinematic immersive sound essence. Other standards and specifications have described mapping of IAB essence to MXF for D-Cinema and IMF applications.

The purpose of this document is to define a baseline method of mapping IAB essence to the MXF Generic Container in a manner compatible with requirements for broadcast in-house archival and repository file formats, including formats based on MXF OP1a, as defined in SMPTE ST 378 and AMWA AS-11.

1 Scope

This SMPTE Registered Disclosure Document (RDD) specifies a method of mapping immersive audio essence, as defined in SMPTE ST 2098-2, to the MXF Generic Container. The mapping supports interleaving with video essence and data in a frame-wrapped manner compatible with requirements for MXF archival and repository file formats.

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 clause explicitly labeled as "Informative" or individual paragraphs that start with "Note:" or “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.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; tables shall be next; then formal languages; then figures; and then any other language forms.

3 Normative References

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

SMPTE ST 336:2017, *Data Encoding Protocol Using Key-Length-Value*.
https://doi.org/10.5594/SMPTE.ST336.2017

SMPTE ST 379-2, Material Exchange Format (MXF) — *MXF Constrained Generic Container*.
https://doi.org/10.5594/SMPTE.ST379-2

SMPTE ST 429-18:2023, *D-Cinema Packaging — Immersive Audio Track File*.
https://doi.org/10.5594/SMPTE.ST429-18.2023

SMPTE ST 2067-201, *Immersive Audio Bitstream Level 0 - Plug-in*.
https://doi.org/10.5594/SMPTE.ST2067-201

SMPTE ST 2098-2:2022, *Immersive Audio Bitstream Specification*.
https://doi.org/10.5594/SMPTE.ST2098-2.2022

4 Mapping Immersive Audio Bitstream Essence into the MXF Generic Container

4.1 General

The essence container shall conform to SMPTE ST 379-2.

This document describes the mapping of individual IABitstream Frames contained within an Immersive Audio Bitstream (IAB) into the MXF Generic Container using Frame Wrapping.

4.2 Frame Wrapping

Each IAFrame shall be KLV-coded as defined in SMPTE ST 336. The IAFrame contains all metadata and audio data for one picture frame, and its duration shall be equal to one Edit Unit. See example in Figure 1. For Long-GOP formats such as MPEG, when the Picture Element sequence has a different transmission order than the display order, the IAFrame sequence shall not be reordered.

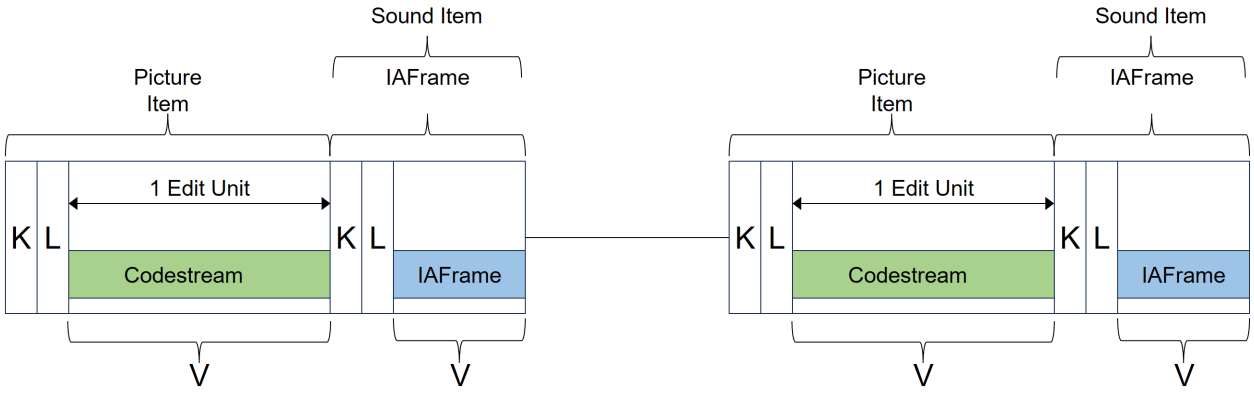

Figure 1 — Example of Frame Wrapping Picture Essence with IAB Sound Essence

4.3 Clip Wrapping

Clip Wrapping shall not be used.

4.4 Custom Wrapping

Custom Wrapping shall not be used.

4.5 KLV Coding of IAB Sound Element

4.5.1 Frame-Wrapped IAB Sound Element Key

The Frame-Wrapped IAB Sound Element shall be identified by the Frame-Wrapped IAB Sound Element UL defined in Table 1.

Table 1 — Frame-Wrapped IAB Sound Element UL

Kind	Leaf
Name	Frame-Wrapped IAB Sound Element
Symbol	`FrameWrappedIABSoundElement`
Description	Identifies a frame-wrapped IAB Sound Element
UL	urn:smpte:ul:060e2b34.01020101.0d010301.16kk10nn where: kk = Element Count nn = Element Number

NOTE The wildcard bytes (14 and 16) in the UL for `FrameWrappedIABSoundElement`, “kk” and “nn”, are replaced with the hexadecimal value 0x7f in an essence keys register, as outlined in SMPTE Metadata Registers > Register (Essence Element Keys) > UL suffix (see Bibliography).

4.5.2 Length

The length field shall be BER-encoded length field as defined in SMPTE ST 336.

4.5.3 Value

The value field shall comprise one IAFrame as defined in SMPTE ST 2098-2.

4.6 IAFrame Constraints

All IAFrames contained in the IABitstream shall have the same:

- FrameRate
- BitDepth
- SampleRate

4.7 Frame-Wrapped IAB Essence Container Label

The Frame-Wrapped IAB Essence Container shall be identified by the Frame-Wrapped IAB Essence Container UL defined in Table 2.

Table 2 — Frame-Wrapped IAB Essence Container UL

Kind	Leaf
Name	Frame-Wrapped IAB Essence Container
Symbol	`IABEssenceFrameWrappedContainer`
Description	Identifier of IAB Essence frame-wrapped Container
UL	urn:smpte:ul:060e2b34.0401010d.0d010301.021d0102

4.8 IAB Essence Descriptor

A single IAB Essence Descriptor, as defined in SMPTE ST 2067-201 and shown in Table 3, shall be associated with the Essence Track.

The Essence Container Label item of the IAB Essence Descriptor shall be as specified in Clause 4.7.

The Sound Essence Coding item of the IAB Essence Descriptor shall be set to the UL value specified in Clause 4.9.

Table 3 — IAB Essence Descriptor UL

Kind	Leaf
Name	IAB Essence Descriptor
Symbol	`IABEssenceDescriptor`
Description	Identifies an Immersive Audio Bitstream Essence Descriptor
UL	urn:smpte:ul:060e2b34.027f0101.0d010101.01017b00

4.9 Immersive Audio Coding Label

The Immersive Audio Coding Label shall be identified by the Immersive Audio Coding UL defined in SMPTE ST 429-18 and shown in Table 4.

Table 4 — Immersive Audio Coding Label UL

Kind	Leaf
Name	Immersive Audio Coding
Symbol	`ImmersiveAudioCoding`
Description	Identifies Immersive Audio Coding per SMPTE 2098-2
UL	urn:smpte:ul:060e2b34.04010105.0e090604.00000000

Bibliography (Informative)

SMPTE ST 378:2004, *Material Exchange Format (MXF) - Operational Pattern 1a (Single Item, Single Package)*. https://doi.org/10.5594/SMPTE.ST378.2004

AMWA AS-11, *Media Contribution File Formats*. https://www.amwa.tv/as-11

SMPTE Metadata Registers > Register (Essence Element Keys) > UL suffix. https://registry.smpte-ra.org/view/draft/docs/Register%20(Essence%20Element%20Keys)/UL%20suffix/