SMPTE ENGINEERING REPORT

35PM Study – IAB in OPL

SMPTE ER 1005:2021

The home of media professionals, technologists, and engineers.

SMPTE Engineering Report

35PM Study – IAB in OPL

Table of Contents

Approved February 10, 2021

1 Introduction

The IMF framework SMPTE ST 2067 suite was created to standardize packaging, interchange, and processing of media content. Interoperation between implementers is based on core constraints with several applications. Composition Playlists (CPL) in IMF define the content of a timeline but do not provide support for optional presentation parameters. Such presentation parameters can be used for processing during playback, repackaging, or transcoding, and can be specified / standardized by Output Profile Lists (OPL, SMPTE ST 2067-10x).

The features of Interactive Object Audio (IOA) have practical value throughout the entertainment value chain. Therefore an increasingly relevant body of use cases employ an Immersive Audio Bitstream (IAB) plug-in. Since the addition of Immersive Audio Bitstream (IAB) support through a plug-in mechanism in IMF, SMPTE ST 2067-201, broadcasters and online distributors can now augment IMF packages with IAB content which can then be compiled into one or more deliverable files. The IMF Output Profile List (OPL) can aid in automating this process for a variety of use cases. The primary examples are rendering output from IAB content into channel based PCM as well as serialized ADM deliverables. This project aims to study in detail the requirements to support such IAB rendering and exporting processes as well as the additional components required for the OPL framework. This report will conclude with one or more proposals to develop standards and / or recommended practices for executing IAB processing in IMF workflows using OPL.

2 Scope of Study

The project examined the use cases of IMF IAB rendering to common deliverables using OPL as outlined in Section 6. The required processing, packaging and output macros are identified. This document reports the findings of this study and recommends new projects to develop required workflow components.

This study was confined to OPL processes that produce PCM or BWF+ADM channel-based bitstreams as output deliverables from IAB. Any additional operations to create a desired output that can be performed by subsequent OPL modules were out of scope. In addition, the subject of direct conversion from IAB to serialized ADM and the subject of reference renderer were not in scope for this study.

3 References

SMPTE ST 377-4:2012, MXF Multichannel Audio Labeling Framework

SMPTE ST 2067-100:2014, Interoperable Master Format – Output Profile List

SMPTE ST 2067-101:2018, Interoperable Master Format – Output Profile List – Common Image Definition and Macros

SMPTE ST 2067-103:2014, Interoperable Master Format – Output Profile List – Common Audio Definition and Macros

SMPTE ST 2067-201:2018, Immersive Audio Bitstream Level 0 Plug-in

SMPTE ST 2098-1:2018, Immersive Audio Metadata

SMPTE ST 2098-5:2018, D-Cinema Immersive Audio Channels and Soundfield Groups

EBU Tech 3388, ADM Renderer Version 2 (Final)

ISO/IEC 14496, ISO BMFF Byte Stream Format

ITU-R BS.2076-2 (10/2019), Audio definition model

ITU-R BS.2127-0 (06/2019), Audio Definition Model renderer for advanced sound systems

4 Terminology

4.1 Audio Related Terms

The terms defined in this section are applicable within the context of this document. All definitions in SMPTE ST 377-4, SMPTE ST 2098-1 and SMPTE ST 2098-5 apply.

Audio Channel
Distinct collection of sequenced audio samples that are intended for delivery to a single loudspeaker, loudspeaker array or other reproduction device

Audio Object
Segment of audio essence with associated metadata describing positional and other properties which may vary with time

Base Layer
Refers to the nominally horizontal layer of Loudspeakers used in 5.1 and 7.1 Soundfield Configurations

Bed
Soundfield Group (group of channels played out simultaneously to create a Soundfield), such as a 5.1, 7.1 or 9.1, that serves as the foundation of the immersive soundtrack mix

Immersive Sound
Includes sound that emanates from sources at and above the Base Layer

Immersive Audio
Consists of Audio Channels and/or Audio Objects, which can be utilized by the content creator to design a soundtrack with sounds above and around the listener. Immersive audio combines metadata with audio essence, which allows the Audio Objects and Audio Channels in the sound track to be rendered successfully into multiple Loudspeaker configurations. Note that Immersive Audio does not have to use Audio Objects.

IAB
Immersive Audio Bitstream, an interoperable bitstream to carry immersive audio as defined in SMPTE 2098-2

4.2 Immersive Sound vs Surround Sound

Surround Sound uses the Base Layer only, while Immersive Sound uses the Base Layer and additional (typically height and top) layers of speakers.

4.3 Interactive Object Audio (IOA)

A collection of audio elements containing both audio essence and associated metadata linked as objects and/or channels as required to recreate an audio presentation. IOA requires a rendering function, which could allow

interaction by a user based on parameters expressed in the metadata, in order to appropriately present the objects and/or channels within a target soundfield.

4.4 File Formats

BWF+ADM
A designation of the BW 64 file format with audio essence and serialized ADM data as defined by Recommendation ITU-R BS.2076

ISO BMFF
A designation of the ISO Based Media File Format (BMFF) as specified by ISO/IEC 14496

5 Audio in OPL – System Overview

5.1 Framework

ST 2067-100 describes how individual macros can be chained together in an OPL document which will allow an OPL processor to transform IMF compositions into other output forms such as media files, metadata outputs or other IMF compositions. During the development of IMF, audio was solely based on channels and soundfield groups. Audio channels from the input are either passed through or re-routed with optional summing to be re-packaged in the output. For example, a mono-essence 5.1 audio track file referenced by a Composition Playlist (CPL) can be passed, channel-by-channel, and re-packaged into an MXF file with H.264 AVC video plus timecode. Historically, such output was considered to be the file-based equivalent of a dubbed video tape. Processed audio signal can also be packaged in another media file format such as ISO BMFF.

As object-based immersive audio became common, the Immersive Audio Bitstream (IAB) track file was incorporated into the IMF framework using a plug-in mechanism as specified in SMPTE ST 2067-201. A set of processing macros in conformance to the OPL schema can support the transformation, packaging and encoding to common deliverable files from a composition with IAB. For example, the transformation from object and channel-based IAB into channel-based output could be facilitated by a dedicated IAB Render Macro to evoke audio rendering to the target output soundfield configurations, followed by known macros such as the Audio Routing and Mixing Macro defined in SMPTE ST 2067-103 and additional macros to package and/or encode the resulting audio channels into the required deliverables, e.g. ISO BMFF and AMWA AS-11 files.

5.2 Benefits

The OPL framework provides standardized components chained in media processing workflows and thereby enables interoperability. At the appropriate granularity, the Macros provide flexibility in processing pipeline design. The example above serves to illustrate this point. In the specific use case described in Section 6.3.1, the IAB Render Macro produces PCM bitstreams directly for an ISO BMFF Output Macro for packaging and export to file.

It is important to recognize that the primary goal of the OPL framework is the predictability of the deliverable, i.e. no surprises, for a given set of inputs. Its design utilizes standardized, granular processes to facilitate mathematically and procedurally precise documentation of media production workflows. Each OPL, as a document, clearly specifies the inputs, processing steps (macros) and algorithms, interaction and connectivity of each module (macro), final output (deliverables), with room for customization. Therefore, for a given IMF package, the inputs and the output of an OPL is exactly prescribed. The exact prescription is to be followed for the guaranteed repeatability of the workflow. This principle implies that any processes that can take in the given set of inputs and produces exactly the output as specified by the OPL are compliant with the corresponding OPL. Such alternative processes allow for optimization internal to the workflow without executing the OPL step-by-step “by the book.” The most illustrative example is the IAB to ISO BMFF file output use case. It is indistinguishable whether:

a) an IAB Render Macro produces PCM bitstreams to be packaged by an ISO BMFF Output Macro resulting in an ISO BMFF file or

b) an IAB Renderer directly produces an equivalent ISO BMFF file

The two alternatives are conforming to the same OPL, i.e. IAB Render Macro followed by an ISO BMFF Output Macro as described in Section 6.3.1. The advantage of having a more granular operation by utilizing the IAB Render Macro is the flexibility to insert additional processing prior to file exporting.

In summary, the OPL framework codifies complex processes that can be interoperable independent of processing plant environment and configuration. The typical usage involves processing and packaging of video, audio and data. Furthermore, the step-by-step scripting does not exclude any means of optimizing by combining steps that produce an equivalent deliverable.

6 IAB Use Cases

6.1 Introduction

As noted in the Scope of Study, the two use cases considered in this study were the transformation (rendering and output) of IAB track files conforming to SMPTE ST 2067-201 to PCM and BWF+ADM channel-based bitstreams.

An IMF package with IAB is the result of content mastering processes in film or television post-production. The IAB track file content (audio objects and bed channels) is specified by the content owner. On the other hand, the distribution outlets specify the deliverable formats for ingest. The facilities who receive IMF packages are responsible for the systems that will transform the input IMF packages and produce the deliverable desired by each distribution customer. In order to clearly direct this process, each IMF package can provide an OPL that references the required input IAB track files and specifies the output (deliverable). The MCA Labeling scheme based on SMPTE ST 377-4 framework is a powerful device and can be used to label the channels and soundfield groups post-render so that additional OPL modules can route and manipulate the audio correctly. An example OPL is provided in Section 7 to illustrate this feature.

6.2 The IAB Render Macro and the BWF+ADM Output Macro

The commercial toolkits available today can produce both a) PCM channels that are a rendition of the IAB and b) a BWF+ADM file. Two OPL macros are proposed to encapsulate such capabilities.

The IAB Render Macro introduced in Section 7.1 and detailed in Annex A.1 produces rendered PCM channels as well as channel-based immersive audio soundfield groups (e.g. 7.1.4). Its output is to be used as the source for an output macro (e.g. ISO BMFF Output Macro) that will create an output audio file. It is important to note that the IAB Render Macro proposed does not produce an actual file or bitstream for file storage or transport.

The BWF+ADM Output Macro introduced in Section 7.2 and detailed in Annex A.3 produces an actual file (a Broadcast Wave file with ADM metadata). Each channel can carry either the PCM data from a bed channel or the PCM data of an audio object. Although the BWF+ADM is basically a regular BW 64 file with metadata, the channels in the file do not represent a playable rendition, they must be rendered into playable channels.

In summary, the difference between the IAB Render Macro and the BWF+ADM Output Macro can be characterized as follows:

a) The IAB Render Macro produces a rendition for a specific soundfield configuration without any metadata, intended for direct-to-speaker use cases.

b) The BWF+ADM Output Macro produces a BW 64 file containing discrete PCM channels for audio bed channels and objects plus ADM metadata for the audio objects (basically the spatial information)

intended for a renderer, commercial or open-source such as the EBU ADM Renderer (EAR) described in EBU Tech 3388 or Recommendation ITU-R BS.2127.

6.3 Recommended OPL Operation

6.3.1 IAB to PCM

The study group recommends the following OPL operation methodology for IAB to PCM.

The OPL Render Macro defines a target soundfield configuration (e.g. 7.1.4) and invokes an immersive audio renderer which might be external or as part of a macro. The IAB is fed to the renderer, which renders it into channels based on the target soundfield configuration. The channels are then fed back into the OPL, which gives each channel an MCA Channel Label and MCA Soundfield Group Label. The result is the target soundfield group of channels, labeled with MCA and ready to be used. A packaging macro in the OPL can then be used to assemble and export the channels into a desired media file, e.g. ISO BMFF. The protocols for the OPL to communicate with external renderers and other processing devices are outside the scope of an OPL macro specification.

This process is appropriate for the example use case of starting with a simple Image+IAB CPL, rendering into a 7.1.4 soundfield group and packaging into MXF or ISO BMFF. A flow diagram of this use case is presented in Figure 1 below.

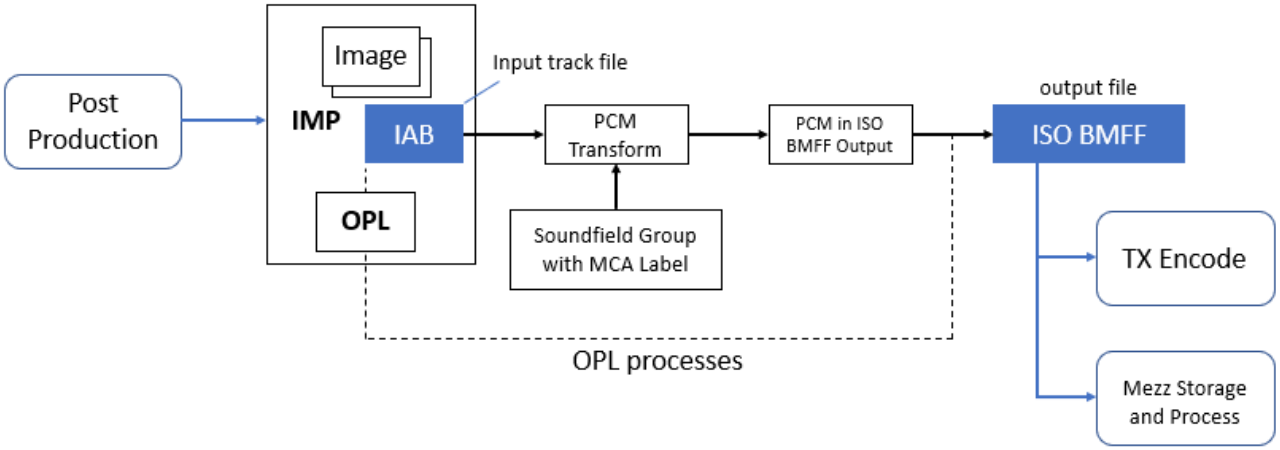

Figure 1. Example IAB to PCM 7.1.4 bitstream transform in a workflow

6.3.2 IAB to BWF+ADM

The study group recommends the following OPL operation methodology for IAB to BWF+ADM.

The OPL BWF+ADM Output Macro invokes a processor, which might be external or part of a macro, to re-package the IAB essence (audio objects and bed channels) into BWF+ADM as a WAV file (see Section 4.4).

This process is appropriate for the example use case of starting with a simple Image+IAB CPL and producing a WAV file that contains the BWF+ADM immersive audio. A flow diagram of this use case is presented in Figure 2 below. The transformation of the input IAB into the output BWF+ADM as a WAV file can be configured in different flows. Since the output of this macro is intended for a commercial or open source external renderer as described at the end of Section 6.2, the OPL flow in Figure 2 presents a single operation to combine re-packaging plus file export in the same OPL macro following the example in Section 7.2. An example IabBwfAdmOutputMacro structure is illustrated in Annex A.3. This output macro supports only the re-packaging

of all essence (PCM beds, object audio and audio metadata) carried by the input IAB into the output BWF+ADM as a WAV file.

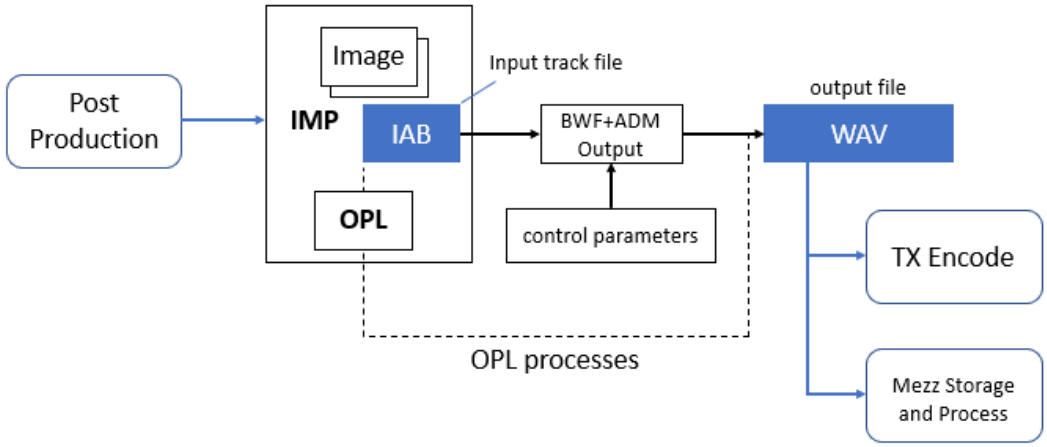

Figure 2. Example IAB to BWF+ADM transform in a workflow

7 Example OPLs

7.1 IMF IAB to PCM Streams

An example OPL to transform an IAB input to PCM streams in an ISO BMFF file is presented in Table 1. The OPL structure is defined in SMPTE ST 2067-100.

Table 1. Example OPL – Overall structure for IMF IAB to PCM steams

```
<OutputProfileList
    xmlns="http://www.smpte-ra.org/schemas/2067-100/2014"
    xmlns:arm="http://www.smpte-ra.org/schemas/2067-103/2014"
    xmlns:opl-ng="urn:cinecert.com:new-opl-stuff"
    xmlns:aaf-grp="http://www.smpte-ra.org/reg/395/2014/13/1/aaf"
    xmlns:elem="http://www.smpte-ra.org/reg/335/2012"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Id>urn:uuid:f56eddec-a4b7-401f-a5b8-36ca47ce7636</Id>
  <Annotation>OPL IAB to PCM ISO BMFF example</Annotation>
  <IssueDate>2020-06-18T17:01:20+00:00</IssueDate>
  <Issuer>aname</Issuer>
  <Creator>aname</Creator>
  <CompositionPlaylistId>
    urn:uuid:36a46664-4c74-4719-be6e-f2ea8d41ce3c
  </CompositionPlaylistId>
  <AliasList/>
  <MacroList>

  <!-- IAB Render Macro goes here -->
    <Macro xsi:type="opl-ng:IabRenderMacroType">
    <!-- IAB Render Macro structure -->
    </Macro>

  <!-- ISO BMFF Output Macro goes here -->
    <Macro xsi:type="opl-ng:IsoBmffOutputMacroType">
    <!-- ISO BMFF Macro structure -->
    </Macro>
  </MacroList>
</OutputProfileList>
```

The stubbed IAB Render Macro and ISO BMFF Output Macro are described in Annexes A.1 and A.2.

7.2 IMF IAB to BWF+ADM

An example OPL to transform an IAB input to a BWF+ADM output is presented in Table 2. The OPL structure is defined in SMPTE ST 2067-100.

Table 2. Example OPL – Overall structure for IMF IAB to BWF+ADM

```
<OutputProfileList
    xmlns="http://www.smpte-ra.org/schemas/2067-100/2014"
    xmlns:arm="http://www.smpte-ra.org/schemas/2067-103/2014"
    xmlns:opl-ng="urn:cinecert.com:new-opl-stuff"
    xmlns:aaf-grp="http://www.smpte-ra.org/reg/395/2014/13/1/aaf"
    xmlns:elem="http://www.smpte-ra.org/reg/335/2012"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Id>urn:uuid:f56eddec-a4b7-401f-a5b8-36ca47ce7636</Id>
  <Annotation>OPL IAB to broadcast WAV with ADM metadata example</Annotation>
  <IssueDate>2020-06-18T17:01:20+00:00</IssueDate>
  <Issuer>aname</Issuer>
  <Creator>aname</Creator>
  <CompositionPlaylistId>
    urn:uuid:36a46664-4c74-4719-be6e-f2ea8d41ce3c
  </CompositionPlaylistId>
  <AliasList/>
  <MacroList>

  <!-- IAB to BWAV ADM goes here -->
    <Macro xsi:type="opl-ng:IabBmfAdmOutputMacroType">
    <!-- IAB to BWF+ADM Output structure -->
    </Macro>

</OutputProfileList>
```

The stubbed IAB to BWF+ADM Output Macro is described in Annex A.3.

8 Conclusion and Recommendations

The IAB in OPL Study Group examined the workflows and components for audio deliverable packaging from Interoperable Master Packages (IMP) using the OPL framework. The Immersive Audio input is the IAB Level 0 Plugin as defined by SMPTE ST 2067-201. This work focused on the below transformations:

- IAB L0 plugin track to PCM soundfield group in ISO BMFF file;
- IAB L0 plugin track to BWF+ADM as a WAV file.

To facilitate the discussion of IAB OPL macros, the Study Group devoted substantial effort to define a set of concise terms and concepts.

The study group recommends the following work to enable the designs detailed in this report.

1. Extension of the MCA Labeling framework to cover existing Immersive Audio soundfield groups;

   Note: This is an ongoing project in SMPTE Technology Committee 31FS.

2. Development of an IAB Render Macro (Annex A.1) to convey the necessary parameters for transforming IAB essence tracks to PCM soundfield group bitstreams;

3. Development of an ISO BMFF Output Macro (Annex A.2) to package a target PCM soundfield group of channels and export to an ISO BMFF file;

4. Development of a BWF+ADM Output Macro (Annex A.3) to re-package an IMF IAB Track File into BWF+ADM as a WAV file.

The standardized OPL framework consists of a basic but clearly defined processing pipeline. When combined with the standardized set of fundamental operators, the system is expected to be interoperable and consistent. Once the necessary components are documented for the transformation of IAB Interoperable Master Packages per this report, the automated servicing workflows can be robust, repeatable, and interoperable.

Annex A Proposed OPL Macros

A.1 IAB Render Macro

A.1.1 Overall

A prototype IAB Render Macro is presented in Table 3. This example is a preliminary proposal and the design is subjected to change in development.

Table 3. IAB Render Macro – Prototype

```
<Macro xsi:type="opl-ng:IabRenderMacroType">
  <Name>iab-renderer</Name>
  <Annotation>simple container for IAB rendering</Annotation>
  <opl-ng:InputIabSequence>
    <opl-ng:Handle>
      cpl/virtual-tracks/aa784a58-7b33-45d0-9b97-0aabf557653d
    </opl-ng:Handle>
  </opl-ng:InputIabSequence>

  <arm:OutputPcmSoundfield>
    <aaf-grp:SoundfieldGroupLabelSubDescriptor>
      <elem:MCALinkID>
        urn:uuid:a6f996ef-868b-4158-ba29-4ea7822e607c
      </elem:MCALinkID>
      <elem:MCALabelDictionaryID>
        urn:smpte:ul:060e2b34.xxxxxxxx.xxxxxxxx.xxxxxxxx
      </elem:MCALabelDictionaryID>
      <elem:MCATagSymbol>sg51</elem:MCATagSymbol>
    </aaf-grp:SoundfieldGroupLabelSubDescriptor>
  </arm:OutputPcmSoundfield>
</Macro>
```

A tabulated layout of the prototype IAB Render Macro is presented in Figure 3 below.

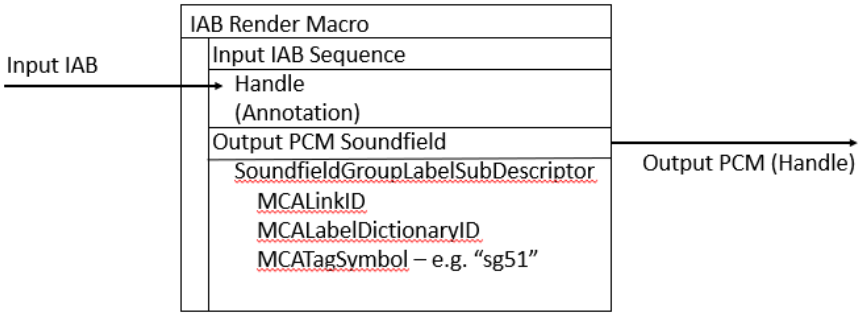

Figure 3. Prototype IAB Render Macro layout

A.1.2 Name

The `Name` element is the name of the Macro instance and uniquely identifies it.

A.1.3 Annotation

The `Annotation` element is a free-form, human-readable annotation describing the Macro instance. It is intended strictly for display to the user.

A.1.4 InputIabSequence

The `InputIabSequence` element provides the input(s) necessary for the processing. The Handle element herein is a `Handle` element of `HandleType` as defined in SMPTE ST 2067-100 that uniquely identifies the input IAB sequence.

A.1.5 OutputPcmSoundfield

The `OutputPcmSoundfield` element includes a SoundfieldGroupSubDescriptor structure that specifies the output soundfield group using MCA Labeling framework according to SMPTE ST 377-4. The labeling mechanism includes values for `MCALinkID`, `MCALabelDictionaryID` and `MCATagSymbol`.

A.2 IAB PCM Output Macro (ISO BMFF Output)

A.2.1 Overall

A prototype of an IAB PCM Output Macro using the ISO BMFF file format is presented in Table 4. This example is a preliminary proposal and the design is subjected to change in development.

Table 4. IAB PCM Output Macro (ISO BMFF Output) – Prototype

```
<Macro xsi:type="opl-ng:IsoBmffOutputMacroType">
  <Name>qt-output</Name>
  <Annotation>Use Case: output to ISO BMFF file</Annotation>
  <opl-ng:OutputPath>
    https://objectstore.example.com/example-pcm-qt.mov
  </opl-ng:OutputPath>

  <opl-ng:InputReferenceImageSequence>
    <opl-ng:Handle>
      cpl/virtual-tracks/b3766b5a-77cd-4e3b-818b-50110d8caaf9
    </opl-ng:Handle>
  </opl-ng:InputReferenceImageSequence>

  <opl-ng:AudioInputEntityList>
    <opl-ng:InputEntity>
      <opl-ng:ChannelIndex>0</opl-ng:ChannelIndex>
      <opl-ng:Handle>macros/iab-renderer/MCATagSymbol=chL</opl-ng:Handle>
    </opl-ng:InputEntity>
    <opl-ng:InputEntity>
      <opl-ng:ChannelIndex>1</opl-ng:ChannelIndex>
      <opl-ng:Handle>macros/iab-renderer/MCATagSymbol=chR</opl-ng:Handle>
    </opl-ng:InputEntity>
    <opl-ng:InputEntity>
      <opl-ng:ChannelIndex>2</opl-ng:ChannelIndex>
      <opl-ng:Handle>macros/iab-renderer/MCATagSymbol=chC</opl-ng:Handle>
    </opl-ng:InputEntity>
    <opl-ng:InputEntity>
      <opl-ng:ChannelIndex>3</opl-ng:ChannelIndex>
      <opl-ng:Handle>macros/iab-renderer/MCATagSymbol=chLFE</opl-ng:Handle>
    </opl-ng:InputEntity>
    <opl-ng:InputEntity>
      <opl-ng:ChannelIndex>4</opl-ng:ChannelIndex>
      <opl-ng:Handle>macros/iab-renderer/MCATagSymbol=chLS</opl-ng:Handle>
```

```
        </opl-ng:InputEntity>
        <opl-ng:InputEntity>
          <opl-ng:ChannelIndex>5</opl-ng:ChannelIndex>
          <opl-ng:Handle>macros/iab-renderer/MCATagSymbol=chRS</opl-ng:Handle>
        </opl-ng:InputEntity>
      </opl-ng:AudioInputEntityList>
    </Macro>
```

A tabulated layout of the prototype ISO BMFF Output Macro is presented in Figure 4 below.

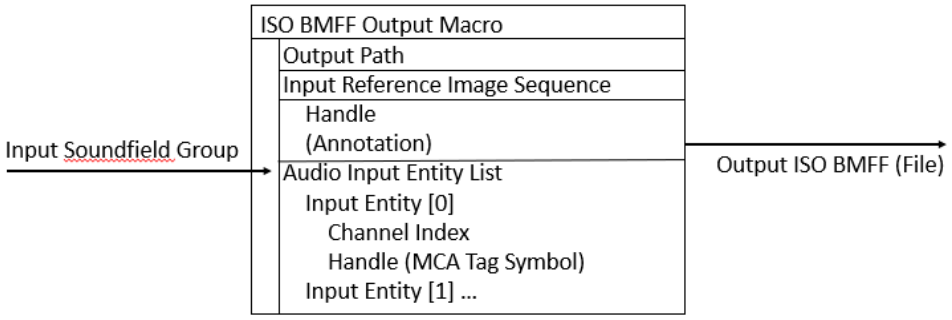

Figure 4. Prototype ISO BMFF Output Macro layout

A.2.2 Name

The `Name` element is the name of the Macro instance and uniquely identifies it.

A.2.3 Annotation

The `Annotation` element is a free-form, human-readable annotation describing the Macro instance. It is intended strictly for display to the user.

A.2.4 OutputPath

The `OutputPath` element is a character string formatted to represent a file location for the output of this Macro.

A.2.5 InputReferenceImageSequence

The `InputReferenceImageSequence` element includes a `Handle` element of `HandleType` as defined in SMPTE ST 2067-100 that uniquely identifies the input image sequence.

A.2.6 AudioInputEntityList – InputEntity

The `AudioInputEntityList` element contains a list of input entities used to produce the output audio channel. Each `InputEntity` element, of `InputEntityType` as defined in SMPTE ST 2067-103, in the list includes a `Handle` element for a Handle that refers to a single audio channel.

A.3 IAB to BWF+ADM Output Macro

A.3.1 Overall

A prototype of an IAB to BWF+ADM Output Macro using the WAV file format is presented in Table 5. This example is a preliminary proposal and the design is subjected to change in development.

Table 5. IAB to BWF+ADM Output Macro – Prototype

```
<Macro xsi:type="opl-ng:IabBwfAdmOutputMacroType">
  <Name>bwf-adm-output</Name>
  <Annotation>Use Case: output to BWF+ADM in WAV file</Annotation>
  <opl-ng:InputReferenceImageSequence>
    <opl-ng:Handle>
      cpl/virtual-tracks/b3766b5a-77cd-4e3b-818b-50110d8caaf9
    </opl-ng:Handle>
  </opl-ng:InputReferenceImageSequence>
  <opl-ng:InputIabSequence>
    <opl-ng:Handle>
      cpl/virtual-tracks/aa784a58-7b33-45d0-9b97-0aabf557653d
    </opl-ng:Handle>
  </opl-ng:InputIabSequence>
  <opl-ng:OutputPath>
    https://objectstore.example.com/example-bwf-adm.wav
  </opl-ng:OutputPath>
</Macro>
```

A tabulated layout of the prototype IAB to BWF+ADM Output Macro is presented in Figure 5 below.

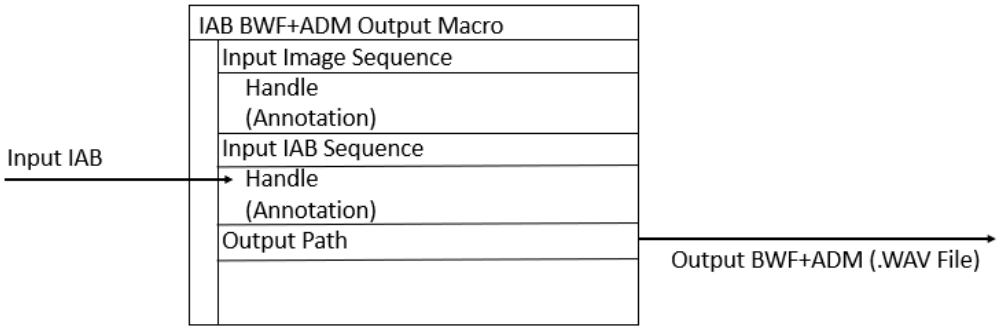

Figure 5. Prototype IAB to BWF+ADM Output Macro layout

A.3.2 Name

The `Name` element is the name of the Macro instance and uniquely identifies it.

A.3.3 Annotation

The `Annotation` element is a free-form, human-readable annotation describing the Macro instance. It is intended strictly for display to the user.

A.3.4 InputReferenceImageSequence

The `InputReferenceImageSequence` element includes a `Handle` element of `HandleType` as defined in SMPTE ST 2067-100 that uniquely identifies the input image sequence.

A.3.5 InputIabSequence

The `InputIabSequence` element provides the input(s) necessary for the processing. The Handle element herein is a `Handle` element of `HandleType` as defined in SMPTE ST 2067-100 that uniquely identifies the input IAB sequence.

A.3.6 OutputPath

The `OutputPath` element is a character string formatted to represent a file location for the output of this Macro.

Bibliography

SMPTE ST 377-1:2019, Material Exchange Format (MXF) – File Format Specification

SMPTE ST 379-1:2009, Material Exchange Format (MXF) — MXF Generic Container

SMPTE ST 379-2:2010, For Television – Material Exchange Format (MXF) — MXF Constrained Generic Container