PROPOSED SMPTE STANDARD

for Television —
Serial Data Transport Interface

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1 Scope

1.1 This standard specifies a data stream used to transport packetized data within a studio/production center environment. The data packets and synchronizing signals are compatible with ANSI/SMPTE 259M (see figure 1).

1.2 Parameters of the protocol are compatible with the 4:2:2 component SDI format as shown in figure 2.

1.3 The data stream is intended to transport any packetized data signal over the active lines that have a maximum data rate up to (approximately) 200 Mb/s for 270 Mb/s system or (approximately) 270 Mb/s for 360 Mb/s system. The maximum data rate may be increased through use of the extended data space as described in annex A.

1.4 Additional documents will describe particular applications of this standard and will include details of data formatting and other parameters, such as compression and error correction, if applicable.

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.

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

ANSI/SMPTE 259M-1997, Television — 10-Bit 4:2:2 Component and $4f_{SC}$ Composite Digital Signals — Serial Digital Interface

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

ANSI/SMPTE 291M-1996, Television — Ancillary Data Packet and Space Formatting

ITU-R BT.656-3, 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]

ITU-R BT.[11/12], Format of Ancillary Data Signals Carried in Digital Component Studio Interface

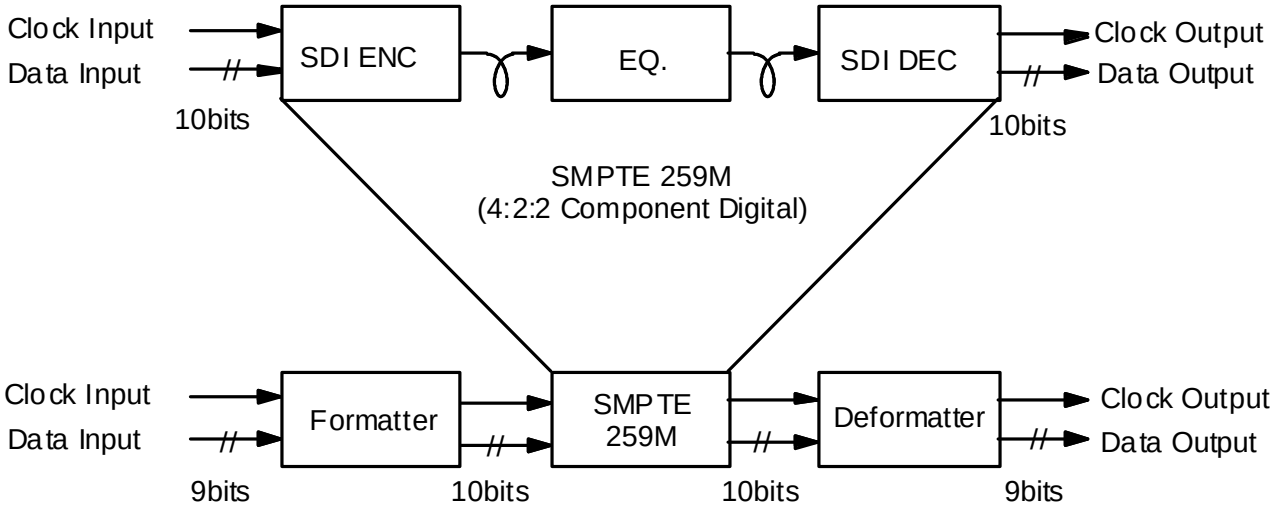


Figure 1 – System block diagram

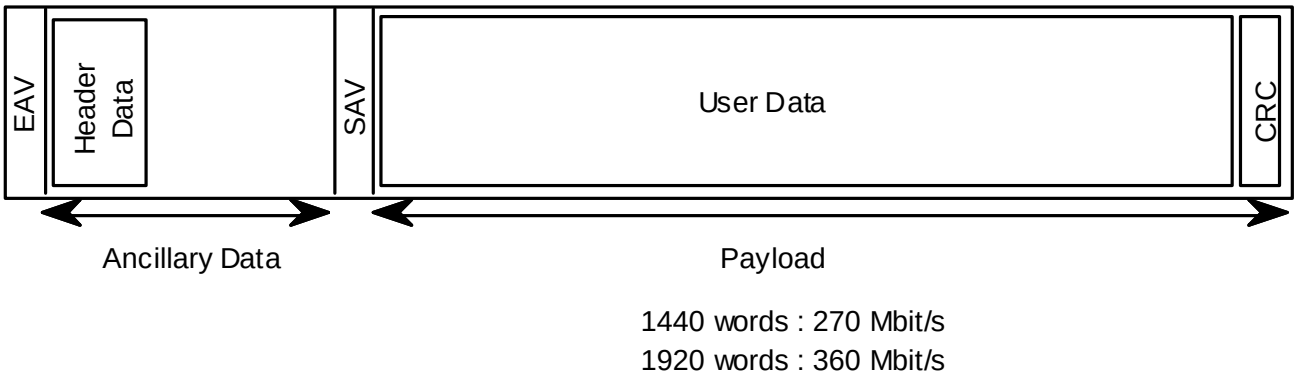


Figure 2 – Signal format (1 line)

3 General specifications

3.1 This standard describes the assembly of a stream of 10-bit words. The resulting word stream shall be serialized, scrambled, coded, and interfaced according to ANSI/SMPTE 259M and ITU-R BT.656.

3.2 The word clock rate shall be 27 MHz or 36 MHz in accordance with ANSI/SMPTE 125M, ANSI/SMPTE 267M, or ITU-R BT.601.

3.3 The data word length shall be 10 bits: B0 through B9. B9 is the most significant bit (MSB). The nominal data rate for the resulting serial data stream shall be 270 Mb/s or 360 Mb/s, respectively.

3.4 The timing reference signals (EAV and SAV) occur on every line, and shall be as described in ANSI/SMPTE 125M, ANSI/SMPTE 267M, or ITU-R BT.656.

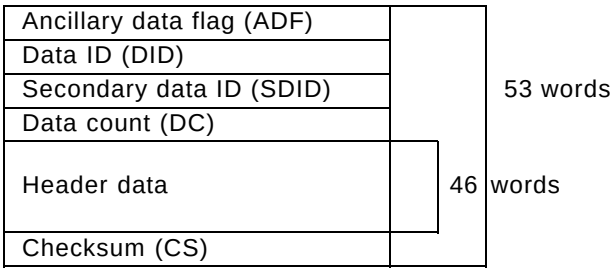
3.5 An ANC data packet forming the header data is placed after EAV, as specified in clause 4. All payload is placed between SAV and EAV. The space after the header data but before SAV is available for ANC data as specified by ANSI/SMPTE 291M and ITU-R BT.[11/12].

3.6 The signal levels and specifications shall be as described in ANSI/SMPTE 259M and ITU-R BT.656.

3.7 The preferred connector type shall be as described in ANSI/SMPTE 259M and ITU-R BT.656.

4 Header data

The data structure for the header data shall conform to ANSI/SMPTE 291M and ITU-R BT.[11/12] ancillary data packet (type 2). The header data shall be located immediately after the EAV as shown in figure 3.



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]
-- Data extension flag [1 word]
-- Reserved data [4 words]
-- Header CRC [2 words]

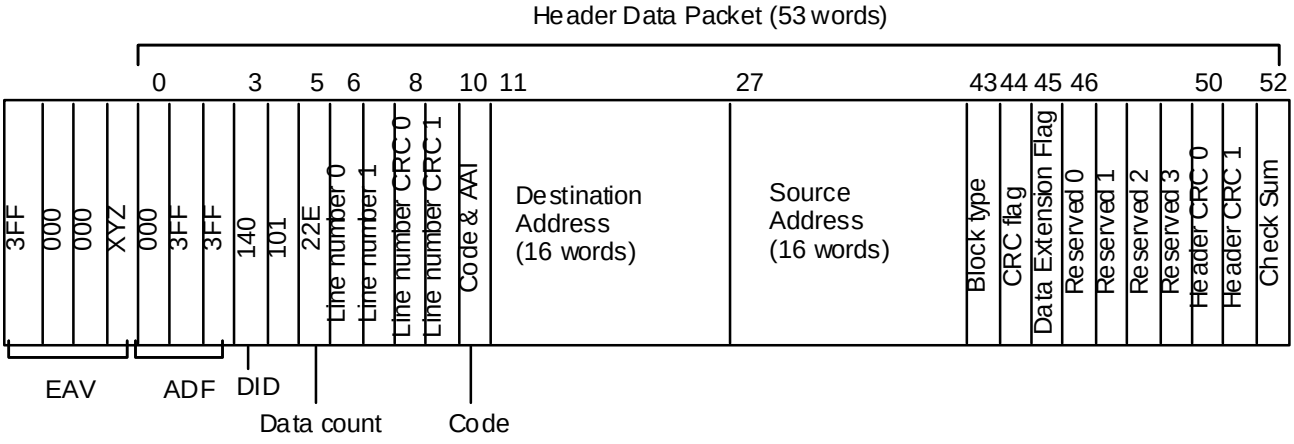


Figure 3 – Header data structure

4.1 Ancillary data formatting

The ADF, DID, SDID, DC, and CS shall conform to ANSI/SMPTE 291M and ITU-R BT.[11/12].

4.1.1 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

4.1.2 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

4.1.3 Data count (DC)

The data count shall represent 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.

4.2 Line number

4.2.1 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 described in ANSI/SMPTE 125M or ITU-R BT.601.

4.2.2 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

4.3 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.

4.4 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

4.4.1 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.

	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

NOTE -- Code = '0000' is used where uncompressed 4:2:2 data are transmitted in the following line. However, uncompressed and compressed signals should not be mixed in the same signal.

Other codes shall be registered with SMPTE (see clause 7).

NOTE -- Code = '1000' is reserved for 143 Mb/s applications.

4.4.2 AAI

The AAI is intended to identify the format of the destination and source address words with 16 different states.

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

Other AAIs shall be registered with SMPTE (see clause 7).

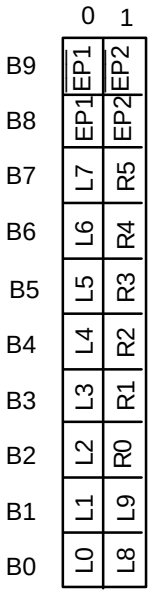


Figure 4 – Line number

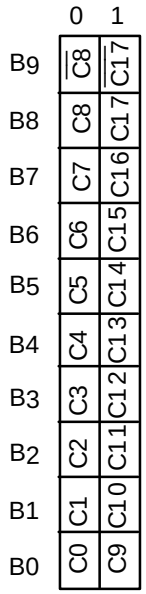


Figure 5 – Line number CRC

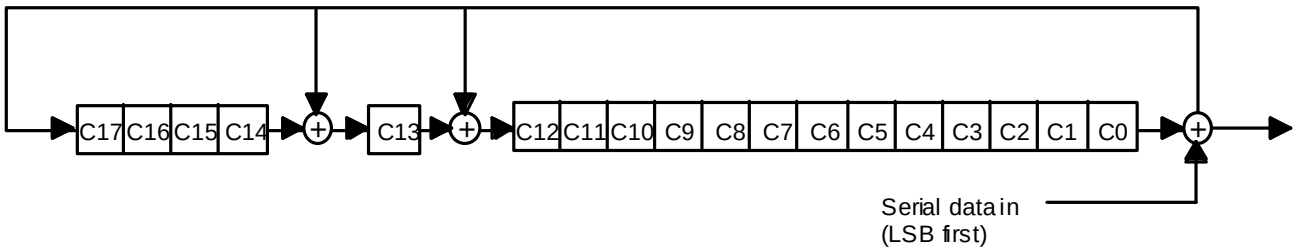


Figure 6 – Generator polynomial

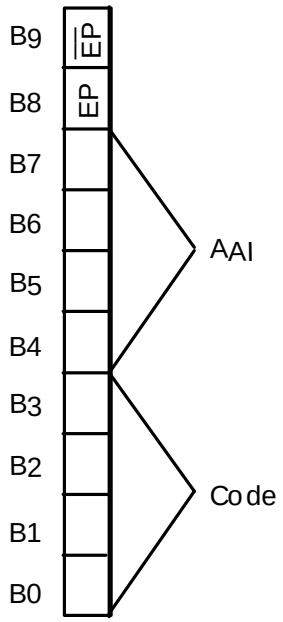


Figure 7 – Code and AAI

4.5 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 are zero filled in accordance with AAI = '0000', it shall indicate the universal address to all devices connected to the interface. Also, it is the default condition when no destination and source address is required.

4.6 Block type

The block type 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

NOTE -- ECC will be determined individually in accordance with each application.

**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.

4.6.1 Fixed block size

The possible segmentation of the fixed block size 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

Other block types shall be registered with SMPTE (see clause 7).

	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

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

4.6.2 Variable block size

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, code and AAI through data extension flag within the header data shall be repeated for each line that carries part of the block.

4.7 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
– [01_h]: The CRC shall be inserted at the end of the payload.
– [00_h]: The CRC shall not 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.

4.8 Data extension flag

The data extension flag shall consist of one word. The data extension flag is intended to indicate whether there are extension data packets loaded after the header data and before the SAV. Extension data packets shall conform to the format defined in annex A.

– B7 through B0
– [00_h]: No extension data packet
– [01_h]: One extension data packet
– [02_h]: Two extension data packets
– [03_h] - [FF_h]: Reserved

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

NOTE -- 360 Mb/s system may contain two extension data packets when [02_h] is used, since the maximum size of the user data in the ANC packet is restricted to 255 words.

4.9 Header expansion reserved data

The header expansion reserved data shall be positioned after the data extension flag. The default value for the reserved data is [200_h].

4.10 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.

5 User data signal format

User data may be present on any line in the area between SAV and EAV. Some applications may constrain the use of certain lines.

– Although data may exist on any line, it should be noted that data can be corrupted during a switch (see SMPTE RP 168).

5.1 Data block

The data block shall consist of either 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).

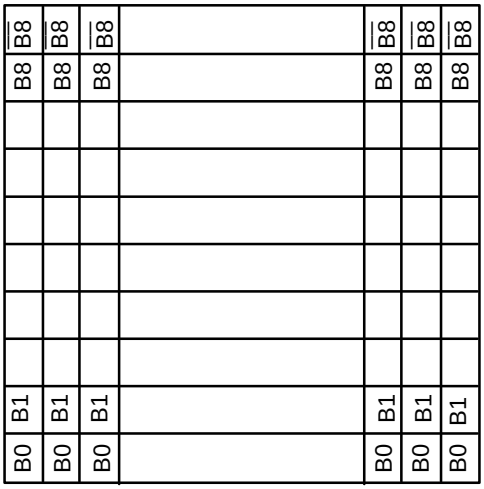


Figure 9 – Data block

5.2 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.

5.2.1 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

5.2.2 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.

5.2.3 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.

Other data types shall be registered with SMPTE (see clause 7).

5.3 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.

6 EDH

Error checking data locations shall always be protected (see SMPTE RP 165).

NOTE -- The data structure of 18-MHz sampling 4:2:2 and 4:2:0P (525P) is different in 360 Mb/s. Manufacturers and users should pay attention if the EDH detection is counted from EAV.

7 Code, AAI, block type, data type registrations

New 'code', 'AAI', 'block type', or 'data type' shall be registered through the SMPTE Registration Authority. Requests for registration of new types require the items below:

– a) Originator (name, affiliation, date)
– b) Brief description of request
– c) Proposed name components (code, AAI, block type, data type)
– d) Related documents (if any)
– e) Value to be registered
– f) Description of each value

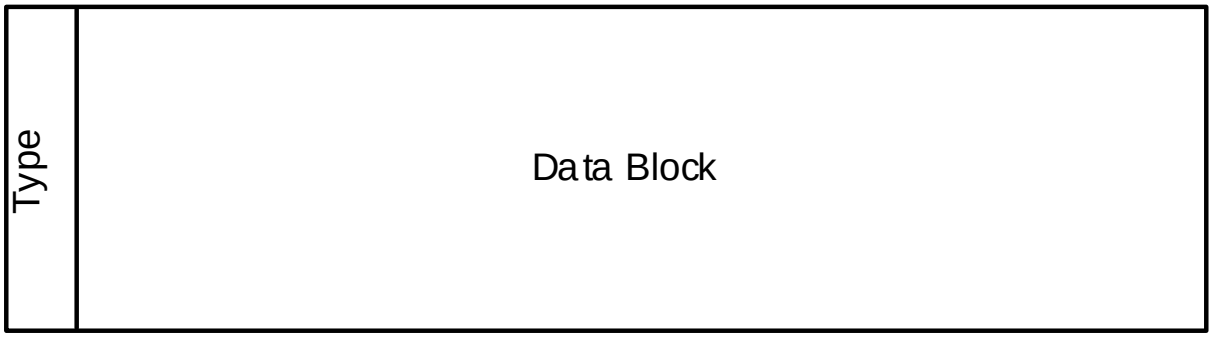


Figure 10 – Data structure (fixed block size)

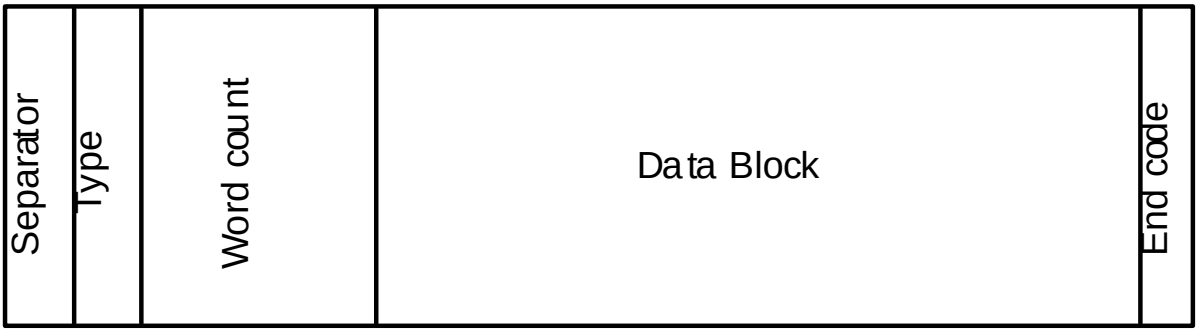


Figure 11 – Data structure (variable block size)

	0	1	2	3
B9	$\overline{EP1}$	$\overline{EP2}$	$\overline{EP3}$	$\overline{EP4}$
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

Type	Description
101_h 102_h 203_h 104_h 205_h 206_h 107_h 108_h 209_h $20A_h$ $10B_h$ $20C_h$ $10D_h$ $10E_h$ $20F_h$ 110_h	SXV
211_h 212_h 113_h 214_h 115_h 116_h 217_h 218_h 119_h $11A_h$ $21B_h$ $11C_h$ $21D_h$ $21E_h$ $11F_h$ 120_h	
221_h 222_h 123_h 224_h 125_h 126_h 227_h 228_h 129_h $12A_h$ $22B_h$ $12C_h$ $22D_h$ $22E_h$ $12F_h$ 230_h	DVCPRO1/Digital S DVCPRO2
131_h 132_h 233_h 134_h 235_h 236_h 137_h 138_h 239_h $23A_h$ $13B_h$ $23C_h$ $13D_h$ $13E_h$ $23F_h$ 140_h	

Type	Description
241_h 242_h 143_h 244_h 145_h 146_h 247_h 248_h 149_h $14A_h$ $24B_h$ $14C_h$ $24D_h$ $24E_h$ $14F_h$ 250_h	DV CAM-1
151h 152_h 253_h 154_h 255_h 256_h 157_h 158_h 259_h $25A_h$ $15B_h$ $25C_h$ $15D_h$ $15E_h$ $25F_h$ 260_h	MPEG-2 P/S MPEG-2 T/S
161h 162_h 263_h 164_h 265_h 266_h 167_h 168_h 269_h $26A_h$ $16B_h$ $26C_h$ $16D_h$ $16E_h$ $26F_h$ 170_h	
271h 272_h 173_h 274_h 175_h 176_h 277_h 278_h 179_h $17A_h$ $27B_h$ $17C_h$ $27D_h$ $27E_h$ $17F_h$ 180_h	

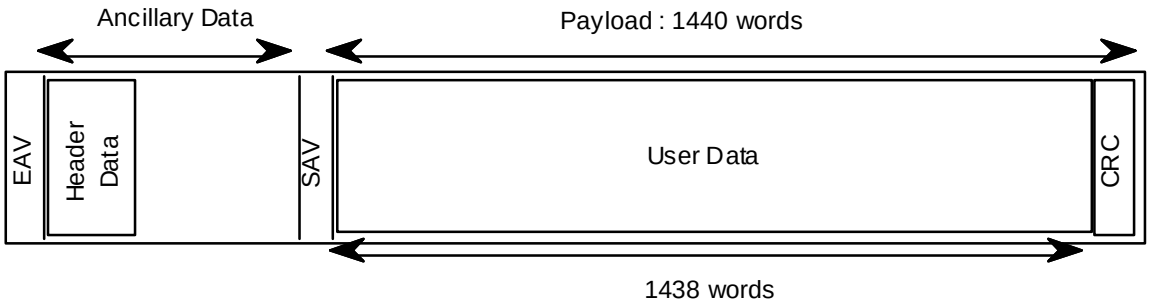
Table 2 -- Data type (concluded)

Type	Description
281_h 282_h 183_h 284_h 185_h 186_h 287_h 288_h 189_h $18A_h$ $28B_h$ $18C_h$ $28D_h$ $28E_h$ $18F_h$ 290_h	SXA
191_h 192_h 293_h 194_h 295_h 296_h 197_h 198_h 299_h $29A_h$ $19B_h$ $29C_h$ $19D_h$ $19E_h$ $29F_h$ $2A0_h$	
$1A1_h$ $1A2_h$ $2A3_h$ $1A4_h$ $2A5_h$ $2A6_h$ $1A7_h$ $1A8_h$ $2A9_h$ $2AA_h$ $1AB_h$ $2AC_h$ $1AD_h$ $1AE_h$ $2AF_h$ $1B0_h$	
$2B1_h$ $2B2_h$ $1B3_h$ $2B4_h$ $1B5_h$ $1B6_h$ $2B7_h$ $2B8_h$ $1B9_h$ $1BA_h$ $2BB_h$ $1BC_h$ $2BD_h$ $2BE_h$ $1BF_h$ $2C0_h$	

Type	Description
$1C1_h$ $1C2_h$ $2C3_h$ $1C4_h$ $2C5_h$ $2C6_h$ $1C7_h$ $1C8_h$ $2C9_h$ $2CA_h$ $1CB_h$ $2CC_h$ $1CD_h$ $1CE_h$ $2CF_h$ $1D0_h$	SXC
2D1h $2D2_h$ $1D3_h$ $2D4_h$ $1D5_h$ $1D6_h$ $2D7_h$ $2D8_h$ $1D9_h$ $1DA_h$ $2DB_h$ $1DC_h$ $2DD_h$ $2DE_h$ $1DF_h$ $1E0_h$	FC
2E1h $2E2_h$ $1E3_h$ $2E4_h$ $1E5_h$ $1E6_h$ $2E7_h$ $2E8_h$ $1E9_h$ $1EA_h$ $2EB_h$ $1EC_h$ $2ED_h$ $2EE_h$ $1EF_h$ $2F0_h$	User application User application User application User application User application User application User application User application User application User application User application User application User application User application User application User application
1F1h $1F2_h$ $2F3_h$ $1F4_h$ $2F5_h$ $2F6_h$ $1F7_h$ $1F8_h$ $2F9_h$ $2FA_h$ $1FB_h$ $2FC_h$ $1FD_h$ $1FE_h$ $2FF_h$ 100_h	User application User application User application User application User application User application User application User application User application User application User application User application User application User application User application Invalid data

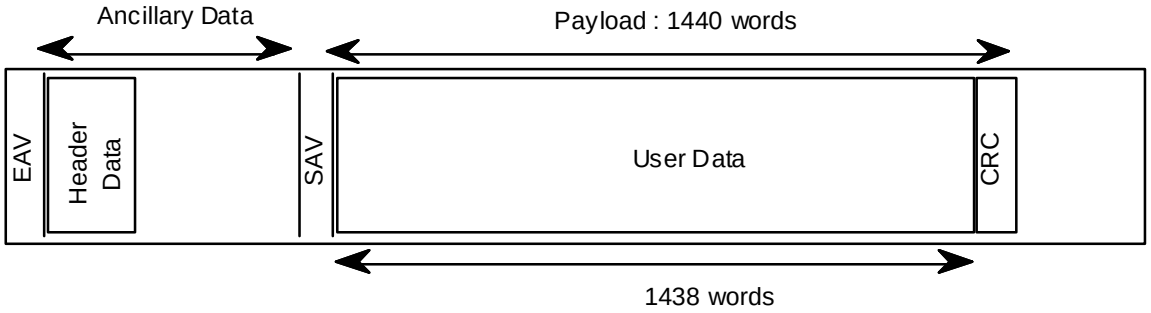
270 Mbps,

* Code=1h



360 Mbps

* Code=1h



* Code=2h

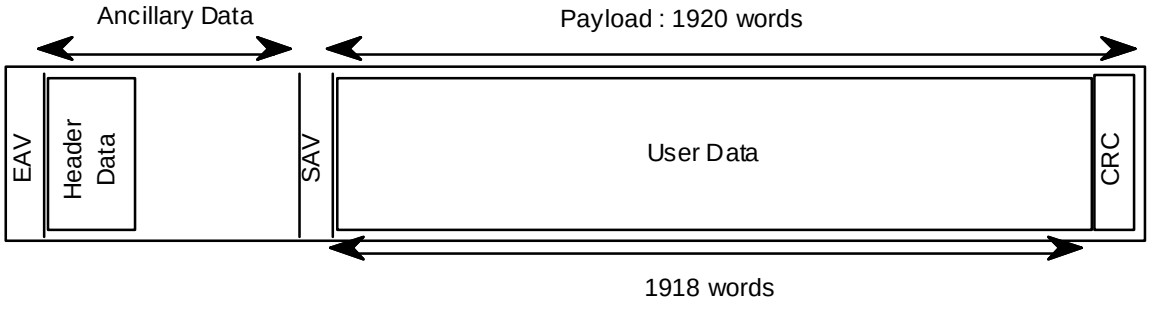


Figure 13 – Payload CRC position

Annex A (normative)
Data extension

In order to increase the amount of data carried on a line beyond that which can be incorporated in the digital active line, it is possible to insert an additional ancillary data packet following the header data in the HANC to carry the extension data. The format of this additional ancillary data packet conforms to ANSI/SMPTE 291M and ITU-R BT.[11/12] and its presence is indicated by the data extension flag in the header data (see 4.8) being active.

An ancillary data packet used to carry extension data is identified by the data ID (DID) and secondary data ID (SDID) having the following values:

-- DID: [140_h]
-- SDID: (To be assigned)

The format of the extended data ancillary data packet is shown in figure A.1. The extended user data shall incorporate a two-word CRC generated using the same generator polynomial as the payload CRC (see 5.3) when the payload CRC flag in the header data is active (payload CRC flag = [101_h]). The CRC applies to DID, SDID, DC, and extended user data.

The extended user data and the user data in the active line are treated as a contiguous data block as shown in figure A.2.

In the case of using a fixed block size with the extension data, a new block type needs to be registered with the SMPTE Registration Authority as described in clause 7.

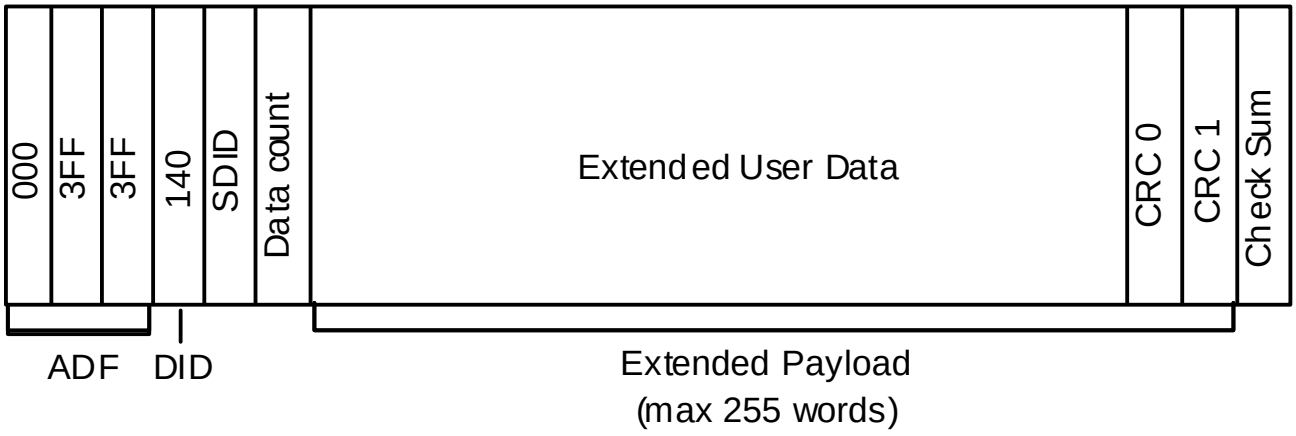


Figure A.1 – Data structure

Figure A.2 – Data block

Annex B (informative)
Data extension flow chart

A data extension flow chart is shown in figure B.1.

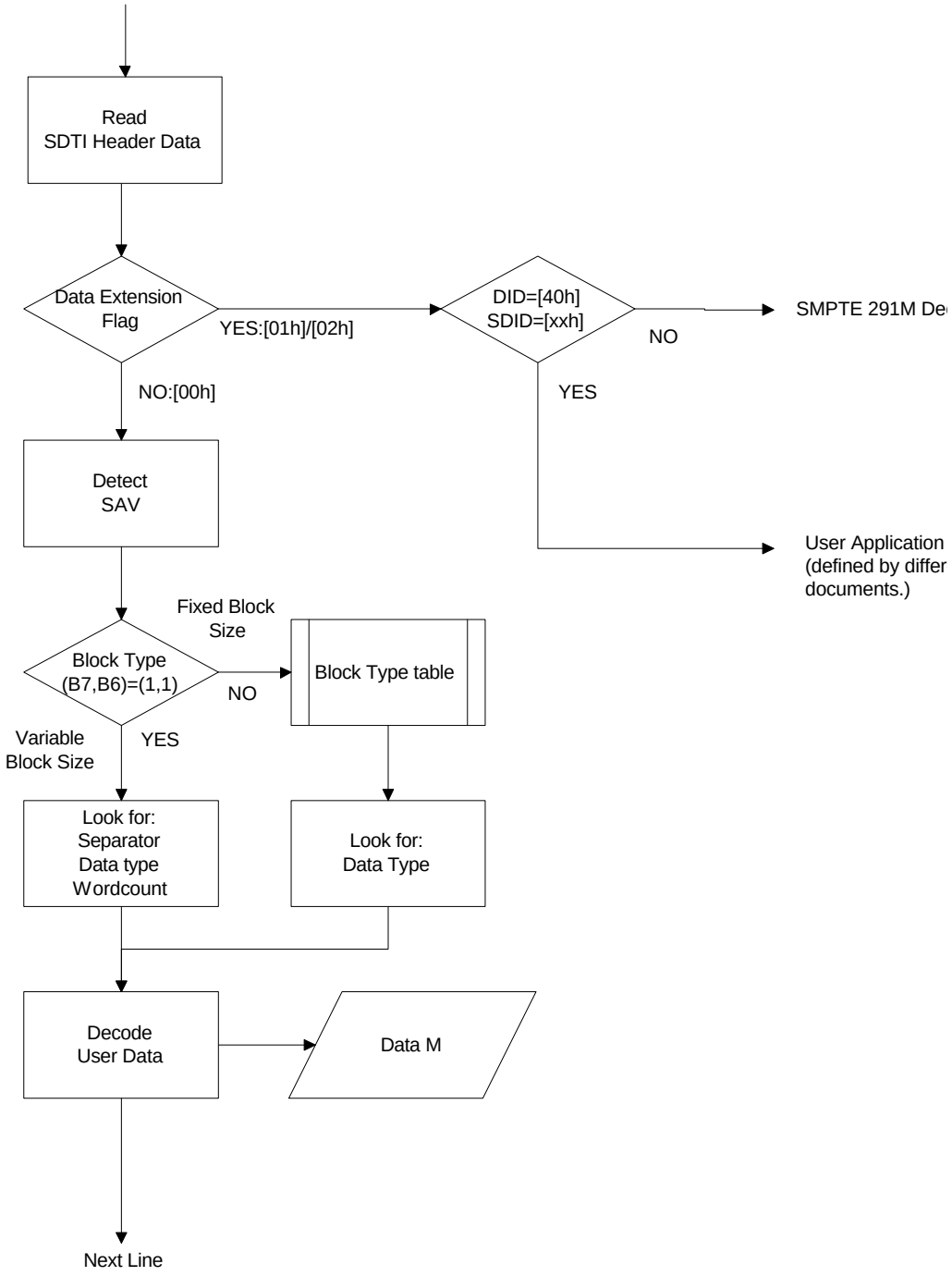


Figure B.1 – Flow chart

Annex C (informative)
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