SMPTE STANDARD

SMPTE 305M-2005
Revision of SMPTE 305.2M-2000

for Television — Serial Data Transport Interface

Table of contents

Introduction

This revision of SMPTE 305.2M is to document format parameters, and to revise normative references cited in previous revisions. This revision is compatible with previous revisions of the standard. Implementation guidance is given in section 6.2.3 in order to retain interoperability. In table 2 data type 200_h is now defined as invalid data, previous ambiguity has been removed. This revision does not implement the extended payload feature of previous versions.

1 Scope

1.1 This standard specifies a data stream protocol used to transport packetized data. The data packets and synchronizing signals are only compatible with 10-bit operation of SMPTE 259M (SDI) as shown in figure 1. Parameters of the protocol are compatible with the 4:2:2 component SDI format as shown in figure 2.

1.2 The data stream uses the digital television active line for the payload. Ancillary data packets defined by SMPTE 291M in the horizontal blanking interval are used to identify the payload application.

1.3 This standard does not provide the specific protocol for the many SDTI data types. Payload data may be organized in fixed length blocks or variable length blocks. Additional documents will describe particular applications of this standard and will include details of data formatting, data location and other parameters, such as compression and error correction, if applicable.

NOTE – SMPTE 352M labels are not used for SDTI application of SMPTE 259M.

2 Normative references

The following standards contain provisions that, 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,

Approved
July 21, 2005

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.

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

ANSI/SMPTE 267-1995, Television — Bit Parallel Digital interface — Component Video Signal 4:2:2 16x9 Aspect Ratio

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

SMPTE 291M-1998, Television — Ancillary Data Packet and Space Formatting

SMPTE 294M-2001, Television — 720x483 Active Line at 59.94-Hz Progressive Scan Production — Bit-Serial Interfaces

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

ITU-R BT.601-5 (10/95), Studio Encoding Parameters of Digital Television for Standard 4:3 and Wide-Screen 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 of ITU-R BT.601(Part A)

ITU-T X.25 (09/98), Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit

3 Version number

The current version number of this standard is version 3. This version is backwards compatible with the previous published version of SMPTE 305.2M-2000 (version 2). See section 6.2.3 for implementation guidance.

4 General specifications

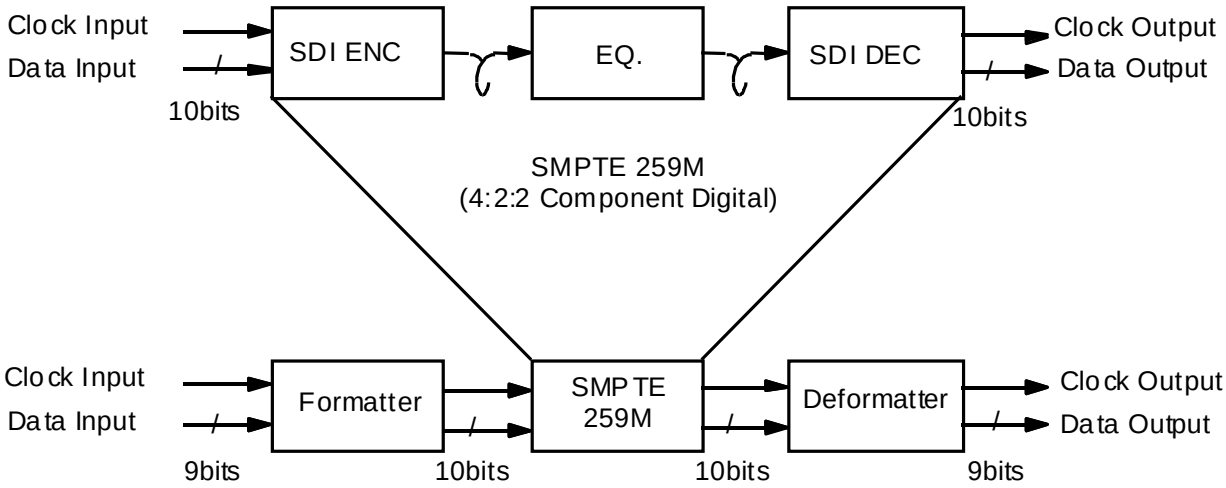


Figure 1 – System block diagram

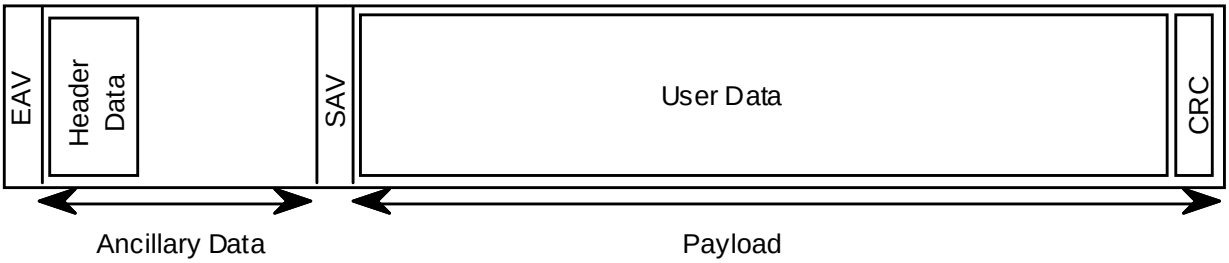


Figure 2 – Signal format (1 line)

4.1 As shown in figure 1, packetized payload data of either 8 or 9 bits is mapped into a stream of 10-bit words compatible with the active line area of standard digital television signals. The resulting word stream shall be formatted, serialized, scrambled, and coded according to SDI standard SMPTE 259M.

4.2 The signal format for one line is shown in figure 2. Header data is contained in an ancillary data packet as described in section 5. The payload consists of user data and the optional CRC described in section 6.

4.3 The following specifications are required for compliance with the SDI standard:

4.3.1 Formatted data word length shall be 10 bits, B0 through B9. B9 is the most significant bit (MSB).

4.3.2 Timing reference signals, end of active video (EAV) and start of active video (SAV), shall occur on every line. Their location will depend on the scanning standard associated with the data type selected from table 2. The locations of EAV and SAV shall conform to ANSI/SMPTE 125M, ANSI/SMPTE 267, SMPTE 294M, or ITU-R BT.656

4.4 For data types using SMPTE 294M, only the first 1920 words of the 2160-word active line are used for payload.

4.5 An ANC data packet forming the header data is placed after EAV, as specified in section 5. All payload is placed between the SAV and EAV. The space after the header data but before SAV is available for ANC data as specified by SMPTE 291M.

NOTE – Some applications may place header data on every line of the relevant SDI interface, regardless if user data are present on the line payload or not. To differentiate such “empty” line from line with user data, the code value of byte 10 of header data is set to 0000_h .

5 Header data

The data structure for the header data shall conform to SMPTE 291M ancillary data packet (type 2). The header data, shown in figure 3, shall be located immediately after the EAV on lines specified in the application document for the data type selected from table 2.

Ancillary data flag (ADF)			53 words
Data ID (DID)			
Secondary data ID (SDID)			
Data count (DC)			
Header data		46	words
Checksum (CS)			

The header data shall include the following:

- Line number (2 words)
- Line number CRC (2 words)
- Code and AAI (1 word)
- Destination address (16 words)
- Source address (16 words)
- Block type (1 word)
- CRC flag (1 word)
- Reserved data (5 words)
- Header CRC (2 words)

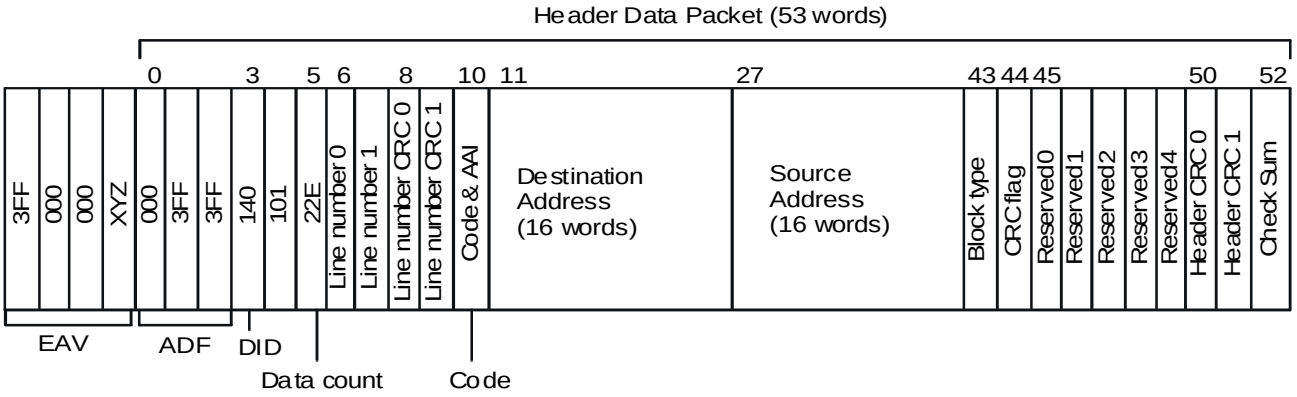


Figure 3 -- Header data structure

NOTE – Byte 43 block type, should be considered as block type (size).

5.1 Ancillary data formatting

The ADF, DID, SDID, DC, and CS shall conform to SMPTE 291M.

5.1.1 Data ID (DID)

The data ID shall have the value of (40_h) for B7 through B0.

- B8 is even parity for B7 through B0
- B9 is the complement of B8

5.1.2 Secondary data ID (SDID)

The secondary data ID shall have the value of (01_h) for B7 through B0.

- B8 is even parity for B7 through B0
- B9 is the complement of B8

5.1.3 Data count (DC)

The data count shall specify 46 words for the header with the value ($2E_h$) for B7 through B0.

- B8 is even parity for B7 through B0
- B9 is the complement of B8

5.2 Line number

5.2.1 The line number shall represent the number from 1 through 525 for 525 systems, and 1 through 625 for 625 systems in order to check the data continuity. The line numbering is defined in SMPTE 125M and ITU-R BT.601.

5.2.2 The line number shall be contained within L9 through L0. R5 through R0 are reserved and set to zero (see figure 4).

- EP1 is even parity for L7 through L0
- EP2 is even parity for R5 through R0, L9, L8

5.3 Line number CRC

Following each line number, a line number CRC shall be inserted. The line number CRC applies to the data ID through the line number for the entire ten bits (see figure 5). The generator polynomial for the line number CRC shall be $G(X) = X^{18} + X^5 + X^4 + 1$, which conforms to ITU-T X.25 (see figure 6).

Line number CRC shall be contained in C17 through C0, and the initial value shall be set to all ones.

5.4 Code and AAI (Authorized address identifier)

Both code and AAI shall consist of four bits (see figure 7).

- Code: B3 through B0
- AAI: B7 through B4
- B8 is even parity for B7 through B0
- B9 is the complement of B8

5.4.1 Code

The code is intended to identify the length of the payload with the following values. The payload shall be contained in the area between SAV and EAV.

Description	B3	B2	B1	B0
Reserved for SDI:	0	0	0	0
1440 word payload:	0	0	0	1
1920 word payload:	0	0	1	0

NOTES

1 Code = ’0000’ is used where uncompressed 4:2:2 data are transmitted in the line containing the header. However, uncompressed video signals and compressed video signals should not be mixed in the same line or block.

2 Code = ’1000’ is reserved for 143 Mb/s applications.

5.4.2 AAI

The AAI specifies the format of the destination and source address words.

Description	B7	B6	B5	B4
Unspecified format:	0	0	0	0
IPv6 address:	0	0	0	1

The value (0_h) is reserved for applications where no source and destination address format is specified.

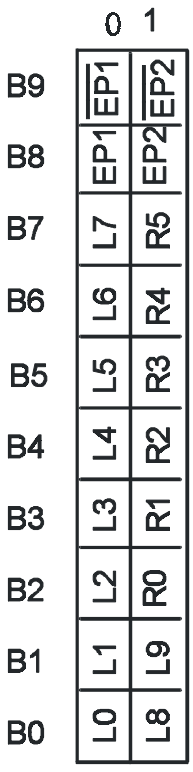


Figure 4 – Line number

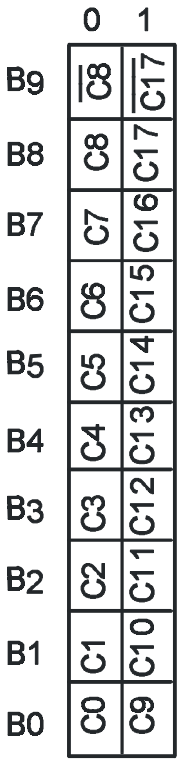


Figure 5 – Line number CRC

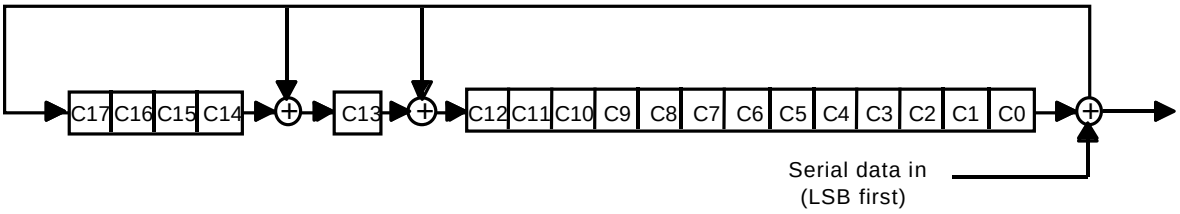


Figure 6 – Generator polynomial

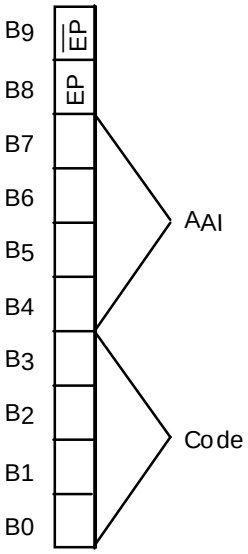


Figure 7 – Code and AAI

5.5 Destination and source address

The destination and source address represents the address of the devices within the connection according to the AAI. Sixteen bytes are allocated for both destination and source address with the following structure (see figure 8):

- Address: B7 through B0
- B8 is even parity for B7 through B0
- B9 is the complement of B8

When all 16 bytes of the destination address are zero filled in accordance with AAI = ’0000’, it shall indicate the universal address to all devices connected to the interface. The default condition when no destination and source address is required is that all 16 bytes of each the destination and source address shall be set to zero in accordance with AAI = ‘0000'.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B9	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$	$\overline{EP}$
B8	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP	EP
B7	A7	A15	A23	A31	A39	A47	A55	A63	A71	A79	A87	A95	A103	A111	A119	A127
B6	A6	A14	A22	A30	A38	A46	A54	A62	A70	A78	A86	A94	A102	A110	A118	A126
B5	A5	A13	A21	A29	A37	A45	A53	A61	A69	A77	A85	A93	A101	A109	A117	A125
B4	A4	A12	A20	A28	A36	A44	A52	A60	A68	A76	A84	A92	A100	A108	A116	A124
B3	A3	A11	A19	A27	A35	A43	A51	A59	A67	A75	A83	A91	A99	A107	A115	A123
B2	A2	A10	A18	A26	A34	A42	A50	A58	A66	A74	A82	A90	A98	A106	A114	A122
B1	A1	A9	A17	A25	A33	A41	A49	A57	A65	A73	A81	A89	A97	A105	A113	A121
B0	A0	A8	A16	A24	A32	A40	A48	A56	A64	A72	A80	A88	A96	A104	A112	A120

Figure 8 – Source and destination address

5.6 Block type (size)

The block type (byte 43) shall consist of one word and is intended to indicate the segmentation of the payload. Either fixed block size or variable block size may be selected. B7 or B6 is the prefix to define the fixed block data structure as follows:

	B7	B6
Fixed block size without ECC:	0	0
Fixed block size with ECC:	0	1
Unassigned:	1	0
Reserved (**):	1	1

**The reserved prefix (B7, B6) = (1, 1) can only be used with the variable block size whose value is (01_h) for B5 through B0.

NOTE – Error correction codes (ECC) will be determined individually in accordance with the application document for the data type selected in table 2.

5.6.1 Fixed block size

The block type segmentation word for the fixed block size is indicated by setting b7 and b6 according to section 5.6, and the values for B5 through B0 are shown in table 1.

Each data packet (data type + data block) shall be placed one right after the other.

– B8 is even parity for B7 through B0
– B9 is the complement of B8

5.6.2 Variable block size

The block type segmentation word for the variable block size shall have the following value:

	B7	B6	B5	B4	B3	B2	B1	B0
Variable block size:	1	1	0	0	0	0	0	1

– B8 is even parity for B7 through B0
– B9 is the complement of B8

With the variable block size, any size of consecutive block data words is permitted. The next data packet can be either placed immediately after the other, or on the next line. For block lengths exceeding the payload of one line, fields "code and AAI" through data "reserved 0", within the header data, shall be repeated for each line that carries part of the block.

5.7 Payload CRC flag

The payload CRC flag shall consist of one word. The payload CRC flag is intended to indicate the presence of the payload CRC with the following values:

– B7 through B0
– (00_h): The CRC shall not be inserted at the end of the payload, the space may be used for data.
– (01_h): The CRC shall be inserted at the end of the payload.
– (02_h) - (FF_h): Reserved
– B8 is even parity for B7 through B0
– B9 is the complement of B8.

Table 1 – Fixed block size

Block type (B5-B0)	Block size	270 Mb/s	360 Mb/s
01_h	1438 (1437) words	1 block	1 block
02_h	719 (718) words	2 blocks	2 blocks
03_h	479 (478) words	3 blocks	4 blocks
04_h	359 (358) words	4 blocks	5 blocks
09_h	1918 (1917) words	--	1 block
$0A_h$	959 (958) words	1 block	2 blocks
$0B_h$	639 (638) words	2 blocks	3 blocks
11_h	766 (765) words	1 block	2 blocks
12_h	383 (382) words	3 blocks	5 blocks
13_h	255 (254) words	5 blocks	7 blocks
14_h	191 (190) words	7 blocks	10 blocks
21_h	5 (4) words	287 blocks	383 blocks
22_h	9 (8) words	159 blocks	213 blocks
23_h	13 (12) words	110 blocks	147 blocks
24_h	17 (16) words	84 blocks	112 blocks
25_h	33 (32) words	43 blocks	58 blocks
26_h	49 (48) words	29 blocks	39 blocks
27_h	65 (64) words	22 blocks	29 blocks
28_h	97 (96) words	14 blocks	19 blocks
29_h	129 (128) words	11 blocks	14 blocks
$2A_h$	193 (192) words	7 blocks	9 blocks
$2B_h$	257 (256) words	5 blocks	7 blocks
$2C_h$	385 (384) words	3 blocks	4 blocks
$2D_h$	513 (512) words	2 blocks	3 blocks
$2E_h$	609 (608) words	2 blocks	3 blocks
31_h	62 (61) words	23 blocks	30 blocks
32_h	153 (152) words	9 blocks	12 blocks
33_h	171 (170) words	8 blocks	11 blocks
34_h	177 (176) words	8 blocks	10 blocks
35_h	199 (198) words	7 blocks	9 blocks
36_h	256 (255) words	5 blocks	7 blocks
37_h	144 (143) words	10 blocks	13 blocks
38_h	160 (159) words	9 blocks	12 blocks

NOTE – The values in parenthesis are the size of the data block because the first word is used for "type".

5.8 Header expansion reserved data

The header expansion reserved data (5 words) shall be positioned after the CRC flag. The default value for the reserved data is (200_h).

5.9 Header CRC

Following each ancillary data header, the header CRC shall be inserted. The header CRC applies to the code through the reserved data for the entire ten bits. The generator polynomial for the header CRC shall be the same as the line number CRC.

6 User data signal format

User data may be present on any line in the area between SAV and EAV. The entire data block is defined as user data because there may not be a data block header on some lines for applications that use variable length blocks. Some applications may constrain the use of certain lines. User data location and organization within the payload are not defined by this standard. Specifications for the payload are defined in application documentation linked to the data type of section 6.2.3 and table 2.

The default word value for the user data area shall be 200_h.

Although data may exist on any line, it should be noted that data may be corrupted during a switch (see SMPTE RP 168). The placement of user data on or near the switch line as defined in SMPTE RP 168 depends upon the application document and the need of a particular application to avoid, or not, the switching line and surrounding lines.

6.1 User data block

The data block shall consist of 8-bit words plus even parity or 9-bit words contained in B8 through B0. B9 of the user data word shall be set to the complement of B8 (see figure 9).

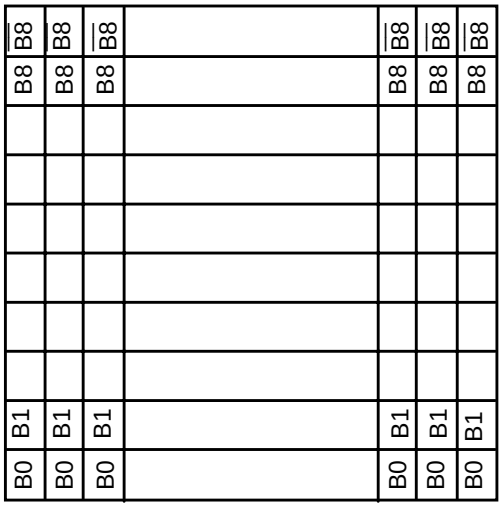


Figure 9 – User data block

6.2 User data block header

Each data block shall be preceded by the data block header. The data structure for the data block header shall be as shown in figure 10 for the fixed block size, and figure 11 for the variable block size.

6.2.1 Separator and endcode

The separator, endcode, and wordcount shall be inserted, if the block type is identified as variable block size. Each data block starts with the separator and ends with the endcode. The values of separator and endcode shall be as follows:

Separator: (309_h)

B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
1	1	0	0	0	0	1	0	0	1

Endcode: ($30A_h$)

B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
1	1	0	0	0	0	1	0	1	0

6.2.2 Wordcount

The wordcount shall consist of four words as shown in figure 12. The wordcount represents the number of data block words. The wordcount shall be contained in C31 through C0, and shall be interpreted as a single 32-bit binary value.

- EP1 is even parity for C7 through C0
- EP2 is even parity for C15 through C8
- EP3 is even parity for C23 through C16
- EP4 is even parity for C31 through C24

When no wordcount is indicated, the value of the wordcount should be set to all zeros for C0 through C31.

It is the intent of this standard that all receiving equipment should attempt to decode data, even if the wordcounts are expected but not present.

6.2.3 Data type

The data type shall consist of one word. The data type identifies the type of data stream and may have 256 different states (see table 2).

- Data type: B7 through B0
- B8 is even parity for B7 through B0
- B9 is the complement of B8.

NOTE – Designers should be aware that previous versions of SMPTE 305 and 305.2 permitted as an “invalid data type” code equal 100_h (see table 2). Receiving equipment should be able to process invalid data type 100_h, as some existing equipment already in operation may not conform to the parity recommendation defined in this paragraph.

6.3 Payload CRC

The payload CRC, if the payload CRC flag is active, shall be inserted at word number addresses 1438-1439 for 1440 word payload, and 1918-1919 for 1920 word payload (see figure 13). The payload CRC applies to word number addresses 0-1437 for 1440 word payload, and 0-1917 for 1920 word payload. The generator polynomial for the header payload CRC shall be the same as the line number CRC and the header CRC.

NOTE – The CRC locations are for fixed blocks where space is available, CRC usage for variable blocks is defined in the application document for the data type selected from table 2.

7 EDH

Error checking data locations shall always be protected (see SMPTE RP 165 commonly known as Error Detection and Handling).

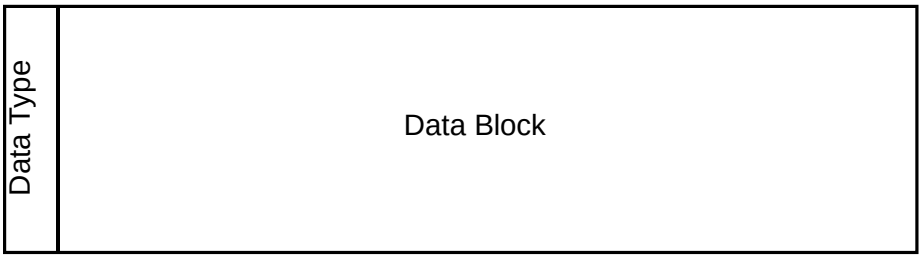


Figure 10 – Data structure (fixed block size)

Figure 11 – Data structure (variable block size)

	0	1	2	3
B9	EP1	EP2	EP3	EP4
B8	EP1	EP2	EP3	EP4
B7	C7	C15	C23	C31
B6	C6	C14	C22	C30
B5	C5	C13	C21	C29
B4	C4	C12	C20	C28
B3	C3	C11	C19	C27
B2	C2	C10	C18	C26
B1	C1	C9	C17	C25
B0	C0	C8	C16	C24

Figure 12 – Wordcount

Table 2 – Data type

Data type values as defined in section 6.2.3 have B8 as even parity, B9 is the complement of B8

Type	Description
101h	
102h	SXV
203h	
104h	CP-System
205h	CP-Picture
206h	CP-Audio
107h	CP-Data
108h	
209h	
20Ah	
10Bh	
20Ch	
10Dh	
10Eh	
20Fh	
110h	
211h	SDTI-PF
212h	
113h	
214h	
115h	
116h	
217h	
218h	
119h	
11Ah	
21Bh	
11Ch	
21Dh	
21Eh	
11Fh	
120h	
221h	DVCPRO1/Digital S
222h	DVCPRO2
123h	
224h	
125h	
126h	
227h	
228h	
129h	
12Ah	
22Bh	
12Ch	
22Dh	
22Eh	
12Fh	
230h	
131h	HD-D5
132h	
233h	
134h	
235h	
236h	
137h	

Type	Description
241h	DV CAM-1
242h	
143h	
244h	
145h	
146h	
247h	
248h	HDCam- D-11
149h	
14Ah	
24Bh	
14Ch	
24Dh	
24Eh	
14Fh	
250h	
151h	
152h	MPEG-2 P/S
253h	MPEG-2 T/S
154h	
255h	
256h	
157h	
158h	
259h	
25Ah	
15Bh	
25Ch	
15Dh	
15Eh	
25Fh	
260h	
161h	
162h	
263h	
16h	
265h	
266h	
167h	
168h	
269h	
26Ah	
16Bh	
26h	
16Dh	
16Eh	
26Fh	
170h	
271h	
272h	
173h	
274h	
175h	
176h	
277h	

138h 239h 23Ah 13Bh 23Ch 13Dh 13Eh 23Fh 140h	

278h 179h 17Ah 27Bh 17Ch 27Dh 27Eh 17Fh 180h	

Type	Description
281h 282h 183h 284h 185h 186h 287h 288h 189h 18Ah 28Bh 18Ch 28Dh 28Eh 18Fh 290h	SXA
191h 192h 293h 194h 295h 296h 197h 198h 299h 29Ah 19Bh 29Ch 19Dh 19Eh 29Fh 2A0h	
1A1h 1A2h 2A3h 1A4h 2A5h 2A6h 1A7h 1A8h 2A9h 2AAh 1ABh 2ACh 1ADh 1AEh 2AFh 1B0h	64 channel AES
2B1h 2B2h 1B3h	

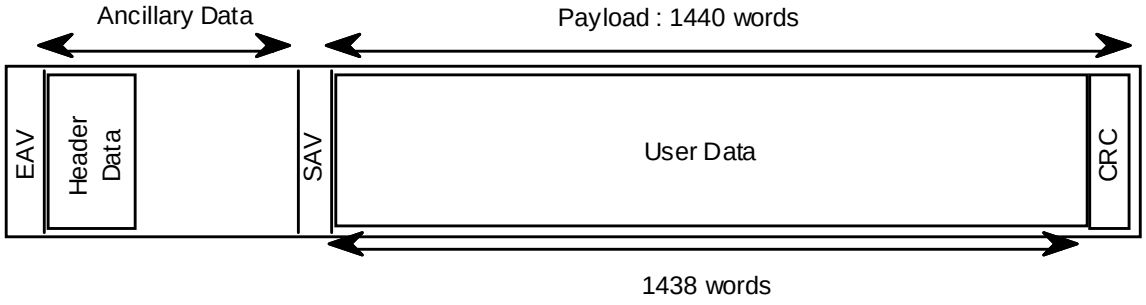
Type	Description
1C1h 1C2h 2C3h 1C4h 2C5h 2C6h 1C7h 1C8h 2C9h 2CAh 1CBh 2CCh 1CDh 1CEh 2CFh 1D0h	SXC
2D1h 2D2h 1D3h 2D4h 1D5h 1D6h 2D7h 2D8h 1D9h 1DAh 2DBh 1DCh 2DDh 2DEh 1DFh 1E0h	FC
2E1h 2E2h 1E3h 2E4h 1E5h 1E6h 2E7h 2E8h 1E9h 1EAh 2EBh 1ECh 2EDh 2EEh 1EFh 2F0h	
1F1h 1F2h 2F3h	

2B4h 1B5h 1B6h 2B7h 2B8h 1B9h 1BAh 2BBh 1BCh 2BDh 2BEh 1BFh	
2C0h	

1F4h 2F5h 2F6h 1F7h 1F8h 2F9h 2FAh 1FBh 2FCh 1FDh 1FEh 2FFh	
200h	Invalid data

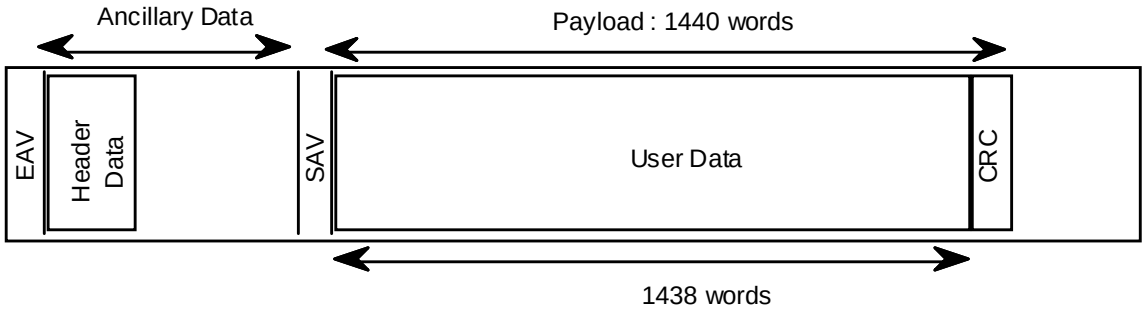
270 Mbps,

* Code=1h



360 Mbps

* Code=1h



* Code=2h

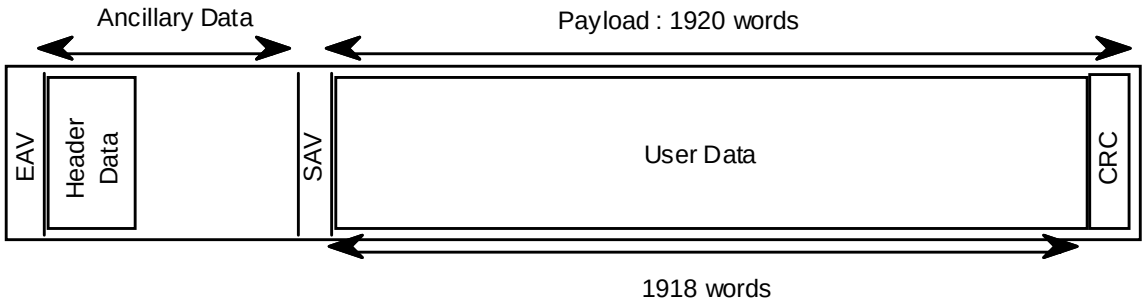


Figure 13 – Payload CRC position

Annex A (informative)
Bibliography

SMPTE RP 168-2003, Definition of Vertical Interval Switching Point for Synchronous Video Switching

IETF (Internet Engineering Task Force) Request for Comments (RFC-1883), IPv6, Internet Standard Track Protocol