SMPTE STANDARD

Format for Non-PCM Audio in AES3 — Type17 Compressed Audio

Table of Contents

Foreword 2
Intellectual Property 2
1 Scope 3
2 Conformance Notation 3
3 Normative References 3
4 Terms and Definitions 4
4.1 Definitions 4
4.2 Abbreviations 4
4.3 Presentation Convention 4
5 Type17 Data Packing 4
5.1 General 4
5.2 Type17 Data Bursts 4
5.3 burst_info 5
5.4 Pause Data Bursts 7
5.5 Type17 Decoder Latency 7
5.6 Compatibility with Consumer Formats 8
Annex A Effect of Repetition Period of Data Burst and Fs on Frame Period and Maximum Data Rate for Type17 (Informative) 9
A.1 Selection of Type17 Mode 9

Approved
July 15, 2016

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 2106 was prepared by Technology Committee 32NF.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. 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.

1 Scope

This standard describes how data rate reduced (non PCM) audio streams conforming to ETSI TS 102 114 are packed into an AES3 data stream, following the methods described by SMPTE ST 337. The type of data in the AES3 stream is identified by a data_type value as defined by SMPTE ST 338 and carried in the burst information word of the data burst preamble. Since the data_type value associated with ETSI TS 102 114 is 17, the term ‘Type 17’ in this document will refer to a bitstream conforming to ETSI TS 102 114, comprising a “core substream” defined in Chapter 5, and / or “extension substream” as defined in Chapter 7.

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; then formal languages; then figures; and then any other language forms.

3 Normative References

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

SMPTE ST 337:2015, Format for Non-PCM Audio and Data in an AES3 Serial Digital Audio Interface

SMPTE ST 338:2016, Format for Non-PCM Audio and Data in AES3 - Data Types

SMPTE ST 339:2015, Format for Non-PCM Audio and Data in AES3 - Generic Data Types

ETSI TS 102 114 v.1.4.1, 2012, DTS Coherent Acoustics; Core and Extensions with Additional Profiles

4 Terms and Definitions

For the purpose of this standard, the following definitions, abbreviations and presentation convention apply.

4.1 Definitions

AES3 Frame rate (f_s)	The frequency of the AES3 Sample Clock
Base Sampling Frequency (f_b)	The base sampling frequency is nominally 48 KHz. This means that the AES3 sample clock is an integer multiple of 48000. The other available base sampling frequency is 44.1 KHz.

4.2 Abbreviations

IEC	International Electrotechnical Commission
ISO/IEC MPEG	The Moving Pictures Expert Group, a joint committee of ISO and IEC

4.3 Presentation Convention

F872h	Value ‘F872’ in hexadecimal format

5 Type17 Data Packing

5.1 General

Type17 coded streams conforming to this specification shall be formed into a sequence of data bursts consisting of data words in a continuous sequence of AES3 frames. Each data burst shall be formatted in compliance with SMPTE ST 337, which consists of a burst preamble, a burst payload and zero padding (stuffing bits).

5.2 Type17 Data Bursts

Type17 audio frames shall be constructed according to ETSI TS 102 114 V1.4.1, Section 7.1. The Type17 audio frame shall be synchronized to the Type17 data burst.

The Type17 data burst shall be padded with the precise number of null AES3 frames to make the Type17 data burst duration exactly match the intended burst timing, consistent with the frame duration.

Figure 1 illustrates a Type17 data burst.

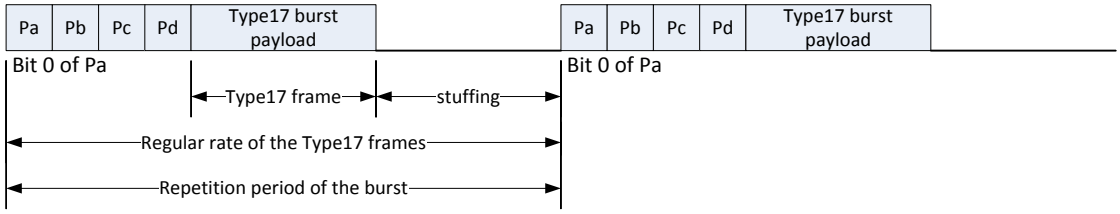

Figure 1 – Type17 data-burst

The Frame Duration is the period of each complete audio frame, and is relative to the base sample rate. In theory, any supported base sample rate may be applied. The nominal base sample rate for Type17 is 48 kHz.

The reference point of a Type17 data-burst is bit 0 of Pa. The data-burst containing Type17 frames shall occur at a regular rate, with the reference point of each Type17 data-burst beginning one audio frame period after the reference point of the preceding Type17 data-burst.

5.3 burst_info

The Pc word of the burst_preamble is the burst_info, which contains the data_type, data_type_dependent fields and data_stream_number, as defined in SMPTE ST 337, Section 7.2.4.

5.3.1 data_type

The data-type of a Type17 data-burst is 17 as defined in SMPTE ST 338, Section 4, Table 1.

5.3.2 data_type_dependent field

The data_type_dependent bits 0 to 2 of the data_type_dependent field for Type17 data bursts shall indicate the burst repetition rate of the burst.

Table 1 shows the available repetition period which is relative to the AES3 sample clock.

Table 1 – Fields of burst-info

Bits of Pc			Value	Meaning	
24-bit mode	20-bit mode	16-bit mode			
8-12	4-8	0-4	0x11	Type17	
13-15	9-11	5-7		According to SMPTE ST 337	
16-18	12-14	8-10	0	Repetition period of data burst in AES3 frames	512
			1		1024
			2		2048
			3		4096
			4		8192
			5		16384
			6		fixed mode 1024
			7		reserved
19	15	11	0	Stream Mode	Single Stream
			1		Multi-Stream
20	16	12	0	Asset Type	Complete Main Program
			1		Object Program
21-23	17-19	13-15		data_stream_number	

5.3.2.1 Burst Repetition Period Code 0 to 5

The burst repetition codes 0 thru 5 (inclusively) indicate the burst repetition period as $\boldsymbol{Samples/f_s}$ where *Samples* is the value indicated in the meaning of Table 1. The burst repetition period shall be indicative of the correct frame timing.

5.3.2.2 Burst Repetition Code 6

A burst repetition code of 6 indicates a burst repetition period of $1024/f_b$.

5.3.2.3 Stream Mode

The data_type_dependent field bit 3 of the data_type_dependent field indicates the use of data_stream_number. If Stream Mode = 0, then data_stream_number indicates individual audio assets. If Stream Mode = 1, then data_stream_number indicates the multiplex order of a bonded set of AES 3 streams.

5.3.2.4 Asset Type

The data_type_dependent field bit 4 of the data_type_dependent field indicates whether the asset is a complete program, or an accessory track (e.g. an audio object such as a replacement dialog track.)

5.3.3 data_stream_number

If Stream Mode indicates Single Stream, then only one AES3 link is in service to deliver the audio.

If Stream Mode indicates Multi-Stream, then Multiple AES3 links are bonded together to act as a single link. data_stream_number indicates the order of the multiplex, starting with the lowest index of synchronized preambles being the first stream in the multiplex, and so on to the higher index. Figure 2 1llustrates an example.

In the example shown in Figure 2, if both AES3 links are clocked at 48 KHz, and the frame duration of each Type17 audio frame is nominally 512 samples per frame, then the burst repetition period is 10.6667 ms, but the available data rate is doubled. See Annex A for some examples of payload capacity vs. delivery scheme.

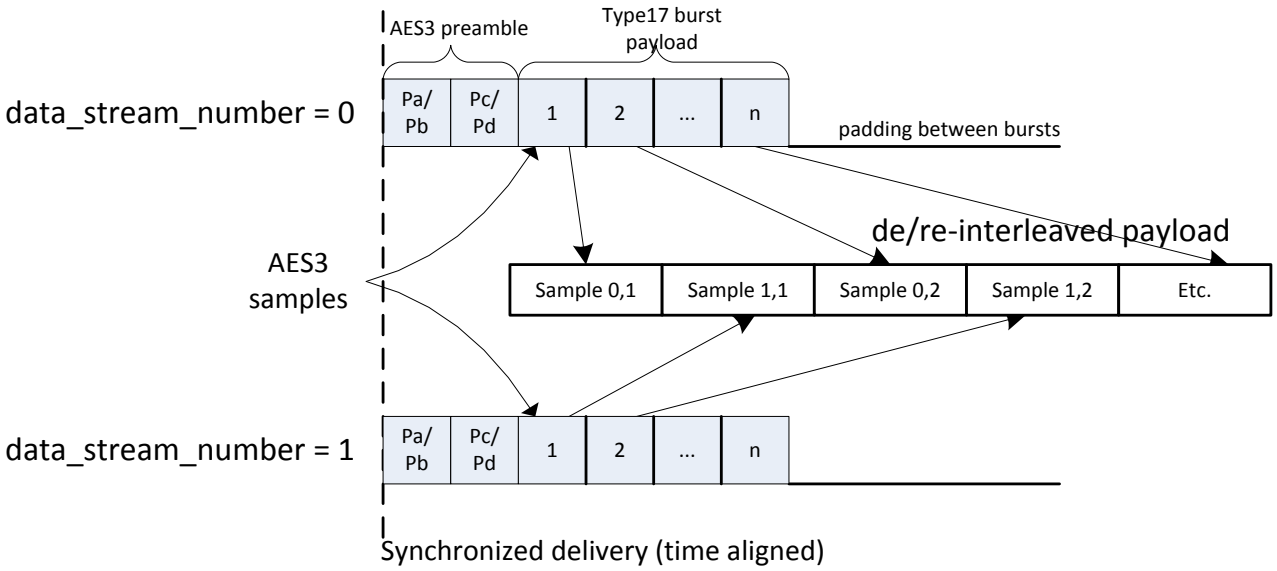

Figure 2 – Example of Type17 payload delivered in two data streams

5.4 Pause Data Bursts

It is recommended that pause data-bursts should be used to fill stream gaps in the Type17 bitstream as described in SMPTE ST 339, Section 6. Pause data-bursts shall be transmitted with a repetition period of three AES3 frames, except when other repetition periods are necessary to fill the precise stream gap length (which may not be a multiple of three AES3 frames), subject to the zero padding requirements of SMPTE ST 337, Section 7.4, “Burst Spacing”.

When a stream gap in a Type17 stream is filled by a sequence of pause data-bursts, the Pa of the first pause data-burst shall be located one burst period following the Pa of the last Type17 frame. The sequence(s) of pause data-bursts which fill the stream gap shall continue from this point up to, (as close as possible considering the three AES3 frame length of the pause data-burst), the Pa of the first Type17 data-burst which follows the stream gap.

5.5 Type17 Decoder Latency

The PCM output latency of a Type17 decoder is defined as a delay measure from the reference point to the first PCM sample emitted from the decoder. The decoder latency is the sum of the burst repetition period plus an additional latency, as illustrated in Figure 3.

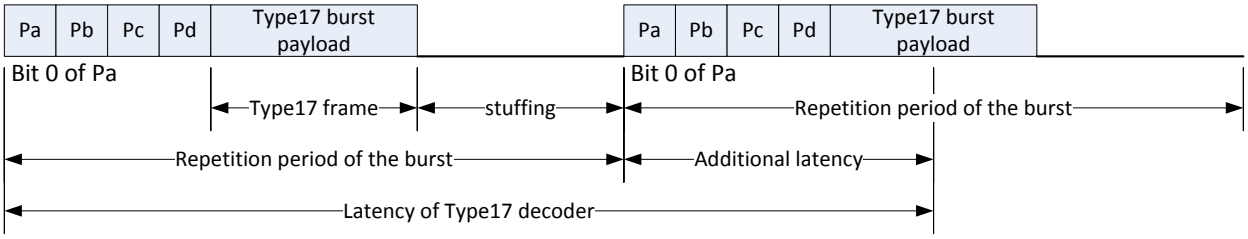

Figure 3 – Latency of Type17 decoding

5.5.1 Burst Repetition Period Code 0 to 5

The burst repetition codes 0 thru 5 (inclusively) have an additional latency of $256/f_b$.

5.5.2 Burst Repetition Code 6

A burst repetition code of 6 has an additional latency of $1024/f_b$.

5.6 Compatibility with Consumer Formats

This standard for the carriage of Type17 bitstreams on AES3 interface is not compatible with consumer formats described in the ISO/IEC standards.

Annex A – Effect of Repetition Period of Data Burst and Fs on Frame Period and Maximum Data Rate for Type17 (Informative)

A.1 Selection of Type17 Mode

The Type17 repetition period selected will depend on available clock rate, the available word depth, and the data rate required by the payload. Table A.1 shows AES3 frame rates and repetition period and payload capacity in Mbps for the symbol rates shown.

Table A.1 – Type17 Payload and Frame Repetition: Some Examples at 48 KHz

Frame Repetition Period	AES3 Frame rate (Fs)	Frame Period (ms)	16-bit maximum data rate (Mbps)	20-bit maximum data rate (Mbps)	24-bit maximum data rate (Mbps)
512	48000	10.67	1.524	1.905	2.286
1024	48000	21.33	1.530	1.913	2.295
2048	48000	42.67	1.533	1.916	2.300
4096	48000	85.33	0.768	1.918	2.302
1024	96000	10.67	3.060	3.825	4.590
2048 (or 1024 fixed)	96000	21.33	3.066	3.833	4.599
4096	96000	42.67	1.536	3.836	4.604
8192	96000	85.33	0.768	3.838	4.606
2048	192000	10.67	6.132	7.665	9.198
4096 (or 1024 fixed)	192000	21.33	3.072	7.673	9.207
8192	192000	42.67	1.536	7.676	9.212
16384	192000	85.33	0.768	7.678	9.214
4096	384000	10.67	6.144	15.345	18.414
8192 (or 1024 fixed)	384000	21.33	3.072	15.353	18.423
16384	384000	42.67	1.536	15.356	18.428
8192	768000	10.67	6.144	30.705	36.846
16384 or (1024 fixed)	768000	21.33	3.072	30.713	36.855
16384	1536000	10.67	6.144	61.425	73.710

The Maximum data rates in this table assume a provision for two AES3 frames for pad between bursts. Specific implementations may have additional restrictions.

If the required data rate to transmit the audio stream cannot be achieved with the AES3 Frame rates and sample depths supported, it may be necessary to multiplex the burst payload over two or more AES3 links.