SMPTE ST 2035:2020
Revision of ST 2035:2012

SMPTE STANDARD

Audio Channel Assignments for Digital Television Recorders (DTRs)

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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 Part XIII of its Administrative Practices.

SMPTE ST 2035 was prepared by Technology Committee 24TB.

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 document replaces SMPTE ST 320 (Channel Assignments and Levels on Multichannel Audio Media) and SMPTE EG 26 (Audio Channel Assignments for Digital Television Tape Recorders with AES Digital Audio Input. This document combines the information in SMPTE ST 320 and SMPTE EG 26 with that in EBU R48 (Allocation of Audio Channels in the D-1 Digital Television Tape-Recording Format) and with ITU Recommendation ITU-R BS.775-2 (Multichannel Stereophonic Sound System with and without Accompanying Picture).

It also includes several other recent operating practices, so becomes a more comprehensive document than any of its antecedents. The audio track capacity of digital TV recorders has expanded beyond that of the early machines; this document extends specific assignments to twelve tracks. Each case reflects a current or prior broadcast practice or convention, and in some cases the same set of audio channels may be arranged in more than one layout in order to accommodate existing practice. There are several reasons to use the AES signal to transport non-PCM audio data, such as rate reduced audio data, so these assignments are included as well.

1 Scope

This Standard specifies the allocation of audio channels to the audio tracks of a digital television recorder for purposes of identification, program distribution and interchange. These allocations are depicted as track layout “cases” in Table 1, such that a track layout may be uniquely specified by stating the case number and letter referenced in Table 1 of this standard. The specifications below are suitable for use in applications such as program delivery specifications.

In cases where there is a one to one correspondence between the audio tracks and the AES3 input and output connections, this Standard specifies the allocation of the audio signals within the AES3 I/O signal pairs to the audio tracks, depending on the operating mode of the AES3 I/O as indicated by its Channel Status data. This allocation also applies when AES3 I/O is via embedded audio as specified in SMPTE ST 272 and SMPTE ST 299.

This standard covers practices that have evolved in both the entertainment and news / sports environments.

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 standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

AES3-1-2009, AES Standard for Digital Audio Engineering — Digital input-output interfacing — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data — Part 1: Audio Content

AES3-2-2009, AES Standard for Digital Audio Engineering — Digital input-output interfacing — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data — Part 2: Metadata and Subcode

AES3-3-2009, AES Standard for Digital Audio Engineering — Digital input-output interfacing — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data — Part 3: Transport

AES3-4-2009, AES Standard for Digital Audio Engineering — Digital input-output interfacing — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data — Part 4: Physical and electrical

SMPTE ST 272:2004 Television — Formatting AES Audio and Auxiliary Data into Digital Video Ancillary Data Space

SMPTE ST 299-1:2009, 24-Bit Digital Audio Format for SMPTE 292 Bit-Serial Interface

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

4 Terms and Definitions

Some of the terms defined below come from entertainment practice, while others come from news or sports practice.

Audio Channel: A single channel of audio that may represent a monophonic program or may be part of a multi-channel audio program.

Audio Program: An Audio Program is composed of one or more Audio Channels. It may also be called a Complete Mix.

Audio Signal: The representation of one Audio Channel applied to the input and output of a digital television recorder.

Audio Track: The space on the storage media or device assigned to a specific Audio Channel

Commentary: A primarily speech or dialog-centric program element, that may also contain music and or effects specific to a single broadcaster or distributor, which is intended to be combined with an International Sound element to form a Complete Mix.

Complete Mix: A mix consisting of all the elements (e.g. music, effects and dialog) required to form a stand alone Audio Program.

Dialog: The primary speech element of a program

Effects: Sound effects.

Element: One component of a complete program, such as speech or music. It may utilize one or more audio channels.

International Sound: A mix consisting of all the elements required to form a stand alone Audio Program, except for the Commentary element. This may also be called Natural Sound.

Left total, Right total (Lt/Rt): A two channel baseband encoded signal intended to be decoded to a four or five channel (surround) signal by a matrix type decoder. The Lt/Rt signal is compatible with a two channel (stereo) signal infrastructure.

Low Frequency Effects (LFE): Sounds intended to be carried by the reduced bandwidth ".1" channel of a 5.1 channel program, which are typically reproduced by a subwoofer. In the ATSC system, the LFE channel is restricted to 120 Hz bandwidth.

Music and Effects (M&E): A complete mix, but without the dialog element(s).

Muted: Digital silence

Secondary Audio Program (SAP): An alternate (mono) program, usually a second language

Video Descriptive Services (VDS): Either a mono or stereo mix of the program including a narrative description of the video, or a verbal description of the visual scene, with embedded control information. The requirement for one or the other will vary by country. These services are intended for use by the visually impaired.

5 General Specification

AES3 provides the necessary specifications for the interfaces, signals, and structures for digital audio I/O. The 2009 Revision of AES3 divided the document into four Parts by topical area. See AES3-1-2009 for an overview. This standard will sometimes refer to "AES3" without further clarification, in which case the reader should expect a generic not a specific, reference. Implementers are expected to have access to all four Parts of AES3.

Table 1 lists a variety of Audio Program types and shows the Audio Channel to Audio Track assignments for each program type. Non-PCM audio data may carry more than one Audio Channel in a single encoded data stream. In this case, the entire stream shall be assigned to a single Audio Track or Track pair.

5.1 DTRs with a One-to-One Correspondence Between I/O Connections and Audio Tracks

The assignment of Audio Signals to Audio Tracks in DTRs with a single AES3 input and/or output for each pair of Audio Tracks (as documented in AES3-4-2009) shall follow Tables 1 and 2. Audio Tracks 1 and 2 shall be assigned to the first AES3 I/O connection with the Audio Signal of Audio Track 1 assigned to AES3 subframe[1] 1 and the Audio Signal of Audio Track 2 assigned to AES3 subframe 2. Additional Audio Signal pairs shall be assigned to the remaining AES3 I/O connections in a similar manner.

In the case of digital audio signals embedded in the ancillary data space of an associated video signal, Audio Tracks 1 and 2 shall be assigned to SMPTE ST 272 channel pair 1, Audio Tracks 3 and 4 to SMPTE ST 272 channel pair 2, etc. up to the maximum number of available SMPTE ST 272 audio channels, based on available ancillary data space in a given format.

5.2 Audio Channel to Audio Track Assignments

Note: The case numbers in Table 1 are historical in nature and have evolved from those used in EBU R48-1988. The case numbers in Table 2 use the same naming conventions for consistency, even though EBU R48 did not extend beyond eight tracks.

[1] Subframes are defined in AES3-3-2009.

Table 1 – Audio Channel to Audio Track assignments by Audio Program type

Case	Program Type	Tracks	1	2	3	4	5	6	7	8
1a	Mono Program	2	Complete Mono mix	International Sound (if any)						
1b	Mono Program	4	Complete Mono mix	Mute	International Sound (if any)					
1c	Mono Program	8	Complete Mono mix	Mute	International Sound (if any)					
2a	Stereo Program	2	Complete Mix Left	Complete Mix Right						
2b	Stereo Program	4	Complete Mix Left	Complete Mix Right	Int'nl Sound Left	Int'nl Sound Right				
2c	Stereo Program	8	Complete Mix Left	Complete Mix Right	Int'nl Sound Left	Int'nl Sound Right				
3a	2 Stereo Programs	4	First program Complete Mix Left	First program Complete Mix Right	Second pgm Complete Mix Left	Second pgm Complete Mix Right				
3b	2 Stereo Programs	8	First program Complete Mix Left	First program Complete Mix Right	Second pgm Complete Mix Left	Second pgm Complete Mix Right				
4a	Mono	2	Commentary	Intn'l Sound						
4b	Mono	4	Commentary	Mute	Intn'l Sound					
4c	Mono	8	Commentary	Mute	Intn'l Sound					
5a	Stereo Intn'l Sound	4	First Commentary	Second Commentary	Intn'l Sound Left	Intn'l Sound Right				
5b	Stereo Intn'l Sound	8	First Commentary	Second Commentary	Intn'l Sound Left	Intn'l Sound Right				
6a	Stereo Program	4	Commentary Left	Commentary Right	Intn'l Sound Left	Intn'l Sound Right				
6b	Stereo Program	8	Commentary Left	Commentary Right	Intn'l Sound Left	Intn'l Sound Right				
7a	Mono Program	4	Dialog	Music	Effects 1	Effects 2				
7b	Mono Program	8	Dialog	Music	Effects 1	Effects 2				

All unlabelled tracks either don't exist or are Muted

Table 1 – Audio Channel to Audio Track assignments by Audio Program type (continued)

Case	Program Type	Tracks	1	2	3	4	5	6	7	8
8a	Mono Pgm + SAP	2	Complete Mono Mix	SAP						
8b	Mono Pgm + SAP	4	Complete Mono Mix	SAP	Intn'l Sound Left (if any)	Intn'l Sound Right (if any)				
8c	Mono Pgm + SAP	8	Complete Mono Mix	SAP	Intn'l Sound Left (if any)	Intn'l Sound Right (if any)				
8d	Mono Pgms + VDS & SAP	4	Mono	Mono	VDS	SAP				
8e	Mono Pgms + VDS	4	Mono	Mono	VDS	Mono				
8f	Mono Pgms + SAP	4	Mono	Mono	Mono	SAP				
8g	Mono Pgms	4	Mono	Mono	Mono	Mono				
9a	Stereo Pgm + SAP	4	Complete Mix Left	Complete Mix Right	SAP					
9b	Stereo Pgm + SAP	8	Complete Mix Left	Complete Mix Right	SAP					
9c	Stereo Pgm + VDS & SAP	4	Complete Mix Left total (Lt)	Complete Mix Right total (Rt)	VDS	SAP				
9d	Stereo Pgm + VDS & Mono	4	Complete Mix Left total (Lt)	Complete Mix Right total (Rt)	VDS	Mono				
9e	Stereo Pgm + Mono & SAP	4	Complete Mix Left total (Lt)	Complete Mix Right total (Rt)	Mono	SAP				
9f	Stereo Pgm + 2 x Mono	4	Complete Mix Left total (Lt)	Complete Mix Right total (Rt)	Mono	Mono				
10a	Multichannel Coded audio	2	Non PCM audio data per ST 337	Non PCM audio data per ST 337						
11a	Stereo Pgm + Multich Coded audio	4 or 8	Complete Mix Left or Left total (Lt)♦	Complete Mix Right or Right total (Rt)♦	Non PCM audio data per ST 337	Non PCM audio data per ST 337				
11b	Multich Pgm + Stereo Pgm	8	Complete mix Left♦	Complete mix Right♦	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround
11c	Multich Pgm + Stereo Pgm	8	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Complete mix Left♦	Complete mix Right♦
11d	Multich Pgm + Lt Rt Surround	8	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Left Total (Lt)	Right Total (Rt)

All unlabelled tracks either don't exist or are Muted

Table 1 – Audio Channel to Audio Track assignments by Audio Program type (continued)

Case	Program Type	Tracks	1	2	3	4	5	6	7	8
11e	Multich Pgm + Multichannel Coded audio	8	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Non PCM audio data per ST 337	Non PCM audio data per ST 337
11f	Multich Pgm + SAP + VDS	8	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Mono SAP‡	Mono VDS ‡
11g	Multich Pgm + Intn'l Sound	8	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Intn'l Sound Left	Intn'l Sound Right
11h	Multich Pgm + SAP + VDS	8	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Mono VDS †	Mono SAP †
11i	Multich Pgm + VDS	8	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Left VDS §	Right VDS.§
12	2 Stereo Pgm + 2 Multich Coded audio	8	Complete mix 1 Left or Left total (Lt)	Complete mix 1 Right or Right total (Rt)	Complete mix 2 Left or Left total (Lt)	Complete mix 2 Right or Right total (Rt)	Non PCM audio data per ST 337 (Pgm 1)	Non PCM audio data per ST 337 (Pgm 1)	Non PCM audio data per ST 337 (Pgm 2)	Non PCM audio data per ST 337 (Pgm 2)

♦ The stereo can be either a downmix from the multichannel sound or a separate stereo balance
‡ If either or both the SAP or VDS are not used in case 11f, the unused track(s) are muted (silent).
† If either or both the SAP or VDS are not used in case 11h, the unused track(s) carry a Mono mix of the Multichannel program
§ If the stereo Video Descriptive Service is not used in case 11i, the unused track(s) carry a Left total, Right total mix of the Multichannel program

Table 2 – 12-Track Audio Channel to Audio Track assignments by Audio Program type

Case	Track Number / Program Type	1	2	3	4	5	6	7	8	9	10	11	12
13a	Stereo Pgms + Multich Pgm	Complete Mix Left total (Lt)	Complete Mix Right total (Rt)	Lt, M&E	Rt, M&E	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Freely Assigned	Freely Assigned
13b	Stereo Pgm (2 Languages) + Multich Pgm	Complete Mix Left total (Lt) (Language 1)	Complete Mix Right total (Rt) (Language 1)	Complete Mix Left total (Lt) (Language 2)	Complete Mix Right total (Rt) (Language 2)	Left (Language 1)	Right (Language 1)	Center (Language 1)	Low Freq Effects (Language 1)	Left Surround (Language 1)	Right Surround (Language 1)	Freely Assigned	Freely Assigned
13c	Stereo Pgm (2 Languages) + Multichannel coded audio	Complete Mix Left total (Lt) (Language 1)	Complete Mix Right total (Rt) (Language 1)	Complete Mix Left total (Lt) (Language 2)	Complete Mix Right total (Rt) (Language 2)	Non PCM Audio per ST 337 (Language 1)	Non PCM Audio per ST 337 (Language 1)	Non PCM Audio per ST 337 (Language 2)	Non PCM Audio per ST 337 (Language 2)	Freely Assigned	Freely Assigned	Freely Assigned	Freely Assigned
13d	Multichannel Pgm + Stereo Pgms	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Complete Mix Left total (Lt)	Complete Mix Right total (Rt)	Lt, M&E	Rt, M&E	Freely Assigned	Freely Assigned
13e	Multichannel Pgm + Stereo Pgm	Left	Right	Center	Low Freq Effects	Left Surround	Right Surround	Complete Mix Left total (Lt)	Complete Mix Right total (Rt)	Freely Assigned	Freely Assigned	Freely Assigned	Freely Assigned

5.3 DTRs with Four Audio Tracks and Four AES3 I/O Connections

Note: This section is carried over from SMPTE EG 26, to cover legacy VTRs. It is not normative for new equipment design.

5.3.1 Channel Status data requirements

The data arriving at each of the AES3 I/O connections (as documented in AES3-4-2009) contain two Audio Signals, carried in subframes 1 and 2, and two streams of Channel Status data (as documented in AES3-2-2009) describing the use of the Channel Status block, (Pro or Consumer) the type of data (PCM or not PCM) and the Channel Mode of the two Audio Signals. The Channel Status data is valid only if Bit 0, Byte 0 of the channel status data is set to "1", indicating that the stream is operating in the Professional mode and only if Bit 1, Byte 0 of the channel status data is set to 0, indicating the carriage of linearly coded (PCM) audio data.

5.3.2 Assignment of Audio Signals to Input connectors

The DTR shall accept two channel Audio Signals (see Table 3) only if they appear on AES3 input connectors 1 and 3, and shall not accept single-channel Audio Signals appearing on AES3 input connectors 2 and 4 when AES3 input connectors 1 or 3 are carrying a two-channel signal. Audio Signals carried in subframe 2 of the AES3 streams connected to inputs 2 and 4 shall not be recorded.

Table 3 – Assignments of the Audio Signals carried in the AES3 inputs to the DTR Audio Tracks, as defined by Channel Status Byte 1, Bits 0, 1, 2 and 3, "Channel Mode".

DTR Audio Track	Audio Signal carried (AES3 pair #-subframe #)	Conditions
1	1-1	Always
2	1-2	If input 1, subframe 2, Channel Status Byte 1, Bits 0 to 3 are equal to 0,1,3 or 4
2	2-1	If input 1, subframe 2 Channel Status Byte 1, Bits 0 to 3 are equal to 2 (mono)
3	3-1	Always
4	3-2	If input 3, subframe 2, Channel Status Byte 1, Bits 0 to 3 are equal to 0,1,3 or 4
4	4-1	If input 3, subframe 2 Channel Status Byte 1, Bits 0 to 3 are equal to 2 (mono)

5.3.3 Channel Status Mode data requirement

The Channel Status Channel Mode data for the Audio Signals carried on the AES3 outputs shall reflect the assignments of Audio Tracks to Audio Signals, as shown in Table 3. AES3 subframes that are not used for Audio Signals (either PCM or non-PCM) shall carry "digital silence".

6 Identifying Track Assignments in Descriptive Metadata

Track assignments may be unambiguously identified by using the alphanumeric Case identifications from Table 1 and Table 2.

Annex A (Informative) **Commonly Used Audio Channel and Audio Signal Connection Assignments for Multichannel Audio Programs**

Tables 1 and 2 identify a wide variety of Audio Channel to Audio Track assignments. These assignments also define the assignment of Audio Signals to the input and output (I/O) connectors (or of pairs of Audio Signals in the case of AES3 I/O connectors) of fixed media recording devices.

Cases 11b through 11i inclusive reflect the common practice of assigning the Left and Right Audio Channels to AES3 connector N, the Center and Low Frequency Effects Audio Channels to AES3 connector N+1 and the Left Surround and Right Surround Audio Channels to AES3 connector N+2.

Annex B (Informative)
Advisory Notes on Package Labels

During the transition to the universal adoption of the case based system, it is recommended that both the Case number from Tables 1 and 2 and the Channel to Track assignments for that case be written on the package.

Annex C (Informative)
EBU R-123 on Track Allocation for File Exchange

The European Broadcasting Union has developed a Recommendation R-123 EBU “Audio Track Allocation for File Exchange”. Readers of this document should take this document into account for purposes of applying track allocations for File Exchange. The document is freely available via http://tech.ebu.ch.

Bibliography (informative)

EBU Recommendation R-123 EBU “Audio Track Allocation for File Exchange,” 9 Jul 2009.