SMPTE 291M-2006
Revision of
SMPTE 291M-1998

SMPTE STANDARD

for Television — Ancillary Data Packet and Space Formatting

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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 Standard 291M was prepared by Technology Committee N26

Approved
September 20, 2006

Introduction

Ancillary data packets and space formatting described by this Standard reside in an Ancillary space defined by the interconnecting interface document. In general sense, Ancillary space in a serial interface is a space not used by the main data stream and is used as a transport for data associated with the main data stream. The type of payload data carried in the ancillary space is then defined in separate application documents.

SAV (Start of Active Video) and EAV (End of Active Video) markers that mark an active digital video/data space exist on all serial digital interfaces (SDI, HD-SDI and SDTI) regardless of number of TV lines of the used television system.

During a horizontal interval of every television line, the ancillary space that is located between EAV and SAV markers is called horizontal ancillary space (HANC space).

During a vertical interval of each frame, the ancillary space located between SAV and EAV markers is called vertical ancillary space (VANC space).

Ancillary data packets are further divided into Type 1 and 2, where Type 1 uses single ID word and Type 2 uses two ID words. Using this method allows for a wider range of identification values within the limited ID word space. In addition, a total of 189 data identification values are reserved for 8-bit applications, whereas up to approximately 29,000 values are provided for 10-bit applications.

The basic formats of ancillary data packets are similar for both Type 1 and Type 2, but they differ in the use of a data block number. The definitions of the individual parts that make up the ancillary data packet, such as ancillary data flags (ADF), data identification (DID), secondary data identification (SDID), data block numbers (DBN), data count (DC), data validity checksum (CS), together with the restrictions on used data, are contained in this standard.

All of the assigned Ancillary ID codes are contained within SMPTE RP 291 (Assigned Ancillary Identification Codes) which serve as a registry document for the ancillary ID space. Reason for such a division is to assure updated information on assigned ancillary codes to implementers. Applications utilizing ancillary data as defined by this standard normatively include their assigned ID values so the RP need not be a normative reference.

Legacy equipment

The serial digital interface (SMPTE 259M, SMPTE 305M, and SMPTE 292M) and component parallel digital interface (SMPTE 125M, SMPTE 274M and SMPTE 296M) are capable of passing 10-bit words (Data 9 – Data 0). However some legacy equipment is only capable of processing 8-bit data words (carried on the interface as Data 9 – Data 2). The passage of 10-bit words through such equipment will therefore result in truncation of the last two LSBs (Data 1 and Data 0) of the ancillary data word.

1 Scope

1.1 This standard specifies the basic formatting structure of the ancillary data space in digital video data streams in the form of 10 bit words. Application of this standard includes 525 line, 625 line, component or composite, and high definition digital television interfaces (750 and 1125 lines) and D-Cinema applications that provide 8-bit or 10-bit data ancillary data space.

1.2 Space available for ancillary data packets is defined in the document specifying the connecting interface.

1.3 Ancillary data packet payload definitions for a specific application shall be according to a SMPTE standard, a Recommended Practice, an Engineering Guideline or a document generated by another organization. When a payload format is considered a registered format, an application document is required and the ancillary packet is identified by a registered data identification word.

2 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.

No Normative references are specified for implementation of this standard.

3 Ancillary data packet format

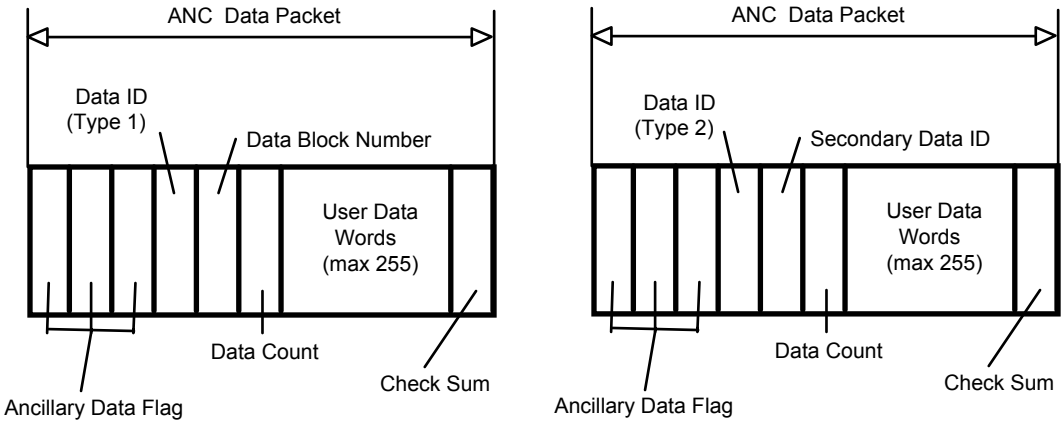
3.1 Ancillary data packet

3.1.1 Ancillary data packets shall be formatted into one of two types Type 1 and Type 2, which depend upon the Data identification word. These two types are shown in Figure 1(a) and 1(b).

3.1.2 The two types of data identification in the ancillary data packet format are specified below:

Type 1 – Shall use a single word data identification; defined as data ID (DID) word which is followed by data block number (DBN) and data count (DC) words.

Type 2 – Shall use *a* dual word data identification; defined as a combination of a data ID (DID) word and a secondary data ID (SDID) word which is followed by data count (DC) word.



(Figure 1a) Type 1 **(Figure 1b) Type 2**

Figure 1 – Ancillary data types (Component data packets shown)

3.1.3 Ancillary data is defined as 10-bit words. This is required by the structure of the signal format and its interface. These bits are annotated using b0 as the LSB of the 10-bit word and b9 as the MSB of the 10-bit word.

3.1.4 Type 1 ancillary data packets shall be comprised of:

a) An ancillary data flag word (ADF) which marks the beginning of the ancillary packet.

b) A data identification word (DID) which defines the use of the user data format carried in the ancillary packet's user data words.

c) A data block number word (DBN) for Type 1 only, which distinguishes successive ancillary packets with a common data ID.

d) A data count number word (DC) which defines the quantity of user data words in the ancillary packet.

e) The user data words (UDW), comprising up to 255 words in each ancillary packet where the user data format is defined in a specific application document.

f) A checksum word (CS).

3.1.5 Type 2 ancillary data packets shall be comprise of the same elements as type 1 ancillary packets, except that the data block number (DBN) is replaced by a secondary data identification word (SDID).

3.1.6 The length of the ancillary data flag word (ADF) is specified in the document defining the interconnecting interface. Unless otherwise noted in this standard, there shall be three words for component data and one word for composite data.

3.1.7 Both data identification types may be used on component or composite interfaces while retaining the same meaning.

3.2 Component ancillary data packet format

3.2.1 The format of the component ancillary data packet is shown in Figure 2.

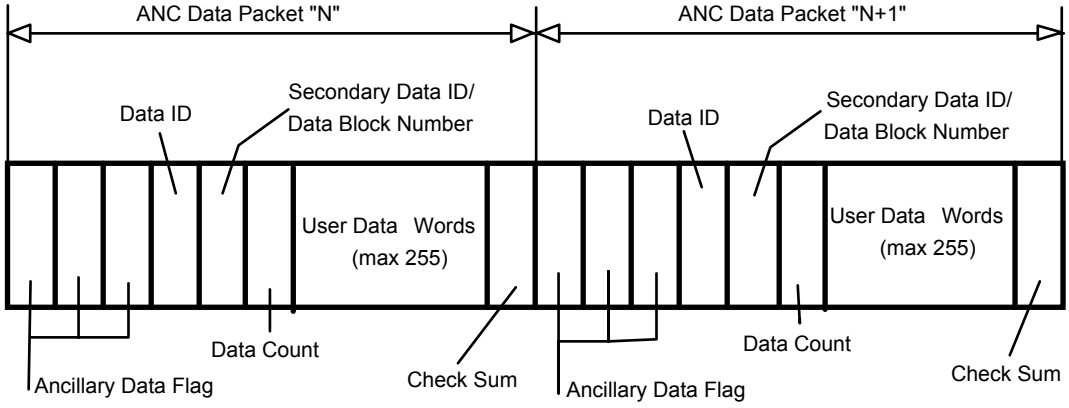


Figure 2 – Component ancillary data packet format

3.2.2 The ancillary data flag for the component ancillary data packet format shall be:

000h 3FFh 3FFh

NOTE – To maximize compatibility between 8-bit and 10-bit equipment, equipment designers are advised to process data values using only the 8 MSBs. Thus values of 000h to 003h and 3FCh to 3FFh are handled identically. References in this standard to any specific data values will assume that only the 8 MSBs are considered significant.

3.3 Composite ancillary data packet format

3.3.1 The format of the composite ancillary data packet shall be as shown in Figure 3.

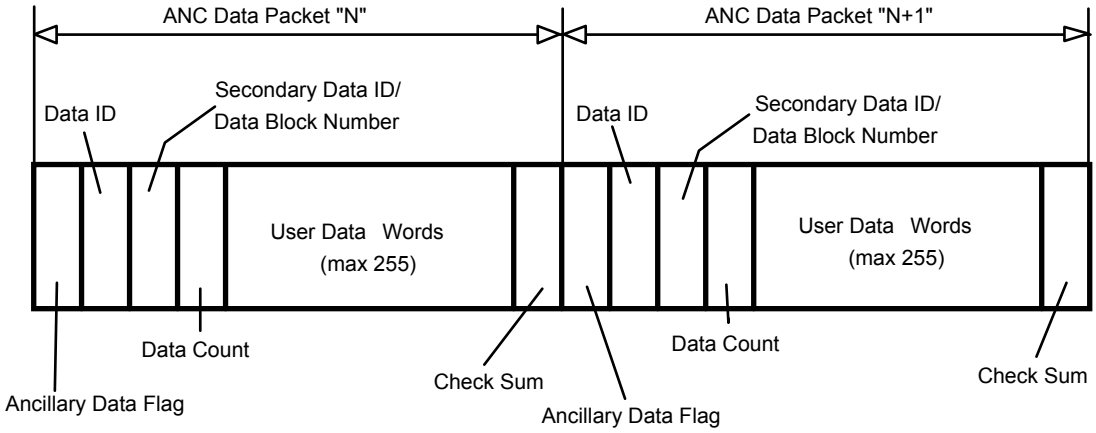


Figure 3 – Composite ancillary data packet format

3.3.2 The Ancillary Data Flag for composite ancillary data packet format shall be 3FCh.

NOTE – Equipment designers should be aware that the value of the composite ancillary data flag 3FCh is processed as referenced in the note of section 3.2.2.

3.3.3 Definitions of other non-user data are specified in sections 3.4 through 3.12.

3.4 Data identification word (DID) (Type 1 and 2 data)

3.4.1 The data ID word (DID) shall consist of 10 bits comprising an 8-bit identification word plus even parity and its inverse as follows:

bits b7 (MSB) through b0 (LSB) shall define the 8-bit DID word (00h - FFh)

bit b8 shall be even parity for bits b7 through b0

bit b9 = not b8

3.4.2 DID words are divided into type 1 and type 2 categories as defined in figures 4a and 4b. The setting of bit b7=1shall indicate type 1 data identification and b7=0 shall indicate type 2 data identification.

The exception to this categorization is word 00h, which shall identify an undefined format.

3.4.3 DID words shown as internationally registered shall be restricted to values in the range shown and are assigned by standards-setting organizations. Ancillary data in this specific class are of general interest; therefore, strict compliance with this standard assures compatibility between such equipment.

3.4.4 DID words shown as user application are not registered and shall be restricted to values in the range shown. They may be assigned by the user and/or by the manufacturer of the specific equipment.

NOTE – Equipment designers are encouraged to make such equipment user configurable to minimize contention problems.

3.4.5 DID words shown as reserved for 8-bit applications shall be restricted to three values in the range shown. Out of the values 04h – 0Fh reserved for 8-bit applications, the only valid values shall be 04h, 08h, 0Ch. Other values in the reserved range should be truncated to these three values.

INFORMATIVE NOTE – Other values in the reserved range should not be used in an 8-bit system because they will be truncated and indistinguishable from DID's such as "Undefined format", "Marked for deletion", "End marker" and "Start marker"

3.4.6 DID words shown as reserved are reserved for future use.

3.5 Secondary data identification word (SDID) (Type 2 data only)

3.5.1 The secondary data ID word (SDID) shall consist of 10 bits, an 8-bit identification plus parity and its inverse as shown:

bits b7 (MSB) through b0 (LSB) shall define the 8-bit SDID word (00h through FFh)

bit b8 shall be even parity for bits b7 through b0

bit b9 = not b8

3.5.2 SDID words which represent the type 2 data identification format shall lie in the range of values from 01h through FFh as shown in Figure 4b. The value 00h is reserved for an undefined format.

3.5.3 When the SDID word value is used for 8-bit applications, the SDID shall be restricted to the 63 values (excluding 00h) indicated below:

x0h, x4h; x8h; xCh,

where x may be any value in the range 0h through Fh.

3.6 Data identification word for deletion of an ancillary data packet

3.6.1 An ancillary data packet with a DID word value equal to 80h may be deleted by any equipment during a subsequent processing cycle (see Annex B). However, the occupied ancillary space shall remain contiguous as defined in section 4.3.

INFORMATIVE NOTE – In an 8-bit system, designers of equipment should be aware that ancillary data with a DID word in the range of 80h – 83h shall be considered as marked for deletion.

Data Type	Data Value DID	Data Assignment
	00h	Undefined format (see 3.4.2)
Type 2 (2 word ID)	01h 03h	Reserved (see 3.4.5)
	04h 0Fh	Reserved for 8-bit applications (see 3.4.5)
	10h 3Fh	Reserved
	40h 4Fh	Internationally registered
	50h 5Fh	User Application
	60h 7Fh	Internationally registered
Type 1 (1 word ID)	80h	Ancillary packet marked for deletion (see 3.6.1)
	81h 83h	Reserved
	84h	Optional Ancillary packet Data End Marker (see 3.8.2)
	85h 87h	Reserved (see 3.8.2)
	88h	Optional ancillary packet Data Start marker (see 3.8.1)
	89h 9Fh	Reserved (see 3.8.1)
	A0h BFh	Internationally registered
	C0h CFh	User Application
	D0h DFh	Internationally registered
	E0h FFh	Internationally registered

Figure 4a – DID

Data Type	Data Value SDID	Data Assignment
	00h	Undefined format
Type 2	01h FFh	None

Figure 4b – SDID

Figure 4 – Data type and data range identification word assignment

3.8 Data identification word for Start marker packet and an End marker packet

3.8.1 An ancillary data packet with a DID equal to 88h shall identify a Start marker packet in a given ancillary space. The data count for this packet shall be set to zero (0) as per section 3.10.1. The length of the start marker packet shall be constant and equal to four words excluding the ADF. Use of this packet is optional.

INFORMATIVE NOTE – Equipment designers are encouraged to include this feature in new equipment, especially equipment dedicated to deletion of ancillary data. In an 8-bit system, designers should be aware that ancillary data with a DID range of 88h – 8Bh shall be considered as data Start marker packets.

3.8.2 An ancillary data packet with a DID equal to 84h shall identify an End marker packet in a given ancillary space. The data count for this packet shall be set to zero (0) as per section 3.10.1. The length of the end marker packet shall be constant and equal to four words excluding the ADF. Use of this packet is optional.

INFORMATIVE NOTE – Equipment designers are encouraged to include this feature in new equipment, especially equipment dedicated to deletion of ancillary data. In an 8-bit system, designers should be aware that ancillary data with a DID in the range of 84h – 87h shall be considered as data End marker packets.

3.9 Data block number (DBN) (Type 1 data only)

3.9.1 The data block number (DBN) word shall be incremented by one for each consecutive related type 1 data packet sharing a common DID and requiring a continuity indication.

3.9.2 The DBN word in the type 1 data identification system consists of 8 bits and shall increment from 1 through 255 where:

bits b7 (MSB) through b0 (LSB) shall define the data block (packet) number word

bit b8 shall be even parity for bits b7 through b0

bit b9 = not b8

INFORMATIVE NOTE – If the number of packets in a message is longer than 255 packets, then the DBN shall be cycled again continuously from 1 through 255 with subsequent groups of packets. Equipment designers are encouraged to include additional information about the message length in the user data words.

3.9.3 When bits b7 through b0 of the data block number (DBN) are set to zero, the DBN shall be inactive and shall not be used by the receiver to indicate data continuity.

3.10 Data count (DC)

The data count (DC) word represents the number of user data words (UDW) to follow from a minimum of 0 up to a maximum of 255 words. In 10-bit applications, it shall consist of 10 bits where:

bits b7 (MSB) through b0 (LSB) shall define the data count number

bit b8 shall be the even parity for b7 through b0

bit b9 = not b8

INFORMATIVE NOTE – Ancillary data packets with a data count value of 0 are possible, but denote packets which are either empty, and therefore can be ignored, or are start marker packets or are end marker packets.

3.11 User data words (UDW)

3.11.1 User data words shall be used to convey information as identified by the DID word and shall not include protected codes as defined in clause 5.

3.11.2 The maximum number of user data words in a single packet shall be 255.

3.11.3 In 10-bit applications, user data words shall consist of 10-bit words formed by:

bit b9 (MSB) through b0 (LSB)

3.11.4 In 8-bit applications, user data words shall consist of 8-bit words formed by:

bit b9 (MSB) through b2 (LSB)

3.12 Checksum word (CS)

3.12.1 The checksum word (CS) shall be used to determine the validity of the ancillary data packet from the data identification (DID) word through the user data words (UDW). It shall consist of 10 bits where:

bits b8 (MSB) through b0 (LSB)shall define the checksum value

bit b9 = not b8

3.12.2 In 10-bit applications, the checksum value shall be equal to the nine least significant bits of the sum of the nine least significant bits of the data identification (DID), the data block number (DBN) or the secondary data identification (SDID), the data count (DC) and all user data words (UDW) in the packet.

3.12.3 Prior to the start of the checksum count cycle, all CS bits shall be preset to zero and any end carry resulting from the checksum count cycle shall be ignored.

INFORMATIVE NOTE – Equipment designers are encouraged to include in a specific user application an additional data protection algorithm due to the limited capability of the checksum system. The protection algorithm shall be included in the user data area.

4 Ancillary data space formatting

4.1 Component data space

Multiple ancillary data packets may be located in any area defined as available for ancillary data. The first packet shall follow immediately after the EAV or SAV denoting the start of that space and any sequence of multiple packets shall be contiguous.

4.2 Composite data space

Multiple ancillary data packets may be located in any area defined as available for ancillary data including all broad pulses. They shall follow immediately after the TRS-ID or start of the broad pulse denoting the start of that space and any sequence of multiple packets shall be contiguous.

4.3 Presence, positioning and deletion of ancillary packets in available space

Ancillary data packets shall be wholly contained within the ancillary space in which they are inserted.

4.3.1 The contiguity of ancillary packets in an ancillary space is maintained only within its nearest interval boundary and the packets in this interval shall be concatenated in time following its boundary.

INFORMATIVE NOTE – For example, if some ancillary packets are marked for deletion with DID=80h from within a specific horizontal blanking interval or a vertical blanking interval (vertical ancillary space), then contiguity of ancillary packets in these intervals is still maintained, but contiguity of packets between different intervals (horizontal or vertical) is not required.

4.3.2 Ancillary data packets may be marked for deletion by replacing the original data ID (DID) of the ancillary packet with a DID equal to 80h and reinserting a new checksum for this packet. This will mark the ancillary packet as invalid while maintaining contiguity of data in the ancillary space. The rest of the marked ancillary packet remains unchanged.

4.3.3 It is recommended that ancillary data packets not be transmitted within an ancillary space following a normal vertical interval switching point as defined in SMPTE RP 168 for a time period covering the remainder of the switched line and during the first horizontal ancillary data space interval subsequent to the switched line.

INFORMATIVE NOTE – Receiving equipment should process data located in any ancillary data space as some existing equipment already in operation may not conform to this recommendation on the switching point.

4.3.4 Optional ancillary data packets with a DID equal to 84h may be used as end marker packets of a contiguous ancillary space and they are the last packet in a given ancillary space. Upon reinsertion of new ancillary data, these packets shall be overwritten by the new data. The end marker packet shall not be inserted in a given ancillary interval if the remaining ancillary space is smaller than the space required.

4.4 Exemptions from ancillary data space formatting

4.4.1 Error detection and handling data as defined in SMPTE RP 165, are located within a fixed part of the ancillary data space and therefore are not overwritten or appended to other data packets or subject to the requirements of section 4.3.1.

4.4.2 Serial Data transmission over SMPTE 259M (SDI)

Ancillary data packets representing header packets for Serial Data transmission over SDI, shall be exempt from rules set in sections 4.1 and 4.2. These Header packets are always located immediately after EAV in HANC component data space or TRS-ID of an ancillary composite data space.

5 Protected codes

5.1 Ancillary data environment

Except for the ancillary data flag (three words in component systems and one word in composite systems), certain codes are protected and not permitted in other parts of the ancillary data packet format.

5.1.1 The ten-bit word values 000h, 001h, 002h, 003h and 3FCh, 3FDh, 3FEh, 3FFh shall not be permitted in any ancillary data packet.

Annex A (informative)
Example of ancillary data formats

Component data stream format

	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	Hex
ADF	0	0	0	0	0	0	0	0	0	0	000h
ADF	1	1	1	1	1	1	1	1	1	1	3FFh
ADF	1	1	1	1	1	1	1	1	1	1	3FFh
DID	p/	p	b7	b6	b5	b4	b3	b2	b1	b0	
DBN/SDID	p/	p	b7	b6	b5	b4	b3	b2	b1	b0	
DC	p/	p	b7	b6	b5	b4	b3	b2	b1	b0	
UDW(0)	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
					|					
UDW(255)	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
CS	b8/	Check sum									

Composite data stream format

	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	Hex
ADF	1	1	1	1	1	1	1	1	0	0	3FCh
DID	p/	p	b7	b6	b5	b4	b3	b2	b1	b0	
DBN/SDID	p/	p	b7	b6	b5	b4	b3	b2	b1	b0	
DC	p/	p	b7	b6	b5	b4	b3	b2	b1	b0	
UDW(0)	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
					|					
UDW(255)	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	
CS	b8/	Check sum									

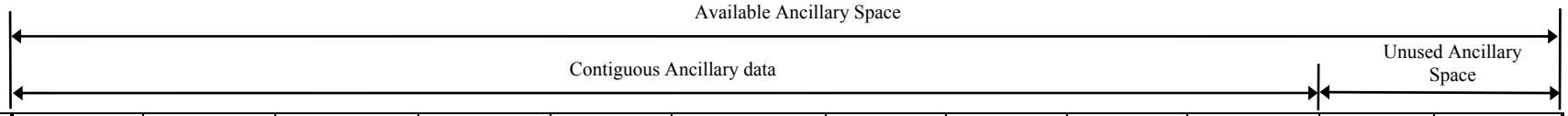
NOTES

1 In Type 2 (8-bit applications), bits b0 and b1 of DID and SDID words are set to zero

ADF:	Ancillary data flag	SDID:	Secondary data identification word
DID:	Data identification word	DC:	Data count
DBN:	Data block number	UDW:	User data word

Annex B (Informative)
Example of a component ancillary data space

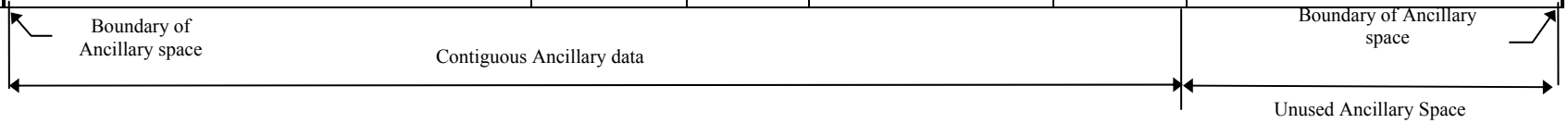
(All values in the table are shown in HEX, Checksum word is omitted.)



ADF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	xxx	xxx
DID	2FF	1FD	2FC	180	2F5	260	2C0	140	104	284	xxx	xxx
DBN/ SDID	101	101	101	xxx	200	260	xxx	xxx	110	00	xxx	xxx
DC	230	224	206	xxx	108	110	xxx	xxx	xxx	00	xxx	xxx
UDW	48 words	36 words	6 words	xxx	8 words	16 words	xxx	xxx	xxx	none	xxx	xxx
Note	AES 20 bit audio packets Group 1 (Ch 1-4) 4 Samples	AES 20-bit audio packets Group 2 (Ch 5-8) 3 Samples	AES Extended audio packets Group 2 (Ch 5-8) 3 Samples	Marked for deletion	LTC time code	ATC Ancillary time code	User defined	User defined	8-bit applica-tion.	Data End Marker packet		
Type	Type 1 data					Type 2	Type 1	Type 2 data		Type 1		

Re-formatted Ancillary space after deletion of marked packet

ADF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	000 3FF 3FF	xxx	xxx	xxx
DID	2FF	1FD	2FC	2F5	260	2C0	140	104	284	xxx	xxx	xxx
DBN/ SDID	101	101	101	200	260	xxx	xxx	110	00	xxx	xxx	xxx
DC	230	224	206	108	110	xxx	xxx	xxx	00	xxx	xxx	xxx
UDW	48 words	36 words	6 words	8 words	16 words	xxx	xxx	xxx	none			
Note	AES 20 bit audio packets Group 1 (Ch 1-4) 4 samples	AES 20-bit audio packets Group 2 (Ch 5-8) 3 samples	AES Extended audio packets Group 2 (Ch 5-8) 3 samples	LTC time code	ATC Ancillary time code	User defined	User defined	8-bit applica-tion.	Data End Marker packet			
Type	Type 1 data				Type 2	Type 1	Type 2		Type 1			



Annex C (normative)
ID code assignments process

(a) An applicant requesting an ID code shall contact SMPTE Headquarters in writing and request an Ancillary packet ID assignment. Contact address may be found at the top of this document .

(b) Each submission for ID code assignment shall be accompanied by proposed application document that describes the purpose and need for such a code.

(c) Assigned ancillary identification codes shall be contained within SMPTE RP 291, Assigned Ancillary Identification Codes, after SMPTE standardization approval process.

Annex D (informative)
Bibliography

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SMPTE 259M-2006, Television — SDTV Digital Signal/Data — Serial Digital Interface

SMPTE 260M-1999, Television — 1125/60 High-Definition Production System — Digital Representation and Bit-Parallel Interface

SMPTE 267M-1995, Television — Bit-Parallel Digital Interface — Component Video Signal 4:2:2 16 x 9 Aspect Ratio

SMPTE 274M-2005, Television — 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates

SMPTE 292M-1998, Television — Bit-Serial Digital Interface for High-Definition Television Systems

SMPTE 296M-2001, Television — 1280 x 720 Progressive Image Sample Structure — Analog and Digital Representation and Analog Interface

SMPTE 305M-2005, Television — Serial Data Transport Interface (SDTI)

SMPTE RP 165-1994, Error Detection Checkwords and Status Flags for Use in Bit-Serial Digital Interfaces for Television

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

SMPTE RP 291-2006, Assigned Ancillary Identification Codes

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)