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Recommendation ITU-R BS.2168-0

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BS Series: Broadcasting service (sound)

Audio definition model and serial representation of audio definition model profile for advanced sound systems emission

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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.2168-0

Audio definition model and serial representation of audio definition model profile for advanced sound systems emission

(2025)

Scope

This Recommendation specifies requirements, recommendations, and constraints for the use of Audio definition model (ADM) (Recommendation ITU-R BS.2076) and serial representation of audio definition model (S-ADM) (Recommendation ITU-R BS.2125) metadata. This emission profile is intended for use with audio coding systems for advanced sound system (AdvSS) emission.

Keywords

ADM, Audio Definition Model, next-generation audio, AdvSS, Advanced sound system, S-ADM, emission

The Radiocommunication Assembly,

considering

a) that advanced sound systems (AdvSS) will use a variety of configurations including channel-, object-, and scene-based audio such as specified in Recommendation ITU-R BS.2051;

b) that advanced sound systems will use the Audio Definition Model (ADM) specified in Recommendation ITU-R BS.2076 to describe the technical format of the audio being delivered and exchanged in file-based workflows;

c) that advanced sound systems will also use the Serial Representation of the Audio Definition Model (S-ADM) specified in Recommendation ITU-R BS.2125 to describe the technical format of the audio being delivered and exchanged in real-time workflows;

d) that multiple audio coding systems for emission with the capability to support the AdvSS, including the combination of audio signals and metadata, are listed in Recommendation ITU-R BS.1196;

e) that due to the flexibility of the ADM and S-ADM it is possible to generate ADM and S-ADM metadata that is too complex for audio coding systems for AdvSS emission;

f) that audio coding systems for AdvSS emission that include metadata only support a limited set of parameters and features of ADM and S-ADM;

g) that audio coding systems for AdvSS emission that include metadata only support a limited number of audio tracks;

h) that defining profiles and levels is a method of specifying sets of constraints,

recommends

that, when compatibility of content that contains ADM and/or S-ADM metadata for input to multiple audio coding systems for AdvSS emission of channel- and object-based audio is required, ADM and S-ADM metadata should fulfill the requirements described in Annex 1.

Annex 1

Advanced sound system: ADM and S-ADM profile for emission

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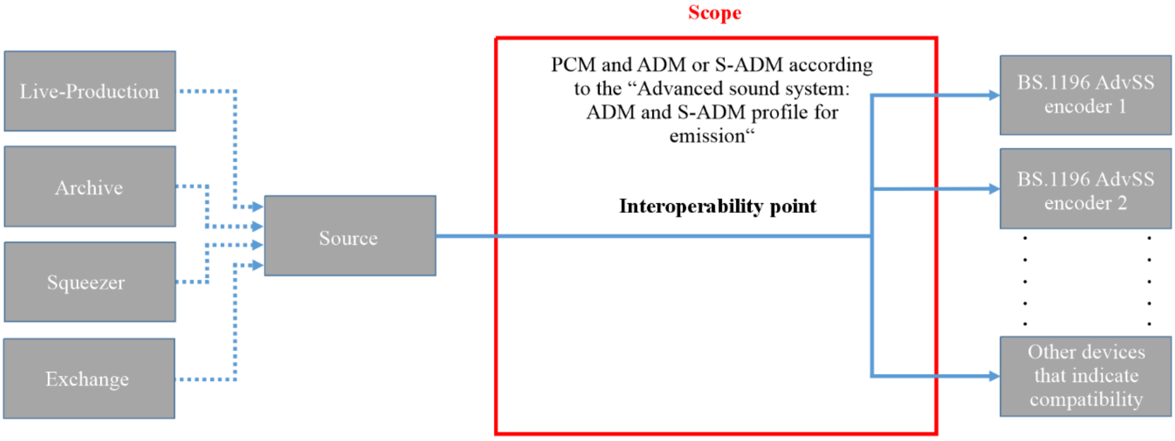
1 Introduction

This Annex specifies requirements, recommendations, and constraints for the use of the ADM specified in Recommendation ITU-R BS.2076 and for the use of the S-ADM specified in Recommendation ITU-R BS.2125. This profile covers channel- and object-based audio intended for use with audio coding systems for advanced sound system (AdvSS) emission.

The scope of this profile is shown in Fig. 1.

FIGURE 1

Advanced sound system: ADM and S-ADM profile for emission scope diagram


Scope
Live-Production
Archive
Squeezer
Exchange
Source
PCM and ADM or S-ADM according to the "Advanced sound system: ADM and S-ADM profile for emission"
Interoperability point
BS.1196 AdvSS encoder 1
BS.1196 AdvSS encoder 2
Other devices that indicate compatibility

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The profile is defined as a specific use of ADM and S-ADM XML elements, attributes, and sub-elements. This Recommendation:

- Specifies the presence of certain elements, attributes and sub-elements.
- Limits the range of certain parameters.
- Defines the ADM and S-ADM topology applicable to the profile.

2 Profile on the `audioFormatExtended` element

This section contains the specifications and requirements concerning the use of the `audioFormatExtended` element and its sub-elements and attributes defined in Recommendation ITU-R BS.2076.

2.1 Requirements on the `audioFormatExtended` element

2.1.1 General requirements

The profile mostly contains requirements on the individual XML elements and attributes of the `audioFormatExtended` element, but there are additional general requirements that also apply. This includes:

- This profile adheres to Recommendation ITU-R BS.2076-3.
- A compliant implementation of this profile shall support the functionality of all ADM XML elements, attributes and sub-elements listed in this profile specification.

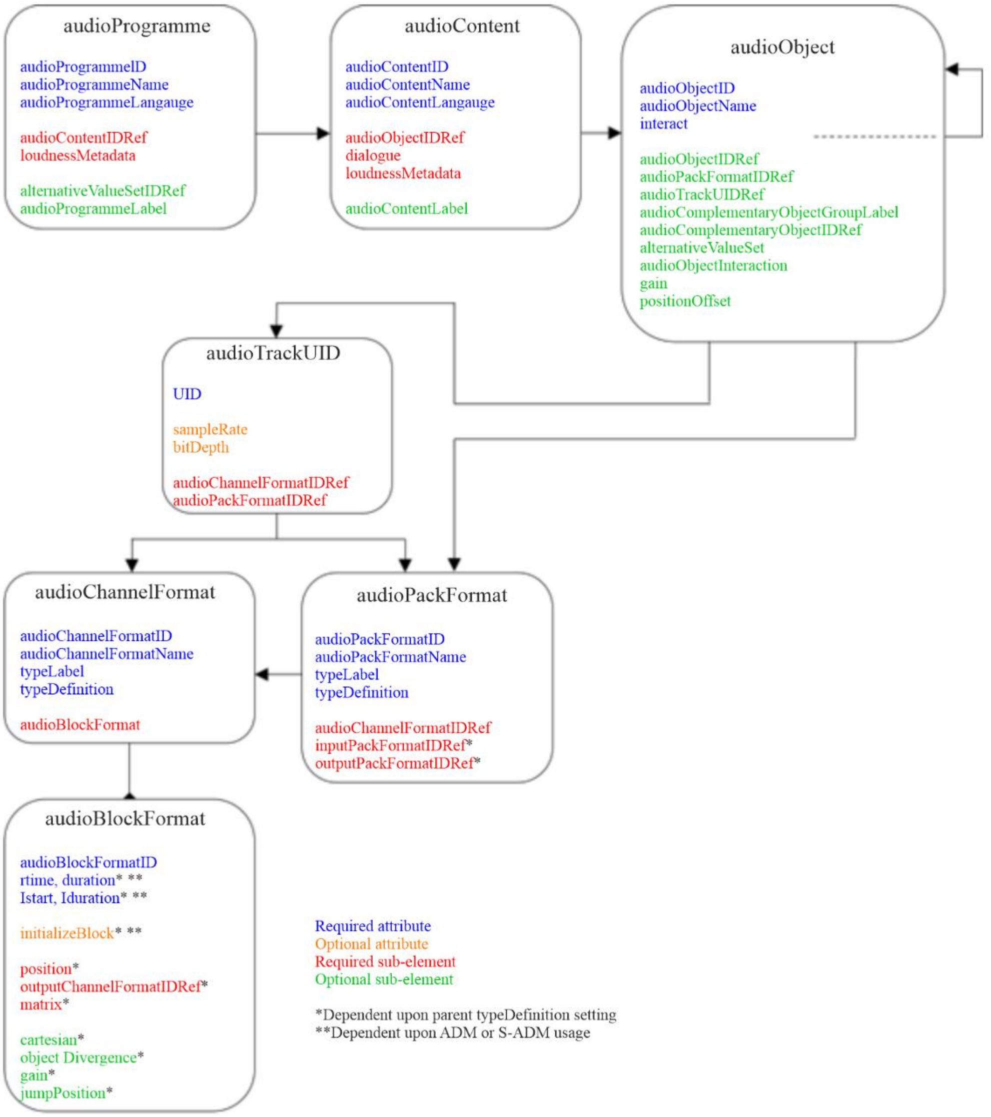
- The presence of any ADM elements, attributes or sub-elements that are not listed in this profile specification will result in non-compliance. ADM metadata including such elements, attributes or sub-elements shall therefore be rejected.
- There are limits on the number of times an ADM XML element can be present depending upon the profile level; See § 2.3 for element count specifics.
- XML code shall be conforming to the Extensible Markup Language (XML) 1.0 with UTF-8 character encoding.
- Integer and floating-point numbers shall be given in a decimal representation without leading zeros.
- XML code shall not overwrite elements defined by Recommendation ITU-R BS.2094.
- Labels for specific `language` attributes should be consistently present for all applicable `audioProgrammeLabel`, `audioContentLabel` and `audioComplementaryObjectGroupLabel` sub-elements in all present `audioProgramme, audioContent` and `audioObject` elements.
- The `audioProgramme` and `audioObject` sub-elements shall exist for the entire duration of the associated audio essence. The sequence of `audioBlockFormat` elements in all `audioChannelFormat` elements shall cover the entire duration of the associated audio essence.

2.1.2 `audioFormatExtended` attribute and sub-element requirements

See § 2.3 and Table 2 for requirements on the number of sub-elements of the `audioFormatExtended` element. Figure 2 shows a diagram of the profile main elements and sub-elements supported by this profile.

FIGURE 2

Profile Main Element and Sub-element Structure



BT.2168-02

TABLE 1

`audioFormatExtended` attribute requirements

Attribute	Requirements	Required
`version`	Shall be set to "ITU-R_BS.2076-3"	Yes

TABLE 2

Profile restrictions on number of `audioFormatExtended` sub-element occurrences

XML element	Min Value	Max Value
audioProgramme	1	MAX_PROGRAMME
audioContent	1	MAX_CONTENT
audioObject	1	MAX_OBJECT
audioPackFormat	0	MAX_PACK_FORMAT
audioChannelFormat	0	MAX_CHANNEL_FORMAT
audioTrackUID	1	MAX_TRACK_UID
audioTrackFormat	0	0
audioStreamFormat	0	0
profileList	1	1

NOTE – This profile is intended to be used with PCM essence only, therefore the elements audioTrackFormat and audioStreamFormat shall not be present because they are not required (see § 5.1 of Recommendation ITU-R BS.2076-3 for further details).

Elements of type “0002” (Matrix) shall be ignored for the counting of element occurrences when comparing to the limits specified in Table 2.

2.1.3 `audioProgramme` attribute and sub-element requirements

TABLE 3

`audioProgramme` attribute requirements

Attribute	Requirements	Required
audioProgrammeID	See § 2.2	Yes
audioProgrammeName	Min length 1 char, max length 64 chars (encoded as UTF-8)	Yes
audioProgrammeLanguage	Shall use a 3-char code defined in ISO 639-2 If the content contains no dominant or any language, then one of the *special situation codes* defined in ISO 639-2 should be used. When the audioProgramme contains a group of complementary audioObject elements for a multilanguage programme, then ISO-639-2 code “und” should be used.	Yes
all other attributes	Shall not be present	

TABLE 4

`audioProgramme` sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
`audioContentIDRef`	The `IDRef` shall match the ID of a present `audioContent` element. The restrictions defined in § 2.1.3.1 shall be fulfilled.	1	MAX_APR_ACO
`audioProgrammeLabel`	Min length 1 char, max length 64 chars (encoded as UTF-8), must include `language` attribute. The `language` attribute shall use a 3-char code defined in ISO 639-2. The `language` attribute shall be unique for each `audioProgrammeLabel` sub-element.	0	MAX_APR_PL
`loudnessMetadata`	See Table 5	1	1
`alternativeValueSetIDRef`	The `IDRef` shall match the ID of an `alternativeValueSet` sub-element of a top-level `audioObject` element that is associated with one of the `audioContent` elements referenced by the `audioProgramme` element. The restrictions defined in § 2.1.3.2 shall be fulfilled.	0	MAX_APR_ACO
`all other sub-elements`	Shall not be present	0	0

TABLE 5

`loudnessMetadata` attribute and sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
`integratedLoudness`	Shall be present if a `dialogueLoudness` sub-element is not present. Can be present if a `dialogueLoudness` element is present.	0	1
`dialogueLoudness`	Shall be present if an `integratedLoudness` sub-element is not present. Can be present if an `integratedLoudness` element is present. The `dialogueLoudness` element included in the `audioProramme` or `audioContent` element should be present if the audio essence of the parent `audioProgramme` or `audioContent` element contains dialogue, respectively.	0	1
`all attributes and other sub-elements`	Shall not be present	0	0

NOTE 1 – Loudness values might be used for level adjustments with supported advanced sound systems (AdvSS). When measured loudness is described, this measurement should be based on the preferred playback configuration.

NOTE 2 – For loudness metadata values included in audioProgramme elements, the effects of applicable gain sub-elements for all included top-level audioObject elements should be taken into account when determining the loudness of the audioProgramme element. The applicable gain sub-element for each included top-level audioObject element shall be determined by taking into account alternativeValueSetIDRef sub-elements of the audioProgramme element, as well as the gain sub-element of the audioObject element and gain sub-elements included in alternativeValueSet sub-elements of the audioObject element. The activation of alternativeValueSet elements and the precedence and inheritance of gain sub-elements between alternativeValueSet sub-elements and their parent audioObject element shall be determined in accordance with Recommendation ITU-R BS.2076-3. When the audioProgramme includes a group of complementary audioObject elements only the default audioObject element should be taken into account.

NOTE 3 – For loudness metadata values included in audioContent elements, the effect of the gain sub-element of the top-level audioObject element associated with the audioContent element should be taken into account when determining the loudness of the audioContent element. The effect of gain sub-elements in alternativeValueSet sub-elements of the top-level audioObject element should not be taken into account.

All loudness values present shall represent a loudness measurement value based on Recommendation ITU-R BS.1770 or a value determined by the content creator.

2.1.3.1 audioContentIDRef requirement detailed explanation

For any audioProgramme element and any group of complementary top-level audioObject elements, the audioProgramme element shall either include all top-level audioObject elements of the group, or exactly one of them or none of them. A top-level audioObject is included in an audioProgramme, if the audioProgramme has an audioContentIDRef sub-element to the audioContent element that is associated with the top-level audioObject element.

In case the audioProgramme element includes all the audioObject elements of the complementary group, the user can switch between the audioObject elements of that group when the audioProgramme element is active. In case the audioProgramme element includes exactly one top-level audioObject element of the complementary group, the selection of this audioObject element is fixed and the user cannot switch to another audioObject element of that group when the audioProgramme element is active. In case the audioProgramme element includes none of the audioObject elements of the complementary group, the user cannot select or activate any of the audioObject elements of that group when the audioProgramme element is active.

Consider, for example, a group of three complementary audioObject elements for English, French and German commentary. It is not allowed for any audioProgramme element to include only the English and French but not the German commentary. Equally, it is not allowed to include only the English and German but not the French commentary and it is not allowed to include only the German and French but not the English commentary.

2.1.3.2 alternativeValueSetIDRef requirement detailed explanation

For any audioProgramme element and any group of complementary top-level audioObject elements, the audioProgramme element may include alternativeValueSetIDRef sub-elements for the group. If this is the case and if the audioProgramme includes all top-level audioObject elements of the group (see § 2.1.3.1), the audioProgramme shall include alternativeValueSetIDRef sub-elements for all of the top-level audioObject elements of the group and not only for a subset of them. Additionally, all alternativeValueSet elements that an audioProgramme element references for members of the same complementary group shall be identical except for the alternativeValueSetID attribute.

The reason for the restrictions above is the following:

According to Table 9, the gain and interactivity properties of audioObject elements that belong to the same group of complementary audioObject elements shall be identical. The restriction here ensures that audioProgramme elements cannot assign differing gain or interactivity properties to audioObject elements that belong to the same group of complementary audioObject elements by referencing differing alternativeValueSet elements for these audioObject elements.

2.1.4 audioContent attribute and sub-element requirements

Each present audioContent element shall be referenced by at least one audioProgramme element.

TABLE 6

audioContent attribute requirements

Attribute	Requirements	Required
audioContentID	See § 2.2	Yes
audioContentName	Min length 1 char, max length 64 chars (encoded as UTF-8)	Yes
audioContentLanguage	Shall use a 3-char code defined in ISO 639-2. If the content contains no dominant or any language, then one of the *special situation codes* defined in ISO 639-2 should be used.	Yes
all other attributes	Shall not be present	

TABLE 7

audioContent sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
audioObjectIDRef	The hexadecimal value wwww of referenced AO_wwww shall match that in parent audioContentID ACO_wwww. The IDRef shall match the ID of a present audioObject element.	1	1
audioContentLabel	Min length 1 char, max length 64 chars (encoded as UTF-8 must include language attribute. The language attribute shall use a 3 char code defined in ISO 639-2. The language attribute shall be unique for each audioContentLabel sub-element.	0	MAX_ACO_CL

TABLE 7 (*end*)

Sub-element	Requirements	Min Qty	Max Qty
	NOTE: If the audioContent references an audioObject that contains one or more alternativeValueSet elements, then this label describes the default and all sets of parameters defined by the alternativeValueSet elements.		
loudnessMetadata	See Table 5	1	1
dialogue	The value of the dialogue sub-element and its attributes shall be set such that the essence described by the referenced audioObject element is accurately represented.	1	1
all other sub-elements	Shall not be present	0	0

2.1.5 audioObject attribute and sub-element requirements

This profile allows for a maximum audioObject element nest level of two.

Within this document the term top-level audioObject element shall be defined as follows. A top-level audioObject element shall be an audioObject element which is referenced directly by an audioContent element. Within the constraints of this profile, each audioContent element has exactly one associated top-level audioObject element.

Each audioObject element shall be referenced exactly once by either a parent audioContent element or a parent audioObject element.

Complementary audioObject elements shall be used for mutually exclusive content versions as, e.g. for alternative language/commentary elements or home and away scenarios. The signal levels of all complementary audioObject elements should be adjusted such that their perceived loudness is the same when their gains are set to 1.0. If the content creator intends to change the loudness of the audioProgramme element or audioContent element such as for a dialogue enhancement use-case, they should be contained in different audioProgramme elements.

TABLE 8

audioObject attribute **requirements**

Attribute	Requirements	Required
audioObjectID	See § 2.2	Yes
audioObjectName	Min length 1 char, max length 64 chars (encoded as UTF-8)	Yes
interact	–	Yes
all other attributes	Shall not be present	

TABLE 9

audioObject sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
audioPackFormatIDRef	Shall be present if and only if the audioObject element does not include any audioObjectIDRef sub-elements. The IDRef shall match the ID of a present audioPackFormat element of type "0003" (Objects) or shall match the ID of one of the common definition audioPackFormat elements of type "0001" (DirectSpeakers) as listed in Table 16.	0	1
audioObjectIDRef	The IDRef shall match the ID of a present audioObject element. Each referenced audioObject element shall include an audioPackFormatIDRef sub-element to an audioPackFormat element of type "0003" (Objects).	0	MAX_AO_AO
audioTrackUIDRef	The IDRef shall match the UID of a present audioTrackUID element Shall be present if and only if the audioObject includes an audioPackFormatIDRef sub-element. If the audioObject element includes an audioPackFormatIDRef sub-element, there shall be exactly as many audioTrackUIDRef sub-elements as there are audioChannelFormatIDRef sub-elements in the referenced audioPackFormat element. Each referenced audioTrackUID element shall refer back to the audioPackFormat element and it shall also refer back to one of the audioChannelFormat elements referenced by this audioPackFormat element. In this way, each audioChannelFormat element referenced by the audioPackFormat element shall be referred back to by a referenced audioTrackUID element exactly once. Shall not refer to a silent track by using "ATU_00000000".	0	MAX_CHANNELS_LAYOUT

TABLE 9 (*continued*)

Sub-element	Requirements	Min Qty	Max Qty
audioComplementaryObjectGroupLabel	Min length 1 char, max length 64 chars (encoded as UTF-8), must include language attribute. The language attribute shall use a 3 char code defined in ISO 639-2. The language attribute shall be unique for each audioComplementaryObjectGroupLabel sub-element.	0	MAX_AO_CL
audioComplementaryObjectIDRef	The IDRef shall match the ID of a present top-level audioObject element shall not be present in audioObject elements that are not top-level audioObject elements. The referenced audioObject element shall not include any audioComplementaryObjectIDRef sub-elements. The interact attributes of complementary audioObject elements shall be identical. The audioObjectInteraction, gain and positionOffset sub-elements of complementary audioObject elements shall be identical. Complementary audioObject elements shall not reference audioPackFormat elements of different types. No audioObject element shall be referenced by more than one audioComplementaryObjectIDRef sub-element.	0	MAX_AO_CO
audioObject Interaction	Shall not be present in audioObject elements that are not top-level audioObject elements. Shall be present if and only if the interact attribute of the parent audioObject element is present and set to “1”. See Tables 10 and 11.	0	1

TABLE 9 (*continued*)

Sub-element	Requirements	Min Qty	Max Qty
gain	Shall not be present in audioObject elements that are not top-level audioObject elements. The value of the gain element shall not be greater than “21” dB or the equivalent linear value. If gainInteractionRange sub-elements are present in the audioObjectInteraction element, the value of the gain element shall not exceed the limits imposed by the gainInteractionRange sub-elements.	0	1
positionOffset	Shall not be present in audioObject elements that are not top-level audioObject elements. Shall not be present if the parent audioObject element includes an audioObjectIDRef sub-element. Shall not be present if the parent audioObject element refers to an audioChannelFormat element of a different type than “0003”. Shall not be present if the audioChannelFormat element referenced by the parent audioObject element (via an audioPackFormatIDRef sub-element) includes audioBlockFormat elements indicating any object position other than {azimuth=“0.0”; elevation=“0.0”; distance=“1.0”} or {X=“0.0”; Y=“1.0”; Z=“0.0”}. The coordinate attribute shall be set to “azimuth” or “X” depending upon the coordinate system used. The value with the coordinate attribute set to “azimuth” shall be between “-30.0” and “30.0”. The value with the coordinate attribute set to “X” shall be between “-1.0” and “1.0”. If positionInteractionRange sub-elements are present in the audioObjectInteraction element, the value of the positionOffset	0	1

TABLE 9 (*end*)

Sub-element	Requirements	Min Qty	Max Qty
	element shall not exceed the limits imposed by the positionInteractionRange sub-elements.		
alternative ValueSet	Shall not be present in audioObject elements that are not top-level audioObject elements. See Tables 12 and 13.	0	MAX_AO_AVS
all other sub-elements	Shall not be present	0	0

TABLE 10

audioObjectInteraction attribute requirements

Attribute	Requirements	Required
onOffInteract	Shall be set to “0”.	Yes
gainInteract	-	No
positionInteract	-	No
all other attributes	Shall not be present	

NOTE – If an object is to be muted within an audioProgramme, then a separate audioProgramme should be used with that object removed or gain set to “0” or “-inf”.

TABLE 11

audioObjectInteraction sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
gainInteraction Range	Shall be present if and only if the gainInteract attribute of the parent audioObjectInteraction sub-element is present. There shall be exactly 0 or exactly 2 gainInteractionRange sub-elements. The value of a gainInteractionRange sub-element with the bound attribute set to “min” shall be set to a value between “-inf” dB and “0.0” dB or an equivalent linear value. The value of a gainInteractionRange sub-element with the bound attribute set to “max” shall be between “0.0” dB and “21.0” dB or an equivalent linear value.	0	2

TABLE 11 (*continued*)

Sub-element	Requirements	Min Qty	Max Qty
positionInteractionRange	Shall not be present if the parent audioObject element includes an audioObjectIDRef sub-element. Shall not be present if the parent audioObject element refers to an audioChannelFormat element of a different type than “0003”. Shall not be present if the audioChannelFormat element referenced by the parent audioObject element (via an audioPackFormatIDRef sub-element) includes audioBlockFormat elements indicating any object position other than {azimuth=“0.0”; elevation=“0.0”; distance=“1.0”} or {X=“0.0”; Y=“1.0”; Z=“0.0”}. Shall be present if and only if the positionInteract attribute of the parent audioObjectInteraction sub-element is present. There shall be exactly 0 or exactly 2 positionInteractionRange sub-elements comprising of one for bound attribute “min” and one for bound attribute “max” for the respective coordinate. The coordinate attribute shall be set to “azimuth” or “X” depending on the coordinate system used. The value of a positionInteractionRange sub-element with the coordinate attribute set to “azimuth” and the bound attribute set to “min” shall be between “-30.0” and “0.0”. The value of a positionInteractionRange sub-element with the coordinate attribute set to “azimuth” and the bound attribute set to “max” shall be between “0.0” and “30.0”.	0	2

TABLE 11 (*end*)

Sub-element	Requirements	Min Qty	Max Qty
	The value of a positionInteractionRange sub-element with the coordinate attribute set to "X" and the bound attribute set to "min" shall be between "-1.0" and "0.0". The value of a positionInteractionRange sub-element with the coordinate attribute set to "X" and the bound attribute set to "max" shall be between "0.0" and "1.0".		
all other sub-elements	Shall not be present	0	0

TABLE 12

alternativeValueSet attribute requirements

Attribute	Requirements	Required
alternativeValueSetID	See § 2.2	Yes

TABLE 13

alternativeValueSet sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
gain	The value of the gain element shall not be greater than "21" dB or the equivalent linear value. If gainInteractionRange sub-elements are present in the audioObjectInteraction element of the parent audioObject element, the value of the gain element shall not exceed the limits imposed by the gainInteractionRange sub-elements	0	1
audioObject Interaction	Shall not be present if the parent audioObject element does not include an audioObjectInteraction sub-element. If present, shall be identical to the audioObjectInteraction sub-element of the parent audioObject except for the gainInteract and positionInteract attributes. See Tables 10 and 11.	0	1

TABLE 13 (*end*)

Sub-element	Requirements	Min Qty	Max Qty
positionOffset	Shall not be present if the parent audioObject element includes an audioObjectIDRef sub-element. Shall not be present if the parent audioObject element refers to an audioChannelFormat element of a different type than "0003". Shall not be present if the audioChannelFormat element referenced by the parent audioObject element (via an audioPackFormatIDRef sub-element) includes audioBlockFormat elements indicating any object position other than {azimuth="0.0"; elevation="0.0"; distance="1.0"} or {X="0.0"; Y="1.0"; Z="0.0"}. The coordinate attribute shall be set to "azimuth" or "X" depending upon the coordinate system used. The value with the coordinate attribute set to "azimuth" shall be between "-30.0" and "30.0". The value with the coordinate attribute set to "X" shall be between "-1.0" and "1.0". If positionInteractionRange sub-elements are present in the audioObjectInteraction element of the parent audioObject element, the value of the positionOffset element shall not exceed the limits imposed by the positionInteractionRange sub-elements.	0	1
all other sub-elements	Shall not be present	0	0

2.1.6 **audioPackFormat** attribute and sub-element requirements

Each present audioPackFormat element of type "0003" shall be referenced by at least one audioObject element. There shall not be two or more audioPackFormat elements of type "0002" (Matrix), which share the same combination of inputPackFormatIDRef sub-element and outputPackFormatIDRef sub-element.

When audioPackFormat elements of typeLabel "0001" are used, the common definitions described in Table 16 shall be referred from the other ADM elements.

TABLE 14

audioPackFormat attribute requirements

Attribute	Requirements	Required
audioPackFormatID	See § 2.2	Yes
audioPackFormatName	Min length 1 char, max length 64 chars (encoded as UTF-8)	Yes
typeLabel	Shall be set to "0002" or "0003" Value must match yyyy in audioPackFormatID AP_yyyyxxxx	Yes
typeDefinition	Shall be set to "Matrix" or "Objects"	Yes
all other attributes	Shall not be present	

TABLE 15

audioPackFormat sub-element requirements for type "0002" (Matrix)

Sub-element	Requirements	Min Qty	Max Qty
audioChannelFormatIDRef	The IDRef shall match the ID of a present audioChannelFormat element of type "0002". There shall be a one-to-one (injective) mapping from the set of audioChannelFormatIDRef sub-elements to the set of audioChannelFormatIDRef sub-elements of the outputPackFormat.	1	24
inputPackFormatIDRef	The IDRef shall match the ID of a common definition audioPackFormat element of type "0001" listed in Table 16. Shall not be identical to the outputPackFormatIDRef sub-element.The same audioPackFormat element shall be also referenced by a present audioObject element.	1	1
outputPackFormatIDRef	The IDRef shall match the ID of a common definition audioPackFormat element of type "0001" listed in Table 16. Shall not be identical to the inputPackFormatIDRef sub-element.	1	1
all other sub-elements	Shall not be present	0	0

TABLE 16

audioPackFormatIDRef, inputPackFormatIDRef and outputPackFormatIDRef requirements for "DirectSpeakers"

Valid Values	Name from Recommendation ITU-R BS.2094	Configuration
AP_00010001, AP_00010801	mono_(0+1+0)	0+1+0
AP_00010002, AP_00010802	stereo_(0+2+0)	0+2+0
AP_0001000a *, AP_0001080a *	3.0_(0+3+0)	0+3+0
AP_00010003, AP_00010803	5.1_(0+5+0)	0+5+0
AP_0001000c *, AP_0001080c *	5.0_(0+5+0)	0+5+0 (w/o LFE)
AP_0001000f, AP_0001080f	7.1back_(0+7+0)	0+7+0
AP_0001001b *, AP_0001081b *	7.0back_(0+7+0)	0+7+0 (w/o LFE)
AP_00010004, AP_00010804	7.1top_(2+5+0)	2+5+0
AP_0001001c *, AP_0001081c *	7.0top_(2+5+0)	2+5+0 (w/o LFE)
AP_00010005, AP_00010805	9.1_5.1.4_(4+5+0)	4+5+0
AP_0001001e *, AP_0001081e *	9.0_5.0.4_(4+5+0)	4+5+0 (w/o LFE)
AP_00010017, AP_00010817	11.1_7.1.4_(4+7+0)	4+7+0
AP_0001001f *, AP_0001081f *	11.0_7.0.4_(4+7+0)	4+7+0 (w/o LFE)
AP_00010009, AP_00010809	22.2_(9+10+3)	9+10+3
AP_00010010 *, AP_00010810 *	22.0_(9+10+3)	9+10+3 (w/o LFE)
* Shall not be referenced by outputPackFormatIDRef sub-elements of audioPackFormat elements of type "Matrix"		

NOTE – Decoders in AdvSS emission codec systems compare the output loudspeaker configuration that they are configured for with the target configurations of the downmix matrices they receive as part of the metadata. By applying a so-called matching algorithm, they determine whether one of the downmix matrices is applicable for the configured output layout. In these matching algorithms, decoder implementations may use loudspeaker layouts with different nominal loudspeaker positions and different tolerance ranges for loudspeaker position than those defined in Recommendations ITU-R BS.2051 and ITU-R BS.2094.

TABLE 17

audioPackFormat sub-element requirements for type "0003" (Objects)

Sub-element	Requirements	Min Qty	Max Qty
audioChannelFormatIDRef	The IDRef shall match the ID of a present audioChannelFormat element of type "0003".	1	1
all other sub-elements	Shall not be present	0	0

2.1.7 audioChannelFormat attribute and sub-element requirements

Each present audioChannelFormat element shall be referenced exactly once by a present audioPackFormat element.

TABLE 18

audioChannelFormat attribute requirements

Attribute	Requirements	Required
audioChannelFormatID	See below and § 2.2	Yes
audioChannelFormatName	Min length 1 char, max length 64 chars (encoded as UTF-8)	Yes
typeLabel	Shall be set to "0002" or "0003". Value must match yyyy in audioChannelFormatID AC_yyyyxxxx.	Yes
typeDefinition	Shall be set to "Matrix" or "Objects"	Yes

TABLE 19

audioChannelFormat sub-element requirements for type "0002" (Matrix)

Sub-element	Requirements	Min Qty	Max Qty
audioBlockFormat	See § 2.1.8	1	1
all other sub-elements	Shall not be present	0	0

TABLE 20

audioChannelFormat sub-element requirements for type "0003" (Objects)

Sub-element	Requirements	Min Qty	Max Qty
audioBlockFormat	See § 2.1.8	1	*
all other sub-elements	Shall not be present	0	0

NOTE – If the audioFormatExtended element is included in a frame element then the maximum number of occurrences of audioBlockFormat is dependent upon the value of sub-element frameFormat attribute duration detailed in § 4.1.4 and the presence of audioBlockFormat attribute initializeBlock detailed in § 2.1.8.

The maximum number of occurrences can be calculated as follows:

$$frameduration \times \frac{1}{5 \times 10^{-3}} + initpresent + n_0$$

where $frameduration$ is equal to attribute value duration in milliseconds, n_0 is the number of audioBlockFormat elements with lduration attribute set to indicate 0.0 seconds, and *initpresent* equals 1 if attribute initializeBlock is present and 0 if it is not present.

2.1.8 audioBlockFormat attribute and sub-element requirements

The sequence of available audioBlockFormat elements of an audioChannelFormat element shall cover the entire duration of the available audio essence of the corresponding audioObject element.

TABLE 21

audioBlockFormat attribute requirements for type “0002” (Matrix)

Attribute	Requirements	Required
audioBlockFormatID	See § 2.2 The hexadecimal value zzzzzzzz in AB_yyyyxxxx_zzzzzzzz shall be set to “00000001”.	Yes
all other attributes	Shall not be present	

TABLE 22

audioBlockFormat sub-element requirements for type “0002” (Matrix)

Sub-element	Requirements	Min Qty	Max Qty
outputChannelFormatIDRef	The IDRef shall match the ID of a common definition audioChannelFormat element of type “0001”. Shall be identical to an audioChannelFormatIDRef sub-element of the outputPackFormat referenced by the audioPackFormat element of type “0002” that the parent audioChannelFormat element belongs to.	1	1
matrix	The gain attribute of the coefficient sub-element shall be set to a value between “-inf” dB and “20.0” dB or the equivalent linear value. Any attributes of the coefficient sub-element, except the gain attribute and the gainUnit attribute shall not be present. There shall be a one-to-one (injective) mapping from the set of coefficient sub-elements to the set of audioChannelFormatIDRef sub-elements of the inputPackFormat referenced by the audioPackFormat element of type “0002” that the parent audioChannelFormat element belongs to. If the gain attribute is not present for a coefficient sub-element, the default gain value is “0.0” dB. If the coefficient sub-element is not present for an audioChannelFormat element of the corresponding inputPackFormat element, the default gain value is “-inf” dB.	1	1
all other sub-elements	Shall not be present	0	0

TABLE 23

audioBlockFormat attribute requirements for type "0003" (Objects)

Attribute	Requirements	Required
audioBlockFormatID	See § 2.2 The hexadecimal value zzzzzzzz in AB_yyyyxxxx_zzzzzzzz shall act as a counter of audioBlockFormat elements within the parent audioChannelFormat. See NOTE In an S-ADM flow, the counter may not reset to "00000001" for the first audioBlockFormat element in the parent audioChannelFormat in every frame element. Between different frame elements of an S-ADM flow, hexadecimal values zzzzzzzz for audioBlockFormat elements may be independent. See NOTE In accordance with Recommendation ITU-R BS.2125-1, hexadecimal value zzzzzzzz shall be set to "00000000" for an audioBlockFormat element with the initializeBlock attribute set to "1". If present, the initialization audioBlockFormat shall be the first audioBlockFormat element (in order of appearance in the XML) within the parent audioChannelFormat element in the frame element. Hexadecimal value zzzzzzzz of other audioBlockFormat elements may be independent of the initialization audioBlockFormat.	Yes
initializeBlock	Shall not be present if the audioFormatExtended element is not included in a frame element.	See requirement
rtime	Shall be present if and only if the audioFormatExtended element is not included in a frame element. The value of the rtime attribute of each audioBlockFormat element shall be equal to the sum of the values of the rtime attribute and the duration attribute of the preceding audioBlockFormat element. Rounding errors shall be as small as possible.	See requirement
duration	Shall be present if and only if the audioFormatExtended element is not included in a frame element. The value shall be set to "0" or ≥ "5" ms.	See requirement

TABLE 23 (*end*)

Attribute	Requirements	Required
lstart	Shall not be present if the audioFormatExtended element is not included in a frame element. If the audioFormatExtended element is included in a frame element, shall be present unless the initializeBlock attribute is present and set to “1”. Shall use the time formats as specified in § 5.13 of Recommendation ITU-R BS.2076-3 or the time format “zzzzzSfffff” specified in § A.1.4.7.1 of Recommendation ITU-R BS.2125-1. The value of the lstart attribute of the first block in the frame, after the initializeBlock (if it is present), shall indicate “0.0” s (e.g. “0Sfffff” or an equivalent representation). The value of the lstart attribute of the (N+1)th audioBlockFormat element in the audioChannelFormat element in the current frame element shall be equal to the sum of the values of the lduration attributes of the N previous audioBlockFormat elements (not considering the initializeBlock, if it is present). Rounding errors shall be as small as possible.	See requirement
lduration	Shall not be present if the audioFormatExtended element is not included in a frame element. If the audioFormatExtended element is included in a frame element, shall be present unless the initializeBlock attribute is present and set to “1”. Shall use the time formats specified in § 5.13 of Recommendation ITU-R BS.2076-3 or the time format ‘zzzzzSfffff’ specified in § A.1.4.7.1 of Recommendation ITU-R BS.2125-1. The total of the values of lduration in the frame shall be equal to the duration of the frame. Rounding errors shall be as small as possible. The value shall be set to “0” or ≥ “5” ms.	See requirement

NOTE – Applications may start parsing the ADM or S-ADM not starting at the beginning. In this case the first audioBlockFormat they may observe may not have audioBlockFormatID commencing from “00000001”.

TABLE 24

audioBlockFormat sub-element requirements for type "0003" (Objects)

Sub-element	Requirements	Min Qty	Max Qty
cartesian	Conditional, depending upon coordinate system used. The coordinate system shall be consistent for all audioBlockFormat elements within the audioFormatExtended element.	0	1
position	Must include coordinate attributes for all three axes. Azimuth shall be set to a value between "-180.0" and "180.0" Elevation shall be set to a value between "-90.0" and "90.0" Distance shall be set to a value between "0.0" and "1.0" X, Y and Z shall be set to values between "-1.0" and "1.0". The screenEdgeLock attribute shall not be present.	3	3
objectDivergence	Must contain either azimuthRange or positionRange attribute depending upon coordinate system used. Shall be set to a value between "0.0" and "1.0" The azimuthRange attribute shall be set to a value between "0.0" and "180.0" (polar coordinates). The positionRange attribute shall be set to a value between "0.0" and "1.0" (Cartesian coordinates)	0	1
gain	The gainUnit attribute of the gain sub-element may be present. The value of the gain sub-element shall not be greater than "10" dB or the equivalent linear value.	0	1
jumpPosition	The interpolationLength attribute of the jumpPosition sub-element shall not be present.	0	1
all other sub-elements	Shall not be present	0	0

2.1.9 audioTrackUID attribute and sub-element requirements

Each present audioTrackUID element shall be referenced by exactly one audioObject element.

Each audioTrackUID element shall correspond to a unique physical audio track and shall be applicable for the entire duration of the available audio essence of the corresponding physical audio track.

TABLE 25

audioTrackUID attribute requirements

Attribute	Requirements	Required
`UID`	See § 2.2	Yes
`sampleRate`	If present, shall correspond to the properties of the referenced audio track	No
`bitDepth`	If present, shall correspond to the properties of the referenced audio track	No

TABLE 26

`audioTrackUID` sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
`audioPackFormatIDRef`	The `IDRef` shall match the ID of a common definition `audioPackFormat` element of type "0001" or a present `audioPackFormat` element of type "0003".	1	1
`audioChannelFormatIDRef`	The `IDRef` shall match the ID of a common definition `audioChannelFormat` element of type "0001" or a present `audioChannelFormat` element of type "0003".	1	1
`all other sub-elements`	Shall not be present	0	0

2.1.10 `profileList` sub-element requirements

TABLE 27

`profileList` sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
`profile`	See Table 28 No two or more `profile` sub-elements shall be identical to each other. There shall be one or more `profile` sub-elements that conform to § 2.1.10.1. There may be one or more `profile` sub-elements that do not conform § 2.1.10.1. If the `audioFormatExtended` element is contained in a `frame` element: For each `profile` element conforming to § 2.1.10.1, there shall be an identical `profile` element in the `profileList` element in the `frameHeader` element in the frame element.	1	*

TABLE 28

profile attribute requirements

Attribute	Requirements	Required
profileName	-	Yes
profileVersion	-	Yes
profileLevel	-	Yes

The profileList element may contain multiple profile sub-elements that do not indicate conformance to this profile, as specified in § 2.1.10.1, but conformance to other profiles. All profile sub-elements shall contain the attributes defined in Table 28.

2.1.10.1 profile element requirements to indicate conformance to this profile

To indicate conformance to this profile, the value of the profile element shall be set to "ITU-R BS.2168" and the attributes of the profile element shall be set according to Table 29.

TABLE 29

profile attribute requirements to indicate conformance to this profile

Attribute	Requirements	Required
profileName	Shall be set to "Advanced sound system: ADM and S-ADM profile for emission".	Yes
profileVersion	Shall be set to "1".	Yes
profileLevel	Shall be set to "0", "1" or "2"; see § 2.3.	Yes

A new value of the profileVersion attribute is required when there are modifications of an existing profile. Revision numbers of this Recommendation and profileVersion values are independent from one another.

2.2 Use of IDs

Several element ID formats are used throughout the sub-elements of the audioFormatExtended element, see § 6 of Recommendation ITU-R BS.2076-3 for further details. In summary, the formats are as shown in Table 30.

TABLE 30

Element ID formats

Element	ID Format
audioProgramme	APR_wwww
audioContent	ACO_wwww
audioObject	AO_wwww
alternativeValueSet	AVS_wwww_zzzz
audioPackFormat	AP_yyyyxxxx
audioChannelFormat	AC_yyyyxxxx
audioBlockFormat	AB_yyyyxxxx_zzzzzzzz
audioTrackUID	ATU_vvvvvvvv

2.2.1 audioProgramme, audioObject, alternativeValueSet

Hexadecimal value wwww shall not indicate a value less than “1001”. In accordance with Recommendation ITU-R BS.2076, wwww in `alternativeValueSet` shall equal that of wwww in the parent `audioObject`.

Hexadecimal value zzzz shall act as a counter of `alternativeValueSet` elements within the parent `audioObject`. It shall commence from “0001” for the first `alternativeValueSet` element within the parent `audioObject` and shall increase by 1 for each subsequent `alternativeValueSet` element within the parent `audioObject` in order of appearance in the XML.

2.2.2 audioContent

Hexadecimal value wwww shall match that of the referenced `audioObject`.

2.2.3 audioPackFormat, audioChannelFormat, audioBlockFormat

Hexadecimal value yyyy shall be set as indicated by Tables 31 and 32. Hexadecimal value xxxx shall not indicate a value less than “1001”. In accordance with Recommendation ITU-R BS.2076, yyyyxxxx in `audioBlockFormat` shall equal that of parent `audioChannelFormat`.

TABLE 31

`audioPackFormatID` yyyy requirements

yyyy	typeLabel, typeDefinition
`“0002”`	`“0002”, “Matrix”`
`“0003”`	`“0003”, “Objects”`

TABLE 32

`audioChannelFormatID` yyyy requirements

yyyy	typeLabel, typeDefinition
`“0002”`	`“0002”, “Matrix”`
`“0003”`	`“0003”, “Objects”`

2.2.4 audioTrackUID

Hexadecimal value vvvvvvvv shall act as a counter of audioTrackUID elements within the audioFormatExtended. It shall commence from “00000001” for the first audioTrackUID element and shall increase by 1 for each subsequent audioTrackUID element in order of appearance in the XML.

2.3 Profile Levels

Each profile level constrains the allowable occurrences of elements and sub-elements.

2.3.1 Level 0

Level 0 imposes no maximum limits of element and sub-element occurrences as indicated in Tables 33 and 34.

TABLE 33

Profile Level 0 element occurrence restrictions

Parameter	Value
MAX_PROGRAMME	unlimited
MAX_CONTENT	unlimited
MAX_OBJECT	unlimited
MAX_PACK_FORMAT	unlimited
MAX_CHANNEL_FORMAT	unlimited
MAX_TRACK_UID	unlimited
MAX_TRACK_NON_COMP See § 2.3.5 Calculating MAX_TRACK_NON_COMP	unlimited
MAX_GROUP_COMP See § 2.3.4 Calculating MAX_GROUP_COMP	unlimited
MAX_GROUP_INDEP See § 2.3.6 Calculating MAX_GROUP_INDEP	unlimited
MAX_CHANNELS_LAYOUT	unlimited

TABLE 34

Profile Level 0 sub-element occurrence restrictions

Parameter	Value
MAX_APR_ACO	unlimited
MAX_APR_PL	unlimited
MAX_ACO_CL	unlimited
MAX_AO_AO	unlimited
MAX_AO_CO	unlimited
MAX_AO_AVS	unlimited
MAX_AO_CL	unlimited

2.3.2 Level 1

Level 1 imposes limits as indicated in Tables 35 and 36.

TABLE 35

Profile Level 1 element occurrence restrictions

Parameter	Value
MAX_PROGRAMME	8
MAX_CONTENT	16
MAX_OBJECT	48
MAX_PACK_FORMAT	32
MAX_CHANNEL_FORMAT	32
MAX_TRACK_UID	32
MAX_TRACK_NON_COMP See § 2.3.5 Calculating MAX_TRACK_NON_COMP	16
MAX_GROUP_COMP See § 2.3.4 Calculating MAX_GROUP_COMP	8
MAX_GROUP_INDEP See § 2.3.6 Calculating MAX_GROUP_INDEP	16
MAX_CHANNELS_LAYOUT	12

TABLE 36

Profile Level 1 sub-element occurrence restrictions

Parameter	Value
MAX_APR_ACO	16
MAX_APR_PL	4
MAX_ACO_CL	4
MAX_AO_AO	16
MAX_AO_CO	15
MAX_AO_AVS	8
MAX_AO_CL	4

2.3.3 Level 2

Level 2 imposes limits as indicated in Tables 37 and 38.

TABLE 37

Profile Level 2 element occurrence restrictions

Parameter	**Value**
MAX_PROGRAMME	16
MAX_CONTENT	28
MAX_OBJECT	84
MAX_PACK_FORMAT	56
MAX_CHANNEL_FORMAT	56
MAX_TRACK_UID	56
MAX_TRACK_NON_COMP See § 2.3.5 Calculating MAX_TRACK_NON_COMP	28
MAX_GROUP_COMP See § 2.3.4 Calculating MAX_GROUP_COMP	14
MAX_GROUP_INDEP See § 2.3.6 Calculating MAX_GROUP_INDEP	16
MAX_CHANNELS_LAYOUT	24

TABLE 38

Profile Level 2 sub-element occurrence restrictions

Parameter	**Value**
MAX_APR_ACO	28
MAX_APR_PL	8
MAX_ACO_CL	8
MAX_AO_AO	28
MAX_AO_CO	27
MAX_AO_AVS	16
MAX_AO_CL	8

2.3.4 Calculating MAX_GROUP_COMP

The number of groups of complementary `audioObject` elements shall not exceed MAX_GROUP_COMP. This number is determined by the number of top-level `audioObject` elements that include at least one `audioComplementaryObjectIDRef` sub-element.

2.3.5 Calculating MAX_TRACK_NON_COMP

The maximum number of non-complementary audio tracks shall not be less than 1 and shall not exceed MAX_TRACK_NON_COMP. This number is determined by the following algorithm:

1 Determine all groups of complementary audioObject elements.

2 For each group of complementary audioObject elements, determine the number of referenced audioTrackUID elements (directly or indirectly) by each of the complementary audioObject elements and accumulate the maximum number to the maximum number of non-complementary audio tracks.

3 Determine all top-level audioObject elements that do not belong to a group of complementary audioObject elements.

4 For each non-complementary top-level audioObject element found in step 3, accumulate the number of (directly or indirectly) referenced audioTrackUID elements to the maximum number of non-complementary audio tracks.

5 Evaluate the maximum number of non-complementary audio tracks with respect to the limits given by 1 and MAX_TRACK_NON_COMP.

2.3.6 Calculating MAX_GROUP_INDEP limits

The number of groups of complementary audioObject elements plus the number of non-complementary top-level audioObject elements shall not be less than 1 and shall not exceed MAX_GROUP_INDEP. A top-level audioObject is non-complementary if it does not contain any audioComplementaryObjectIDRef sub-elements itself and if it is not referenced by any audioComplementaryObjectIDRef sub-element of any other audioObject element.

2.4 Downmix matrices

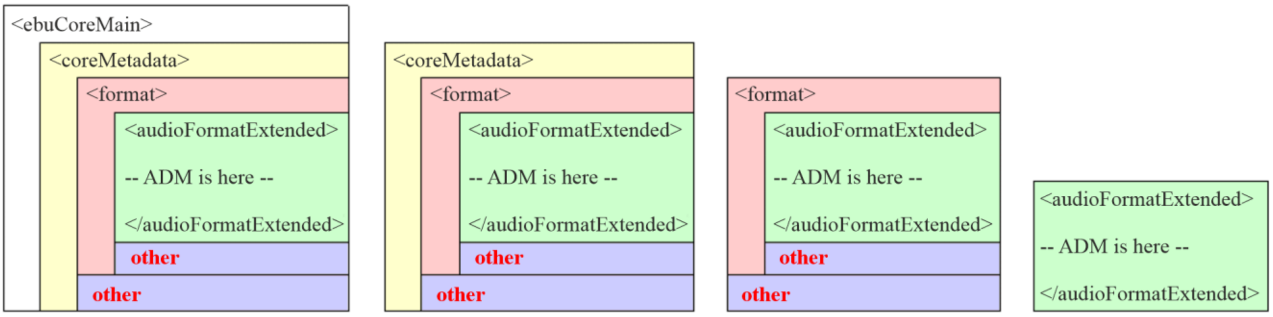
In the ADM, downmix matrices can be specified using audioPackFormat elements and audioChannelFormat elements of type "0002" (Matrix). According to the constraints of this profile, audioPackFormat elements of type "0002" are not referenced by audioObject elements or audioTrackUID elements and audioChannelFormat elements of type "0002" are not referenced by audioTrackUID elements. In this way, the definition of downmix matrices takes the role of side information which is essentially decoupled from the main UML model of the ADM. The downmix matrices are applied for each audioObject if an audioPackFormat (loudspeaker configuration) used in the audioObject needs to be converted to a different audioPackFormat for playback depending on the content creator's intention.

3 Location of **audioFormatExtended** element when S-ADM is not used

The parent element of the ADM constrained in § 2 is audioFormatExtended. The audioFormatExtended element can be located within the ebuCoreMain [1] element or within the other XML elements. Examples of the location of audioFormatExtended within other XML elements is shown in Fig. 3. Other Recommendations may define additional sub-elements for the carriage of metadata. Such additional sub-elements should be ignored if unknown to an implementation.

FIGURE 3

Examples of the location of `audioFormatExtended` element



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4 Profile recommendations on the `frame` element in S-ADM

This section contains the recommendations and requirements concerning the use of the `frame` element and its sub-elements and attributes defined in Recommendation ITU-R BS.2125.

4.1 Requirements on the `frame` element

4.1.1 General requirements

The profile mostly contains requirements on the individual XML elements and attributes of the `frame` element, but there are additional general requirements that also apply. This includes:

- This profile adheres to Recommendation ITU-R BS.2125-1.
- A compliant implementation of this profile shall support the functionality of all S-ADM XML elements, attributes and sub-elements listed in this profile specification.
- The presence of any S-ADM elements, attributes and sub-elements that are not listed in this profile specification will result in non-compliance. S-ADM metadata including such elements, attributes or sub-elements shall therefore be rejected.
- XML code shall be conforming to the Extensible Markup Language (XML) 1.0 with UTF-8 character encoding.
- Integer and floating-point numbers shall be given in a decimal representation without leading zeros.

4.1.2 `frame` attribute and sub-element requirements

The `frame` element is the root element of S-ADM. The `frame` element directly includes the `audioFormatExtended` element, which includes the ADM metadata. Other Recommendations may define additional sub-elements for the carriage of metadata. Such additional sub-elements should be ignored if unknown to an implementation.

TABLE 39

`frame` attribute requirements

Attribute	Requirements	Required
`version`	Shall be set to “ITU-R_BS.2125-1”	Yes

TABLE 40

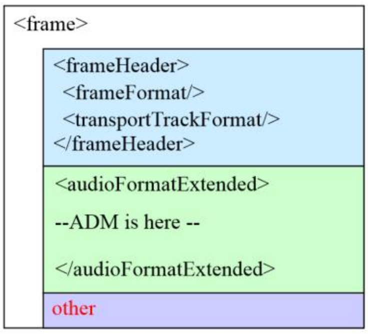
`frame` sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
`audioFormatExtended`	Shall conform to § 2.1	1	1
`frameHeader`	Shall conform to § 4.1.3	1	1
`other sub-elements`	Other Recommendations may define additional sub-elements for the carriage of metadata. Such additional sub-elements should be ignored if unknown to an implementation.		

Figure 4 shows the structure of how the `audioFormatExtended` element is carried in S-ADM.

FIGURE 4

Location of `audioFormatExtended` within frame element



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4.1.3 `frameHeader` attribute and sub-element requirements

TABLE 41

`frameHeader` sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
`frameFormat`	Shall conform to § 4.1.4	1	1
`transportTrackFormat`	Shall conform to § 4.1.5	1	*
`profileList`	Shall conform to § 4.1.7	1	1

4.1.4 `frameFormat` attribute and sub-element requirements

TABLE 42

`frameFormat` attribute requirements

Attribute	Requirements	Required
`frameFormatID`	The hexadecimal value `xxxxxxxx` in FF_`xxxxxxxx` shall act as a counter of frame elements in an S-ADM flow. See NOTE 1.	Yes
`start`	Shall use one of the following time formats: • 'hh:mm:ss.zzzzz' • 'hh:mm:ss.zzzzzSfffff' • 'zzzzzSfffff' See NOTE 2.	Yes
`duration`	The minimum value of duration shall be "5" ms. Shall use one of the following time formats: • 'hh:mm:ss.zzzzz' • 'hh:mm:ss.zzzzzSfffff' • 'zzzzzSfffff' See NOTE 2.	Yes
`type`	Shall be set as follows: "header" or "full" for the first frame of a flow, "full" for subsequent frames of the same flow. See NOTE 1.	Yes
`timeReference`	Shall be set to "local"	Yes
`flowID`	May be present	No
`all other attributes`	Shall not be present	

NOTE 1 – S-ADM `frame` elements may be used in modified S-ADM flows that differ from the original flow as part of which the `frame` elements were originally generated. This may for example be the case in workflows including frame-based editing, cutting, truncating, concatenating, looping, splicing, and switching of original S-ADM flows. In this case, the hexadecimal value `xxxxxxxx` in the `frameFormatID` attribute may not have the properties of a frame counter for the modified S-ADM flow.

NOTE 2 – These time formats are described in more detail in § 5.13 of Recommendation ITU-R BS.2076-3 and in § A.1.4.7.1 of Recommendation ITU-R BS.2125-1.

TABLE 43

`frameFormat` sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
`all sub-elements`	Shall not be present	0	0

The `changeIDs` sub-element is not used as the frame type is either "full" or "header", so it is likely that the entire frame will be parsed anyway. For this profile, the data overhead of the extra metadata to carry `changeIDs` sub-elements is more disadvantageous than the potential processing speed gains this sub-element can provide.

4.1.5 `transportTrackFormat` attribute and sub-element requirements

TABLE 44

`transportTrackFormat` attribute requirements

Attribute	Requirements	Required
`transportID`	Shall be set as follows: ‘TP_xxxx’ with unique hex digits xxxx.	Yes
`transportName`	Min length 1 char, max length 64 chars (encoded as UTF-8)	Yes
`numTracks`	The value of the `numTracks` attribute shall be equal to the value of the `numIDs` attribute.	Yes
`numIDs`	Shall not be set to “0” Shall not be larger than the number of `audioTrackUID` elements in the `audioFormatExtended` element.	Yes

TABLE 45

`transportTrackFormat` sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
`audioTrack`	Shall conform to § 4.1.6	1	*

4.1.6 `audioTrack` attribute and sub-element requirements

Considering all `audioTrack` sub-elements in all `transportTrackFormat` elements, each `audioTrackUID` sub-element in the `audioFormatExtended` element shall be referenced exactly once.

TABLE 46

`audioTrack` attribute requirements

Attribute	Requirements	Required
`trackID`	Shall be set to the physical transport track index of the corresponding audio interface. Shall be unique among `trackID` attributes of `audioTrack` elements in the same parent `transportTrackFormat` element. Shall not be set to a value less than “1”.	Yes
`formatLabel`	Shall be set to “0001”	Yes
`formatDefinition`	Shall be set to “PCM”	Yes

TABLE 47

audioTrack sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
audioTrackUIDRef	The IDRef shall match the ID of a present audioTrackUID element. Shall not be set to “ATU_00000000”	1	1

4.1.7 profileList attribute and sub-element requirements

TABLE 48

profileList sub-element requirements

Sub-element	Requirements	Min Qty	Max Qty
profile	See Table 28 No two or more profile sub-elements shall be identical to each other There shall be one or more profile sub-elements that conform to § 2.1.10.1 There may be one or more profile sub-elements that do not conform § 2.1.10.1 For each profile element conforming to § 2.1.10.1, there shall be an identical profile element in the profileList element in the audioFormatExtended element	1	*

5 Bibliography

[1] EBU Tech 3293, “EBU Core Metadata Set”.

Attachment 1
to Annex 1
(informative)

1 Topology options

This section describes overall metadata topology and two different methods for the selection of alternative, mutually exclusive audio objects that define a specific audio mix. The simplest method is that for each permutation of audio objects, a unique audio programme is created. This method does however have some disadvantages. As the number of audio object options increases, the multiplying effect causes a rapid increase in the count of audio programmes. In addition, the signalling of the relationship between the underlying audio objects is not explicit as no mechanism exists that can define them as being part of a mutually exclusive group.

For a multilanguage use case that shares common elements such as M&E (Music and Effects) it is recommended that complementary audio objects be used. The advantage to this method is that the metadata structure implicitly signals the relationship between various audio objects, and those references are contained within a single audio programme.

Conversion between the two methods is only possible when the originating metadata utilizes complementary audio objects for the reasons given above. The general steps required to convert a composition are as follows.

In the following, the term complementary group leader is used to refer to an `audioObject` element that contains one or more `audioComplementaryObjectIDRef` sub-elements.

In the following, the term complementary group is used to refer to a set of `audioObject` elements consisting of exactly one complementary group leader and all `audioObject` elements that the complementary group leader references via `audioComplementaryObjectIDRef` sub-elements.

In the following an `audioProgramme` is said to reference a complementary group if each `audioObject` of the complementary group is referenced by the `audioProgramme` via a reference to the `audioContent` element that references the `audioObject`. Note that it is also possible for an `audioProgramme` to reference only exactly one `audioObject` from a complementary group. In this case, the `audioProgramme` is not said to reference the complementary group.

1 The following element structures are copied from the source composition into a new output ADM composition

   a) `audioContent`

   b) `audioPackFormat`

   c) `audioChannelFormat`

   d) `audioTrackUID`

2 Identify all `audioProgramme` elements in the source composition that do not reference any complementary group. The whole audio programme structure for each is copied into the output ADM composition

3 Identify all `audioObject` elements in the source composition that are not complementary group leaders, these are copied into the output ADM composition

4 For each complementary group leader, a new audioObject structure is created in the output ADM composition using all present element attributes and sub-elements excluding audioComplementaryObjectGroupLabel and audioComplementaryObjectIDRef

5 Do the following for each audioProgramme in the source composition that references one or more complementary groups:

a) Determine the number of complementary groups referenced by the current audioProgramme and denote that number by K.

b) Do the following for each unique combination of K audioObjects consisting of exactly one audioObject from each of the K complementary groups that the current audioProgramme references:

i) Create a new audioProgramme element in the output ADM composition.

ii) The text value of the audioProgrammeName attribute from the source audioProgramme is copied to the newly created audioProgramme

iii) In the source audioProgramme, identify all audioContentIDRefs to audioContents that do not reference members of the K complementary groups, these are copied into the newly created audioProgramme along with all audioProgrammeLabel and loudness elements

iv) In the source audioProgramme, identify all audioContentIDRefs to audioContents referencing any of the K audioObjects in the current combination, these are copied to the newly created audioProgramme

v) If the language attributes of all audioContents referenced by the newly created audioProgramme are set to the same value, copy that value to the language attribute of the newly created audioProgramme. (audioContents with missing language attributes are ignored for the comparison.)

vi) In the source audioProgramme, identify all alternativeValueSetIDRefs to audioObjects that are also referenced by the newly created audioProgramme. These alternativeValueSetIDRefs are copied to the newly created audioProgramme.

6 Evaluate the profile conformance of the output ADM composition and add a profileList with corresponding profile sub-elements.