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**Recommendation ITU-R BS.2076-0**  
(06/2015)

**Audio Definition Model**

**BS Series**  
**Broadcasting service (sound)**

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*Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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## RECOMMENDATION ITU-R BS.2076-0\*

**Audio Definition Model**

(2015)

**Scope**

This Recommendation describes the structure of a metadata model that allows the format and content of audio files to be reliably described. This model, called the Audio Definition Model (ADM), specifies how XML metadata can be generated to provide the definitions of tracks in an audio file.

**Keywords**

ADM, Audio Definition Model, BWF, Metadata, Wave-file, WAVE, object-based, channel-based, scene-based, renderer, XML, XSD, format, immersive

The ITU Radiocommunication Assembly,

*considering*

- a) that Recommendation ITU-R BS.2051 – Advanced sound system for programme production, highlights the need for a file format that is capable of dealing with the requirements for future audio systems;
- b) that Recommendation ITU-R BS.1909 – Performance requirements for an advanced multichannel stereophonic sound system for use with or without accompanying picture, outlines the requirements for an advanced multichannel stereophonic sound system;
- c) that it is desirable that there is a single open standard for a metadata model for defining audio content that file and streaming formats could either adopt or become compatible with by means of suitable interfacing,

*recommends*

for the following use cases:

- applications requiring a generic metadata model for, and a formalized description of, custom/proprietary audio formats and content (including codecs);
- generating and parsing audio metadata with general-purpose tools, such as text editors;
- an organization's internal production developments, where multi-purpose metadata needs to be added;
- a human-readable and hand-editable file for describing audio configurations (such as describing a mixing studio channel configuration) in a consistent and translatable format is needed,

to use the Audio Definition Model (ADM) described in Annex 1 for metadata to describe audio formats used in programme production and international exchange.

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\* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in July 2015 in accordance with Resolution ITU-R 1.

## Annex 1

### Audio Definition Model

#### 1 Introduction

Audio for broadcasting and cinema is evolving towards an immersive and interactive experience which requires the use of more flexible audio formats. A fixed channel-based approach is not sufficient to encompass these developments and so combinations of channel, object and scene-based formats are being developed. Reports ITU-R BS.2266 [1] and Recommendations ITU-R BS.1909 [2] and ITU-R BS.2051 [3] highlight these developments and the need for the production chain to accommodate them.

The central requirement for allowing all the different types of audio to be distributed, whether by file or by streaming, is that whatever file/stream format is used, metadata should co-exist to fully describe the audio. Each individual track within a file or stream should be able to be correctly rendered, processed or distributed according to the accompanying metadata. To ensure compatibility across all systems, the Audio Definition Model is an open standard that will make this possible.

#### 2 Background

This purpose of this model is to formalise the description of audio. It is not a format for carrying audio. This distinction will help in the understanding of the model.

##### 2.1 Cooking Analogy

To help explain what the ADM actually does, it may be useful to consider a cooking analogy. The recipe for a cake will contain a list of ingredients, instructions on how to combine those ingredients and how to bake the cake.

The ADM is like a set of rules for writing the list of ingredients; it gives a clear description of each item, for example: 2 eggs, 400g flour, 200g butter, 200g sugar.

The ADM provides the instructions for combining ingredients but does not tell you how to do the mixing or baking; in the audio world that is what the renderer does.

The ADM is in general compatible with wave-file based formats such as ITU-R BS.1352, the BWF as defined by the EBU in [4] and other wave based formats that support the usage of the needed additional chunks.

When used in the context of a BWF file according to [4], the *<chma>* chunk of the BWF file is like the bar code on the packet of each of the ingredients; this code allows us to look up the model's description of each item. The bag containing the actual ingredients is like the 'data' chunk of the BWF file that contains the audio samples.

From a BWF file point of view, we would look at our bar codes on each ingredient in our bag, and use that to look up the description of each item in the bag. Each description follows the structure of the model. There might be ingredients such as breadcrumbs which could be divided into its own components (flour, yeast, etc.); which is like having an audio object containing multiple channels (e.g. 'stereo' containing 'left' and 'right').

## 2.2 Brief overview

This model will initially use XML as its specification language, though it could be mapped to other languages such as JSON (JavaScript Object Notation) if required. When it is used with BWF files according to [4], the XML can be embedded in the `<axml>` chunk of the file.

The model is divided into two sections, the **content** part, and the **format** part. The content part describes what is contained in the audio, so will describe things like the language of any dialogue, the loudness and so on.

The format part describes the technical nature of the audio so it can be decoded or rendered correctly. Some of the format elements may be defined before we have any audio signals, whereas the content parts can usually only be completed after the signals have been generated.

While this model is based around a wave-file based format, it is a more general model. However, examples are given using BWF according to the definition in [4] as this explains more clearly how the model works. It is also expected that the model's parameters are added to in subsequent versions of this specification to reflect the progress in audio technology.

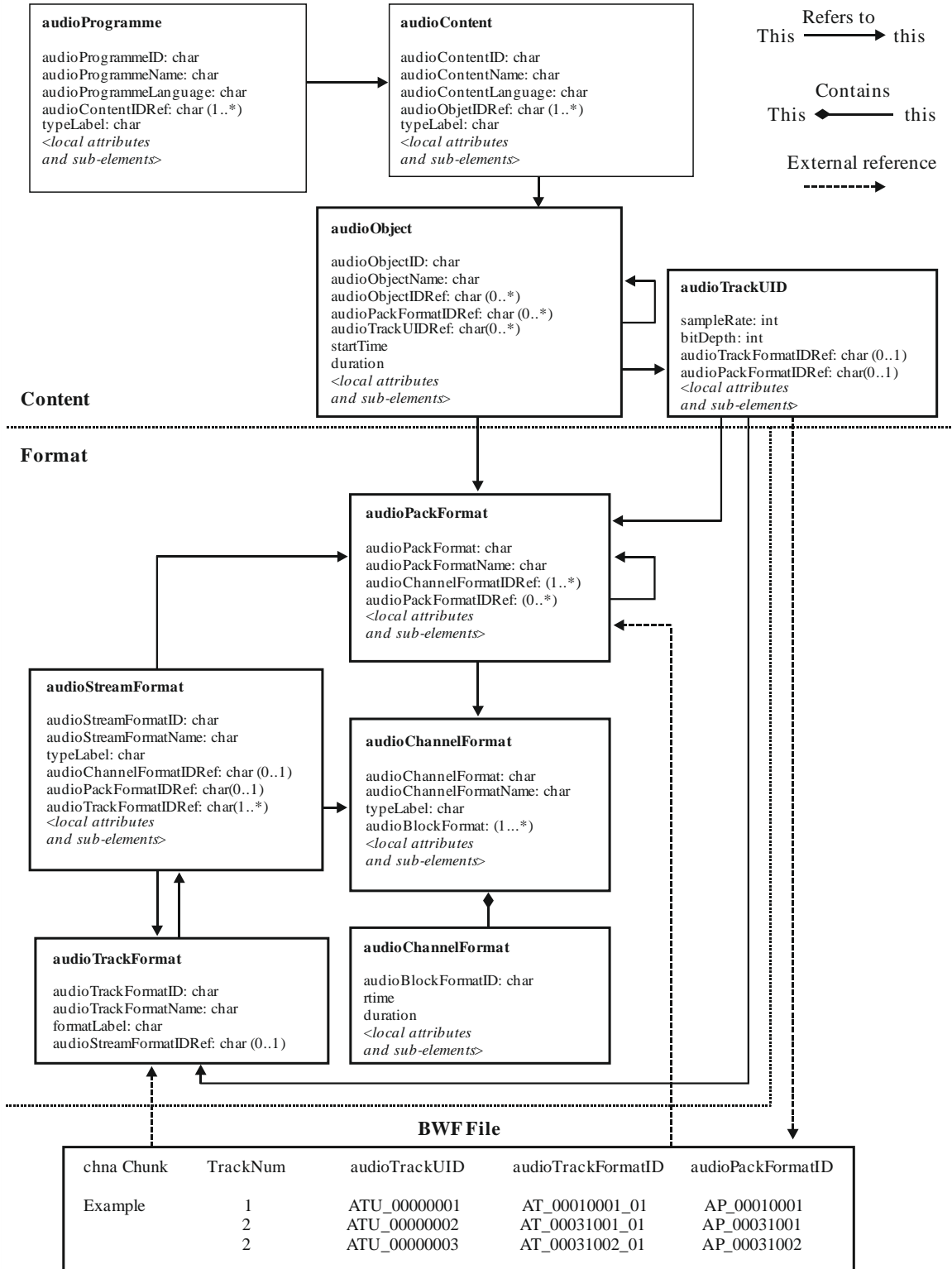
## 3 Description of the model

The overall diagram of the model is given in Fig. 1. This shows how the elements relate to each other and illustrates the split between the content and format parts. It also shows the `<chma>` chunk of a BWF file according to [4] and how it connects the tracks in the file to the model.

Where a BWF file according to [4] contains a number of audio tracks, it is necessary to know what each track is. The `<chma>` chunk contains a list of numbers corresponding to each track in the file. Hence, for a 6 track file, the list is at least 6 long. For each track there is an `audioTrackFormatID` number and an `audioTrackUID` number (notice the additional 'U' which stands for 'unique'). The reason the list could be longer than the number of tracks is that a single track may have different definitions at different times so will require multiple `audioTrackUIDs` and references.

The `audioTrackFormatID` is used to look up the definition of the format of that particular track. The `audioTrackFormatIDs` are not unique; for example, if a file contains 5 stereo pairs, there will be 5 identical `audioTrackFormatIDs` to describe the 'left' channel, and 5 to describe the 'right' channel. Thus, only two different `audioTrackFormatIDs` will need to be defined. However, `audioTrackUIDs` are unique (hence the 'U'), and they are there to uniquely identify the track. This use of IDs means that the tracks can be ordered in any way in the file; their IDs reveal what those tracks are.

FIGURE 1  
Overall UML Model



### 3.1 Format

The audioTrackFormatID answers the question "What is the format of this track?" The audioTrackFormat will also contain an audioStreamFormatID, which allows identification of the

combination of the `audioTrackFormat` and `audioStreamFormat`. An `audioStreamFormat` describes a decodable signal.

The `audioStreamFormat` is made up of one or more `audioTrackFormats`. Hence, the combination of `audioStreamFormat` and `audioTrackFormat` reveals whether the signal has to be decoded or not.

The next stage is to find out what type of audio the stream is; for example it may be a conventional channel (e.g. ‘front left’), an audio object (e.g. something named ‘guitar’ positioned at the front), a HOA (Higher Order Ambisonics) component (e.g. ‘X’) or a group of channels. Inside `audioStreamFormat` there will be a reference to either an `audioChannelFormat` or `audioPackFormat` that will describe the audio stream. There will only be one of these references.

If `audioStreamFormat` contains an `audioChannelFormat` reference (i.e. `audioChannelFormatIDRef`) then `audioStreamFormat` is one of several different types of `audioChannelFormat`. An `audioChannelFormat` is a description of a single waveform of audio. In `audioChannelFormat` there is a `typeDefinition` attribute, which is used to define what the type of channel is.

The `typeDefinition` attribute can be set to ‘DirectSpeakers’, ‘HOA’, ‘Matrix’, ‘Objects’ or ‘Binaural’. For each of those types, there is a different set of sub-elements to specify the static parameters associated with that type of `audioChannelFormat`. For example, the ‘DirectSpeakers’ type of channel has the sub-element ‘speakerLabel’ for allocating a loudspeaker to the channel.

To allow `audioChannelFormat` to describe dynamic channels (i.e. channels that change in some way over time), it uses `audioBlockFormat` to divide the channel along the time axis. The `audioBlockFormat` element will contain a start time (relative to the start time of the parent `audioObject`) and duration. Within `audioBlockFormat` there are time-dependent parameters that describe the channel which depend upon the `audioChannelFormat` type.

For example, the ‘Objects’ type of channel has the sub-elements ‘azimuth’, ‘elevation’ and ‘distance’ to describe the location of the sound. The number and duration of `audioBlockFormats` is not limited, there could be an `audioBlockFormat` for every sample if something moves rapidly, though that might be a bit excessive! At least one `audioBlockFormat` is required and so static channels will have one `audioBlockFormat` containing the channel’s parameters.

If `audioStreamFormat` refers to an `audioPackFormat`, it describes a group of channels. An `audioPackFormat` element groups together one or more `audioChannelFormats` that belong together (e.g. a stereo pair). This is important when rendering the audio, as channels within the group may need to interact with each other.

The reference to an `audioPackFormat` containing multiple `audioChannelFormats` from an `audioStreamFormat` usually occurs when the `audioStreamFormat` contains non-PCM audio which carries several channels encoded together. `AudioPackFormat` would usually not be referred from `audioStreamFormat` for most channel and scene-based formats with PCM audio. Where this reference does exist, the function of `audioPackFormat` is to combine `audioChannelFormats` that belong together for rendering purposes.

For example, ‘stereo’, ‘5.1’, ‘1st order Ambisonics’ would all be examples of an `audioPackFormat`. Note that `audioPackFormat` just describes the format of the audio. For example, a file containing 5 stereo pairs will contain only one `audioPackFormat` to describe ‘stereo’. It is possible to nest `audioPackFormats`; a ‘2nd order HOA’ could contain a ‘1st order HOA’ `audioPackFormat` alongside `audioChannelFormats` for the R, S, T, U & V components.

## 3.2 Content

Using an audio scene with 5 stereo pairs as an example, the `audioTrackFormat` defines which audio tracks are left and right, not which ones belong together, nor what is represented in them.

AudioObject is used to determine which tracks belong together and where they are in the file. This element links the actual audio data with the format, and this is where audioTrackUID comes in. For a stereo pair (in PCM), audioObject will contain references to two audioTrackUIDs; therefore, those two tracks will contain stereo audio. It will also contain a reference to audioPackFormat, which defines the format of those two tracks as a stereo pair.

As there are 5 stereo pairs in this example, 5 audioObject elements will be needed. Each one will contain the same reference to a stereo audioPackFormat, but will contain different reference to audioTrackUIDs, as each stereo pair is carrying different audio. The order of audioTrackUIDRefs is not important in an audioObject, as the format definition through audioTrack, audioStreamFormat, audioChannelFormat and audioPackFormat determines which track is which.

The audioObject element also contains startTime and duration attributes. This start time is the time when the signal for the object starts in a file or recording. Thus, if startTime is “00:00:10.00000”, the signal for the object will start 10 seconds into the track in the audio file.

As audioPackFormat can be nested, it follows that audioObjects can be nested. Therefore, the audioObject will contain not only references to the two audioTrackUIDs carrying the stream, but also references to two audioObjects, one for the 5.1 and one for the 2.0.

AudioObject is referred to by audioContent, which gives a description of the content of the audio; it has parameters such as language (if there's dialogue) and the loudness parameters. Some of the values for these parameters can only be calculated after the audio has been generated, and this is why they are not in the format part.

AudioProgramme brings all the audioContent together; it combines them to make the complete 'mix'.

For example:

- an audioProgramme may contain audioContent for 'narrator' and another one for 'background music';
- an audioProgramme for France may contain audioContents called 'dialogue-fr' and 'backgroundMusic', and another audioProgramme for the UK which contains audioContents called 'dialogue-en' and the same 'backgroundMusic'.

Multiple audioProgramme elements can be defined in one ADM XML tree representation. This facilitates the description of a presentation that represents a predefined number of meaningful mixes that users can choose from. Each audioProgramme element may reference just a subset of audioContent elements of the ADM XML tree. This is one method to enable the ADM to describe personalized audio.

For example:

- Following the previous example for audioProgramme, a single ADM XML tree can contain both French and English audioProgramme elements.
- An ADM XML tree describing a sports program can contain audioProgramme elements for a home team and an away team. The home team audioProgramme may contain audioContent elements for a 'home team biased commentary', and another one for 'ambience'. The away team audioProgramme may contain audioContent for an 'away team biased commentary' and the same 'ambience'.



	Ambience	Neutral commentary	Home team biased commentary	Away team biased commentary
Default mix	•	•		
Home team	•		•	
Away team	•			•

#### 4 Standard formats

For many situations, particularly in channel and scene-based work, many of the required formats will be common. For example, mono, stereo and 5.1 all have standard definitions and it would be inefficient to generate and carry a mass of XML every time one of these formats needs to be described. Therefore, the EBU plans to generate a set of standard format descriptions for many of the commonly used formats.

This set will be freely available in a reference XML file, which will be updated regularly. The reference file will not have to be included in a file using the ADM but can be externally referred to. Therefore a file will not need to carry the XML of the format if only standard formats are used. The occasions any ADM XML code will need to be carried in a file is when audioProgramme, audioContent and audioObject are used, or custom definitions are required.

#### 5 ADM elements

Each of the elements within the ADM is described in the following subsections. The attributes and sub-elements marked with an asterisk (\*) are already defined in the EBU Core Metadata set [5].

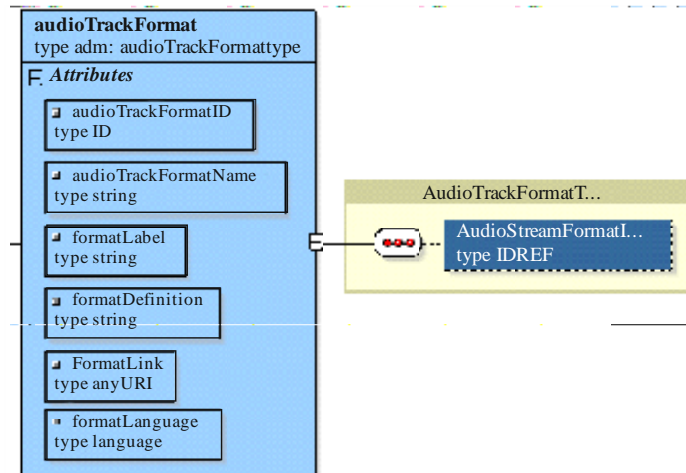
##### 5.1 audioTrackFormat

The audioTrackFormat element corresponds to a single set of samples or data in a single track in a storage medium. It is used to describe what format the data is in, allowing a renderer to decode the signal correctly. It is referred from the audioStreamFormat element which is used to identify the combination of tracks required to decode the track data successfully.

For PCM audio an audioStreamFormat will refer to a single audioTrackFormat and so the two elements are effectively describing the same thing. For coded audio, multiple audioTrackFormats will have to be combined in a single audioStreamFormat to generate decodable data.

Software that parses the model can start from either audioTrackFormat or audioStreamFormat. To allow for this flexibility audioTrackFormat can also refer back to the audioStreamFormat. However, it is a strict requirement that if this reference is used, the audioTrackFormat must refer to the same audioStreamFormat that is referring back to it.

FIGURE 2  
audioTrackFormat



BS.207602

### 5.1.1 Attributes

Attribute	Description	Example
audioTrackFormatID	ID for track	AT_00010001_01
audioTrackFormatName	Name for track	PCM_FrontLeft
formatLabel	Descriptor of the format	0001
formatDefinition	Description of the format	PCM
formatLink	URI for the format (not currently used in the ADM)	
formatLanguage	Language of the formatDefinition (not currently used in the ADM)	

### 5.1.2 Sub-elements

Element	Description	Example	Quantity
audioStreamFormatIDRef	Reference to an audioStreamFormat	AS_00010001	0 or 1

### 5.1.3 Sample code

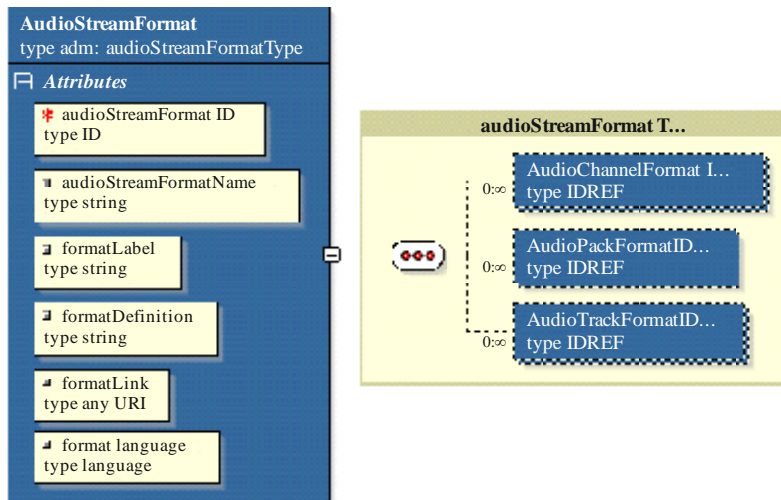
```

<audioTrackFormat audioTrackFormatID="AT_00010001_01"
audioTrackFormatName="PCM_FrontLeft" formatDefinition="PCM" formatLabel="0001">
  <audioStreamFormatIDRef>AS_00010001</audioStreamFormatIDRef>
</audioTrackFormat>
  
```

## 5.2 audioStreamFormat

A stream is a combination of tracks (or one track) required to render a channel, object, HOA component or pack. The audioStreamFormat establishes a relationship between audioTrackFormats and the audioChannelFormats or audioPackFormat. Its main use is to deal with non-PCM encoded tracks, where one or more audioTrackFormats must be combined to represent a decodable signal that covers several audioChannelFormats (by referencing an audioPackFormat).

FIGURE 3  
audioStreamFormat



BS.207603

### 5.2.1 Attributes

Attribute	Description	Example
audioStreamFormatID	ID for the stream	AS_00010001
audioStreamFormatName	Name of the stream	PCM_FrontLeft
formatLabel*	Descriptor of the format	0001
formatDefinition*	Description of the format	PCM
formatLink*	URI for the format (not currently used in the ADM)	
formatLanguage*	Language of format description (not currently used in the ADM)	

### 5.2.2 Sub-elements

Element	Description	Example
audioChannelFormatIDRef	Reference to audioChannelFormat	AC_00010001
audioPackFormatIDRef	Reference to audioPackFormat	AP_00010003
audioTrackFormatIDRef	Reference to audioTrackFormat	AT_00010001_01

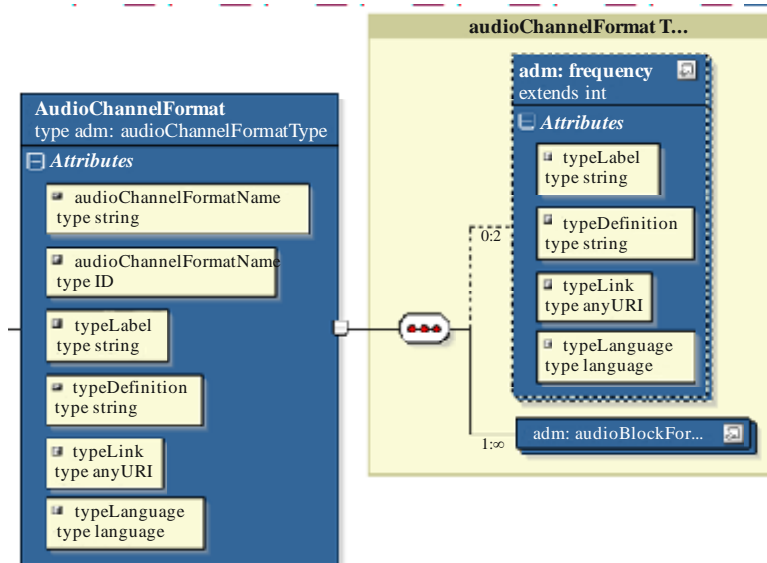
### 5.2.3 Sample code

```
<audioStreamFormat audioStreamFormatID="AT_00010001"
audioStreamFormatName="PCM_FrontLeft" formatDefinition="PCM"
formatLabel="0001">
  <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
</audioStreamFormat>
```

### 5.3 audioChannelFormat

An audioChannelFormat represents a single sequence of audio samples on which some action may be performed, such as movement of an object which is rendered in a scene. It is sub-divided in the time domain into one or more audioBlockFormats.

FIGURE 4  
audioChannelFormat



BS 2076-0

#### 5.3.1 Attributes

Attribute	Description	Example
audioChannelFormatName	Name of the channel	FrontLeft
audioChannelFormatID	ID of the channel, see § 6 for the use of the audioChannelFormatID in typical channel configurations	AC_00010001
typeLabel*	Descriptor of the type of channel	0001
typeDefinition*	Description of the type of channel	DirectSpeakers
typeLink*	URI for the type (not currently used in the ADM)	
typeLanguage*	Language of the typeDefinition (not currently used in the ADM)	

The typeDefinition of the audioChannel Format specifies the type of audio it is describing, and also determines which parameters are used within its audioBlockFormat children.

Currently, there are five different typeDefinitions:

typeDefinition	typeLabel	Description
DirectSpeakers	0001	For channel-based audio, where each channel feeds a speaker directly
Matrix	0002	For channel-based audio where channels are matrixed together, such as Mid-Side, Lt/Rt
Objects	0003	For object-based audio where channels represent audio objects (or parts of objects), so include positional information
HOA	0004	For scene-based audio where Ambisonics and HOA are used
Binaural	0005	For binaural audio, where playback is over headphones

### 5.3.2 Sub-elements

Element	Description	Attributes	Quantity
audioBlockFormat	Time division of channel containing dynamic metadata	See § 5.4	1...*
frequency	Sets a high or low cut-off frequency for the audio in Hz	typeDefinition = "lowPass" or "highPass"	0...2

The optional frequency parameter allows a frequency range of the audio to be specified. This can be either low-pass or high-pass, or by combining both to achieve band-pass and band-stop. The mostly common use of this is for LFE channels where a low-pass frequency (e.g. 200 Hz) can be specified.

### 5.3.3 Sample code

```
<audioChannelFormat audioChannelFormatID="AC_00010001"
audioChannelFormatName="FrontLeft" typeDefinition="DirectSpeakers">
  <audioBlockFormat ...>
    ...
  </audioBlockFormat>
</audioChannelFormat>
```

## 5.4 audioBlockFormat

An audioBlockFormat represents a single sequence of audioChannelFormat samples with fixed parameters, including position, within a specified time interval.

### 5.4.1 Attributes

Attribute	Description	Example
audioBlockFormatID	ID for block	AB_00010001_00000001
rtime	Start time of block (relative to the start time of the parent audioObject)	00:00:00.00000
duration	Duration of block	00:00:05.00000

The sub-elements within audioBlockFormat are dependent upon the typeDefinition or typeLabel of the parent audioChannelFormat element.

Currently, there are five different typeDefinitions:

typeDefinition	typeLabel	Description
DirectSpeakers	0001	For channel-based audio, where each channel feeds a speaker directly
Matrix	0002	For channel-based audio where channels are matrixed together, such as Mid-Side, Lt/Rt
Objects	0003	For object-based audio where channels represent audio objects (or parts of objects) and so include positional information
HOA	0004	For scene-based audio where Ambisonics and HOA are used
Binaural	0005	For binaural audio, where playback is over headphones

## 5.4.2 Sample code

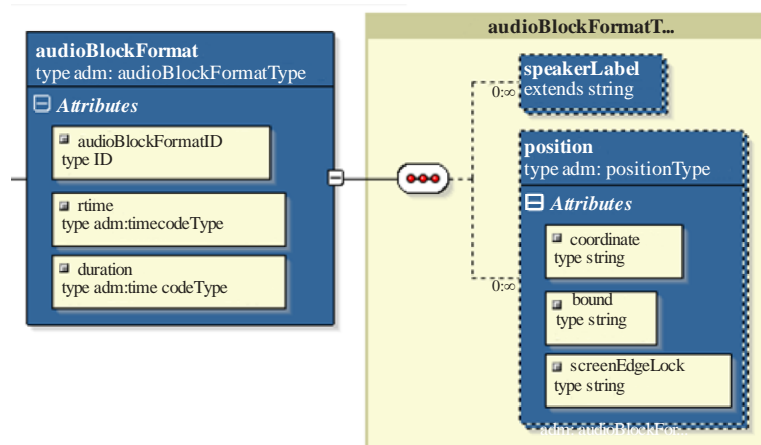
```
<audioBlockFormat audioBlockFormatID="AB_00010001_00000001" rtime="00:00:00.00000"
duration="00:00:05.00000">
  ...
</audioBlockFormat>
```

## 5.4.3 Sub-elements

### 5.4.3.1 If audioChannelFormat.typeDefinition == "DirectSpeakers"

For channel-based systems, this is the metadata used to describe the channel. If the channel is intended to be played out through a specific loudspeaker, then use *speakerLabel* to indicate the label of that speaker. While both the maximum and minimum values for the three position elements are available (using the bound attribute), they should be avoided as the exact position should normally be specified by omitting the bound attribute.

FIGURE 5  
audioBlockFormat (DirectSpeakers)



Element	Attribute	Bound attribute	Description	Units	Example	Quantity
speakerLabel		N/A	A reference to the label of the speaker position	–	M-30	0...*
position	coordinate="azimuth"		Exact azimuth location of sound	Degrees	–30.0	1
position	coordinate="azimuth"	max	Max. azimuth location of sound	Degrees	–22.5	0 or 1
position	coordinate="azimuth"	min	Min. azimuth location of sound	Degrees	–30.0	0 or 1
position	coordinate="elevation"		Exact elevation location of sound	Degrees	0.0	1
position	coordinate="elevation"	max	Max. elevation location of sound	Degrees	5.0	0 or 1
position	coordinate="elevation"	min	Min. elevation location of sound	Degrees	0.0	0 or 1
position	coordinate="distance"		Exact normalized distance from origin	Normalized to 1	1.0	0 or 1
position	coordinate="distance"	max	Max. normalized distance from origin	Normalized to 1	0.8	0 or 1
position	coordinate="distance"	min	Min. normalized distance from origin	Normalized to 1	0.9	0 or 1
position	screenEdgeLock		Defines a speaker position at a screen edge	Left, right, top, bottom	left	0 or 1

The **screenEdgeLock** attribute allows a speaker to be positioned on the edge of the screen. The attribute can be used in combination with the coordinate="elevation" and/or the coordinate="azimuth" attribute and it is set to a string stating at which edge of the screen to the speaker position should be assumed to be (if screen-size information is available), so it is either "left", "right", "top", "bottom". The coordinate attribute must still be included so it is clear which dimension is being set, and to provide an alternative position should the screen not exist or no screen-size information be available.

The example XML code below illustrates how a speaker positioned on the right edge of the screen can be defined (with an alternative position of –29.0 degrees should the screen not exist).

```
<audioBlockFormat ...>
  <speakerLabel>M-SC</speakerLabel>
  <position coordinate="azimuth" screenEdgeLock="right">–29.0</position>
  <position coordinate="elevation">0.0</position>
  <position coordinate="distance">1.0</position>
</audioBlockFormat>
```

The distance measure is normalized, as absolute speaker distances from the origin are rarely used, but an absolute reference distance is available in audioPackFormat. These coordinates are based on the polar system, as this is the common way of describing channel and speaker locations. However it is also possible to use the Cartesian coordinate system by using different coordinate attributes ('X', 'Y' and 'Z'); and this system is described in more detail in § 8.

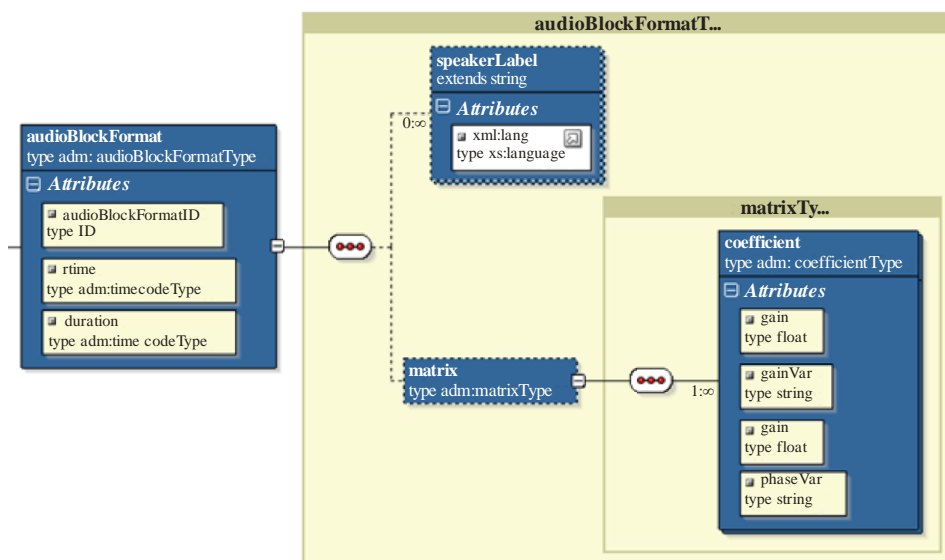
5.4.3.1.1 Sample code

```
<audioBlockFormat ...>
  <speakerLabel>M-30</speakerLabel>
  <position coordinate="azimuth">-30.0</position>
  <position coordinate="elevation">0.0</position>
  <position coordinate="distance">1.0</position>
</audioBlockFormat>
```

5.4.3.2 If audioChannelFormat.typeDefinition == “Matrix”

This is for channel-based matrix channels, such as mid-side and Lt/Rt. The matrix element contains a list of coefficient sub-elements which each refer to other channels and a multiplication factor. All the coefficients in this list should be added together to generate the matrix equation.

FIGURE 6  
audioBlockFormat (Matrix)



BS.2076-06

For example, the matrix element of a ‘Side’ channel will contain two coefficient sub-elements, one with the value 1.0 referring to "Left" and the other with a value of -1.0 referring to ‘Right’; this gives Side=Left-Right.

The values for gain and phase shift can either be constants (using gain and phase) or they may be variables (using gainVar and phaseVar) that allow the renderer to decide the value, maybe via another source of metadata. This type of channel can also be used to specify down-mixes of channels, such as Lo/Ro.

Element	Sub-elements	Description	Quantity
matrix	coefficient	Contains the coefficients for combining other channels	1



Sub-element	Attribute	Description	Units	Example	Quantity
coefficient	gain	Multiplication factor of another channel. Constant value.	Ratio	-0.5	1...*
coefficient	gainVar	Multiplication factor of another channel. Variable.	Ratio	csel	1...*
coefficient	phase	Phase shift of another channel. Constant value.	Degrees	90	1...*
coefficient	phaseVar	Phase shift of another channel. Variable.	Degrees	ph	1...*
coefficient		Reference to other channel definition		AC_000100 01	1...*

#### 5.4.3.2.1 Sample code

```
<audioBlockFormat ...>
  <matrix>
    <coefficient gain="1.0">AC_00010001</coefficient>
    <coefficient gain="-1.0">AC_00010002</coefficient>
  </matrix>
</audioBlockFormat>
```

#### 5.4.3.3 If audioChannelFormat.typeDefinition == "Objects"

This is for object-based audio where the position of the audio object may change dynamically. As well as the polar coordinates of the object, there are parameters for the object's size, and whether it is a diffuse or coherent sound.

The channelLock parameter will inform a renderer to send the object's audio to the nearest speaker or channel, rather than the usual panning, interpolation, etc. The jumpPosition parameter will ensure the renderer does not perform any temporal interpolation of the position values, so the object will jump in space rather than move smoothly to the next position.

The position elements use the coordinate attribute to specify which axis is used. The primary coordinate system is the Polar coordinate system, which uses azimuth, elevation and distance axes. However, it is possible to specify other axes for other coordinates such as X, Y and Z for the Cartesian coordinate system. This is described in more detail in § 8.

The position and object size parameters definitions depend upon the coordinate system used, so they are each described in the two following tables.

For a polar/spherical coordinate system:

Sub-element	Attribute	Description	Units	Example	Quantity	Default
position	coordinate="azimuth"	azimuth "theta" of sound location	Degrees ( $-180 \leq \theta \leq 180$ )	-22.5	1	
position	coordinate="elevation"	elevation "phi" of sound location	Degrees ( $-90 \leq \phi \leq 90$ )	5.0	1	
position	coordinate="distance"	distance "r" from origin	$\text{abs}(r) \leq 1$	0.9	0 or 1	1.0
width		horizontal extent	Degrees	45	0 or 1	0.0
height		vertical extent	Degrees	20	0 or 1	0.0
depth		distance extent	Ratio	0.2	0 or 1	0.0

For a Cartesian coordinate system:

Sub-element	Attribute	Description	Units	Example	Quantity	Default
position	coordinate="X"	left/right dimension	Normalized Units $abs(X) \leq 1$	-0.2	1	
position	coordinate="Y"	back/front dimension	Normalized Units $abs(Y) \leq 1$	0.1	1	
position	coordinate="Z"	bottom/top dimension	Normalized Units $abs(Z) \leq 1$	-0.5	0 or 1	0.0
width		X-width	Normalized Units $0 \leq X \leq 1$	0.03	0 or 1	0.0
depth		Y-width	Normalized Units $0 \leq Y \leq 1$	0.05	0 or 1	0.0
height		Z-width	Normalized Units $0 \leq Z \leq 1$	0.07	0 or 1	0.0

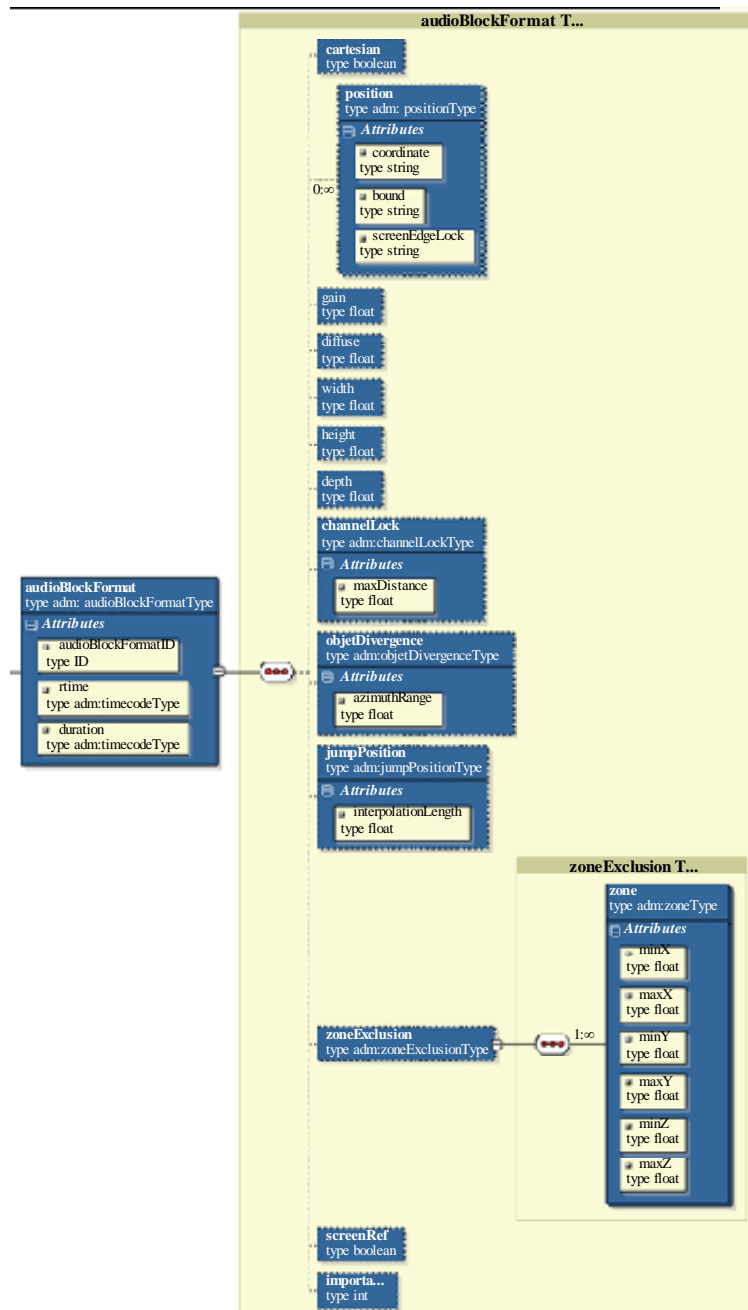
The **screenEdgeLock** attribute also exists with the **position** element, which is described in § 5.4.3.1.

The following parameters are independent of the coordinates system used:

Sub-element	Attribute	Description	Units	Example	Quantity	Default
cartesian		Specifies coordinate system, if the flag is set to 1 the Cartesian coordinate system is used, otherwise spherical coordinates are used.	1/0 flag	1	0 or 1	0
gain		Apply a gain to the audio in the object	linear gain value	0.5	0 or 1	1.0
diffuse		Describes the diffuseness of an audioObject (if it is diffuse or direct sound)	0.0 to 1.0	0.5	0 or 1	0
channelLock	maxDistance	If set to 1 a renderer can lock the object to the nearest channel or speaker, rather than normal rendering. The optional maxDistance attribute defines the radius of a sphere around the object's position. If one or more speakers exist in the defined sphere or on its surface, the object snaps to the nearest speaker. If maxDistance is undefined, a default value of infinity is assumed, meaning that the object should snap to the nearest of all speakers (unconditioned channelLock).	1/0 flag for channelLock, float value for maxDistance in the range from 0.0 to 2.0	1, 1.0	0 or 1	0 (channelLock), infinity (maxDistance)
objectDivergence	azimuthRange	Adjusts the balance between the object's specified position and two other positions specified by the azimuthRange value (symmetrical on both sides of the object at the object's position +/- azimuthRange). A value of 0 for the objectDivergence means no	0 to 1.0 for objectDivergence, 0.0 to 180.0 (angle) for azimuthRange	0.5, 60.0	0 or 1	0.0, 0.0

Sub-element	Attribute	Description	Units	Example	Quantity	Default
		divergence.				
jumpPosition	interpolationLength	If set to 1 the position will be interpolated over a period set by the attribute interpolationLength. If set to 0 then interpolation will take the entire length of the block. An interpolationLength value of zero will mean the object jumps without interpolation.	1/0 flag for jumpPosition seconds (5d.p) for interpolationLength	1, 0.05125	0 or 1 for jumpPosition	0
zoneExclusion ("zone" sub-elements)		Indicates which speaker/room zones the object should not be rendered through.	see "zone" sub-elements		0 or 1	
zone (sub-element of zoneExclusion)	minX maxX minY maxY minZ maxZ	Specifies the corner points of a cuboid in the 3D space that will be excluded from rendering. Multiple zone elements can be used to specify more complex exclusion shapes.	-1.0 to 1.0 float for each attribute, string for a label to describe the exclusion zone	minX=-1.0 maxX=1.0 minY=-1.0 maxY=0.0 minZ=-1.0 maxZ=1.0 "Rear half"	1..*	
screenRef		Indicates whether the object is screen-related (flag is equal to 1) or not (flag is equal to 0)	1/0 flag	0	0 or 1	0
importance		Importance of an object. Similar to definition for audioPack, except specifically for an object.	0 to 10	10	0 or 1	10

FIGURE 7  
audioBlockFormat (Objects)



#### 5.4.3.3.1 Sample code

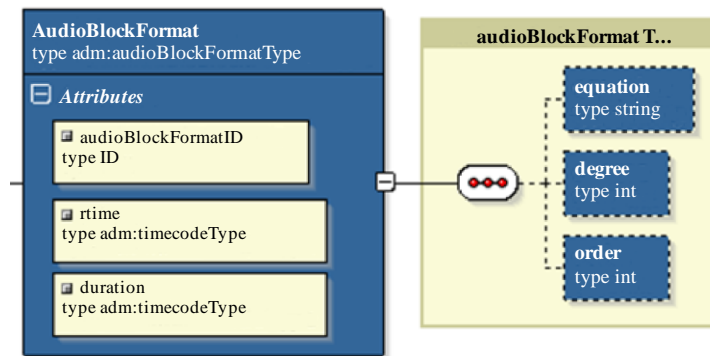
```

<audioBlockFormat ...>
  <position coordinate="azimuth">-22.5</position>
  <position coordinate="elevation">5.0</position>
  <position coordinate="distance">0.9</position>
  <depth>0.2</depth>
</audioBlockFormat>
  
```

**5.4.3.4 If audioChannelFormat.typeDefinition == “HOA”**

This is for scene-based channels (or components) such as Ambisonics/HOA. The component can be described by either a combination of degree and order values, or an equation. The different versions of Ambisonics (such as N3D and FuMa) are specified by providing suitable names for the parent audioChannelFormat and audioPackFormat elements. Each version should be assigned a range of ID values to accommodate a sufficient number of channels. It is recommended that C-style mathematical notation be used for the equation element (e.g. ‘cos(A)\*sin(E)’).

FIGURE 8  
audioBlockFormat (HOA)



BS.207608

Sub-element	Description	Type	Example	Quantity
equation	An equation to describe the HOA component	string		0 or 1
degree	Degree of the HOA component	int	1	0 or 1
order	Order of the HOA component	int	1	0 or 1

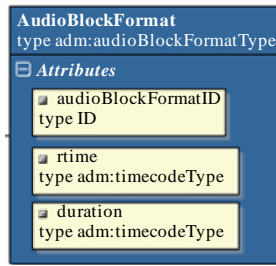
**5.4.3.4.1 Sample code**

```
<audioBlockFormat ...>
  <degree>1</degree>
  <order>1</order>
</audioBlockFormat>
```

**5.4.3.5 If audioChannelFormat.typeDefinition == “Binaural”**

This is for binaural representation of audio. Given that binaural consists of two channels, the left and right ear, this is rather simple. As the name of the audioChannelFormat will be either “leftEar” or “rightEar” there is no other metadata required in audioBlockFormat.

FIGURE 9  
audioBlockFormat (Binaural)



BS.207609

### 5.4.3.6 Sample code

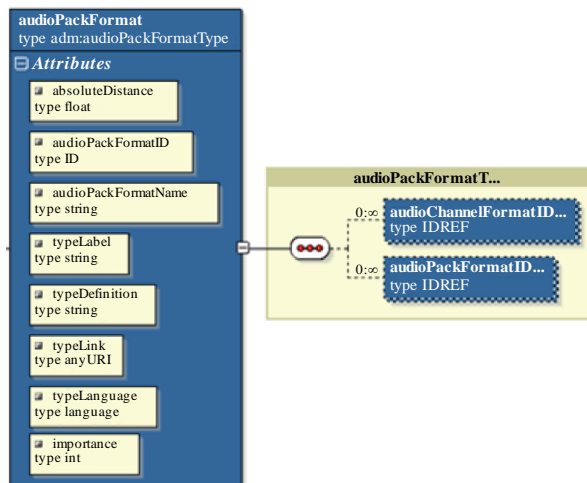
```
<audioBlockFormat .../>
```

## 5.5 audioPackFormat

The `audioPackFormat` groups together one or more `audioChannelFormats` that belong together.

Examples of `audioPackFormats` are ‘stereo’ and ‘5.1’ for channel-based formats. It can also contain references to other packs to allow nesting. The `typeDefinition` is used to define the type of channels described within the pack. The `typeDefinition/typeLabel` must match those in the referred `audioChannelFormats`.

FIGURE 10  
audioPackFormat



BS.207610

### 5.5.1 Attributes

Attribute	Description	Example
audioPackFormatID	ID for the pack, see § 6 for the use of the audioPackFormatID in typical channel configurations	AP_00010001
audioPackFormatName	Name for the pack	stereo
typeLabel	Descriptor of the type of channel	0001

Attribute	Description	Example
typeDefinition	Description of the type of channel	DirectSpeakers
typeLink	URI for the type (not currently used in the ADM)	
typeLanguage	Language of the typeDefinition (not currently used in the ADM)	
importance	Importance of a pack. Allows a renderer to discard a pack below a certain level of importance. 10 is the most important, 0 is the least.	10

There are five different typeDefinitions:

typeDefinition	typeLabel	Description
DirectSpeakers	0001	For channel-based audio, where each channel feeds a speaker directly
Matrix	0002	For channel-based audio where channels are matrixed together, such as Mid-Side, Lt/Rt
Objects	0003	For object-based audio where channels represent audio objects (or parts of objects), so include positional information
HOA	0004	For scene-based audio where Ambisonics and HOA are used
Binaural	0005	For binaural audio, where playback is over headphones

### 5.5.2 Sub-elements

Element	Description	Example	Quantity
audioChannelFormatIDRef	Reference to an audioChannelFormat	AC_00010001	0..*
audioPackFormatIDRef	Reference to an audioPackFormat	AP_00010002	0..*
absoluteDistance	Absolute distance in metres	4.5	0 or 1

There is an overall absolute distance parameter which can be used with the normalized distance parameters specified with the audioBlockFormats, to give absolute distances to each block.

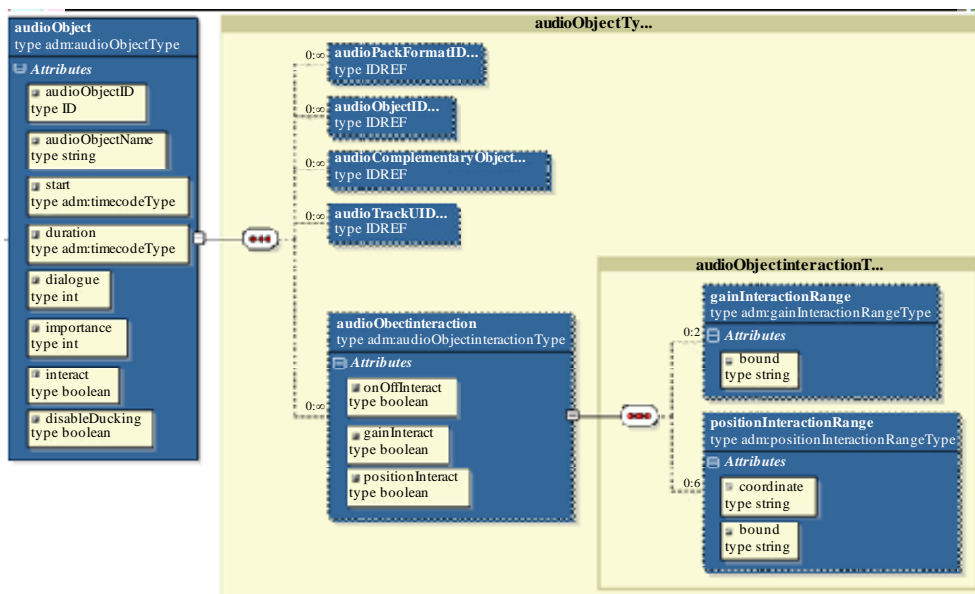
### 5.5.3 Sample code

```
<audioPackFormat      audioPackFormatID="AP_00010002"      audioPackFormatName="stereo"
typeLabel="0001">
  <audioChannelIDRef>AC_00010001</audioChannelIDRef>
  <audioChannelIDRef>AC_00010002</audioChannelIDRef>
</audioPackFormat>
```

## 5.6 audioObject

An audioObject establishes the relationship between the content, the format via audio packs, and the assets using the track UIDs. AudioObjects can be nested and so they can refer to other audioObjects.

FIGURE 11  
audioObject



BS.207611

### 5.6.1 Attributes

Attribute	Description	Example
audioObjectID	ID of the object	AO_1001
audioObjectName	Name of the object	dialogue_stereo
start	Start time for the object, relative to the start of the programme	00:00:00.00000
duration	Duration of object	00:02:00.00000
dialogue	If the audio is not dialogue set a value of 0; if it contains only dialogue a value of 1; if it contains both then a value of 2.	0
importance	Importance of an object. Allows a renderer to discard an object below a certain level of importance. 10 is most important, 0 least.	10
interact	Set to 1 if a user can interact with the object, 0 if not.	1
disableDucking	Set to 1 to disallow automatic ducking of object, 0 to allow ducking	0

### 5.6.2 Sub-elements

Element	Description	Example
audioPackIDRef	Reference to an audioPack for format description	AP_00010001
audioObjectIDRef	Reference to another audioObject	AO_1002
audioComplementaryObjectIDRef	Reference to another audioObject that is complementary to the object, e.g. to describe mutually exclusive languages.	AO_1003
audioTrackUIDRef	Reference to an audioTrackUID (when using a BWF file according to [4] this is listed in the <code>&lt;chna&gt;</code> chunk)	ATU_00000001



Element	Description	Example
audioObjectInteraction	Specification of possible user interaction with the object.	

If the value of audioTrackUIDRef is set to ATU\_00000000 then it does not refer to a track in the file, but refers to a silent or empty track. This could be useful for multichannel formats where some of the channels are not being used, so instead of storing zero value samples in the file, this silent track is used instead thus saving space in the file.

### 5.6.3 audioComplementaryObjectIDRef

The audioComplementaryObjectIDRef element contains a reference to another audioObject that is complementary to the parent audioObject. A list of audioComplementaryObjectIDRefs can therefore be used to describe mutually exclusive content, e.g. language tracks that contain the same dialogue in different dub versions (“XOR” relationship).

To avoid cross-references between audioComplementaryObjectIDRefs of several audioObjects, the audioComplementaryObjectIDRef sub-element should only be included in one corresponding parent audioObject for each set of mutually exclusive contents. The parent audioObject with the audioComplementaryObjectIDRefs should be the one that contains the default version of the set of mutually exclusive contents.

### 5.6.4 audioObjectInteraction sub-element

An audioObjectInteraction element describes any possible user interaction with the corresponding parent audioObject. It should be present only if the “Interact” attribute of the parent audioObject is set to 1. In case the “Interact” attribute of the parent audioObject is set to 0, any audioObjectInteraction element should be ignored. The audioObjectInteraction element has the following attributes and sub-elements.

Attribute	Description	Example
onOffInteract	Set to 1 if a user can switch the object on or off, 0 if not.	1
gainInteract	Set to 1 if a user can change the gain of the object, 0 if not.	1
positionInteract	Set to 1 if a user can change the position of the object, 0 if not.	0

Element	Coordinate attribute	Bound attribute	Description	Units	Example
gainInteractionRange	N/A	min	Minimum gain factor of possible user gain interaction (gainMin = gain (or 1.0 if not defined) * gainInteractionRangeMin)	linear gain value	0.5
	N/A	max	Maximum gain factor of possible user gain interaction (gainMax = gain (or 1.0 if not defined) * gainInteractionRangeMax)	linear gain value	1.5
positionInteractionRange	azimuth	min	Minimum azimuth offset value of possible user position interaction	Degrees	-30.0
	azimuth	max	Maximum azimuth offset value of possible user position interaction	Degrees	+30.0
	elevation	min	Minimum elevation offset value of possible user position interaction	Degrees	-15.0

Element	Coordinate attribute	Bound attribute	Description	Units	Example
	elevation	max	Maximum elevation offset value of possible user position interaction	Degrees	+15.0
	distance	min	Minimum normalized distance of possible user position interaction	0 to 1	0.5
	distance	max	Maximum normalized distance of possible user position interaction	0 to 1	0.5
positionInteractionRange	X	min	Minimum X-axis offset value of possible user position interaction	Normalized Units ( $\text{abs}(X) \leq 1$ )	-0.5
	X	max	Maximum X-axis offset value of possible user position interaction	Normalized Units ( $\text{abs}(X) \leq 1$ )	+0.5
	Y	min	Minimum Y-axis offset value of possible user position interaction	Normalized Units ( $\text{abs}(Y) \leq 1$ )	-0.2
	Y	max	Maximum Y-axis offset value of possible user position interaction	Normalized Units ( $\text{abs}(Y) \leq 1$ )	0.0
	Z	min	Minimum Z-axis offset value of possible user position interaction	Normalized Units ( $\text{abs}(Z) \leq 1$ )	0.1
	Z	max	Maximum Z-axis offset value of possible user position interaction	Normalized Units ( $\text{abs}(Z) \leq 1$ )	0.4

#### 5.6.4.1 Sample code

```
<audioObjectInteraction onOffInteract="1" gainInteract="1" positionInteract="1">
  <gainInteractionRange bound="min">0.5</gainInteractionRange>
  <gainInteractionRange bound="max">2.0</gainInteractionRange>
  <positionInteractionRange coordinate="elevation" bound="min">
    -10.0
  </positionInteractionRange>
  <positionInteractionRange coordinate="elevation" bound="max">
    +10.0
  </positionInteractionRange>
  <positionInteractionRange coordinate="azimuth" bound="min">
    -30.0
  </positionInteractionRange>
  <positionInteractionRange coordinate="azimuth" bound="max">
    +30.0
  </positionInteractionRange>
</audioObjectInteraction>
```

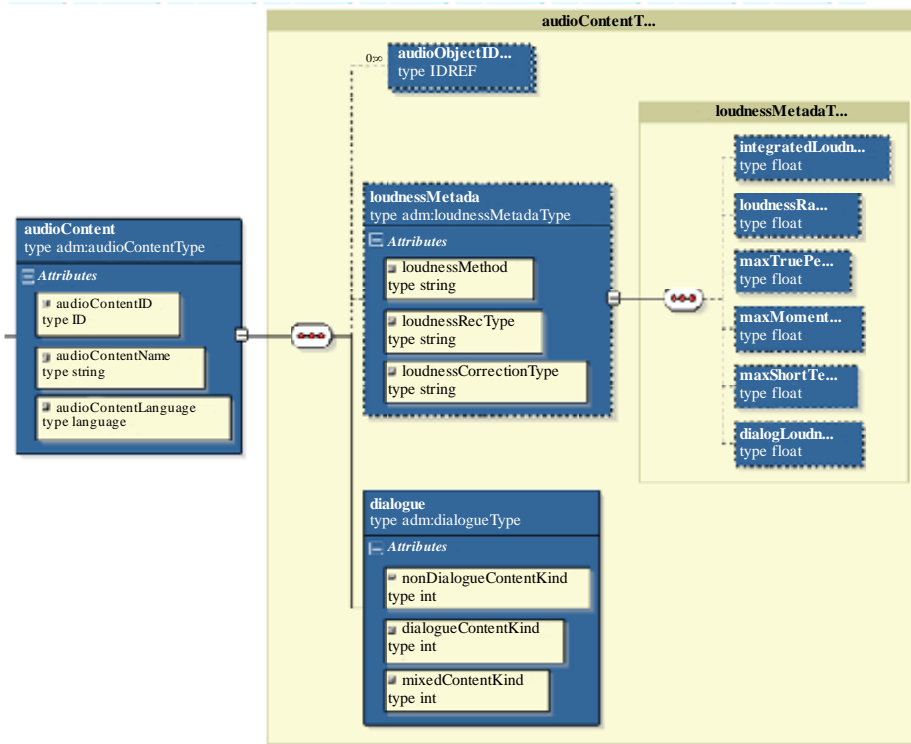
#### 5.6.5 Sample code

```
<audioObject audioObjectID="AO_1001" audioObjectName="Dialogue_stereo">
  <audioPackIDRef>AP_00010001</audioPackIDRef>
  <audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000002</audioTrackUIDRef>
</audioObject>
```

### 5.7 audioContent

An audioContent element describes the content of one component of a programme (e.g. background music), and refers to audioObjects to tie the content to its format. This element includes loudness metadata.

FIGURE 12  
audioContent



BS 2076-0

### 5.7.1 Attributes

Attribute	Description	Example
audioContentID	ID of the content	ACO_1001
audioContentName	Name of the content	Music
audioContentLanguage	Language of the content	en

### 5.7.2 Sub-elements

Element	Description	Example
audioObjectIDRef	Reference to audioObject	AO_1001
loudnessMetadata	See § 5.7.3	
dialogue	If the audio is not dialogue set a value of 0; if it contains only dialogue set a value of 1; if it contains both then set a value of 2.	0

### 5.7.3 dialogue

This element specifies the kind of content that is included in the parent audioContent. The Dialogue sub-element can take the values 0 (no dialogue), 1 (pure dialogue) or 2 (mixed). It has an attribute that specifies the type of content using defined lists (enumerators) of content kinds.

The attribute is dependent on the value of the Dialogue element.

Value of dialogue	Attribute	Description	Example
0	nonDialogueContentKind	ID of the contained content kind (enumerator, see specification below)	0
1	dialogueContentKind	ID of the contained content kind (enumerator, see specification below)	0
2	mixedContentKind	ID of the contained content kind (enumerator, see specification below)	0

nonDialogueContentKind	Description
0	undefined
1	music
2	effect
dialogueContentKind	Description
0	undefined
1	(storyline) dialogue
2	voiceover
3	spoken subtitle
4	audio description/visually impaired
5	commentary
6	emergency
mixedContentKind	Description
0	undefined
1	complete main
2	mixed
3	hearing impaired

#### 5.7.4 Loudness attributes and sub-elements

Attribute	Description	Example
loudnessMethod	The method or algorithm used to calculate the loudness.	“BS.1770”
loudnessRecType	The RecType indicates which regional recommended practice was followed in the loudness correction of the audio	“R128”
loudnessCorrectionType	The correction type is used to indicate what correction the audio, for example, file-based or real-time.	“File-based”

The audio could be measured by various means, relating to loudness algorithm, regional recommended practice followed, and by what correction type. The loudnessMethod or algorithm used will typically be BS.1770, but in the future, there could be newer methods. The RecType indicates the regional recommended practice that was followed as a character string, such as, “EBU R128”, “ATSC A/85”, “ARIB TR B32” or “FreeTV OP59”. The CorrectionType specifies how the audio has been correlated: in an off-line file-based or a real-time process.

Element	Description	Units	Example
integratedLoudness	Integrated loudness value	LKFS/LUFS	-23.0
loudnessRange	Loudness range	LU	10.0
maxTruePeak	Maximum true-peak	dBTP	-2.3
maxMomentary	Maximum momentary loudness	LKFS/LUFS	-19.0
maxShortTerm	Maximum short term loudness	LKFS/LUFS	-21.2
dialogueLoudness	Loudness of the average dialogue	LKFS/LUFS	-24.0

NOTE – ITU-R BS.1770 uses LKFS for loudness units, and the EBU uses LUFS. Both units are identical, and the model does not require the units to be expressed in the metadata.

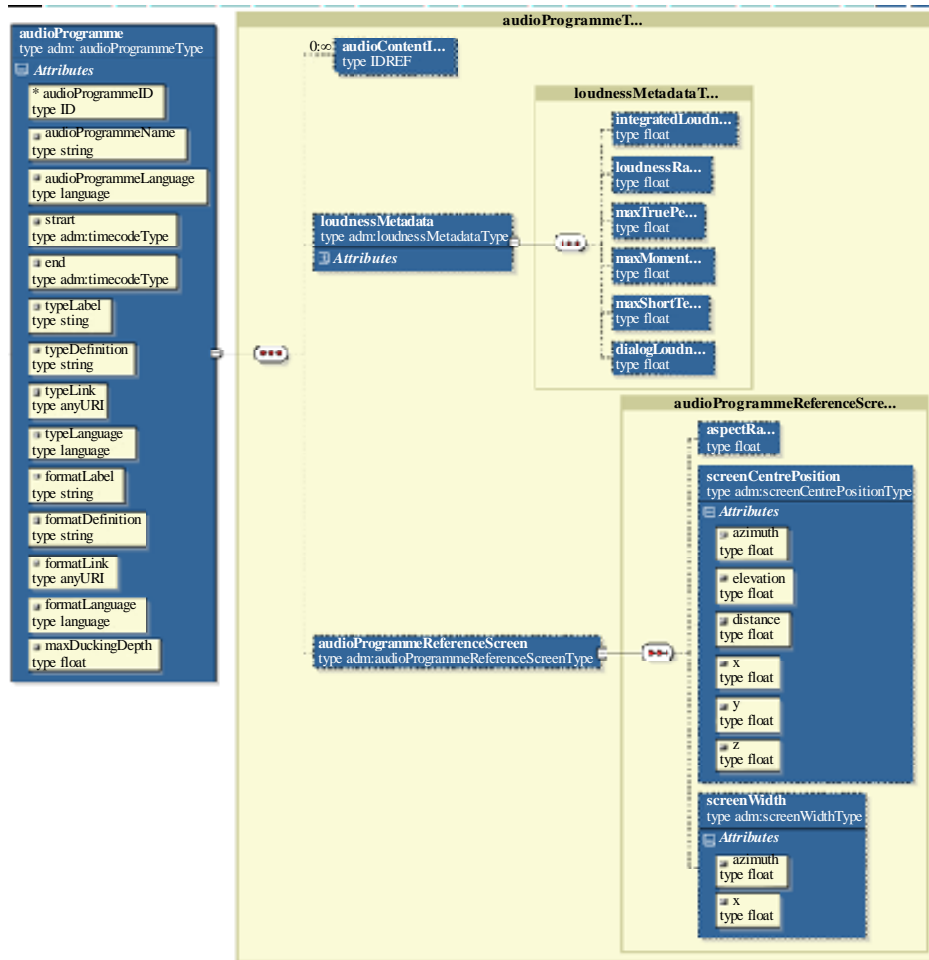
### 5.7.5 Sample code

```
<audioContent audioContentID="ACO_1001" audioContentName="Music">
  <audioObjectIDRef>AO_1001</audioObjectIDRef>
  <loudnessMetadata>
    <integratedLoudness>-23.0</integratedLoudness>
    <maxTruePeak>-2.3</maxTruePeak>
  </loudnessMetadata>
</audioContent>
```

## 5.8 audioProgramme

An audioProgramme element refers to a set of one or more audioContents that are combined to create a full audio programme. It contains start and end timecodes for the programme which can be used for alignment with video timecodes. Loudness metadata is also included to allow the programme's loudness to be recorded.

FIGURE 13  
audioProgramme



BS 2076-0

### 5.8.1 Attributes

Attribute	Description	Example
audioProgrammeID	ID of the programme	APR_1001
audioProgrammeName	Name of the programme	
audioProgrammeLanguage	Language of the dialogue	fr
start	Start timecode for the programme	00:00:10.00000
end	End timecode for the programme	00:10:00.00000
typeGroup (Label, Definition, Link, Language)	(not currently used)	
formatGroup (Label, Definition, Link, Language)	(not currently used)	
maxDuckingDepth	Indicates the maximum amount of automatic ducking allowed for every audioObject in the programme. Range is 0 to -62 dB	

### 5.8.2 Sub-elements

Element	Description	Example
audioContentIDRef	Reference to content	ACO_1001
loudnessMetadata	See § 5.8.3	
audioProgrammeReferenceScreen	Specification of a reference/production/monitoring screen size for the audioProgramme, see § 5.8.4. If the reference screen-size is not given, a default screen-size is implicitly defined (see § 9.9).	

### 5.8.3 audioProgrammeReferenceScreen

An audioProgrammeReferenceScreen element describes a reference/production/monitoring screen that was used by the content creator during the production of the content of this audioObject.

Attribute	Description	Example
aspectRatio	Aspect ratio of the screen (proportional relationship between its width and its height (with respect to the image dimensions))	1.78, 1.6

Element	Coordinate Attribute	Description	Units	Example
screenCentrePosition	azimuth	Azimuth angle of the centre of the screen	Degrees	+30.0
	elevation	Elevation angle of the centre of the screen	Degrees	-15.0
	distance	Distance to the centre of the screen. Default is 1.0	0.0 to 1.0	1.0
	X	X-coordinate of the centre of the screen	Normalized units ( $abs(X) \leq 1$ )	-0.3
	Y	Y-coordinate of the centre of the screen	Normalized units ( $abs(Y) \leq 1$ )	-0.2
	Z	Z-coordinate of the centre of the screen	Normalized units ( $abs(Z) \leq 1$ )	1.0
screenWidth	azimuth	Width of the screen in polar coordinates (azimuth opening angle theta)	Degrees ( $0 < theta \leq 180$ )	+58.0
	X	Width of the screen in Cartesian coordinates (width of the screen on the X-axis)	$0 < X \leq 2$	0.8

### 5.8.4 Loudness attributes and sub-elements

Attribute	Description	Example
loudnessMethod	The method or algorithm used to calculate the loudness.	“BS.1770”
loudnessRecType	The RecType indicates which regional recommended practice was followed in the loudness correction of the audio	“R128”
loudnessCorrectionType	The correction type is used to indicate what correction the audio, for example, file-based or real-time.	“File-based”

The audio could be corrected or normalized by numerous means, relating to loudness algorithm, regional recommended practice followed, and by what correction type. The loudnessMethod or algorithm used will typically be “BS.1770” as defined in Recommendation ITU-R BS.1770 [6], but in the future, there could be newer methods. The RecType indicates the regional recommended practice that was followed as a character string, such as “EBU R128”, “ATSC A/85”, “ARIB TR B32” or “FreeTV OP59”. The CorrectionType specifies how the audio has been correlated: in an off-line file-based or a real-time process.

Element	Description	Units	Example
integratedLoudness	Integrated loudness value	LKFS/LUFS	-23.0
loudnessRange	Loudness range	LU	10.0
maxTruePeak	Maximum true-peak	dBTP	-2.3
maxMomentary	Maximum momentary loudness	LKFS/LUFS	-19.0
maxShortTerm	Maximum short term loudness	LKFS/LUFS	-21.2
dialogueLoudness	Loudness of the average dialogue	LKFS/LUFS	-24.0

NOTE – ITU-R BS.1770 uses LKFS for loudness units, and the EBU uses LUFS. Both units are identical, and the model does not require the units to be expressed in the metadata.

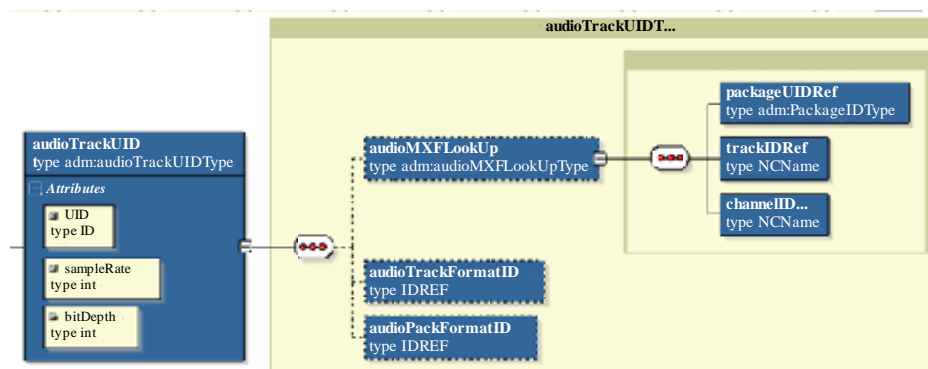
### 5.8.5 Sample code

```
<audioProgramme audioProgrammeID="APR_1001" audioProgrammeName="Documentary">
  <audioContentIDRef>ACO_1001</audioContentIDRef>
  <audioContentIDRef>ACO_1002</audioContentIDRef>
</audioProgramme>
```

## 5.9 audioTrackUID

The audioTrackUID uniquely identifies a track or asset within a file or recording of an audio scene. This element contains information about the bit-depth and sample-rate of the track. It also contains sub-elements that allow the model to be used for non-BWF applications by performing the job of the <chna> chunk. When using the model with MXF files the audioMXFLookUp sub-element (which contains sub-elements to refer to the audio essences in the file) is used.

FIGURE 14  
audioTrackUID





### 5.9.1 Attributes

Attribute	Description	Example
UID	The actual UID value	ATU_00000001
sampleRate	Sample rate of track in Hz	48000
bitDepth	Bit-depth of track in bits	24

### 5.9.2 Sub-elements

Element	Description	Example
audioMXFLookUp	See § 5.9.3	
audioTrackFormatIDRef	Reference to an audioTrackFormat description	AT_00010001_01
audioPackFormatIDRef	Reference to an audioPackFormat description	AP_00010002

### 5.9.3 MXF sub-elements

MXF has different meanings for the terms ‘track’ and ‘channel’ from their use in the ADM. In MXF ‘track’ is the storage medium containing audio or video, and for audio this ‘track’ can be sub-divided into ‘channels’.

Element	Description	Type	Example
packageUIDRef	Reference to an MXF package	UMID string	urn:smpte:umid: 060a2b34.01010105.01010f20.13000000. 540bca53.41434f05.8ce5f4e3.5b72c985
trackIDRef	Reference to an MXF track	int	MXFTRACK_3
channelIDRef	Reference to a channel track	Int	MXFCHAN_1

### 5.9.4 Sample code

```
<audioTrackUID UID="ATU_00000001" sampleRate="48000" bitDepth="24"/>
```

## 5.10 audioFormatExtended

AudioFormatExtended is the parent element, containing all the ADM elements.

### 5.10.1 Sub-elements

Element	Description
audioProgramme	Description of the whole audio programme.
audioContent	Description of the content of some audio within the programme.
audioObject	The link between the actual audio tracks and their format.
audioPackFormat	A description of a pack of channels that relate together.
audioChannelFormat	A description of an audio channel.
audioStreamFormat	A description of an audio stream.
audioTrackFormat	A description of an audio track.
audioTrackUID	The unique identifier for an actual audio track.

## 6 Use of IDs

The ID attributes in each of the elements have three main purposes: to allow the elements to reference each other, to provide a unique identification for each defined element, and to provide a logical numerical representation of the contents of the element. The IDs for each element follows the following format:

Element	ID format
audioPackFormat	AP_yyyyxxxx
audioChannelFormat	AC_yyyyxxxx
audioBlockFormat	AB_yyyyxxxx_zzzzzzzz
audioStreamFormat	AS_yyyyxxxx
audioTrackFormat	AT_yyyyxxxx_zz
audioProgramme	APR_www
audioContent	ACO_www
audioObject	AO_www

The yyyy part is a four digit hexadecimal number that represents the **type** of element it is, by using the typeLabel values. Currently there are 5 defined type label values:

typeDefinition	typeLabel	Description
DirectSpeakers	0001	For channel-based audio, where each channel feeds a speaker directly
Matrix	0002	For channel-based audio where channels are matrixed together, such as Mid-Side, Lt/Rt
Objects	0003	For object-based audio where channels represent audio objects (or parts of objects), so include positional information
HOA	0004	For scene-based audio where Ambisonics and HOA are used
Binaural	0005	For binaural audio, where playback is over headphones

The xxxx part is a four digit hexadecimal number which identifies the description within a particular type. Values in the range 0001-0FFF are reserved for standard definition such as 'FrontLeft' or 'Stereo'. Values in the range 1000-FFFF are for custom definitions, which will be particularly used in object-based audio where all the objects will be custom definitions.

The audioChannelFormatID values in the range 0001-0FFF specify the channel with respect to the channel label and channel configuration. The following audioChannelFormatIDs should be used for typical speaker configurations such as Stereo, 5.1 and 22.2.

### Example of Channel Labels

Attribute	ID of channel	Name of channel
audioChannelFormatID	AC_00010001	FrontLeft
audioChannelFormatID	AC_00010002	FrontRight
audioChannelFormatID	AC_00010003	FrontCentre
audioChannelFormatID	AC_00010004	LFE-1

Attribute	ID of channel	Name of channel
audioChannelFormatID	AC_00010005	LeftSurround
audioChannelFormatID	AC_00010006	RightSurround
audioChannelFormatID	AC_00010101	FrontLeftCentre
audioChannelFormatID	AC_00010102	FrontRightCentre
audioChannelFormatID	AC_00010103	BackLeft
audioChannelFormatID	AC_00010104	BackRight
audioChannelFormatID	AC_00010105	BackCentre
audioChannelFormatID	AC_00010106	LeftSurroundDirect
audioChannelFormatID	AC_00010107	RightSurroundDirect
audioChannelFormatID	AC_00010108	SideLeft
audioChannelFormatID	AC_00010109	SideRight
audioChannelFormatID	AC_0001010A	FrontLeftWide
audioChannelFormatID	AC_0001010B	FrontRightWide
audioChannelFormatID	AC_0001010C	TopFrontLeft
audioChannelFormatID	AC_0001010D	TopFrontRight
audioChannelFormatID	AC_0001010E	TopFrontCentre
audioChannelFormatID	AC_0001010F	TopBackLeft
audioChannelFormatID	AC_00010110	TopBackRight
audioChannelFormatID	AC_00010111	TopBackCentre
audioChannelFormatID	AC_00010112	TopSideLeft
audioChannelFormatID	AC_00010113	TopSideRight
audioChannelFormatID	AC_00010114	TopCentre
audioChannelFormatID	AC_00010115	LFE-2
audioChannelFormatID	AC_00010116	BottomFrontLeft
audioChannelFormatID	AC_00010117	BottomFrontRight
audioChannelFormatID	AC_00010118	BottomFrontCentre
audioChannelFormatID	AC_00010119	TopLeftSurround
audioChannelFormatID	AC_0001011A	TopRightSurround
audioChannelFormatID	AC_0001011B	LeftScreenEdge
audioChannelFormatID	AC_0001011C	RightScreenEdge

The audioPackFormatID specifies the channel configuration. The following standard values for typical channel configurations should be used where applicable:

#### Examples of Channel Configurations

Attribute	ID of pack	Name of pack
audioPackFormatID	AP_00010001	Mono
audioPackFormatID	AP_00010002	Stereo
audioPackFormatID	AP_00010003	5.1
audioPackFormatID	AP_00010004	7.1Top or 2/0/0+3/0/2+0/0/0.1

audioPackFormatID	AP_00010005	9.1Top or 2/0/2+3/0/2+0/0/0.1
audioPackFormatID	AP_00010007	10.2 or 2/0/1+3/2/2+0/0/0.2
audioPackFormatID	AP_00010008	13.1 or 2/0/2+5/2/2+0/0/0.1
audioPackFormatID	AP_00010009	22.2 or 3/3/3+3/2/2+2/0/0.2

In audioBlockFormat the *zzzzzzzz* part is an 8 digit hexadecimal number that acts as an index/counter for the blocks within the channel. The *yyyyxxxx* values should match those of the parent audioChannelFormat ID.

In audioTrackFormat the *zz* part is a 2 digit hexadecimal number that acts as an index/counter for the tracks within the stream. The *yyyyxxxx* values should match those of the reference audioStreamFormat ID.

The audioProgramme, audioContent and audioObject do not have a type and so have no *yyyy* values. As there is initially no intention to have standard definitions for these elements the values for *www* will be in the hexadecimal range 1000-FFFF because they will always be custom values. However, keeping the standard range of values (0000-0FFF) set aside for now may be useful in future; for example, EBU R 123 configurations may use them.

## 7 <chna> Chunk

While the ADM is designed to be a general model, its relationship with the BW64 file is important to explain. The following describes how a BW64 file will access the ADM metadata via a new RIFF chunk called <chna>. An overview of this new chunk is given here.

The ADM is linked to the BW64 file using the audioTrackFormat, audioPackFormat and audioObject (via audioTrackUID) elements. The BW64 file will contain a new chunk called <chna> (short for ‘channel allocation’), which will contain a set of IDs for each track in the file. These IDs will either refer to elements, or be referred to from an element.

Each track in the chunk contains the following IDs:

- **audioTrackFormatID** – the ID of the description of a particular audioTrackFormat element. As audioTrackFormat also refers to audioStreamFormat and either audioPackFormat or audioChannelFormat, this ID is enough to describe the format for a particular track.
- **audioPackFormatID** – the ID of the description of a particular audioPackFormat. As most audioChannelFormats need to be assigned to an audioPackFormat (e.g. ‘FrontLeft’ channel in ‘5.1’ pack), it must be specified in the <chna> chunk with this ID.
- **audioTrackUID** – the unique ID that identifies the track. The content descriptor audioObject requires knowledge of which tracks in the file are being described, so contains a list of audioTrackUID references which correspond to audio tracks in the file.

To enable tracks to contain more than one audioTrackFormatID, in order to allow different formats in the track at different times, the track number can be allocated multiple IDs. An example of such as allocation is below:

Track No	audioTrackUID	audioTrackFormatID	audioPackFormatID
1	00000001	00010001_01	00010001
2	00000002	00031001_01	00031001
2	00000003	00031002_01	00031002

Here, track number two has two audioTrackUIDs as the audioTrackFormats and audioPackFormats assigned to it are used at different times in the file. The times of allocation would have to be found by inspecting the audioObject elements that cover those audioTrackUIDs. An example of this is a programme where tracks 1 and 2 contain the theme tune which lasts for the first minute of the file. These tracks are free after this first minute, so some audio objects from the main body of the programme are stored in them subsequently. As the theme tune and the audio objects have completely different formats and contents they require different audioTrackUIDs.

## 8 Coordinate system

The position elements in audioBlockFormat, for both the ‘DirectSpeakers’ and ‘Objects’ typeDefinitions, allow different axes to be specified in the coordinate attribute. The primary coordinate system used is the polar system which uses azimuth, elevation and distance. To ensure consistency when specifying positions each of the polar axes should be based on these guidelines:

- **The origin is in the centre**, where the sweet-spot would be (although some systems do not have a sweet-spot, so the centre of the space should be assumed).
- **Azimuth** – angle in the horizontal plane with 0 degrees as straight ahead, and positive angles to the left (or anti-clockwise) when viewed from above.
- **Elevation** – angle in the vertical plane with 0 degrees horizontally ahead, and positive angles going up.
- **Distance** – a normalized distance, where 1.0 is assumed to be the default radius of the sphere.

It is also possible to specify Cartesian coordinates by using X, Y and Z as the coordinate attributes. It is recommended that normalized values be used here, where the values 1.0 and –1.0 are on the surface of the cube, with the origin being the centre of the cube.

The direction of each axis should be:

- **X** – left to right, with positive values to the right.
- **Y** – front to back, with positive values to the front.
- **Z** – top to bottom, with positive values to the top.

If normalized distances are used in the coordinate system they can be scaled to an absolute distance by multiplying by the absoluteDistance parameter in the audioPackFormat.

In Ambisonics and HOA, the coordinate system is also Cartesian based, but the axes are different. In this case the direction of each axis is:

- **X** – front to back, with positive values to the front.
- **Y** – left to right, with positive values to the left.
- **Z** – top to bottom, with positive values to the top.

To avoid confusion with the other Cartesian system, it is recommended the axes be labelled ‘X\_HOA’, ‘Y\_HOA’ & ‘Z\_HOA’. However, the HOA component definitions are unlikely to include coordinate information and so this information is primarily to ensure the rendering is correctly done.

## 9 Object-based parameter descriptions

### 9.1 gain

The **gain** parameter is a linear gain and controls the level of the audio signal in the object. At rendering the level of signal will be multiplied by the gain value. If the gain parameter is not set a value of 1.0 is assumed, so the audio signal's level is not adjusted.

### 9.2 diffuse

The **diffuse** value between 0.0 and 1.0 describes the diffuseness of a sound.

### 9.3 channelLock

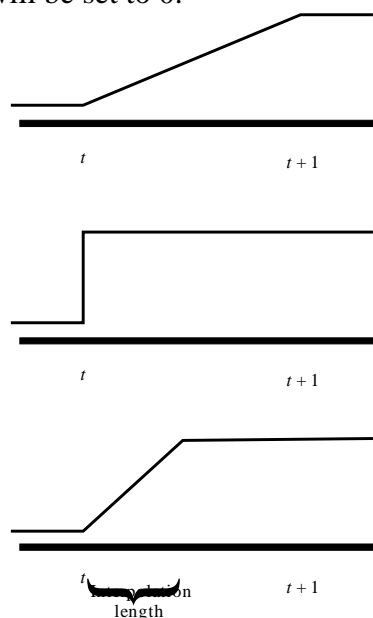
If the **channelLock** flag is set to 1 then the renderer will send the audio signal to the nearest (in terms of 3D position) channel or speaker position. A typical application for this is where the exact location of the object is not critical, but the need for un-processed reproduction of that signal takes priority.

The optional **maxDistance** attribute defines the radius  $r$ ,  $0 \leq r \leq 2$ , of a sphere around the object's position. If one or more speakers exist in the defined sphere or on its surface, the object snaps to the nearest speaker. If **maxDistance** is undefined, a default value of infinity is assumed, meaning that the object should snap to the nearest of all speakers (unconditioned **channelLock**).

### 9.4 jumpPosition and interpolationLength

If the **jumpPosition** flag is set to 0 then the renderer will interpolate a moving object between positions over the full duration of the block. If it is set to 1 it will use its **interpolationLength** attribute to set the interpolation period. If it is set to 0 the **interpolationLength** will be ignored.

The **interpolationLength** parameter allows the interpolation of a moving object to be done over a shorter time period than the next update time. This allows the control of the crossfading of objects that may be desirable due to processing done to objects. If the value is set to zero then the object will jump position without interpolation. If this attribute is not included when **jumpPosition** is set to 1, then the interpolation length will be set to 0.



## 9.5 zoneExclusion

The **zoneExclusion** parameter is used to dynamically reconfigure the object renderer to “mask out” certain speaker zones during playback. This guarantees that no loudspeaker belonging to the masked zones will be used for rendering the applicable object. Typical zone masks used in production today include sides and rear. Multiple **zone** sub-elements within **zoneExclusion** can be set simultaneously to mask out more than one zone. The default is that all zones are enabled and when **zoneExclusion** is set to one or more of the indicated zones, those are “masked out” during playback. The sub-element **zone** is used to define the coordinates of the zone in the unit-cuboid.

Zones are defined by the sub-element **zone** by specifying the corner points of a unit-cuboid in 3D space by: minX, maxX, minY, maxY, minZ, maxZ.

For example: minX= -1.0 maxX=1.0 minY= -1.0 maxY= -1.0 minZ= -1.0 maxZ=1.0 specifies the rear wall.

## 9.6 objectDivergence

The **objectDivergence** parameter (0.0 to 1.0) indicates the amount an object is split symmetrically into a pair of virtual objects, so that a phantom object is created in the position of the original object. The spread of the signal between the virtual objects should not create an image shift from the original object position and should be power preserving across virtual objects and the original. The **azimuthRange** attribute allows the angle of virtual objects to be specified. Thus, a value of 45 degrees would place virtual objects 45 degrees to the left and right of the specified object. The default angle is 45 degrees if this attribute is not used. The values of **objectDivergence** should be interpreted as:

Value	Description
0	No divergence with only the original object being present.
1	Maximum divergence where this would represent virtual objects being created azimuthRange degrees on either side of the original position.

Example: With an LCR loudspeaker configuration and the object positioned directly at the C position, and the LR virtual objects specified by using an **azimuthRange** of 30 degrees. An **objectDivergence** value of 0 indicating no divergence, only the centre speaker would be firing. A value of 0.5 would have all three (LCR) loudspeakers firing equally, and a value of 1 would have the L and R loudspeakers firing equally.

## 9.7 screenRef

The **screenRef** flag is used to indicate whether the object is screen-related or not.

The **screenRef** flag can be used by a renderer for a special processing of all screen-related objects taking into account the size of a local reproduction screen compared to the production screen-size.

If a renderer uses the **screenRef** flag to enable a special processing, it should use the reference/monitoring/production screen-size of the currently rendered audioProgramme as the reference screen.

If the flag is set and no audioProgrammeReferenceScreen element is included in the corresponding currently rendered audioProgramme, the reference production/monitoring screen is implicitly defined on the basis of Recommendation ITU-R BT.1845-1 – Guidelines on metrics to be used when tailoring television programmes to broadcasting applications at various image quality levels, display sizes and aspect ratios [8].

A UHD TV-1 (3 840 × 2 160) production/monitoring display and an optimal viewing distance are assumed. Based on the resolution of the production screen and the optimal viewing distance, an optimal horizontal viewing angle can be derived. In case of a UHD TV-1 display it results in an optimal horizontal viewing angle of 58°. The size of the production/monitoring screen is defined as:

Azimuth of left bottom corner of screen	29.0°
Elevation of the left bottom corner of screen	-17.5°
Aspect ratio	1.6
Width of the screen	58°

These spherical values can be transferred to Cartesian coordinates assuming a reference distance of 1.0 by first transferring the values above to the “standard” azimuth/elevation convention (0° azimuth is in front of the right ear, positive values are counted counter-clockwise; 0° elevation is directly above the head, positive values are counted downwards to the front) and then using the trigonometric functions to gain the Cartesian coordinates. This results in the following values (orientation of the Cartesian coordinate axes as in § 8):

X-coordinate of the centre of the screen	0.0
Y-coordinate of the centre of the screen	0.8341
Z-coordinate of the centre of the screen	0.0
Aspect ratio	1.6
Width of the screen	0.9428

## 9.8 importance

The **importance** parameter allows a renderer to discard objects below a certain level of importance, with 10 being the most, and 0 the least.

## 10 References

- [1] Report ITU-R BS.2266 – Framework of future audio broadcasting systems
- [2] Recommendation ITU-R BS.1909 – Performance requirements for an advanced multichannel stereophonic sound system for use with or without accompanying picture
- [3] Recommendation ITU-R BS.2051 – Advanced sound system for programme production
- [4] EBU Tech 3285 – Specification of the Broadcast Wave Format (BWF)
- [5] EBU Tech 3293 – EBU Core Metadata Set (Version 1.5, April 2014)
- [6] Recommendation ITU-R BS.1770 – Algorithms to measure audio programme loudness and true-peak audio level
- [7] EBU R 123 – EBU Audio Track Allocation for File Exchange (referenced in the Attachment to this Annex)
- [8] Recommendation ITU-R BT.1845-1 – Guidelines on metrics to be used when tailoring television programmes to broadcasting applications at various image quality levels, display sizes and aspect ratios (03/2010)



## Attachment to Annex 1

### Examples of ADM usage

This section contains a selection of examples of metadata that uses the ADM. These are to help illustrate how the ADM is used, but should not be considered as references for audio definitions.

#### A.1 Channel-based example

The most common use of audio is still channel-based, where tracks within a file each represent a static audio channel. This example demonstrates how to define two tracks, streams and channels; and a pack for stereo. The track and stream definitions are for PCM audio. Two objects are defined, both stereo, but containing different content so there are 4 tracks used. This example uses a programme called ‘Documentary’ containing ‘Music’ and ‘Speech’ each defined as separate stereo objects.

The format-related elements in this example represent a tiny subset of the standard reference set of definitions. In practice, this XML code would be part of the standard reference file and would not have to be included in the BWF file. All that would be required is a *<chna>* chunk with the references to the audioTrackFormats and audioPackFormats and any extra XML required for audioObject, audioContent and audioProgramme.

##### A.1.1 Summary of elements

These are the elements in the format part of the description:

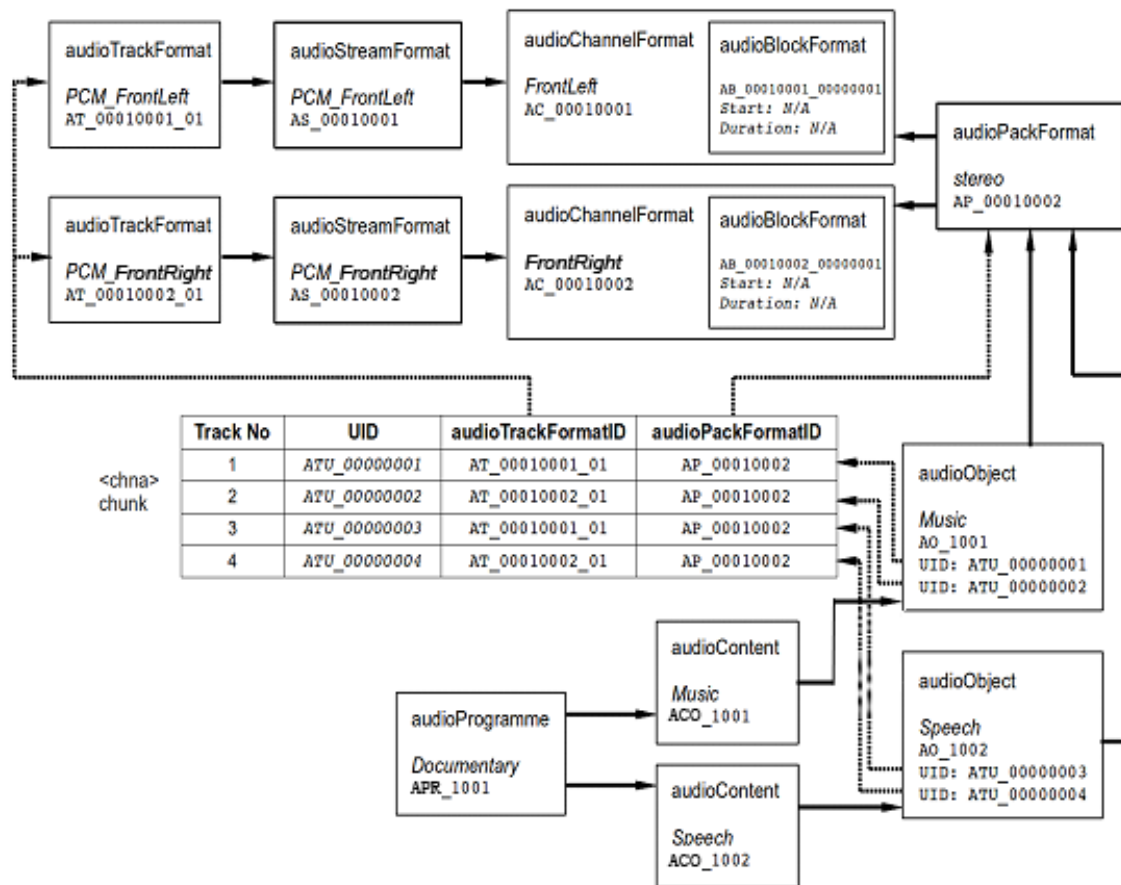
Element	ID	Name	Description
audioTrackFormat	AT_00010001_01	PCM_FrontLeft	Defines track as PCM
audioTrackFormat	AT_00010002_01	PCM_FrontRight	Defines track as PCM
audioStreamFormat	AS_00010001	PCM_FrontLeft	Defines stream as PCM
audioStreamFormat	AS_00010002	PCM_FrontRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010001 AB_00010001_00000001	FrontLeft	Describes channel as front left with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010002 AB_00010002_00000001	FrontRight	Describes channel as front right with a position and speaker reference
audioPackFormat	AP_00010002	Stereo	Defines a stereo pack referring to two channels.

These are the elements in the content part of the description:

Element	ID	Name	Description
audioObject	AO_1001	Music	Object for ‘Music’, stereo format
audioObject	AO_1002	Speech	Object for ‘Speech’, stereo format
audioContent	ACO_1001	Music	Music content
audioContent	ACO_1002	Speech	Speech content
audioProgramme	APR_1001	Documentary	Programme ‘Documentary’ containing ‘Music’ and ‘Speech’ content

### A.1.2 Diagram

The diagram shows how the defined elements relate to each other. The top half of the diagram covers the elements that describe the 2 channel stereo format. The <chna> chunk in the middle shows how the four tracks are connected to the format definitions. The content definition elements are at the bottom of the diagram, with the audioObject elements containing the track UID references to the UIDs in the <chna> chunk.



### A.1.3 Sample code

This XML sample code does not include the audioFormatExtended parent element and the XML header for clarity.

The first excerpt of code covers the format elements, which could be contained within the standard reference file:

```

<!-- ##### -->
<!-- PACKS -->
<!-- ##### -->

<audioPackFormat      audioPackFormatID="AP_00010002"      audioPackFormatName="Stereo"
typeLabel="0001"      typeDefinition="DirectSpeakers">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>

```

```

<audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
</audioPackFormat>

<!-- ##### -->
<!-- CHANNELS -->
<!-- ##### -->

<audioChannelFormat                                audioChannelFormatID="AC_00010001"
audioChannelFormatName="FrontLeft"  typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010001_00000001">
    <speakerLabel>M+30</speakerLabel>
    <position coordinate="azimuth">30.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010002"
audioChannelFormatName="FrontRight" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010002_00000001">
    <speakerLabel>M-30</speakerLabel>
    <position coordinate="azimuth">-30.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<!-- ##### -->
<!-- STREAMS -->
<!-- ##### -->

<audioStreamFormat                                audioStreamFormatID="AS_00010001"
audioStreamFormatName="PCM_FrontLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef> </audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010002"
audioStreamFormatName="PCM_FrontRight"  formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010002_01</audioTrackFormatIDRef>

</audioStreamFormat>

<!-- ##### -->
<!-- AUDIO TRACKS -->
<!-- ##### -->

<audioTrackFormat                                audioTrackFormatID="AT_00010001_01"
audioTrackFormatName="PCM_FrontLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010001</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010002_01"
audioTrackFormatName="PCM_FrontRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010002</audioStreamFormatIDRef>
</audioTrackFormat>

```

The second excerpt covers the content part, which would have to be included in the <axml> chunk of the BWF file:

```

<!-- ##### -->
<!-- PROGRAMMES -->
<!-- ##### -->

<audioProgramme audioProgrammeID="APR_1001" audioProgrammeName="Documentary">
  <audioContentIDRef>ACO_1001</audioContentIDRef>
  <audioContentIDRef>ACO_1002</audioContentIDRef>
</audioProgramme>

<!-- ##### -->
<!-- CONTENTS -->
<!-- ##### -->

<audioContent audioContentID="ACO_1001" audioContentName="Music">
  <audioObjectIDRef>AO_1001</audioObjectIDRef>
  <loudnessMetadata>
    <integratedLoudness>-28.0</integratedLoudness>
  </loudnessMetadata>
</audioContent>

<audioContent audioContentID="ACO_1002" audioContentName="Speech">
  <audioObjectIDRef>AO_1002</audioObjectIDRef>
  <loudnessMetadata>
    <integratedLoudness>-23.0</integratedLoudness>
  </loudnessMetadata>
</audioContent>

<!-- ##### -->
<!-- OBJECTS -->
<!-- ##### -->

<audioObject audioObjectID="AO_1001" audioObjectName="Music" start="00:00:00.00">
  <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000002</audioTrackUIDRef>
</audioObject>

<audioObject audioObjectID="AO_1002" audioObjectName="Speech" start="00:00:00.00">
  <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>

```

```

    <audioTrackUIDRef>ATU_00000003</audioTrackUIDRef>
    <audioTrackUIDRef>ATU_00000004</audioTrackUIDRef>
</audioObject>
<!-- ##### -->
<!-- AUDIO TRACK UIDs -->
<!-- ##### -->

<audioTrackUID UID="ATU_00000001">
    <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
    <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000002">
    <audioTrackFormatIDRef>AT_00010002_01</audioTrackFormatIDRef>
    <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000003">
    <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
    <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000004">
    <audioTrackFormatIDRef>AT_00010002_01</audioTrackFormatIDRef>
    <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>
</audioTrackUID>

```

## A.2 Object-based example

To demonstrate how the ADM can be used in object-based audio here is a simple example using a single object. This example uses multiple audioBlockFormats within an audioChannelFormat to describe the dynamic properties of an object called “Car”. The audioBlockFormats uses the start and duration attributes to frame the time dependent metadata, thus allowing the object’s position to move in space.

### A.2.1 Summary of elements

These are the elements in the format part of the description:

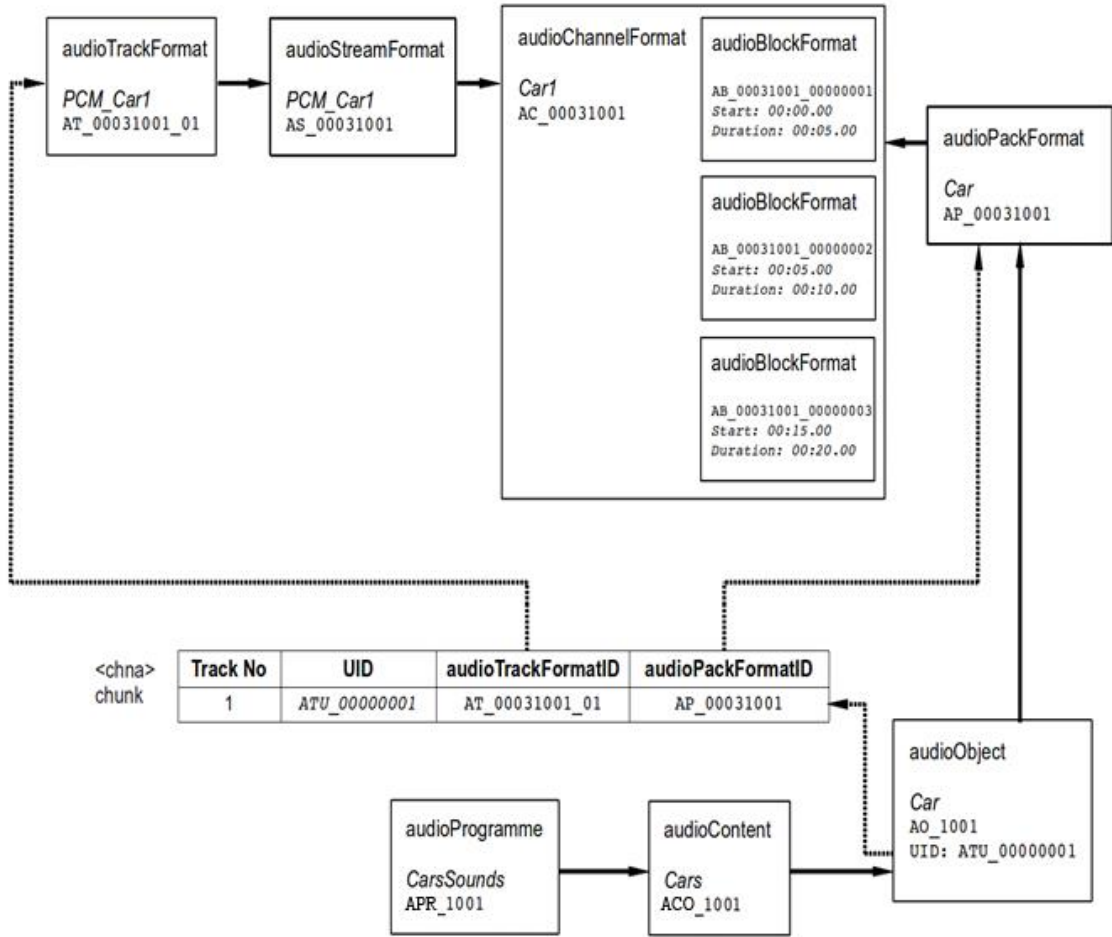
Element	ID	Name	Description
audioTrackFormat	AT_00031001_01	PCM_Car1	Defines track as PCM
audioStreamFormat	AS_00031001	PCM_Car1	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00031001 AB_00031001_00000001 AB_00031001_00000002 AB_00031001_00000003	Car1	Describes channel as an object type containing 3 blocks with different positional metadata in each.
audioPackFormat	AP_00031001	Car	Defines a pack referring to one channel.

These are the elements in the content part of the description:

Element	ID	Name	Description
audioObject	AO_1001	Car	Object for 'Car, stereo format
audioContent	ACO_1001	Cars	'Cars' content
audioProgramme	APR_1001	CarsSounds	Programme 'CarsSounds' containing 'Cars' content

### A.2.2 Diagram

The diagram shows how the defined elements relate to each other. The top half of the diagram covers the elements that describe the single channel object containing 3 blocks. The *<chna>* chunk in the middle shows how the single track is connected to the format definitions. The content definition elements are at the bottom of the diagram, with the audioObject element containing the track UID references to the UID in the *<chna>* chunk.



### A.2.3 Sample code

This XML sample code does not include the audioFormatExtended parent element and the XML header for clarity. The excerpt of code covers both the format and content elements:

```

<!-- ##### -->
<!-- PROGRAMMES -->
<!-- ##### -->

<audioProgramme audioProgrammeID="APR_1001" audioProgrammeName="CarsSounds">
  <audioContentIDRef>ACO_1001</audioContentIDRef>
</audioProgramme>

<!-- ##### -->
<!-- CONTENTS -->
<!-- ##### -->

<audioContent audioContentID="ACO_1001" audioContentName="Cars">
  <audioObjectIDRef>AO_1001</audioObjectIDRef>
  <loudnessMetadata>
    <integratedLoudness>-23.0</integratedLoudness>
  </loudnessMetadata>
</audioContent>

<!-- ##### -->
<!-- OBJECTS -->
<!-- ##### -->

<audioObject audioObjectID="AO_1001" audioObjectName="Car" start="00:00:00.00000">
  <audioPackFormatIDRef>AP_00031001</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
</audioObject>

<!-- ##### -->
<!-- PACKS -->
<!-- ##### -->

<audioPackFormat          audioPackFormatID="AP_00031001"          audioPackFormatName="Car"
typeLabel="0003" typeDefinition="Objects">
  <audioChannelFormatIDRef>AC_00031001</audioChannelFormatIDRef>
</audioPackFormat>

<!-- ##### -->
<!-- CHANNELS -->
<!-- ##### -->

<audioChannelFormat  audioChannelFormatID="AC_00031001"  audioChannelFormatName="Car1"
typeLabel="0003" typeDefinition="Objects">
  <audioBlockFormat  audioBlockFormatID="AB_00031001_00000001"  rtime="00:00:00.00000"
duration="00:00:05.00000">
    <position coordinate="azimuth">-22.5</position>
    <position coordinate="elevation">5.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
  <audioBlockFormat  audioBlockFormatID="AB_00031001_00000002"  rtime="00:00:05.00000"
duration="00:00:10.00000">
    <position coordinate="azimuth">-24.5</position>
    <position coordinate="elevation">6.0</position>
  </audioBlockFormat>

```



```

    <position coordinate="distance">0.9</position>
  </audioBlockFormat>
  <audioBlockFormat  audioBlockFormatID="AB_00031001_00000003"  rtime="00:00:15.00000"
duration="00:00:20.00000">
    <position coordinate="azimuth">-26.5</position>
    <position coordinate="elevation">7.0</position>
    <position coordinate="distance">0.8</position>
  </audioBlockFormat>
</audioChannelFormat>

<!-- ##### -->
<!-- STREAMS -->
<!-- ##### -->

<audioStreamFormat  audioStreamFormatID="AS_00031001"  audioStreamFormatName="PCM_Car1"
formatLabel="0001"  formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00031001</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00031001_01</audioTrackFormatIDRef>
</audioStreamFormat>

<!-- ##### -->
<!-- AUDIO TRACKS -->
<!-- ##### -->

<audioTrackFormat  audioTrackFormatID="AT_00031001_01"  audioTrackFormatName="PCM_Car1"
formatLabel="0001"  formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00031001</audioStreamFormatIDRef>
</audioTrackFormat>

```

### A.3 Scene-based example

The other main type of audio is scene-based where the audio channels are representing Ambisonics/HOA components. Their use is very similar to that of the channel-based approach with the main difference being the parameters used within audioBlockFormat. This example shows a simple 1<sup>st</sup> order Ambisonics (using the N3D method) configuration using 4 channels mapped onto 4 tracks. Like the channel-based approach, the format elements would be defined in a standard reference file so in practice would not need to be included in the BWF file itself.

#### A.3.1 Summary of elements

These are the elements in the format part of the description:

Element	ID	Name	Description
audioTrackFormat	AT_00040001_01	PCM_N3D_ACN_0	Defines track as PCM
audioTrackFormat	AT_00040002_01	PCM_N3D_ACN_1	Defines track as PCM
audioTrackFormat	AT_00040003_01	PCM_N3D_ACN_2	Defines track as PCM
audioTrackFormat	AT_00040004_01	PCM_N3D_ACN_3	Defines track as PCM
audioStreamFormat	AS_00040001	PCM_N3D_ACN_0	Defines stream as PCM
audioStreamFormat	AS_00040002	PCM_N3D_ACN_1	Defines stream as PCM
audioStreamFormat	AS_00040003	PCM_N3D_ACN_2	Defines stream as PCM
audioStreamFormat	AS_00040004	PCM_N3D_ACN_3	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00040001 AB_00040001_00000001	N3D_ACN_0	Describes channel as ACN0 HOA component

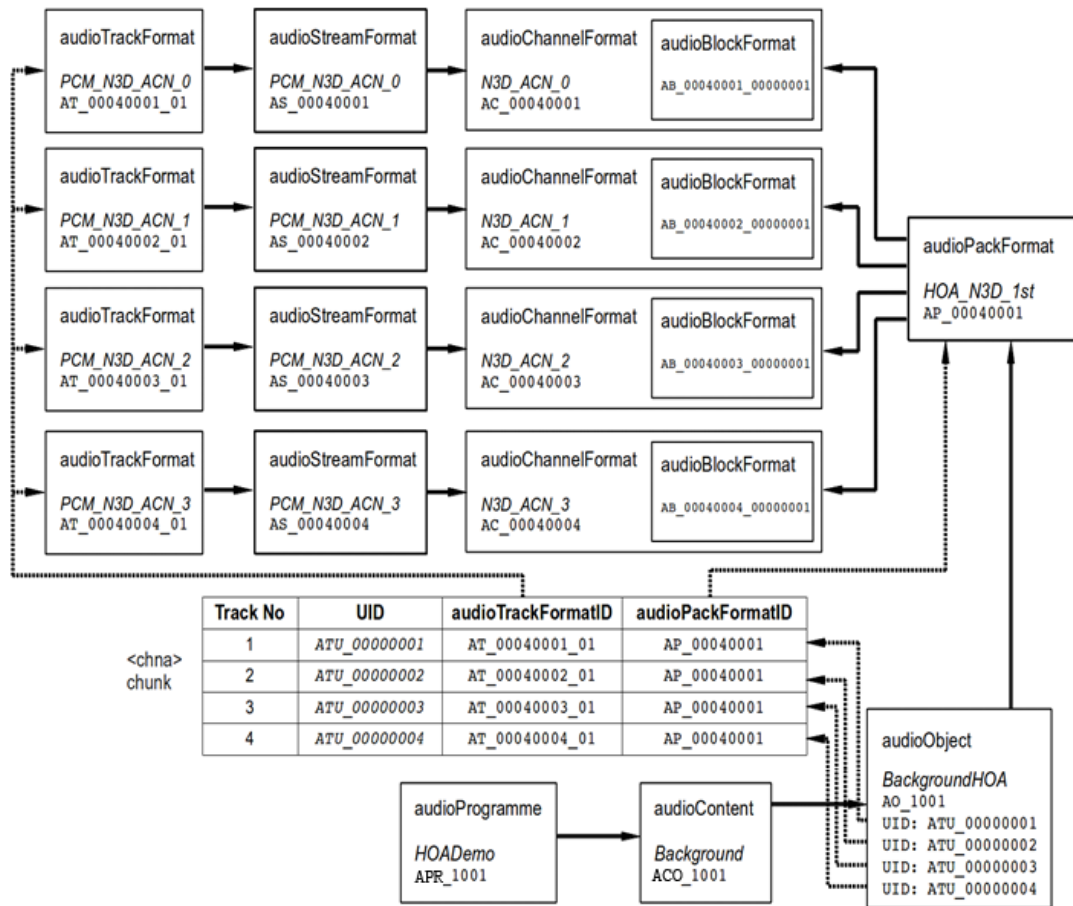
Element	ID	Name	Description
audioChannelFormat & audioBlockFormat	AC_00040002 AB_00040002_00000001	N3D_ACN_1	Describes channel as ACN1 HOA component
audioChannelFormat & audioBlockFormat	AC_00040003 AB_00040003_00000001	N3D_ACN_2	Describes channel as ACN2 HOA component
audioChannelFormat & audioBlockFormat	AC_00040004 AB_00040004_00000001	N3D_ACN_3	Describes channel as ACN3 HOA component
audioPackFormat	AP_00040001	HOA_N3D_1st	Defines a 1 <sup>st</sup> order HOA pack referring to four ACN channels.

These are the elements in the content part of the description:

Element	ID	Name	Description
audioObject	AO_1001	BackgroundHOA	Object for 'BackgroundHOA', 1 <sup>st</sup> order HOA format
audioContent	ACO_1001	Background	'Background' content
audioProgramme	APR_1001	HOADemo	'HOADemo' containing a 'Background' content

### A.3.2 Diagram

The diagram shows how the defined elements relate to each other. The top half of the diagram covers the elements that describe the 4 channels of the 1<sup>st</sup> order HOA (N3D method). The <chna> chunk in the middle shows how the four tracks are connected to the format definitions. The content definition elements are at the bottom of the diagram, with the audioObject element containing the track UID references to the UIDs in the <chna> chunk.



### A.3.3 Sample code

This XML sample code does not include the audioFormatExtended parent element and the XML header for clarity. The first excerpt of code covers the format elements, which could be contained within the standard reference file:

```

<!-- ##### -->
<!-- PACKS -->
<!-- ##### -->

<audioPackFormat      audioPackFormatID="AP_00040001"      audioPackFormatName="HOA_N3D_1st"
typeLabel="0004"      typeDefinition="HOA">
  <audioChannelFormatIDRef>AC_00040001</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00040002</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00040003</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00040004</audioChannelFormatIDRef>
</audioPackFormat>

<!-- ##### -->
<!-- CHANNELS -->
<!-- ##### -->

<audioChannelFormat      audioChannelFormatID="AC_00040001"
audioChannelFormatName="N3D_ACN_0"      typeDefinition="HOA">
  <audioBlockFormat audioBlockFormatID="AB_00040001_00000001">
    <equation>1</equation>
  </audioBlockFormat>
</audioChannelFormat>

```

```

    <degree>0</degree>
    <order>0</order>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat
                                audioChannelFormatID="AC_00040002"
audioChannelFormatName="N3D_ACN_1" typeDefinition="HOA">
  <audioBlockFormat audioBlockFormatID="AB_00040002_00000001">
    <equation>sqrt(3)*cos(E)</equation>
    <degree>1</degree>
    <order>-1</order>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat
                                audioChannelFormatID="AC_00040003"
audioChannelFormatName="N3D_ACN_2" typeDefinition="HOA">
  <audioBlockFormat audioBlockFormatID="AB_00040003_00000001">
    <equation>sqrt(3)*sin(E)</equation>
    <degree>1</degree>
    <order>0</order>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat
                                audioChannelFormatID="AC_00040004"
audioChannelFormatName="N3D_ACN_3" typeDefinition="HOA">
  <audioBlockFormat audioBlockFormatID="AB_00040004_00000001">
    <equation>sqrt(3)*cos(E)*cos(A)</equation>
    <degree>1</degree>
    <order>1</order>
  </audioBlockFormat>
</audioChannelFormat>

<!-- ##### -->
<!-- STREAMS -->
<!-- ##### -->

<audioStreamFormat
                                audioStreamFormatID="AS_00040001"
audioStreamFormatName="PCM_N3D_ACN_0" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00040001</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00040001_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat
                                audioStreamFormatID="AS_00040002"
audioStreamFormatName="PCM_N3D_ACN_1" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00040002</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00040002_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat
                                audioStreamFormatID="AS_00040003"
audioStreamFormatName="PCM_N3D_ACN_2" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00040003</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00040003_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat
                                audioStreamFormatID="AS_00040004"
audioStreamFormatName="PCM_N3D_ACN_3" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00040004</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00040004_01</audioTrackFormatIDRef>
</audioStreamFormat>

```

```

<!-- ##### -->
<!-- AUDIO TRACKS -->
<!-- ##### -->

<audioTrackFormat                                audioTrackFormatID="AT_00040001_01"
audioTrackFormatName="PCM_N3D_ACN_0"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00040001</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00040002_01"
audioTrackFormatName="PCM_N3D_ACN_1"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00040002</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00040003_01"
audioTrackFormatName="PCM_N3D_ACN_2"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00040003</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00040004_01"
audioTrackFormatName="PCM_N3D_ACN_3"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00040004</audioStreamFormatIDRef>
</audioTrackFormat>

```

The second excerpt covers the content part, which would have to be included in the <axml> chunk of the BWF file:

```

<!-- ##### -->
<!-- PROGRAMMES -->
<!-- ##### -->

<audioProgramme audioProgrammeID="APR_1001" audioProgrammeName="HOADemo">
  <audioContentIDRef>ACO_1001</audioContentIDRef>
</audioProgramme>

<!-- ##### -->
<!-- CONTENTS -->
<!-- ##### -->

<audioContent audioContentID="ACO_1001" audioContentName="Background">
  <audioObjectIDRef>AO_1001</audioObjectIDRef>
</audioContent>

<!-- ##### -->
<!-- OBJECTS -->
<!-- ##### -->

<audioObject audioObjectID="AO_1001" audioObjectName="BackgroundHOA">
  <audioPackFormatIDRef>AP_00040001</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000002</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000003</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000004</audioTrackUIDRef>
</audioObject>

```

```

<!-- ##### -->
<!-- AUDIO TRACK UIDs -->
<!-- ##### -->

<audioTrackUID UID="ATU_00000001">
  <audioTrackFormatIDRef>AT_00040001_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00040001</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000002">
  <audioTrackFormatIDRef>AT_00040002_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00040001</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000003">
  <audioTrackFormatIDRef>AT_00040003_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00040001</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000004">
  <audioTrackFormatIDRef>AT_00040004_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00040001</audioPackFormatIDRef>
</audioTrackUID>

```

#### A.4 Material exchange format mapping example

The ADM has been designed to not only allow BWF files according to [4] to become a flexible multichannel file format, but also be incorporated by other file formats. Currently, material exchange format ((MXF) – SMPTE 377M), which carries both video and audio, has a rather limited capability in terms of specifying its audio format. The ADM could be used by MXF files in a similar way to BWF files allowing a comprehensive format description of the audio.

MXF files often use EBU R 123 [7] (“EBU Audio Track Allocation for File Exchange”) audio track configurations. This is a set of channel and matrix-based track allocations for between 2 and 16 track files or streams. This example will show how a particular R123 configuration can be represented by the ADM that’s suitable for MXF.

This example will demonstrate how the 4a R 123 configuration can be represented by the ADM. This configuration uses 4 tracks:

Track Number	Track Use	Group
1	Stereo Left (PCM)	PCM Stereo pair
2	Stereo Right (PCM)	
3	MCA (Dolby E)	Multichannel audio Dolby E stream
4	MCA (Dolby E)	

##### A.4.1 Summary of elements

These are the elements in the format part of the description:

Element	ID	Name	Description
audioTrackFormat	AT_00010001_01	PCM_FrontLeft	Defines track as PCM
audioTrackFormat	AT_00010002_01	PCM_FrontRight	Defines track as PCM
audioTrackFormat	AT_00020001_01	DolbyE1	Defines track as containing Dolby E data
audioTrackFormat	AT_00020001_02	DolbyE1	Defines track as containing Dolby E data
audioStreamFormat	AS_00010001	PCM_FrontLeft	Defines stream as PCM
audioStreamFormat	AS_00010002	PCM_FrontRight	Defines stream as PCM
audioStreamFormat	AS_00020001	DolbyE_5.1	Defines stream as Dolby E
audioChannelFormat & audioBlockFormat	AC_00010001 AB_00010001_00000001	FrontLeft	Describes channel as front left with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010002 AB_00010002_00000001	FrontRight	Describes channel as front right with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010003 AB_00010003_00000001	FrontCentre	Describes channel as front centre with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010004 AB_00010004_00000001	LFE	Describes channel as LFE with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010005 AB_00010005_00000001	SurroundLeft	Describes channel as front right with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010006 AB_00010006_00000001	SurroundRight	Describes channel as front right with a position and speaker reference
audioPackFormat	AP_00010002	Stereo	Defines a stereo pack referring to two channels.
audioPackFormat	AP_00010003	5.1	Defines a 5.1 pack referring to 6 channels.

These are the elements in the content part of the description:

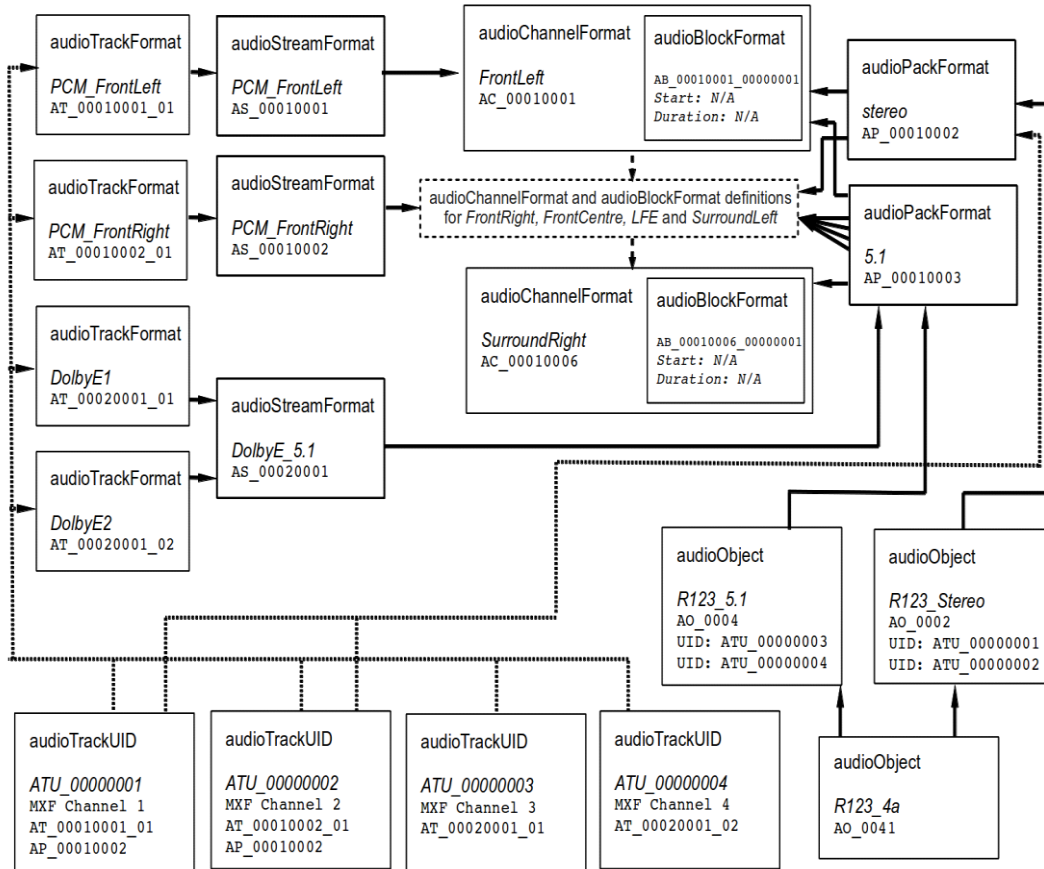
Element	ID	Name	Description
audioObject	AO_0041	R123_4a	Object for R123 4a configuration
audioObject	AO_0002	R123_Stereo	Object for stereo
audioObject	AO_0004	R123_5.1	Object for 5.1

#### A.4.2 Diagram

The diagram shows how the defined elements relate to each other. The top half of the diagram covers the elements that describe the 2 channel stereo PCM format and the 6 channel Dolby E 5.1 encoded format. In the Dolby E part, two audioTrackFormats refer to a single audioStreamFormat as Dolby E requires that two tracks are combined to decode the audio signals. The Dolby E audioStreamFormat refers to an audioPackFormat as it is representing a group of channels rather than a single one. This 5.1 audioPackFormat refers to the 6 audioChannelFormats that describe each channel.

The R123 4a configuration is represented by an audioObject (named 'R123\_4a') which refers to two further audioObjects (for the stereo and 5.1 groups) which contain the references to the audioTrackUIDs. This demonstrates the nesting feature of audioObjects.

As MXF does not feature a *<chna>* chunk, it uses sub-elements of audioTrackUID to generate references to the essences within the MXF file. The audioMXFLookUp sub-element is designed to facilitate these relationships.



### A.4.3 Sample code

This XML sample code does not include the audioFormatExtended parent element and the XML header for clarity. The first excerpt of code covers the format elements, which could be contained within the standard reference file:

```

<!-- ##### -->
<!-- PACKS -->
<!-- ##### -->

<audioPackFormat          audioPackFormatID="AP_00010002"          audioPackFormatName="Stereo"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
</audioPackFormat>

<audioPackFormat          audioPackFormatID="AP_00010003"          audioPackFormatName="5.1"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>

```



```

<audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
<audioChannelFormatIDRef>AC_00010003</audioChannelFormatIDRef>
<audioChannelFormatIDRef>AC_00010004</audioChannelFormatIDRef>
<audioChannelFormatIDRef>AC_00010005</audioChannelFormatIDRef>
<audioChannelFormatIDRef>AC_00010006</audioChannelFormatIDRef>
</audioPackFormat>

<!-- ##### -->
<!-- CHANNELS -->
<!-- ##### -->

<audioChannelFormat                                audioChannelFormatID="AC_00010001"
audioChannelFormatName="FrontLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010001_00000001">
    <speakerLabel>M+30</speakerLabel>
    <position coordinate="azimuth">30.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010002"
audioChannelFormatName="FrontRight" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010002_00000001">
    <speakerLabel>M-30</speakerLabel>
    <position coordinate="azimuth">-30.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010003"
audioChannelFormatName="FrontCentre" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010003_00000001">
    <speakerLabel>M+00</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010004"
audioChannelFormatName="LFE"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <frequency typeDefinition="lowPass">200</frequency>
  <audioBlockFormat audioBlockFormatID="AB_00010004_00000001">
    <speakerLabel>LFE+00</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">-20.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010005"
audioChannelFormatName="SurroundLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010005_00000001">
    <speakerLabel>M+110</speakerLabel>
    <position coordinate="azimuth">110.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

```

```

</audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010006"
audioChannelFormatName="SurroundRight"              typeLabel="0001"
typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010006_00000001">
    <speakerLabel>M-110</speakerLabel>
    <position coordinate="azimuth">-110.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<!-- ##### -->
<!-- STREAMS -->
<!-- ##### -->

<audioStreamFormat                                audioStreamFormatID="AS_00010001"
audioStreamFormatName="PCM_FrontLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010002"
audioStreamFormatName="PCM_FrontRight"  formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010002_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat audioStreamFormatID="AS_00020001" audioStreamFormatName="DolbyE_5.1"
formatLabel="DolbyE" formatDefinition="DolbyE">
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
  <audioTrackFormatIDRef>AT_00020001_01</audioTrackFormatIDRef>
  <audioTrackFormatIDRef>AT_00020001_02</audioTrackFormatIDRef>
</audioStreamFormat>

<!-- ##### -->
<!-- AUDIO TRACKS -->
<!-- ##### -->

<audioTrackFormat                                audioTrackFormatID="AT_00010001_01"
audioTrackFormatName="PCM_FrontLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010001</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010002_01"
audioTrackFormatName="PCM_FrontRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010002</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat audioTrackFormatID="AT_00020001_01" audioTrackFormatName="DolbyE1"
formatLabel="0002" formatDefinition="data">
  <audioStreamFormatIDRef>AS_00020001</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat audioTrackFormatID="AT_00020001_02" audioTrackFormatName="DolbyE2"
formatLabel="0002" formatDefinition="data">
  <audioStreamFormatIDRef>AS_00020001</audioStreamFormatIDRef>
</audioTrackFormat>

```

The second excerpt (below) covers the content part, in this case audioObjects and audioTrackUIDs, which should be contained within the MXF file. The audioTrackUIDs contain the audioMXFLookUp elements which locate the essence within the MXF file.

```

<!-- ##### -->
<!-- OBJECTS -->
<!-- ##### -->

<audioObject audioObjectID="AO_0041" audioObjectName="R123_4a">
  <audioObjectIDRef>AO_0002</audioObjectIDRef>
  <audioObjectIDRef>AO_0004</audioObjectIDRef>
</audioObject>

<audioObject audioObjectID="AO_0002" audioObjectName="R123_Stereo">
  <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000002</audioTrackUIDRef>
</audioObject>

<audioObject audioObjectID="AO_0004" audioObjectName="R123_5.1coded">
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000003</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000004</audioTrackUIDRef>
</audioObject>

<!-- ##### -->
<!-- AUDIO TRACK UIDs -->
<!-- ##### -->

<audioTrackUID UID="ATU_00000001">
  <audioMXFLookUp>
<packageUIDRef>urn:smpte:umid:060a2b34.01010105.01010f20.13000000.540bca53.41434f05.8ce5
f4e3.5b72c985</packageUIDRef>
  <trackIDRef>MXFTRACK_3</trackIDRef>
  <channelIDRef>MXFCHAN_1</channelIDRef>
  </audioMXFLookUp>
  <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000002">
  <audioMXFLookUp>
<packageUIDRef>urn:smpte:umid:060a2b34.01010105.01010f20.13000000.540bca53.41434f05.8ce5
f4e3.5b72c985</packageUIDRef>
  <trackIDRef>MXFTRACK_3</trackIDRef>
  <channelIDRef>MXFCHAN_2</channelIDRef>
  </audioMXFLookUp>
  <audioTrackFormatIDRef>AT_00010002_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010002</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000003">
  <audioMXFLookUp>

<packageUIDRef>urn:smpte:umid:060a2b34.01010105.01010f20.13000000.540bca53.41434f05.8ce5

```

```

f4e3.5b72c985</packageUIDRef>
  <trackIDRef>MXFTRACK_3</trackIDRef>
  <channelIDRef>MXFCHAN_1</channelIDRef>
</audioMXFLookUp>
<audioTrackFormatIDRef>AT_00020001_01</audioTrackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000004">
  <audioMXFLookUp>
<packageUIDRef>urn:smpte:umid:060a2b34.01010105.01010f20.13000000.540bca53.41434f05.8ce5
f4e3.5b72c985</packageUIDRef>
  <trackIDRef>MXFTRACK_3</trackIDRef>
  <channelIDRef>MXFCHAN_1</channelIDRef>
</audioMXFLookUp>
  <audioTrackFormatIDRef>AT_00020001_02</audioTrackFormatIDRef>
</audioTrackUID>

```

## A.5 Personalized Audio Example

To demonstrate how the ADM can be used to describe personalized audio, here is an example using a combination of channel-based audio for the ambience/bed and object-based audio for the commentator objects. This example uses multiple audioProgramme elements that represent five different preset mixes for a sports programme: default mix, just the action, clear commentary, home team, and away team. The corresponding ADM XML tree contains four different audioContent elements to choose from: ambience, main commentary, home team biased commentary, and away team biased commentary.

	Ambience	Main commentary 1	Main commentary 2	Home team biased commentary	Away team biased commentary
Default mix	•	•	•		
Just the action	•				
Clear commentary		•	•		
Home team	•			•	
Away team	•				•

### A.5.1 Summary of elements

These are the elements in the format part of the description:

Element	ID	Name	Description
audioTrackFormat	AT_00010001_01	PCM_FrontLeft	Defines track as PCM
audioStreamFormat	AS_00010001	PCM_FrontLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010001 AB_00010001_00000001	FrontLeft	Describes channel as front left with a position and speaker reference
audioTrackFormat	AT_00010002_01	PCM_FrontRight	Defines track as PCM
audioStreamFormat	AS_00010002	PCM_FrontRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010002 AB_00010002_00000001	FrontRight	Describes channel as front right with a position and speaker reference

Element	ID	Name	Description
audioTrackFormat	AT_00010003_01	PCM_FrontCentre	Defines track as PCM
audioStreamFormat	AS_00010003	PCM_FrontCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010003 AB_00010003_00000001	FrontCentre	Describes channel as front centre with a position and speaker reference
audioTrackFormat	AT_00010004_01	PCM_LFE	Defines track as PCM
audioStreamFormat	AS_00010004	PCM_LFE	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010004 AB_00010004_00000001	LFE	Describes channel as LFE with a position and speaker reference
audioTrackFormat	AT_00010005_01	PCM_SurroundLeft	Defines track as PCM
audioStreamFormat	AS_00010005	PCM_SurroundLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010005 AB_00010005_00000001	SurroundLeft	Describes channel as surround left with a position and speaker reference
audioTrackFormat	AT_00010006_01	PCM_SurroundRight	Defines track as PCM
audioStreamFormat	AS_00010006	PCM_SurroundRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010006 AB_00010006_00000001	SurroundRight	Describes channel as surround right with a position and speaker reference
audioPackFormat	AP_00010003	5.1	Defines a 5.1 pack referring to six channels.
audioTrackFormat	AT_00031001_01	PCM_Main_Comm1	Defines track as PCM
audioStreamFormat	AS_00031001	PCM_Main_Comm1	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00031001 AB_00031001_00000001	Main_Comm1	Describes channel as an object type containing a single block with positional metadata.
audioTrackFormat	AT_00031002_01	PCM_Main_Comm2	Defines track as PCM
audioStreamFormat	AS_00031002	PCM_Main_Comm2	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00031002 AB_00031002_00000001	Main_Comm2	Describes channel as an object type containing a single block with positional metadata.
audioTrackFormat	AT_00031003_01	PCM_Home_Comm	Defines track as PCM
audioStreamFormat	AS_00031003	PCM_Home_Comm	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00031003 AB_00031003_00000001	Home_Comm	Describes channel as an object type containing a single block with positional metadata.
audioTrackFormat	AT_00031004_01	PCM_Away_Comm	Defines track as PCM
audioStreamFormat	AS_00031004	PCM_Away_Comm	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00031004 AB_00031004_00000001	Away_Comm	Describes channel as an object type containing a single block with positional metadata.
audioPackFormat	AP_00031001	MainComm1	Defines a pack referring to one channel.
audioPackFormat	AP_00031002	MainComm2	Defines a pack referring to one channel.

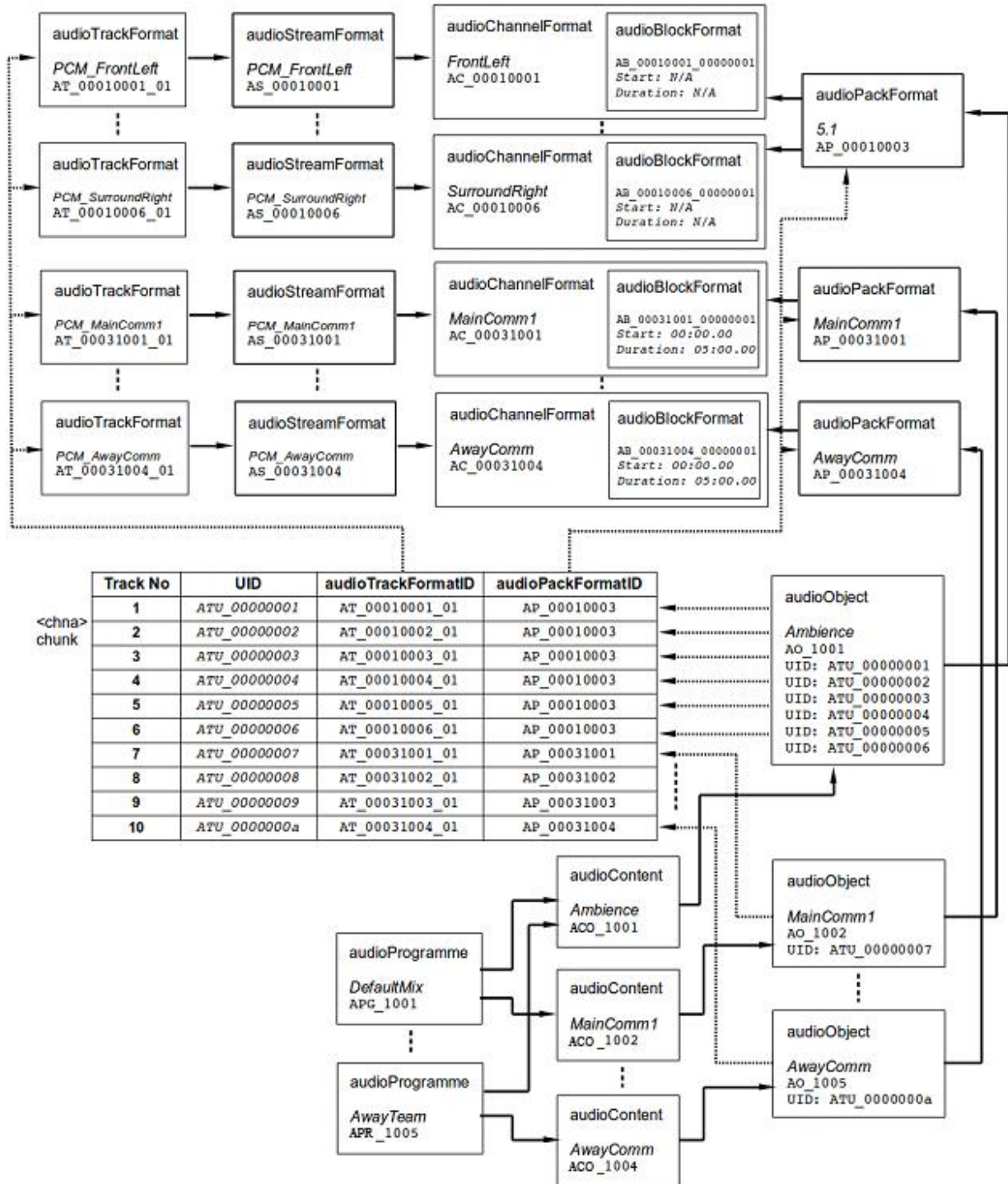
Element	ID	Name	Description
audioPackFormat	AP_00031003	HomeComm	Defines a pack referring to one channel.
audioPackFormat	AP_00031004	AwayComm	Defines a pack referring to one channel.

These are the elements in the content part of the description:

Element	ID	Name	Description
audioObject	AO_1001	Ambience	Object for 'Ambience', 5.1 format
audioContent	ACO_1001	Ambience	'Ambience' content
audioObject	AO_1002	Main_Comm1	Object for 'Main_Comm1', mono format
audioObject	AO_1003	Main_Comm2	Object for 'Main_Comm2', mono format
audioContent	ACO_1002	Main_Comm	'Main_Comm' content
audioObject	AO_1004	Home_Comm	Object for 'Home_Comm', mono format
audioContent	ACO_1003	Home_Comm	'Home_Comm' content
audioObject	AO_1005	Away_Comm	Object for 'Away_Comm', mono format
audioContent	ACO_1004	Away_Comm	'Away_Comm' content
audioProgramme	APR_1001	DefaultMix	Programme 'DefaultMix' containing 'Ambience' and 'Main_Comm' content
audioProgramme	APR_1002	JustTheAction	Programme 'JustTheAction' containing only 'Ambience' content
audioProgramme	APR_1003	ClearCommentary	Programme 'ClearCommentary' containing only 'Main_Comm' content
audioProgramme	APG_1004	HomeTeam	Programme 'HomeTeam' containing 'Ambience' and 'Home_Comm' content
audioProgramme	APG_1005	AwayTeam	Programme 'AwayTeam' containing 'Ambience' and 'Away_Comm' content

### A.5.2 Diagram

The diagram shows how the defined elements relate to each other. The top half of the diagram covers the elements that describe the 5.1 channel ambience/bed and the 4 mono objects. The <chna> chunk in the middle shows how the tracks are connected to the format definitions. The content definition elements are at the bottom of the diagram, with the audioObject element containing the track UID references to the UID in the <chna> chunk.



### A.5.3 Sample code

This XML sample code does not include the audioFormatExtended parent element and the XML header for clarity. The excerpt of code covers both the format and content elements:

```

<!-- ##### -->
<!-- PROGRAMMES -->
<!-- ##### -->

<audioProgramme audioProgrammeID="APR_1001" audioProgrammeName="DefaultMix">
  <audioContentIDRef>ACO_1001</audioContentIDRef>

```

```

    <audioContentIDRef>ACO_1002</audioContentIDRef>
</audioProgramme>

<audioProgramme audioProgrammeID="APR_1002" audioProgrammeName="JustTheAction">
    <audioContentIDRef>ACO_1001</audioContentIDRef>
</audioProgramme>

<audioProgramme audioProgrammeID="APR_1003" audioProgrammeName="ClearCommentary">
    <audioContentIDRef>ACO_1002</audioContentIDRef>
</audioProgramme>

<audioProgramme audioProgrammeID="APR_1004" audioProgrammeName="HomeTeam">
    <audioContentIDRef>ACO_1001</audioContentIDRef>
    <audioContentIDRef>ACON_1003</audioContentIDRef>
</audioProgramme>

<audioProgramme audioProgrammeID="APR_1005" audioProgrammeName="AwayTeam">
    <audioContentIDRef>ACO_1001</audioContentIDRef>
    <audioContentIDRef>ACO_1004</audioContentIDRef>
</audioProgramme>

<!-- ##### -->
<!-- CONTENTS -->
<!-- ##### -->

<audioContent audioContentID="ACO_1001" audioContentName="Ambience">
    <audioObjectIDRef>AO_1001</audioObjectIDRef>
    <loudnessMetadata>
        <integratedLoudness>-23.0</integratedLoudness>
    </loudnessMetadata>
</audioContent>

<audioContent audioContentID="ACO_1002" audioContentName="Main_Comm">
    <audioObjectIDRef>AO_1002</audioObjectIDRef>
    <audioObjectIDRef>AO_1003</audioObjectIDRef>
    <loudnessMetadata>
        <integratedLoudness>-23.0</integratedLoudness>
    </loudnessMetadata>
</audioContent>

<audioContent audioContentID="ACO_1003" audioContentName="Home_Comm">
    <audioObjectIDRef>AO_1004</audioObjectIDRef>
    <loudnessMetadata>
        <integratedLoudness>-23.0</integratedLoudness>
    </loudnessMetadata>
</audioContent>

<audioContent audioContentID="ACO_1004" audioContentName="AwayComm">
    <audioObjectIDRef>AO_1005</audioObjectIDRef>
    <loudnessMetadata>
        <integratedLoudness>-23.0</integratedLoudness>
    </loudnessMetadata>
</audioContent>

<!-- ##### -->
<!-- OBJECTS -->
<!-- ##### -->

```



```

<audioObject audioObjectID="AO_1001" audioObjectName="Ambience">
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000002</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000003</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000004</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000005</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000006</audioTrackUIDRef>
</audioObject>

<audioObject          audioObjectID="AO_1002"          audioObjectName="Main_Comm1"
start="00:00:00.00000">
  <audioPackFormatIDRef>AP_00031001</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000007</audioTrackUIDRef>
</audioObject>

<audioObject          audioObjectID="AO_1003"          audioObjectName="Main_Comm2"
start="00:00:00.00000">
  <audioPackFormatIDRef>AP_00031002</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000008</audioTrackUIDRef>
</audioObject>

<audioObject audioObjectID="AO_1004" audioObjectName="Home_Comm" start="00:00:00.00000">
  <audioPackFormatIDRef>AP_00031003</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000009</audioTrackUIDRef>
</audioObject>

<audioObject audioObjectID="AO_1005" audioObjectName="Away_Comm" start="00:00:00.00000">
  <audioPackFormatIDRef>AP_00031004</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_0000000a</audioTrackUIDRef>
</audioObject>

<!-- ##### -->
<!-- PACKS -->
<!-- ##### -->

<audioPackFormat          audioPackFormatID="AP_00010003"          audioPackFormatName="5.1"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010003</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010004</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010005</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010006</audioChannelFormatIDRef>
</audioPackFormat>

<audioPackFormat          audioPackFormatID="AP_00031001"          audioPackFormatName="MainComm1"
typeLabel="0003" typeDefinition="Objects">
  <audioChannelFormatIDRef>AC_00031001</audioChannelFormatIDRef>
</audioPackFormat>

<audioPackFormat          audioPackFormatID="AP_00031002"          audioPackFormatName="MainComm2"
typeLabel="0003" typeDefinition="Objects">
  <audioChannelFormatIDRef>AC_00031002</audioChannelFormatIDRef>
</audioPackFormat>

<audioPackFormat          audioPackFormatID="AP_00031003"          audioPackFormatName="HomeComm"
typeLabel="0003" typeDefinition="Objects">
  <audioChannelFormatIDRef>AC_00031003</audioChannelFormatIDRef>

```

```

</audioPackFormat>

<audioPackFormat      audioPackFormatID="AP_00031004"      audioPackFormatName="AwayComm"
typeLabel="0003" typeDefinition="Objects">
  <audioChannelFormatIDRef>AC_00031004</audioChannelFormatIDRef>
</audioPackFormat>

<!-- ##### -->
<!-- CHANNELS -->
<!-- ##### -->

<audioChannelFormat      audioChannelFormatID="AC_00010001"
audioChannelFormatName="FrontLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010001_00000001">
    <speakerLabel>M+30</speakerLabel>
    <position coordinate="azimuth">30.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat      audioChannelFormatID="AC_00010002"
audioChannelFormatName="FrontRight" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010002_00000001">
    <speakerLabel>M-30</speakerLabel>
    <position coordinate="azimuth">-30.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat      audioChannelFormatID="AC_00010003"
audioChannelFormatName="FrontCentre" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010003_00000001">
    <speakerLabel>M+00</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat      audioChannelFormatID="AC_00010004"      audioChannelFormatName="LFE"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <frequency typeDefinition="lowPass">200</frequency>
  <audioBlockFormat audioBlockFormatID="AB_00010004_00000001">
    <speakerLabel>LFE+00</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">-20.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat      audioChannelFormatID="AC_00010005"
audioChannelFormatName="SurroundLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010005_00000001">
    <speakerLabel>M+110</speakerLabel>
    <position coordinate="azimuth">110.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

```

```

</audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010006"
audioChannelFormatName="SurroundRight" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010006_00000001">
    <speakerLabel>M-110</speakerLabel>
    <position coordinate="azimuth">-110.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00031001"
audioChannelFormatName="MainComm1" typeLabel="0003" typeDefinition="Objects">
  <audioBlockFormat audioBlockFormatID="AB_00031001_00000001" rtime="00:00:00.00000"
duration="00:05:00.00000">
    <position coordinate="X">-1.0</position>
    <position coordinate="Y">1.0</position>
    <position coordinate="Z">0.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00031002"
audioChannelFormatName="MainComm2" typeLabel="0003" typeDefinition="Objects">
  <audioBlockFormat audioBlockFormatID="AB_00031002_00000001" rtime="00:00:00.00000"
duration="00:05:00.00000">
    <position coordinate="X">1.0</position>
    <position coordinate="Y">1.0</position>
    <position coordinate="Z">0.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00031003" audioChannelFormatName="HomeComm"
typeLabel="0003" typeDefinition="Objects">
  <audioBlockFormat audioBlockFormatID="AB_00031003_00000001" rtime="00:00:00.00000"
duration="00:05:00.00000">
    <position coordinate="X">0.0</position>
    <position coordinate="Y">1.0</position>
    <position coordinate="Z">0.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00031004" audioChannelFormatName="AwayComm"
typeLabel="0003" typeDefinition="Objects">
  <audioBlockFormat audioBlockFormatID="AB_00031004_00000001" rtime="00:00:00.00000"
duration="00:05:00.00000">
    <position coordinate="X">0.0</position>
    <position coordinate="Y">1.0</position>
    <position coordinate="Z">0.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<!-- ##### -->
<!-- STREAMS -->
<!-- ##### -->

<audioStreamFormat                                audioStreamFormatID="AS_00010001"
audioStreamFormatName="PCM_FrontLeft" formatLabel="0001" formatDefinition="PCM">

```

```

<audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
<audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010002"
audioStreamFormatName="PCM_FrontRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010002_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010003"
audioStreamFormatName="PCM_FrontCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010003</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010003_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010004"
audioStreamFormatName="PCM_LFE" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010004</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010004_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010005"
audioStreamFormatName="PCM_SurroundLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010005</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010005_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010006"
audioStreamFormatName="PCM_SurroundRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010006</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010006_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00031001"
audioStreamFormatName="PCM_MainComm1" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00031001</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00031001_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00031002"
audioStreamFormatName="PCM_MainComm2" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00031002</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00031002_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00031003"
audioStreamFormatName="PCM_HomeComm" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00031003</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00031003_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00031004"
audioStreamFormatName="PCM_AwayComm" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00031004</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00031004_01</audioTrackFormatIDRef>
</audioStreamFormat>

<!-- ##### -->

```

```

<!-- AUDIO TRACKS -->
<!-- ##### -->

<audioTrackFormat
                                audioTrackFormatID="AT_00010001_01"
audioTrackFormatName="PCM_FrontLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010001</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AT_00010002_01"
audioTrackFormatName="PCM_FrontRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010002</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AT_00010003_01"
audioTrackFormatName="PCM_FrontCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010003</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat  audioTrackFormatID="AT_00010004_01"  audioTrackFormatName="PCM_LFE"
formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010004</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AT_00010005_01"
audioTrackFormatName="PCM_SurroundLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010005</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AT_00010006_01"
audioTrackFormatName="PCM_SurroundRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010006</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AT_00031001_01"
audioTrackFormatName="PCM_MainComm1"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00031001</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AT_00031002_01"
audioTrackFormatName="PCM_MainComm2"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00031002</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AT_00031003_01"
audioTrackFormatName="PCM_HomeComm"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00031003</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AT_00031004_01"
audioTrackFormatName="PCM_AwayComm"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00031004</audioStreamFormatIDRef>
</audioTrackFormat>

<!-- ##### -->
<!-- AUDIO TRACK UIDs -->
<!-- ##### -->

<audioTrackUID UID="ATU_00000001">
  <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>

```

```

</audioTrackUID>

<audioTrackUID UID="ATU_00000002">
  <audioTrackFormatIDRef>AT_00010002_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000003">
  <audioTrackFormatIDRef>AT_00010003_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000004">
  <audioTrackFormatIDRef>AT_00010004_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000005">
  <audioTrackFormatIDRef>AT_00010005_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000006">
  <audioTrackFormatIDRef>AT_00010006_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000007">
  <audioTrackFormatIDRef>AT_00031001_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00031001</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000008">
  <audioTrackFormatIDRef>AT_00031002_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00031002</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_00000009">
  <audioTrackFormatIDRef>AT_00031003_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00031003</audioPackFormatIDRef>
</audioTrackUID>

<audioTrackUID UID="ATU_0000000a">
  <audioTrackFormatIDRef>AT_00031004_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00031004</audioPackFormatIDRef>
</audioTrackUID>

```

## A.6 22.2 multichannel programme with an alternative dialogue example

### A.6.1 Summary of elements

These are the elements in the format part of the description:

Element	ID	Name	Description
audioTrackFormat	AT_00010001_01	PCM_FrontLeft	Defines track as PCM

<b>Element</b>	<b>ID</b>	<b>Name</b>	<b>Description</b>
audioStreamFormat	AS_00010001	PCM_FrontLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010001 AB_00010001_00000001	FrontLeft	Describes channel as front left with a position and speaker reference
audioTrackFormat	AT_00010002_01	PCM_FrontRight	Defines track as PCM
audioStreamFormat	AS_00010002	PCM_FrontRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010002 AB_00010002_00000001	FrontRight	Describes channel as front right with a position and speaker reference
audioTrackFormat	AT_00010003_01	PCM_FrontCentre	Defines track as PCM
audioStreamFormat	AS_00010003	PCM_FrontCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010003 AB_00010003_00000001	FrontCentre	Describes channel as front centre with a position and speaker reference
audioTrackFormat	AT_00010004_01	PCM_LFE1	Defines track as PCM
audioStreamFormat	AS_00010004	PCM_LFE1	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010004 AB_00010004_00000001	LFE1	Describes channel as LFE1 with a position and speaker reference
audioTrackFormat	AT_00010007_01	PCM_BackLeft	Defines track as PCM
audioStreamFormat	AS_00010007	PCM_BackLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010007 AB_00010007_00000001	BackLeft	Describes channel as surround left with a position and speaker reference
audioTrackFormat	AT_00010008_01	PCM_BackRight	Defines track as PCM
audioStreamFormat	AS_00010008	PCM_BackRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010008 AB_00010008_00000001	BackRight	Describes channel as surround right with a position and speaker reference
audioTrackFormat	AT_00010008_01	PCM_FrontLeftCentre	Defines track as PCM
audioStreamFormat	AS_00010009	PCM_FrontLeftCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010009 AB_00010009_00000001	FrontLeftCentre	Describes channel as front left centre with a position and speaker reference
audioTrackFormat	AT_00010009_01	PCM_FrontRightCentre	Defines track as PCM
audioStreamFormat	AS_0001000a	PCM_FrontRightCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_0001000a AB_0001000a_00000001	FrontRightCentre	Describes channel as front right centre with a position and speaker reference
audioTrackFormat	AT_0001000b_01	PCM_BackCentre	Defines track as PCM
audioStreamFormat	AS_0001000b	PCM_BackCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_0001000b AB_0001000b_00000001	BackCentre	Describes channel as back centre with a position and speaker reference

Element	ID	Name	Description
audioTrackFormat	AT_0001000c_01	PCM_LFE2	Defines track as PCM
audioStreamFormat	AS_0001000c	PCM_LFE2	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_0001000c AB_0001000c_00000001	LFE2	Describes channel as LFE2 with a position and speaker reference
audioTrackFormat	AT_0001000d_01	PCM_SideLeft	Defines track as PCM
audioStreamFormat	AS_0001000d	PCM_SideLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_0001000d AB_0001000d_00000001	SideLeft	Describes channel as surround right with a position and speaker reference
audioTrackFormat	AT_0001000e_01	PCM_SideRight	Defines track as PCM
audioStreamFormat	AS_0001000e	PCM_SideRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_0001000e AB_0001000e_00000001	SideRight	Describes channel as side right with a position and speaker reference
audioTrackFormat	AT_0001000f_01	PCM_TopFrontLeft	Defines track as PCM
audioStreamFormat	AS_0001000f	PCM_TopFrontLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_0001000f AB_0001000f_00000001	TopFrontLeft	Describes channel as top front left with a position and speaker reference
audioTrackFormat	AT_00010010_01	PCM_TopFrontRight	Defines track as PCM
audioStreamFormat	AS_00010010	PCM_TopFrontRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010010 AB_00010010_00000001	TopFrontRight	Describes channel as top front right with a position and speaker reference
audioTrackFormat	AT_00010011_01	PCM_TopFrontCentre	Defines track as PCM
audioStreamFormat	AS_00010011	PCM_TopFrontCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010011 AB_00010011_00000001	TopFrontCentre	Describes channel as top front centre with a position and speaker reference
audioTrackFormat	AT_00010012_01	PCM_TopCentre	Defines track as PCM
audioStreamFormat	AS_00010012	PCM_TopCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010012 AB_00010012_00000001	TopCentre	Describes channel as top centre with a position and speaker reference
audioTrackFormat	AT_00010013_01	PCM_TopBackLeft	Defines track as PCM
audioStreamFormat	AS_00010013	PCM_TopBackLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010013 AB_00010013_00000001	TopBackLeft	Describes channel as top back left with a position and speaker reference
audioTrackFormat	AT_00010014_01	PCM_TopBackRight	Defines track as PCM
audioStreamFormat	AS_00010014	PCM_TopBackRight	Defines stream as PCM
audioChannelFormat &	AC_00010014 AB_00010014_00000001	TopBackRight	Describes channel as top back right with a position

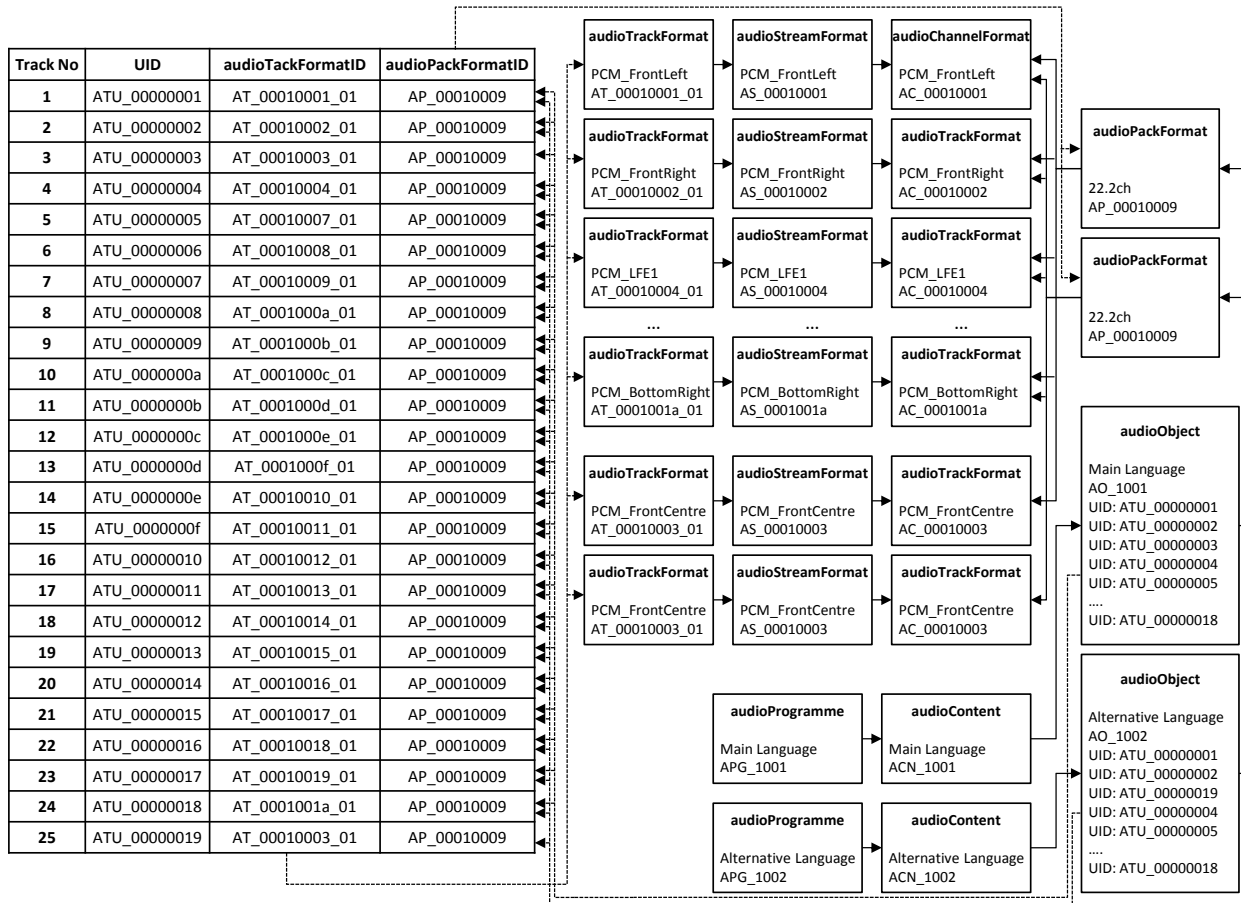


Element	ID	Name	Description
audioBlockFormat			and speaker reference
audioTrackFormat	AT_00010015_01	PCM_TopSideLeft	Defines track as PCM
audioStreamFormat	AS_00010015	PCM_TopSideLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010015 AB_00010015_00000001	TopSideLeft	Describes channel as top side left with a position and speaker reference
audioTrackFormat	AT_00010016_01	PCM_TopSideRight	Defines track as PCM
audioStreamFormat	AS_00010016	PCM_TopSideRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010016 AB_00010016_00000001	TopSideRight	Describes channel as top side right with a position and speaker reference
audioTrackFormat	AT_00010017_01	PCM_TopBackCentre	Defines track as PCM
audioStreamFormat	AS_00010017	PCM_TopBackCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010017 AB_00010017_00000001	TopBackCentre	Describes channel as top back centre with a position and speaker reference
audioTrackFormat	AT_00010018_01	PCM_BottomFrontCentre	Defines track as PCM
audioStreamFormat	AS_00010018	PCM_BottomFrontCentre	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010018 AB_00010018_00000001	BottomFrontCentre	Describes channel as bottom front centre with a position and speaker reference
audioTrackFormat	AT_00010019_01	PCM_BottomFrontLeft	Defines track as PCM
audioStreamFormat	AS_00010019	PCM_BottomFrontLeft	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010019 AB_00010019_00000001	BottomFrontLeft	Describes channel as bottom front left with a position and speaker reference
audioTrackFormat	AT_0001001a_01	PCM_BottomFrontRight	Defines track as PCM
audioStreamFormat	AS_0001001a	PCM_BottomFrontRight	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_0001001a AB_0001001a_00000001	BottomFrontRight	Describes channel as bottom front right with a position and speaker reference
audioPackFormat	AP_00010009	22.2	Defines a 22.2 pack referring to 24 channels.
audioObject	AO_1001	MainLanguage	Object for 'MainLanguage', 22.2 format
audioObject	AO_1002	AlternativeLanguage	Object for 'AlternativeLanguage', 22.2 format
audioContent	ACN_1001	MainLanguage	'MainLanguage' content
audioContent	ACN_1002	AlternativeLanguage	'AlternativeLanguage' content
audioProgramme	APG_1001	MainLanguage	Programme 'MainLanguage' containing 'MainLanguage' content
audioProgramme	APG_1002	AlternativeLanguage	Programme 'AlternativeLanguage'

Element	ID	Name	Description
			containing 'AlternativeLanguage' content

**A.6.2 Diagram**

The diagram shows how the defined elements relate to each other. The top half of the diagram covers the elements that describe the 22.2 channel and the one alternative dialogue object. The <chma> chunk in the middle shows how the tracks are connected to the format definitions. The content definition elements are at the bottom of the diagram, with the audioObject element containing the track UID references to the UID in the <chma> chunk.



**A.6.3 Sample code**

This XML sample code does not include the audioFormatExtended parent element and the XML header for clarity. The excerpt of code covers both the format and content elements:

```

<!-- ##### -->
<!-- PROGRAMMES -->
<!-- ##### -->

<audioProgramme audioProgrammeID="APG_1001" audioProgrammeName="Main_Language">
  <audioContentIDRef>ACN_1001</audioContentIDRef>
</audioProgramme>

```

```
<audioProgramme audioProgrammeID="APG_1002" audioProgrammeName="Alternative_Language">
  <audioContentIDRef>ACN_1002</audioContentIDRef>
</audioProgramme>

<!-- ##### -->
<!-- CONTENTS -->
<!-- ##### -->

<audioContent audioContentID="ACN_1001" audioContentName="Main_Language">
  <audioObjectIDRef>AO_1001</audioObjectIDRef>
  <loudnessMetadata>
    <integratedLoudness>-24.0</integratedLoudness>
  </loudnessMetadata>
</audioContent>

<audioContent audioContentID="ACN_1002" audioContentName="Alternative_Language">
  <audioObjectIDRef>AO_1002</audioObjectIDRef>
  <loudnessMetadata>
    <integratedLoudness>-24.0</integratedLoudness>
  </loudnessMetadata>
</audioContent>

<!-- ##### -->
<!-- OBJECTS -->
<!-- ##### -->

<audioObject audioObjectID="AO_1001" audioObjectName="Main_Language">
  <audioPackFormatIDRef>AP_00010009</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000002</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000003</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000004</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000005</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000006</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000007</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000008</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000009</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_0000000a</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_0000000b</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_0000000c</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_0000000d</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_0000000e</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_0000000f</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000010</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000011</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000012</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000013</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000014</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000015</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000016</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000017</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000018</audioTrackUIDRef>
</audioObject>

<audioObject audioObjectID="AO_1002" audioObjectName="Alternative_Language">
  <audioPackFormatIDRef>AP_00010009</audioPackFormatIDRef>
```

```
<audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000002</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000019</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000004</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000005</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000006</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000007</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000008</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000009</audioTrackUIDRef>
<audioTrackUIDRef>ATU_0000000a</audioTrackUIDRef>
<audioTrackUIDRef>ATU_0000000b</audioTrackUIDRef>
<audioTrackUIDRef>ATU_0000000c</audioTrackUIDRef>
<audioTrackUIDRef>ATU_0000000d</audioTrackUIDRef>
<audioTrackUIDRef>ATU_0000000e</audioTrackUIDRef>
<audioTrackUIDRef>ATU_0000000f</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000010</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000011</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000012</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000013</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000014</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000015</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000016</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000017</audioTrackUIDRef>
<audioTrackUIDRef>ATU_00000018</audioTrackUIDRef>
</audioObject>

<!-- ##### -->
<!-- PACKS -->
<!-- ##### -->

<audioPackFormat          audioPackFormatID="AP_00010009"          audioPackFormatName="22.2"
typeLabel="0001"  typeDefinition="DirectSpeakers">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010003</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010004</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010007</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010008</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010009</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_0001000a</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_0001000b</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_0001000c</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_0001000d</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_0001000e</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_0001000f</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010010</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010011</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010012</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010013</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010014</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010015</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010016</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010017</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010018</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_00010019</audioChannelFormatIDRef>
  <audioChannelFormatIDRef>AC_0001001a</audioChannelFormatIDRef>
</audioPackFormat>
```

```
<!-- ##### -->
<!-- CHANNELS -->
<!-- ##### -->

<audioChannelFormat audioChannelFormatID="AC_00010001" audioChannelFormatName="FrontLeft"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010001_00000001">
    <speakerLabel>M+060</speakerLabel>
    <position coordinate="azimuth">60.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010002"
audioChannelFormatName="FrontRight" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010002_00000001">
    <speakerLabel>M-060</speakerLabel>
    <position coordinate="azimuth">-60.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010003"
audioChannelFormatName="FrontCentre" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010003_00000001">
    <speakerLabel>M+000</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010004" audioChannelFormatName="LFE1"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <frequency typeDefinition="lowPass">200</frequency>
  <audioBlockFormat audioBlockFormatID="AB_00010004_00000001">
    <speakerLabel>LFE+045</speakerLabel>
    <position coordinate="azimuth">45.0</position>
    <position coordinate="elevation">-30.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010007" audioChannelFormatName="BackLeft"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010007_00000001">
    <speakerLabel>M+135</speakerLabel>
    <position coordinate="azimuth">135.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010008" audioChannelFormatName="BackRight"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010008_00000001">
```

```

    <speakerLabel>M-135</speakerLabel>
    <position coordinate="azimuth">-135.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010009"
audioChannelFormatName="FrontLeftCentre"           typeLabel="0001"
typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010009_00000001">
    <speakerLabel>M+030</speakerLabel>
    <position coordinate="azimuth">30.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_0001000a"
audioChannelFormatName="FrontRightCentre"         typeLabel="0001"
typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_0001000a_00000001">
    <speakerLabel>M-030</speakerLabel>
    <position coordinate="azimuth">-30.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_0001000b"
audioChannelFormatName="BackCentre" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_0001000b_00000001">
    <speakerLabel>M+180</speakerLabel>
    <position coordinate="azimuth">180.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_0001000c"
audioChannelFormatName="LFE1" typeLabel="0001" typeDefinition="DirectSpeakers">
  <frequency typeDefinition="lowPass">200</frequency>
  <audioBlockFormat audioBlockFormatID="AB_0001000c_00000001">
    <speakerLabel>LFE-045</speakerLabel>
    <position coordinate="azimuth">-45.0</position>
    <position coordinate="elevation">-30.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_0001000d"
audioChannelFormatName="SideLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010009_00000001">
    <speakerLabel>M+090</speakerLabel>
    <position coordinate="azimuth">90.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

```

```

<audioChannelFormat audioChannelFormatID="AC_0001000e" audioChannelFormatName="SideRight"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_0001000a_00000001">
    <speakerLabel>M-090</speakerLabel>
    <position coordinate="azimuth">-90.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_0001000f"
audioChannelFormatName="TopFrontLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_0001000f_00000001">
    <speakerLabel>U+045</speakerLabel>
    <position coordinate="azimuth">45.0</position>
    <position coordinate="elevation">45.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010010"
audioChannelFormatName="TopFrontRight" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010010_00000001">
    <speakerLabel>U-045</speakerLabel>
    <position coordinate="azimuth">-45.0</position>
    <position coordinate="elevation">45.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010011"
audioChannelFormatName="TopFrontCentre" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010011_00000001">
    <speakerLabel>U+000</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">45.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010012" audioChannelFormatName="TopCentre"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010012_00000001">
    <speakerLabel>T+000</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">90.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat audioChannelFormatID="AC_00010013"
audioChannelFormatName="TopBackLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010013_00000001">
    <speakerLabel>U+135</speakerLabel>
    <position coordinate="azimuth">135.0</position>
    <position coordinate="elevation">45.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

```

```

</audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010014"
audioChannelFormatName="TopBackRight"  typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010014_00000001">
    <speakerLabel>U-135</speakerLabel>
    <position coordinate="azimuth">-135.0</position>
    <position coordinate="elevation">45.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010015"
audioChannelFormatName="TopSideLeft"  typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010015_00000001">
    <speakerLabel>U+090</speakerLabel>
    <position coordinate="azimuth">90.0</position>
    <position coordinate="elevation">45.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010016"
audioChannelFormatName="TopSideRight" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010016_00000001">
    <speakerLabel>U-090</speakerLabel>
    <position coordinate="azimuth">-90.0</position>
    <position coordinate="elevation">45.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010017"
audioChannelFormatName="TopBackCentre" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010017_00000001">
    <speakerLabel>U+180</speakerLabel>
    <position coordinate="azimuth">180.0</position>
    <position coordinate="elevation">45.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010018"
audioChannelFormatName="BottomFrontCentre" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010018_00000001">
    <speakerLabel>B+000</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">-30.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_00010019"
audioChannelFormatName="BottomFrontLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010019_00000001">
    <speakerLabel>B+045</speakerLabel>

```



```

    <position coordinate="azimuth">45.0</position>
    <position coordinate="elevation">-30.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat                                audioChannelFormatID="AC_0001001a"
audioChannelFormatName="BottomFrontRight"          typeLabel="0001"
typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_0001001a_00000001">
    <speakerLabel>B-045</speakerLabel>
    <position coordinate="azimuth">-45.0</position>
    <position coordinate="elevation">-30.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<!-- ##### -->
<!-- STREAMS -->
<!-- ##### -->

<audioStreamFormat                                audioStreamFormatID="AS_00010001"
audioStreamFormatName="PCM_FrontLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010002"
audioStreamFormatName="PCM_FrontRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010002_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010003"
audioStreamFormatName="PCM_FrontCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010003</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010003_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010004"
audioStreamFormatName="PCM_LFE1" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010004</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010004_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010007"
audioStreamFormatName="PCM_BackLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010007</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010007_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010008"
audioStreamFormatName="PCM_BackRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010008</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010008_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010009"
audioStreamFormatName="PCM_FrontLeftCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010009</audioChannelFormatIDRef>

```

```

<audioTrackFormatIDRef>AT_00010009_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_0001000a"
audioStreamFormatName="PCM_FrontRightCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_0001000a</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_0001000a_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_0001000b"
audioStreamFormatName="PCM_BackCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_0001000b</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_0001000b_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_0001000c"
audioStreamFormatName="PCM_LFE2"
formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_0001000c</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_0001000c_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_0001000d"
audioStreamFormatName="PCM_SideLeft"
formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_0001000d</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_0001000d_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_0001000e"
audioStreamFormatName="PCM_SideRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_0001000e</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_0001000e_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_0001000f"
audioStreamFormatName="PCM_TopFrontLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_0001000f</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_0001000f_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010010"
audioStreamFormatName="PCM_TopFrontRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010010</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010010_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010011"
audioStreamFormatName="PCM_TopFrontCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010011</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010011_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010012"
audioStreamFormatName="PCM_TopCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010012</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010012_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010013"
audioStreamFormatName="PCM_TopBackLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010013</audioChannelFormatIDRef>

```

```

<audioTrackFormatIDRef>AT_00010013_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010014"
audioStreamFormatName="PCM_TopBackRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010014</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010014_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010015"
audioStreamFormatName="PCM_TopSideLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010015</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010015_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010016"
audioStreamFormatName="PCM_TopSideRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010016</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010016_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010017"
audioStreamFormatName="PCM_TopBackCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010017</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010017_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010018"
audioStreamFormatName="PCM_BottomFrontCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010018</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010018_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010019"
audioStreamFormatName="PCM_BottomFrontLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010019</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_00010019_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_0001001a"
audioStreamFormatName="PCM_BottomFrontRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_0001001a</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AT_0001001a_01</audioTrackFormatIDRef>
</audioStreamFormat>

<!-- ##### -->
<!-- AUDIO TRACKS -->
<!-- ##### -->

<audioTrackFormat                                audioTrackFormatID="AT_00010001_01"
audioTrackFormatName="PCM_FrontLeft" formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010001</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010002_01"
audioTrackFormatName="PCM_FrontRight" formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010002</audioStreamFormatIDRef>
</audioTrackFormat>

```

```
<audioTrackFormat                                audioTrackFormatID="AT_00010003_01"
audioTrackFormatName="PCM_FrontCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010003</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat  audioTrackFormatID="AT_00010004_01"  audioTrackFormatName="PCM_LFE1"
formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010004</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat audioTrackFormatID="AT_00010007_01" audioTrackFormatName="PCM_BackLeft"
formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010007</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010008_01"
audioTrackFormatName="PCM_BackRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010008</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010009_01"
audioTrackFormatName="PCM_FrontLeftCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010009</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_0001000a_01"
audioTrackFormatName="PCM_FrontRightCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_0001000a</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_0001000b_01"
audioTrackFormatName="PCM_BackCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_0001000b</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat  audioTrackFormatID="AT_0001000c_01"  audioTrackFormatName="PCM_LFE2"
formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_0001000c</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat audioTrackFormatID="AT_0001000d_01" audioTrackFormatName="PCM_SideLeft"
formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_0001000d</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_0001000e_01"
audioTrackFormatName="PCM_SideRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_0001000e</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_0001000f_01"
audioTrackFormatName="PCM_TopFrontLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_0001000f</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010010_01"
audioTrackFormatName="PCM_TopFrontRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010010</audioStreamFormatIDRef>
</audioTrackFormat>
```

```
<audioTrackFormat                                audioTrackFormatID="AT_00010011_01"
audioTrackFormatName="PCM_TopFrontCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010011</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010012_01"
audioTrackFormatName="PCM_TopCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010012</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010013_01"
audioTrackFormatName="PCM_TopBackLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010013</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010014_01"
audioTrackFormatName="PCM_TopBackRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010014</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010015_01"
audioTrackFormatName="PCM_TopSideLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010015</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010016_01"
audioTrackFormatName="PCM_TopSideRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010016</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010017_01"
audioTrackFormatName="PCM_TopBackCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010017</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010018_01"
audioTrackFormatName="PCM_BottomFrontCentre"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010018</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_00010019_01"
audioTrackFormatName="PCM_BottomFrontLeft"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010019</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AT_0001001a_01"
audioTrackFormatName="PCM_BottomFrontRight"  formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_0001001a</audioStreamFormatIDRef>
</audioTrackFormat>

<!-- ##### -->
<!-- AUDIO TRACK UIDs -->
<!-- ##### -->

<audioTrackUID UID="ATU_00000001">
  <audioTrackFormatIDRef>AT_00010001_01</audioTrackFormatIDRef>
  <audioPackFormatIDRef>AP_00010009</audioPackFormatIDRef>
</audioTrackUID>
```





```

<audioTrackFormatIDRef>AT_00010003_01</audioTrackFormatIDRef>
<audioPackFormatIDRef>AP_00010009</audioPackFormatIDRef>
</audioTrackUID>

```

## A.7 Example of the use of the Matrix type

### A.7.1 Summary of elements

These are the elements in the format part of the description:

Element	ID	Name	Description
audioTrackFormat	AT_00010001_01	PCM_FrontLeft	Defines track as PCM
audioTrackFormat	AT_00010002_01	PCM_FrontRight	Defines track as PCM
audioTrackFormat	AT_00010003_01	PCM_Centre	Defines track as PCM
audioTrackFormat	AT_00010004_01	PCM_LFE	Defines track as PCM
audioTrackFormat	AT_00010005_01	PCM_SurroundLeft	Defines track as PCM
audioTrackFormat	AT_00010006_01	PCM_SurroundRight	Defines track as PCM
audioTrackFormat	AT_00020003_01	PCM_Lo	Defines track as PCM
audioTrackFormat	AT_00020004_01	PCM_Ro	Defines track as PCM
audioStreamFormat	AS_00010001	PCM_FrontLeft	Defines stream as PCM
audioStreamFormat	AS_00010002	PCM_FrontRight	Defines stream as PCM
audioStreamFormat	AS_00010003	PCM_Centre	Defines stream as PCM
audioStreamFormat	AS_00010004	PCM_LFE	Defines stream as PCM
audioStreamFormat	AS_00010005	PCM_SurroundLeft	Defines stream as PCM
audioStreamFormat	AS_00010006	PCM_SurroundRight	Defines stream as PCM
audioStreamFormat	AS_00020003	PCM_Lo	Defines stream as PCM
audioStreamFormat	AS_00020004	PCM_Ro	Defines stream as PCM
audioChannelFormat & audioBlockFormat	AC_00010001 AB_00010001_00000001	FrontLeft	Describes channel as front left with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010002 AB_00010002_00000001	FrontRight	Describes channel as front right with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010003 AB_00010003_00000001	FrontCentre	Describes channel as front centre with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010004 AB_00010004_00000001	LFE	Describes channel as LFE with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010005 AB_00010005_00000001	SurroundLeft	Describes channel as surround left with a position and speaker reference
audioChannelFormat & audioBlockFormat	AC_00010006 AB_00010006_00000001	SurroundRight	Describes channel as surround right with a position and speaker reference
audioChannelFormat &	AC_00020003 AB_00020003_00000001	Lo	Describes channel as Lo with a matrix combination of FL, C and



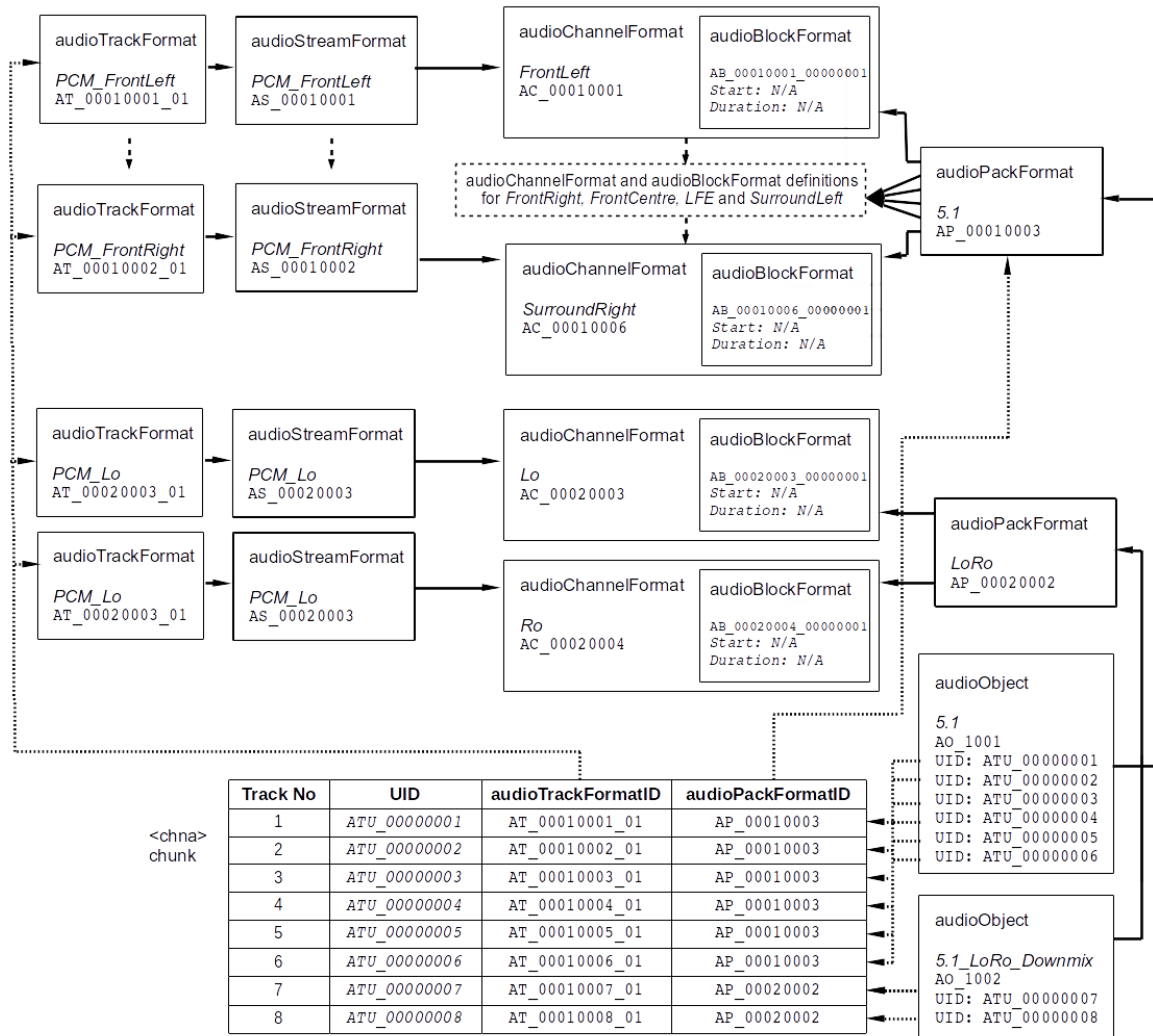
Element	ID	Name	Description
audioBlockFormat			SL channels
audioChannelFormat & audioBlockFormat	AC_00020004 AB_00020004_00000001	Ro	Describes channel as Ro with a matrix combination of FR, C and SR channels
audioPackFormat	AP_00020002	LoRo	Defines a LoRo pack referring to two matrix channels.
audioPackFormat	AP_00010003	5.1	Defines a 5.1 pack referring to 6 channels.

These are the elements in the content part of the description:

Element	ID	Name	Description
audioObject	AO_1001	5.1	Object for 5.1 mix
audioObject	AO_1002	5.1_LoRo_Downmix	Object for 5.1 to Lo/Ro down-mix

### A.7.2 Diagram

The diagram shows how the defined elements relate to each other. The top half of the diagram covers the elements that the 5.1 channels and the Lo/Ro down-mix channel. The *<chna>* chunk in the middle shows how the tracks are connected to the format definitions. The content definition elements are at the bottom of the diagram, with the audioObject element containing the track UID references to the UID in the *<chna>* chunk.



**A.7.3 Sample code**

This XML sample code does not include the audioFormatExtended parent element and the XML header for clarity. The first excerpt of code covers the format elements, which could be contained within the standard reference file:

```

<!-- ##### -->
<!-- OBJECTS -->
<!-- ##### -->

<audioObject audioObjectID="AO_1001" audioObjectName="5.1">
  <audioPackFormatIDRef>AP_00010003</audioPackFormatIDRef>
  <audioTrackUIDRef>ATU_00000001</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000002</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000003</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000004</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000005</audioTrackUIDRef>
  <audioTrackUIDRef>ATU_00000006</audioTrackUIDRef>
</audioObject>

<audioObject audioObjectID="AO_1002" audioObjectName="5.1_LoRo_Downmix">
  <audioPackFormatIDRef>AP_00020002</audioPackFormatIDRef>
  
```

```

    <audioTrackUIDRef>ATU_00000007</audioTrackUIDRef>
    <audioTrackUIDRef>ATU_00000008</audioTrackUIDRef>
</audioObject>

<!-- ##### -->
<!-- PACKS -->
<!-- ##### -->

<audioPackFormat          audioPackFormatID="AP_00010003"          audioPackFormatName="5.1"
typeLabel="0001" typeDefinition="DirectSpeakers">
    <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
    <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
    <audioChannelFormatIDRef>AC_00010003</audioChannelFormatIDRef>
    <audioChannelFormatIDRef>AC_00010004</audioChannelFormatIDRef>
    <audioChannelFormatIDRef>AC_00010005</audioChannelFormatIDRef>
    <audioChannelFormatIDRef>AC_00010006</audioChannelFormatIDRef>
</audioPackFormat>

<audioPackFormat          audioPackFormatID="AP_00020002"          audioPackFormatName="LoRo"
typeLabel="0002" typeDefinition="Matrix">
    <audioChannelFormatIDRef>AC_00020003</audioChannelFormatIDRef>
    <audioChannelFormatIDRef>AC_00020004</audioChannelFormatIDRef>
</audioPackFormat>

<!-- ##### -->
<!-- CHANNELS -->
<!-- ##### -->

<audioChannelFormat          audioChannelFormatID="AC_00010001"
audioChannelFormatName="FrontLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
    <audioBlockFormat audioBlockFormatID="AB_00010001_00000001">
        <speakerLabel>M+30</speakerLabel>
        <position coordinate="azimuth">30.0</position>
        <position coordinate="elevation">0.0</position>
        <position coordinate="distance">1.0</position>
    </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat          audioChannelFormatID="AC_00010002"
audioChannelFormatName="FrontRight" typeLabel="0001" typeDefinition="DirectSpeakers">
    <audioBlockFormat audioBlockFormatID="AB_00010002_00000001">
        <speakerLabel>M-30</speakerLabel>
        <position coordinate="azimuth">-30.0</position>
        <position coordinate="elevation">0.0</position>
        <position coordinate="distance">1.0</position>
    </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat          audioChannelFormatID="AC_00010003"
audioChannelFormatName="FrontCentre" typeLabel="0001" typeDefinition="DirectSpeakers">
    <audioBlockFormat audioBlockFormatID="AB_00010003_00000001">
        <speakerLabel>M+00</speakerLabel>
        <position coordinate="azimuth">0.0</position>
        <position coordinate="elevation">0.0</position>
        <position coordinate="distance">1.0</position>
    </audioBlockFormat>
</audioChannelFormat>

```

```

<audioChannelFormat      audioChannelFormatID="AC_00010004"      audioChannelFormatName="LFE"
typeLabel="0001" typeDefinition="DirectSpeakers">
  <frequency typeDefinition="lowPass">200</frequency>
  <audioBlockFormat audioBlockFormatID="AB_00010004_00000001">
    <speakerLabel>LFE+00</speakerLabel>
    <position coordinate="azimuth">0.0</position>
    <position coordinate="elevation">-20.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat      audioChannelFormatID="AC_00010005"
audioChannelFormatName="SurroundLeft" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010005_00000001">
    <speakerLabel>M+110</speakerLabel>
    <position coordinate="azimuth">110.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat      audioChannelFormatID="AC_00010006"
audioChannelFormatName="SurroundRight" typeLabel="0001" typeDefinition="DirectSpeakers">
  <audioBlockFormat audioBlockFormatID="AB_00010006_00000001">
    <speakerLabel>M-110</speakerLabel>
    <position coordinate="azimuth">-110.0</position>
    <position coordinate="elevation">0.0</position>
    <position coordinate="distance">1.0</position>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat      audioChannelFormatID="AC_00020003"      audioChannelFormatName="Lo"
typeLabel="0002" typeDefinition="Matrix">
  <audioBlockFormat audioBlockFormatID="AB_00020003_00000001">
    <speakerLabel>M+30</speakerLabel>
    <matrix>
      <coefficient gain="1.0">AC_00010001</coefficient>
      <coefficient gainVar="clef">AC_00010003</coefficient>
      <coefficient gainVar="slev">AC_00010005</coefficient>
    </matrix>
  </audioBlockFormat>
</audioChannelFormat>

<audioChannelFormat      audioChannelFormatID="AC_00020004"      audioChannelFormatName="Ro"
typeLabel="0002" typeDefinition="Matrix">
  <audioBlockFormat audioBlockFormatID="AB_00020004_00000001">
    <speakerLabel>M-30</speakerLabel>
    <matrix>
      <coefficient gain="1.0">AC_00010002</coefficient>
      <coefficient gainVar="clef">AC_00010003</coefficient>
      <coefficient gainVar="slev">AC_00010006</coefficient>
    </matrix>
  </audioBlockFormat>
</audioChannelFormat>

<!-- ##### -->
<!-- STREAMS -->
<!-- ##### -->

```

```

<audioStreamFormat                                audioStreamFormatID="AS_00010001"
audioStreamFormatName="PCM_FrontLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010001</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AS_00010001_AT_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010002"
audioStreamFormatName="PCM_FrontRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010002</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AS_00010002_AT_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010003"
audioStreamFormatName="PCM_FrontCentre" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010003</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AS_00010003_AT_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010004"
audioStreamFormatName="PCM_LFE" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010004</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AS_00010004_AT_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010005"
audioStreamFormatName="PCM_SurroundLeft" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010005</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AS_00010005_AT_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00010006"
audioStreamFormatName="PCM_SurroundRight" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00010006</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AS_00010006_AT_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00020003"
audioStreamFormatName="PCM_Lo" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00020003</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AS_00020003_AT_01</audioTrackFormatIDRef>
</audioStreamFormat>

<audioStreamFormat                                audioStreamFormatID="AS_00020004"
audioStreamFormatName="PCM_Ro" formatLabel="0001" formatDefinition="PCM">
  <audioChannelFormatIDRef>AC_00020004</audioChannelFormatIDRef>
  <audioTrackFormatIDRef>AS_00020004_AT_01</audioTrackFormatIDRef>
</audioStreamFormat>

<!-- ##### -->
<!-- AUDIO TRACKS -->
<!-- ##### -->

<audioTrackFormat                                audioTrackFormatID="AS_00010001_AT_01"
audioTrackFormatName="PCM_FrontLeft" formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010001</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat                                audioTrackFormatID="AS_00010002_AT_01"

```

```
audioTrackFormatName="PCM_FrontRight" formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010002</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AS_00010003_AT_01"
audioTrackFormatName="PCM_FrontCentre" formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010003</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat audioTrackFormatID="AS_00010004_AT_01" audioTrackFormatName="PCM_LFE"
formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010004</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AS_00010005_AT_01"
audioTrackFormatName="PCM_SurroundLeft" formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010005</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat
                                audioTrackFormatID="AS_00010006_AT_01"
audioTrackFormatName="PCM_SurroundRight" formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00010006</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat audioTrackFormatID="AS_00020003_AT_01" audioTrackFormatName="PCM_Lo"
formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00020003</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackFormat audioTrackFormatID="AS_00020004_AT_01" audioTrackFormatName="PCM_Ro"
formatLabel="0001" formatDefinition="PCM">
  <audioStreamFormatIDRef>AS_00020004</audioStreamFormatIDRef>
</audioTrackFormat>

<audioTrackUID UID="ATU_00000001"/>
<audioTrackUID UID="ATU_00000002"/>
<audioTrackUID UID="ATU_00000003"/>
<audioTrackUID UID="ATU_00000004"/>
<audioTrackUID UID="ATU_00000005"/>
<audioTrackUID UID="ATU_00000006"/>
<audioTrackUID UID="ATU_00000007"/>
<audioTrackUID UID="ATU_00000008"/>
```

---