

# SMPTE STANDARD

## Mapping AAC Compressed Audio into the MXF Generic Container



<b>Table of Contents</b>	<b>Page</b>
Foreword .....	2
Intellectual Property .....	2
Introduction.....	2
1 Scope .....	3
2 Conformance Notation .....	3
3 Normative References .....	3
4 Definition of Acronyms, Terms and Data Types .....	4
4.1 Acronyms (Informative) .....	4
4.2 Terms .....	5
5 Technical Introduction (Informative).....	6
5.1 Compressed Audio Coding Summary.....	6
5.2 Mapping the Compressed Audio Streams to the MXF Generic Container .....	6
6 Essence Descriptor for Compressed Audio Mapping .....	6
6.1 AAC SubDescriptor .....	6
6.2 Key for the ACC SubDescriptor .....	7
6.3 AAC Sampling Frequency.....	7
6.4 AAC Channel Configuration .....	8
7 Sound Essence Coding Label.....	10
8 Essence Element Key .....	11
9 AAC Sound Essence Container Label .....	11
10 Index Table for Compressed Audio Mapping .....	12
11 POS Offset .....	12
Annex A Index Table Example (Informative) .....	13
Bibliography (Informative) .....	17

## Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in its Standards Operations Manual.

SMPTE ST 381-4 was prepared by Technology Committee 31FS.

## Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

## Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

This standard documents the mapping of MPEG-2 AAC (Advanced Audio Coding), MPEG-2 HE (High Efficiency) AAC, MPEG-4 AAC, MPEG-4 HE AAC and MPEG-4 HE AAC v2 (referred to collectively in this document as the "AAC family"). MPEG-2 AAC is documented in ISO/IEC 13818-7 and MPEG-4 AAC is documented in ISO/IEC 14496-3.

## 1 Scope

This standard specifies the mapping of ISO/IEC 13818-7 and ISO/IEC 14496-3 AAC family compressed audio coding into the Material Exchange Format Generic Container (MXF-GC). It does not address mapping of uncompressed audio or audio compressed with other codecs.

## 2 Conformance Notation

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

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

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

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

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

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

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

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

## 3 Normative References

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

SMPTE ST 377-1:2011, Material Exchange Format (MXF) — File Format Specification

Amendment 1:2012 to SMPTE ST 377-1:2011

Amendment 2:2012 to SMPTE ST 377-1:2011

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

SMPTE ST 381-2:2011, Material Exchange Format (MXF) — Mapping MPEG Streams into the MXF Constrained Generic Container

ISO/IEC 13818-7:2006, Information technology — Generic coding of moving pictures and associated audio information: Part 7: Advanced Audio Coding (AAC)

ISO/IEC 14496-3:2009, Information technology – Coding of audio-visual objects – Part 3: Audio

ISO/IEC 14496-3:2009/Amd 4:2013, Information technology – Coding of audio-visual objects – Part 3: Audio, Amendment 4: New levels for AAC profiles

## **4 Definition of Acronyms, Terms and Data Types**

The general glossary of acronyms, terms and data types used in the MXF specification is given in SMPTE ST 377-1 and SMPTE ST 379-2. Several AAC specific acronyms are defined by ISO/IEC 13818-7 or ISO/IEC 14496-3 and are restated below for the convenience of the reader.

### **4.1 Acronyms (Informative)**

The definitions that follow are copied from SMPTE ST 2041-3 and SMPTE ST 2041-2, which are existing SMPTE Standards dealing with the MPEG AAC family of audio codecs. Additional background material is found in those documents.

#### **4.1.1 ADIF**

Audio Data Interchange Format, a wrapper structure defined in ISO/IEC 13818-7 and ISO/IEC 14496-3, consisting of one header at the start of the sequence followed by a `raw_data_stream()`. As such, the ADIF is useful only for systems with only a defined start and no need to start decoding from within the audio data stream.

#### **4.1.2 ADTS**

Audio Data Transport Stream, a wrapper structure defined in ISO/IEC 13818-7 and ISO/IEC 14496-3, consisting of a fixed header, a variable header, an optional error check (`CRC_check`) and a specified number of `raw_data_blocks()`. The fixed header of the ADTS contains the syncword plus all parts of the header which are necessary for decoding and which do not change from frame to frame. The variable header of the ADTS contains header data which changes from frame to frame. The ADTS only supports a `raw_data_stream()` with only one program.

#### **4.1.3 LC**

Low Complexity. In the context of this specification, this term refers to the MPEG-2 AAC Low Complexity Profile as specified in ISO/IEC 13818-7 or the MPEG-4 AAC Low Complexity object type as specified in ISO/IEC 14496-3.

#### **4.1.4 LATM**

Low overhead Audio Transport Multiplex. A multiplexing layer defined by ISO/IEC 14496-3, used for multiplexing of audio elementary streams. This Standard is limited to transport of a single audio elementary stream.

#### 4.1.5 LOAS

Low Overhead Audio Stream. A synchronization layer defined by ISO/IEC 14496-3. Provides three formats which are specifically suited for being used on different underlying transmission layers depending on their characteristics.

#### 4.1.6 PS

Parametric Stereo. A tool able to capture the stereo image of the audio input signal into a limited number of parameters, requiring only a small overhead. Together with a monaural downmix of the stereo input signal generated by the parametric stereo coding tool, the parametric stereo decoding tool is able to regenerate the stereo signal.

#### 4.1.7 SBR

Spectral Band Replication. A bandwidth extension tool used in combination with a general audio codec. When integrated into the MPEG AAC codec, a significant improvement of the performance is available, which can be used to lower the bitrate or improve the audio quality. This is achieved by replicating the “highband,” i.e. the high frequency part of the spectrum. A small amount of data representing a parametric description of the highband is encoded and used in the decoding process. The data rate is much lower than the data rate required when using conventional AAC coding of the highband.

### 4.2 Terms

#### 4.2.1 Audio access unit

Individually accessible portion of audio data within an elementary stream.

#### 4.2.2 Audio frame

Audio frame is an audio access unit. Audio timing cannot be set to an audio frame in a file interleaved with video. The term audio frame is used in this document.

Audio frame is one of the syntactic elements that are defined in the AAC documents as follows:

##### 4.2.2.1 ADIF

ISO/IEC 13318-7 Table 2 — Syntax of `adif_sequence()`  
ISO/IEC 14496-3 Table 1.A.1 – Syntax of `adif_sequence`

##### 4.2.2.2 ADTS

ISO/IEC 13318-7 Table 5 — Syntax of `adts_frame()`  
ISO/IEC 14496-3 Table 1.A.5 – Syntax of `adts_frame()`

##### 4.2.2.3 LATM

ISO/IEC 14496-3 Table 1.40 – Syntax of `EPMuxElement()`  
ISO/IEC 14496-3 Table 1.41 – Syntax of `AudioMuxElement()`

##### 4.2.2.4 LOAS

ISO/IEC 14496-3 Table 1.36 – Syntax of `AudioSyncStream()`  
ISO/IEC 14496-3 Table 1.37 – Syntax of `EPAudioSyncStream()`  
ISO/IEC 14496-3 Table 1.39 – Syntax of `AudioPointerStreamFrame()`

## 5 Technical Introduction (Informative)

The following sections from ISO documents are restated here as introductory text.

### 5.1 Compressed Audio Coding Summary

AAC compressed audio generates audio frames, which for AAC, is defined by MPEG as the smallest part of the encoded bitstream which can be decoded by itself, where decoded means “fully reconstructed sound”. An audio frame is the smallest entity to which timing information can be attributed. A decoder consumes audio frames.

MXF files compliant with this standard store complete AAC audio frames within the wrapper initially used by the AAC encoder, that is either ADIF, ADTS, or LATM/LOAS. Should a playout device need to construct MPEG-2 Transport Streams, those wrappers can be simply placed in MPEG-2 PES and then into MPEG-2 Transport Packets and transmitted. See ISO/IEC 13818-1 for more details.

A set of the required tools for decoding compressed audio streams is defined and constrained by one or more AAC Profiles.

#### 5.1.1 AAC LC – AAC Profile

The most common profile in MPEG-2 AAC is the Low Complexity Profile. The MPEG-4 AAC Profile is the counterpart to the MPEG-2 AAC Low Complexity Profile. Contrary to the MPEG-2 AAC LC Profile, the MPEG-4 AAC Profile enables the usage of an additional tool called “Perceptual Noise Shaping” or PNS.

#### 5.1.2 HE AAC – High Efficiency AAC Profile

This Profile utilizes the Spectral Band Replication (SBR) tool in conjunction with the tools used for AAC LC. This Profile is a superset of the AAC Profile. For further information please refer to ISO/IEC 14496-3.

This is called “AAC (LC) + SBR” in ISO/IEC 13818-7, rather than “HE AAC.”

#### 5.1.3 HE AAC v2 – High Efficiency AAC v2 Profile

This Profile utilizes the Spectral Band Replication (SBR) tool and the Parametric Stereo (PS) tool in conjunction with the tools used for AAC LC. This Profile is a superset of the High Efficiency AAC Profile. For further information please refer to ISO/IEC 14496-3.

### 5.2 Mapping the Compressed Audio Streams to the MXF Generic Container

The mapping of the Compressed Audio stream uses the MXF Generic Container in either the Frame-based wrapping, Clip-based wrapping, or the Custom wrapping as defined in SMPTE ST 379-2.

## 6 Essence Descriptor for Compressed Audio Mapping

### 6.1 AAC SubDescriptor

For AAC audio, the MPEG Audio Descriptor, defined in SMPTE ST 381-2 Section 10.4, shall be used. If present the AAC SubDescriptor shall be strongly referenced from the MPEG Audio Descriptor. The AAC SubDescriptor adds AAC specific properties and is shown in Table 1. If the values are not constant throughout the essence described, the properties in Table 1 shall not be present..

**Table 1 – AAC SubDescriptor**

Item Name	Type	Len	Item UL	Req ?	Meaning	Default
AAC SubDescriptor	Set UL	16	See Table 2	Req	Advanced Audio Coding SubDescriptor	
Length	BER Length	4		Req	Set length	
All items from the abstract SubDescriptor as specified in SMPTE ST 377-1 Annex B.3, SubDescriptor						
AAC Sampling Frequency	UInt8	1	060e2b34 0101010e 04020403 01040000	Opt	Low order 4 bits of Sampling Frequency Index. Upper 4 bits are zeros *1	
AAC Channel Configuration	UInt8	1	060e2b34 0101010e 04020403 01030000	Opt	Low order 4 bits of Channel Configuration. Upper 4 bits are zeros *2	

\*1 ISO/IEC 13818-7 (MPEG-2 AAC) and ISO/IEC 14496-3 (MPEG-4 AAC).

\*2 ISO/IEC 13818-7 (MPEG-2 AAC) and ISO/IEC 14496-3 (MPEG-4 AAC) ISO/IEC 14496-3:2009/Amd 4 defines the extended code points up to 14.

## 6.2 Key for the AAC SubDescriptor

The key (UL) for the AAC SubDescriptor shall be as defined in Table 2.

**Table 2 – Key for the AAC SubDescriptor**

Byte No.	Description	Value (hex)	Meaning
1-7	Defined in the Structural Header Metadata Implementation section of SMPTE ST 377-1		
8	Register Version	01h	Version of the Registry
9-13	Defined in the Structural Header Metadata Implementation section of SMPTE ST 377-1		
14	Set Kind (1)	01h	AAC SubDescriptor
15	Set Kind (2)	78h	
16	Reserved	00h	Reserved

## 6.3 AAC Sampling Frequency

AAC sampling frequency shall take the value of the low order 4 bits of either `sampling_frequency_index` (for MPEG-2 AAC) or `samplingFrequencyIndex` (for MPEG-4 AAC). These values are found in either Table 35 of ISO/IEC 13818-7:2006 (MPEG-2 AAC) or Table 1.18 of ISO/IEC 14496-3:2009 (MPEG-4 AAC), respectively, which is reproduced below for the convenience of the reader.

For ISO/IEC 13818-7 (MPEG-2 AAC), values 0x0c through 0x0f are Reserved.

For ISO/IEC 14496-3 (MPEG-4 AAC), values 0x0d and 0x0e are Reserved.

**Table 3 – Sampling Frequency Index (Informative)**

Sampling Frequency Index	Value
00h	96000
01h	88200
02h	64000
03h	48000
04h	44100
05h	32000
06h	24000
07h	22050
08h	16000
09h	12000
0ah	11025
0bh	8000
0ch	7350 (This value is Reserved for MPEG-2 AAC)
0dh	reserved
0eh	reserved
0fh	(This value means "Escape Value for MPEG-4 AAC") (This value is Reserved for MPEG-2 AAC)

#### 6.4 AAC Channel Configuration

AAC channel configuration shall take the value of the low order bits of a ChannelConfiguration value as defined in Table 42 of ISO/IEC 13818-7:2006 (MPEG-2 AAC) or Table 1.19 of ISO/IEC 14496-3:2009 with ISO/IEC 14496-3:2009/Amd 4 (MPEG-4 AAC) and which is reproduced below for the convenience of the reader.

For ISO/IEC 13818-7 (MPEG-2 AAC), this is a 3-bit value; for of ISO/IEC 14496-3 (MPEG-4 AAC), this is a 4-bit value

**Table 4 – Channel Configuration (Informative)**

value	number of channels	channel to speaker mapping
0	—	(not used)
1	1	center front speaker
2	2	left, right front speakers
3	3	center front speaker, left, right front speakers
4	4	center front speaker, left, right front speakers, rear center speakers
5	5	center front speaker, left, right front speakers, left surround, right surround speakers
6	5.1	center front speaker, left, right front speakers, left surround, right surround speakers, low frequency enhancement speaker
7	7.1 Front	center front speaker left, right front center speakers, left, right front speakers, left surround, right surround speakers, low frequency enhancement speaker
8-10	—	Reserved
11	6.1	center front speaker, left, right front speakers, left surround, right surround speakers, rear center speaker, low frequency enhancement speaker This value is Reserved for MPEG-2 AAC
12	7.1 Back	center front speaker left, right front speakers, left surround, right surround speakers, rear surround left, right speakers, low frequency enhancement speaker This value is Reserved for MPEG-2 AAC
13	22.2	center front speaker, left, right front center speakers, left, right front speakers, left, right side surround speakers, rear left, right surround speakers, rear center speaker, left front low freq. enhancement speaker, right front low freq. enhancement speaker, center front vertical height speaker, left, right front vertical height speakers, left, right vertical height side surr. speakers, top center surround speaker, left, right surr. vertical height rear speakers, center vertical height rear speaker, center front vertical bottom speaker, left, right front vertical bottom speakers This value is Reserved for MPEG-2 AAC

value	number of channels	channel to speaker mapping
14	7.1 Top	center front speaker, left, right front speakers, left surround, right surround speakers, low frequency enhancement speaker, left, right front vertical height speakers This value is Reserved for MPEG-2 AAC
15	—	This value means “Escape Value for MPEG-4 AAC) This value is Reserved for MPEG-2 AAC.

## 7 Sound Essence Coding Label

The Sound Essence Coding Label is used in the Generic Sound Essence Descriptor. The values for the Sound Essence Coding Label for AAC are given in Table 5. These Label values are also listed in the SMPTE Labels Register.

**Table 5 – Sound Essence Coding Label Value for AAC**

Byte No.	Description	Value (hex)	Meaning
1	Object Identifier	06h	
2	Label size	0eh	
3	Designator	2bh	ISO, ORG
4	Designator	34h	SMPTE
5	Registry Category Designator	04h	Labels
6	Registry Designator	01h	Labels Registry
7	Structure Designator	01h	Labels Structure
8	Version Number	0dh	Version of the Registry
9	Parametric	04h	Node used to define parametric data
10	Sound Essence	02h	Identifies Sound Essence
11	Sound Coding Characteristics	02h	Identifies Sound Coding Characteristics
12	Compressed Sound Coding	02h	Identifies Compressed Sound Coding
13	MPEG Audio Compression	04h	Identifies MPEG Audio Compression
14	MPEG Audio Coding Details 1	xxh	See Table 6
15	MPEG Audio Coding Details 2	yyh	See Table 6
16	MPEG Audio Coding Details 3	00h	Reserved

The values for bytes 14 and 15 of the Label identify the usage of AAC and shall be as enumerated in Table 6.

**Table 6 –Values of Bytes 14 and 15 for Sound Essence Coding Label for AAC Audio**

MPEG Standard	AAC General Name	Value of Byte 14 (hex)	Value of Byte 15 (hex)	AAC Profile
MPEG-2 AAC	LC	03h	01h	Low Complexity profile MPEG-2 AAC
MPEG-2 AAC	LC + SBR	03h	02h	Low Complexity profile MPEG-2 AAC+SBR
MPEG-4 AAC	AAC LC	04h	01h	MPEG-4 AAC Profile
MPEG-4 AAC	AAC LC + SBR	04h	02h	MPEG-4 High Efficiency AAC Profile
MPEG-4 AAC	AAC + SBR + PS	04h	03h	MPEG-4 High Efficiency AAC v2 Profile

Note: AAC “General Name” is the commonly used terminology.

## 8 Essence Element Key

The mapping of the Compressed Audio stream shall use the MXF Generic Container in either the Frame-based wrapping, Clip-based wrapping, or the Custom wrapping as defined in SMPTE ST 379-2. Compressed audio streams shall be wrapped using the MPEG Sound Element Key as defined in SMPTE ST 381-2 Table 3 (“Key Value for the MPEG Sound Element, which is reproduced below for the convenience of the reader.

**Table 7 – Key Value for the MPEG AAC Sound Element (Informative)**

Byte No.	Description	Value (hex)	Meaning
1-12	Specified by the MXF Generic Container Specification, SMPTE ST 379-2		
13	Item Type Identifier	16h	Generic Container Sound Item (as defined in SMPTE ST 379-2)
14	Essence Element Count	kkh	Count of Sound Elements in this Sound Item
15	Essence Element Type	05h 06h 07h	Frame Wrapped Sound Element Clip Wrapped Sound Element Custom Wrapped Sound Element
16	Essence Element Number	nnh	The Number (used as an Index) of this Sound Element in this Sound Item

## 9 AAC Sound Essence Container Label

Each sound element identified by an AAC Sound Essence Container Label shall be one of the syntactic elements that are defined in Section 4.2.2. The values of the first 12 bytes of the MPEG Essence Container Label shall be as defined in SMPTE ST 379-2 (Table 4). The values for the MPEG Essence Container Label shall be as given in Table 8.

**Table 8 – Specification of the MPEG Essence Container Label**

Byte No.	Description	Value (hex)	Meaning
1-7	Specified by the MXF Generic Container Specification, SMPTE ST 379-2		
8	Version Number	0dh	Version of the Registry
9-12	Specified by the MXF Generic Container Specification, SMPTE ST 379-2		
13	Essence Container Kind	02h	MXF Generic Container (as defined in SMPTE ST 379-2)
14	Mapping Kind	16h 17h 18h	ADIF ADTS LATM/LOAS
15	Wrapping Kind	01h 02h 03h	Frame Wrapping Clip Wrapping Custom Wrapping
16	Locally defined	00h	Reserved

Note: The individual Essence Container ULs defined in this standard are registered in the SMPTE Labels Register which readers can find in SMPTE RA web site at <https://smpte-ra.org/smpete-metadata-registry>.

This SMPTE label is the individual “Essence Container” Property used in the Partition Pack, in the Preface Set and in the appropriate File Descriptor.

## 10 Index Table for Compressed Audio Mapping

Index Tables should be implemented wherever possible.

## 11 POS Offset

The audio frame duration of AAC audio is usually not the same as the access unit duration of the associated video frame. The MXF Format specification SMPTE ST 377-1 section 11.1.3 (“Complex Interleaves of Compressed Audio”) contains provisions for adding optional information to the index tables to enable synchronization accuracy of greater than one frame. MXF Applications requiring MXF synchronization accuracy less than a frame shall use the PosTable mechanism described in that section and tabulated in SMPTE ST 377-1 Table 28 (“Structure of Index Entry Array”). An example of PosTables is given in informative Annex B.

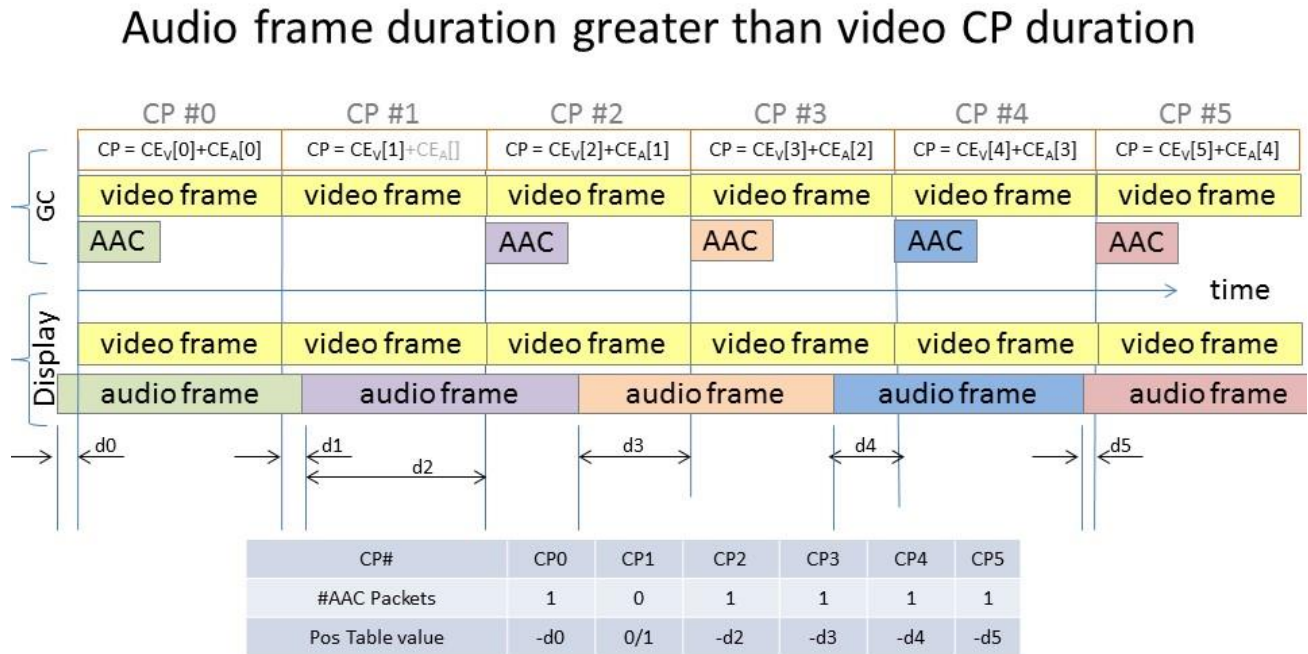
SMPTE ST 377-1 Table 28 defines the PosTable as a Rational (a pair of INT32s) representing a numerator and a denominator. SMPTE ST 381-2 advises that the synchronized audio sample is in the same Content Package as the synchronized video frame. The maximum PosTable value shall be 0 and all the entries in the table shall be negative or zero. In the case where there are no AAC audio samples in the Content Package, then the PosTable values shall be 0/1, i.e. Distinguished Value.

Note: SMPTE ST 377-1 does not require values of Rational to be normalized or reduced, thus decoders can encounter non-normalized values of POS offset.

Note: AAC AudioPointerStream() also offers a method to achieve synchronization accuracy. However, it is suggested that MXF applications use the POS offset mechanism instead.

## Annex A Index Table Example (Informative)

The following example shows an example Index table with PosTable Offsets. The Figure A.1 below illustrates the packing rules and the meaning of the PosTable Offset value.



**Figure A.1 – Audio frame duration greater than video CP duration**

Table A.1 below shows the PosTable calculations for a video stream with a frame rate of 30/1.001 fps and audio sampled at 48 kHz with AAC packets containing 1024 samples.

The first 20 frames are calculated showing the video frame number, the time T() that the video frame is displayed, the synchronous audio sample number, the audio packet number of the first packet in the MXF Content Package, the number of available samples from preceding edit units and the number remaining at the end of the current edit unit, the number of audio packets in that Content Package, and the value of PosTable Offset as a decimal number and as a Rational. The denominator of the Rational is chosen so the Rational is exactly equal to the decimal number.

Table A.2 below show the same for 24/1 fps with audio sampled at 48 kHz and 1024 samples. This will illustrate examples of video frames having longer duration than audio frames as well as audio frames having longer duration than video frames.

ST 381-4a is an Excel spreadsheet that demonstrates how to calculate PosTable Offsets for any arbitrary combination of video frame rate, audio sample rate, and AAC packet size.

ST 381-4a shows the sequence length of the PosTable and at least that many entries in each case.

**Table A.1 – PosTable Offset example 30/1.001 fps video with 48kHz audio in 1024 sample audio frames (Informative)**

EditUnit	Sync Audio Samples	Starting AAC Frame	Available Samples	Unused Samples	AAC Frames this EU	Pos Offset Numerator	Pos Offset Denominator
0	0	0	0	0	1	0	48048
1	1601.6	1	1024	-577.6	2	-17328	48048
2	3203.2	3	3072	-131.2	1	-3936	48048
3	4804.8	4	4096	-708.8	2	-21264	48048
4	6406.4	6	6144	-262.4	1	-7872	48048
5	8008	7	7168	-840	2	-25200	48048
6	9609.6	9	9216	-393.6	1	-11808	48048
7	11211.2	10	10240	-971.2	2	-29136	48048
8	12812.8	12	12288	-524.8	2	-15744	48048
9	14414.4	14	14336	-78.4	1	-2352	48048
10	16016	15	15360	-656	2	-19680	48048
11	17617.6	17	17408	-209.6	1	-6288	48048

12	19219.2	18	18432	-787.2	2	-23616	48048
13	20820.8	20	20480	-340.8	1	-10224	48048
14	22422.4	21	21504	-918.4	2	-27552	48048
15	24024	23	23552	-472	2	-14160	48048
16	25625.6	25	25600	-25.6	1	-768	48048
17	27227.2	26	26624	-603.2	2	-18096	48048
18	28828.8	28	28672	-156.8	1	-4704	48048
19	30430.4	29	29696	-734.4	2	-22032	48048
20	32032	31	31744	-288	1	-8640	48048

Table A.2 – PosTable Offset example 24/1 fps video with 48kHz audio in 1024 sample audio frames (informative)

EditUnit	Sync Audio Samples	Starting AAC Frame	Available Samples	Unused Samples	AAC Frames this EU	Pos Offset Numerator	Pos Offset Denominator
0	0	0	0	0	1	0	48000
1	2000	1	1024	-976	2	-23424	48000
2	4000	3	3072	-928	2	-22272	48000
3	6000	5	5120	-880	2	-21120	48000
4	8000	7	7168	-832	2	-19968	48000
5	10000	9	9216	-784	2	-18816	48000
6	12000	11	11264	-736	2	-17664	48000
7	14000	13	13312	-688	2	-16512	48000
8	16000	15	15360	-640	2	-15360	48000
9	18000	17	17408	-592	2	-14208	48000
10	20000	19	19456	-544	2	-13056	48000
11	22000	21	21504	-496	2	-11904	48000
12	24000	23	23552	-448	2	-10752	48000
13	26000	25	25600	-400	2	-9600	48000
14	28000	27	27648	-352	2	-8448	48000
15	30000	29	29696	-304	2	-7296	48000
16	32000	31	31744	-256	2	-6144	48000
17	34000	33	33792	-208	2	-4992	48000
18	36000	35	35840	-160	2	-3840	48000
19	38000	37	37888	-112	2	-2688	48000
20	40000	39	39936	-64	2	-1536	48000

## **Bibliography (Informative)**

SMPTE ST 336:2007, Data Encoding Protocol Using Key-Length-Value

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

SMPTE ST 381-1:2005 (Archived 2011), Television — Material Exchange Format (MXF) — Mapping MPEG Streams into the MXF Generic Container

SMPTE ST 400:2012, SMPTE Labels Structure

SMPTE ST 2041-2:2010, Format for Non-PCM Audio in AES3 — MPEG-2 AAC and HE AAC Audio in ADTS

SMPTE ST 2041-3:2010, Format for Non-PCM Audio and Data in AES3 — MPEG-4 AAC and HE AAC Compressed Digital Audio in ADTS and LATM/LOAS Wrappers

SMPTE Labels Register, <https://smpte-ra.org/smpte-metadata-registry>

ISO/IEC 13818-1:2015, Information technology — Generic coding of moving pictures and associated audio information: Systems