

SMPTE RECOMMENDED PRACTICE

Ancillary Data Space Use —
4:2:2 SDTV and HDTV Component
Systems and 4:2:2 2048 ×1080
Production Image Formats



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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 Operations Manual.

SMPTE RP 291-2 was prepared by Technology Committee 32NF.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Recommended Practice. 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.

Ancillary data space in a serial digital interface is that space not used by either the main video data stream or synchronizing signals and thus can be used as a transport for data associated with the main data stream. The packetized payload data carried in the ancillary data space is defined in separate application documents conforming to SMPTE ST 291-1.

This document defines the supplementary usage rules for Ancillary data spaces on an interconnecting interface compliant with SMPTE ST 291-1.

The ancillary data space located during the horizontal interval of every video line (between EAV and SAV) is called horizontal ancillary data space (HANC). The ancillary data space located during the vertical interval of each field or frame, (between SAV and EAV) is called vertical ancillary data space (VANC).

Ancillary data packets transported in the ancillary data space need to conform to rules of SMPTE ST 291-1. Some of the rules documented in SMPTE ST 291-1 are also repeated in this document. The packet location in ancillary data space is defined by an application document.

1 Scope

This document provides information on the size of the ancillary data space in 8-bit and 10-bit 4:2:2 component HDTV systems and 10-bit 4:2:2 2048x1080 Production Image formats operating on 1.485 Gb/sec, and 2.97 Gb/sec and dual link 1.485 Gb/sec serial digital interfaces. Additionally, the document covers 8-bit and 10-bit 4:2:2 component SDTV systems operating on 270 Mb/sec serial digital interfaces. The frame rates of the included formats are in range from 24 Hz/1.001, 25 Hz, 30 Hz/1.001, 48 Hz/1.001, 50 Hz, and 60 Hz/1.001 for progressive, progressive segmented frames or interlace formats. This document also describes the rules for carriage of ancillary data packets conforming to SMPTE ST 291-1

The carriage of ancillary data packets in composite SDTV systems, 4:4:4 component systems 360 Mb/sec and 540 Mb/sec and multiple link 2.97 Gb/sec serial digital interfaces, 12-bit interfaces, as well as the carriage of ancillary data packets in file formats are not covered by this document.

Numerical values shown in tables are based on a 10-bit interface word.

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

Note: All references in this document to other SMPTE documents may use the current numbering style (e.g. SMPTE ST 125:1995) although, during a transitional phase, a reference document as published (printed or PDF) may bear an older designation (such as ANSI/SMPTE 125M-1995). Documents with the same root number (e.g. 125) and publication year (e.g. 1995) are functionally identical.

The following standards contain provisions that, through reference to 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 125:1995, Television — Component Video Signal 4:2:2 — Bit-Parallel Digital Interface

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

SMPTE ST 296:2012 - 1280 × 720 Progressive Image 4:2:2 and 4:4:4 Sample Structure — Analog and Digital Representation and Analog Interface

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

SMPTE ST 372:2011, Dual Link 1.5 Gb/s Digital Interface for 1920 × 1080 and 2048 × 1080 Picture Formats

SMPTE ST 425-1:2011, Source Image Format and Ancillary Data Mapping for the 3 Gb/s Serial Interface

SMPTE ST 2048-2:2011, 2048 × 1080 Digital Cinematography Production Image FS/709 Formatting for Serial Digital Interface

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

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

Recommendation ITU-R BT 601-7 (2011), Studio Encoding Parameters of Digital Television for Standard 4:3 and Wide-Screen 16:9 Aspect Ratios

Recommendation ITU-R BT 656-5 (2007), Interface 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

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

4 Glossary, Definitions of Acronyms and Terms (Informative)

Glossary and definition of acronyms and terms used throughout this document are only valid for this Recommended Practice. Any similar terms used in other documents may deviate from the definitions included in this document, and this difference can be ignored.

4.1 Glossary, Definitions of Acronyms and Terms

4.1.1

ADF

Ancillary Data Flag (3 digital code words – 000h, 3FFh, 3FFh) indicates the start of an Ancillary data packet in all component video.

4.1.2

Ancillary Data Space

Ancillary data space in a serial interface is space not used by the main video data stream or the synchronizing signals and thus can be used as a transport for data transmission associated with the main video data stream. This data space is essentially equal to the space defined by the horizontal or vertical intervals of a given video. The type of payload data carried in the ancillary data space is defined in separate application documents.

4.1.3

Ancillary Data Rate

MWords/sec; a data throughput rate through ancillary space. For calculation of packet data payload throughput via an ancillary packet see Annex B.

4.1.4

Ancillary Data packet Type 1

Ancillary data packets Type 1 use a single digital ID code word called the DID, defined in SMPTE ST 291-1.

4.1.5

Ancillary Data packet Type 2

Ancillary data packets Type 2 use a pair of digital ID code words in combination called DID/SDID, defined in SMPTE ST 291-1.

4.1.6

color difference (C_B/C_R)

Component signals C_B and C_R that represent the color of an image and are derived from the basic red, blue and green color components of an image.

4.1.7

CS

Check Sum word (1 digital code word) is used to determine the validity of the ancillary data packet. CS serves as a detector to indicate if that the ancillary data packet was transmitted over an interface without data corruption. The CS calculation for ancillary data packets is defined in SMPTE ST 291-1

4.1.8

DC

Data Count Word (1 digital code word) indicating the length of the ancillary data packet payload. The use of the DC code word is defined in SMPTE ST 291-1.

4.1.9

DID

Data Identification word (1 digital code word) is the main identification code word used by an Ancillary data packet application for ancillary data packets of Type 1 or as the first word of a pair (DID/SDID) for ancillary data packets of Type 2. Value ranges of DID words is defined in SMPTE ST 291-1.

4.1.10

D-VITC

Digital Vertical Interval Time Code defined in SMPTE ST 266 for SDTV Component Systems.

4.1.11

EAV

End of Active Video – consists of 4 digital data code words; this acronym is used for SDTV.

4.1.12

HANC

Horizontal Ancillary Data Space is the Ancillary Data Space located during the horizontal interval of a video line. The expressions HANC or HANC space are used interchangeably throughout the document.

4.1.13

H-EAV

In HDTV, video End of Active Video (EAV) consists of 8 digital code words; to differentiate from the EAV in SDTV video. Within this document, this is called H-EAV. However, the majority of SMPTE documents use the acronym EAV interchangeably regardless of whether it is related to SDTV or HDTV.

4.1.14**HDTV video**

High Definition Television Video; commonly based on use of 720 or 1080 line video; it can be either progressive or interlaced scanning. 2048 x 1080 format is excluded from HDTV nomenclature.

4.1.15**HD-SDI**

High Definition Serial Digital Interface – commonly used by 720 and 1080 line video interfaces operating at nominal 1.485 or 2.97 Gb/sec.

4.1.16**“h”**

A suffix indicating that a value is shown in a hexadecimal format.

4.1.17**“H”**

A subscript indicating that a specific value is referenced to a horizontal time point defined by a specific point on a video line.

4.1.18**Horizontal interval**

An interval on each line of a field or frame between time reference points EAV and SAV designated for this purpose. In the past this space used to be called “horizontal blanking interval” and some older documents still use this expression.

4.1.19**luma (Y)**

A component signal that presents brightness of an image.

4.1.20**PRE-VANC**

The portion of the VANC starting with the line following the end of the active video area and ending with the line before the vertical interval switch point in the vertical interval of a frame or field; see the illustration in Figure 2.

4.1.21**Protected value**

Code values that are reserved for synchronization purposes on the serial interface, or for identifying an ancillary data packet and thus are not permitted to be used in data payloads.

4.1.22**RP**

An acronym used by SMPTE for a Recommended Practice document. Within the text or tables of this document, prefix SMPTE prior Recommended Practice number will not always be used; therefore the expression SMPTE RP XXX or RP XXX indicates identical document.

4.1.23**SDTV video**

Standard Definition Television Video; commonly based on use of 525 or 625 scan lines; it is primarily used for interlaced component video.

4.1.24**SAV**

Start of Active Video – consists of 4 digital code data words; this acronym is used equally for both SDTV and HDTV video.

4.1.25**SDI**

Serial Digital Interface – commonly used by 525 and 625 television line interfaces operating at 270 Mb/sec.

4.1.26**SDID**

Secondary Data Identification word (1 digital code word) is used in combination with a given DID code word

4.1.27**ST**

An acronym used by SMPTE for a Standard document. Within the text or tables of this document, prefix SMPTE prior Standard's number will not always be used; therefore the expression SMPTE ST XXX or ST XXX indicates identical document.

4.1.28**synchronizing words**

(3FFh, 000h, 000h, XYZh) – digital data code words providing indication of time events in various TV video.

4.1.29**UDW**

User Data Word, representing a word of an ancillary data packet payload; maximum 255 words for each ancillary packet

4.1.30**Vertical interval**

An interval is formed by multiple lines of a field or frame located between time reference points designated for this purpose. The vertical interval of a field or frame starts at the beginning of a line following the last line of an active image for field or frame N, and ends at the last line prior to the start of an active image for field or frame N+1. This vertical interval used to be called a “vertical blanking interval” and some older documents still use this expression.

4.1.31**VANC**

Vertical Ancillary Data Space is the Ancillary Data Space located between SAV and EAV during the vertical interval of a video frame or field. The expressions VANC or VANC space are used interchangeably throughout the document.

4.1.32 **v**

A subscript indicating that a specific value is referenced to vertical time point defined by a specific line of a video frame

4.2 Ancillary Space Tabulation

This document contains 8 tables which tabulate the sizes of HANC, VANC and POST-VANC ancillary data spaces. Table 1 below provides an overview of the information covered by each table.

Table 1 – Pointers to tables

Ancillary space	Interface	SDTV	1280 x 720 1920x1080	2048x1080
HANC space	Single Link	Table 2a		
	Dual Link	NA	Table 2b	
VANC space	Single Link	Table 3a		Table 3b
	Dual Link	NA	Table 3c	
POST-VANC space	Single Link	Table 4a		Table 4b
	Dual Link	NA	Table 4c	

5 Ancillary Data Space Definitions

Ancillary data space in a serial digital interface is that space not used by either the main video data stream or synchronizing signals and thus can be used as a transport for data associated with the main data stream. The ancillary data space available in serial digital interface transports is approximately equivalent to horizontal interval space and vertical interval space for a specific video format. The sizes of these ancillary intervals for component video documents are shown in Table 2 thru Table 4.

Note: Previous SMPTE documents used the nomenclature "Vertical Blanking Interval" which has been changed to "Vertical Interval" in new documents. Similarly, previous SMPTE documents used the nomenclature "Horizontal Blanking Interval" which has been changed to "Horizontal Interval" in new documents.

For an SDTV video, SAV and EAV serial digital interface markers provide demarcation in an active digital video/data space and exist on all SDTV serial digital interfaces regardless of the number of TV lines used by the television video.

For an HDTV video, SAV and H-EAV serial digital interface markers provide demarcation in an active digital video/data space and exist on all HDTV serial digital interfaces regardless of the number of TV lines used by the television video.

This document will not normally differentiate between EAV and H-EAV due to the established practice of using the terms synonymously. The available ancillary data space shown in this document takes account of the different number of words for the EAV and H-EAV markers.

The space located in the horizontal interval of every video line (between EAV and SAV) is called horizontal ancillary data space (HANC). The space located between SAV and EAV of the vertical interval lines of each field or frame is called the vertical ancillary data space (VANC).

Early documented video (525 or 625 line video) used as a timing reference point for vertical alignment a timing point indicated as 0_V and for the horizontal alignment a timing point as 0_H .

The switching point (line) during the vertical interval of a typical video frame, where the switch between different video streams might happen, is different from the vertical timing reference point (0_V) that is defined in television video shown in the reference documents.

Available ancillary data space for ancillary data packet insertion is determined by the image source and streaming interface documents. Additional ancillary data space made available by use of external channels (e.g. alpha channel) and by combining multiple serial digital interfaces forming new structures are excluded from this document due to the complexities involved. Such space is to be identified by relevant mapping documents for those various interfaces.

The type of payload data carried in the ancillary data space is defined in separate application documents for specific types of ancillary data. A listing of existing application documents is available on SMPTE registration Web site. (See Section 13 of this document).

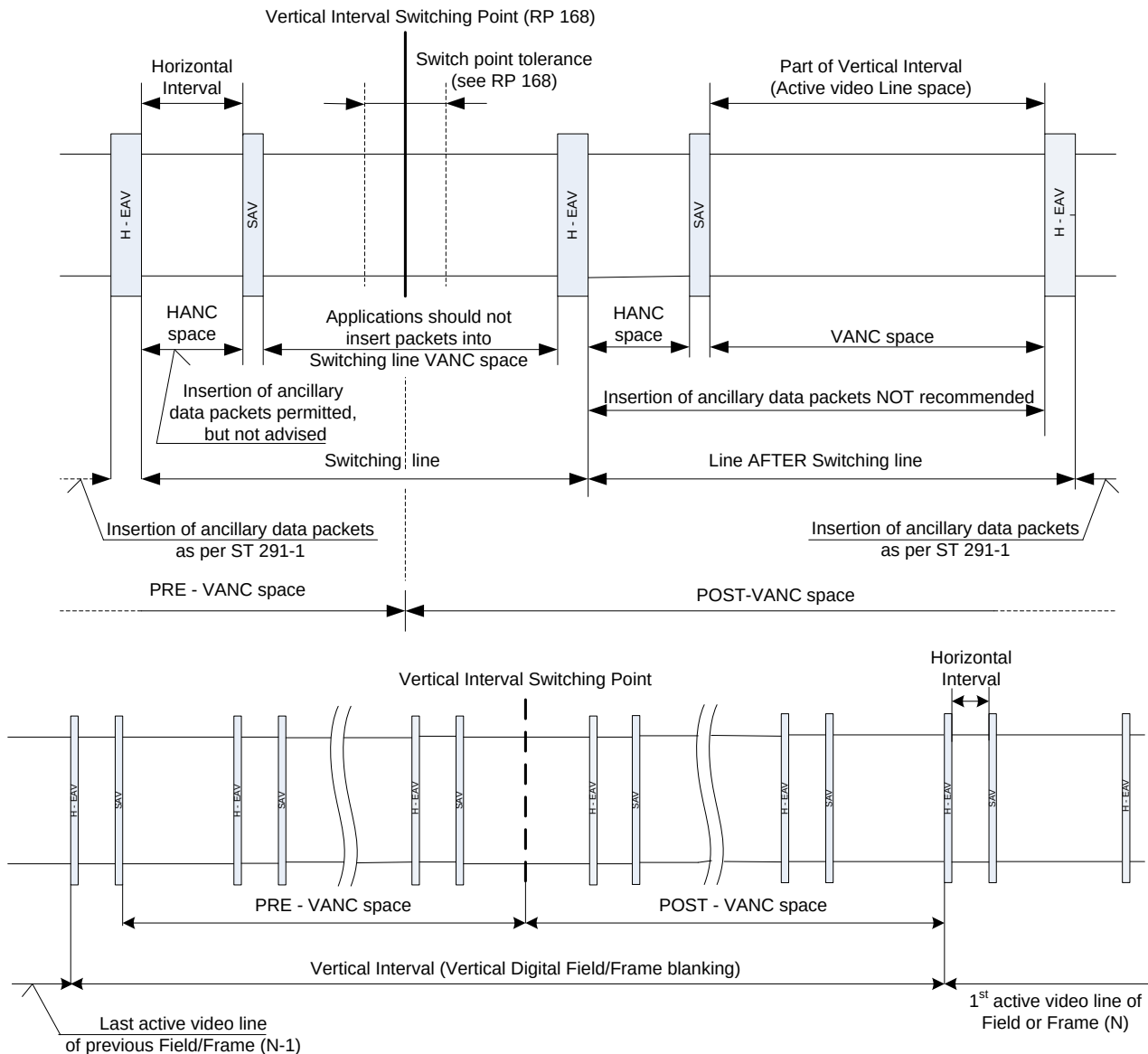


Figure 1 – Horizontal and Vertical Interval around a Switching Line

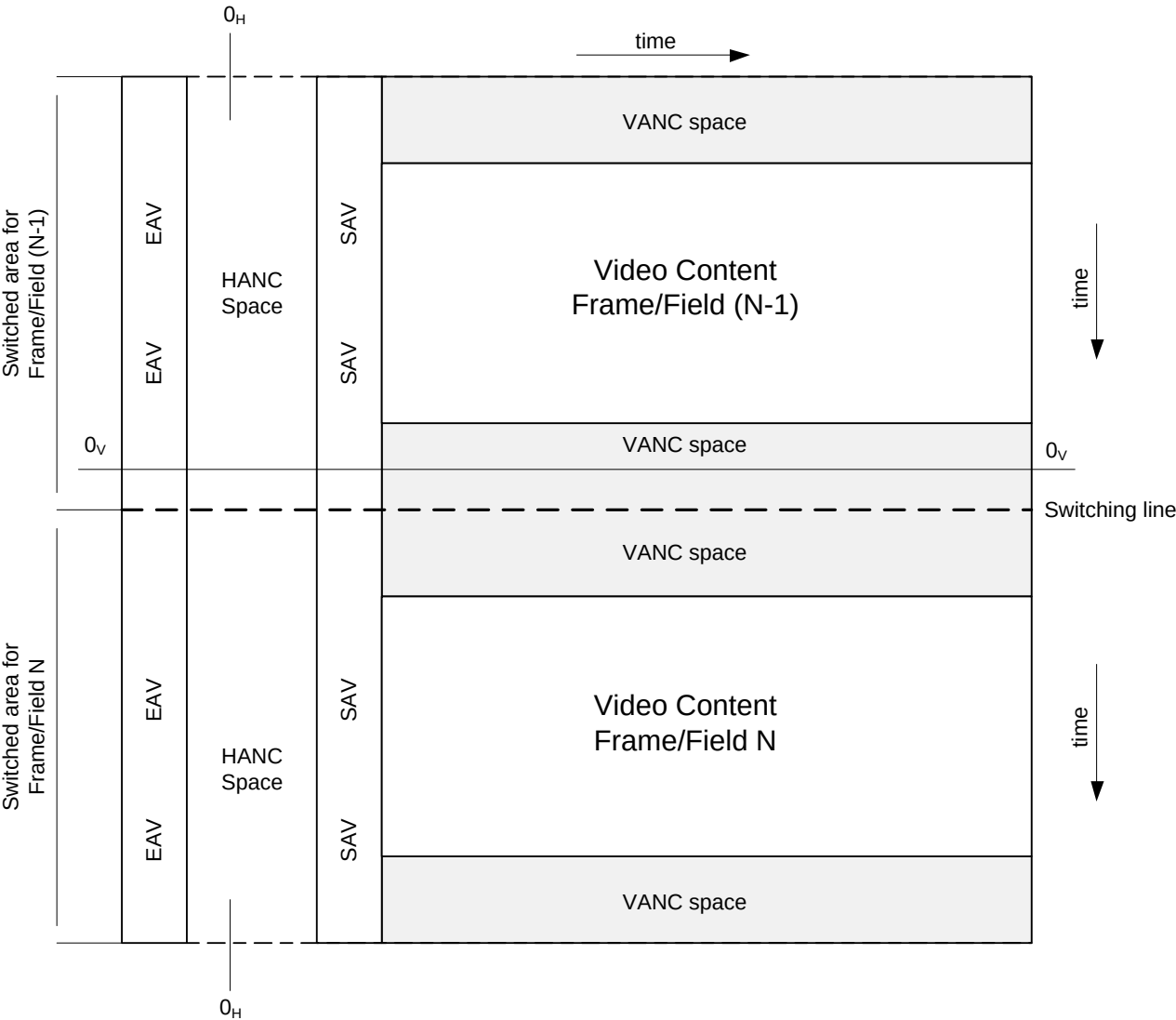


Figure 2 – A switched area of a video frame construct on a digital serial interface

5.1 Horizontal Ancillary Data Space (HANC)

The space located in the horizontal interval of every video line is called horizontal ancillary data space. The size of the ancillary data space available in HANC in different component video formats is indicated in Tables 2a and 2b. These values are derived from the reference documents for the individual image formats and their serial interfaces.

The horizontal ancillary data rate (HANC word rate) shown in Tables 2a, and 2b is in MWords/sec inclusive of ancillary data payload rate as well as the packet overhead

Note: To determine the ancillary data packet payload bit rate for an application HANC or VANC space, see Annex B.

**Table 2a – Horizontal Ancillary data space (HANC) for component video
(Single Link interfaces SDTV, 1280x720, 1920x1080 and 2048x1080)**

System Number (Reference Image Standard)	Total lines per frame	Frame (P) or Field (I) Rate (Hz)	Image Sample Structure	10-bit SDI interface bit rate (Mb/sec) (Reference Interface Standard)	H interval Interval words on SDI Interface (HANC Words/line)	HANC word rate (MWord/sec)
1 (ITU-R BT.601)	625	25I	720x576	270 (ST 259)	280	4.361
2 (ST 125)	525	30I*	720x483	270 (ST 259)	268	4.201**
3 (ST 296)	750	24P*	1280x720	1485 (ST 292-1)	5666	101.750**
4 (ST 296)		25P			5336	99.917
5 (ST 296)		30P*			4016	90.149**
6 (ST 296)		50P			1376	51.531
7 (ST 296)		60P*			716	32.145**
8 (ST 274)	1125	24P*	1920x1080	1485 (ST 292-1)	1636	44.089**
9 (ST 274)		25P			1416	39.790
10 (ST 274)		30P*			536	18.056**
11 (ST 274)		50P		2970 (ST 425-1 Level A)	1416	79.579
12 (ST 274)		60P*			536	36.112**
13 (ST 274)		50P		2970 (ST 425-1 Level B)	1416	79.508
14 (ST 274)		60P*			536	36.080**
15 (ST 274)		50I		1485 (ST 292-1)	1416	39.754
16 (ST 274)		60I*			536	18.040**
17 (ST 274)		24PsF*			1636	44.049**
18 (ST 274)		25PsF			1416	39.754
19 (ST 274)		30PsF*			536	18.040**
20 (ST2048-1)	1125	24P*	2048 x 1080	1485 (ST 292-1)	1380	37.190**
21 (ST2048-1)		25P			1160	32.596
22 (ST2048-1)		30P*			280	9.432**
23 (ST2048-1)		48P*		2970 (ST 425- 1 Level A)	1380	74.379**
24 (ST2048-1)		50P			1160	65.192
25 (ST2048-1)		60P*			280	18.864**
26 (ST2048-1)		48P*		2970 (ST 425– 1 Level B)	1380	74.313**
27 (ST2048-1)		50P			1160	65.134
28 (ST2048-1)		60P*			280	18.848**
29 (ST2048-1)		24PsF*		1485 (ST 292-1)	1380	37.157**
30 (ST2048-1)		25PsF			1160	32.567
31 (ST2048-1)		30PsF*			280	9.424**

Notes:

- 1) Frame rates marked with “*” represent a non-integer frame rate (divide by 1.001 to get the actual frame rate).
- 2) HANC Word rate/sec marked with “**” is based on non-integer frame rate. Implementations operating with an integer frame rate ought to multiply the MWord/sec rate value in Table 2a by 1.001 to derive the actual HANC MWord/sec data throughput.
- 3) PsF signifies a progressive scanning system over an interlaced interface.

**Table 2b – Horizontal Ancillary data space (HANC) for component video
(Dual Link interfaces 1920x1080 and 2048x1080)**

System Number (Reference Image Standard)	Total lines per frame	Frame (P) or Field (I) Rate (Hz)	Image Sample Structure	10-bit Serial Digital Interface bit rate (Mb/sec) (Reference Interface Standard)		H interval Interval words on SDI Interface (HANC Words/line)	HANC word rate (MWord/sec)		
32a (ST 2048-2)	1125	50P	1920 x 1080	1485 (ST 372 DL Link)	A	708	39.754		
32b (ST 2048-2)					B	708	39.754		
33a (ST 2048-2)		60P*			A	268	18.040**		
33b (ST 2048-2)					B	268	18.040**		
34a (ST 2048-2)		48P*	2048 x 1080	1485 (ST 372-DL Link)	A	690	37.157**		
34b (ST 2048-2)					B	690	37.157**		
35a (ST 2048-2)		50P			A	580	32.567		
35b (ST 2048-2)					B	580	32.567		
36a (ST 2048-2)		60P*			A	140	9.424**		
36b (ST 2048-2)					B	140	9.424**		

Note:

- 1) Frame rates marked with “*” represent a non-integer frame rate (divide by 1.001 to get the actual frame rate).
- 2) HANC Word rate/sec marked with “**” is based on non-integer frame rate. Implementations operating with an integer frame rate ought to multiply the MWord/sec rate value in Table 2b by 1.001 to derive the actual HANC MWord/sec data throughput.
- 3) DL signifies Dual Link connectivity (SMPTE ST 372).
- 4) PsF signifies a progressive scanning system over an interlaced interface.

5.1.1 Horizontal Ancillary Data Space (HANC Space) Switching

There is no separate definition of a switch point in Horizontal Ancillary data Space. Switching of HANC space and its data packet stream is accomplished simply by a vertical interval switch compliant with SMPTE RP 168.

Due to the disturbance of the interface stream following such a switch, it is recommended that ancillary data packets are not inserted into the HANC space of the line immediately following the vertical interval switch line.

Insertion of ancillary data packets is permitted into any HANC space with the exception as indicated above. For SDTV systems ancillary data is also prohibited in the HANC space reserved for an EDH data packet defined in SMPTE RP 165. Designers should be aware, that any ancillary data information present in the reserved EDH space may be overwritten by the EDH packet.