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SMPTE STANDARD

Vertical Ancillary Data Mapping of ANSI/SCTE 104 Messages

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Foreword

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SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices. This SMPTE Engineering Document was prepared by Technology Committee D27.

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 serves in conjunction with ongoing work under SMPTE S22 defining communications mechanisms between program originator's Traffic and Billing systems and their facility Automation Systems. One facet of the end-to-end program system is Automation System triggering of downstream Digital Program Insertion ("DPI"). Such insertion is triggered typically by the presence of ANSI/SCTE 35 messages in the MPEG-2 Transport Stream.

ANSI/SCTE 104 defines the Communications API between the Automation System and the associated Compression System that results in the insertion of those ANSI/SCTE 35 messages. ANSI/SCTE 104 was drafted with bidirectional TCP/IP data communications in mind, but made explicit provision for unidirectional carriage of messages in video signals.

1 Scope

This Standard specifies a mechanism for the mapping of ANSI/SCTE 104 messages (with a maximum size of 2000 bytes) into 10-bit vertical ancillary data space. It is equally applicable to standard definition digital systems as well as high definition digital systems.

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.

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.

ANSI/SCTE 35-2004, Digital Program Insertion Cueing Message for Cable

ANSI/SCTE 104-2004, Automation System to Compression System Communications Applications Program Interface (API)

SMPTE 291M-2006, Television — Ancillary Data Packet and Space Formatting

SMPTE RP 168-2002, Definition of Vertical Interval Switching Point for Synchronous Video Switching

4 Definitions

4.1 Byte

Throughout this Standard, the term ‘byte’ shall refer to 8-bit values (and not 10-bit values) unless otherwise stated. In this Standard, 10-bit values are called “words.”

4.2 Inserter

An Inserter is a device that places an ANSI/SCTE 104 message into the VANC space of a digital video data stream in response to receipt of that message via TCP/IP or serial data communications.

4.3 Injector

An Injector is a device (or combination of devices) that convert ANSI/SCTE 104 message data into an SCTE 35 splice_info_section() placed in an MPEG-2 TS. In the context of this document the Injector expects to receive the ANSI/SCTE 104 message data in VANC.

5 Format of VANC Data Packets

Each data packet shall comply with the format defined in SMPTE 291M for a 10-bit type 2 ancillary space (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.

The DID word shall be set to the value 41h. The SDID word shall be set to the value of 07h. The same values of DID/SDID shall be used for all duplicated or continued packets (see § 5.2.2 and 5.2.3).

DC is a count of the number of words in the UDW.

Each ANSI/SCTE 104 message shall begin a new VANC data packet. If an ANSI/SCTE 104 message exceeds the capacity of a single VANC packet, multiple data packets will be required. No more than one complete ANSI/SCTE 104 message may be transmitted per video frame time.

An ANSI/SCTE 104 message utilizing this specification shall be limited to a maximum of 200 bytes in length for a single_operation_message() structure or a maximum of 2000 bytes in length for a multiple_operation_message() structure.

NOTE – Additional guidance on message length is provided by Informative § 5.3.3.

5.1 UDW Format

The UDW of each ANSI/SCTE 104 message starts with a one byte Payload Descriptor, followed by one or more bytes from the variable length ANSI/SCTE 104 message itself as shown in Figure 1. The format of the ANSI/SCTE 104 message bytes is defined in § 7 (“Message Formats”) of ANSI/SCTE 104.

The ANSI/SCTE 104 single_operation_message() or a multiple_operation_message() structure (as the case may be) shall first be extracted from whatever outer message structure may have been used to transport it to the Inserter before being placed in VANC.

The ANC packet UDW shall be a sequence of 10-bit words. The ANSI/SCTE 104 message information is transmitted in bits b7 through b0 of the 10-bit data word. Bit b8 is even parity for bits b7 through b0 of the 10-bit data word, and bit b9 equals not bit b8.

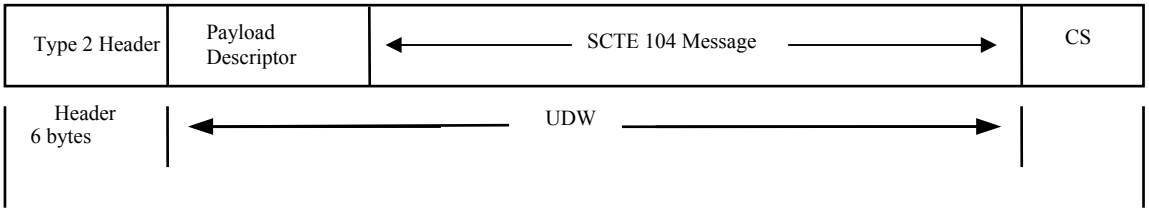

Figure 1 – VANC packet overall structure

The Payload Descriptor shall be added by the Inserter per § 5.2. Other single or double-byte values from either an ANSI/SCTE 104 single_operation_message() or a multiple_operation_message() shall be placed into the UDW words following the Payload Descriptor.

NOTE – These values should be according to Table 7-3 of ANSI/SCTE 104 for a single_operation_message()or FFFFh for a multiple_operation_message().

5.2 Payload Descriptor Format

The Payload Descriptor is a one byte value, added by the Inserter, that shall be the first word of the UDW. Table 1 summarizes the function of each bit of the Payload Descriptor byte.

Table 1 – Payload Descriptor Bit Assignments

Bit Position	Name	Description
7 (MSB)	Reserved	Shall set to '0'
6	Reserved	Shall set to '0'
5	Reserved	Shall set to '0'
4	VERSION (MSB)	Two bit value used to indicate syntax revision for mapping scheme – shall be set to "01"
3	VERSION (LSB)	
2	CONTINUED_PKT	Set to "1" when the ANSI/SCTE 104 message payload carried continues in the next VANC packet (see § 5.2.2).
1	FOLLOWING_PKT	Set to "1" when this packet is a continuation from the prior VANC packet in a video frame (see § 5.2.2).
0 (LSB)	DUPLICATE_MSG	Set to "1" when this message duplicates the message of a previous video frame

A Payload Descriptor byte value of 08h ('0000 1000_b') indicates the payload is carried in a single VANC data packet. Other values indicate other possible combinations.

5.2.1 Mapping syntax version flags

Two bits in the descriptor byte are used to signal the mapping syntax version to decoding devices. Bit 4 shall be set to logical zero and bit 3 shall be set to logical one for the mapping syntax described in this Standard.

Table 2 – Encoding Version (Bits 3 and 4)

	Bit 4	Bit 3
Reserved	0	0
Version 1 Mapping (current)	0	1
Reserved for future use	1	0
Reserved for future use	1	1

5.2.2 Continued packet and following packet flags

ANSI/SCTE 104 messages longer than 254 bytes must be encoded in two or more consecutive VANC packets (see § 5.4). These packets should be inserted on the same line of the video or continued on the line following. The “Continued_Pkt” flag (bit 2 of the payload descriptor byte) in all but the last VANC packets shall be set to logical one to signal that the ANSI/SCTE 104 message is split across two or more packets. The “Following_pkt” flag (bit 1 of the payload descriptor byte) in the packet containing the first part of the ANSI/SCTE 104 message shall be set to logical zero. The “Following_pkt” flag in the packet(s) containing the remaining parts of the ANSI/SCTE 104 message shall be set to logical one.

Table 3 – Continued Packet and Following Packet Flag Bits (Bits 1 and 2)

		CONTINUED_PKT Bit 2	FOLLOWING_PKT Bit 1
ANSI/SCTE 104 messages are contained within a single packet		0	0
ANSI/SCTE 104 messages are contained within two or more packets	First packet	1	0
	Intermediate packets	1	1
	Final packet	0	1

5.2.3 Duplicate message flag

Certain ANSI/SCTE 104 messages are permitted to be repeated multiple times in different frames of video to ensure receipt (See § 8.3 in ANSI/SCTE 104). This may be accomplished either by the Automation System or by the Inserter. Should the inserter provide this function, it must retain the message contents in a buffer, and it shall set the Duplicate_Msg flag bit to logical one in each and every duplicated message. A message may not be duplicated within the same frame of video. Duplicated messages need not be placed in immediately succeeding frames, rather may be spaced apart by several frames. Note: If this approach is taken, then certain values within certain SCTE 104 messages (such as pre-roll times) may need to be adjusted to maintain frame accuracy.

NOTE – Receiving equipment may use packets with the Duplicate_Msg flag bit set to logical one to assist downstream equipment with recovery from interruptions in the video stream.

5.3 ANSI/SCTE 104 Message Format

5.3.1 Serial data connection

If the VANC Inserter utilizes a serial data connection to the Automation System, then the messages received, which should have been encoded with the syntax specified in § B.1 (“The Basic Link Layer Syntax”) of ANSI/SCTE 104, shall be decoded into the normal ANSI/SCTE 104 message format specified above. This entails removal of any ESC sequences in the message prior to placement in the VANC payload.

5.3.2 TCP/IP data connection

If the VANC Inserter utilizes a TCP/IP data connection to the Automation System then the message bytes as received (after removal of any TCP/IP wrapper data) shall be placed intact into the VANC UDWs (see § 5.1).

5.3.3 Maximum ANSI/SCTE 104 message size (Informative)

ANSI/SCTE 104 messages using the single_operation_message() structure cannot exceed 200 bytes in length due to constraints in the message syntax, and typically range is between 13 and 21 bytes in length. ANSI/SCTE 104 messages using the multiple_operation_message() structure might, under certain circumstances, exceed 254 bytes in length, although a typical message length is less than 100 bytes. The normative constraints on message size may be found in the final paragraph of § 5.

Should the Automation System wish to send a number of time deferred requests at once (which would result in a single very large multiple_operation_message() structure), that it might instead divide these into several multiple_operation_message() structures which have the same trigger point value specified. Inserter manufacturers should be encouraged to document the maximum message length handled by a given device.

5.4 ANSI/SCTE 104 Messages Exceeding Single Packet Capacity

As noted in § 5, an ANSI/SCTE 104 single_operation_message() structure shall not exceed 200 bytes and is thus limited to a single ANC packet. Should an ANSI/SCTE 104 multiple_operation_message() structure exceed 254 bytes in length, it shall be divided into two or more smaller ANC packets by breaking the message at implementer determined points and setting the payload descriptor byte bits per § 5.2.2. The value of DC in each ANC packet along with the value of messageSize in each multiple_operation_message() structure permits the receiver to properly reassemble the full ANSI/SCTE 104 message.

6 Location of the Vertical Ancillary Data

The ANC data packet containing ANSI/SCTE 104 Data shall be located in the active line portion of lines 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 shall be placed in the vertical ancillary area of either field. For progressive segmented frame systems, the data packets shall be placed in the VANC 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 VANC 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.

Receiving equipment shall identify the ANC packets on the basis of their ANC DID and SDID fields.

NOTES

1 For high definition signals, the packet location is constrained to the Y stream in order to ensure passage of this data through deployed devices that do not process VANC data in the C stream.

2 Designers should be aware that although this standard specifies VANC as the location for the transport of information in an SD-SDI interface, there are legacy devices that will not pass this information if it is located on video lines where the V-bit (see SMPTE 125M and ITU-R BT.656) is set to logical one .

Annex A (Informative)
Bibliography

ITU-R BT.601-6 (01/07), Studio Encoding Parameters of Digital Television for Standard 4:3 and Wide-Screen 16:9 Aspect Ratios

ITU-R BT.656-4 (02/98), 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)

SCTE 67-2006, Digital Program Insertion Cueing Message for Cable – Interpretation for SCTE 35

ANSI/SMPTE 125M-1995, Television — Component Video Signal 4:2:2 — Bit-Parallel Digital Interface

SMPTE 352M-2002, Television — Video Payload Identification for Digital Interfaces

SMPTE RP 291-2006, Assigned Ancillary Identification Codes

Annex B (Informative)
Comments on the Preferred Location of VANC Packets

Notwithstanding the possibility that the VANC packets may be placed on any line in the vertical blanking interval, it may be desirable to further constrain the location to a preferred line to improve the probability of successful passage through the production process. System designers should be aware that many devices, particularly recorders, will pass data on only a small subset of lines in the vertical ancillary space. This must be taken into account in the system design and choice of data location.

Some recording devices record only one line of data from the vertical blanking interval while others may record up to 11 lines. These recorders may select the lines that they record, however, it is a common practice to set them to record three consecutive lines starting at the second line after the switching line. This constrains the available lines to the second line, the third line, and the fourth line after the switching line.

It has been observed that some poorly behaved devices do not test for existing ANC packets and consequently overwrite existing ANC packets. Typically, these devices insert data on the second line after the switching line.

Annex C (Informative)
Parsing Messages Conveyed via Serial Data Connections

As noted in § 5.3.1, a serial data connection will utilize a mechanism to prevent confusing message start_delimiter (02h), end_delimiter (03h), or ESC (1Bh) bytes with actual data bytes in the body of the message. Each occurrence of these byte values will have had that byte preceded by an ESC, thus forming a two character sequence of 1B02h, 1B03h, or 1B1Bh. This substitution operation must be done by the message transmitter.

The Inserter (which is a receiving device of the message) needs to remove the “excess” ESC characters prior to computing the message CRC value, as specified in § B.2 (“The Escape Sequence”) of ANSI/SCTE 104. Once the resultant message CRC is validated, then the message body, minus the CRC, is placed into VANC per this document.