SMPTE ST 2038:2021
Revision of ST 2038:2008

SMPTE STANDARD

Carriage of Ancillary Data Packets in an MPEG-2 Transport Stream

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Foreword

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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 document.

This document defines the carriage of ancillary (ANC) data within MPEG-2 Transport Streams. The mechanism provides a data pipe through which SMPTE ST 291-1 ANC data packets can be conveyed transparently through equipment that uses the MPEG-2 Transport Stream protocol. The data need not be recognized or interpreted by said equipment.

A mechanism is provided such that the ANC data will be presented frame-accurately with the corresponding video.

This mechanism is not intended for the carriage of audio, since there are already well-established mechanisms for doing that.

This mechanism is not intended to carry EDH packets.

1 Scope

This document defines the syntax and semantics for the carriage of SMPTE ST 291-1 Ancillary Data Packets in MPEG-2 Transport Stream PES packets.

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.

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.

SMPTE ST 291-1:2011, Ancillary Data Packet and Space Formatting

Recommendation ITU-R BT.1700 (02/2005), Characteristics of Composite Video Signals for Conventional Analogue Television Systems

Recommendation ITU-R BT.1120-9 (12/2017), Digital interfaces for studio signals with 1920 × 1080 image formats

ISO/IEC 13818-1:2018, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information: Part 1 Systems

4 MPEG-2 Transport Stream Syntax

4.1 PMT Signaling

The ANC data stream shall be identified in the PMT of the MPEG-2 Program of which it is part, using the following ISO/IEC 13818-1 syntax.

4.1.1 stream_type

The stream_type shall be set to 0x06 (PES private data).

4.1.2 anc_data_descriptor

The anc_data_descriptor, shown in Table 1, shall be used in the ES loop. The tag value shall be 0xC4 (user-defined in ATSC, DVB and SCTE).

Table 1 – anc_data_descriptor syntax

Syntax	No. of bits	Mnem.	Valid Range
anc_data_descriptor() {			
descriptor_tag	8	uimsbf	0xC4
descriptor_length	8	uimsbf	0x00.. 0xFF
for (I=0; i<N; i++) {			
descriptor()			
}			
}			

4.1.2.1 Semantics

descriptor(): This structure may be used to convey additional information about the ANC data component. The use is optional and currently undefined. Compliant receive devices shall ignore unrecognized descriptors.

4.1.3 Registration Descriptor

The anc_data_descriptor_tag is in ISO/IEC 13818-1 user private data code space. The anc_data_descriptor shall be preceded by an ISO/IEC 13818-1 registration_descriptor with format_identifier set to 0x56414E43 ("VANC").

4.2 ANC Data PES Packet

The format of the ANC data PES packet is shown in Table 2.

Table 2 – Format of the ANC Data PES packet

Syntax	No. of bits	Identifier
anc_data_packet() {		
packet_start_code_prefix	24	0x000001
stream_id	8	0xBD [private_stream_1]
PES_packet_length	16	uimsbf
'10'	2	'10'
PES_scrambling_control	2	'00' [not scrambled]
PES_priority	1	bslbf
data_alignment_indicator	1	'1' [payload aligned]
copyright	1	bslbf
original_or_copy	1	bslbf
PTS_DTS_flags	2	'10' [PTS present]
ESCR_flag	1	'0' [not present]
ES_rate_flag	1	'0' [not present]
DSM_trick_mode_flag	1	'0' [not present]
additional_copy_info_flag	1	'0' [not present]
PES_CRC_flag	1	'0' [not present]
PES_extension_flag	1	'0' [not present]
PES_header_data_length	8	0x05
'0010'	4	'0010'
PTS[32..30]	3	bslbf
marker_bit	1	'1'
PTS[29..15]	15	bslbf
marker_bit	1	'1'
PTS[14..0]	15	bslbf
marker_bit	1	'1'
for (i=0; i<N; i++) {		
'000000'	6	'000000'
c_not_y_channel_flag	1	bslbf
line_number	11	uimsbf
horizontal_offset	12	uimsbf
DID	10	bslbf
SDID	10	bslbf
data_count	10	bslbf
for (j=0; j<data_count; j++) {		
user_data_word	10	bslbf
}		
checksum_word	10	bslbf
while (!bytealigned) {		
'1'	1	bslbf
}		
}		
for (i=0 ;i<N; i++) {		
stuffing_byte	8	'1111 1111'
}		
}		

Each ANC data PES packet shall only contain ANC data from one line. Additionally, all ANC data packets extracted from the same line shall be conveyed in the same ANC data PES packet. PES packets containing ANC shall be ordered according to the raster line number.

The PTS value in the ANC data packet shall match the PTS value in the corresponding video PES packet within ± 2 ms.

In the case of field pictures, PTS values for ANC data PES packets shall match the PTS within ± 2 ms for field 1 of the frame with which the ANC data is associated. For 3:2 pull-down, the equivalent PTS values for field 1 shall be inferred if that field is not coded (due to repeat field-frame).

The PTS values for ANC lines that belong to the same field shall be identical.

4.2.1 Semantics

Except as noted below, the definition of all syntax fields shall be as defined in ISO/IEC 13818-1 (shown as gray shaded fields in Table 2). In the case of fixed value assignment, the values shall be as defined in Table 2.

c_not_y_channel_flag: For HD, this flag, when set to '1', indicates the ANC data corresponds to the color difference channel. When set to '0, this flag indicates the ANC data corresponds to the luminance channel. For SD, this flag shall be set to '0'.

line_number: This field contains the line number (as defined in ITU-R BT.1700 [SD] or ITU-R BT.1120-9 [HD]) that corresponds to this ancillary data packet. The lines that are available to convey ancillary data are as defined in the applicable sample structure specification, and may be further restricted per SMPTE RP 168.

horizontal_offset: This field defines the location of the ANC packet relative to SAV. 0 means that the ADF sequence begins immediately following SAV. For HD, this is in units of Y samples (e.g., the range 0 to 2199 for 1080i @ 59.94). For SD, this is in units of (27MHz) multiplexed word numbers.

Note: This field has a width of 12 bits, thus it has a maximum value of 4095. SMPTE ST 296 (1280 x 720 progressive active images) image sampling systems 7 and 8 (1280 x 720 progressive @ 24 fps and 1280 x 720 progressive @ 23.98 fps respectively) have a luma sample number maximum of 4124. It is unlikely that an actual implementation would have an ANC packet begin at a Horizontal_Offset beyond 4092 in these formats.

DID, SDID, data_count, user_data_word, checksum_word: These fields represent the data to be reinserted as ancillary data, per SMPTE ST 291-1. For the purposes of the "for" loop syntax counter only, only the lower 8 bits of data_count, corresponding to bits b7 (MSB) through b0 (LSB) of the 10-bit SMPTE ST 291-1 data count word, shall be used.

stuffing_byte: This is a fixed 8-bit value equal to '1111 1111' that may be inserted by a transmitting device. It may be ignored by the receiving device.

Bibliography (Informative)

SMPTE ST 274:2008, Television — 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates

SMPTE ST 296:2012, Television — 1280 x 720 Progressive Image Sample Structure — Analog and Digital Representation and Analog Interface

SMPTE RP 168:2009, Definition of Vertical Interval Switching Point for Synchronous Video Switching