SMPTE ST 334-1:2015
Revision of
SMPTE 334-1-2007

SMPTE STANDARD

Vertical Ancillary Data Mapping of Caption Data and Other Related Data

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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 its Standards Operations Manual.

SMPTE ST 334-1 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 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.

Introduction

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

The following suite of SMPTE Engineering Documents defines the carriage of Closed Caption data in production and distribution television systems:

SMPTE ST 334-1	Vertical Ancillary Data Mapping of Caption Data and Other Related Data
SMPTE ST 334-2	Caption Distribution Packet (CDP) Definition
SMPTE RP 2007	Closed-Caption CDP and "Grand Alliance" Serial Interfaces for DTV
SMPTE EG 43	System Implementation of CEA-708 and CEA-608 Closed Captioning and Program-Related Data

Users should note that the data described in this standard may also be transported in KLV format according to SMPTE ST 336, or via other means.

1 Scope

This standard defines a method of mapping closed captioning and certain other related data services into the 10-bit vertical ancillary (“VANC”) data space. It specifies the structure of packets carrying CEA-708, as well as CEA-608 closed captioning data, time code data, and ATSC A/65 closed caption descriptor information, which may be carried in vertical ancillary data space, via serial data communications interfaces, or via other means.

The related data services include data broadcast services intended for the public as well as broadcaster internal control and communications.

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 recommended practice. 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 291-1:2011, Ancillary Data Packet and Space Formatting

SMPTE ST 334-2:2015, Caption Distribution Packet (CDP) Definition

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

CEA 608-E (2008), Line 21 Data Services

CEA 708-E (2013), Digital Television (DTV) Closed Captioning

4 Location of Vertical Ancillary Data

The data packets shall be located in the active line portion of one line in the vertical ancillary space. Data may be located in any lines in the area from the second line after the line specified for switching, as defined in SMPTE RP 168, to the last line before active video, inclusive.

For interlaced systems, the data packets carrying only Defined Data Services (see Table 1) shall be placed in the vertical ancillary area of the first field and should not be repeated in the vertical ancillary area of the second field. Data packets carrying other services (see Table 2) shall be placed in the vertical ancillary area of the associated field.

For progressive segmented frame systems, the data packets shall be placed in the vertical ancillary area of the first segment of the frame and shall not be repeated in the vertical ancillary area of the second segment. For progressive formats, the ANC packet shall be placed in the vertical ancillary area of the frame.

When the ANC packets defined in this standard are carried in a high definition signal, they shall be carried in the Y stream.

Individual data services are not assigned to any specific data lines; receiving equipment should identify and select services on the basis of their ANC DID and SDID fields.

5 Format of VANC Data Packets

Each data packet follows the format defined in SMPTE ST 291-1 for a type 2 ANC packet. It consists of the ancillary data flag (ADF), the data ID (DID), the secondary data ID (SDID), the data count (DC), the user data words (UDW), and the checksum (CS). The UDW consists of the data payload plus forward error correction overhead.

5.1 ANC Packet Header Format

The ADF has the value 000h 3FFh 3FFh.

The following value of DID is used for the closed captioning services defined in this standard: 161h (61h plus parity bits per SMPTE ST 291-1). A second value of DID (162h = 62h plus parity) is used for other services which are identified by this standard, and whose format is specified by recommended practices.

Other data services which are internal to a broadcast network may use DID values in the ranges specified for user application data (40h-5Fh and C0h-Dfh). These DID values are not registered.

The specified values of DID (61h and 62h) identify type 2 ANC packets. In each packet, the SDID code identifies the type of data. Table 1 shows the values of DID and SDID for services defined within this standard. Table 2 shows the values of DID and SDID for other services.

Table 1 – Defined data services

Service	DID	SDID	DC
Closed captioning (CEA-708) (CDP)	61h (161h)	1 (101h)	Variable
CEA-608 data	61h (161h)	2 (102h)	3 (203h)

Table 2 – Variable-format data services

Service	DID	SDID	DC
Program description (DTV)	62h (162h)	1 (101h)	Variable
Data broadcast (DTV)	62h (162h)	2 (102h)	Variable
VBI data	62h (162h)	3 (203h)	Variable

Note: The DID/SDID 61h/02h can only be used in nominal 30/60 fps systems. The DID/SDID 61h/01h (CDP) must be used for other fps. In all cases, the preferred method is to use the CDP 61h/01h.

DC is a count of the number of words in the UDW; bits b7-b0 of DC represent the number of words of user data; bits b8 and b9 are parity per SMPTE ST 291-1.

For defined services such as captioning, the format of the data in the UDW is defined in this specification or in a normative reference. For other data services, the data content is not specified here, and the value of DC is variable.

5.2 UDW Format

All data services consist of 8-bit data bytes, which are transmitted in bits b7-b0 of the 10-bit data word. Bit b8 is even parity for b7 through b0, and b9 = not b8. In addition to providing a simple error detection capability, this avoids transmitting data which match one of the code words 0-3 and 1020-1023 which are prohibited by SMPTE ST 291-1.

The data payload for each service is inserted into the UDW of the ANC packet as a sequence of 10-bit words. The number of words is indicated in the DC field of the ANC packet header.

5.3 Defined Services

The services shown in Table 1 have their format defined in this clause. The values in parentheses for DID, SDID, and DC include parity bits b8 and b9.

5.3.1 Format of the closed captioning (CEA-708) (CDP)

The payload of the closed captioning (CEA-708) packet is the caption distribution packet (CDP) defined in SMPTE ST 334-2. This packet has a variable length and shall be placed in the vertical ancillary area per Section 4.

5.3.2 Format of the CEA-608 data

In NTSC video, the closed captioning, XDS, content advisory, and other services are carried in a format defined by the CEA-608 standard. Closed captioning may be carried in line 21 of either field. XDS, content advisory and other data may be in line 21 of field 2 only.

These can be carried in an ANC packet in a serial digital stream to allow the CEA-608 data waveform to be recreated and reinserted into an NTSC signal produced by converting the DTV signal into an analog signal at a station. The format of this ANC packet is defined in Annex A, is of fixed length, and shall be placed in the vertical ancillary area per Section 4.

Note: The preferred method of carrying CEA-608 data is to place it in a CDP rather than the structure defined in Annex A.

5.4 Other Data Services

Table 2 lists other data services whose format is not specified by this standard. Their DID and SDID values are specified here to ensure that they can be correctly and consistently recognized and routed.

The DTV program description service carries data which pertain to the video and audio programs. Its contents are defined in SMPTE RP 207.

The DTV data broadcast service carries data intended for broadcast to the public along with the video and audio programs. Its contents are the subject of a future recommended practice.

The VBI data service is intended for use in reconstituting data in the VBI of a standard-definition analog video signal produced from the digital video program. Its contents are defined in SMPTE RP 208.

5.5 Timing of Data and Video (Informative)

There is no specific provision in this standard for ensuring that the relative timing between the video and its embedded VANC data is correct. The only timing relationship that exists is created when the data are embedded in the video. Once that relationship is established, the deterministic nature of SMPTE ST 292-1 or SMPTE ST 259 transport ensures that the relationship is preserved.

Annex A Bibliography (Informative)

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 170:2004) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 170M-2004). Documents with the same root number (e.g. 170) and publication year (e.g. 2004) are functionally identical.

ATSC A/53, Part 4:2009, ATSC Digital Television Standard, Part 4 – MPEG-2 Video System Characteristics

ATSC A/65:2013, Program and System Information Protocol for Terrestrial Broadcast and Cable

Recommendation ITU-R BT.656-5 (12/07), Interfaces for Digital Component Video Signals in 525-Line and 625-Line Television Systems Operating at the 4:2:2 Level of Recommendation ITU-R BT.601 (Part A)

Recommendation ITU-R BT.1700 (02/05), Characteristics of Composite Video Signals for Conventional Analogue Television Systems

SMPTE ST 125:2013, SDTV Component Video Signal Coding 4:4:4 and 4:2:2 for 13.5 MHz and 18 MHz Systems

SMPTE ST 170:2004, Television — Composite Analog Video Signal — NTSC for Studio Applications

SMPTE ST 259:2008, Television — SDTV Digital Signal/Data — Serial Digital Interface

SMPTE ST 292-1:2012, 1.5 Gb/s Signal/Data Serial Interface

SMPTE ST 344:2000, Television — 540 Mb/s Serial Digital Interface [Archived 2006]

SMPTE ST 425-1:2014, Source Image Format and Ancillary Data Mapping for the 3 Gb/s Serial Interface

SMPTE RP 207:2005, Transport of Program Description Data in Vertical Ancillary Data Packets

SMPTE RP 208:2002, Transport of VBI Packet Data in Ancillary Data Packets [Archived 2004]

SMPTE RP 291-2:2013, Ancillary Data Space Use — 4:2:2 SDTV and HDTV Component Systems and 4:2:2 2048 x 1080 Production Image Formats

SMPTE EG 43:2009, System Implementation of CEA-708 and CEA-608 Closed Captioning and Program-Related Data

Annex B Format of the ANC CEA-608 Packet (Normative)

The data payload for CEA-608 data is 2 bytes per field. The ANC packet encapsulates these two bytes without modification, and adds a byte which identifies the VBI line and field to be used for insertion. The data count (DC) is therefore 3 (203h).

Note: Implementers must be aware that CEA-608 data is field based and that the field relationship must be maintained.

The format of the packet is as follows:

Header:

ADF (3 words)

DID = 161h

SDID = 102h

DC = 203h

UDW:

LINE (1 word)

CEA-608 data (2 words)

Suffix:

CS (1 word)

The LINE value at the start of the UDW represents the field number and line where the data are intended to be carried. Bit b7 of the LINE value is the field number (0 for field 2; 1 for field 1). Bits b6 and b5 are 0. Bits b4-b0 form a 5-bit unsigned integer which represents the offset (in lines) of the data insertion line, relative to the base line for the original image format (line 9 of 525-line field 1, line 272 of 525-line field 2, line 5 of 625-line field 1, line 318 of 625-line field 2).